

In collaboration with Connected Places
Catapult and The Business of Cities



Global Future Council on Cities of Tomorrow

Data for the City of Tomorrow: Developing the Capabilities and Capacity to Guide Better Urban Futures

INSIGHT REPORT
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Contents

Foreword	3
Executive summary	5
1 Introduction	7
2 City data: The why, where and who	10
3 What cities should do	18
4 Next steps	32
Contributors	34
Endnotes	35

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Foreword



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The year 2024 will mark the 170th anniversary of a breakthrough moment in urban data: the 1854 cholera outbreak in London. As citizens watched their neighbours fall sick, the terror of illness was fuelled by the mystery of its spread. Prevailing speculations about transmission ranged from a type of bad air, or “miasma”, to divine retribution, and people invented treatments and preventative measures that were no less imaginative.

The physician John Snow, however, approached the question systematically, beginning with what could be empirically charted: the spread of illness across urban space. Using cartography as a diagnostic tool, he identified a cluster of cases surrounding a single water pump and concluded

that the well itself was contaminated. Based on his map, the area was quarantined, the contagion was mitigated, and the standard practices of urban sanitation and utilities management were transformed. Building on this methodology, Snow went on to pioneer modern epidemiology. His key tool for so doing was urban data.

Much has changed since 1854, but the conceptual framework of Snow’s intervention can still serve as a guiding light for us today. Rather than deferring to conventional wisdom, Snow decided to go out and measure the problem for himself. He collected data, mapped it onto the city and analysed the patterns that emerged. His analysis was focused on a life-and-death problem that people faced, making it

relevant and impactful. These principles are timeless and are even more relevant today as the data available to us grows exponentially.

The rise of big data has arrived in two parts. First, sensors themselves are becoming more ubiquitous and more powerful. Ranging from high-resolution remote sensing data to anonymized cell-phone data, the movement of people flows can be tracked through a city and an increasingly wide range of phenomena can be understood, from mobility patterns to social segregation and disparities in the provision of basic services, such as water supply and sanitation.

Many organizations are helping to harness this data for shared benefit. For some years now, UN-Habitat has promoted the use of easily acquired transport data in improving mobility services for people – everything from mobility patterns to social segregation. In recent research, MIT has found that accelerometers built into mobile phones are sensitive enough to detect the vibrations of bridges, creating a low-cost early warning system for structural damage. With specialized sensors, which are growing cheaper, we can measure environmental data and better enable cities to address the climate crisis. Connected Places Catapult, the United Kingdom's innovation accelerator for cities, transport and place leadership, supports many thousands of small and medium-sized enterprises each year to demonstrate how urban and mobility data can be used to drive decarbonization.

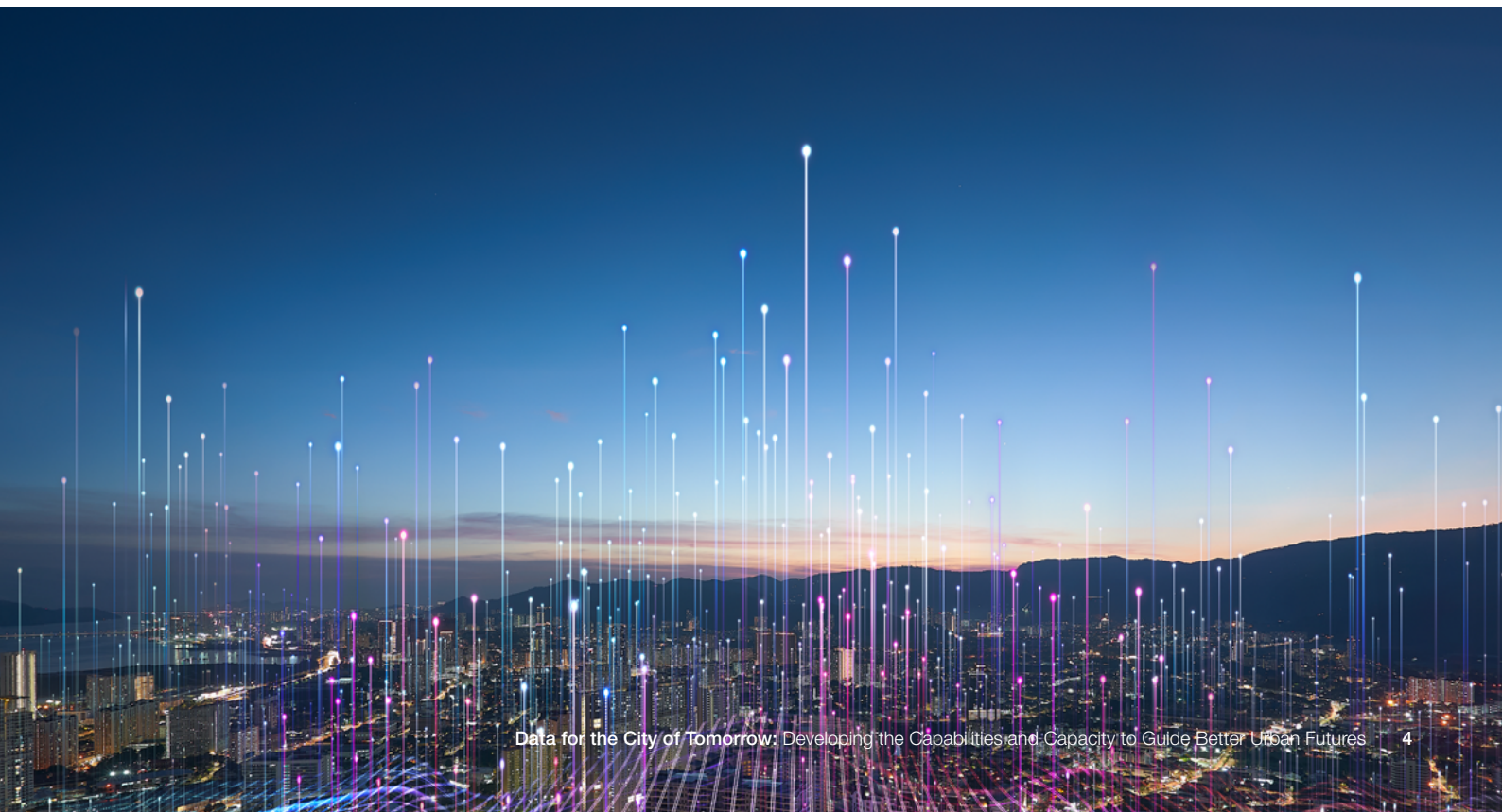
Second, we are experiencing a software revolution that is commensurate with our new hardware. The rise of artificial intelligence (AI) is allowing us to analyse big data as quickly as we receive it. AI will be able to classify every vehicle on a road, allowing cities to track traffic patterns and determine if a new bike lane is functioning.

However, the combination of ubiquitous sensing and AI raises dangerous possibilities for surveillance, meaning that we must quickly develop robust standards around ethics and privacy for more people-centred cities, without being afraid of the new possibilities.

How can cities take advantage of this fast-moving technological change, while upholding global commitments enshrined in the New Urban Agenda¹ to deploy technology and innovation in ways that ensure sustainability, inclusivity, prosperity and human rights in cities?

This publication is a comprehensive manual for municipal governments and their partners. It invites the reader to imagine future scenarios and address vexing and seemingly intractable problems of urban governance. Countless patterns can be found, invisible flows of information that we can redirect towards a better future for all, including the poor and vulnerable. With big data analysis, we could quantify which elements of a city's social infrastructure contribute to segregation and which contribute to integration and improved service delivery for all. Governments could test the effectiveness of placing a community health clinic in a particular location, identify the buildings consuming excess energy, or improve public transport operations, reducing waiting and travel times, and take measures to counter the spread of epidemics. We can be quite sure that some of the most exciting applications have not yet even been imagined. We need to think with data before we can realize all we can do with it.

We hope this report will be useful for all who are involved in making cities more vibrant, inclusive and climate smart.



Executive summary

The success of this “century of cities” will rely on whether cities can deliver good urbanization.

As the World Economic Forum Global Future Council on Cities of Tomorrow identified in its 2022 reports on climate resilience, digital technologies, city finance and urban inclusion, a systems approach is essential if cities are to achieve their goals for people and the planet.²

A systems approach looks at the whole. It embraces the deep interdependencies in cities between the land, climate, transport, housing, energy, inequality, health, commerce and technology. Decisions in one area consider goals and impacts in others.

To think, track, coordinate and then act with a systems mindset relies on data. How do cities use data to come to grips with these interconnected issues? More data than ever exists to communicate what is happening in cities. The marketplace for city data is deepening.³ The speed, scale, diversity and potential of data grow and grow. And in a post-pandemic context of high economic uncertainty, cities are hungry for data that yields more situational awareness and customized insights, informed and actionable choices, cost savings, effective and efficient use of assets, better relationships with citizens and sustainable outcomes.



While cities like Bogota, Helsinki and Singapore are actively harnessing the potential of data to improve services, few agree on how different types of cities should aggregate, analyse and apply data to their immediate issues and strategic challenges. Indeed, concern among rights activists and residents is growing about the way personal data is being gathered and used, including by urban authorities. This report offers a look at what data exists, and how cities can take the best next steps to make the most of it.

This short guide is for city authorities, advocates and agents of change. It provides a route into the urban data ecosystem, and an overview of some of the ways to develop data policies and capabilities fit for the needs of the many different kinds of city contexts worldwide.

There is ample room for optimism and creativity. New technologies generate fresh and real-time insights into how people use cities and what they need from those who run, develop and finance them. The rapid AI-led acceleration of computing capabilities is improving the forecasting and predictive power of urban data. More city data is being produced by corporates, studied in universities and translated into enterprise. The ensemble of astute city data providers, customers and interpreters expands every year. With it, more cities are able to grasp their possibilities locally and their position in the wider world.

Yet cities, whether large or small, well-resourced or budget-constrained, need support to translate the promise of urban data into insights and services tailored to their unique conditions. And to reach a

systems approach, the data gaps on critical issues are still too numerous – not least, place productivity, sustainability, climate readiness, fiscal and financial capability, inclusiveness and governance.

This report shows that the imperatives for cities are to:

- 1 Be open to the purpose of data to achieve multiple city goals.** Cities' data priorities and investments should be broad-based and attend to the complementary goals of improving city management, mobilizing investment, fostering enterprise, gauging future risks and evaluating policy success.
- 2 Confront the gaps head on.** Whatever stage a city has reached, there is room to innovate to fill its data gaps, invest in skills and capacity as well as the technology "kit", embed privacy and security, and enlist the full range of supportive partners and providers.
- 3 Keep data connected to people.** The social license of city data is fundamental. The integrity and safeguarding of personal data are key pillars of public trust in city institutions and data partnerships. It is a continuous task to manage the governance and communication in a way that is honest with citizens and builds their confidence. This means clearly explaining the benefits and potential drawbacks, anticipating biases and encouraging nuanced debate.

And the imperatives for the businesses and institutions that work with cities on data and leadership are to:

- 4 Support cities to become mature customers.** It is important to help cities avoid over-dependence on single suppliers or data sets, assess supply chain risks, and learn to navigate the pitfalls and promises of AI-led data analytics. It is also necessary to build competence, flexibility and durable systems for cities to become capable users and creators over time.
- 5 Pursue more coordinated leadership and innovation in city data.** To empower a global majority of cities to apply data in the service of systems approaches, more bridges need to be built across research disciplines, large institutional funders, forward-looking businesses and city networks. Instead of fragmented goodwill, cities can rely on more collectively crafted data frameworks that combine the know-how of multiple parties and focus squarely on the unmet needs and long-term challenges.



1

Introduction

Data is an essential enabler of more integrated and iterative cities.

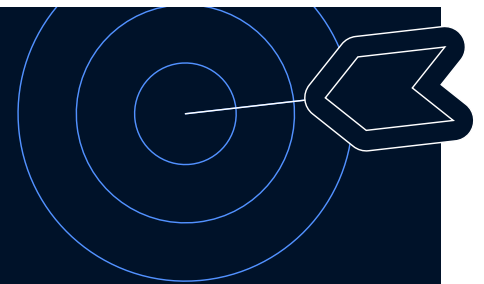
In 2023, around 56% of the world is urbanized.⁴ Almost 65% of people use the internet.⁵ Soon, 75% of the world’s jobs will require digital skills.⁶ No wonder data and cities are interwoven. This interconnection will only expand as the AI revolution is synchronized with the world’s urban population, predicted to grow by another 3 billion people in the coming decades, especially in Africa and Asia where most city growth is expected to take place. Can data be optimized to serve the development and direction of cities, including those that have yet to be built?

In 2022, the Global Future Council on Cities of Tomorrow established in four reports that systems approaches are essential to build more inclusive and climate-ready cities that can adopt innovative financing and mission-led technology.⁷ A systems approach takes account of the complex interplay between different systems that concentrate in cities. The idea is to avert the risk that siloed

solutions in one domain have negative, unintended consequences in many others, for example when transport policies incentivize carbon-intensive and unproductive sprawl.

The reports observed that city leaders must move beyond business-as-usual and develop a realistic change agenda to address their cities’ unmet needs. To do so, they must rely on better tools, more integrated policy interventions, stronger ways to assess choices and progress, and more relevant examples and yardsticks.

Data is an essential enabler for these kinds of improvements to take hold. Cities need real-time data collection, superior analytics and compelling visualizations if they are to shape better pathways of sustainable urbanization. They also need the ability to pool data and work with others, including in the private and not-for-profit sectors.



“

Data can be utilized for evidence-based decision-making and more proactive service delivery to citizens.

World Economic Forum, Using Digital Technology for a Green and Just Recovery in Cities, 2022

“

[There is a] lack of data to localize challenges, establish the baseline and track progress/performance.

World Economic Forum, Delivering Climate-Resilient Cities Using a Systems Approach, 2022

This report builds on the potential of data and its gaps identified in the Global Future Council's publications. It looks more concretely into what city data exists, what works for different sorts of cities, and how data is already being used by cities to guide bigger and more strategic choices on climate change and much more.⁸

Rapid digital transformation and dramatic increases in data availability are already taking place in cities. From Barcelona to Bogota, Seattle to Singapore, cities are mobilizing data analytics, machine learning and simulation capabilities to drive more efficient service

provision and empower residents. Some smaller and medium-sized cities are also making promising progress to collect, curate and apply data, including in low- and middle-income settings. The potential of data to help navigate many more cities through the unprecedented urban, climate and digital transitions ahead is very high and likely underestimated.

Yet the majority of the world's cities have yet to fully leverage this opportunity. The gap between "data-rich" and "data-poor" cities appears to be growing.⁹ Closing the gap between the promise and the practice of urban data is urgent.



A systems approach depends on data

The challenges facing cities are increasingly interdependent. Issues such as climate shocks and stresses, urban sprawl and segregation, deepening inequality and affordability difficulties, as well as the digital divide, are all "wicked problems" that demand more coordinated "systems" responses. Such responses, as the World Economic Forum report *Delivering Climate-Resilient Cities Using a Systems Approach* observes, create bigger and longer-term benefits as they link "connecting

multiple infrastructures, enhance integrated governance and finance, and deepen engagement among diverse stakeholders".

This shift is impossible if cities do not become comprehensively data-informed and able to lead a richer conversation with citizens and partners about the opportunities and trade-offs data poses. More than ever, residents expect data to be accurate, responsive and relevant.

Confronting the stubborn issues

Several persistent challenges still impede the positive application of high-resolution data to improve city-making and management (Table 1).

This document aims to support city authorities, advocates and agents in mapping the urban data ecosystem and implementing collaborative data policies. It provides ideas and context to assess data sources and indicators (Section 2) and data strategy and delivery (Section 3).

This report benefits from many short, insightful case illustrations from cities around the world. While the problems that cities encounter may be similar, each city has a unique context so the way it implements the strategy will need to be adjusted to reflect its situation.

Ultimately, cities and citizens stand to benefit from an improved grasp of city data and a toolkit offering guidance on what to do with it. This report provides some of the groundwork for a more collaborative effort to support cities in this quest.

TABLE 1 The challenges holding back the application of data to city-making and management¹⁰

Problem and need	Limited data availability	Definitions and coherence issues	Few agreed standards
The problem	In many parts of the world, especially in lower-income cities and regions, the reservoir of public, private and civic data from which to draw is still modest.	No accepted universal definition yet exists for what constitutes a city, where cities stop, or what defines liveability, smartness or prosperity.	Efforts to standardize city indicators and data-collection processes ¹¹ are still at an early stage and are not uncontested. Data is also hard to interpret in a vacuum and translate into policy decisions.
What cities need	<ul style="list-style-type: none"> – Better data planning – Stronger digital infrastructure – More reliable or pooled resources – Incentives for data to spread to new places 	<ul style="list-style-type: none"> – More clarity on “what success looks like” – More “like-for-like” data across diverse cities or contexts 	<ul style="list-style-type: none"> – An agreed consensus on what data matters, for what and for whom – Advice to navigate the many data choices available
	Lack of skills and capacity	Governance and processes issues	Lack of trust
The problem	The collection of data, the development of accurate models and the preparation of information for decision-makers and residents rely on strong local capability and a culture of valuing this activity.	Only some cities have data strategies, chief data or technology officers, or enjoy strategic partnerships with data service providers.	Citizens do not always trust their local government or city with their data. They may also not fully understand how data is being used, especially with enhanced data sets (like digital twins).
What cities need	<ul style="list-style-type: none"> – Funds and structures to recruit the skills required – Strong technical and communication systems to maximize the value of data 	<ul style="list-style-type: none"> – Credible governance and systems to organize data around problems – Tools to combine public- and private-sector information – Tried-and-tested arrangements for durable partnerships and responsible co-ownership 	<ul style="list-style-type: none"> – Improved dialogue with citizens about the security and use of their data – Clear data policies and communication on the benefits data use will deliver to people and businesses and will contribute to sustainability – Local and international media to popularize good data for cities

2

City data: The why, where and who

Cities can benefit from the effective use of data.

Data matters to cities' quest to develop an integrated systems approach to their infrastructure, investment, sustainability and inclusiveness. This

section outlines how and why data supports cities and their partners, and explores a range of sources they have available to them.

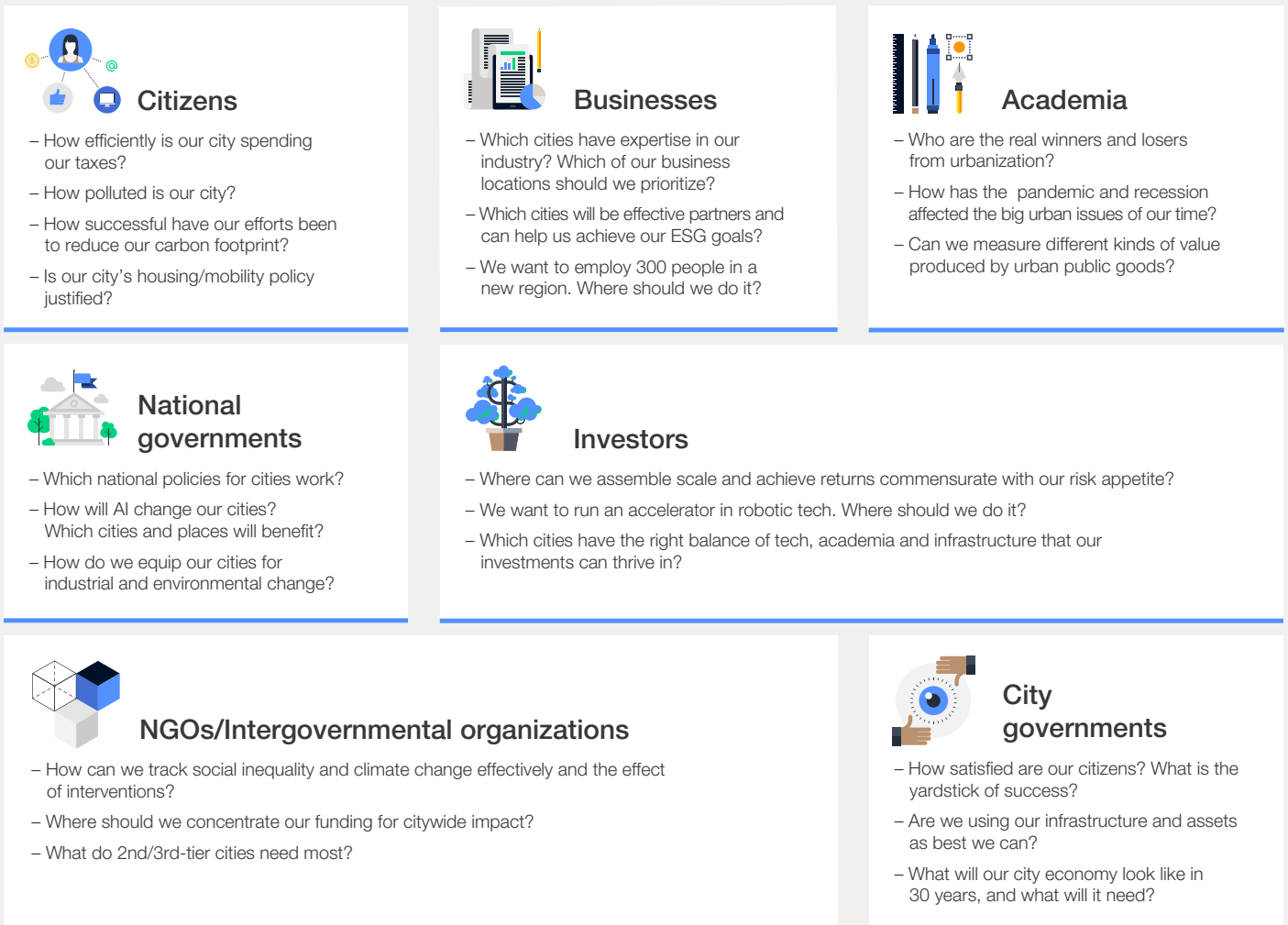
2.1 The value of data

Data can serve many purposes for a city, for its leaders, its citizens, its policy-makers, its businesses, its entrepreneurs and its investors (Figure 1). These purposes are tactical and strategic, short term and long term.¹²

Cities rely on data to provide early warning, mobilize evidence, share understanding, drive behavioural

nudges, inform evidence-based choices, engage citizens and establish legitimacy about their decisions, often in near real time. Numerous global studies suggest that many cities can extract tens to hundreds of millions of dollars per year through the more effective use of data, through cost and time savings, greater productivity, improved standards of development, revenue generation or enabled innovation.¹³

FIGURE 1 Examples of various city stakeholders' questions that can be answered with the help of data



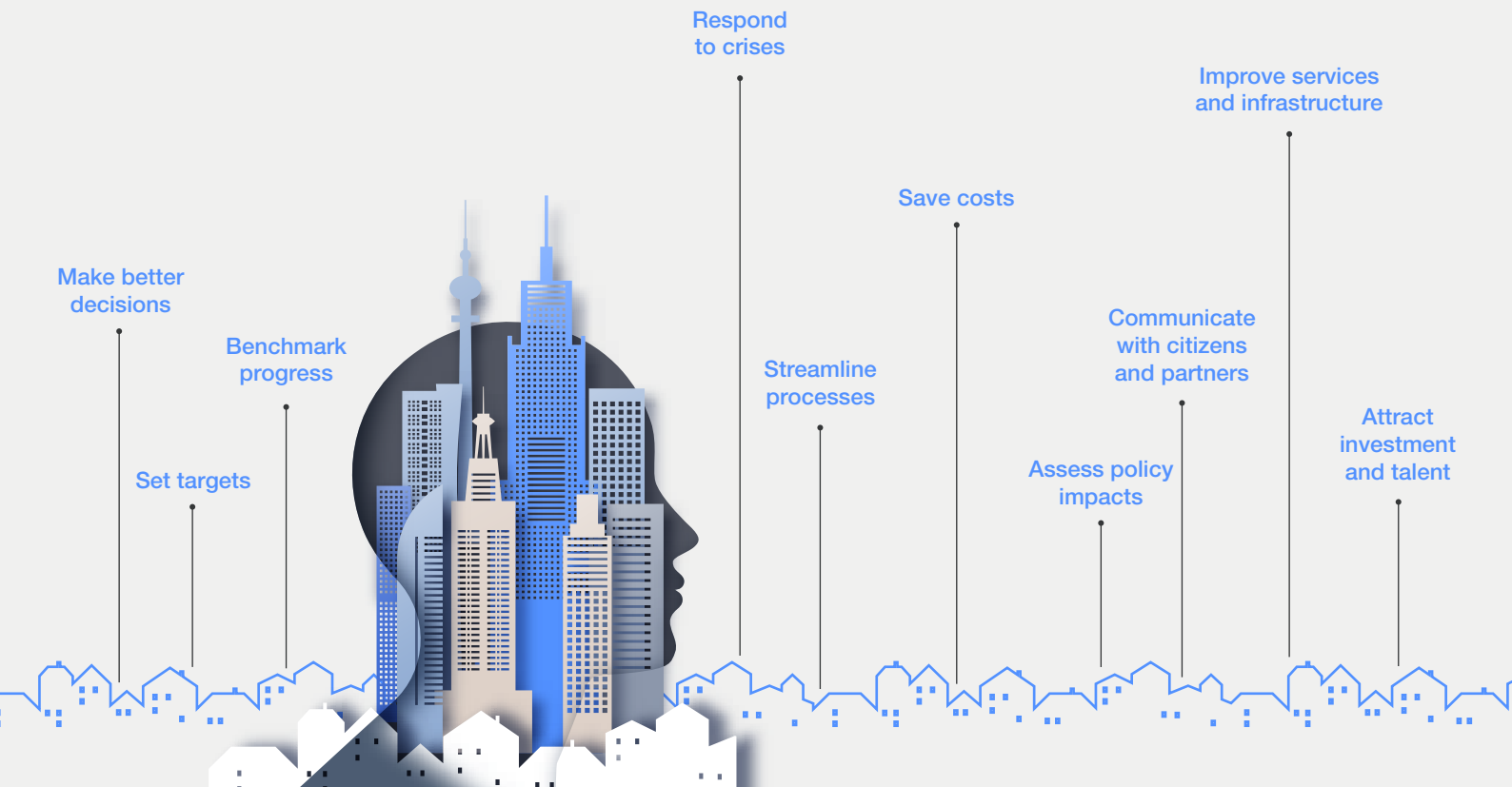
Source: The Business of Cities research¹⁴

For city leadership teams, data helps to review local conditions on a city's own terms and benchmark progress over time. Survey tools and online aggregation are ways that cities gather data continually to track public sentiment, while being mindful of data protection and privacy. Data also helps cities set targets, track change relative to others, and start to assess the impacts of specific

policies, interventions or crises, among other benefits (Figure 2).

Data that is systematically collected and prepared for use by city management can increase the effectiveness and legitimacy of decision-making and strategic planning.

FIGURE 2 The potential benefits of data in cities



Source: The Business of Cities research, informed by insights from Global Covenant of Mayors for Climate & Energy and CDP¹⁵

The mature use of city data can support a stronger conversation a city can have with itself about its future, and the choices ahead that require collective insight and intelligence. As such, urban data can

be a vehicle for a more co-created city rather than a more automated one where decisions are made outside the view or control of citizens.

2.2 The sources of data

Numerous sources of data in, for and about cities exist. Cities located in data-rich environments, including those in Organisation for Economic Co-operation and Development (OECD) economies, source data from statistical offices, internet of things (IoT) sensors, citizens' services usage, social media and private organizations. The deployment of digital sensors across urban built environments is adding to the reservoir of data produced about people, behaviour, society, business and innovation.¹⁶

Matching data sources to city goals

Not all data asks or answers the same sorts of questions a city and its leaders pose. It is important for cities, and those who guide them, to understand what kinds of data can serve different goals (Table 2).

Most discussions of city data refer to the raw material of information that is gathered for the day-to-day task of managing the city – the performance

of infrastructure, the satisfaction of citizens, and so on. New technologies are important aids in the quest to manage the city better.

Other sources of data are usually necessary when a city is asking itself big-picture questions about how it is performing, what its future may be and whether policies are working.

TABLE 2 City leadership questions that different types and sources of data can answer¹⁷

Question and data type	Asset management and service delivery	Long-term strategy and vision	Performance and policy modelling and evaluation
Commonly asked questions	<ul style="list-style-type: none"> – Are all citizens satisfied with urban infrastructure and services in the city? – How well are our public services being delivered? – Can we do more with less and are there savings we can make? 	<ul style="list-style-type: none"> – Ours is what kind of city? – Is our city liveable, affordable, sustainable and resilient? – Which cities are similar to ours? – What actions are other cities taking that we can adopt and adapt? – What targets shall we set and by when can we achieve them? – If a city has set targets: are we on track to meet our targets? – Are we on track to meet our net zero and Sustainable Development Goal commitments? 	<ul style="list-style-type: none"> – Are we attracting talent and investment? – Are we creating or losing jobs? – Do we have sufficient and stable tax revenues? – Are our citizens satisfied with the performance of the city administration? – Are we making decisions openly and transparently? – Are we communicating our progress to citizens effectively? – Are our policies being implemented? – Are our policies having any unintended spillover effects?
Data types or sources commonly used	<ul style="list-style-type: none"> – Monitoring devices – IoT sensors, apps, tech-enabled services – Online crowdsourced surveys 	<ul style="list-style-type: none"> – International rankings and indexes – Large multilateral data sets – Standards – Public data (domestic) – Data provided by private companies (e.g. utilities) 	<ul style="list-style-type: none"> – Census and public statistics – Satellite/mobile data – Real-time data from digital platforms – In situ city data collection – Baseline review of up-to-date statistics – Open data sources

A wide range of data sets can add value to a whole host of departments and sectors in a city. This not only includes core city leadership departments but also service providers, arms-length city

management agencies, businesses and even citizens. Table 3 includes examples of essential and more advanced indicators for a number of themes that are central to the question of strategic planning.



TABLE 3 | Types of indicators that can be used in strategic planning, across various themes¹⁸

Indicator type	Economic and financial	Infrastructure	Liveability and inclusion	Environment and climate	Governance
Essential indicators (commonly available and more easily measured)	<ul style="list-style-type: none"> – GDP/disposable income per capita – Productivity – Employment 	<ul style="list-style-type: none"> – Infrastructure accessibility – Infrastructure utilization 	<ul style="list-style-type: none"> – Fragility (e.g. crime rates, perceived safety) – Healthcare and education accessibility – Diversity, equity and inclusion gaps – Poverty and inequality 	<ul style="list-style-type: none"> – Air quality – Green coverage/canopy – Renewable energy share – Energy consumption – Direct greenhouse gas (GHG) emissions 	<ul style="list-style-type: none"> – Citizen satisfaction – Perceived transparency/corruption
More advanced and relevant indicators (not as commonly measured or easily available)	<ul style="list-style-type: none"> – Employment in skilled and unskilled sectors – Talent attraction/retention – Local business and enterprise environment 	<ul style="list-style-type: none"> – Infrastructure quality – Infrastructure resilience – Infrastructure integration and interoperability – Infrastructure security (e.g. cybersecurity) 	<ul style="list-style-type: none"> – Labour market flexibility and inclusion – Quality and affordability of housing – Social cohesion 	<ul style="list-style-type: none"> – Localized air pollution – Indirect GHG emissions – Density 	<ul style="list-style-type: none"> – Fiscal and budgetary capabilities – Governance integration/fragmentation – External city brand and reputation

Until now, the collection of data to inform strategic planning in cities has typically accessed what can easily be measured and is already widely available. The task ahead is for city leaders to harness data

to help define problems, measure them, use them to make evidence-based decisions, and deliver services to citizens in a more effective and intuitive manner.



2.3 The strengths and limitations of data types

Pros and cons are associated with every type of data. Different types of data have different sorts of use cases.

At a high level, data for cities can be distinguished along four axes: 1) whether it is internal or external/comparative; 2) whether it is publicly developed or privately owned; 3) whether it is purposefully sensed (i.e. derived from sensors deployed

for specific uses) or user generated (i.e. made available by humans); and 4) whether it is gathered deliberately or opportunistically (where data is used for a purpose outside of that for which it was originally intended).

Each of these types of data bring diverse challenges and opportunities. Table 4 provides examples of how various types of data might be leveraged.

TABLE 4 | Strengths and weaknesses of data sources, and potential use cases for city leadership¹⁹

Data type	Strength	Weakness	Potential use case
Census data sets	<ul style="list-style-type: none"> – Useful high-level overview – Very good local granularity – Comprehensive understanding of the population, economy and social activities – Very easy to see the evolution over time 	<ul style="list-style-type: none"> – Quickly outdated: most censuses conducted only every 5 or 10 years – Highly focused on core socio-demographic information (less on sustainability, innovation, culture) – Potentially skewed by the availability and location of people at the time of the census 	<ul style="list-style-type: none"> – To assess demand for housing, amenities and infrastructure in a city and its neighbourhoods – To understand demographic changes and future demands for services – To track change over longer time frames (e.g. 10-30 years)
Big data	<ul style="list-style-type: none"> – Large volumes – Transparent: often able to scrutinize data and interrogate context – Often created by citizens and populated through big platforms – Useful insight into new angles on land use, mobility, amenities, density, etc. 	<ul style="list-style-type: none"> – Inconsistent: some cities/countries have strong participation or data volunteer communities, others do not – Multiple competing platforms with the potential to obscure meaningful conclusions – High barriers to entry: expertise needed for effective data use – Potentially biased towards digitally literate parts of the population 	<ul style="list-style-type: none"> – To track change over shorter time frames (e.g. 1 month to 5 years) – To explore potential reasons for changing circumstances – To access new insights on specific issues/challenges
Big data that is commercially provided	<ul style="list-style-type: none"> – Consistent: often uniform and pre-cleaned, ready for use – Ability to answer more complex questions about locating assets, the effects of development decisions, etc. 	<ul style="list-style-type: none"> – Potential to become outdated – Geography gaps: little incentive for firms to gather data in low-profit sectors or low-income countries – Expensive access – Siloed: rarely opened up to or informed by expertise 	<ul style="list-style-type: none"> – To model the effects of making specific decisions/ investments (e.g. via digital twins)
Comparative rankings and studies	<ul style="list-style-type: none"> – Good coverage across multiple themes – Easier to understand perceptions and spot misconceptions – Useful to inform strategic conversations – Easy to understand – Mostly free access 	<ul style="list-style-type: none"> – Difficult direct tracking: potential method changes over time – Difficult interpretation: hard to disentangle the reasons for changing scores – Quickly outdated data, often by 1-2 years – Studies still focused on expats and visitors (less on local residents) – Prevalence of large cities vs small cities – Focused mainly on core cities vs metropolitan areas 	<ul style="list-style-type: none"> – To assess performance advantages and issues at a high level – To understand perceptions of the global public and opinion-shapers – To spot comparator and peer cities

Data type	Strength	Weakness	Potential use case
Crowdsourced and user-generated data sets and surveys	<ul style="list-style-type: none"> – Agility and flexibility in geographical scale – Breadth: very large, unmatched by others – Real-time and responsive: users incentivized to make contributions as up-to-date as possible – New perspectives, e.g. on city sentiment – Multiple agendas: economy, tourism, mobility, climate change 	<ul style="list-style-type: none"> – No agreed methodologies: much scope for opportunism – Proprietary data: potentially unsuitable for citywide analysis – Limited and unpredictable data releases – Less transparency of inputs, exclusions and partiality – Costly access – Pushback from residents: lack of clear data protection and privacy standards 	<ul style="list-style-type: none"> – To assess public sentiment for particular services – To learn about trends at different geographical levels (districts, neighbourhoods, regions) – To understand local perceptions and how they align or diverge from policy – To enhance the efficiency of citywide services (e.g. to target them more effectively, improve traffic flows, etc.)
Data owned by private companies	<ul style="list-style-type: none"> – High quality – Useful insight into less easily accessed issues (e.g. retail preferences, in-building behaviour, emissions) – Potential availability of a good technical team to maintain and process the data 	<ul style="list-style-type: none"> – Difficult availability: hard to find or keep track of – Less coordination when releasing data – Possible ethical and/or privacy concerns when sharing data across organizational borders 	<ul style="list-style-type: none"> – To make the case for national or private investment into neglected areas (e.g. streets, security, green buildings) – To understand consumer trends and preferences for certain kinds of activities, retail, public space



2.4 The use of city data for benchmarking

The benchmarking of cities is the practice of comparing how one city is performing against another. Many national governments, international organizations and investors engage in benchmarking to inform their choices. Cities themselves also undertake this exercise to help them identify strengths, reveal risks and prioritize corrective actions.

When the data and the surrounding context are carefully assembled, benchmarks help cities learn from others and help identify cities in similar situations to partner with. A growing trend is to balance comparative data with a focus on “types” of cities and the unique conditions in each metropolis. Connected Places Catapult, for instance, has a Global City Typology Index to segment distinct kinds of support needs for cities depending on their infrastructure, commercial and decision-making circumstances.²⁰

When considering data sources to assist in building an international view of how a city is performing, certain initial key points should be kept in mind:

- Some cities are part of many comparative studies and some are not.
- Comparisons may consist of specific indicators, or composite “indices”. Unpicking the cause of a city’s performance, and its implication, requires care and detail.
- Different benchmarks define the city boundary in different ways: the inner city, the city government or a metropolitan region.

- It is useful to prioritize benchmarks that compare genuinely relevant comparators, not cities in very different contexts.
- Many benchmarks prioritize the interests or perspectives of a narrow audience (e.g. expats, visitors, investors, long-term residents). They may still be valuable but their indicators may be selective or omit alternative viewpoints.
- Some benchmarks are updated every year or more frequently. Others are less regular and are therefore harder to use to track progress. Data that is sensitive to real-world change and policy influence is important.

Comparison and competition between cities, when executed with effectively standardized and responsive collection methods, will start to allow cities to compare policy and technology experiments. Virtuous competitions could emerge as cities strive to “win” accolades for the fastest improvements on emissions, green space, educational outcomes, etc.

The World Economic Forum’s recent work on climate change, urban inclusion and digital infrastructure reveals a number of areas where progress is taking place to allow more cities to compare their progress with others (Table 5).²¹

TABLE 5 Using data to understand emissions, inclusive infrastructure and digital tech: progress and recommended next steps²²

Progress	Greenhouse gas (GHG) emissions	Inclusive infrastructure	Digital tech and uptake
Good news	<ul style="list-style-type: none"> – More granular emissions data increasingly available – Many more cities reporting their GHG inventory – Carbon Disclosure Project serving as a global sharing platform – Accessibility of sector-specific performance benchmarks (e.g. QUEST in Canada) 	<ul style="list-style-type: none"> – Greater monitoring of infrastructure performance, not only on technical criteria or by aggregate benefit but also in terms of how it affects vulnerable groups – Recognition that public transport and services are perceived and accessed differently by women, children, wheelchair users, low-income neighbourhood citizens 	<ul style="list-style-type: none"> – Improved “supply” indicators, e.g. mobile network coverage, or access to computers and good internet service – Greater demand to measure usage and uptake: digital skills, business requirements, employable capabilities, familiarity with services
Key next steps	<ul style="list-style-type: none"> – Engage more cities beyond key networks, such as the C40 Cities Climate Leadership Group, the ICLEI (Local Governments for Sustainability) and the Global Covenant of Mayors – Translate standards into prioritized choices for cities 	<ul style="list-style-type: none"> – Use tools to gather data disaggregated by gender, age, race, income and disability status – Develop more longitudinal data – Establish the net inclusivity impacts of investment decisions 	<ul style="list-style-type: none"> – Develop more indicators to assess the influence digital technologies have on the city’s economy, society and the environment – Conduct effective surveys of businesses and citizens to track skills and behaviour²³

BOX 1 | International Organization for Standardization, Sustainable Development Goals and data

Several efforts are under way to standardize the way city-level data is collected and to systematize the ways cities are measured and compared. The Sustainable Development Goals (SDGs) are an important driving force behind this momentum: organizations such as the OECD, UN-Habitat, the World Council on City Data and the Sustainable Development Solutions Network are all leading the charge on applying SDGs to cities and enabling cities and their leaders to monitor progress, make comparisons to others, and assess their distance from achieving the SDGs.²⁴

Among the perceived advantages of these SDG-based approaches are:

- A more systematic and harmonized approach to international benchmarking
- A more reliable way for city governments to compare themselves with confidence
- A way to help promote a spirit of collaboration and joint learning

- An accurate time-series to monitor progress and spot areas for improvement
- A strong brand profile that creates appetite for cities to excel

The International Organization for Standardization (ISO) standard on sustainable cities and communities provides an important overview of more than 100 indicators gathered from over 250 cities. It allows cities to undertake audits and certifications to drive further improvements and select the most relevant indicators for driving progress.

Moving forward, more cities will benefit from access to the reliable resources and support to complete and update their standards. Cities will need to consider in what circumstances and for what agendas ISO and similar standards can aid their direction and decision-making, and explore what additional approaches are necessary. Along the way, it will be important for the producers of standards to align and adjust methodologies, ensure indicators remain relevant to changing contexts and reduce the risks of duplication.

BOX 2 | The value and sources of data: Key takeaways

Positive signs indicate that access to city data continues to grow. This spans everything from public transport, fixed assets and digital connectivity to neighbourhood variety and the uptake of public services. In many cities, satellites, trackers and IoT sensors are becoming more affordable and effective. And more cities are exploring ways to keep track of what happens beyond their official boundaries – not least the greenhouse gas impacts and flows associated with urban activities.

The world's cities now rely on deeper progress to make city-level data available right across the city size, scale and income spectrum. Improved urban data in major global organizations and programmes, such as the Intergovernmental Panel on Climate Change, could be one example of such progress. Cities will benefit from well-resourced studies undertaken for nations and continents and applying them to themselves, and from greater willingness to develop a full set of criteria relevant for the different political, economic and social contexts cities find themselves in.

Looking forward, cities will gain from guidance and innovation to:

- 1. Ensure more data fully aligns with cities' most pressing challenges.** This data focuses more on the quality, consistency, parity, resilience and experience of city services, amenities and infrastructure – rather than on just raw quantity – on everything from housing stock to jobs, to disabled access and electric vehicles.
- 2. Provide data that equips cities to look forward as well as to look back.** The use of city data simulations, modelling and predictions to inform policies is still limited.
- 3. Build the capacity to analyse and derive meaningful insights from data.** Often city authorities lack the skills and resources necessary to utilize data. The forging of successful long-term public-private relationships in the areas of data collection and utilization is not yet mature.

Many examples of cities and other partners finding ways to overcome these challenges exist. The effort requires thorough research and benchmarking, applying other cities' best practices, and engaging forward-looking businesses, civic institutions and researchers from various disciplines.

3

What cities should do

Leadership can optimize the roles of data for long-term success.

City authorities, planners and decision-makers worldwide have many important choices to make about how they optimize the role of data.

Numerous frameworks, created by universities, national government agencies, multilateral organizations and city networks, already exist to help city leaders make sense of data and make use of it.²⁶

This section aims to:

- Provide a simple set of first principles and recommendations for those seeking to rise to the “data in and for cities” challenge

- Present a variety of relevant global case studies (megacities, medium-sized cities and smaller centres), at all stages of their data journey, that can equip and empower city leaders and their alliances

Six pillars and 12 recommendations can help city leaders establish suitable data governance structures (Table 6). Descriptions of the principles follow and point to promising practices in other cities.

TABLE 6 **6 pillars and 12 recommendations to help inform suitable data governance structures²⁷**

Category	Guidance
Leadership and organization	<ol style="list-style-type: none"> 1. Establish data leadership, teams and alliances 2. Develop data strategies
Digital skills	<ol style="list-style-type: none"> 3. Spread digital skills across the city governance system 4. Empower citizens to play their full part
Data usage and impact	<ol style="list-style-type: none"> 5. Disseminate city data for broad-based insight and decision-making 6. Foster a data-informed culture across the city
Collaboration and partnerships	<ol style="list-style-type: none"> 7. Collaborate on data across levels of government 8. Leverage the value of data partnerships
People-focused standards and services	<ol style="list-style-type: none"> 9. Build and uphold high standards of data privacy, security, equity and ethics 10. Develop proactive citizen services
Implementation	<ol style="list-style-type: none"> 11. Use agile processes and avoid lock-in 12. Monitor outcomes

Leadership and organization

1. Establish data leadership, teams and alliances

Clear leadership of a city's data strategy is essential. Many cities have found that the responsibility for the use of data and the impact of data on cities must lie at the top leadership level.

Many cities across the globe have set up a chief data officer position or close equivalent. Some, like Barcelona, have fused this role with the chief architect to create a single office that combines the physical and the digital. Others oversee citywide innovation teams. These individuals can play an important part in increasing and enhancing the use and stewardship of data in government.

For these leaders, the goal is rarely as simple as having an "open data portal" to make city data public. Indeed, doing so without due diligence can

expose cities and city assets to cyber risks and public opposition. What are required are credible channels for data and evidence to inform policy and resident services. To this end, the city of Bogota, Colombia created Ágata, a Data Analytics Agency, to translate city data more effectively into public policies and public services that better address users' needs.²⁸

Data leadership becomes an effective alliance when there is a clear grasp of the existing data-driven talent in and around the city government: the data analysts, the Geographic Information Systems (GIS) specialists, the client relationship managers, the procurement managers, the public works directors, and so on.²⁹ Cape Town's data-led restructuring in 2016 created two units that benefit from active collaboration with universities and research labs, which have helped to amplify the role of data-informed city policies and programmes.³⁰



Recommendations

Action 1

Establish leadership at the mayor or deputy-mayor level (or equivalent) responsible for enhancing the capability, use and impact of data across the whole city

Action 2

Build a technology and data team able to guide and orchestrate the collection, use and value proposition of data in cities

Action 3

Assemble capabilities that span different strands and styles of city data expertise: benchmarking, public services, citizen sentiment, sensors, sharing across organizations

2. Develop data strategies

Optimizing the purpose, profile and partnership of data is at the heart of successful data strategies for cities. A strategic data approach that closely aligns with wider city goals produces clear long-term priorities behind which others can organize.

Good-practice city examples indicate that successful strategies:

- “Think big but act small”. A compelling vision for how analytics can improve city liveability should be matched by an audit of existing capabilities and resources, attention to the absorptive capacity of others in the city to benefit, and pilot projects to test new approaches. Staying grounded helps to set clear localized definitions, objectives and expectations.³¹
- Are realistic about what can be accomplished, especially in light of shifting budgets and priorities.³² Defined goals and time periods are useful. For example, Amman has a roadmap that defines data investment priorities and technical requirements for short-term (1-3-year), medium-term (3-5-year) and long-term (5-10-year) time frames.³³
- Are not limited to one single agency or capability. Singapore’s new data strategy, for example, was jointly developed by the merger of two authorities to form the statutory board Infocomm Media Development Authority.
- Are informed at each stage by stakeholders. The city of Brussels assessed its data maturity through interviews with city business departments, elaborated its vision in four collaborative working sessions and launched its roadmap with a participative “show-and-tell” activity.³⁴



Recommendations

Action 1

Establish the baseline by assessing the current collection and use of data in cities

Action 2

Develop or review an overarching and compelling vision for how data can improve the city, using a strategy that is aligned with the city’s; Account for the city’s particular context and needs in both the short term and long term

Action 3

Break down the strategy into concrete objectives and measures that have both citywide and departmental relevance; Ensure targets are SMART (specific, measurable, achievable, relevant and time bound)

Digital skills

3. Spread digital skills across the city governance system

Data cannot remain in a silo. Expertise on using data has to reside throughout a city administration, not just in an IT department or designated data intelligence unit.

Cities can plan and lead in a more evidence-led way when there is greater capacity among staff to leverage different kinds of data. Recognizing this, Portugal's second city, Porto, offers digital training (courses, workshops, webinars) to city council staff to enhance the day-to-day use of data across all departments.³⁵

The required data skills vary. It is necessary to navigate the different registries and systems for storing information, and to grasp the restrictions on sharing or combining data. Skills of data interoperability are also important, as city data usually needs harmonized data formats and consent approval.³⁶ It is advantageous to integrate data skills in adjacent departments, such as homeless services, education provision and small business support. More affordable mobile sensor hardware will make a significant difference to the volume and coverage of data, which in turn is likely to incentivize more cities to create whole-city capacity.³⁷

Non-technical know-how can be just as important. City officials need knowledge of process, legal and procurement rules to share data, which explains why the UK innovation accelerator Connected Places Catapult recently developed a Creative Commons toolkit to help local government teams practically share non-personal data.

Important mechanisms can include:

- The appointment of a set of data stewards in diverse departments with responsibility for coordinating particular data sets³⁸
- A Data Academy oriented to practical city projects, with a curriculum that promotes peer-to-peer data learning and sharing³⁹
- A skills assessment survey for staff to be conscious of existing skills, discover gaps, elevate talent, and charge data teams with sourcing the next logical capacity-building opportunities⁴⁰



Recommendations

Action 1

Survey and baseline data skills across city departments, agencies and closely related organizations to understand the gaps and the upskilling required

Action 2

Consider data skills in recruiting processes, and other reform and restructuring activities the city goes through

Action 3

Decide which skills need to be complemented through external support and capacity-building, working with the private sector, universities, the national government or neighbouring local governments

4. Empower citizens to play their full part

Cities can equip citizens with the skills and platforms to contribute data, use data and make informed choices. This is key to making city data inclusive, in terms of the access provided and the insights generated. Bilbao, Spain has a digital literacy programme comprising digital training and courses for citizens, especially for groups at risk of exclusion.

Organizing, visualizing and sharing data efficiently help cities better understand what their residents need and develop policies that will align with their expectations. For example, the Asunción Open Data Kit open-source smartphone tool in Paraguay allowed 10,000 of the city's poorest residents to be surveyed and included in city decision-making for the first time since the 2002 census.⁴¹

More cities are realizing that they can communicate with citizens through engaging data dashboards. Paris is an example; its data is organized according to six easy-to-understand themes: attractiveness, cleanliness, education, environment, security and solidarity.⁴²

Cities can also provide assurances and reliable platforms for citizens and entrepreneurs to share data. One example is Singapore, whose Infocomm Media Development Authority set up a citywide data exchange to drive data innovation among businesses. The idea in these cases is to provide open-source software, tools and services so that secure marketplaces can be built.



Recommendations

Action 1

Measure the existing state of citizens' digital/data skills and their use of (and appetite for) digital or data-driven tools

Action 2

Initiate programmes to increase the digital participation and literacy of citizens, particularly for groups at risk of (digital) exclusion

Action 3

Focus on what can make city data more inspiring, engaging and resonant and not only on improving the capability of citizens to participate

Data usage and impact

5. Disseminate city data for broad-based insight and decision-making

It is one thing to create data, process it and develop excellent insights from it. It is another to then successfully share data with relevant stakeholders and end-users in formats that are conducive to analysis, co-creation, visualization and informed decision-making.

Cities find it useful to create standardized data interfaces in one place that can be used by many types of audiences. This was one reason behind London's creation of the London Datastore, an open data portal for secure data sharing, which also provides analysis and visualization tools and is evolving into a hybrid data catalogue that includes private-sector data.⁴³

City data can be shared across multiple channels to suit target audiences. These audiences may be technical or non-technical, within or outside of government. The Digital Authority of Abu Dhabi created a Data Management Platform that collates and standardizes diverse government data assets so they can be shared with both the business community and civil society.⁴⁴ Copenhagen meanwhile partnered with Hitachi to trial a data brokerage programme that engaged 1,000 individuals and organizations to understand the data landscape and potential use cases before subsequently offering 140 tailored data sets.⁴⁵

Sharing data effectively depends on mapping how it is, or can be, used. In Paraguay, the national procurement agency introduced an open platform, enabling civil society to monitor budgets and contracts. This significantly improved how funds for school facilities were allocated. In Ciudad del Este, Paraguay's second city, 80% of schools in greatest need received funding, up from 20% in 2015.⁴⁶



Recommendations

Action 1

Make data as accessible as possible for city employees and for external stakeholders, to enable others to find solutions using the data

Action 2

Maximize the impact of visualization and simulation models (including digital twins) to help decision-makers and engage stakeholders

Action 3

Engage partners and decision-makers early on to ascertain what they need to understand and visualize data; often, less is more: the forest cannot be seen for the trees if there is too much data or it is poorly presented

6. Foster a data-informed culture across the city

The value of city data is limited if it is not used or handled in suitable ways. To get the most out of it, utilizing data needs to become the standard in city administrations, whenever possible.

To get the best from their data, city and local governments need a whole-city approach. That means patiently working together with neighbours and getting all departments on board to understand the opportunities and risks related to data, and encouraging them to see data not as a niche innovation activity but a founding enabler of effective organization and decision-making – “not 100 percent of any one person’s job [but] a significant part of everyone’s job”.^{47,48}

Establishing ownership and conviction in data among the diverse senior leaders in city departments is viewed as key. Mandatory enforcement is rarely possible or desirable.

Collective ownership helps teams respond during crises by providing data platforms related to public health, services and environmental management.⁴⁹

Positive elements cities of different kinds have tested to build culture include:

- Citywide data collaboratives or governing bodies that meet regularly and are chaired by outward-facing individuals who can convene and motivate a diverse group
- Umbrella goals that invite multiple organizations to work on a common problem using data⁵⁰
- Challenges and competitions that help promote innovative ideas that are community-driven, address complex challenges and focus on the achievement of outcomes⁵¹
- “Living labs” that help provide a recognized and visible space within the city for stakeholders to come together, collaborate and test local solutions⁵²



Recommendations

Action 1

Encourage managers and staff to support opinions with data and evidence when possible

Action 2

Showcase data best practices across city and local government, and create incentives for innovations inspired by data

Action 3

Create a multi-purpose data platform, for example by including easy-to-use analytics tools, and provide access to it throughout city administrations and wider partners in government

Collaboration and partnerships

7. Collaborate on data across levels of government

The application of data benefits greatly from national and international alignment, allowing data sharing, benchmarking and progress monitoring. This approach also creates a higher level of accountability within cities themselves.

As cities become more spatially distributed, it is even more important for data to be interoperable. More than ever, citizens commute across city borders and use services in one place but live in another. In this context, data is required to help cities establish appropriate accountability (legal and financial) for activities that take place in and beyond their boundaries.

National frameworks are important tools to ensure interoperability between data sets collected at the regional or local level and to facilitate knowledge sharing between local players. In India, as part of the Smart Cities Mission, a data maturity assessment framework was introduced, enabling local governments to self-evaluate the maturity of their data infrastructure.⁵³

Coordinating a multilevel approach relies on strong groundwork. It is forged collaboratively and benefits from decisive leadership either at the city or higher levels. It starts often by the creation of citywide policies that establish the structure and framework for how to collect, use, govern and publish data.⁵⁴



Recommendations

Action 1

Work jointly with other cities or neighbouring local governments on data issues of shared interest to demonstrate to higher levels of government the value of data partnerships

Action 2

Encourage governments to set up national data strategies, data standards and reporting and monitoring platforms that support cities in their implementation and use

Action 3

Create national and/or international exchange platforms for the use of data in cities; Explore peer-to-peer clubs of like-minded cities as they have a mutual interest in a durable partnership

8. Leverage the value of data partnerships

Data is not a command-and-control activity. Success relies on making connections outside of government, which are essential to spot new opportunities, design data projects, pool initiatives and create joint support in the quest to ally data to the city's future.

Common partners include leading technology and telecoms corporates, forward-thinking local data start-ups, the main academic institutions, cultural bodies and international organizations.⁵⁵ CityVerve Manchester, for example, was a consortium of 21 organizations that used IoT to help the city council improve its design and delivery of services. The breadth of partnership provided access to multiple sources of data via a unifying layer that overcame the need to assemble data sets from separate platforms. One result was a more open-ended model of collaboration focused on sectoral use cases.⁵⁶

Partners may provide much more responsive and better packaged data. For example, Waze and Airbnb are essential in informing many cities' traffic, infrastructure and hospitality planning. Other developers can ensure that data-sharing platforms evolve with the end-user in mind.⁵⁷ Kansas City in America's Midwest worked with Cisco Systems and other community stakeholders to develop real-time transport visualizations that could inform choices about infrastructure maintenance, interactive kiosks for tourists, and free public Wi-Fi.

Partnership-origin data guides lower- and middle-income cities on urban planning and services. Mobile network operator data, remote sensing data and utility service data provide not only the infrastructure for data collection, such as sensor-based tech, but also the user interfaces for communicating data.⁵⁸ In 2020, the central bureau of statistics, BPS Indonesia, collaborated with mobile operator Telkomsel to redraw the metropolitan boundaries of Bandung, the country's third largest city. The partnership, based on commuting data, helped the Government revise budget allocations and inform local government responsibilities.



Recommendations

Action 1

Involve partners early in projects' planning and design phase to develop a united vision and increase the probability of innovative ideas

Action 2

Use different forms of partnerships: strategic partnerships, joint ventures, platform partnerships or sector-specific partnerships; Look for innovative financing models that incentivize successful implementation, such as outcome-based financing, consumption-based financing or as-a-service financing

Action 3

Explore options for the co-ownership of data and intellectual property; firms with a long-term presence in the region can help create continuity and stability during political or funding cycles that affect cities⁵⁹

People-focused standards and services

9. Build and uphold high standards of data privacy, security, equity and ethics

The expansion of data-led leadership in cities introduces new types of risks related to privacy, security, bias and fairness of access to city services. These have a serious effect on public trust and the appetite for harnessing data for the public good. Cities must be proactive in identifying, pre-empting and addressing these risks.

Cities tend to benefit from:

- Clear policies on how data is used, who the stakeholders are, how privacy is mitigated, and what steps are taken when failures occur⁶⁰
- Modular approaches to personal data that separate storage, anonymization and processing
- Commitment to equitable data practices that continually look to avoid algorithmic bias against minorities

Technology simply to monitor vulnerabilities alone is rarely enough.⁶¹ Cities have begun to more regularly adopt tools designed to let users easily flag issues and help teams flexibly and efficiently respond to them.⁶² Montreal recently introduced a Digital Data Charter, enabling citizens to control the personal data the city collects when delivering public services by, in effect, banning the collection of biometric data without consent by public entities.

Some places have gone further, passing legislation that mandates adherence to stricter standards. Dubai's ambition to become a leader in the digital economy as part of its 2040 Urban Master Plan spurred it to recently become the first city in the world to ensure that data sharing is mandated by law. Under new legislation, data must be published and exchanged via electronic systems, bulletins or reports.⁶³

Cities are also working together. The Igarapé Institute and think tank New America have recently set up a diverse working group to manage predictive analytics in the Global South – the Global Task Force on Predictive Analytics for Security and Development. This work develops a wide range of codes of conduct and principles to guide the design and development of algorithms for city deployments.⁶⁴



Recommendations

Action 1

Create standards that are legible, practical, future proof and pro-innovation; Raise awareness of these standards and offer training to ensure they are understood and used by all stakeholders, from industry to governments and non-governmental organizations

Action 2

Look to reserve resources for the privacy-preserving, secure and ethical use of data in all city data projects

Action 3

Design data projects with equity in mind to ensure all citizens have equal access to services, independent of their capabilities and backgrounds; Test solutions with citizens before they go live; Publicly disclose the reasoning and logic behind providing data services to avoid biases and ethical issues

10. Develop proactive citizen services

Citizen expectations for service delivery are rising fast.⁶⁵ The social value of data-informed city government and leadership must be considered central.

The use of personal data and predictive analytics allows cities to offer their citizens more targeted and proactive services when they are needed.⁶⁶ This can improve citizen satisfaction and produce significant cost savings and a lower risk of fraud for cities and data officers. The city of Helsinki, long known as one of Europe's data pioneers, successfully tested proactive preschool student placement in two school districts: 84% of families with preschool-age children who were proactively sent an SMS

message proposing a placement in a nearby school accepted the placement.⁶⁷ Benefits of proactive public services become even more apparent in periods when urgent action is required (such as during a pandemic), as they are quicker to provide with less duplication.⁶⁸

The digitization of services can also boost citizen participation and foster greater trust in government, as citizens are empowered to contribute to the decision-making process and decide on priorities. The Mijn Rotterdam website's objective is to bring the neighbourhood feel online. Through this digital meeting place, Rotterdammers can discuss and decide what is crucial for them.⁶⁹ Similarly, in Surat, Gujarat, a pioneer in India's national Smart Cities Mission, the open data portal includes a community module to allow public users to interact with data and share their findings and views with others.⁷⁰



Recommendations

Action 1

Create citizen profiles (e.g. by clustering citizens) while ensuring citizens maintain control of the use of their personal data

Action 2

Develop capabilities for predictive analytics, e.g. recognizing citizens' significant life events

Action 3

Create personalized recommendations for citizens

Implementation

11. Use agile processes and avoid lock-in

Greater real-time data made available to decision-makers and place leaders allows them to be more agile during the implementation phase, react to challenges more nimbly and use data to inform next steps.

“If you fail, fail fast. If you succeed, iterate, monitor and scale.”⁷¹ The use of iterative processes, by prototyping, testing and making improvements, provides opportunities for city leaders to test new solutions on a smaller scale, identify barriers to implementation, troubleshoot issues after delivery and solve them before citywide scale-up. This can reduce implementation costs and increase citizen trust in the Government, as projects are better managed. Delft, a small university city in the

Netherlands, recently shifted from a manual data-collection process to a proof-of-concept interactive dashboard to monitor and improve the process of de-icing the city’s roads in the cold winter months. This change helped highlight the advantage of involving de-icing companies to improve the solution and adjusting the tender process to encourage innovation in the process.

Building flexibility into processes and projects can also enable city leaders to build on their success, share knowledge with other city departments and apply it to other areas. In 2020, Antananarivo, the capital of Madagascar, partnered with the non-profit Gather Hub to trial a data-led approach to solving urban sanitation challenges, by creating a visualization tool that enables city leaders to identify sanitation risk areas and make data-driven decisions on the ground.⁷²



Recommendations

Action 1

Start with a pilot approach on a smaller scale in data projects before expanding, and feed insights back into the design and development phases

Action 2

Engage stakeholders early on in solution design and testing

Action 3

Ensure arrangements and partnerships create shared risk, mutual incentives for success and flexibility in time frames and costs

12. Monitor outcomes

Data is a vehicle for cities to clarify if they are heading in the right direction and to change course if they are not. Seen in this way, target aims and accomplishments benefit from the establishment of monitoring systems that can continually inform decision-making while being simple enough to endure and achieve wide support.

For example, the Brazilian city of Curitiba, long known for its efforts to promote social and environmental sustainability, recently defined a set of 123 indicators along three axes (solidarity, sustainability and responsibility) to more closely monitor the effect of policies and make sure they benefit all citizens.⁷³

Existing frameworks offer a useful starting point. The “Sustainable Cities and Communities” SDG provides promising indicators for city services and quality of life, for example. Since 2007, Vienna has produced a consistent *Integration and Diversity Monitor*, a report that allows comparisons to previous years, providing a good evidence-based proxy for assessing the consequences of integration and diversity policies and identifying obstacles.

Climate change is also an area in which innovation in monitoring is possible. For instance, the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories allowed the city of Calgary, Canada’s oil and gas hub, to be at the forefront of national efforts to transition to clean energy. Its dedicated Climate Team measures, tracks and reports citywide GHG emissions to both the general public and federal Government.



Recommendations

Action 1

Define metrics that represent target achievements, data sources and measurement cycles, at the most senior levels and for specific departments and projects; Consider metrics that also reflect inclusivity as well as aggregate outcomes and impacts

Action 2

Establish processes to ensure metrics are used to steer decision-making, inform realistic targets and shape strategy execution

Action 3

Publicly report monitoring outcomes to inform citizens and create accountability; Use monitoring exercises as an opportunity for full “state of the city” dialogues

Pertaining to data, cities must lead, organize, build capacity and build confidence in partnerships. This is easier for some cities to achieve than others, given their endowment, the character of their national system and the competing issues they must address.

Across every continent and all city types, some cities have innovated and pioneered approaches to data. The common achievements and practices of cities taking the lead are:

- Improving levels of city autonomy and standards of public governance
- Being willing to break down data silos, adopt an integrated attitude and build collective intelligence across the city government and neighbourhoods, informing broad and negotiated choices
- Focusing on the relationships, channels and persuasive people that will make data habitual, impactful and influential
- Succeeding on a small scale and applying this success more widely rather than pursuing big-ticket solutions

- Valuing diverse data “skills” – science, storage, assembly, legibility and communication
- Treating citizens and small companies as agents and allies rather than as customers or inconveniences
- Engaging in regular self-correction and being willing to confront limitations, which includes an appetite to work across both geographical and administrative boundaries

Cities still often rely on leadership from higher tiers of government to provide the data impetus, finance and platforms from which they can benefit. They tend to gain from close collaboration with data, technology and statistics agencies at higher levels and with other cities of similar size with whom they can pool efforts and advocacy.

Better city approaches to data do not arise in a vacuum separated from wider issues of city governance and capacity. Improvements to decision-making structures, devolved capability, access to finance and staff retention all have a positive knock-on effect on the potential of cities to adopt the data norms and practices outlined in this section.



4

Next steps

Time, dialogue, policy, leadership and the pooling of collective experiences will accelerate data-informed decision-making.

The promise of data in cities has been articulated for over 40 years.⁷⁴ The next cycle of design and delivery of data-led initiatives in, by and for cities can benefit from an understanding of what has worked and what has not.

Data will be essential to shift cities to successfully marshal a systems approach. This shift has been observed by the World Economic Forum Global Future Council as critical for climate action, technology, finance and inclusion. The world is now on the cusp of a new acceleration to understand the systems dynamics and interdependencies in cities. It will take time, dialogue, policy, leadership and the pooling of collective experiences to accelerate data-informed decision-making on an urban scale. Each set of stakeholders has responsibilities to support this transition (Table 7).

What is clear is that:

1. Proactive efforts are needed to introduce new data sources to cities. Cities primarily collect data from private companies, facility operators and other operational agencies when making

their GHG inventory. They can be made more aware of emerging data, such as satellite data, open street data, and new data processed and released by international organizations (e.g. the World Bank, OECD). These sources promise more spatial and temporal accuracy that will make a big difference to cities' day-to-day work.

2. More conduits are needed between data producers and city leaders. The world's cities will benefit from more coordinated dialogue between the data producers and providers and the organizations that work with and convene many cities (e.g. international financial institutions, city networks and national agencies). Otherwise, fragmentation will reign and not enough cities will know how to navigate and negotiate their way through the maze of choices.

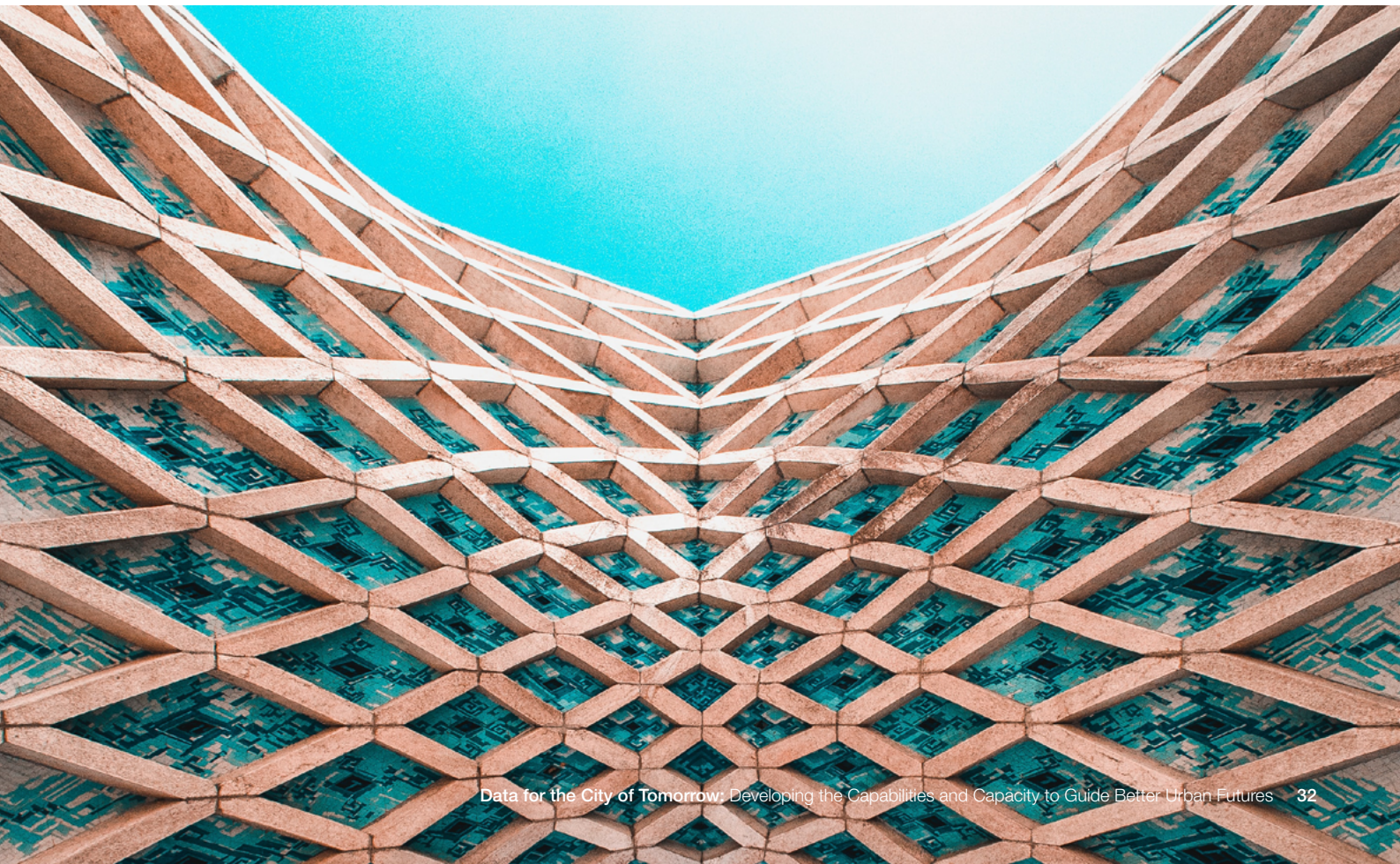




TABLE 7 | Dos and don'ts of various players in cities⁷⁵

	Do 	Don't 
City governments	<ul style="list-style-type: none"> – Build data governance and leadership that can also coordinate at a wider metropolitan/regional level – Find out what peers are doing – Partner with cities and nations to build shared platforms 	<ul style="list-style-type: none"> – Start too big, too soon – Assume what has worked so far will be enough – Ignore the privacy, security and ethics risks until it is too late
Global corporates	<ul style="list-style-type: none"> – Explore joint city data ventures with leading global institutions – Open up APIs and encourage innovative city policy uses – Show the rest of the market the opportunity 	<ul style="list-style-type: none"> – Neglect the city data opportunity due to a lack of market size/return on investment – Oversell one data solution as “the answer” – Focus solely on the cities/locations that are ready-made customers
International organizations	<ul style="list-style-type: none"> – Assist more cities through effective guides and capacity-building – Try to influence the emergence of highly trusted global frameworks – Act as a neutral broker to explain the distinct added value of each kind of data and method 	<ul style="list-style-type: none"> – Duplicate initiatives taking place elsewhere – Impose one-size-fits-all frameworks on diverse kinds of city – Ignore the cutting edge of the city data market
Data start-ups operating in one main city	<ul style="list-style-type: none"> – Build strong links with knowledge institutions and partners with international reach – Triangulate innovations with progress happening elsewhere – Set high visualization and user engagement standards 	<ul style="list-style-type: none"> – See the wider city data quest as “not my business” – View proprietorial software/hardware as a barrier to partnership – Avoid opportunities to expand the core client base and type
Infrastructure and data providers	<ul style="list-style-type: none"> – Focus on translating information into city leadership insight – Explore how other cities can benefit – Establish public-private partnerships with partner cities 	<ul style="list-style-type: none"> – Present data opportunities without capacity-building tools – Discount the opportunity to positively shape the global city data landscape – Create tools with high built-in obsolescence

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