

# GLOBAL REVIEW OF SMART CITY GOVERNANCE PRACTICES

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دبي ورلد  
DP WORLD



# FOREWORD

## Message from UN-Habitat Executive Director



A handwritten signature in black ink, which appears to read 'Maimunah'.

**Ms. Maimunah Mohd Sharif**

Under-Secretary-General and Executive Director, United Nations Human Settlements Programme (UN-Habitat)

Today, half of the world's population - 3.5 billion people - live in cities. This growing urbanization trend is now accompanied by digitalization fuelled by advancements in connectivity and the rise of newer technologies such as artificial intelligence. Digital technologies have the potential to transform how people live, do business and participate in democratic life in cities. The digitalization trend has contributed to the emergence of the "smart city" concept which is being widely discussed now by both governments, at all levels, the private sector and international bodies. Smart cities raise questions around impact, governance, values and principles and the role of government in digital transformation.

Whilst smart cities and associated digital technologies have transformative potential for positive change, they can also perpetuate existing social and economic inequalities. It is for the reason that UN-Habitat promotes a "people-centered" approach to smart cities and advocate for commitment to human rights, digital inclusion and the use of digital technologies to improve people's quality of life.

The people-centered smart city approach is anchored on a number of existing global frameworks. In the New Urban Agenda, Member States commit to "adopting a smart-city approach that makes use of opportunities from digitalization,

clean energy and technologies, as well as innovative transport technologies". The UN Secretary General's Roadmap on Digital Cooperation calls for the redoubling of efforts to better harness the potential of digital technologies while mitigating the harm that they may cause.

To operationalize these frameworks in the context of smart cities, it is important to understand how the governance of smart city initiatives is interpreted and implemented in different settings. This report, Global Review of Smart City Governance Practices, captures the findings of a global online survey undertaken to understand smart city governance practices employed by municipal governments. It also explores the mechanisms, partnerships and design principles guiding the choice of urban technological infrastructure. The report puts emphasis on the significance of regulating the ethical aspects of smart city technologies and the role municipal governments.

I believe local governments have an important role to play in the governance of smart cities and in countering the challenges and risks of rising digitalization in public service delivery and implications such as digital divide, digital inclusion and social equity.

# FOREWORD

## Message from CAF



**Antonio Silveira**

Physical Infrastructure and Digital Transformation Manager



**Angel Cardenas**

Urban Development and Creative Economies Manager

In Latin America and the Caribbean, the most urbanized developing region on the planet, smart city management is a key element in improving people's lives. In a context of exponential growth in the amount of available data and an increase in the demand for services imposed by the change in citizens' expectations, the search for innovative management models, more than an opportunity, is an imperative.

CAF – Development Bank of Latin America, within the framework of its Digital Transformation Agenda and its initiatives for smart cities, seeks to promote territories that are more attentive to the needs of the economy and society, through the expansion and use of physical infrastructures, new technologies, data intelligence and innovative governance mechanisms. We accompany the region's cities in their digital transformation through a new way of looking at territorial management capabilities and public service, so that they are increasingly better, more sustainable, more transparent and people-centric.

The collaboration between CAF, UN-Habitat and Edinburgh Napier University makes us very proud and also offers many lessons. The elaboration of digital transformation strategies is complex and involves the articulation of several actors. Implementing the proper governance and incentive mechanisms are critical to make them come to fruition. Digital transformation plans are designed to be discussed and adapted as the city, its people and technologies advance, and having the right institutions, regulations and channels to make them happen are essential. The ability to have a world-encompassing approach to governing smart city transitions is of great use to cities in the region, and also allows to disseminate the good examples we have on this matter.

With this work, we hope to contribute to the debate on issues of inclusive urban development in the region and to the dissemination of innovative initiatives that seek to strengthen the intelligent management of cities.

# FOREWORD

## Message from Edinburgh Napier University



**Professor Andrea Nolan OBE**

Principal and Vice Chancellor of  
Edinburgh Napier University



**Professor Nick Antonopoulos**

Vice Principal and Deputy Vice Chancellor  
of Edinburgh Napier University

Available data pictures a challenging scenario: the world is far from attaining resource efficient, safe, and universally accessible urban settlements, and more work is needed to ensure that nobody is left behind.

More sustainable urban futures are urgently required, and the transformative power of smart technologies offers the opportunity to accelerate the implementation of this goal. The transition to smart cities is introducing the means for designing and experimenting with new approaches to urban sustainability enhancement. Through smart city initiatives, the many urban challenges facing cities worldwide can be tackled – ranging from inefficient and polluting energy systems to water scarcity, traffic congestion, unaffordable housing, gender-based inequalities, urban poverty, and much more. But capturing the sustainability potential embedded in these emerging technological developments demands radical changes in the way we study, govern, and organize urban environments.

At Edinburgh Napier University, we are strongly committed to supporting this change, and this dedication manifests in the continuous contribution of our research community to shaping academic and policy-oriented debates on smart city development. With multidisciplinary research that unites social science to engineering and technology studies, our researchers have been investing significant intellectual resources in activities whose main objective is to provide

urban development actors worldwide with the knowledge required to effectively manage the complexity of smart city initiatives and to ensure that digital innovation becomes a true instrument for boosting sustainable urban development and public value creation.

The report *Global Review of Smart City Governance Practices* demonstrates the intrinsic value of these collaborative and interdisciplinary research efforts. The partnership with UN-Habitat, Tallinn University of Technology, and CAF – Development Bank of Latin America – has produced a milestone in the international landscape for smart city policy development: the first-ever global overview and comparison of how the governance of smart city initiatives is interpreted and managed across regions.

Among its key recommendations, the report reaffirms the critical importance to adopt a people-centred rather than technology-led approach to smart city initiatives and urge caution in strategizing smart city ambitions. The report also highlights the need to position local governments at the forefront of urban digital transformations, but it further emphasizes that multi-stakeholder capacity and citizen empowerment are of the utmost importance. Effective governance requires organizing for collective action. Clear and powerful advice that will inform any efforts to leverage smart technologies in the construction of more sustainable urban futures.





# INTRODUCTION

## Smart city initiatives

Housing, transportation, energy, public lighting, waste management, healthcare, public safety, telecommunications, and education are only some of the many services that towns and cities offer to satisfy the needs of their residents. Increasingly, many of these services are being delivered or supported by digital technologies. The ongoing digital transformation provides new opportunities but also creates challenges, and it is increasingly apparent that delivering effective urban digital services is a complex task. Part of the challenge for local governments in what we are calling *smart city initiatives* is establishing digital leadership functions, understanding the fast-moving digital landscape and finding new ways to collaborate with the various stakeholders that participate in the development of cities. They need to find ways to equip urban areas with new digital technologies that help run operations, contribute to positive urban development and improve the quality of life of residents while reducing the environmental impact of cities.

Smart city initiatives are not only about technology. Successful transition to smart cities requires technology to be contextualized and combined with changes in policy, regulatory, organizational and institutional settings within local governments. It also calls for a redefinition of user practices and attitudes, skills and behaviours within local communities. To sustain this transformation process, smart city initiatives set in motion collaborative ecosystems, typically based on cross-sector partnerships, whose activities change the configuration of urban infrastructures. These changes are complementary and instrumental to solving technical and social challenges that can prevent newly introduced digital technologies from being adopted in an effective way – an outcome that would compromise their capability to solve or mitigate the urban challenges they are meant to address.

What is emerging is that the key challenge in this transition process is the governance aspect; there is a strong need for local governments to orchestrate activities in highly collaborative contexts involving actors such as various municipal departments and agencies, private sector suppliers, universities and other research institutes, civil society organizations and residents.

## The governance challenge

The political and executive bodies of national and local governments are at the forefront of the digital transition. As representatives of public interests, governments at all levels are increasingly expected to provide the leadership needed to ensure that digital technologies in urban spaces produce positive outcomes. This is, however, easier said than done.

The novelty and complexity of many smart city initiatives make it difficult for public sector organizations to effectively govern digital transformation processes. There is a strong need for guidance and more clarity on a wide range of issues, including the collection and management of data, data privacy, collaboration with the private sector, technology procurement and public participation in smart city initiatives.

Building on a global study on the governance of smart city initiatives, this report offers a two-fold contribution that helps overcome such a critical knowledge gap.

- First, it details how smart city governance is being approached by cities across the world. Differences and similarities of existing pathways have been insufficiently clear for many years. There is a need to examine the global state of smart city governance practices and compare them.
- Second, by building on the data describing this global scenario, the report provides key practical recommendations for local governments and their officials who are responsible for governing the planning, implementation and sustainability of smart city initiatives.

## Structure of the report

The report is structured in six main sections. It begins by introducing the methodology used to conduct the analysis, where systematic literature review methods and a global online survey were combined. Building on this analysis, it then presents a proposed governance framework for smart city initiatives.

The smart city governance framework has three pillars. These three pillars are covered in the following three sections of

the report. Each section introduces a pillar of the governance framework and details the findings of the global online survey while reflecting on their significance in the context of the systematic literature review.

The report then highlights key lessons and opportunities for improvement in the current global practices, that are exposed through the survey data. Organized by pillar, these lessons are presented in the last section of the report, along with recommendations for local governments on how to improve smart city governance mechanisms.



# METHODOLOGY

## A two-stage analysis

Many public sector organizations across the world have been experimenting with smart city initiatives and their actions have generated a data-rich environment from which to learn. It is by sourcing, reviewing and codifying this critical knowledge that this global study advances the current understanding of smart city governance approaches across the world, exposing differences and similarities. This objective was achieved by means of a two-stage analytical process.

### Stage 1



#### Systematic literature review

A systematic review of the most relevant academic literature reporting on local and regional governance mechanisms of smart city initiatives.

### Stage 2



#### Global online survey

An online survey targeting individuals knowledgeable about city-level smart city governance approaches, in particular public sector officials.

### Stage 1: Systematic literature review

Approximately 150 scientific publications were analysed. This literature covers three decades of research on the governance of smart city initiatives and was used to develop a smart city governance framework. This framework highlights the key governance areas to be considered when managing the planning, implementation, and maintenance operations of smart city initiatives. The framework is divided into three pillars: *Strategy*, *Collaborative Environment*, and *Technological Infrastructure* (see Figure 1).

### Stage 2: Global online survey

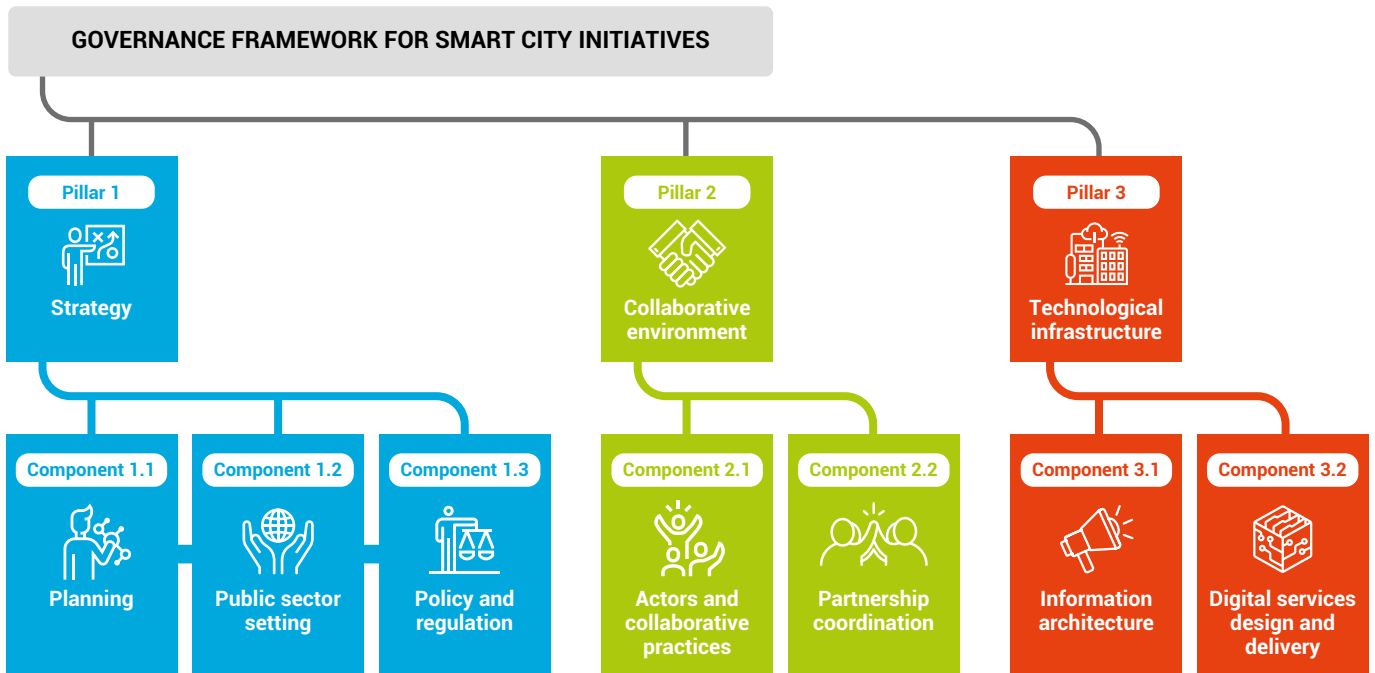
The findings of the review were complemented with data collected through an online survey, which was structured based on the governance framework. The survey was completed by approximately 300 respondents in more than 250 municipalities in Africa, Asia, Europe, Latin America, and North America (Figure 2).

Significant efforts went into ensuring a high response rate to the survey and a global representation of the responses. The survey was translated into nine languages and distributed globally by combining many different communication channels. The support of city networks and smart city associations was key to reaching such many respondents.

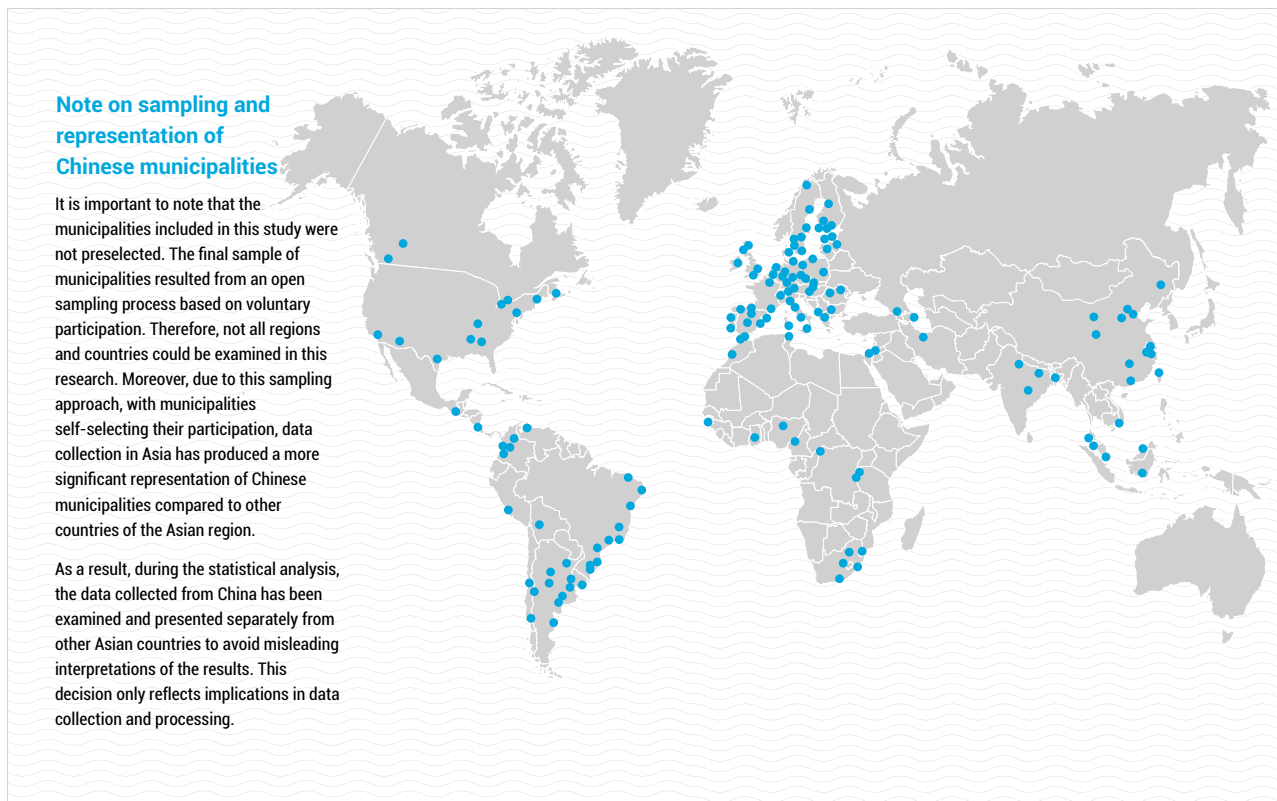


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**Figure 1** Governance framework for smart city initiatives



**Figure 2** Municipalities included in the online survey



# GOVERNANCE FRAMEWORK FOR SMART CITY INITIATIVES

## Pillars and components of the governance framework

The framework concerns the governance of the key pillars underpinning smart city initiatives:

- **Pillar 1: Strategy** Refers to the governance of strategic smart city frameworks, which include the public policies, regulations and institutional arrangements that municipal governments and other relevant government agencies at different administrative levels require to manage smart city initiatives.
- **Pillar 2: Collaborative ecosystem** Refers to the governance mechanisms that are needed to manage the networks of stakeholders that are involved in smart city initiatives, as well as the wide range of tools that enable the formation and management of the collaborative partnerships sustaining the development of these initiatives.
- **Pillar 3: Technological infrastructure.** Refers to the governance efforts required to steer the design and provision of hardware and software elements underpinning smart city services.

The first pillar (**Strategy**) groups all activities required to develop the policies and regulations that govern the implementation and usage of digital technologies in urban areas, such as standards for cybersecurity, public technology procurement and innovation and municipal rules for smart city planning. National- and local-level smart city policies also belong to this category. In addition, this pillar reflects the governance of public sector setting in the context of smart city initiatives: the organizational structure, internal culture, attitude towards digital innovation and availability of fiscal and human resources – a set of main determinants of success in smart city initiatives. Finally, this pillar also includes the administration of smart city planning processes and their outcomes, including strategic

plans, vision statements, funding strategies and monitoring processes adopted by municipal governments to orient and direct the implementation of digital transformation projects.

The second pillar (**Collaborative ecosystem**) contributes to shaping the urban innovation ecosystem where smart city initiatives take place through the interaction of multiple actors. The partnerships sustaining smart city initiatives cannot be limited to public organizations and private companies; broader participation is needed, extending collaboration to research institutions, residents and civil society organizations. Building these coalitions requires governance tools and strategies able to ensure that all stakeholders, including marginalized groups, can effectively participate and contribute to the development of smart city initiatives. These tools span from trust and leadership (fundamental to manage tensions and power dynamics among different stakeholders) to digital skills training, communication (enhancing the inclusivity and transparency of smart city initiatives) and public participation. This pillar also comprises the management of physical and virtual innovation hubs (such as coworking spaces, incubators, accelerators, makerspaces and living labs) whose presence in urban settings facilitate the collaboration and sharing of knowledge among multiple partners participating in urban digital transformation projects.

The third pillar (**Technological infrastructure**) covers the governance of two main elements: the information architecture supporting the collection, transmission, integration, and usage of data across urban systems and the design and delivery of smart city services that feed and make use of this data environment. Key components of this pillar are tools deployed for data governance and the measures in place to ensure that smart city technologies are safe, resilient, interoperable and respectful of data privacy and human rights. This pillar also contains those mechanisms that enable the delivery and management of smart city services, such as the business models making smart city solutions scalable, and the measures taken to enhance user satisfaction and incentivise technology adoption among residents.

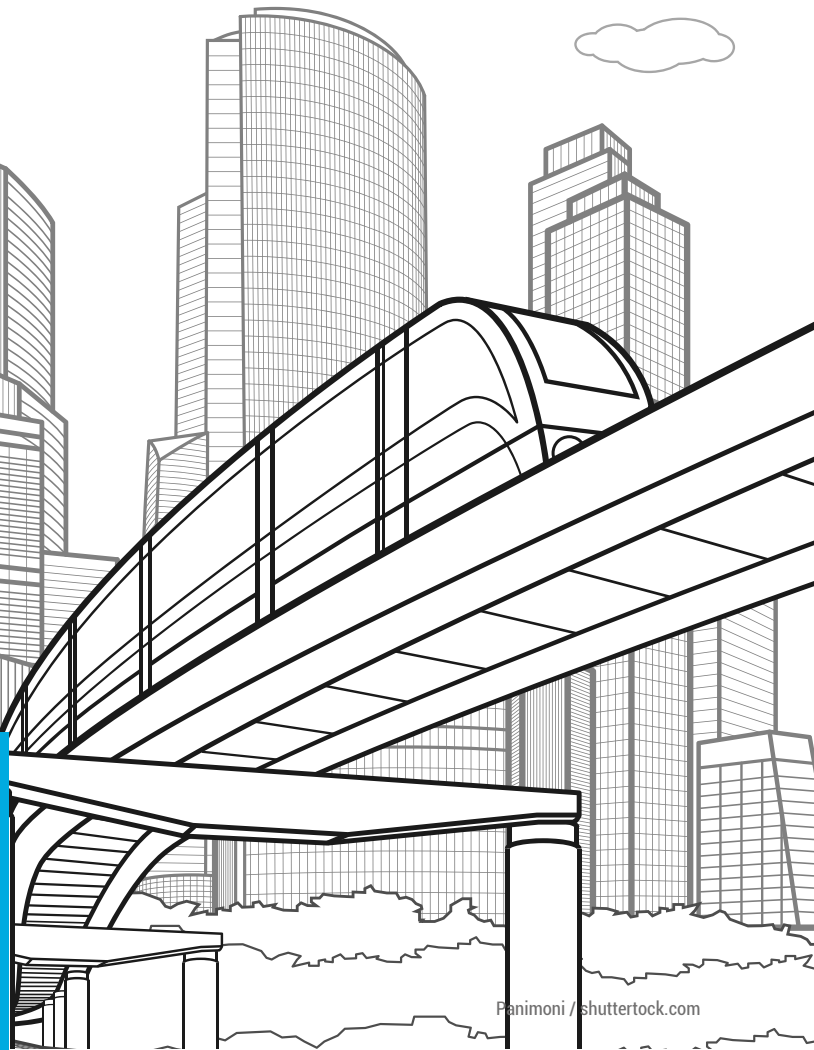


## Pillar One

# 01



## STRATEGY



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### Component 1.1: Planning

The planning phase of smart city initiatives is usually formalized by combining a smart city definition, a vision statement<sup>1</sup> and a strategic plan adopted at the municipal level. Among the respondents, 70% highlighted that their city has at least one of these strategic tools and one third has introduced all of them.

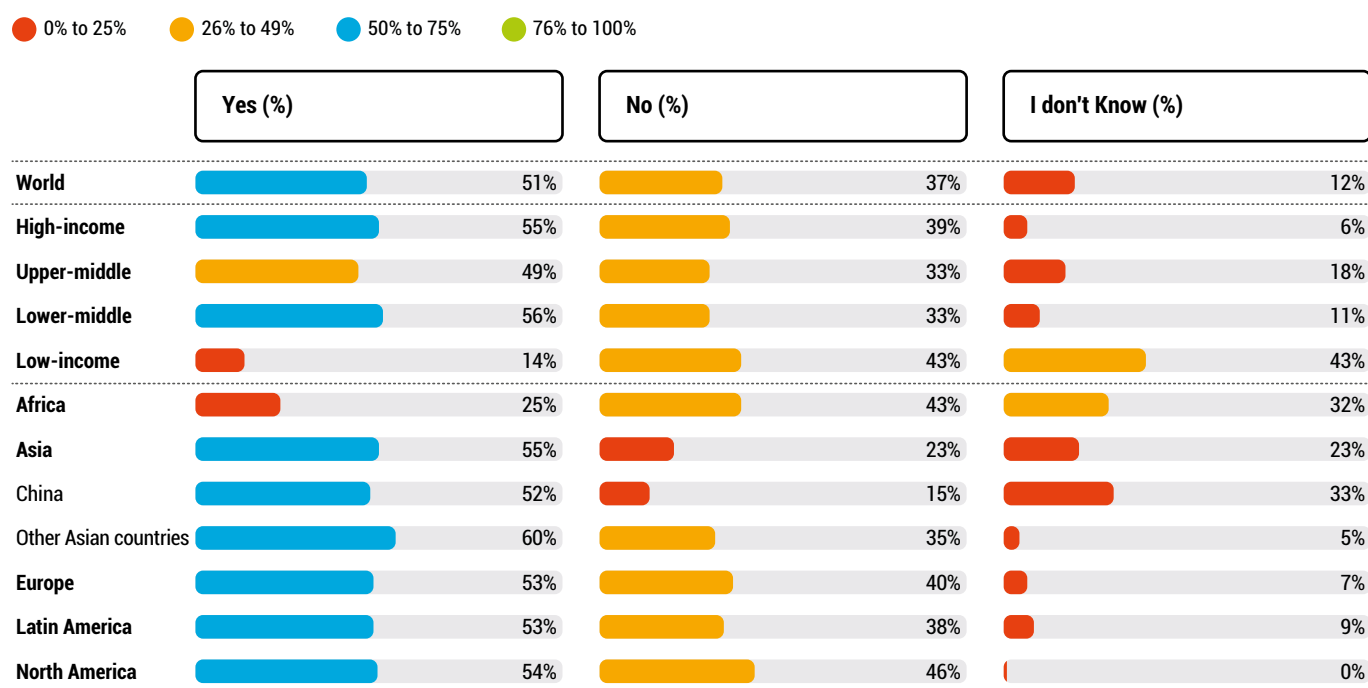
While definitions need to be case-specific and place-sensitive, a well-established overall understanding of the smart city concept can serve as a basis to build strategic efforts on. This notion is partially reflected in the survey; about half of all respondents worldwide (51%) indicated that their city is working with an official smart city definition. This figure is consistent across different geographic areas, with about half of all respondents from Latin America, North America, Europe and Asia working on smart city initiatives in their

respective cities on the basis of a specific definition of the smart city concept. The exception is Africa, where only 25% of the respondents indicated that their cities are operating with a clear smart city definition. Moreover, about 12% of respondents did not know whether their city follows an official smart city definition. This was particularly common among respondents from Africa and China (see Table 1).

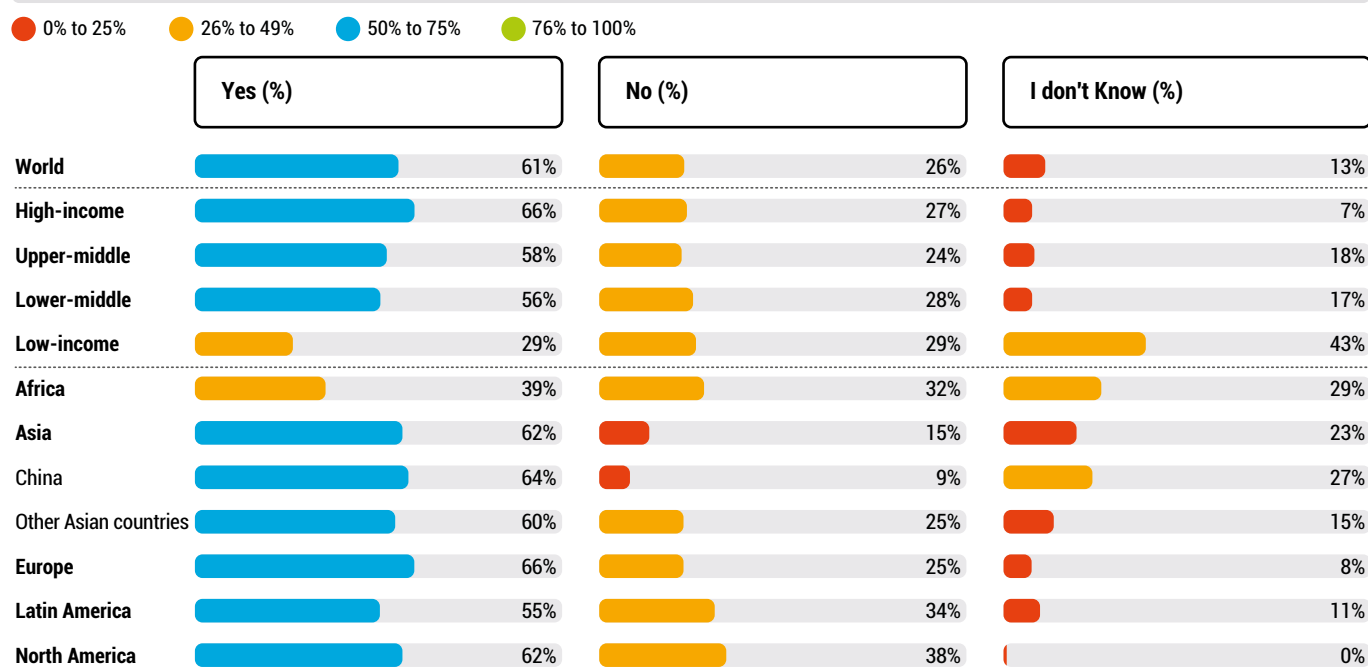
Compared to the previous question, slightly more cities appear to have a smart city vision statement; 61% of all respondents have reported a smart city vision in their city. Respondents from Europe, Asia and North America mostly reported the presence of a vision statement, with the Latin American respondents (55%) being only slightly below the global average, while the continent of Africa, according to the respondents, lags behind with around 39% (see Table 2).



**Table 1** Does your city have an official definition of the "smart city" concept?



**Table 2** Does your municipal government have a vision statement that describes what the city wants to achieve in the long-term with smart city initiatives?



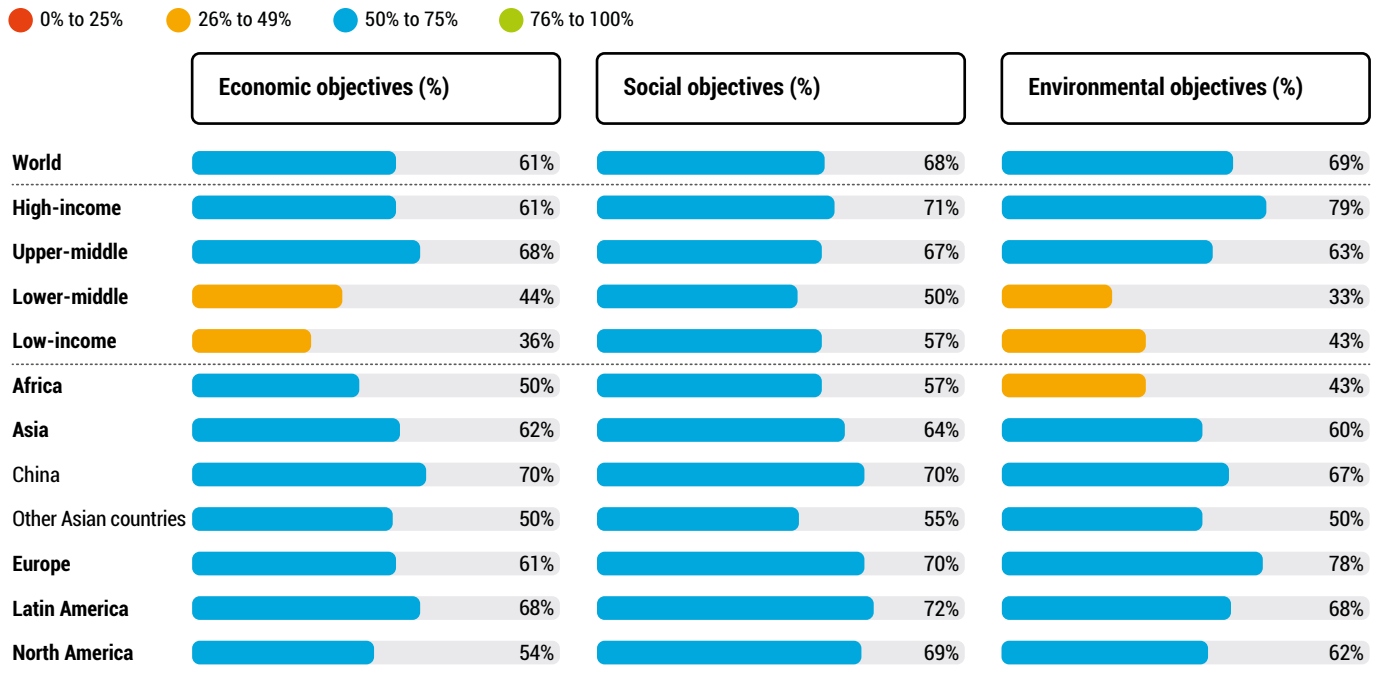
Objectives are key elements of smart city visions and strategic plans, and they contribute to summarising the overarching motivations that trigger smart city initiatives. In the global sample covered by the online survey, environmental objectives are most commonly being pursued, with 69% of respondents claiming that an environmental focus has been included in

the smart city initiatives of their cities either to a very large or good extent. Social objectives follow closely with 68%, and economic objectives complement the spectrum with 61%. The relatively balanced shares between the three listed objectives are in line with the view that digital technologies should be designed and implemented holistically to improve the quality

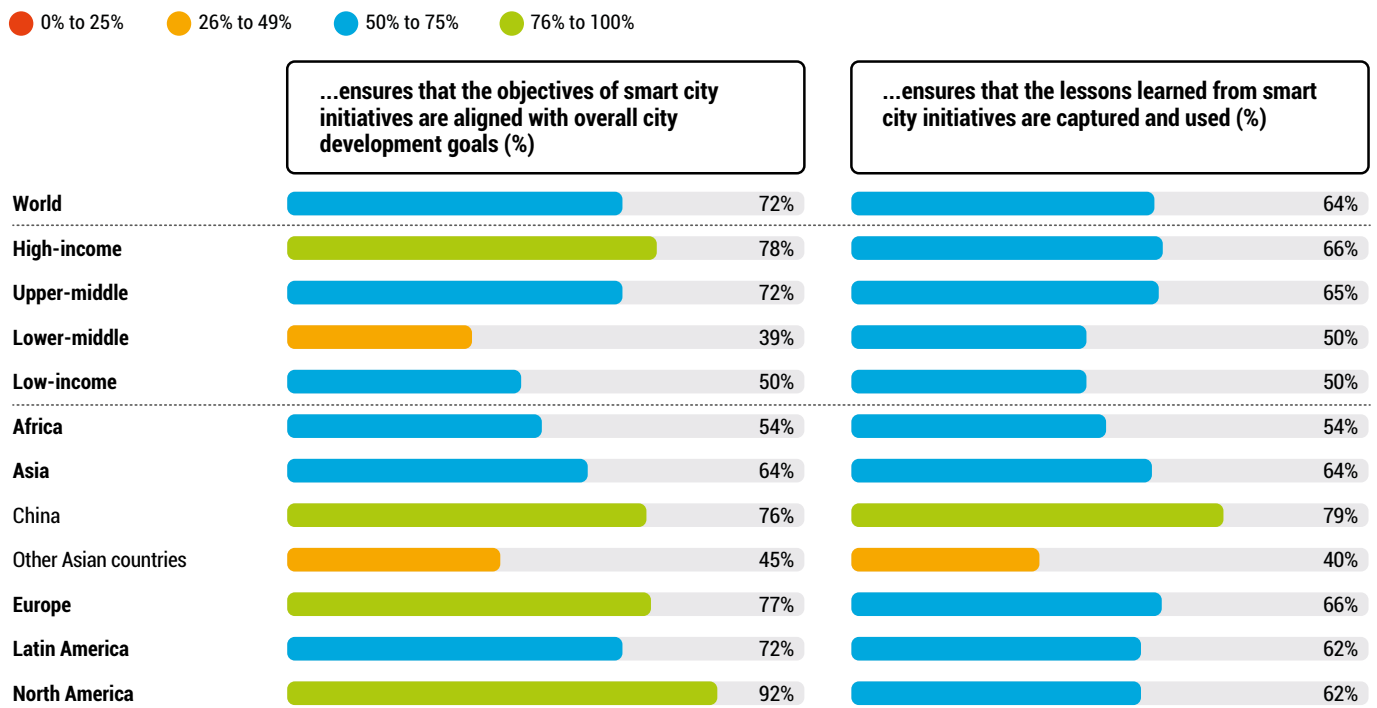
of life of citizens while also boosting the economic prosperity of cities. Environmental objectives are more often a priority for European municipalities and those located in high-income countries, whereas cities from lower-income countries tend to prioritise social objectives. Moreover, cities in higher-income

economies tend to follow objectives more strategically than their lower income counterparts; while on average about 70% of the respondents from high-income cities reported to explicitly follow the above-mentioned objectives, only about 45% followed suit from their low-income counterparts (see Table 3).

**Table 3** To what extent are these objectives included in the smart city initiatives of your municipal government?



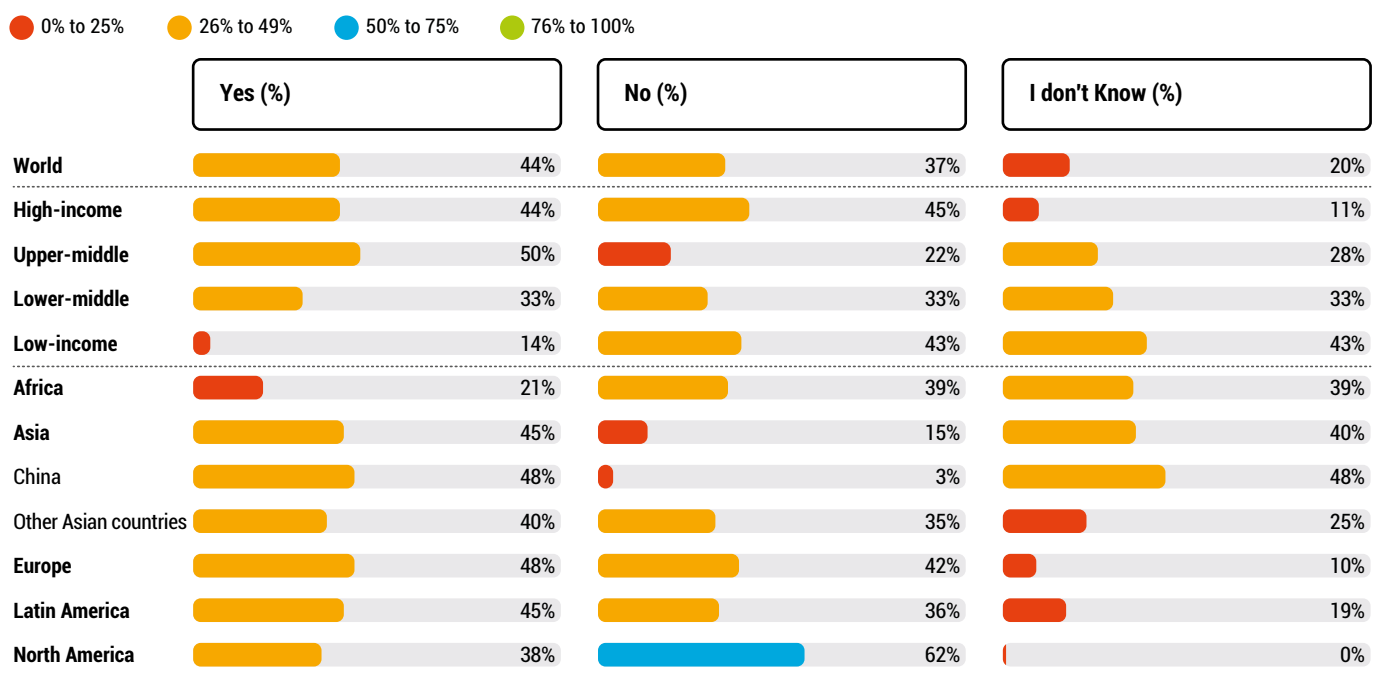
**Table 4** To what extent do you agree with the following statements? Smart city development in your city...  
(Answers: "Strongly Agree" and "Agree")



The data presented in Table 4 indicates that smart city initiatives generally cater to their respective cities' development needs. When asked to what extent smart city development responds to the overall development needs of their city, one in four respondents voiced strong agreement, while almost one in two generally agree. When combining the responses "Strongly Agree" and "Agree", these figures are particularly pronounced in North America (92%), Europe (77%), China (76%) and Latin America (72%). This result suggests that smart city initiatives are relatively well embedded into the overall development of cities rather than being conceived in isolation, an issue frequently highlighted in existing smart city literature.

Little under half of all respondents reported that their cities have established strategic plans for supporting their smart city initiatives. Especially those from Latin America, Asia and Europe formulate such plans, while North American and African cities less commonly do so. This discrepancy might be traced back to the different capabilities, skills and resources that cities possess. In fact, the sample shows that higher-income economies are more likely to have strategic plans for smart city initiatives than their lower-income counterparts (see Table 5).

**Table 5** Does your municipal government have a strategic plan for coordinating smart city initiatives?



### BOX 1: Guadalajara, Mexico



### Vision and objectives

In its smart city project, the city of Guadalajara follows a clearly defined vision, which is to "recognise and enhance the creativity, talent, courage and determination that characterise us Mexicans and Guadalajarans, through a space where the use of technology and the drive for innovation provide economic, mobility, environmental and social benefits". To achieve this vision, the city has also defined several goals, which all serve the main objective to "strengthen Mexico's position within the creative economy through the generation of better jobs, competitive advantages for the industry and new spaces that promote coexistence, talent, innovation and productivity".<sup>8</sup>

## BOX 2: Medellin, Colombia

### Strategic plan

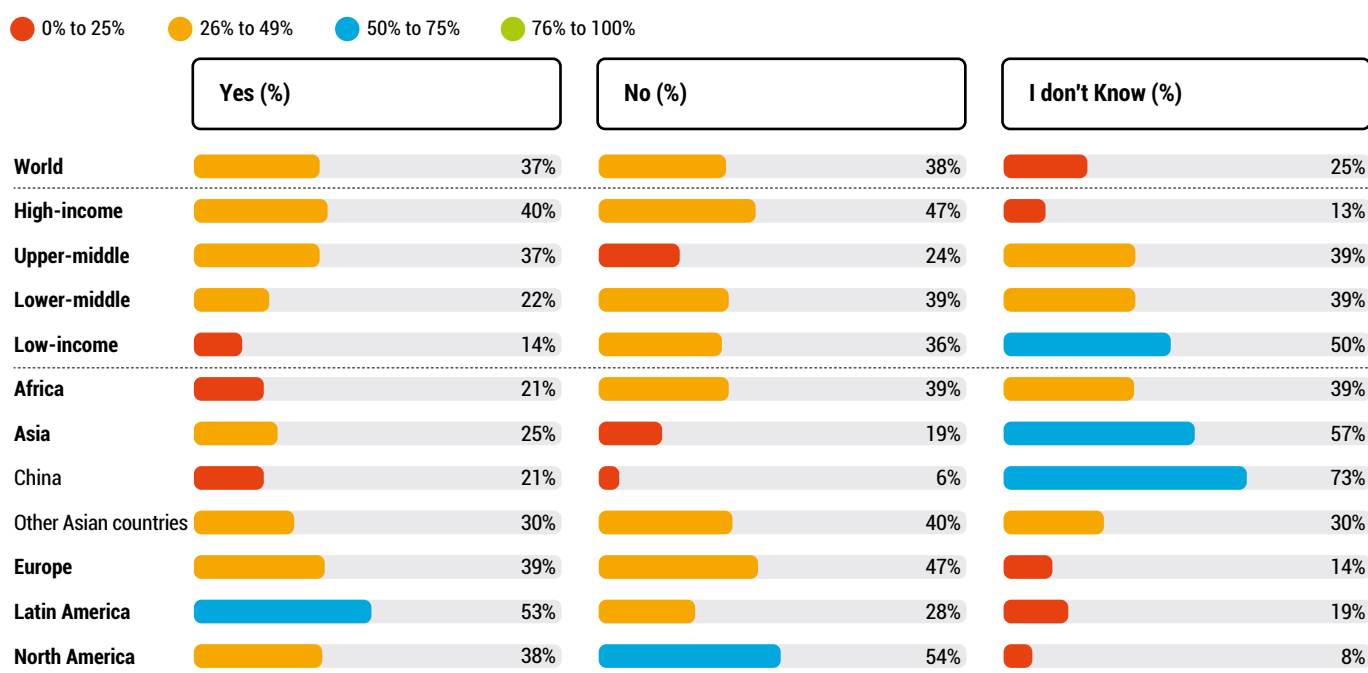
The transformation process of the city of Medellin towards becoming a smart city started in 2004. Several programmes have been launched since then such as *Digital Medellin* and the *Medellin Smart City Strategy* (2007) which aims to improve the quality of life in the city by employing smart city services and further ICT-based solutions. In addition to the *Smart City Strategy*, Medellin also initiated *Route N*, the city's strategic plan for science, technology and innovation (STI), for the period 2011-2021. Together, these plans formed the backbone of Medellin's smart city endeavours, aiming to transform Medellin's economy into a knowledge-based economy with particular attention to the ICT, energy and health industries.<sup>2</sup> The smart city plan furthermore outlines the four major action areas: citizen participation (creating a culture of participation), open government (making data openly available for the benefit of citizens), social innovation (making citizens active collaborators) and sustainability (economic, environmental, political and social sustainability for the sake of future generations).<sup>3</sup>

## BOX 3: Prague, Czech Republic

### Monitoring

Based on a set of pre-defined indicators, the City of Prague regularly evaluates and assesses its initiatives and progress made towards becoming a smart city. These indicators cover the five main areas of i) mobility of the future, ii) waste-free city, iii) smart buildings and energy, iv) attractive tourism as well as v) people and the urban environment. Taking the second area – waste-free city – as an example, Prague developed several measurable indicators around the main levers *material utilisation of waste*, *intelligent waste collection and storage system* and *use of wastewater and rainwater for energy and raw material purposes*. The number of trips of collection vehicles for different kinds of waste per calendar year is being measured and compared against the overarching goal of reducing the number of kilometres that collection vehicles drive. Smart routing systems or smart bins that indicate when bins are full and ready for collection can support Prague in this endeavour.<sup>4</sup>

**Table 6** Does your city monitor the overall impact of smart city initiatives?

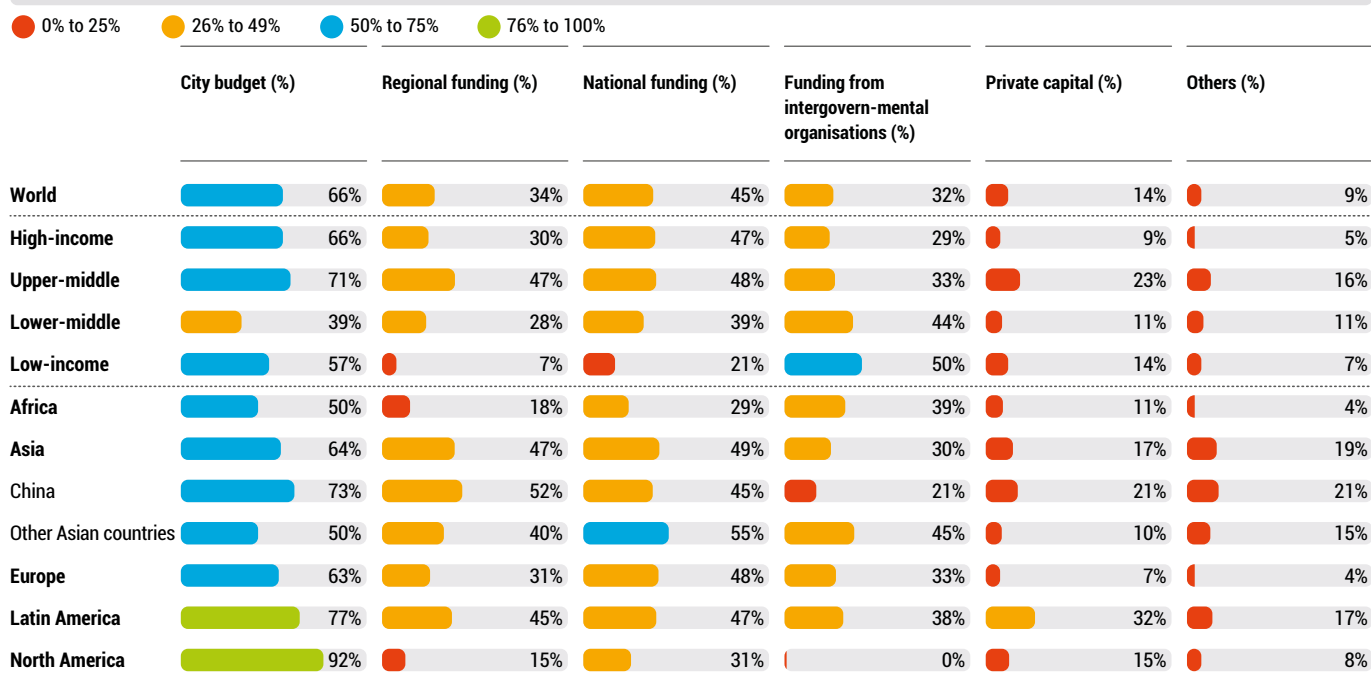


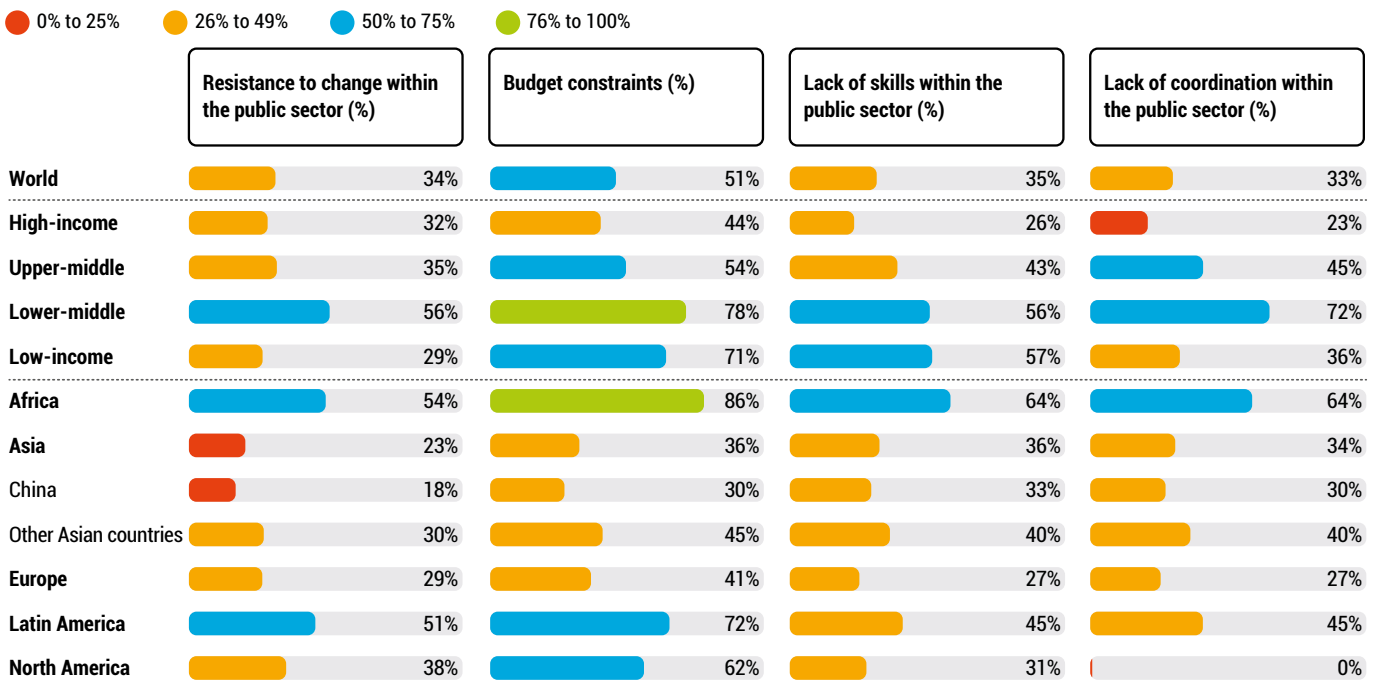
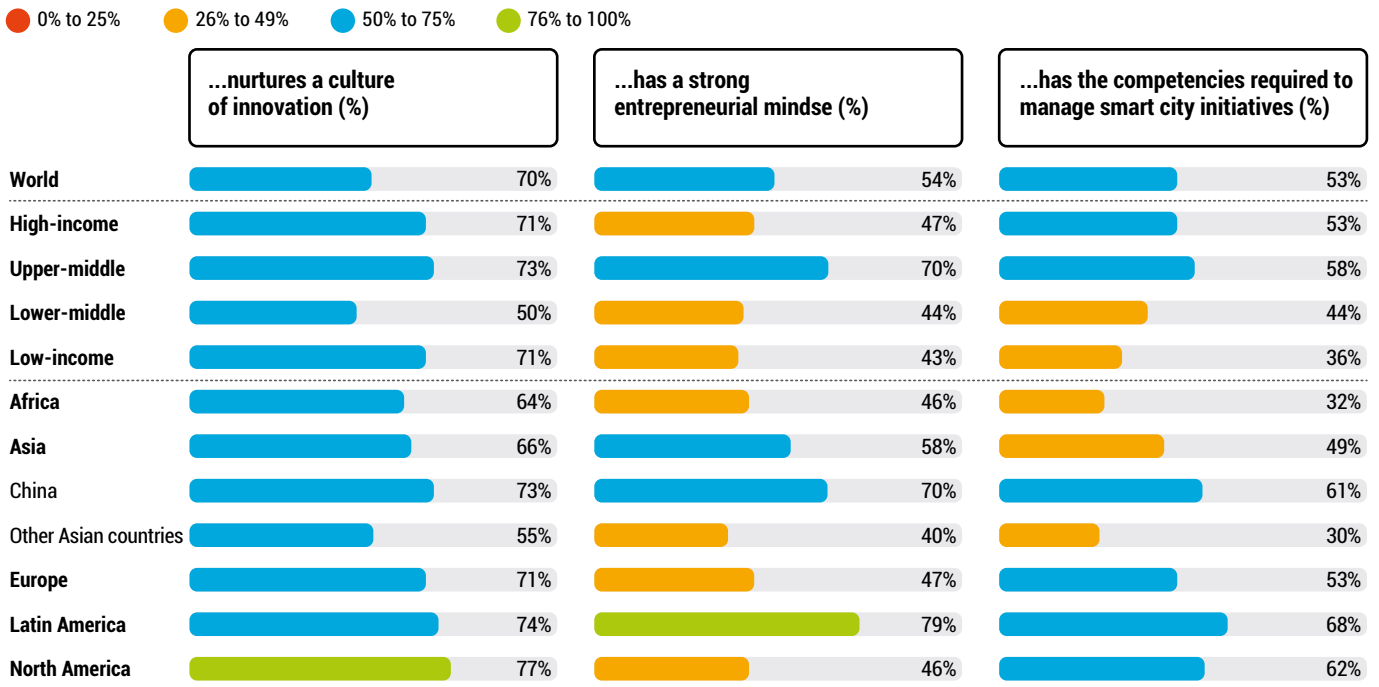
A crucial element for any smart city initiative to be successful lies in the ability of stakeholders to monitor project activities. Only a little over a third of all respondents indicated that their respective cities monitor their smart city initiatives. This figure is lowest among African and Chinese cities (21% each). Latin American cities appear to be the most active in this regard, with more than half of the respondents confirming that their cities have put in place monitoring efforts (see Table 6).

As part of their strategic planning activities for smart city initiatives, municipal governments are also expected to define the criteria for the selection of technological solutions (further discussed in the section *Pillar 3: Technological Infrastructure*) and the funding strategy. The survey revealed that the municipal budget is one of the most common means for funding smart city initiatives. About 65% of all initiatives worldwide rely on this source either to a very large or good

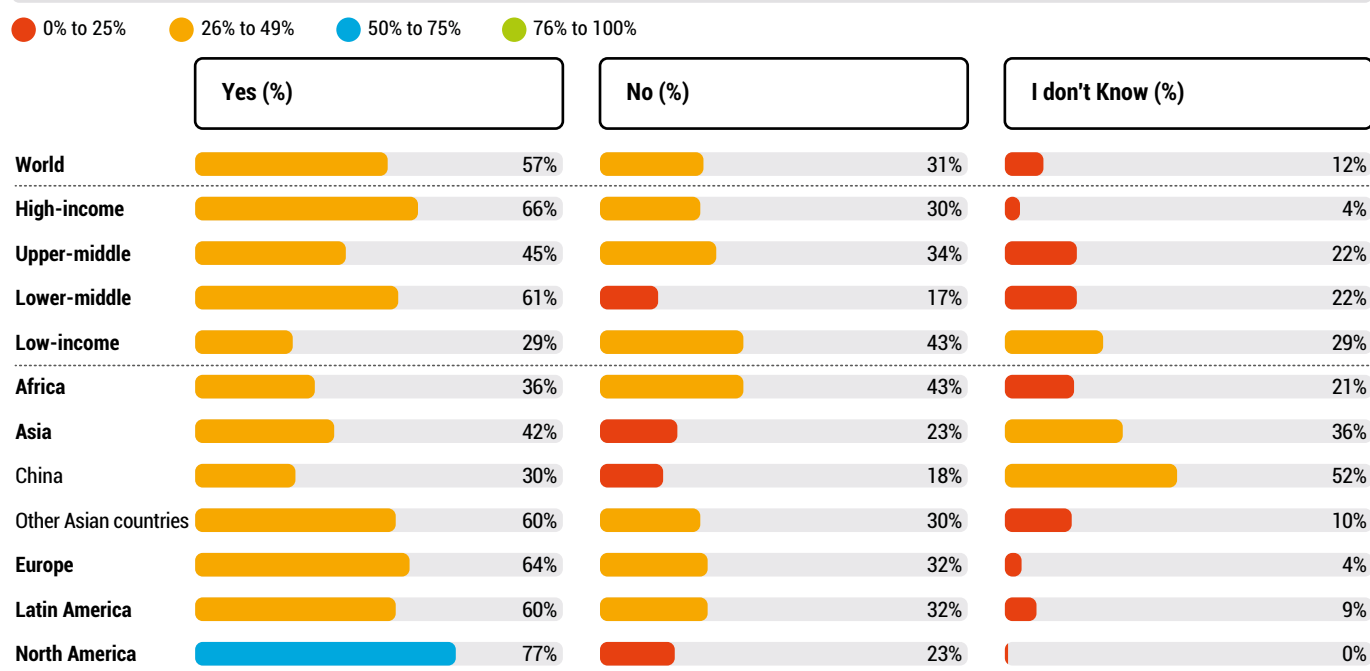
extent. A similar situation can be seen for national funding sources, which are frequently employed in all world regions. Regional differences, instead, can be observed regarding the funding stemming from other sources. For instance, the survey data suggests that the use of private capital is relatively more prevalent in Latin American cities and municipalities located in middle-income economies, even if it remains the least utilised funding source overall. Latin American and Asian cities rely more often on regional funding than their counterparts from other regions, while funding from intergovernmental streams is utilised more among Latin American, African and European cities (see Table 7), thanks to the efforts of institutions such as the European Union, United Nations and Development Banks. It is also important to note that almost half of the respondents reported budget constraints to be an issue in the smart city initiatives of their cities, a key point that will be further discussed in the following section.

**Table 7** To what extent does your municipal government rely on the following funding sources to finance smart city initiatives? (Answers: "To a very large extent" and "To a good extent")



**Table 8** Do these factors constrain the smart city initiatives of your city? (Answers: "Always" and "Most of the time")**Table 9** To what extent do you agree with the following statements? Your municipal government... (Answers: "Strongly agree" and "Agree")

**Table 10** Does your city have a dedicated entity (such as a smart city unit, team, working group, etc.) that is tasked with overseeing the city's smart city initiatives?



## Component 1.2: Public sector setting

The organisational structure of public organisations, alongside their resources and culture, have significant influence on the governance of smart city initiatives. The structure of municipal authorities, in particular, affects their decision-making power and their ability to lead smart city initiatives and to coordinate with project partners. One third of the respondents lamented a lack of coordination within the public sector, but a significant variance can be observed across regions. None of the North American cities included in the sample has experienced coordination issues among actors in the public sector, which are, however, reported in 64% of the African cities and 45% of the Latin American municipalities (see Table 8). These challenges are analysed in further detail in the section *Pillar 2: Innovation Ecosystem*.

Zooming in on the resources and culture of public sector organisations, about half of the respondents identified budget constraints as a major barrier to smart city initiatives. The incidence is higher among African cities, followed by Latin American ones. Unsurprisingly, this issue seems less pronounced among respondents positioned in high-income economies (see Table 8). Likewise, the lack of skills within the public sector appears to primarily affect cities in low- and lower-middle income countries. Overall, however, only 53% of the respondents claimed that their municipal government has

the competencies needed to manage smart city initiatives, with lower-income countries and African cities scoring the lowest rates (see Table 9).

Regarding cultural aspects within the public sector, 34% of participants reported resistance to change in public organisations as a barrier to smart city initiatives in their cities. This percentage is consistent across regions, except for lower-middle income economies, where it is significantly higher (more than half of the respondents highlighted this challenge; see Table 8).

At the same time, 70% of respondents agreed that their municipal governments nurture a culture of innovation, with results being generally consistent across regions. A strong entrepreneurial mindset was reported by 54% of respondents worldwide. However, regional differences can be noted: 79% of respondents from Latin American cities describe their municipal governments as having a strong entrepreneurial mindset, while this percentage is significantly lower in Europe (47%), North America (46%) and Africa (46%) (see Table 9).

Another important aspect to consider in light of the structure of the public sector is the presence of a dedicated unit (such as a department, a task force, a working group or similar) that oversees and coordinates the planning and implementation of smart city initiatives in the city. Previous research has emphasised how such dedicated entities (hereinafter referred to as smart city units), while not being

a guarantor for success, have the potential to foster cross-sector collaboration of smart city efforts, enhance their impact and long-term sustainability, and more strategically embed initiatives into the overall development plans of the city due to increased coordination inside and outside the boundaries of the municipal government.

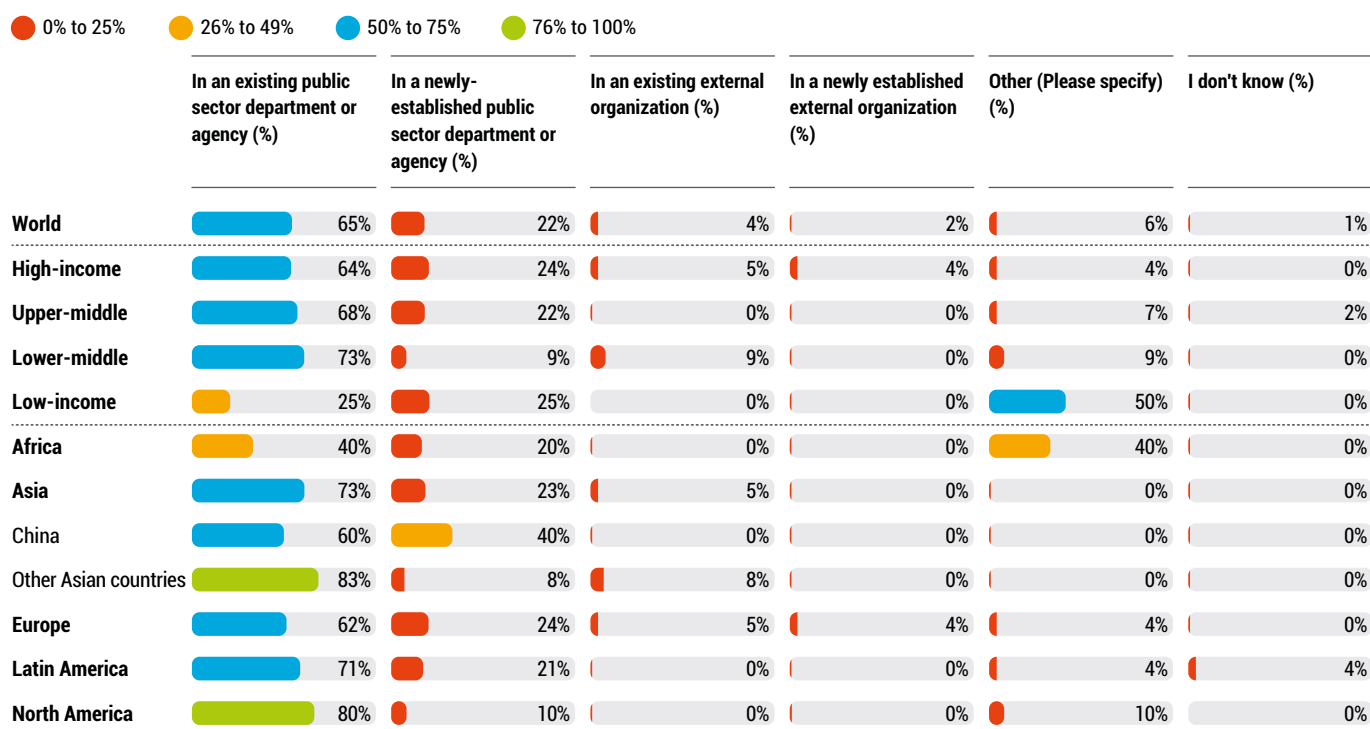
It is a promising sign to see that more than half of the respondents indicated that their cities have established a smart city unit. This share is particularly high among respondents from North America, but lower in China and Africa (see Table 10).

About 65% of all the smart city units detected in our survey are integrated into an already existing public sector department or agency, while a new department or agency has been set up for about 22% of them. Especially cities in Latin America, North America and Asia tend to integrate their units into already existing organisations. European cities, on the other hand, are relatively more likely to set up new units for coordinating their smart city initiatives and activities. Overall, our survey suggests that cities rarely delegate the coordination of their

smart city endeavours to external organisations. Only about one in twenty smart city units worldwide is located at an external organisation, be it in a newly established or already existing one (see Table 11). This suggests that cities prefer to build their own internal capacities for smart city coordination and complement them with external input, rather than primarily relying on the latter.

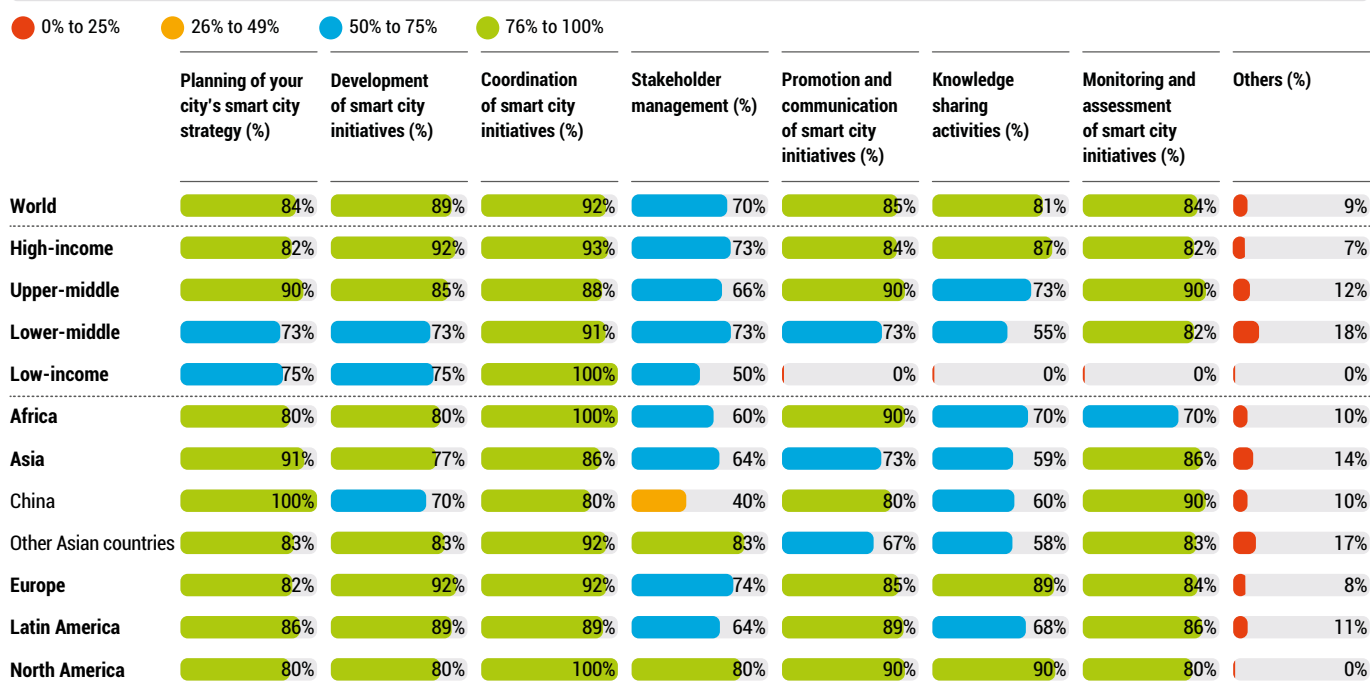
This preference towards capacity building is reflected in the functions and activities covered by smart city units. Worldwide, these units fulfil many of the functions listed in Table 12. While stakeholder management is the least common activity performed by smart city units, the coordination and development of smart city initiatives features particularly high in their agenda. Knowledge sharing activities are more frequently performed by smart city units in North America and Europe, while Asian units less commonly promote and communicate their smart city initiatives than their peers in other geographical regions. But despite these differences, almost all of the listed functions are fulfilled by at least more than half of the respective cities' smart city units across all areas, with stakeholder management in China being the only exception.

**Table 11** Where is the dedicated entity located?





**Table 12** Which functions are covered by the dedicated entity?



## Component 1.3: Policy and regulations

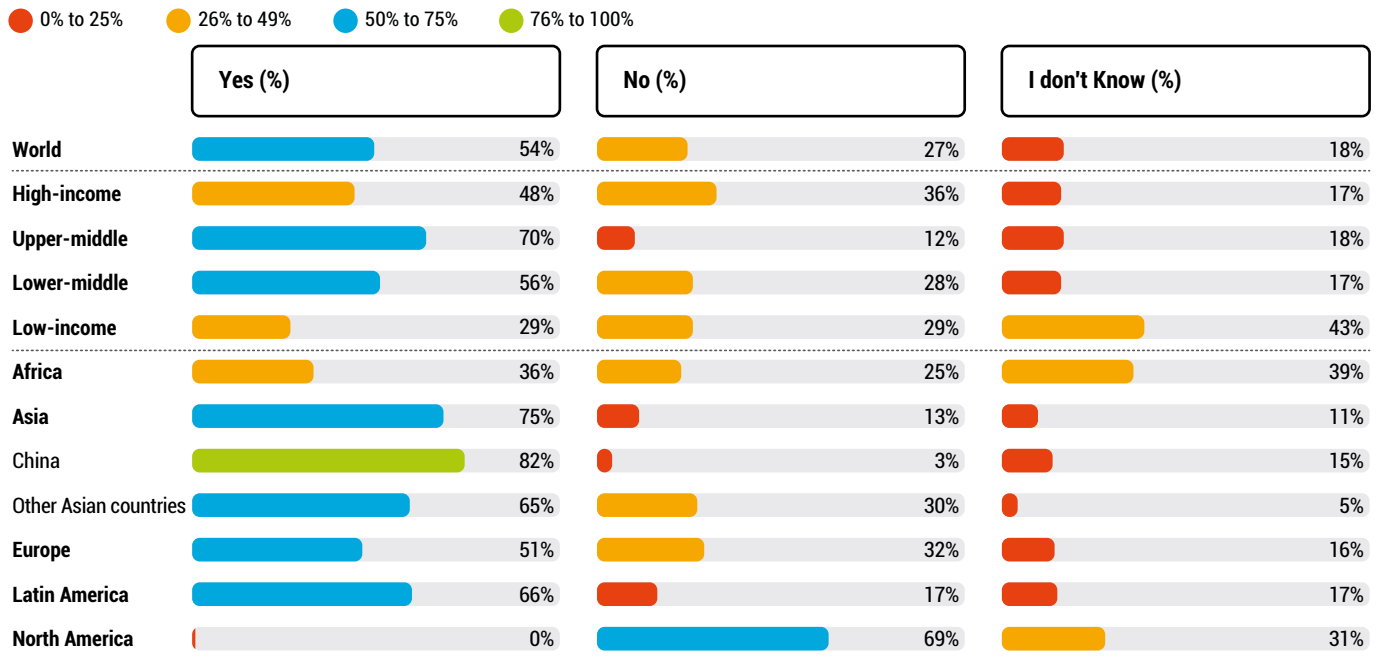
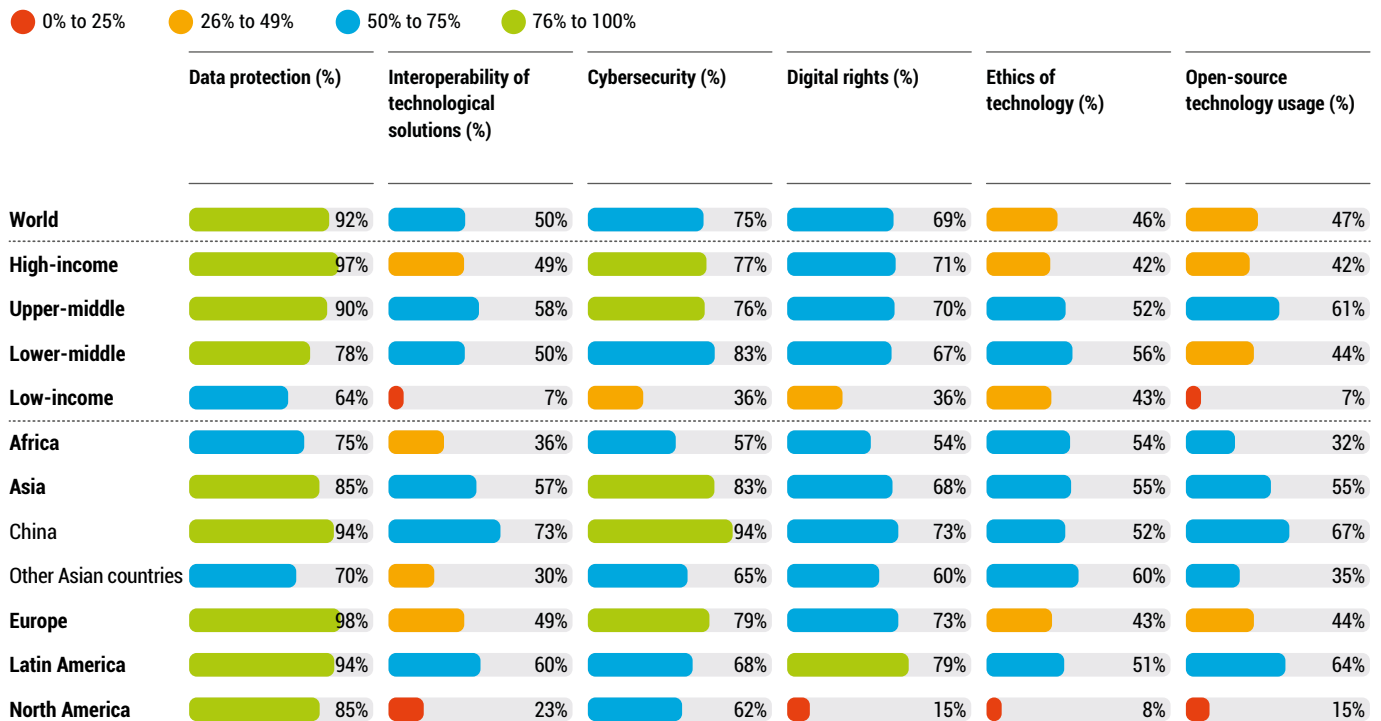
Cities are embedded in regional and national contexts and the policies introduced at these levels also influence how smart city initiatives are approached at the municipal level. National policies specifically designed for smart city initiatives can serve as incentives and catalysers and, if properly framed, as a framework in which innovation can prosper. More than half of the respondents indicated that their countries have adopted specific policies for smart city initiatives. This share is higher in Asia and Latin America, where nearly 75% and 66% of respondents, respectively, reported the existence of a national smart city policy. On the other end of the spectrum, respondents did not highlight national policies in North American cities (see Table 13).

In addition to these policies, laws and regulations passed at both national and international level are crucial elements to consider when implementing smart city initiatives and influence their capability to create public value. Of relevance in this context are the national laws and international regulations that set rules and conditions for the design, development, use, and management of digital technologies in urban settings.

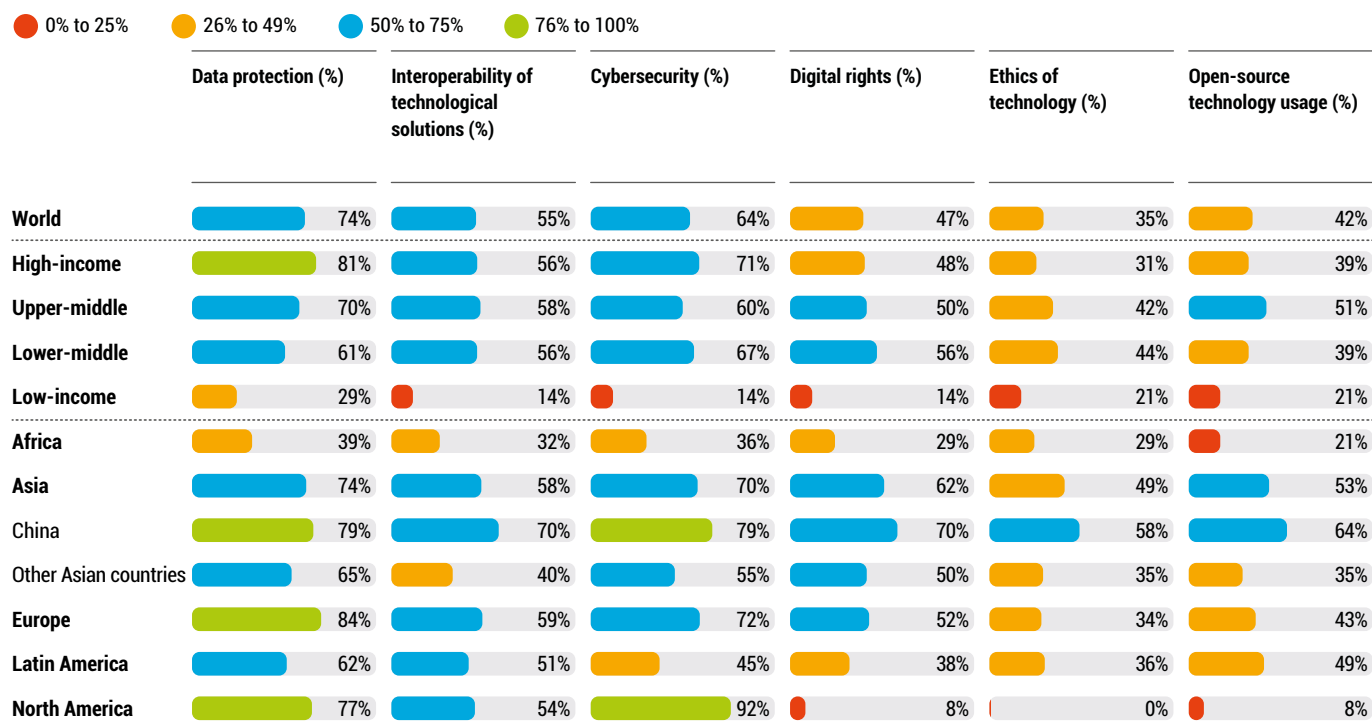
### BOX 4: Estonia

#### Ensuring interoperability between organisations and systems in Estonia

Being a country with one of the highest presences of public services online worldwide, Estonia laid the foundations of its digital transformation on data interoperability and sharing standards in the early 2000s. The Baltic nation developed a national regulatory framework that establishes the use of and maintenance of "X-Road", a data exchange technology platform for public authorities.<sup>5</sup> X-Road ensures information security and privacy, while allowing data sharing and co-functioning of diverse public and private e-services within the country itself as well as between countries. For instance, the solution has allowed the delivery of healthcare public services across borders for citizens in both Estonia and Finland.<sup>6</sup> In 2021, more than 450 entities, including 150 public sector institutions, were connected through X-Road, with approximately 13,000 interfaced information systems.<sup>7</sup>

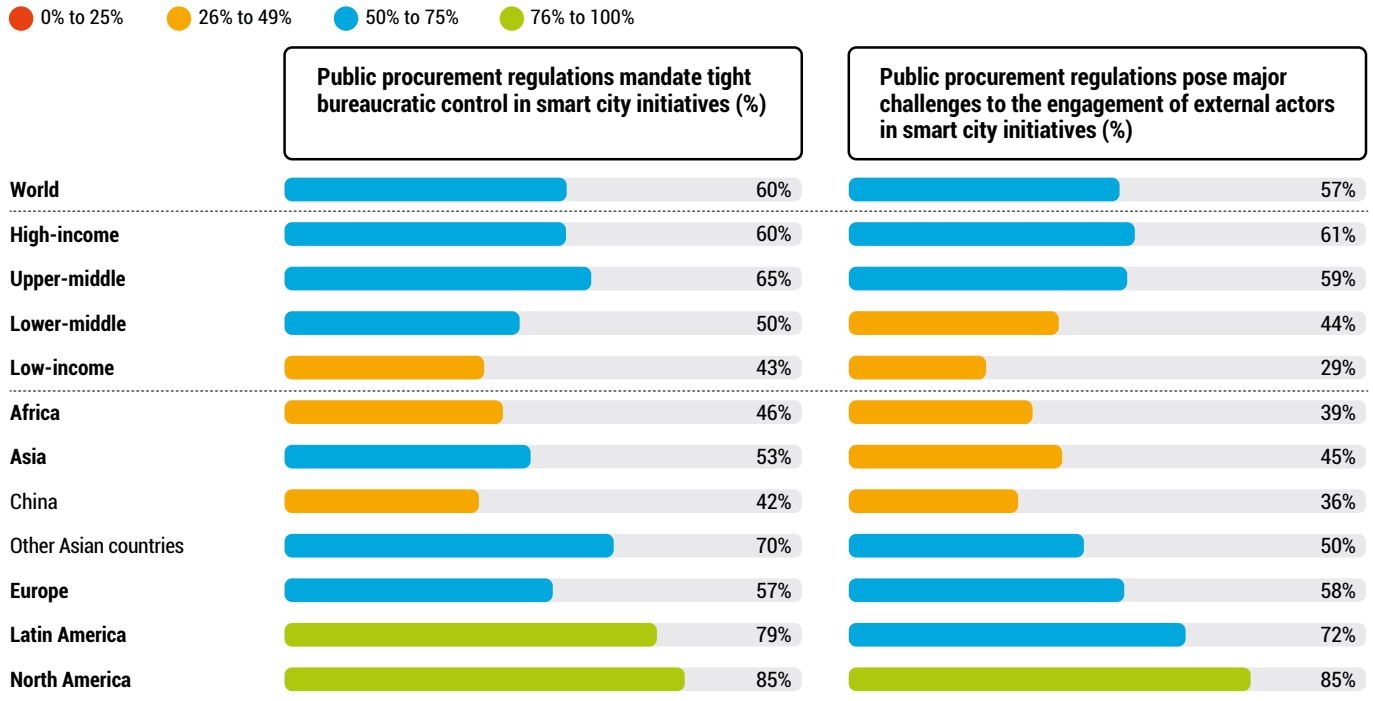
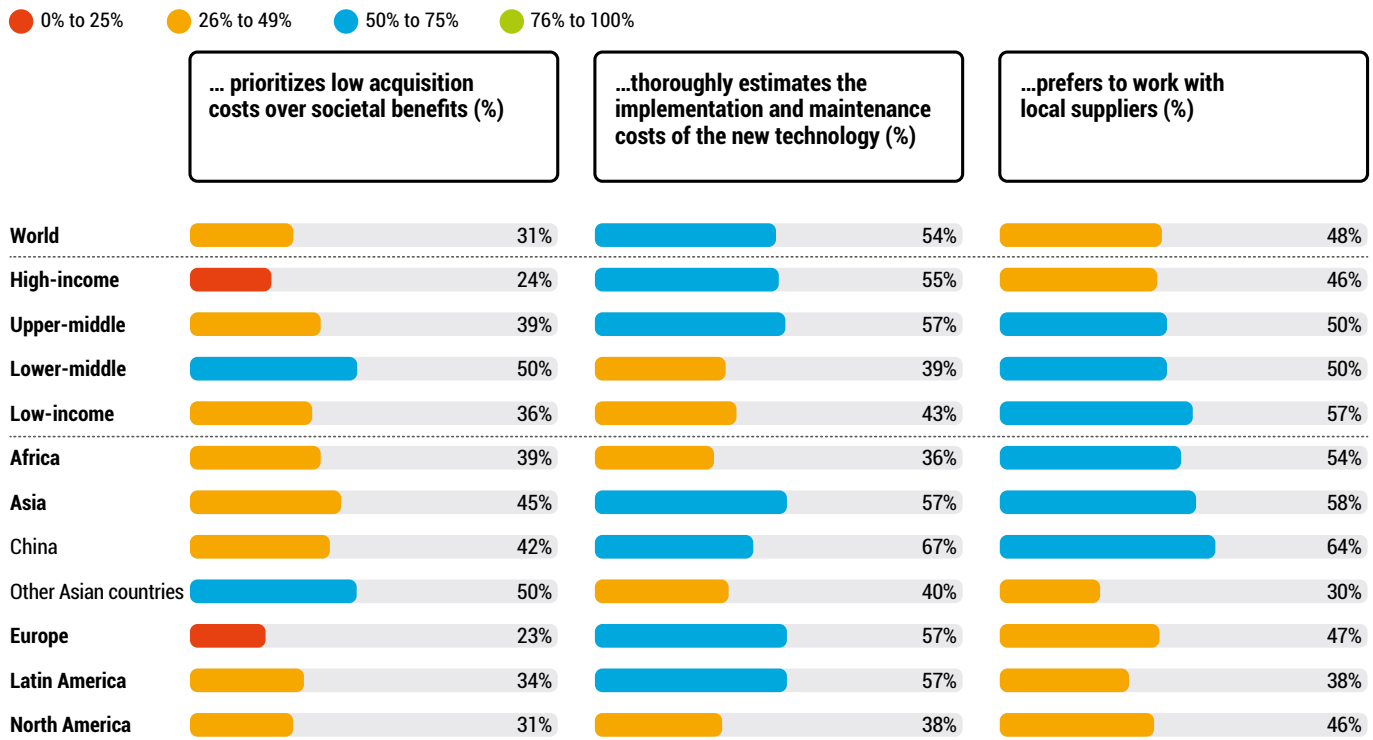
**Table 13** Does your country have a national policy to guide smart city initiatives?**Table 14** Does your country have laws or regulations in place to manage the following matters? (Answers: "Yes")

**Table 15** In the procurement processes of your municipal government, are there specific requirements on the following matters? (Answers: "Yes")



Many experts taking part in our survey confirmed that the smart city initiatives in their cities lean on regulations on data protection (92%), cybersecurity (75%) and digital rights (69%). The interoperability of technical solutions and ethics of technology have received considerably less attention with only between 46% and 50% of the respondents highlighting the presence of corresponding legislative tools in their cities. Moreover, the results of the survey show that the smart-city-related laws and regulations presented in this study are generally more prevalent in higher- than lower-income countries. The discrepancy is particularly pronounced with respect to the interoperability of technical solutions. Concerns around the ethics of technology, however, appear to be more common in middle-income rather than high- and low-income countries (see Table 14).

Another pivotal aspect of smart city planning processes are technology procurement practices. Our sample shows that procurement requirements oftentimes reflect the conditions set by laws and regulations on various aspects of digital technologies. Hence, where these laws and regulations have been set up, it is more likely that they are also translated into requirements for procurement. Interestingly, the interoperability of technological solutions is more often a requirement in cities' technology procurement practices than it is a legal condition. Furthermore, digital rights and data protection are less commonly anchored in procurement practices than they are in laws and regulations (see Table 14 & Table 15).

**Table 16** To what extent do you agree with these statements? (Answers: "Always" and "Most of the time")**Table 17** To what extent do you agree with the following statements? When selecting new technological solutions for the city, the municipal government... (Answers: "Strongly agree" and "Agree")

About 60% of the respondents agreed that public procurement regulations mandate tight bureaucratic control on smart city initiatives and pose major challenges to the engagement of external partners. These issues were particularly remarked in Latin American and North American municipalities, where public procurement regulations and their tight bureaucratic control were identified as a major challenge by 79% and 85% of the respondents, respectively (see Table 16).

As to the criteria driving the procurement processes for smart city initiatives, about half of the respondents worldwide claimed that their municipal governments thoroughly estimate the implementation and maintenance costs of new technologies when they are acquired. Similarly, about half of the cities included in our sample seem to prefer to work with local suppliers. This preference is most clearly expressed in Africa and China, whereas Latin American cities rely on local suppliers less frequently. Moreover, low acquisition costs tend to be prioritised over societal benefits, mainly in Africa and Asia, and, more generally, in lower- than higher-income economies (see Table 17).



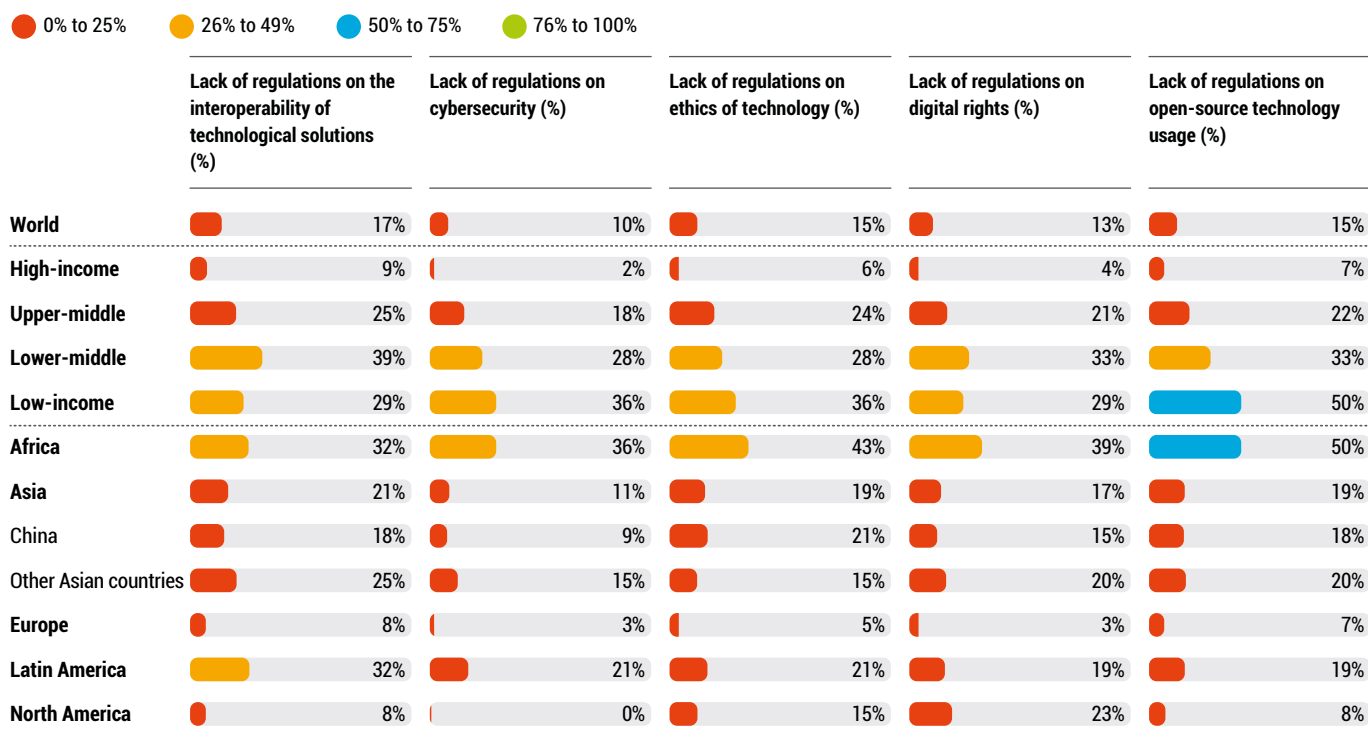
A lack of coherently structured procurement practices and laws and regulations can have adverse effects on smart city initiatives. Yet, respondents witness actual constraints only sometimes. Due to its practical nature and direct implications, the lack of regulations on interoperability and technological solutions is being criticised the most, albeit by a narrow margin. Moreover, the lack of laws and regulations for supporting smart city initiatives appears to be more critical in lower-income economies (see Table 18). This data might imply that dedicated orchestration is needed more in those countries and cannot be easily delegated to other infrastructures, networks or ecosystems that could cover some of these functions and might already be in place in higher-income countries.

The effect of laws and regulations, however, cannot solely be based on their existence, but is also determined by their ease of application and implementation. On a global scale, laws

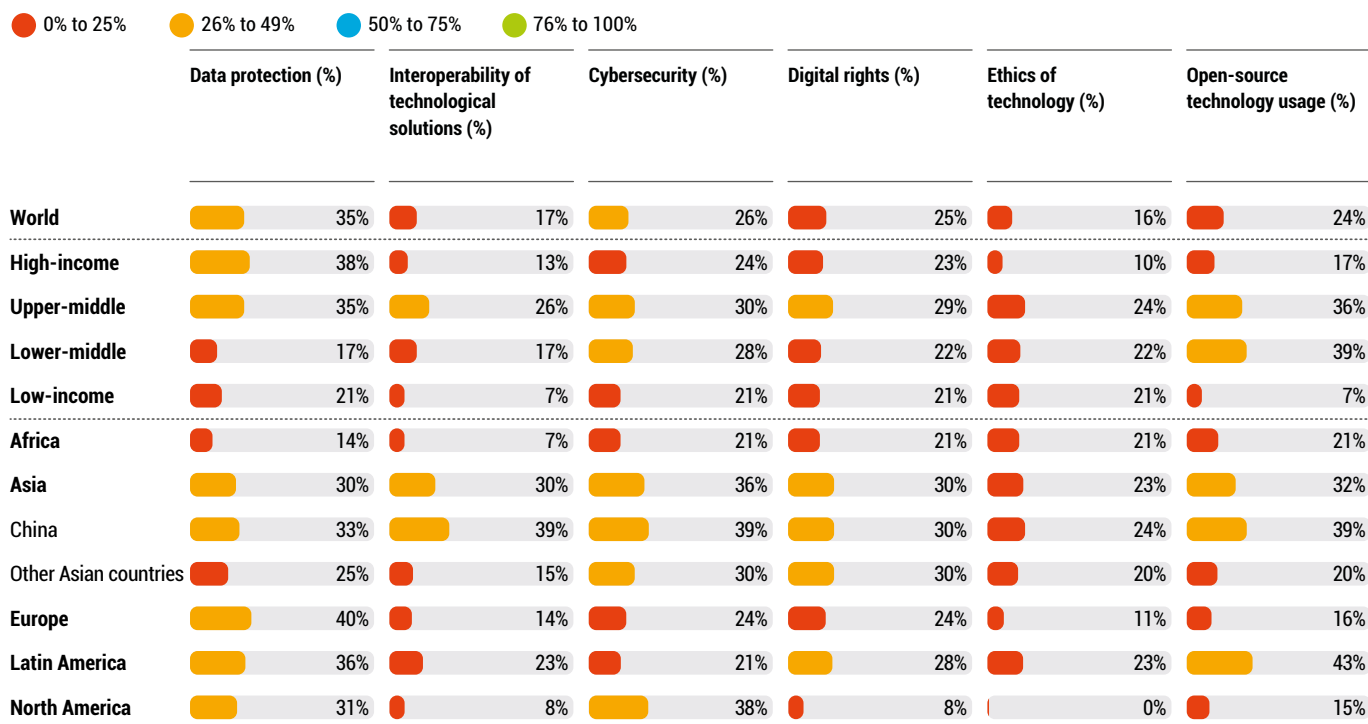
and regulations on cybersecurity, open-source technology usage, digital rights and cybersecurity appear to be easier to implement than those on interoperability of technological solutions and ethics of technology. High-income economies are those struggling the most with ethics of technologies, while low-income countries find it more difficult to implement regulations on interoperability and open-source software. Conversely, the use of open-source software was perceived as less problematic among Latin American respondents, who also struggle with the application of laws concerned with cybersecurity, ethics and interoperability. But overall, the implementation of laws and regulations remains a compelling issue for most of the municipalities that participated in this study (see Table 19).



**Table 18** Do these factors constrain the smart city initiatives of your city? (Answers: "Always" and "Most of the time")



**Table 19** In your municipal government, how difficult is it to apply legal requirements on the following matters? (Answers: "Very easy" and "Easy")



## Pillar Two

# 02



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## COLLABORATIVE ECOSYSTEM

### Component 2.1: Actors and collaborative practices

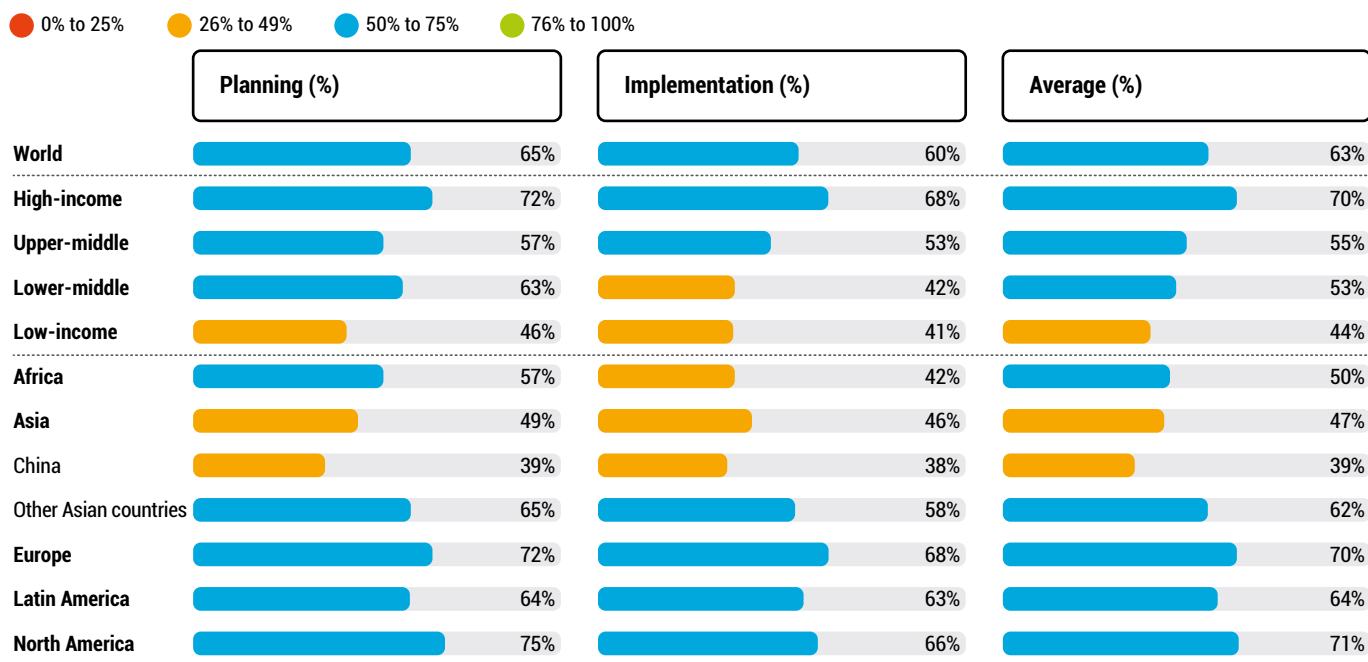
Municipal governments are central actors in the planning and development processes of smart city initiatives. They play a key role in ensuring that smart city initiatives respond to the needs of each specific city and their local communities. In smart city initiatives, municipal governments collaborate with a broad range of actors, from public and private organizations to academia and other research institutions, intergovernmental organizations, civil society, and residents. However, collaboration practices differ in each city, leading to variation among countries and regions. For example, the overall levels of collaboration activity - referring to the number of external actors that each municipality collaborates with in their smart city initiatives - are higher in North America and Europe (approximately 70% of collaboration with all various

external actors), which are followed by Latin America (64%), and are representatively lower in Africa (50%). In Asia, China comprises the lower levels of average collaboration activity (39%) while the collaboration rates of Asian countries (62%) are more similar to those captured in Latin America (see Table 20).

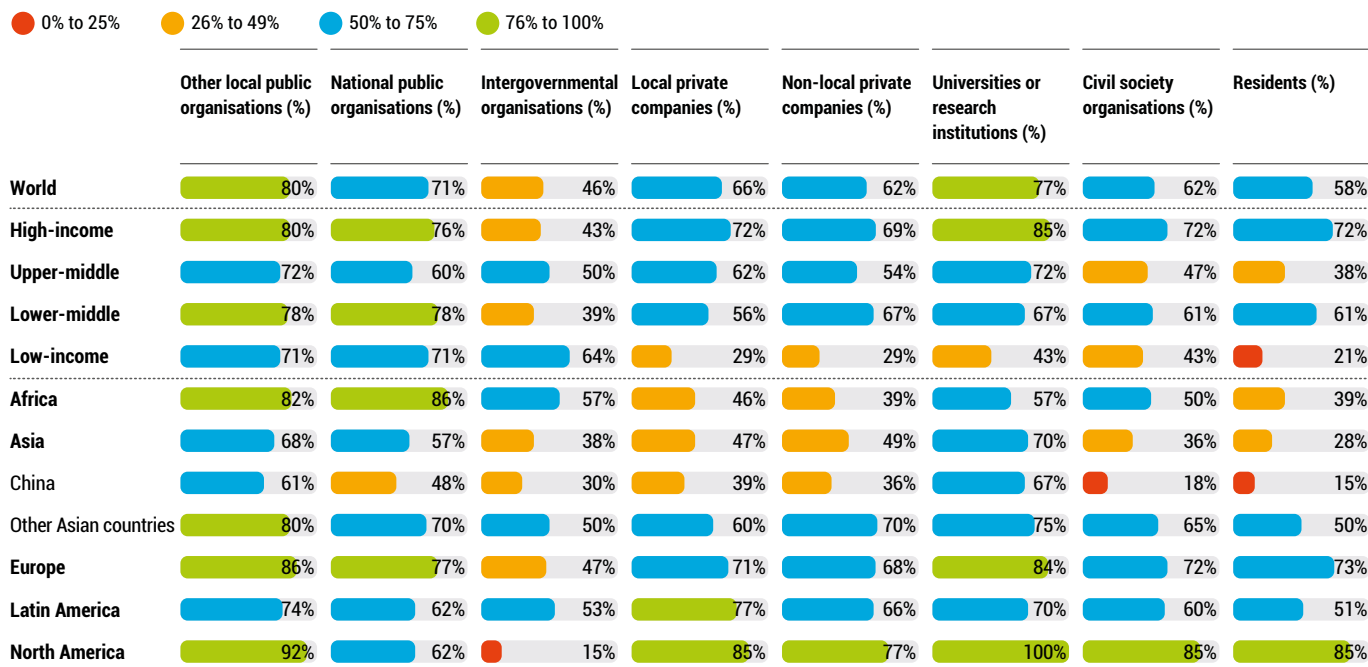
Collaboration practices vary in relation to the different phases of smart city initiatives (i.e. planning, implementation) as per the different nature of the tasks and functions needed in each of these phases. During planning activities, municipal governments are observed to have higher collaboration levels with the following actors: other local public organizations (80%), universities or other research institutions (77%), and national public organisations (71%). Private companies and civil society organizations are associated with lower percentages, with active collaboration reported in 64% and 62% of the cities, respectively. Intergovernmental organisations have the overall lowest collaboration levels, with highest presence in Africa (57%) and Latin America (53%), and lowest rates in North America (15%) and China (30%), as shown in Table 21.



**Table 20** Overall municipal collaboration levels with external actors



**Table 21** Who does your municipal government collaborate with in the planning of their smart city initiatives?



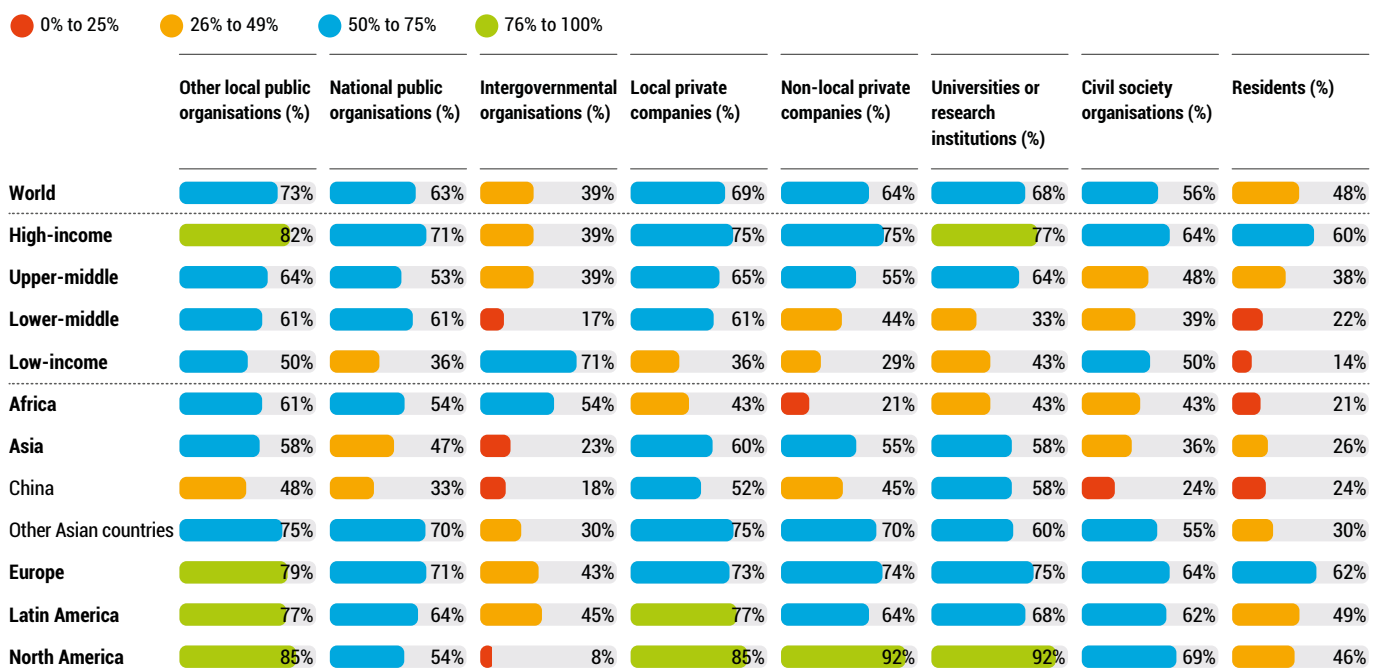
In the implementation of smart city initiatives, respondents observed lower collaboration rates between municipal governments and other stakeholders engaged in the planning phase, with the exception of private sector companies, which have higher collaboration rates in most countries and regions (see Table 22). In Asia, the highest rate of collaboration in the implementation of smart city initiatives takes place with local private companies (60% of respondents). Likewise, in Latin America, private sector companies are associated with the highest collaboration rates in both planning and implementation phases, with a more prominent role of local private companies in the region (77% of presence in both planning and implementation phases).

## BOX 5: Vienna, Austria

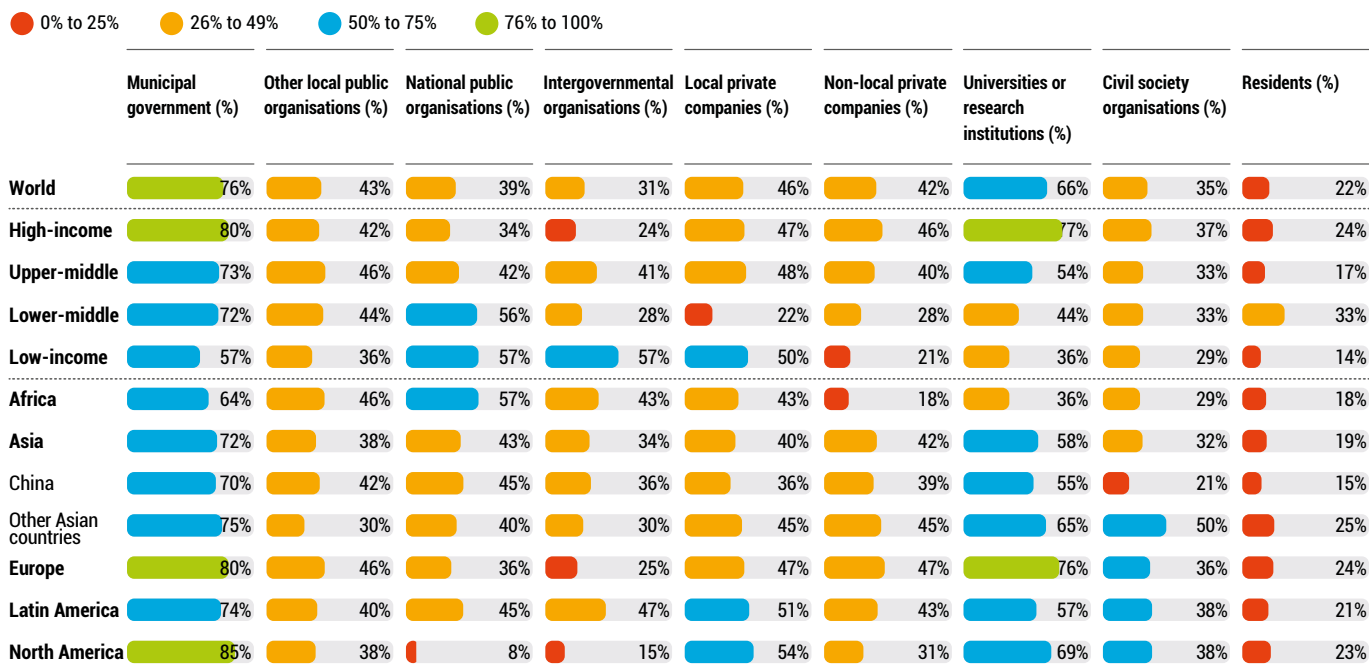
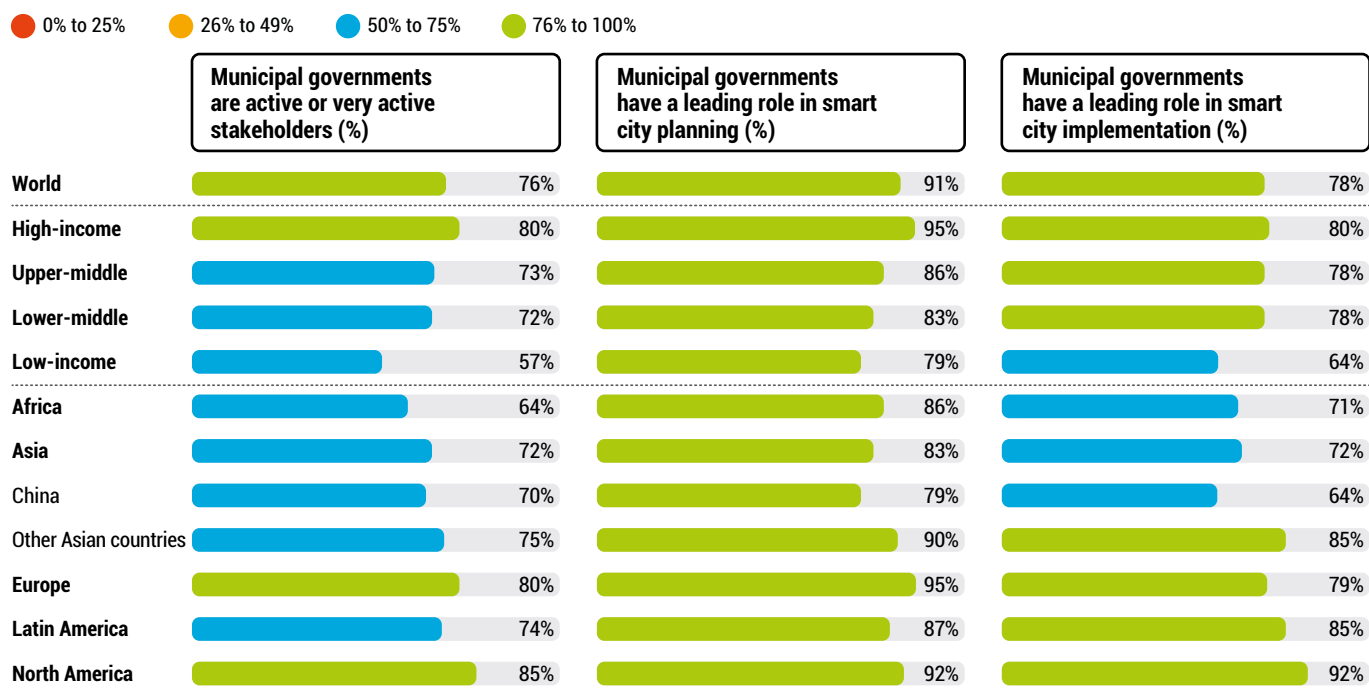
### Cross-departmental collaboration in Vienna

A central point in Vienna's smart city strategy is the initiation of cross-departmental projects. The city notes that "major, innovative, multidimensional beacon projects require inspiration and impetus to get them off the ground in the first place and coordinated partnerships within the municipal administration for their implementation, not least with regard to raising of funds and planning of resources". To further spur collaboration, Vienna's smart city strategy relies on a diverse array of stakeholders from business, research and development and civil society. Through these links, the city of Vienna hopes to realise several benefits ranging from the exchange of expertise to the implementation of innovative solutions.<sup>9</sup>

**Table 22** Who does your municipal government collaborate with in the implementation of their smart city initiatives?





**Table 23** To what extent are these actors active in the smart city initiatives of your city? (Answers: "Active" and "Very active")**Table 24** Municipal governments: active engagement and leadership

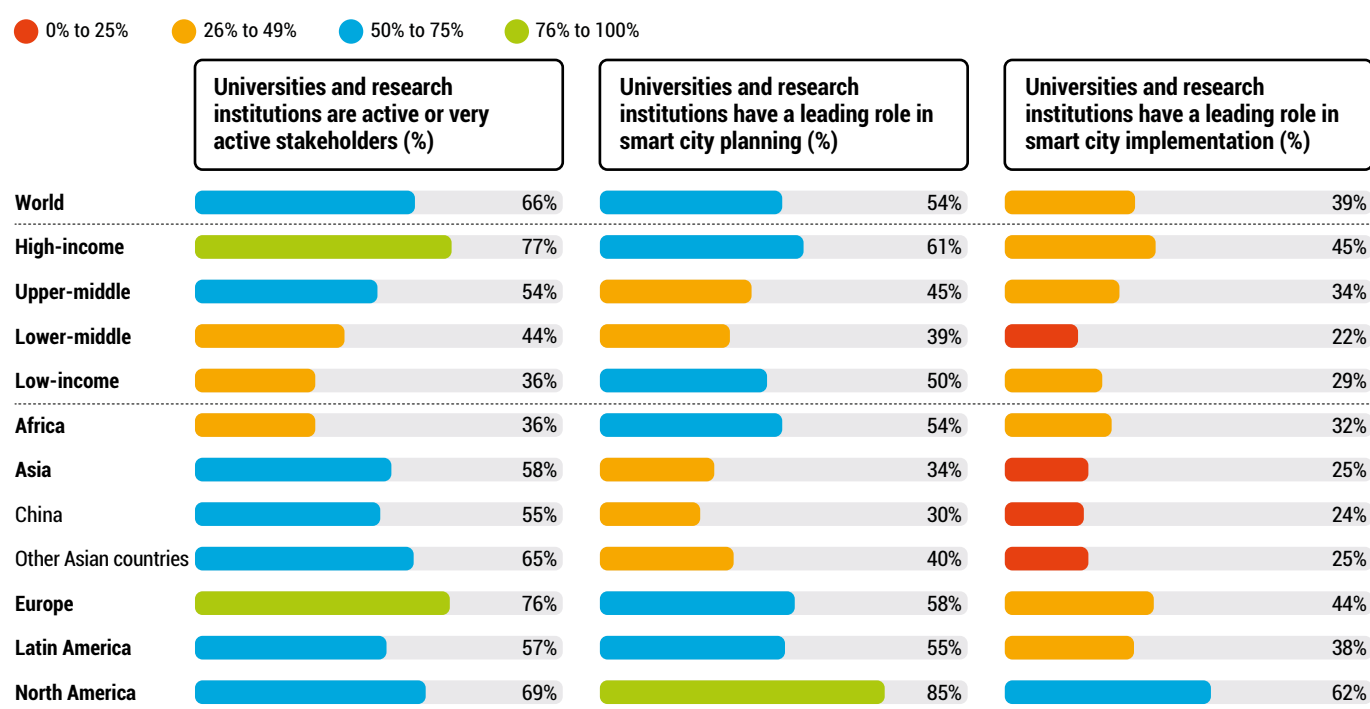
While municipal governments collaborate with different stakeholders, entities play different roles and have different activity levels in smart city initiatives. For example, in the planning phases, municipal governments are observed to have collaboration practices with residents in 58% of the cases (see Table 21), whereas the percentage decreases to 48% in implementation stages (see Table 22). However, only 22% of the respondents have identified residents as “active actors” (see Table 23), meaning that the collaboration with residents is not directly associated with their active participation. The following sections describe the different levels of active engagement and various roles that diverse stakeholders can play in smart city initiatives.

Overall, the most active stakeholders in smart city initiatives are municipal governments (see Table 23). Respondents have selected municipal governments as the main leading actors in the planning and implementation stages of smart city initiatives in all countries and regions (see Table 24). However, their level of engagement decreases from high- to low-income countries. High-income countries have the highest rates of active engagement, where respondents reported municipal government as active stakeholders in 80% of the cases. This rate is progressively lower as the income-level decreases, with just 57% of active engagement in low-income countries (see Table 24). Furthermore, in low-income countries, intergovernmental and national public organizations are identified as active as municipal governments. Only in this group of countries municipalities share the same levels of active engagement than other actors (see Table 23).

Universities and research institutions are the second most active stakeholder after municipal governments (see Table 23), with greater activity rates in high-income countries. In North America, almost all respondents reported that these entities collaborate with municipal governments (96% of average between planning and implementation phases, see Table 21 and Table 22), although only 69% of them indicated that they are active stakeholders (see Table 25). Overall, universities are a key collaborating actor in both planning and implementation phases in most of the countries, despite some regional differences in their levels of collaboration. In fact, these entities are observed as the second most important leading partner for the planning of smart city initiatives in all regions, except for Asia, where they are the third one after national public organizations (see Table 25 and Table 26).

Furthermore, approximately 65% of respondents confirmed that universities play various important roles. A leadership role is highlighted by almost half of the respondents, who also selected universities and other research institutes as the second most important data provider, after national public organizations: 43% of respondents confirmed that their municipal governments rely on university-provided data (see Table 39 in section Pillar 3: Technological infrastructure). In addition, 71% of respondents identified that universities and research institutions are instrumental in facilitating knowledge exchange in the smart city initiatives of their cities.

**Table 25** Universities and research institutions: active engagement and leadership



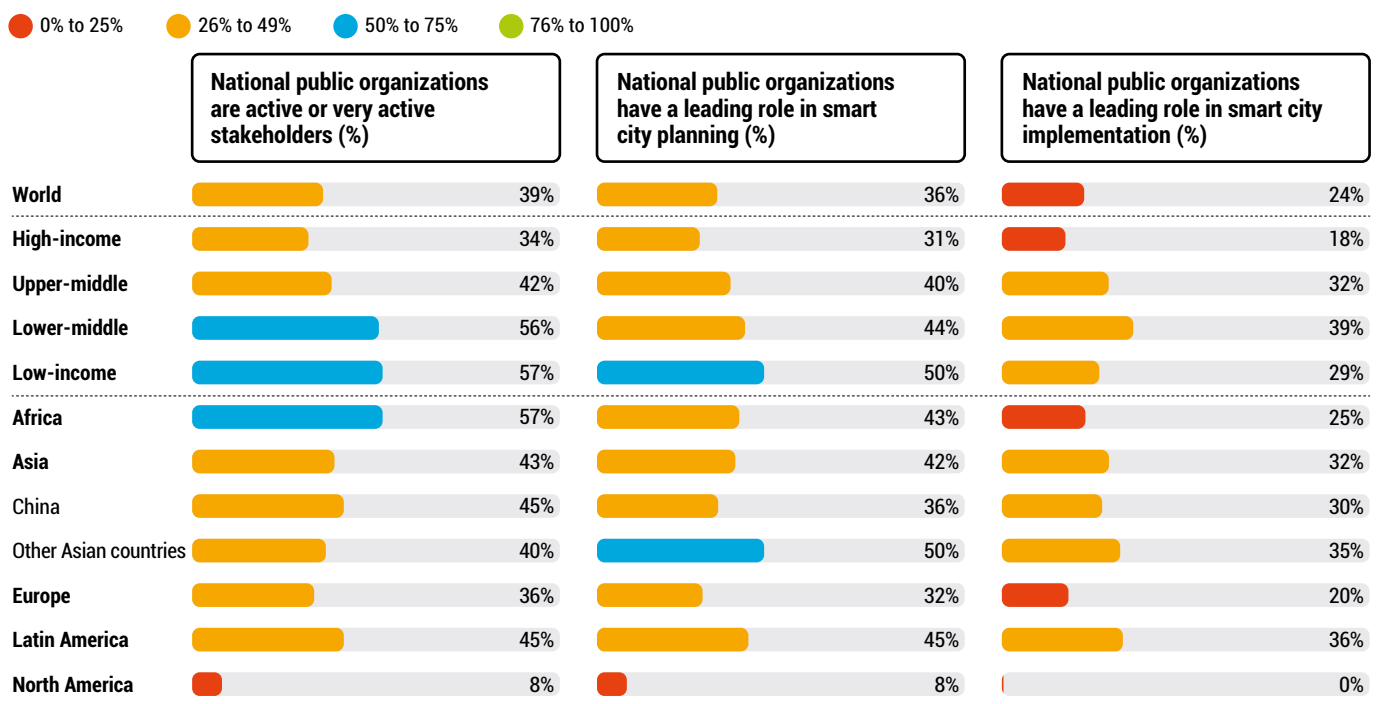
The results suggest that national public organizations are frequently involved in the planning and implementation of smart cities initiatives. However, they are not recognized as active stakeholders. As an example, national entities are collaborating partners in approximately three-fourths of the European cities (see Table 21 and Table 22), but only one-third of the respondents reported them as active actors (see Table 26).

Among their main roles, national public organizations are identified as the main external provider of both data and funding for municipal smart city initiatives (see Table 7 in section *Pillar 1: Strategy*). Multi-level governance practices should be considered to ensure local autonomy, coordinated efforts, and mutual benefits among different government tiers. As shown in Table 26, this is particularly relevant in lower income countries, where national public organizations are in general more active. As shown in Table 26, this is particularly relevant in lower and lower-middle income countries, where national public organizations are in general more active. . Further information on the coordination practices among local and national entities can be found in the following section (see section *Component 2.2: Partnership coordination*).

In general, private companies have moderate levels of active engagement. While they are observed to have high collaboration rates in planning and implementing smart city initiatives (see Table 21 and Table 22), they are less active actors than municipal governments or universities and other research institutes (see Table 23).

Building on the findings of this study, it is important to note that, in all regions, data provided by external parties mainly come from national public organizations, universities and other research institutes or residents. Private sector companies are the second lowest provider of data in most smart city initiatives, with particularly low rates in Europe and North America (see Table 39 in section *Pillar 3: Technological infrastructure*). Similarly, private sector funding has been included among the least used financial resources in smart city initiatives, representing a funding source in just 32% of the cases in Latin America, 15% in North America and Asia, 11% in Africa, and 7% in Europe (see Table 7 in section *Pillar 1: Strategy*). These rates might indicate that private sector companies are mostly engaged as contracted delivery partners, with low levels of proactive engagement and share of in-house assets (e.g., financial resources, data, etc.).

**Table 26** National public organizations: active engagement and leadership

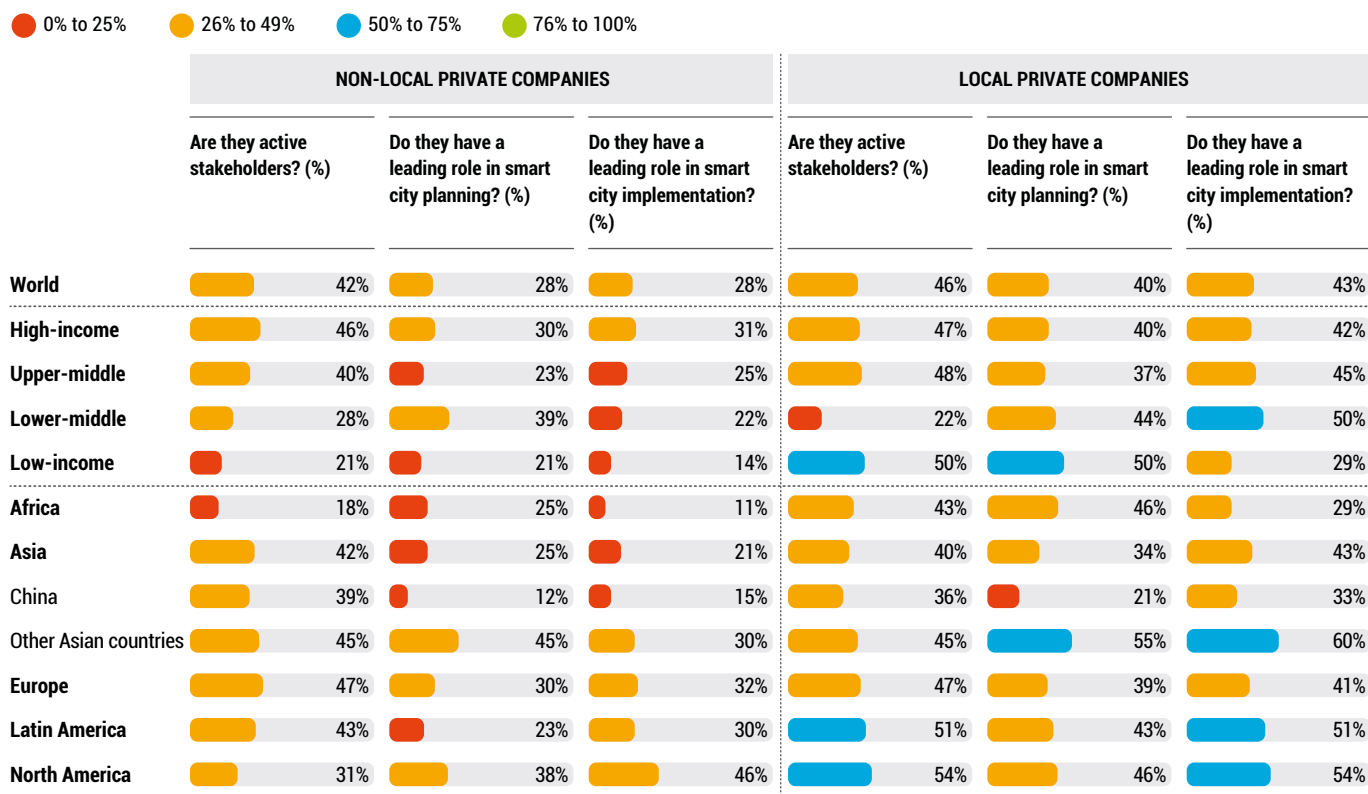


Furthermore, the overall lack of Business-to-Government collaboration models, constitute a main barrier to unlock the full potential of private sector data to contribute to developing smart city initiatives that foster public interests and needs.

Nonetheless, private companies, and especially local private companies, stand as key players in the smart city collaboration

ecosystem of many cities involved in this study. In regions such as Latin America and Asian countries (excluding China), local private companies undertake a leadership role in the implementation of smart city initiatives in 51% and 60% of the cases, respectively, becoming the second most important leader after the municipal government (see Table 27).

**Table 27** Private companies: active engagement and leadership



## BOX 6: Santiago de Chile, Chile

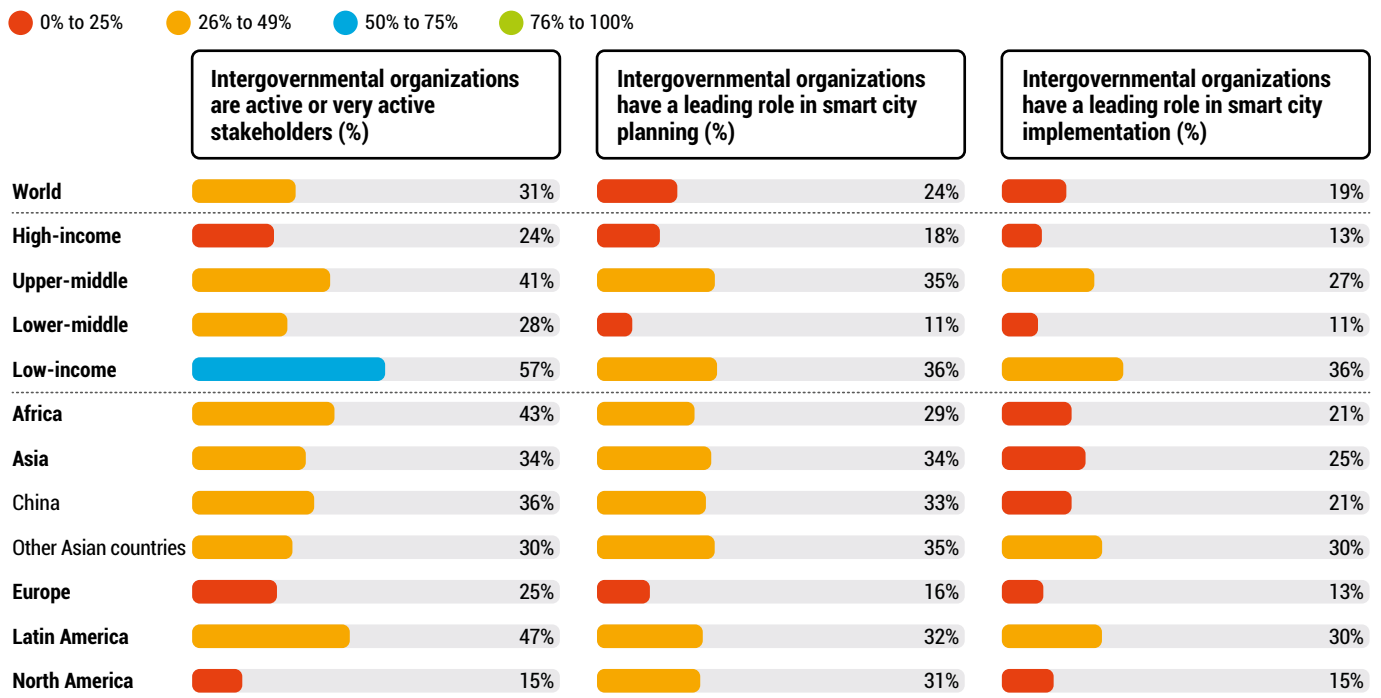
### Private sector participation

In Santiago de Chile, companies are considered an integral part in the process of resilience-building. The Santiago +B project aims to motivate companies, and especially small- and medium-sized enterprises (SMEs) to self-evaluate their social and environmental impact. This, in turn, is expected to increase the private sector's participation in the region's resilience agenda and smart city initiatives. To ensure a mutually beneficial participation of companies, proven instruments and standards are employed, while participating businesses become part of a network that allows for more direct communication and exchange of knowledge. The Santiago +B project is embedded in the city's overall resilience strategy, which comprises the four focal areas of i) human approach (placing people at the centre of discussion), ii) participatory city (including key stakeholders in decision-making), iii) territorial intelligence (making the best decision for each territory in the city in light of its respective particularities) as well as iv) promoting the right to the city (providing access to the city's services to all citizens).<sup>10</sup>

Intergovernmental organizations, such as United Nations, European Union or International Development Banks, represent the group of entities with lower collaboration levels with municipal governments, in comparison with the other actors (see Table 21 and Table 22). This rate is particularly low in North America, with an average of just 12% of respondents reporting collaboration practices with intergovernmental organizations, followed by Asia (24% in China, and 40% in other Asian countries) and Europe (45%). In turn, Africa reports the highest levels of collaboration with this kind of organizations (55%) followed by Latin America (49%).

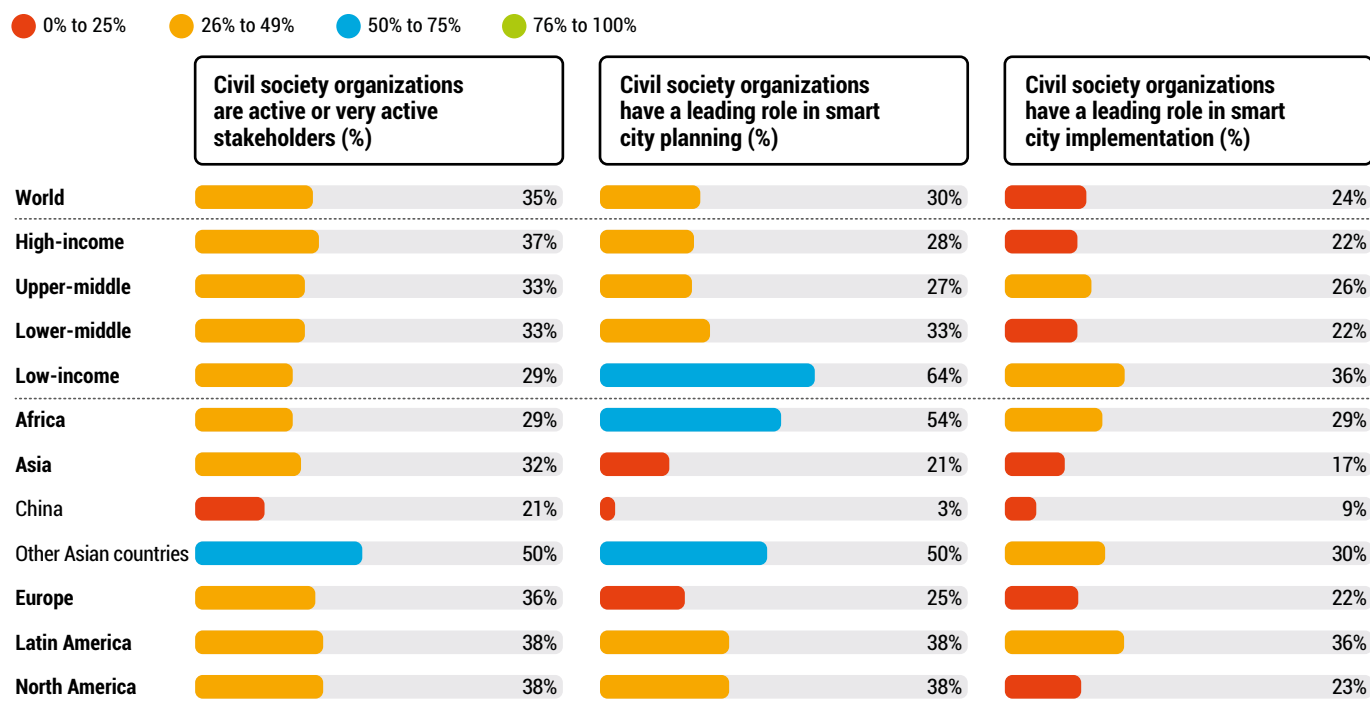
Similarly, the highest level of active engagement of intergovernmental organizations is found in Latin America (47%, see Table 28). Africa has the second highest level of intergovernmental organizations' active engagement (43%), where they are the second main provider of data, after national public organizations (see Table 39), and the second source of funding for smart city initiatives, after the city budget (see Table 7 in section *Pillar 1: Strategy*). In this region, however, intergovernmental organizations report lower levels of leadership in smart city planning and implementation (see Table 28).

**Table 28** Intergovernmental organizations: active engagement and leadership

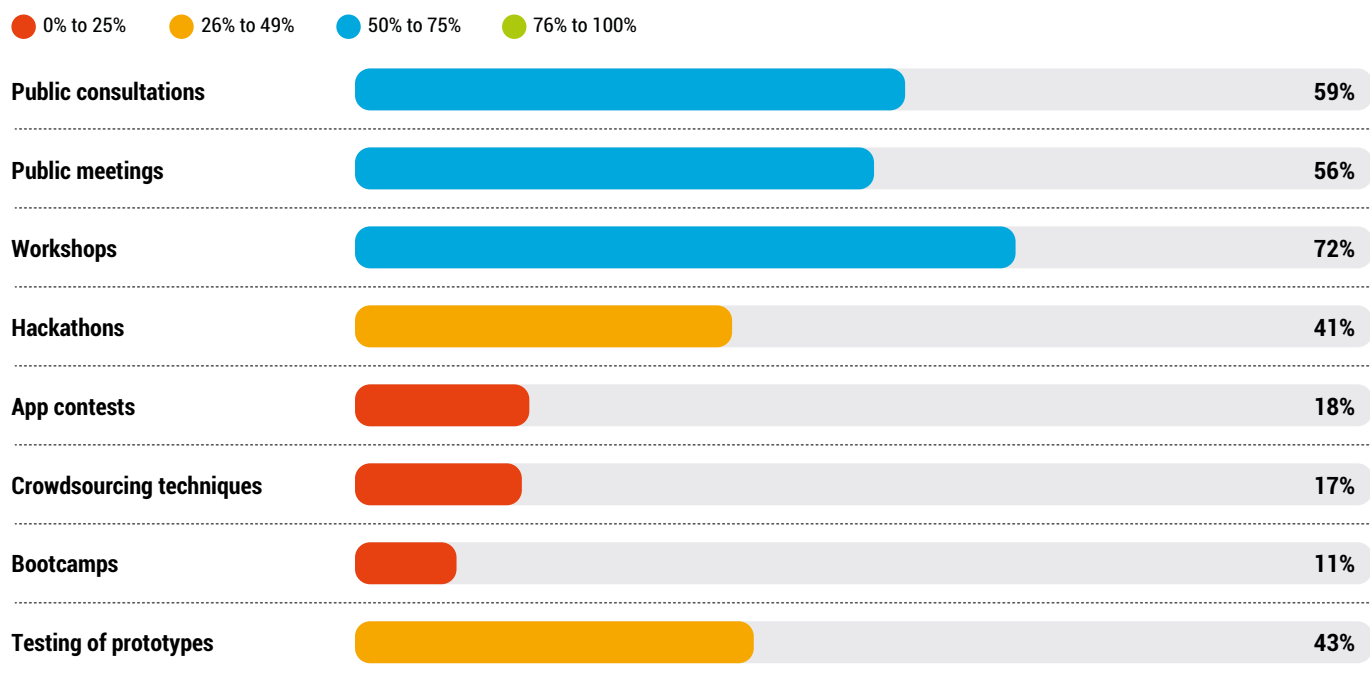




**Table 29** Civil society organizations: active engagement and leadership



**Table 30** What instruments does your city use to ensure that stakeholders participate in smart city initiatives?



Overall, civil society organizations have low levels of active engagement (only 35% of the respondents marked them as active partners), making them the third least active actor after residents (22%) and intergovernmental organizations (31%), as shown in Table 23. These levels are quite homogeneous across the different regions, with slightly higher rates in high-income countries (37%) and lower ones in low-income economies (29%).

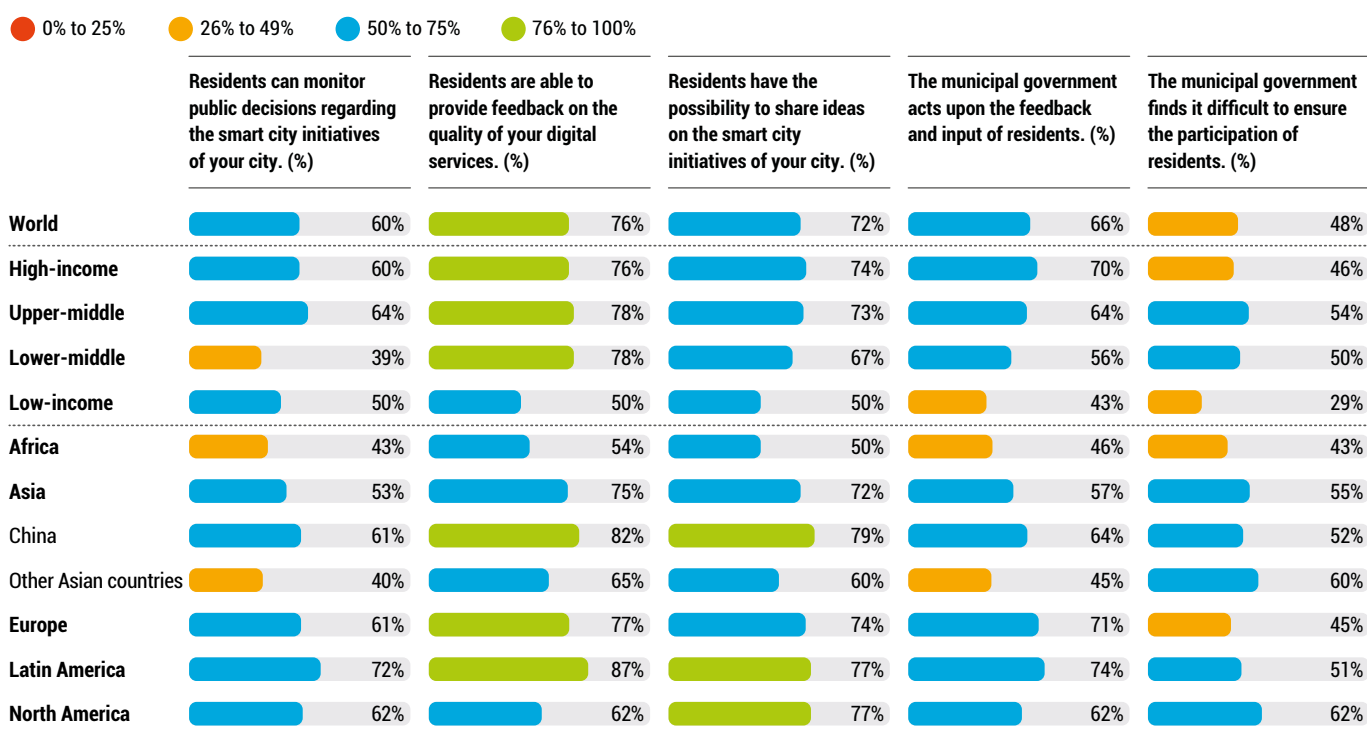
This moderately low rate of active engagement is contrasted with moderately high levels of collaboration with municipal governments in both planning (62%, see Table 21) and implementation phases (56%, see Table 22) of smart city initiatives. In Africa, civil society organizations are the second most important partner (together with universities and other research centres in planning phases, and with local private entities in implementation stages). However, the level of active engagement of civil society organizations is the lowest among all actors, with just 29% of respondents reporting them as active or very active.

In terms of public engagement, most respondents confirmed that their municipalities deploy participation tools to engage stakeholders in smart city initiatives. As shown in Table 30, workshops are the most frequently used instruments for public participation (72%) followed by public consultations

(59%) and public meetings (56%). Disaggregated data of survey responses further indicate that, North America has slightly different patterns, with public consultations (92%), public meetings (77%), and testing of prototypes (69%) being used more than workshops or any other techniques.

Regarding the capacity of residents to engage in and influence smart city initiatives, more than three quarters of the respondents confirmed that residents of their cities can provide feedback on the quality of digital services. Moreover, 72% of respondents also confirmed that residents have the possibility to share ideas, whereas 60% responded that residents are provided with the means for monitoring public decisions on smart city initiatives (see Table 31). However, respondents also identified that municipal governments act upon feedback and inputs of residents in only 66% of the cases worldwide, with particularly low rates in Africa (46%) and Asia (45%), with the exclusion of China. Interestingly, 48% of respondents confirmed that it is difficult for municipal governments to ensure participation of residents, even though only 22% reported overall low willingness of residents to participate in smart city initiatives (see Table 32). Imbalances can be found at the regional level, with 40% of respondents in Asia reporting low willingness of residents to engage in smart city initiatives, followed by Africa (32%) and Latin America (26%).

**Table 31** Resident inclusion and participation (Part 1)



## BOX 7: Iserlohn, Germany

### Public participation in Iserlohn

In the "Waldstadtlabor" in Iserlohn's city centre, an open space has been created to spur conversation between citizens and the municipality about the digital transformation of their city. Topics such as digitalisation, sustainability and climate protection, are discussed here. In addition to this space, events, workshops or conferences are held in the city. As a digital participation offer, a separate communication platform is available for citizens online. The goal of the "Waldstadtlabor" and other participation tools is to involve Iserlohn's citizens in smart city topics for a joint future-oriented approach.<sup>11</sup>

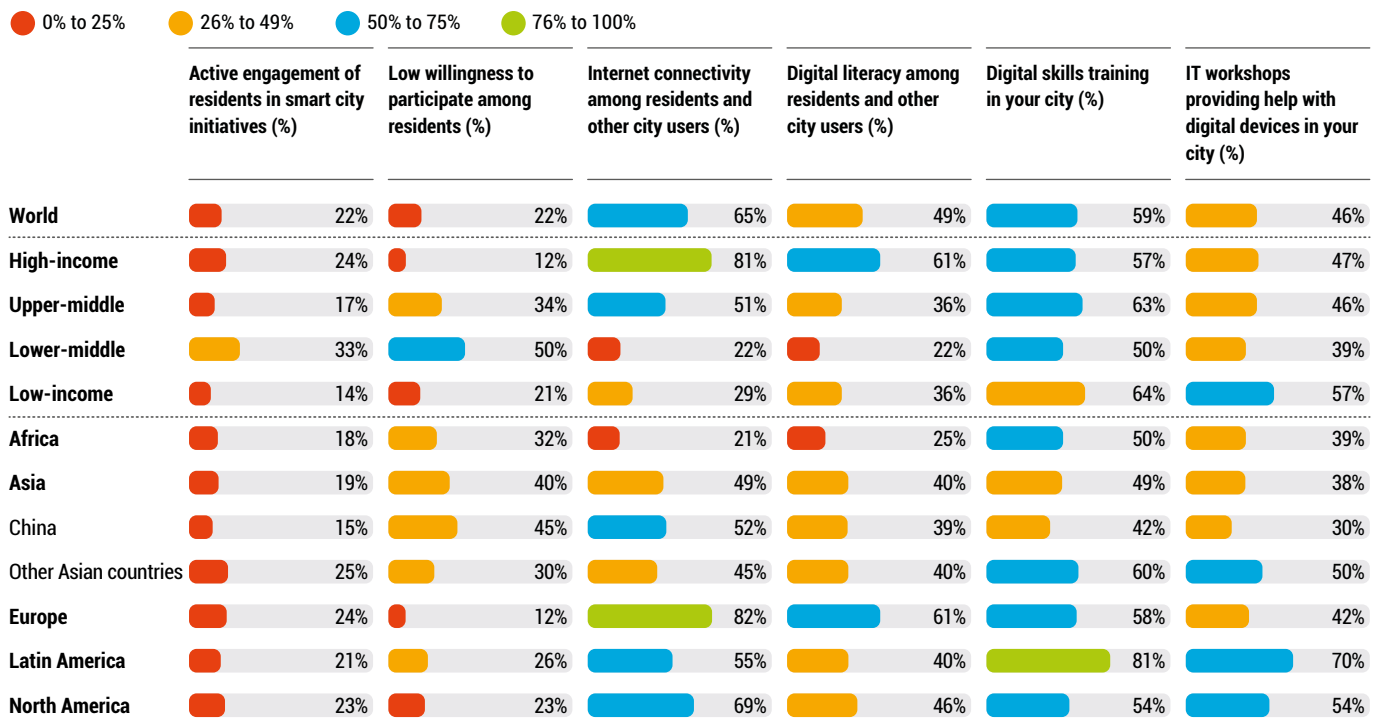


The capacity of residents to participate in smart city initiatives is also associated with aspects such as internet connectivity (access and affordability) and the levels of digital literacy and skills among city users. These aspects represent digital divides (see the UN-Habitat playbook *Assessing the Digital Divide: Understanding Internet Connectivity and Digital Literacy in Cities*) and play an important role in enabling digital inclusion policies. Among the regions of the study, the lowest rates of digital literacy (25%) and internet connectivity (21%) were reported in Africa, whereas the highest levels of digital literacy (61%) and internet connectivity (82%) among residents was recorded in the European sample (see Table 32).

Following the survey responses, Latin America was associated to moderate levels of digital literacy (40%) and internet connectivity (55%).

In addition, different measures to improve the digital inclusion of residents are identified in the study. As shown in the following section of the report (see *Pillar 3: Technological Infrastructure*), Latin America has emerged as the region with the highest level of digital skills trainings (81%) and IT workshops that provide help with digital devices (71%), followed by North America and Europe, with rates at approximately 50% (see Table 32).

**Table 32** Resident inclusion and participation (Part 2)



## Component 2.2: Partnership coordination

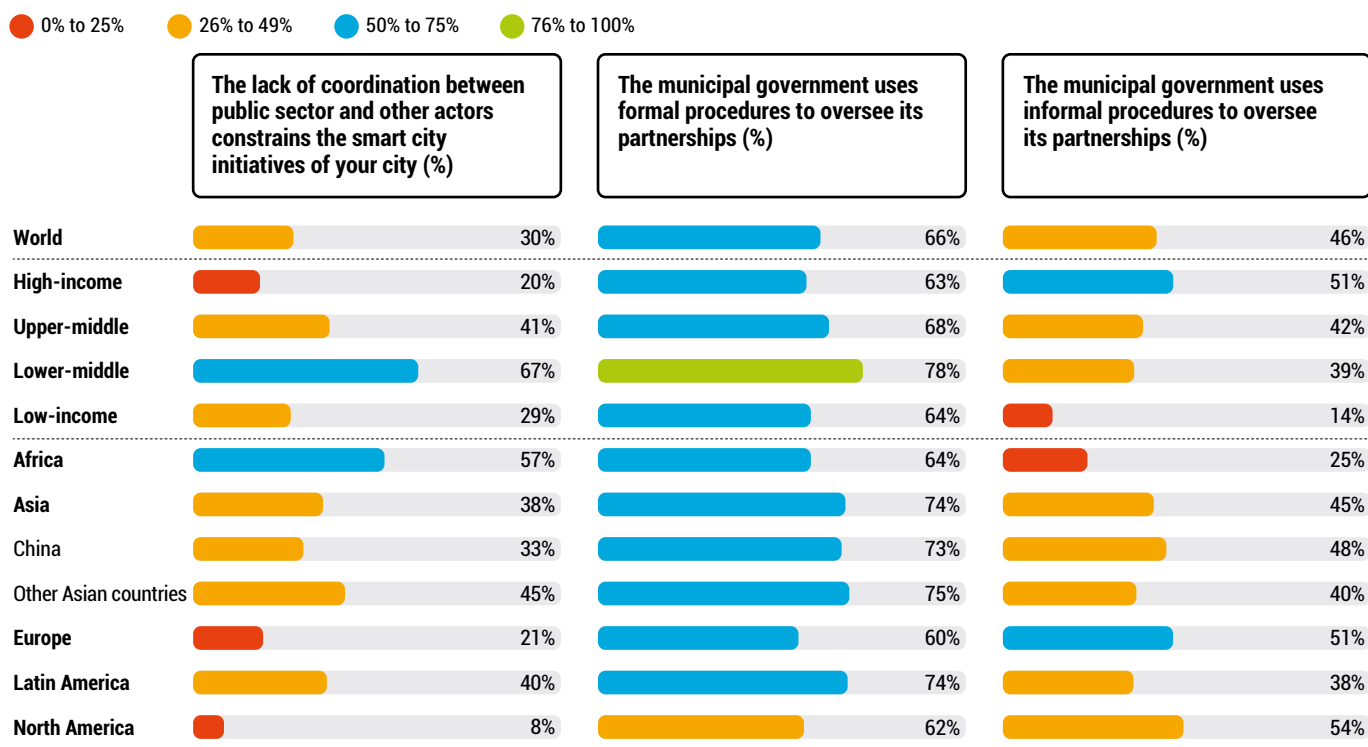
Activating multi-stakeholder collaborations towards the realization of people-centred smart cities requires the engagement of multiple societal sectors and types of entities. Managing these collaborative ventures is a complex task that entails a combination of different procedures, collaborative and leadership skills, and managerial abilities.

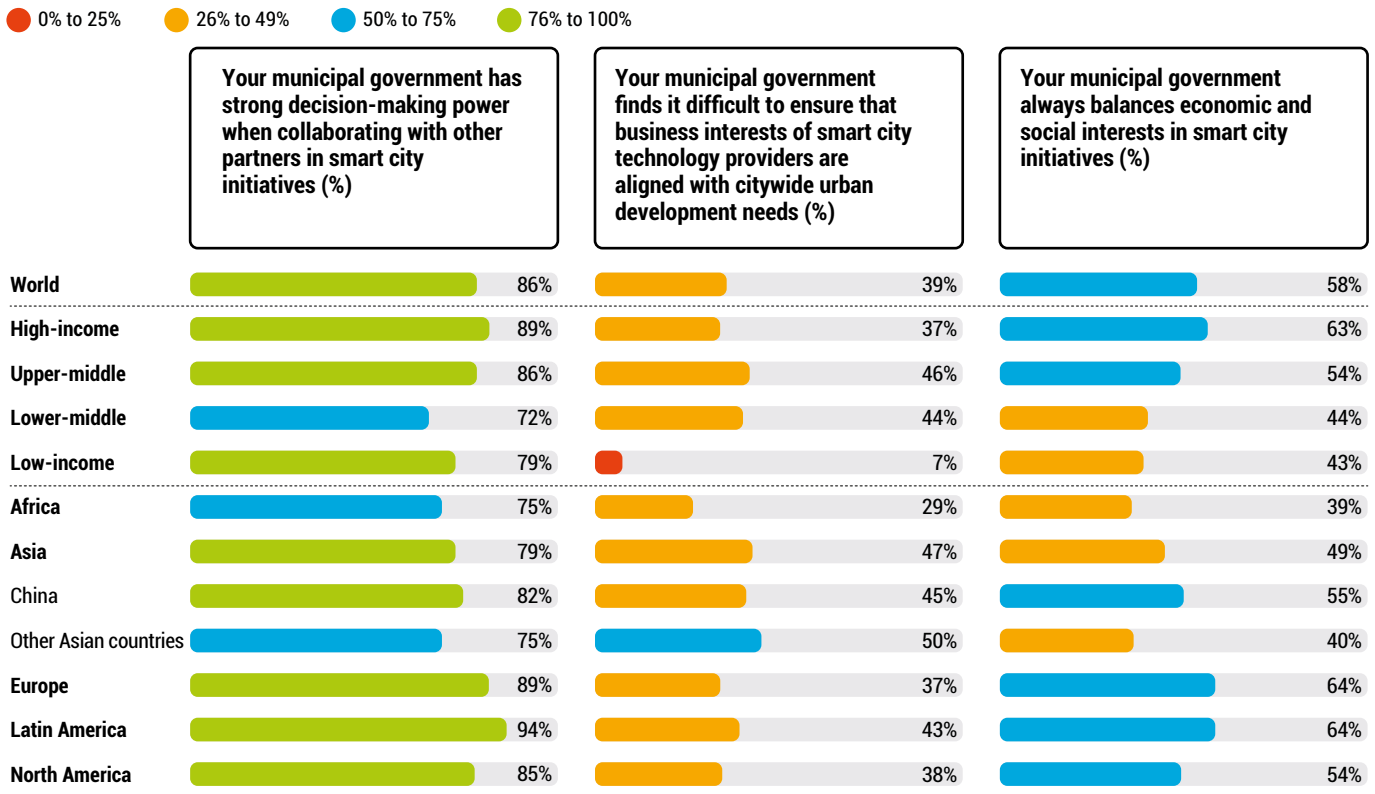
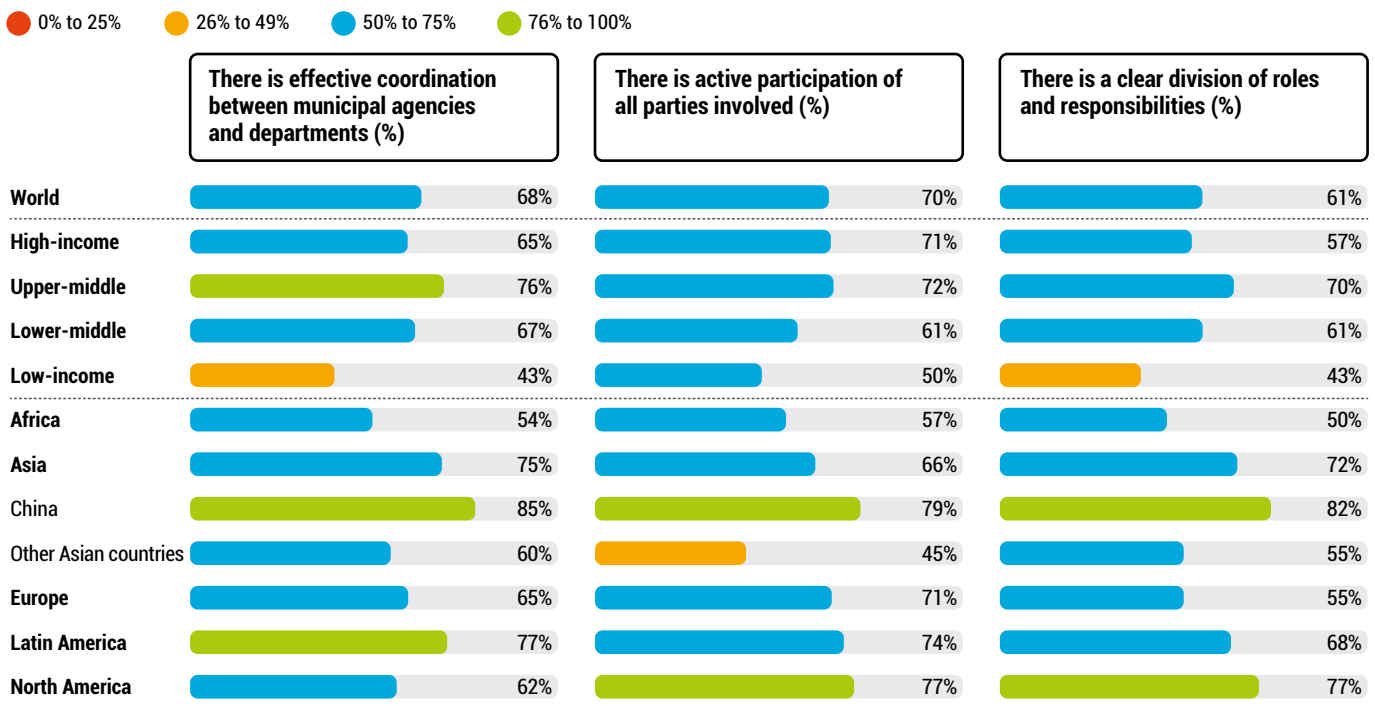
In the smart city initiatives that our respondents refer to, municipal governments have made use of both formal and informal procedures to oversee their partnerships with other stakeholders. Two thirds of the respondents have confirmed the use of formal instruments such as bureaucratic control measures or formal regulations, with the highest rates reported in Asia and Latin America (74%, as shown in Table 33).

Informal procedures, such as trust-building or stewardship models, seem to have lower application rates than formal instruments in most cities and regions. North America and Europe report the highest number of respondents observing the use of informal procedures (54% and 51% respectively), while in Asia is less than the half (45%) and Latin America only 38% (see Table 33).

Coordination among different stakeholders is also a crucial factor in smart city collaborations. Approximately one third of the respondents have identified the lack of coordination between the public sector and other actors as a barrier to the development of smart city initiatives in their cities (see Table 33). North America reports the highest rates of coordination between public sector and other actors, which also coincides with the highest rate of dedicated smart city entities in municipal governments (77%, see Table 10 in section Pillar 1: Strategy).

**Table 33** Coordination and procedures



**Table 34** Decision-making power and interests' alignment**Table 35** Collaboration between different agencies and departments within the municipal government

Partnerships and collaborations imply active and transparent dialogue to reach agreements among the different partners involved. The negotiation of diverse and often competing interests is a common issue arising from the development of smart city initiatives. The survey data shows that approximately 40% of the respondents suggest their municipal governments find it difficult to ensure that business interests of smart city technology providers are aligned with citywide urban development needs (see Table 34). In low-income countries, where the study has shown a more prominent role of intergovernmental organizations over private sector companies, only 7% of respondents have reported the alignment of technology providers' interests and city needs as a main constraint.

Overall, most respondents have suggested that their municipal government has strong decision-making power when collaborating with other partners in smart city initiatives (86% of the cases). However, only one third of those respondents have reported that, in these initiatives, their municipality always balances economic and social interests (see Table 34). The highest rates of municipal decision-making power are observed in Latin America. In the region, 94% of respondents reported strong municipal decision-making power, but only 64% of them indicated that their municipal governments balance economic and social interests in all smart city initiatives.

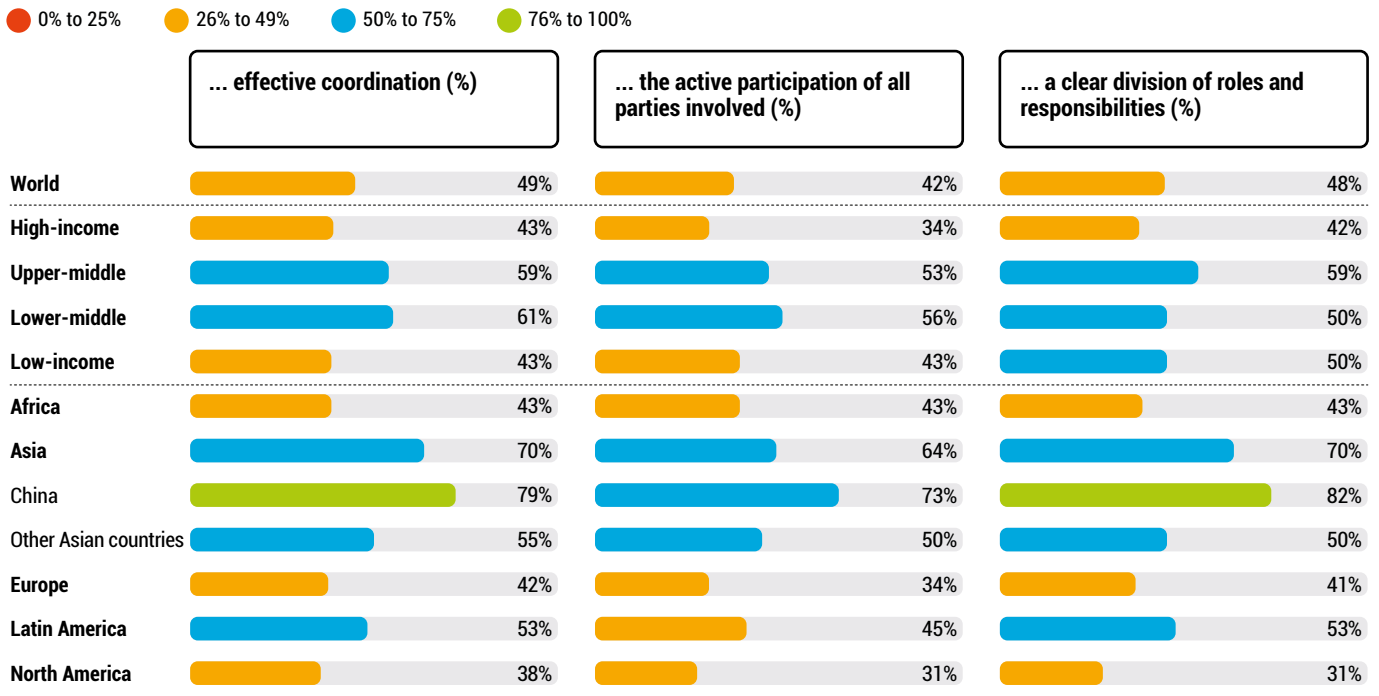
Public sector collaboration is mainly observed from two perspectives: horizontally, among different entities of the

municipal government, and vertically, between the local and national level. Overall, better collaboration practices have been reported in the horizontal direction, while lower levels of coordination and less clear distribution of roles and responsibilities are observed between municipal and national governments (see Table 35 and Table 36).

As shown in Table 35, the collaboration between different agencies and departments within the municipal government has overall medium-to-high levels of effective coordination (68%), active participation of the parties involved (70%) and a clear division of roles and responsibilities (61%). At the regional level, Latin America reports the highest levels of effective coordination between different agencies and departments of the municipal government (77%), followed by Asia (75%), with particularly good rates reported in China (85%). Effective municipal-level collaboration decreases in Africa, where respondents have led to overall rates between 50% and 57%.

Regarding collaboration between municipal and national government, only 49% of respondents remarked an effective coordination between the two tiers of government. In addition, the effective distribution of decision-making powers was reported in just 42% of the cities included in the sample, and a clear division of roles and responsibilities in 48% of the cases. As previously mentioned, this global representation directly relates to the multi-level governance aspects of smart city initiatives, a governance area in which cities seem to face difficulties (see Table 36).



**Table 36** Collaboration between municipal and national governments

The region with the highest rates of effective collaboration between local and national public entities is Asia (in which China reports a rate of 79%, and 55% other Asian countries), followed by Latin America (53%), and thirdly Africa (43%). However, there is not sufficient information to evaluate

whether municipal governments have adequate levels of autonomy in decision-making and work under a balanced structure of multi-level governance. Overall, Europe and North America report lower levels of effective coordination, distribution of powers, and division of responsibilities between national and local public entities, as shown in Table 36.

### BOX 8: India



### National Smart City Policy

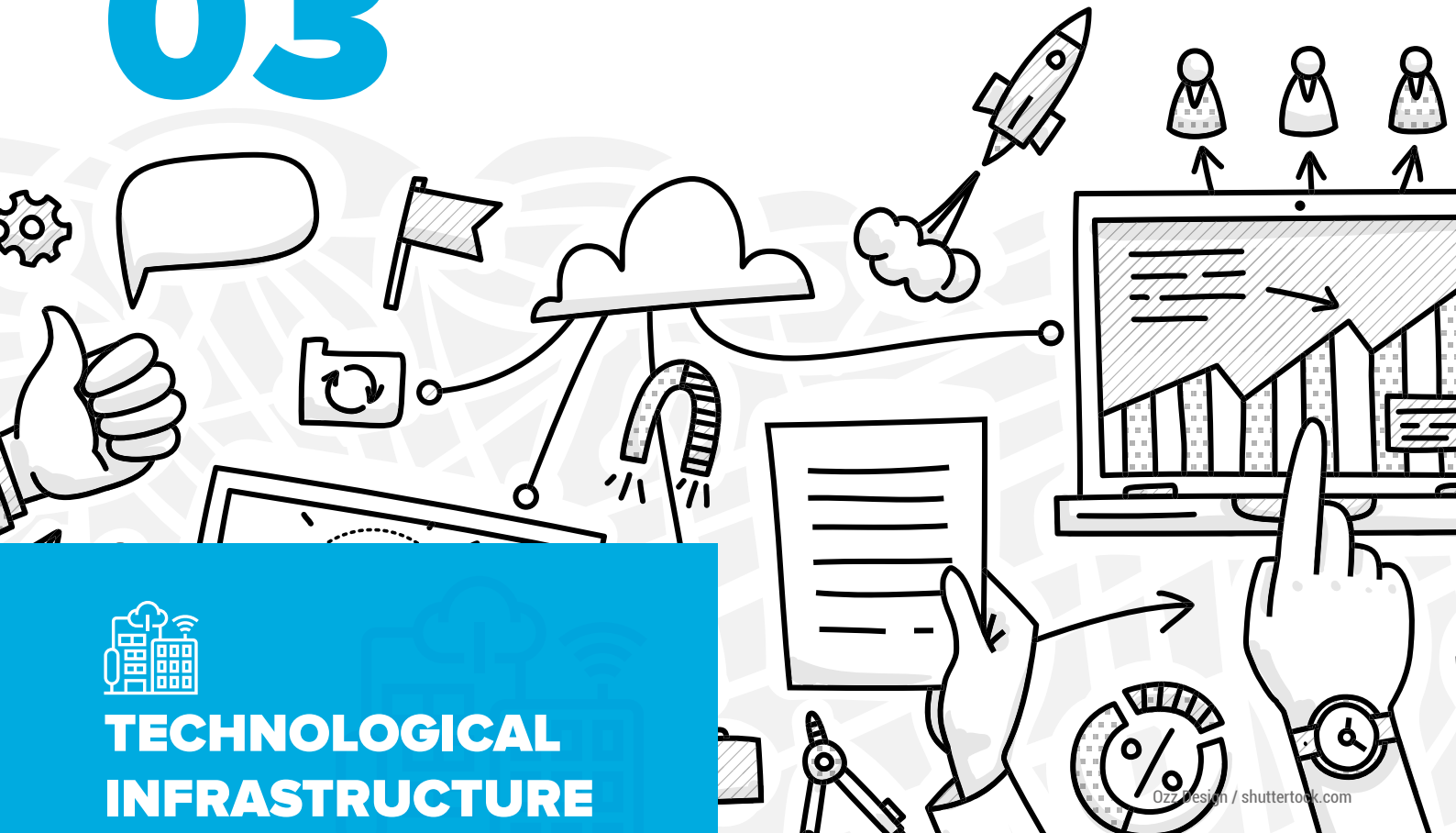
India's national Smart Cities Mission is an urban renewal and retrofitting programme run by the Government of India, aiming to develop smart cities nationwide, where aspects such as quality of life and sustainability enjoy specific attention. Since 2015, the Union Ministry of Urban Development serves as the main coordinating and implementing body and cooperates with the state governments of the participating cities. 100 cities embarked on their individual missions which ought to be completed between 2019 and 2023. The missions rely on area-based development and pan-city development along the three action axes of redevelopment, retrofitting and greenfield. Nearly USD 27 billion were made available for all missions by the central government, state and local governments as well as other funding sources.<sup>12</sup>





## Pillar Three

# 03



## TECHNOLOGICAL INFRASTRUCTURE

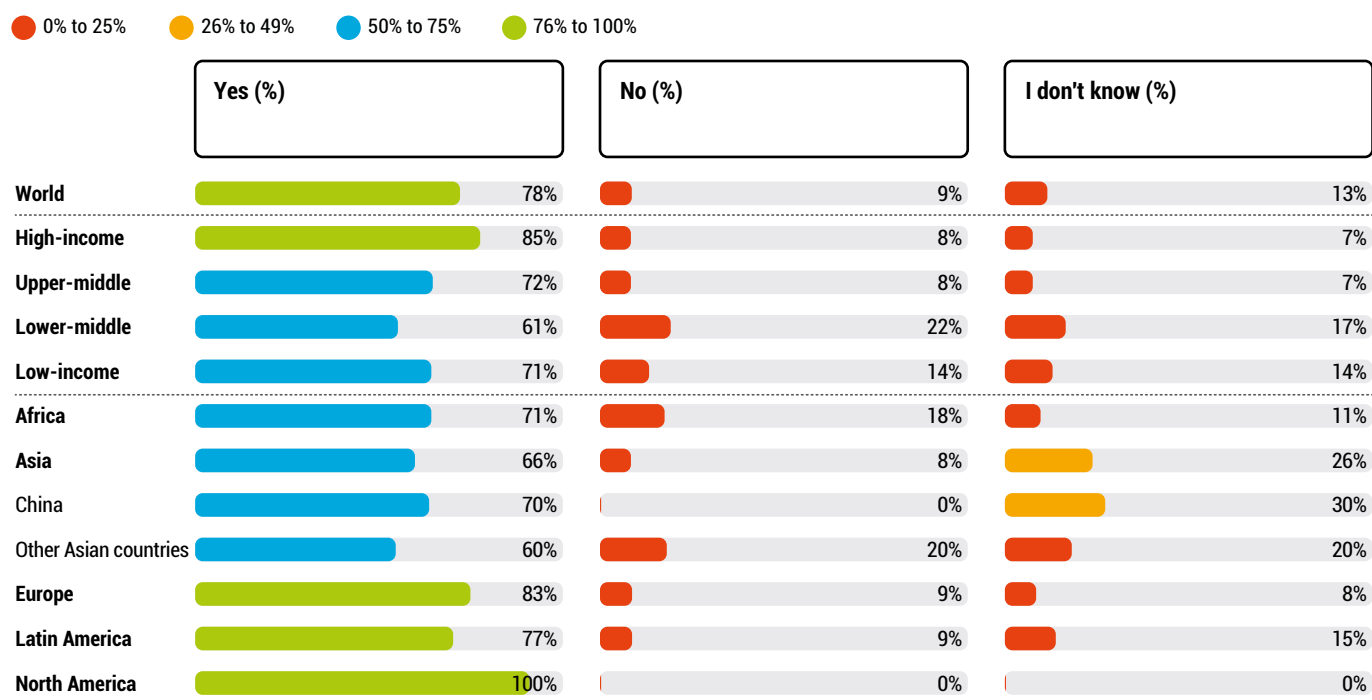
### Component 3.1: Information architecture

About 80% of the respondents across all regions reported that data is used to inform the decision-making process of municipal governments (see Table 37). This percentage decreases in lower-income economies, but it remains above 60%.

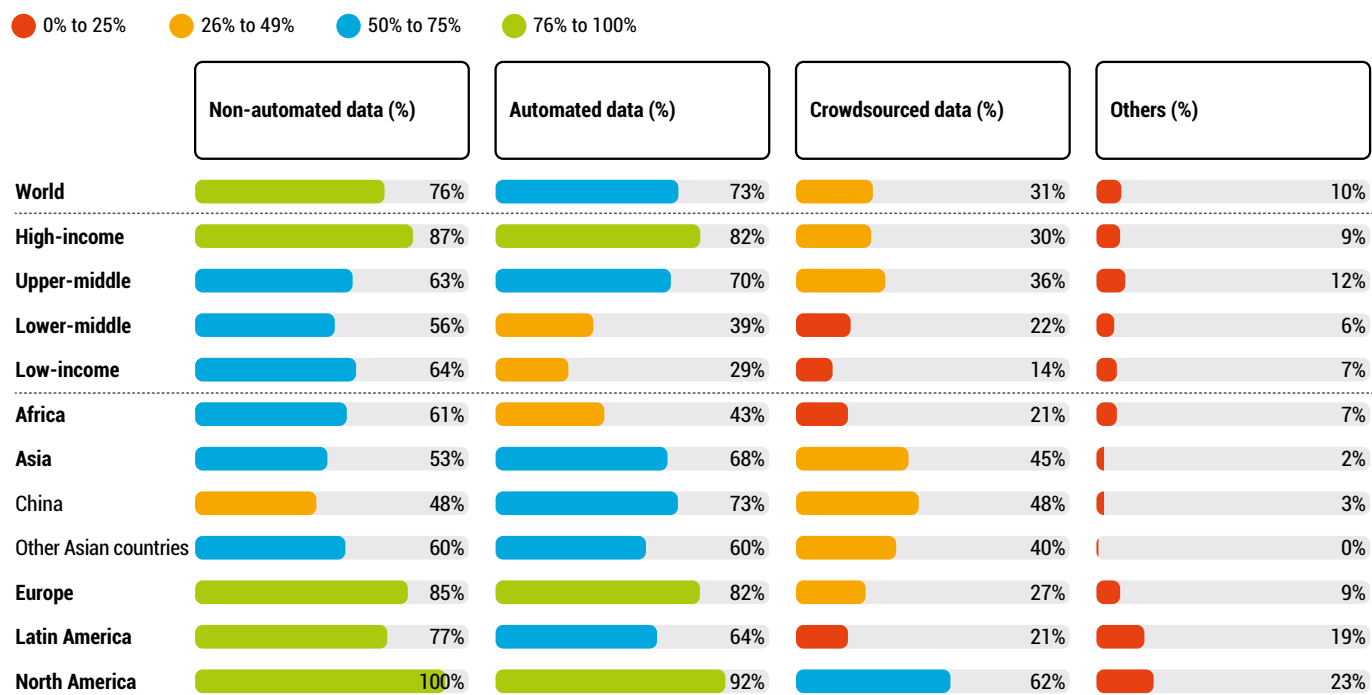
Municipalities collect and use a wide range of data (see Table 38). Overall, non-automated data collection tools, such as questionnaires, surveys, and consultations are the most frequently used. However, these tools are also frequently combined with additional data sources. 81% of

the respondents from high-income countries reported the use of automated data gathered from sensing devices, such as air quality monitors, energy meters and weather stations. Interestingly, the use of this type of data declines as the income becomes lower, reaching only 29% in low-income countries. Crowdsourced data and other types of large-scale databases are generally more popular in North America, Asia and Europe, where between 62% and 27% of the respondents highlighted the adoption of this data source in their cities, whereas the figure drops to 21% in Latin America and Africa, respectively.

**Table 37** Does your municipal government use data to inform decision making?



**Table 38** Data collected and used by municipal governments



## BOX 9: Rio de Janeiro, Brazil

### Rio Operations Centre

Rio de Janeiro's Operations Centre (COR) is a central entity collecting and managing a vast amount of data stemming from the city's sensors and further data sources, which are received through various protocols (e.g. FTP, SOAP, and REST) in different formats (e.g. XML, JSON, KML, GeoJSON). Among other functions, the created infrastructure serves a Community and Alert Warning System, which combines and analyses data and information on various elements concerning transport and mobility, citizen safety, the environment and energy efficiency. The Community and Alert Warning System informs about risk situations and warnings by sending out SMSs to residents and community workers in high-risk areas in addition to launching sirens in these areas. The system operates in 103 communities in Rio de Janeiro, and it relies on more than 160 sirens and 80 automatic rain gauges as well as about 200 points of support to complement the central COR.<sup>13</sup>

## BOX 10: Toronto, Canada

### Digital autonomy

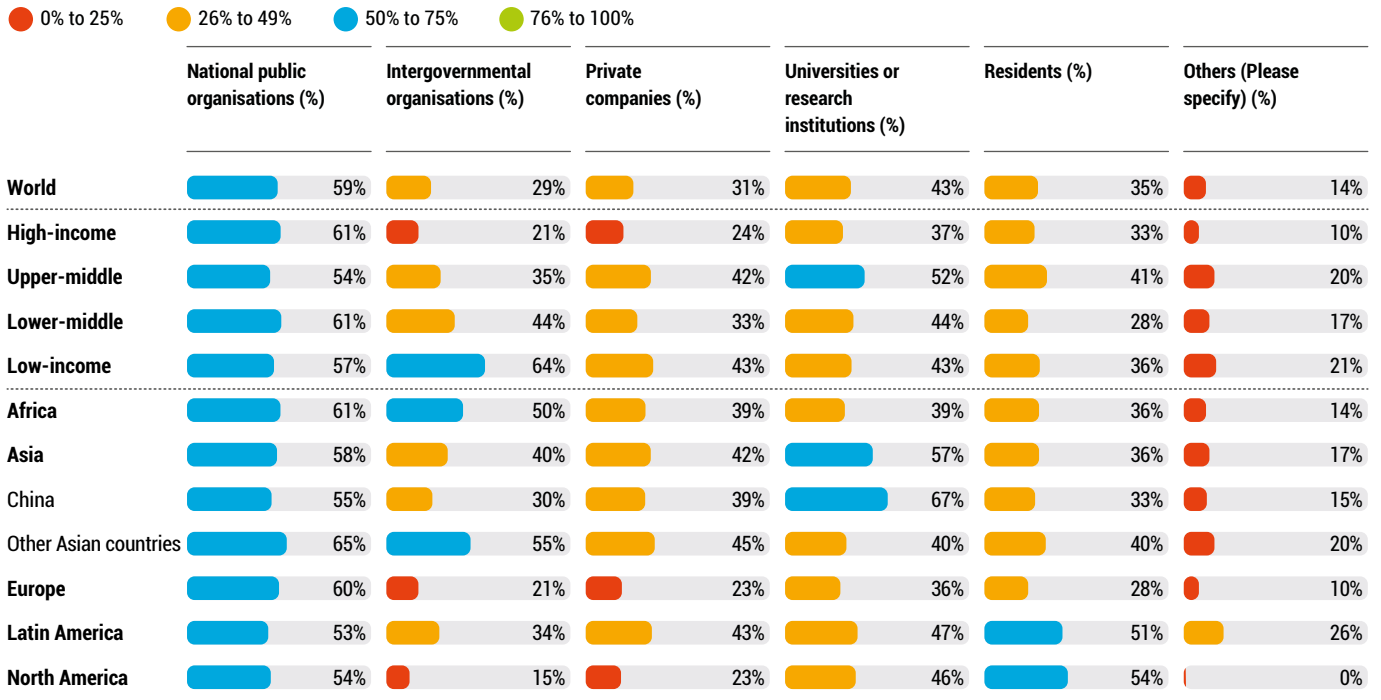
Toronto's Digital Infrastructure Strategic Framework foresees that "the city will maintain control in the selection, use and design of its digital infrastructure, so that it – and its residents – can act with autonomy and in a self-determined manner within the digital realm." The focus lies on the city's internal capacity building in data and digital infrastructure gathering, development, management and analysis instead of having to rely on third parties and contractors. To achieve these objectives, Toronto identified five strategic principles and priorities: i) open source, ii) intellectual property, iii) open standards and interoperability, iv) maintenance and repair as well as v) democratic control.<sup>14</sup>

Besides data that they directly collect, local governments also rely on third-party data providers (see Table 39). Across geographical areas, national public organizations have been indicated consistently as the main external data source. This external data provider is followed by universities and research institutions, with approximately half of the respondents suggesting that their municipal governments work with this data provider in Latin America, North America, and Asia. The only exceptions are Europe and Africa, where the percentages decrease to approximately 40%. It is also worth noting that municipalities from China, according to our respondents, mainly source their data from universities and other research institutes (67%) and only in second instance from national organisation (55%). Moreover, data sourced from intergovernmental organisations were indicated only by about a third of the respondents worldwide. However, while the share of North American and European cities seems to lag behind the global average (15 and 21%, respectively), the percentages are remarkably higher when looking at African and Asian municipalities outside China (50% and 55%, respectively). These figures are similar to those related to the adoption of data provided by private companies; municipalities

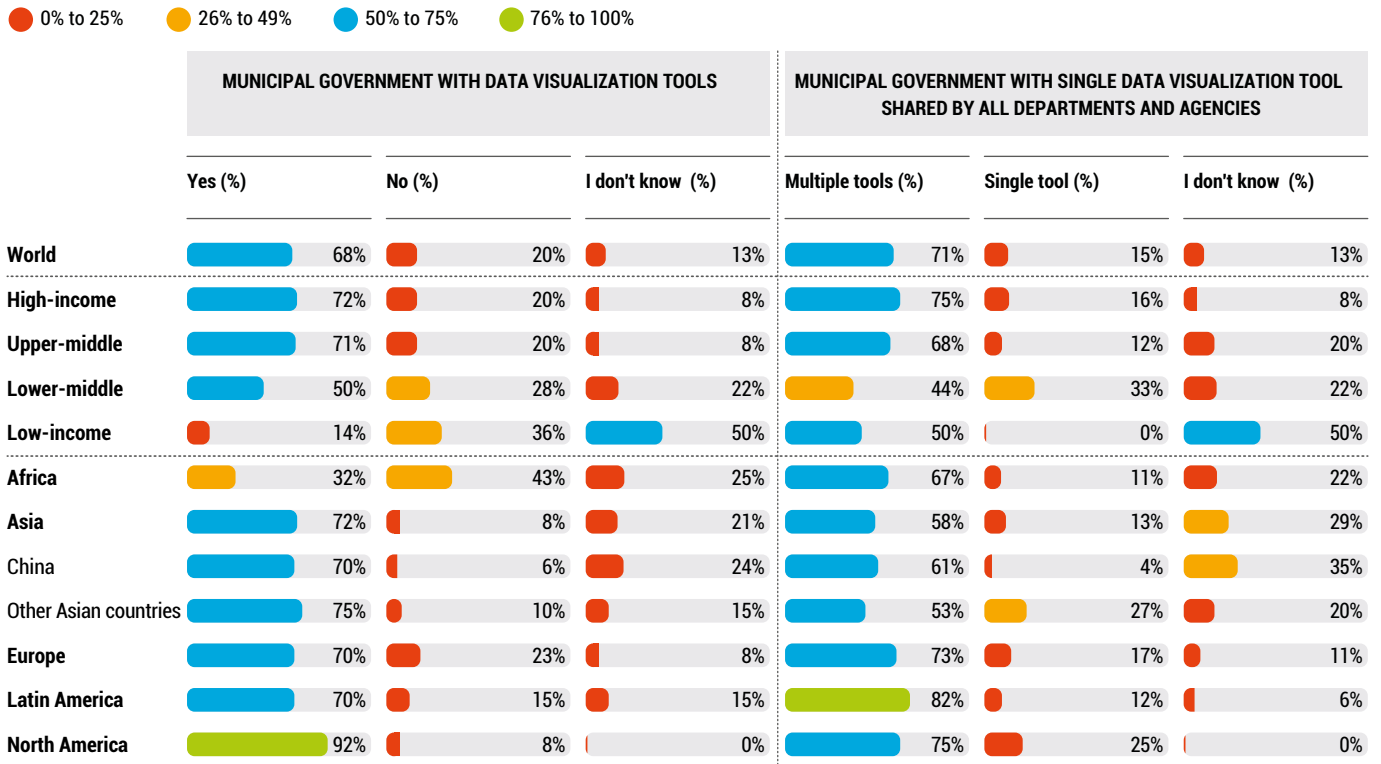
in Africa, Asia and Latin America have reported the use of such data in approximately 40% of the cases, whereas this percentage drops by half in Europe and North America. The fact that municipalities positioned in the Global South rely on data from external or non-national actors may point to a lack of availability, reliability, accessibility and usability of existing public national and sub-national datasets in this geographical area.

Overall, 68% of respondents pointed out that their municipal government makes use of data visualisation tools, indicating that they have become a primary way for their cities to analyse, explore and communicate data gathered from various sources, including smart technologies and applications. Outliers at the two extremes of the sample are North America (92%) and Africa (32%). However, departments and agencies within the same municipal government rarely (one out of six) share a single visualization tool (see Table 40). This trend indicates a potential opportunity to improve system integration that can lead to a more transversal reading of available data, which in turn can provide additional and more articulated data-driven representations of urban operations.

**Table 39** Data provided by third parties that municipalities rely on



**Table 40** Municipal data visualization tools

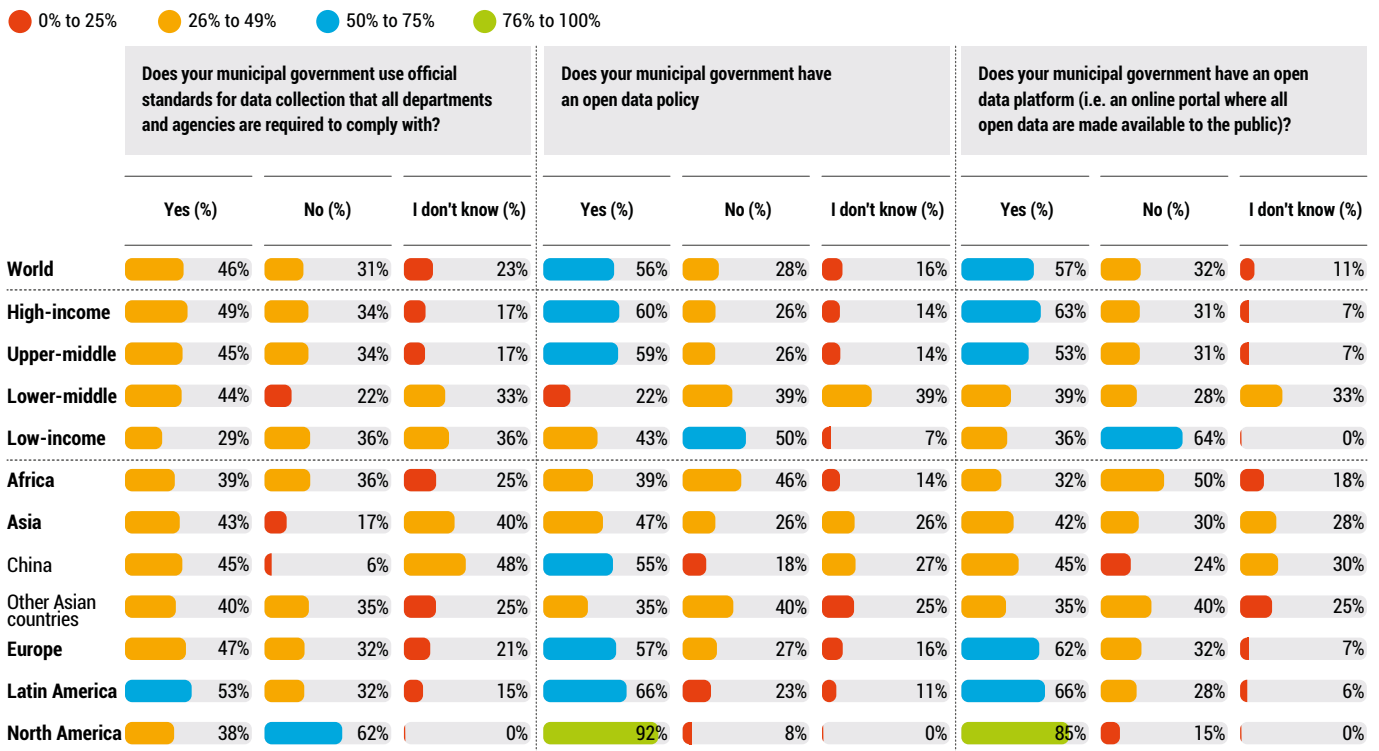


## BOX 11: Winterthur, Switzerland

## Using dashboards to display data

Networked sensors can measure data and transmit it in real time. In the city of Winterthur, Switzerland, the data gathered through these sensors are displayed, analysed and evaluated on a dashboard. The idea to create a dashboard originally arose from the city's energy department's need for better traffic data. Until the project's initiation, no reliable, comprehensive and continuous sensor data had been available. In a like manner, the installed induction loops had offered only little information about the vehicles passing through Winterthur's streets nor their characteristics such as size, speed etc. With the installation of new IoT sensors the city managed to address this information gap. The gathered data, however, does not only inform traffic control, but is also of interest to other specialised agencies and end-use applications, such as public lighting or air pollution calculations. Various measurements of motion detectors, climate loggers, water level sensors for water bodies and stormwater basins, traffic radar and noise level meters are now being displayed on an *OpenStreetMap* map. For this smart city project, the city of Winterthur worked together with a private partner.<sup>15</sup>

Table 41 Municipal data collection standards and open data policies



Insufficient system integration is emphasized by half of the respondents globally, who remarked the limited presence of official standards for data collection to coordinate the actions of different departments and agencies, an essential feature to enable information to travel from one application or system to another and be used seamlessly (see Table 41). These types of standards are in place in less than half of the municipalities included in the survey sample, with African and North American cities reaching the lowest figures – 39% and 38%, respectively. This result is in line with and echoed by the low interoperability of technical solutions both in legislative frameworks and technology procurement practices that has been noted in previous sections of this report (see Table 14 and Table 15 in *Pillar 1: Strategy*). Despite the limited internal coordination, many cities have formulated an open data policy that encourages the use, reuse, and free distribution of governmental datasets. The highest rate has been detected in North America (92%), while Latin America, Europe, Asia, and Africa follow with a percentage between 66% and 39%.

By only analysing the municipalities with an open data policy, the survey data revealed that 80% also have an open data platform where open data is made available to the public. It is important to note that principles of good open data governance recommend ensuring that data is made comparable and interoperable and that it is properly encoded. Commonly agreed data standards play a crucial role in making this happen. Despite being beyond the reach of this survey, given the presence of some misalignment between the adoption of the data standards, policies, and platforms that current practices display, it would be important to examine whether and how these principles are captured in the formulation of open data policies and how data standards are embedded in systems, platforms, and analytical products.

## Component 3.2: Digital service design and delivery

The design and delivery of smart city services is positioned at the critical junction between the development of smart city strategies and their translation into tangible outcomes.

The design and delivery process should align with technical and socio-economic aspects of a city, to make sure that services are usable, desirable, and sustainable in the long term. For example, existing digital skills among citizens and civil servants are key factors influencing individual engagement in digital public services, and it should be central in the development of technical infrastructures. Lack of skills within the public sector (56%) and limited digital literacy among residents and other city users (50%) are some of the main challenges in the implementation of smart city initiatives in low and lower-middle income countries, and a relevant issue among Latin American and African cities (see Table 42).

As seen in Table 43, when selecting new technological solutions, 73% of the respondents suggested that their municipal government builds on already available technological resources, but in lower-income economies this figure falls to 56%. At the same time, the acceptance of new digital technologies among residents and city users is highly considered in high and middle-high income countries (70% of the respondents) whereas this aspect seems to become less relevant in lower-middle and low-income regions (40%). It is worth noticing, however, that resistance to change within the public sector is indicated as a barrier mainly in Latin America (51%) and Africa (54%), as shown in Table 42.

**Table 42** Barriers to smart city initiatives

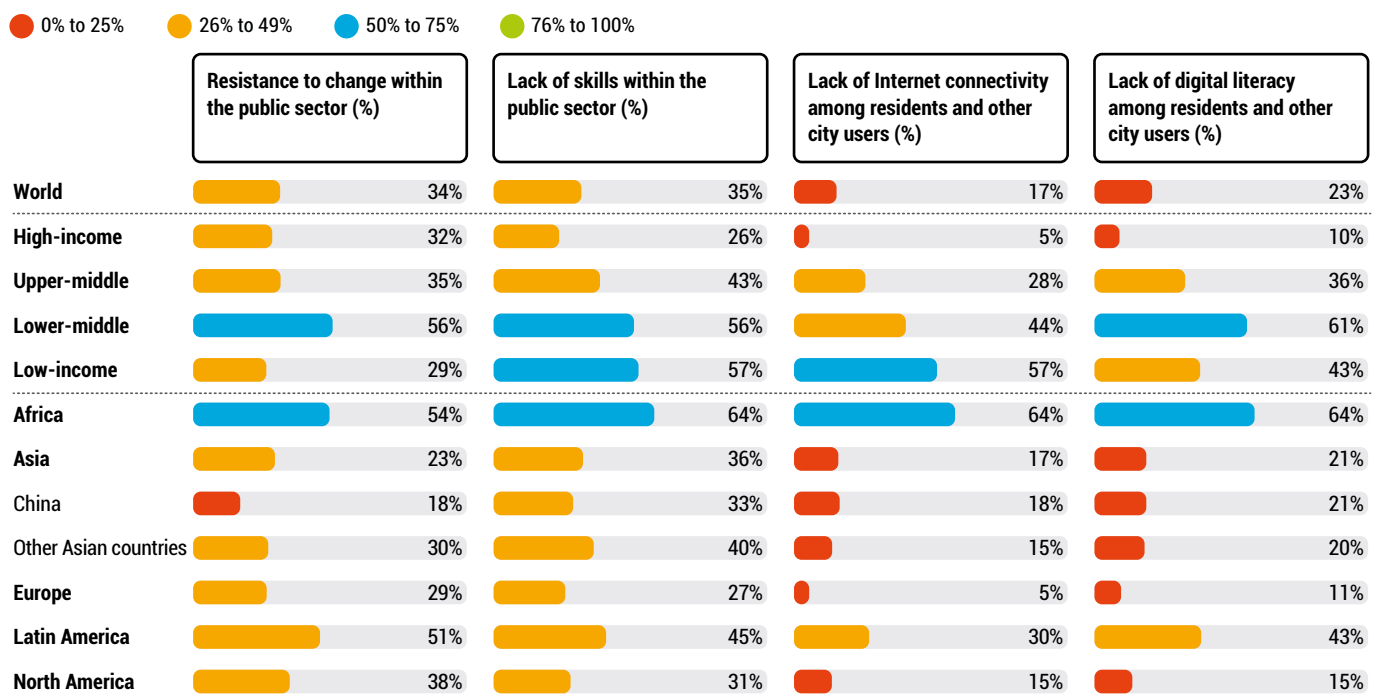


Table 43 When selecting new technological solutions for the city, the municipal government...

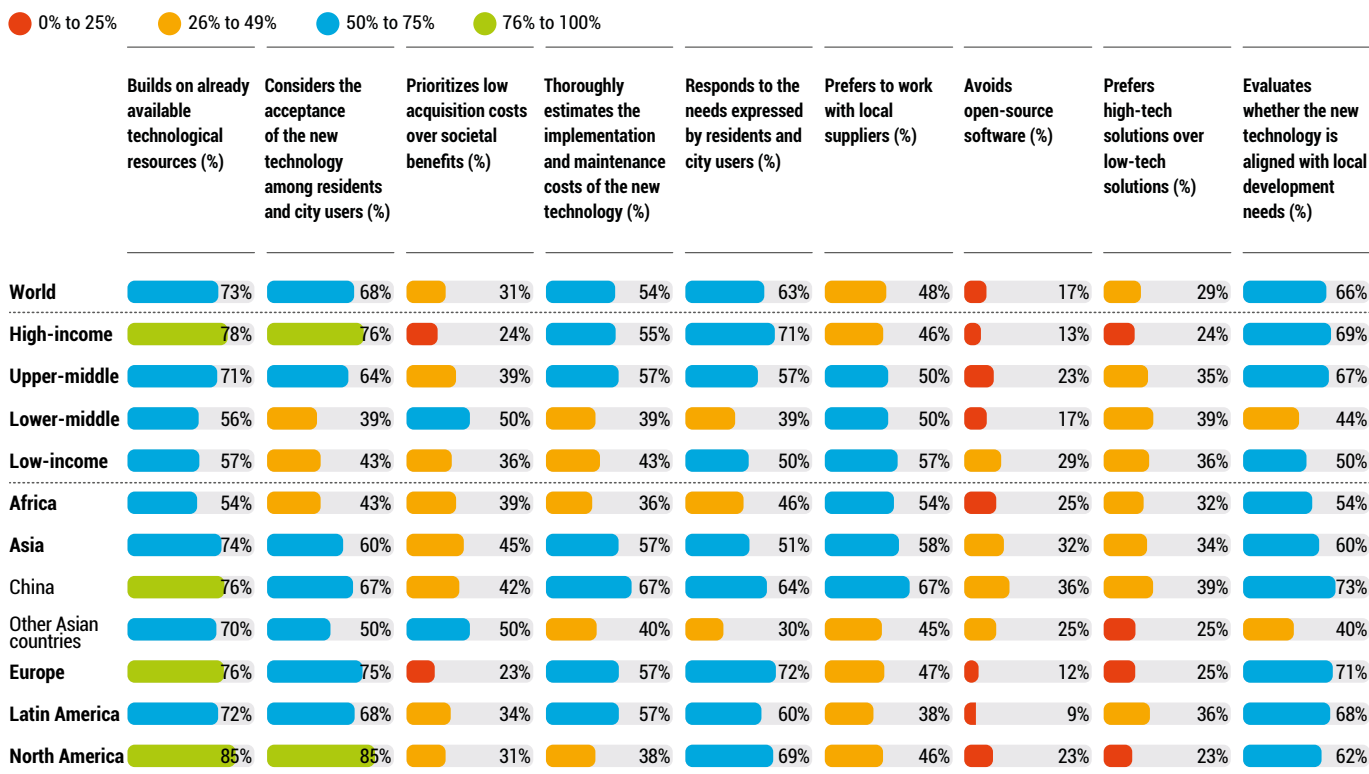


Table 44 Measures in place for digital inclusion of residents





Municipal governments use several measures to ensure that newly introduced digital solutions are accessible to their citizens and several forms of digital divide are bridged (see Table 44). Within the sample, Latin America appears to be the most active in introducing measures that aim to enhance the digital inclusion of residents. These measures include digital skills training (81% of respondents), workshops providing help with digital devices (70%), and free WiFi access across the city (79%). The provision of free WiFi access emerges as the most popular measure; it has been selected in 63% of the overall responses and there is consistency across geographical areas and income groups. However, lack of internet connectivity among city users is identified as a challenge in Africa (64%) and, to a certain extent, in Latin America (30%), whereas it has not been highlighted as a serious issue in other regions. Moreover, among available measures to sustain digital inclusion, North American cities are the only ones where subsidies for broadband services and digital devices have been highlighted (about half of the sample), whereas this solution seems to be less popular in other cities worldwide.

Sixty-three per cent of the respondents affirmed that technology selection by municipalities tries to respond to the need expressed by residents and city users (see Table 43).

Workshops, public consultations, and meetings are the most used instruments for enhancing stakeholder participation in smart city initiatives (see Table 30 in the section *Pillar 2: Collaborative Ecosystem*). Furthermore, about half of the respondents from Europe, Latin America, and North America indicated the use of hackathons, app contests and testing of prototypes. These tools allow to iteratively test practical ideas and improve them throughout the development process, helping to link the needs of potential users to the design of digital solutions (see Table 45).

Once in place, the use of smart city services can be boosted by means of municipal websites and unified service portals that can help enhance the visibility and accessibility of available services. According to the survey (Table 46), a large majority of municipalities in Asia, Europe and Latin America offer digital public services through a single point of access, a measure which is adopted by only 46% of cities in North America and 25% in Africa. This is mirrored by the actual provision of basic public services in a digital format; respondents highlighted that municipalities deliver digitalized basic services mostly in Latin America (55%), Europe (66%) and Asia (72%), with Chinese cities showing the highest figure (79%). North America follows closely (46%), whereas African cities are lagging behind (14%).

**Table 45** Instruments used to support stakeholder participation in smart city initiatives

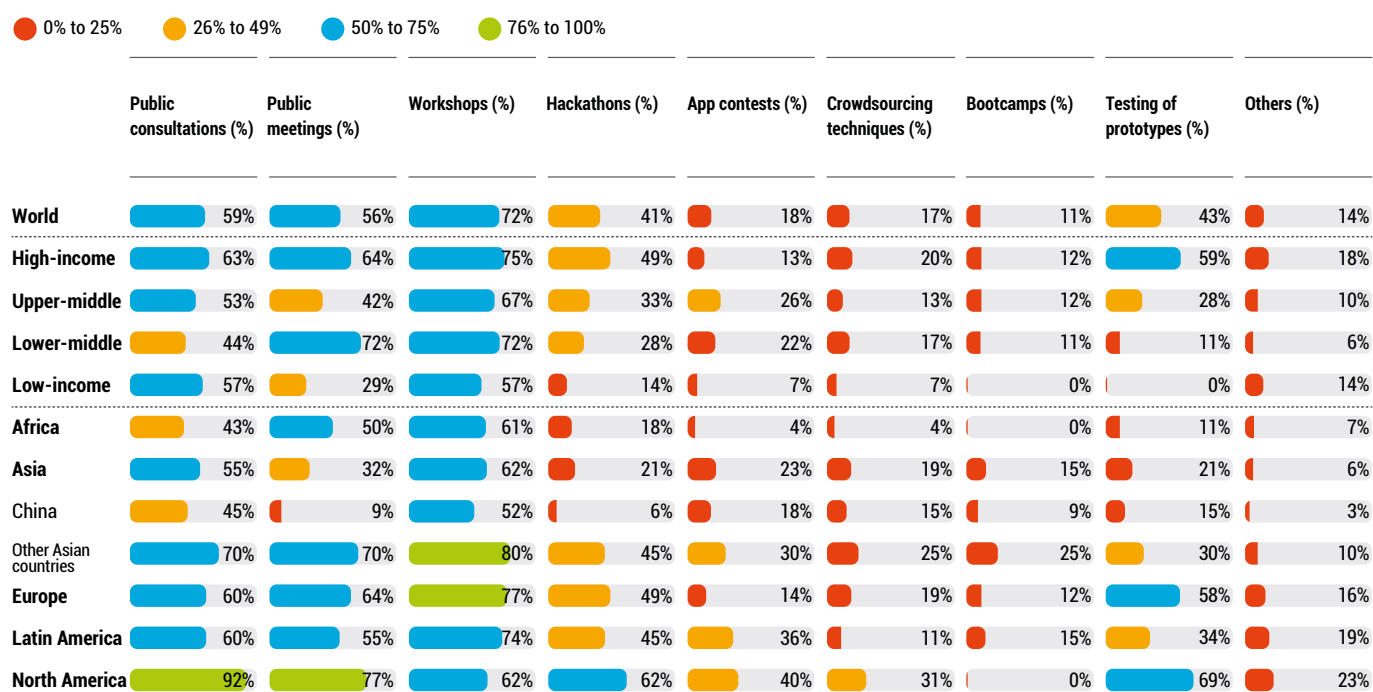


Table 46 Digital service provision

● 0% to 25%   ● 26% to 49%   ● 50% to 75%   ● 76% to 100%

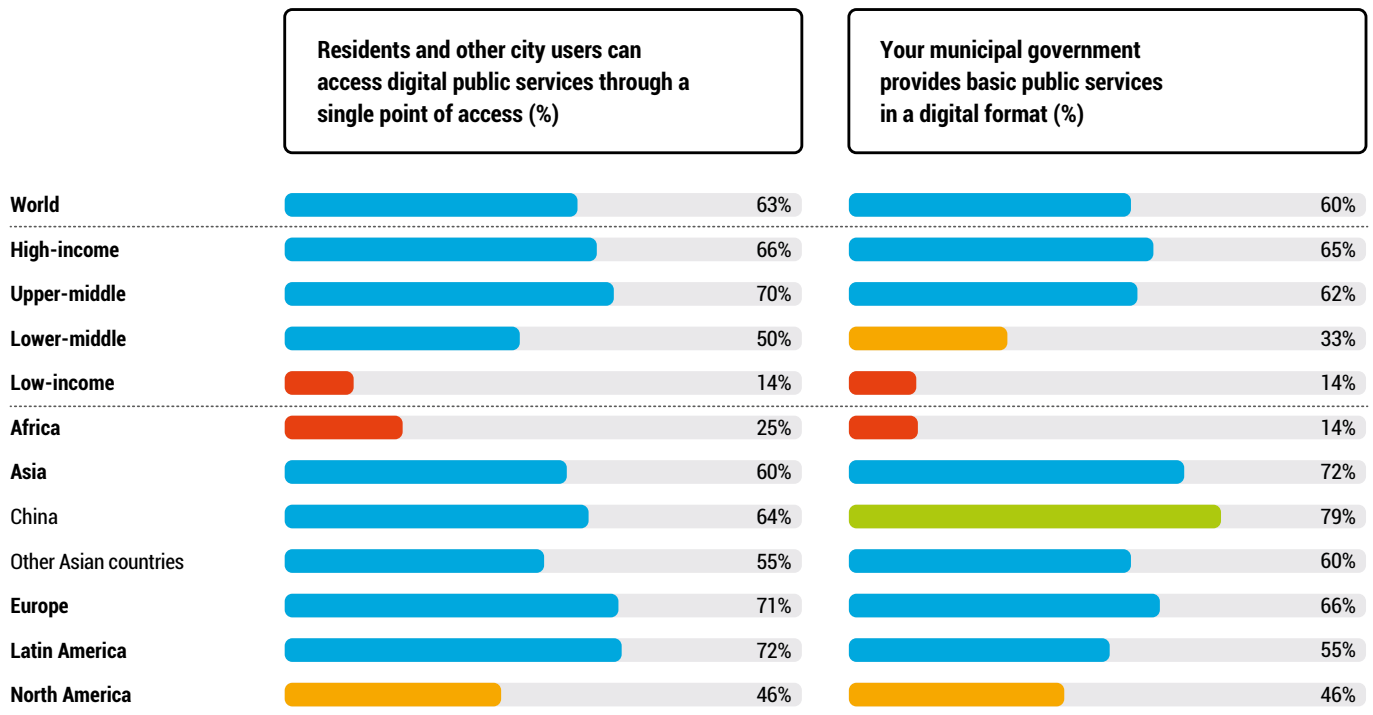
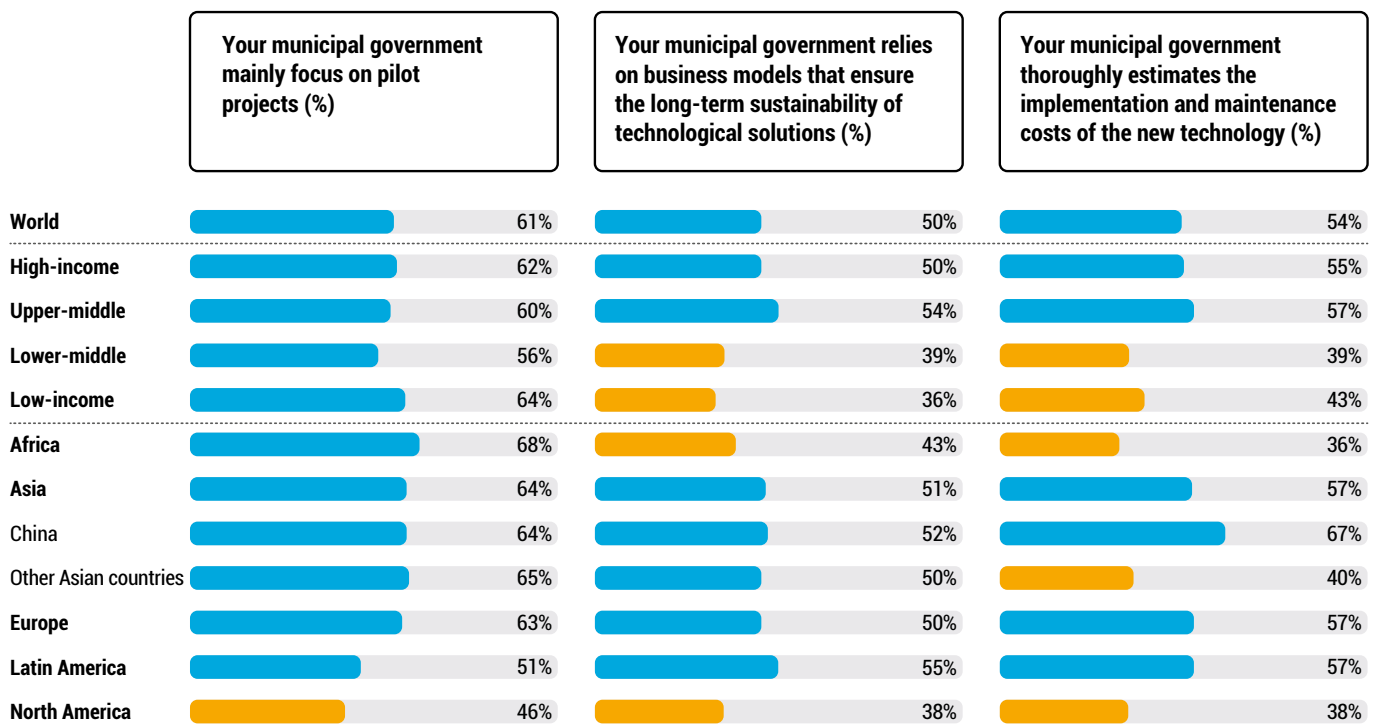


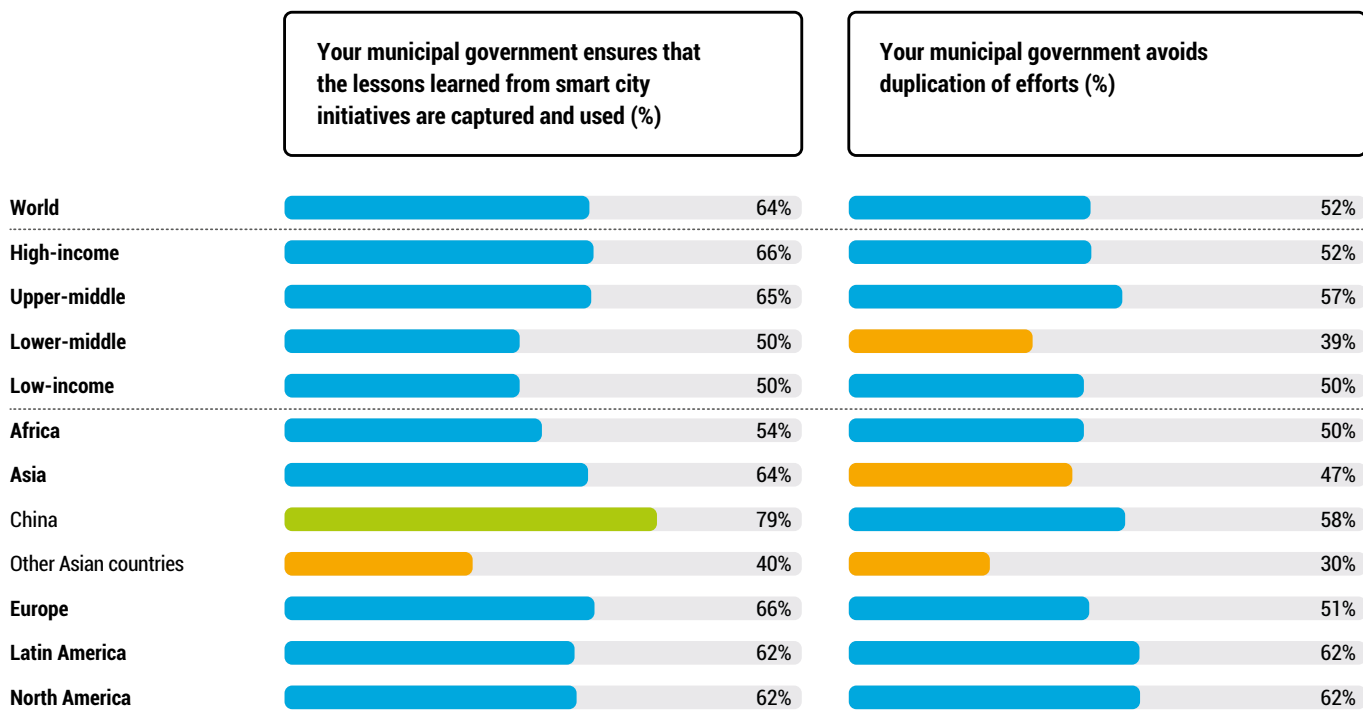
Table 47 Sustainability of business models for smart cities initiatives

● 0% to 25%   ● 26% to 49%   ● 50% to 75%   ● 76% to 100%



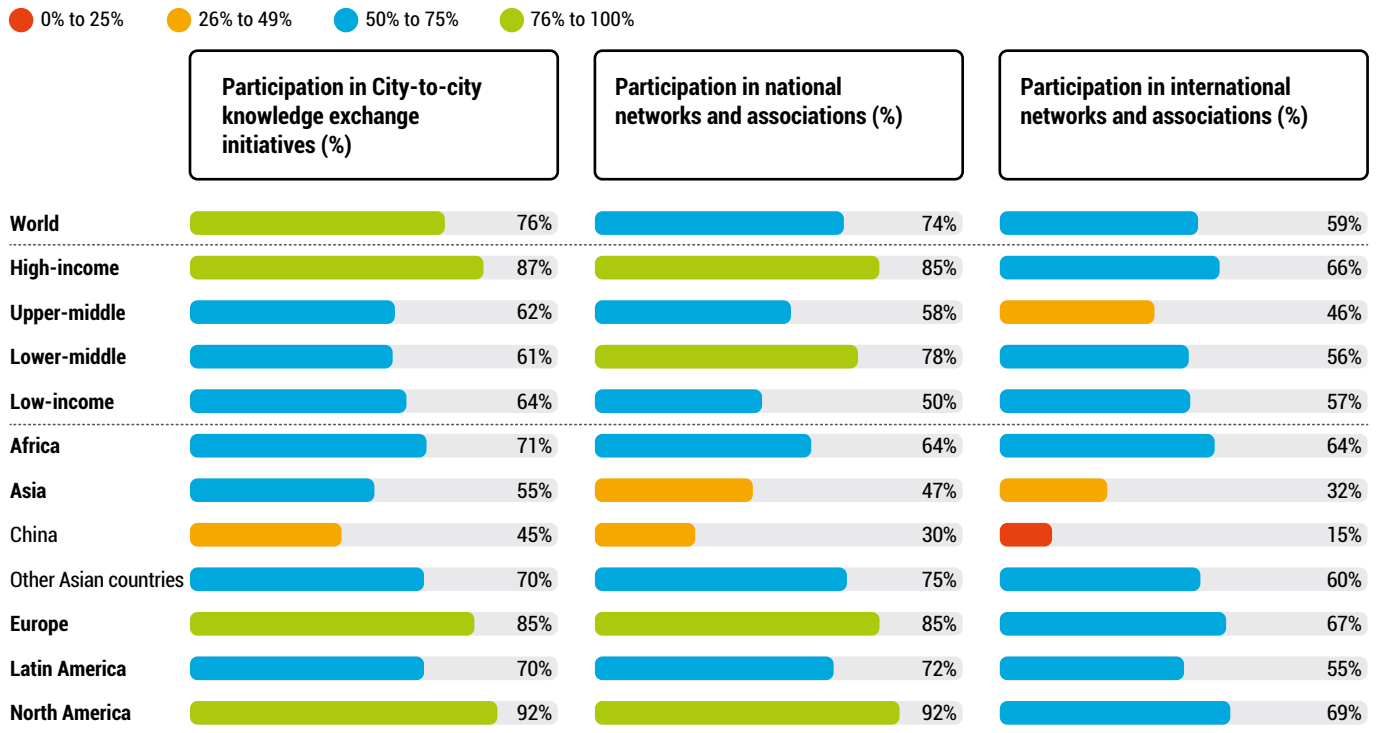
**Table 48** Knowledge management and lessons learned on smart city initiatives

● 0% to 25%   ● 26% to 49%   ● 50% to 75%   ● 76% to 100%



The survey highlighted a certain worry regarding the longevity of smart cities initiatives. 61% of respondents across the surveyed regions affirmed that their municipal government mainly focuses on pilot projects, while half of the respondents do not think that technological solutions in their cities build on business models that ensure long-term sustainability or that thoroughly estimate the implementation and maintenance costs over time (see Table 47).

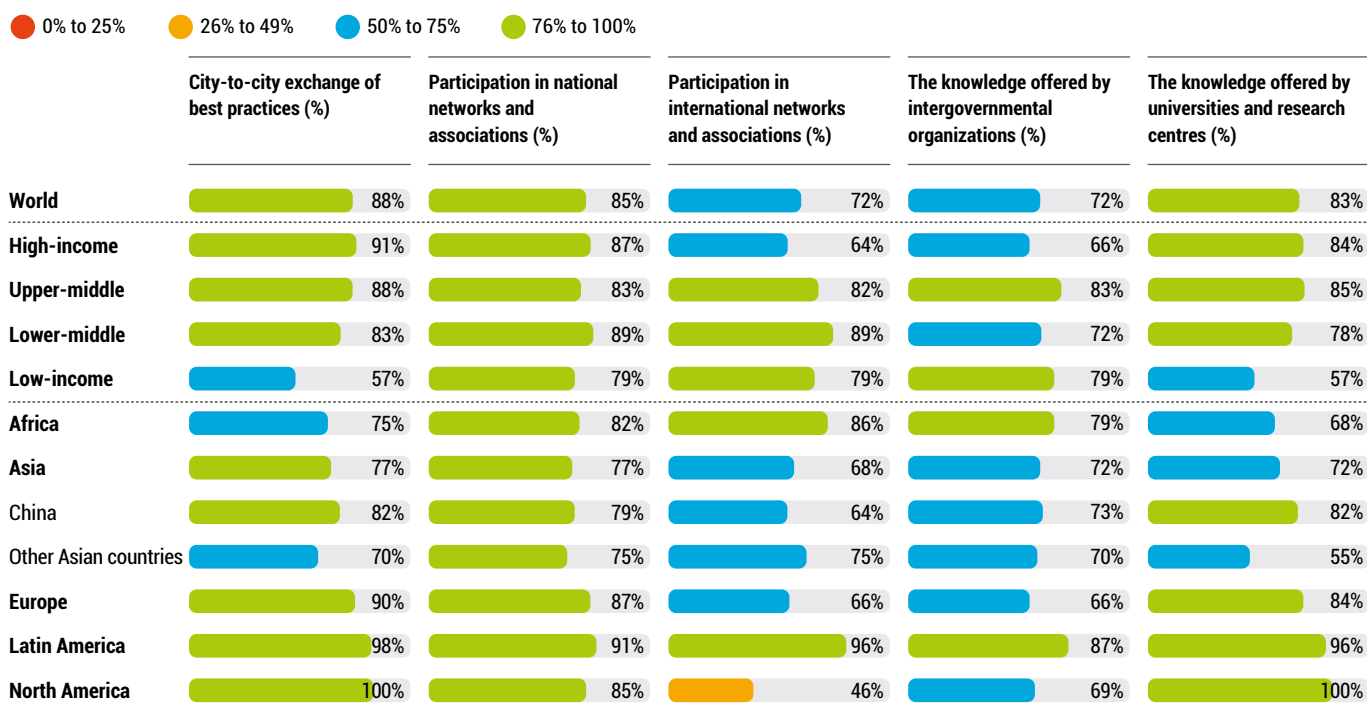
Knowledge-management initiatives can help sustain the scalability and replication of smart city solutions. 64% respondents globally reported their municipality as active in ensuring that the lessons learned from their smart city initiatives are captured and reused, while 52% affirmed that smart city development in their city avoids duplications of efforts. These percentages are quite consistent across all regions, as seen in Table 48, with Chinese cities showing a higher involvement in the documentation and use of lessons learnt (79%).

**Table 49** Participation in smart city knowledge-sharing initiatives

According to the respondents, most municipalities in the sample are actively engaged in city-to-city exchanges (76%), as well as national (74%) and international networks and associations (59%). However, the participation of

municipalities in China appears to be below average, especially when observing the percentage of respondents that have highlighted the involvement of their Chinese municipalities in networks and associations both at national and international level (30% and 15% respectively) (see Table 49).

**Table 50** Do knowledge-sharing initiatives improve the capability of your municipal government to manage smart city initiatives?



## BOX 12: Africa

### Smart-City Knowledge-Sharing Activities: Cross-City Collaboration

The ASToN network for digital transition for sustainable and inclusive cities is a “network of eleven African cities developing digital tools and practices in order to create sustainable and inclusive cities”. The network is financed by the French Development Agency (AFD) and managed by the French National Urban Renovation Agency (ANRU). ASToN relies on peer exchange and learning in which local stakeholders are activated. Using the European URBACT cooperation programme as a role model, ASToN has established a city-to-city cooperation network facilitating exchange of knowledge and best practices, learning, mainstreaming of projects and practices and supporting partners in improving their local policies and action plans. The key pillars upon which ASToN and any subsequent collaboration builds on are *integrated and sustainable urban development, local action plan, local action group, transnational exchange* as well as *training and capacity building*.<sup>16</sup>

Almost all respondents also recognized the positive impact of knowledge-sharing initiatives in the field of smart cities. City-to-city exchanges of best practices are the most popular measure, indicated by 88% of the overall sample, followed by the participation to national networks and associations focused on smart city initiatives, with 85%. Interestingly,

knowledge-sharing initiatives enabled through the participation in international networks and intergovernmental organizations are considered to improve smart city initiatives, in particular among Latin American and African municipalities, while the knowledge offered by universities and research centres appear to be considered as more relevant in Europe, Latin America and North America (see Table 50).

# CONCLUSIONS

## Key lessons

The global smart city governance practices observed through the data collected through the survey and systematic literature review can be summarized in the following set of key lessons.

### Pillar 1: Strategy

- Many municipalities have adopted a mix of strategic tools (vision statement, definition, strategic plan) to support their smart city initiatives. This variety of approaches is consistent with the flexibility required to manage digital innovation activities, whose long-term planning needs to be location and context-specific and open for new input. However, it is also equally common for municipalities worldwide to work on smart city initiatives without employing formalized strategic tools. This approach can cause ambiguity around the conceptualization and implementation of smart city initiatives, with possible negative impact on collaborative dynamics.
- In Africa and Asia, respondents showed higher levels of uncertainty as to whether city-level interpretations of the smart city concept or other strategic tools are available.
- The objectives of smart city initiatives largely respond to the overall development needs of local communities. Different objectives are being pursued depending on the cities' economic, environmental, and social conditions. This suggests that smart city initiatives are relatively well embedded in the city's overall management.
- Only a limited number of cities worldwide monitor their smart city initiatives. This trend reflects the widely acknowledged absence of clear, objective and robust metrics to measure the outcomes of these initiatives.
- About half of the cities have established a dedicated smart city unit for the coordination and implementation of smart city initiatives.
- Half of respondents reported that their municipal government lacks some of the competencies required to manage smart city initiatives.
- Only half of the municipal governments covered in the survey display an innovation-oriented mindset. This could deter digital innovation efforts and cause a resistance to change, a problem highlighted by 34% of the respondents.

- The implementation and application of legal frameworks and regulations specific to smart city initiatives remain a major challenge for many municipalities worldwide. Probable causes of these difficulties may be related to the: (1) lack of solid regulatory and legal frameworks for smart city technologies at the national and international level; and (2) limited legal and regulatory expertise within municipal governments.
- Laws and regulations on technological aspects of smart city initiatives are more prevalent in higher- than lower-income countries. The discrepancy is particularly pronounced with respect to the interoperability of technical solutions.
- Regulating ethical aspects of technology and enforcing digital rights in smart city initiatives remain a challenge worldwide.

### Pillar 2: Collaborative ecosystem

- Collaborative practices differ at each stage of smart city initiatives. In all regions, survey respondents reported higher collaboration levels in planning phases than in implementation stages. In planning phases, local public organizations and universities and other research institutions have higher levels of collaboration, followed by national public entities and private sector companies. In implementation phases, collaborative levels are lower for all actors, except for private sector companies, which report higher participation than in planning stages.
- It is difficult for municipal governments worldwide to ensure the active participation of residents in smart city initiatives. This raises concerns regarding efforts to make smart cities more people-centric.
- Municipalities in low-income countries are the least likely to collaborate with both local and non-local private companies. In turn, they show the highest rates of collaboration with intergovernmental organizations. This trend might reflect shortcomings in the market of smart city technologies, where IT suppliers have manifested a tendency to prioritize collaborations with high-income countries and their cities.
- Local private companies are one of the main actors leading the implementation of smart city initiatives, especially in Latin American, North American, and Asian municipalities, except for China.

- Data sharing with private companies remains limited worldwide, reflecting the widely acknowledged technical, legal and financial difficulties of data sharing practices from private to public entities.
- One third of municipalities worldwide do not act upon the feedback of their residents, with a higher incidence in African and Asian cities, excluding China. This again raises concerns regarding the people-centricity of smart city initiatives.
- The lack of coordination between public sector organizations and other actors working on smart city initiatives has been identified as a major constraint by one-third of respondents. In turn, in North America and Europe, good coordination is reported in the 75% of the cities that have established a dedicated unit tasked with overseeing smart city initiatives.
- Despite their strong decision-making power, many municipalities in Latin America have reported difficulties in aligning business interests with urban development needs.
- Half of the municipalities that are involved in this study show a lack of effective coordination between national and local governments in the context of smart city initiatives.
- Although most municipalities have an open data platform, half of the respondents globally remarked the limited presence of official standards for data collection, with African and North American cities showing the lowest adoption rates.
- Lack of skills within the public sector and limited digital literacy among residents remain major challenges to the introduction of smart city services in urban settings, especially in low and lower-middle income countries.
- Most of the respondents confirmed that smart city initiatives in their municipalities are built upon existing technological resources.
- Municipalities in lower-middle and low-income countries are less likely to consider the acceptance of new technologies among residents and other city users when designing smart city services.
- Hackathons, app contests and prototyping techniques are among the main tools that cities from Europe, Latin and North America use to develop and test smart city services.
- Municipal websites and unified service portals that help enhance the visibility and accessibility of smart city services are widely used, especially in Asia, Europe, and Latin America.
- Two thirds of respondents affirmed that their municipal governments tend to mainly focus on pilot projects, but the percentage is lower in North America and Latin America.
- The long-term sustainability of smart city initiatives has been highlighted as a key concern worldwide, with a higher incidence in Africa and North America.
- Most cities globally engage in knowledge exchange practices and, in particular, in city-to-city sharing initiatives, with the only notable exception being China. The positive impact of these practices has been recognized broadly, but they have been given less relevance in Asia and Africa.

## Pillar 3: Technological infrastructure

- Data-driven decision making plays a central role in local governments, especially in higher-income economies.
- Local governments generate and assemble data from various sources. Compared to European and North American regions, municipalities in Africa, Asia and Latin America are more likely to rely on data from external and non-national actors. This condition might reflect limited capabilities for internal data collection.
- Data visualisation tools are a primary way for cities to explore and analyse data, and departments and agencies within the same municipal government rarely share one single data visualization tool.

## Recommendations to municipal governments

In the light of current governance practices and key lessons, the following strategic recommendations are proposed to municipal governments. The objective of these recommendations is to sustain improvements in local approaches to the governance of smart city initiatives.

### Pillar 1: Strategy

#### Take a strategic and active leadership approach to smart city development

- Define a clear roadmap to coordinate different smart city stakeholders and their actions. The roadmap needs to be flexible and dynamic, acting as a living document, to ensure that established course of actions can be promptly adjusted and updated in response to fast-changing technological landscapes. The roadmap is required to combine long-term thinking with short-term goals and identify the resource required to accomplish them.
- As part of your smart city roadmap, explicit objectives and goals need to be set in agreement with other smart city stakeholders. The objectives need to be regularly revised to keep them aligned with the overall city strategy and the needs of your residents.
- Ensure that your smart-city approach responds to people's needs and is anchored to human rights' principles and a strong commitment to digital inclusion.
- Put in place the measures required to monitor your smart city initiatives and learn from your actions. These measures should be based on performance indicators consistent with your objectives.
- When selecting the digital technologies to use in smart city initiatives, evaluate what digital solutions best fit your needs. The evaluation should assess the potential digital solutions against your specific objectives, internal know-how, and existing technological assets. Consider whether low technology and open-source solutions can help reduce development and implementation costs.
- Include specific strategies to promote interoperability and manage data sharing.

#### Set up a smart city unit

- Enhance your strategic capacities by creating a cohesive collaborative environment and by establishing a dedicated unit tasked with overseeing and orchestrating the smart city initiatives of the city. The smart city unit requires strong connections across departments and agencies, executive support, autonomy in decision making, and adequate human and financial resources.

#### Nurture an innovation-oriented culture

- Set adequate incentives and initiatives to stimulate the creativity of your staff and promote a positive attitude towards change and digital innovation.

#### Address the regulatory challenges associated with digital technologies

- Adopt local laws and regulations to deal with the technical, legal and ethical issues that may arise from smart city initiatives, in alignment with the regulatory requirements set by national authorities.
- Develop or acquire the expertise needed to deal with technical, legal and ethical challenges associated with smart city initiatives. Your internal expertise can also be increased by interacting with knowledge sharing initiatives, such as city-to-city networks.
- Cooperate with intergovernmental organizations and public authorities at different administrative levels to help establish common frameworks for the regulation of technical, legal and ethical aspects associated with smart city initiatives.

### Pillar 2: Collaborative ecosystem

#### Establish smart city partnerships tailored to project and local-context requirements

- Ensure that the partnerships supporting smart city initiatives are inclusive and open to the input of multiple stakeholders. These partnerships are also required to be formed by considering the different expertise required in each project phase, which tend to differ from planning to implementation.
- Ensure that the partnerships supporting smart city initiatives are aligned with the capacities existing within the local collaborative ecosystem and consider context-related gaps and needs.



### **Introduce measures to balance the interests and objectives of different stakeholders**

- Ensure that smart city partnerships adopt legal and managerial safeguards to prevent commercial interests from prevailing over wider public interests.
- Ensure that the smart city partnerships apply business models designed to achieve the correct balance between the social, environmental and economic objectives expressed by different partners.

### **Build capacity for public engagement**

- Intensify communication efforts to raise the awareness of residents about smart city initiatives. Multiple communication channels should be used to target different audiences and deliver regular progress updates.
- Strengthen the capability to collect, manage and act upon the feedback of residents to ensure that smart city initiatives in your city respond to their needs.
- Formulate inclusive engagement strategies that consider existing barriers to public participation, such as lack of experience in participatory processes, limited digital literacy time pressures and other practicalities.
- Ensure that participatory processes are designed and managed by applying expert knowledge.

## **Pillar 3: Technological infrastructure**

### **Promote system integration, data standards, and interoperability**

- Break departmental silos and promote inter-agency collaboration to encourage data integration and interoperability.
- Introduce the technological solutions, legal requirements and managerial practices required to enable the integration of IT systems in use across different agencies and departments.
- Ensure alignment with established national and international digital and data standards to allow interoperability both internally and externally.

### **Build capacity for managing smart city services**

- Develop training initiatives and hiring programmes to expand internal skillsets so that departments and agencies have the expertise needed to manage smart city services.
- Develop the internal capabilities and processes needed to assess technology acceptance among residents and other potential users before introducing new smart city services.
- Provide adequate support mechanisms to promote the active involvement of target users in the design, testing, and monitoring phases of smart city services.

### **Capture, leverage, and transfer relevant practical knowledge**

- Ensure that the lessons learnt from smart city initiatives are captured, disseminated, and embedded in future activities.
- Intensify the engagement in knowledge-sharing activities at both local, national, and international level to acquire relevant lessons and know-how to apply locally.

### **Focus more the long-term sustainability of smart city services**

- Manage technological path dependencies to achieve efficiency without stifling innovations or reinforcing lock-in effects.
- Develop business models and project partnerships that ensure the long-term sustainability and scalability of smart city solutions beyond start-up phases.

## ENDNOTES

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- 1 Vision statements describe the future that a group or entity (in this case, local municipalities) aspires to create.
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