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Street smart

Putting the citizen at the center of smart city initiatives

"A smart sustainable city is an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness while ensuring that it meets the needs of present and future generations with respect to economic, social, cultural, and environmental aspects."

The UNECE–ITU Smart Sustainable Cities Indicators.

Executive Summary –
Key takeaways

The challenges of urban living today

Urban life poses multiple challenges for citizens – from public security to transport, cultural issues to concerns about sustainability. In fact, nearly one third of the citizens we surveyed say they may leave their city due to the challenges they face living there.

Smart city initiatives deliver value and earn loyalty

Across major urban services, smart city initiatives have demonstrated their value across the world. Ranging from transport and parking management to flood management, smart city initiatives have benefitted multiple cities. Citizens also believe that the smart city will lead to more sustainability (58%) and better urban services (57%). Cities that deliver these gains can prevent the drain that occurs when citizens and businesses move to other smart cities that offer better prospects. This migration of people and business may become more pronounced as remote working becomes more commonplace during the global health pandemic, with remote workers able to more easily migrate to communities that they feel offer a better lifestyle.

Smart city programs should focus on key use cases

Citizens recognize the value of smart cities and are willing to use a range of use cases that span a number of urban services. To ensure authorities direct resources to the highest-potential use cases, we analyzed a long list of 44 use cases (see Appendix for full list) and assessed them against two criteria: whether citizens are likely to use the solution and whether they are willing to pay more for the solution:

- Transport and mobility – as well as utilities (electricity and water) – are seen as particularly attractive areas that citizens are eager to use.

- Over a third (36%) are willing to pay more for using smart city initiatives. This figure is higher for Millennials (44%), Gen Z (41%) and citizens in the higher income bracket of $80,000+ (43%).

Progress on smart cities is slow and a number of factors are critical to accelerating momentum

Our research finds that only a small minority of city officials (9%) are in advanced stages of smart city implementations, with 22% having just begun implementing a handful of initiatives. Accelerating implementation requires close collaboration between key stakeholders – city officials, citizens, and external parties, such as startups, academic institutes, or venture capital funds. It also requires a focus on three drivers: trust, innovation and data. We suggest three key development areas:

1. Creating a compelling smart city vision with sustainability and resilience as its cornerstones.
2. Empowering city officials to act as entrepreneurs while ensuring that data protection and trust are built into how citizen data is gathered and used.
3. Building a culture of innovation and collaboration with citizens and external entities.

Introduction

Many of us city dwellers face a dichotomy. Whether at home or at work, we are connected to an always-on digital highway characterized by a universe of apps, seamless video communication and online delivery. Yet, our city experience lacks a digital touch, from how cities are governed to how secure they are. Citizens also find challenges such as pollution (42%) and of lack of sustainability initiatives (36%) a major concern, and may leave their city as a result.

Smart city initiatives are critical to addressing these issues and also key to developing resilience to challenges such as COVID-19. This means developing a compelling smart city vision and delivery plan, with technology a key enabler. To frame this journey, we need to first understand what undermines cities today, what citizens want from a smart city, and how municipalities can accelerate smart city initiatives — overcoming the many challenges that stand in the way and creating measurable value.

To probe these areas, we undertook this global research study, which spanned 10 countries and sought views from both sides of the smart city fence:

1. **The citizen view:** We surveyed 10,000 citizens in April 2020, looking at everything from the challenges they face today to their willingness to use smart city initiatives.
2. **The city official view:** We surveyed 300 city officials in April 2020 to get their view on smart city initiatives and the challenges of implementation. We also conducted one-on-one interviews with a number of senior city officials to get their perspectives and understand their first-hand experience of smart city implementation.

Drawing on that research, this report explores five key themes:

1. What challenges are undermining today's city experience for citizens?
2. Why do smart cities hold the key to improving urban life?
3. What do citizens hope for and want from a smart city?
4. What challenges stand in the way of success?
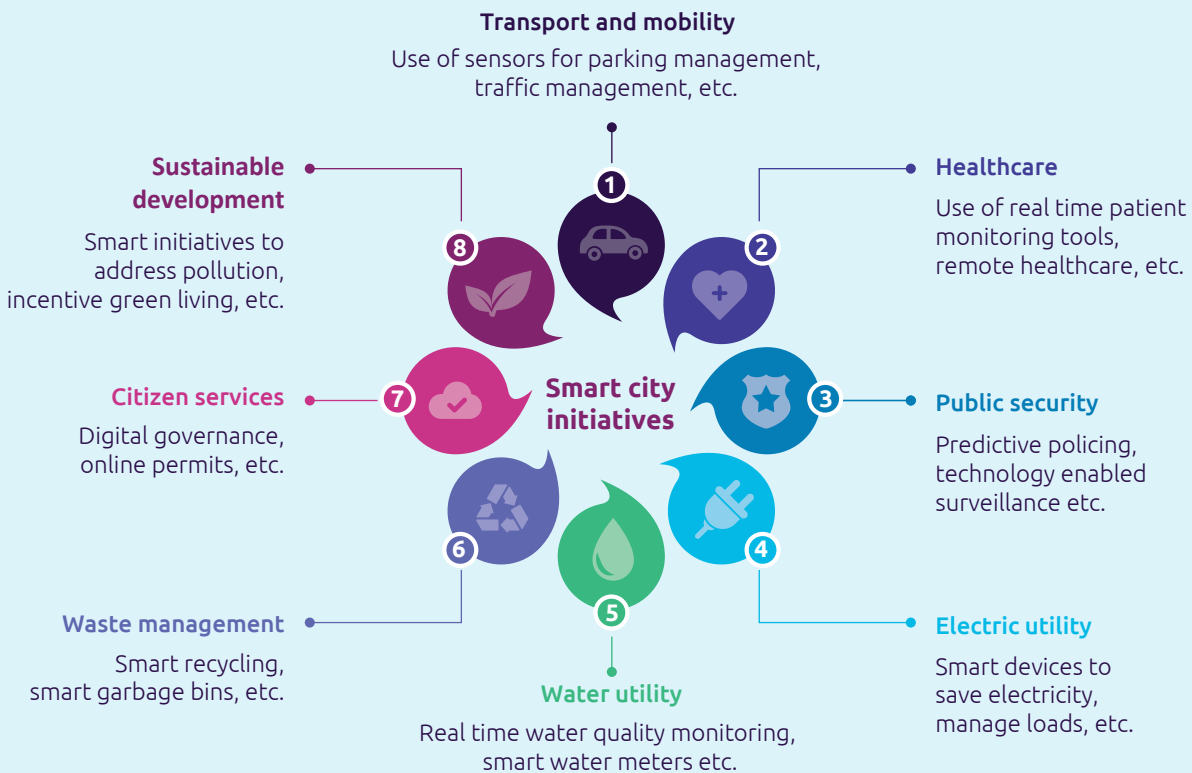5. How can cities accelerate implementation?

Smart city definition

For this research, we use the United Nations Economic Commission for Europe definition of a smart city (i):

"A smart sustainable city is an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness while ensuring that it meets the needs of present and future generations with respect to economic, social, cultural, and environmental aspects"

Throughout the report, as Figure 1 shows, we have explored and examined smart city initiatives across a range of areas, and which include emergency services (medical, police, and fire-fighting services), healthcare, public transportation, public assets (such as roads, parks, museums, etc.), waste management, public administration (inclusive of permits and licenses) and utility networks (such as water, gas and electricity supply networks). We have also considered smart city initiatives for sustainable development.

Figure 1. Areas considered for smart cities initiatives

Transport and mobility
Use of sensors for parking management, traffic management, etc.

Sustainable development
Smart initiatives to address pollution, incentive green living, etc.

Healthcare
Use of real time patient monitoring tools, remote healthcare, etc.

Citizen services
Digital governance, online permits, etc.

Smart city initiatives

Public security
Predictive policing, technology enabled surveillance etc.

Waste management
Smart recycling, smart garbage bins, etc.

Water utility
Real time water quality monitoring, smart water meters etc.

Electric utility
Smart devices to save electricity, manage loads, etc.

(i) The UNECE–ITU Smart Sustainable Cities Indicators, Geneva, December 14–15, 2015.

Broken cities: the challenges undermining today's citizen experience

Megacities are an established phenomenon today as urbanization accelerates. Nearly 55% of the world's population lives in cities now[1] (two-thirds are expected to by 2050) and we may have 43 megacities with a population of more than 10 million by 2030 (up from 33 in 2018).[2]

But many of today's major cities emerged during the industrial revolution and fall short of what people now expect in this digital age. Smaller cities are also struggling to provide high quality public services.In fact, we found that 54% of citizens feel technology firms would be better able to provide urban services than their current city's authorities. Many citizens are frustrated with their city experience and will vote with their feet: leaving their current base to move to what they see as a more advanced city

Citizens face multiple challenges in their current city of residence

In our research, we found that many citizens are unhappy with where they currently live, pointing to health and wellbeing issues, lack of professional growth and underwhelming sustainability initiatives. This dissatisfaction is a global phenomenon:
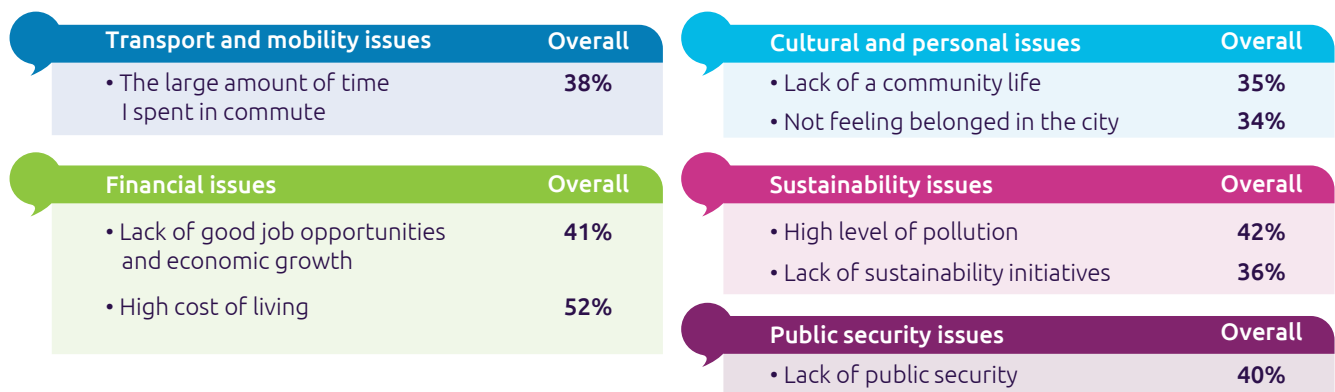
- More than one in three citizens across the world (35%) are unhappy with a lack of community life and cultural activities:
  - This reaches 42% in Washington, DC (making it highest in all American cities surveyed) and 39% in London (highest in all European cities).
- 42% of citizens across the world, and 63% of citizens in Milan, say they will leave their city due to increased pollution.
- 41% of citizens overall, and 57% of citizens in Rome, say they may leave because good job opportunities and economic growth are limited

Traditional, systemic challenges are also a major factor: 45% of citizens across the world suffer from high commute time due to poor transport infrastructure/traffic.

Figure 2. Citizens are unhappy with multiple facets of city experience

Key pain points that can lead to citizens to leaving a city

🗨 I may leave my city in future due to... 🗨

Transport and mobility issues	Overall
• The large amount of time I spent in commute	38%

Financial issues	Overall
• Lack of good job opportunities and economic growth	41%
• High cost of living	52%

Cultural and personal issues	Overall
• Lack of a community life	35%
• Not feeling belonged in the city	34%

Sustainability issues	Overall
• High level of pollution	42%
• Lack of sustainability initiatives	36%

Public security issues	Overall
• Lack of public security	40%

Source: Capgemini Research Institute, Smart Cities Survey, April 2020 (n=10,000 citizens),

Although public security and financial issues emerge as key challenges, there are nuances at a city-specific level. For instance, transport and mobility emerges as the biggest concern for citizens in multiple European cities.

Figure 2.1. Major pain points differ by cities

France		UK		Germany		Netherlands		Italy	
Paris	🌿	London	🛡	Berlin	🛡	Amsterdam	🛡	Rome	🚗
Toulouse	$	Manchester	🛡	Munich	🚗	Rotterdam	$	Milan	$
Marseille	🛡	Bristol	🚗	Dusseldorf	🛡	The Hague	🚗	Florence	🛡
Lille	🛡	Birmingham	🛡	Frankfurt	🛡	Utrecht	🚗	Turin	🌿
Lyon	🌿	Leeds	🛡	Hamburg	🚗	Eindhoven	🚗	Naples	🚗
				Cologue	🚗				
				Damstadt	🚗				

Spain		Sweden		USA		India	
Madrid	🚗	Stockholm	🛡	Washington, DC	🚗	New Delhi	🚗
Barcelona	🛡	Gothenburg	🚗	New Work	🚗	Mumbai	$
Valencia	$	Malmo	🚗	Los Angeles	🛡	Chennai	🤝
Malaga	$	Linkoping	🚗	Boston	$	Bengaluru	🚗
Seville	🚗	Helsingborg	🛡	San Franscisco	🚗	Hyderabad	🚗
						Pune	🚗

Major reasons for citizens leaving city

🌿 Sustainability issues   🤝 Cultural and personal issues   🚗 Transport and mobility issues   🛡 Public security issues $ Financial issues

Figure 2.2. The cities where citizens are least likely to leave

Top five cities citizens least likely to leave					
	1	2	3	4	5
City	Vienna	Linkoping	Tampere	Bristol	Zurich
Country	Austria	Sweden	Finland	UK	Switzerland

Please refer to the appendix for a complete list of cities.

Percentages refer to the global share of citizens who agree with the statement.

Source: Capgemini Research Institute, Smart Cities Survey, and April 2020 (n=10,000 citizens).
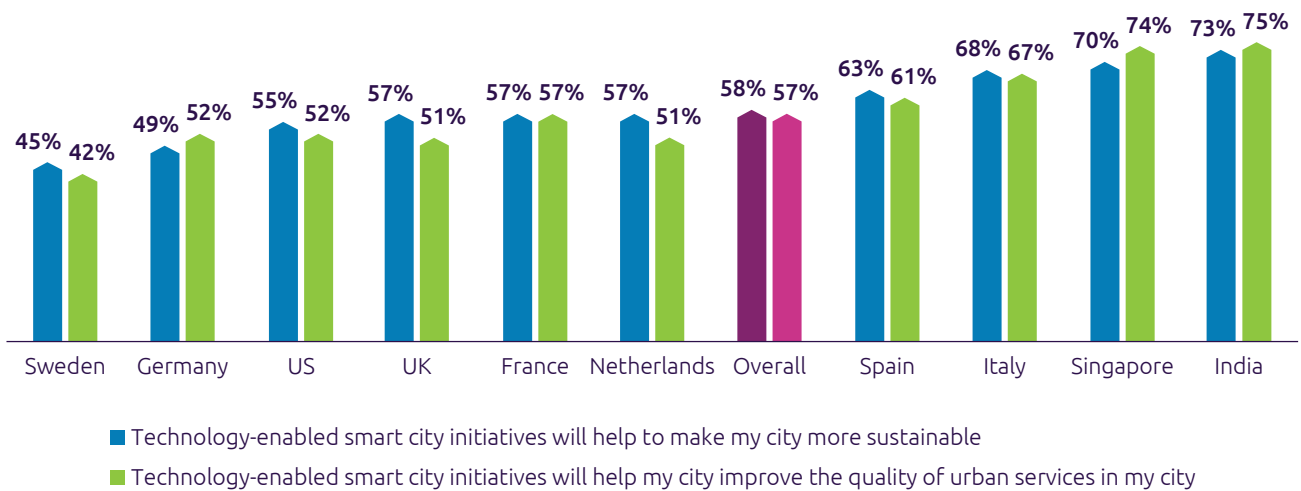
Why do smart cities hold the key to improving urban life?

Citizens believe smart cities will provide an elevated experience that is not limited to basic infrastructure needs. Our research found that citizens want to live in smart cities because they believe that:

- The city will be more sustainable (58%).
- The quality of urban services will improve (57%).
- There will be a better quality of life (54%).
- It will improve their efficiency at work (53%).

As Figure 3 shows, sustainability and improved urban services are seen as two of the major upsides of smart cities for citizens across the world. Toyota, for example, is planning to build a smart city in Japan that will be fully sustainable. The "Woven City" will be powered by hydrogen fuel cells and rooftop solar panels. In addition, only fully autonomous and zero-emission cars will be permitted.[3]

Figure 3. Sustainability and better urban services key drivers for smart cities

	Sweden	Germany	US	UK	France	Netherlands	Overall	Spain	Italy	Singapore	India
Technology-enabled smart city initiatives will help to make my city more sustainable	45%	49%	55%	57%	57%	57%	58%	63%	68%	70%	73%
Technology-enabled smart city initiatives will help my city improve the quality of urban services in my city	42%	52%	52%	51%	57%	51%	57%	61%	67%	74%	75%

■ Technology-enabled smart city initiatives will help to make my city more sustainable
■ Technology-enabled smart city initiatives will help my city improve the quality of urban services in my city

Source: Capgemini Research Institute, Smart Cities Citizen Survey, April 2020 (n=10,000 citizens).

Given that people are enthusiastic about the improvements that can come from a smart city, they are an attractive prospect. We found, for example, that 60% of citizens want to live in a smart city. This was particularly true for Millennials (64%) and those who earned more than $80,000 (more than two-thirds of this group want to live in a smart city). However, enthusiasm is not confined to higher earners: 56% of citizens with income less than $20,000 also want to live in smart cities.
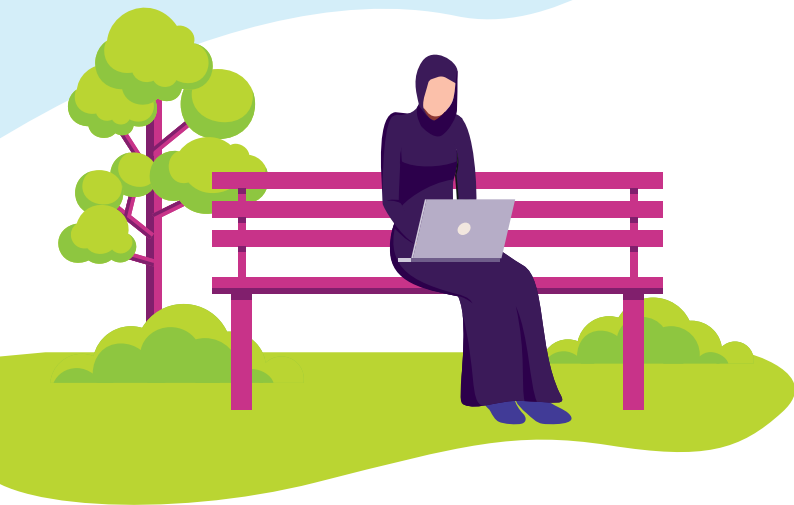
Citizens using smart city initiatives are happier with the quality of their city life

Our research shows that citizens who use smart city initiatives are happier with their quality of life compared to those who have no experience of smart city programs. For example, as Figure 4 shows, 73% of those who have used smart city initiatives say they are happier with their quality of life in terms of health factors, such as air quality. However, this drops sharply to 56% among those who have not used a smart city initiative.

Figure 4. Citizens who use smart city initiatives are happier with the quality of their life
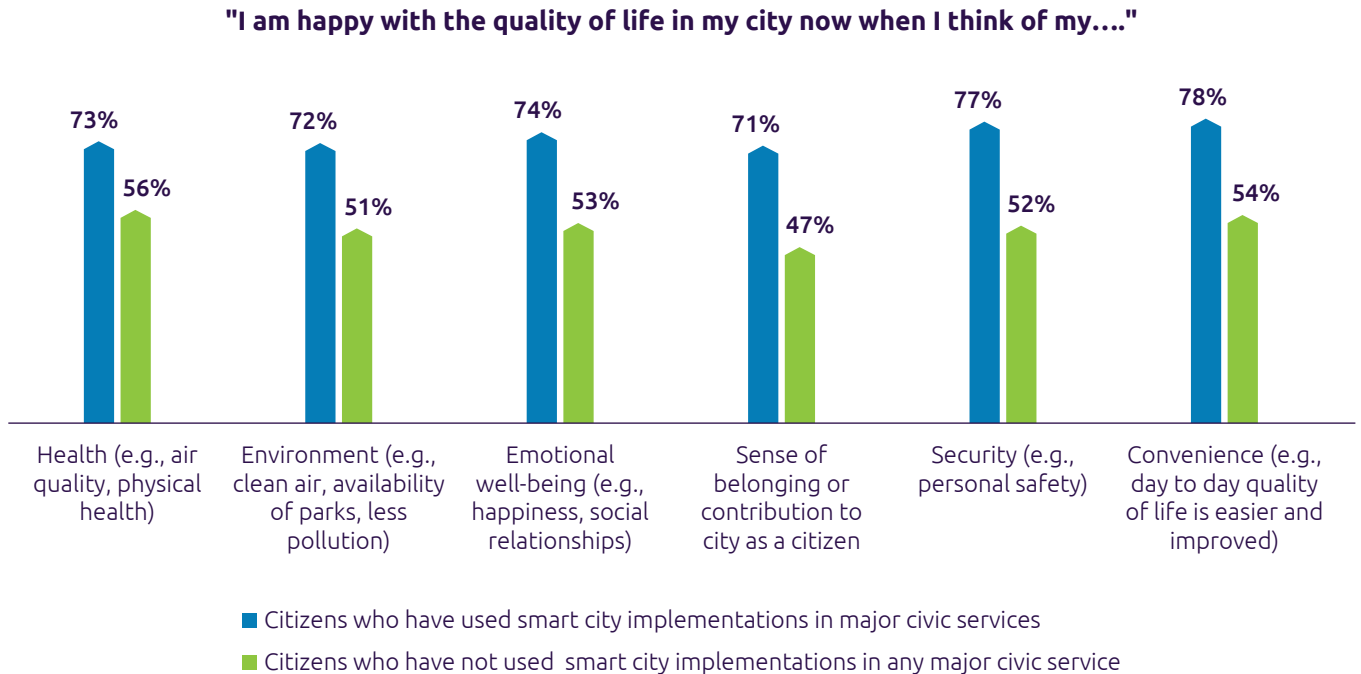
"I am happy with the quality of life in my city now when I think of my...."

- Citizens who have used smart city implementations in major civic services
- Citizens who have not used smart city implementations in any major civic service

73%

of citizens who have used smart city initiatives say they are happier with their quality of life in terms of health factors, such as air quality

Smart cities improve quality of life and the citizen experience significantly

Citizens have a strong appetite for using smart city solutions that can improve their lives and environment, showing a willingness to take part in initiatives in areas ranging from healthier living to recycling:

Healthier living: There are several use cases that directly impact healthier living for citizens. For example, air monitoring stations can help cities keep real-time tabs on air quality and take corrective measures if necessary. King's Collage in London has developed an air pollution app that uses the GPS data and information from the "London Air Quality Network" to provide details on exposure to pollution. The app also notifies the user if air quality deteriorates beyond the limits prescribed by the World Health Organization.[4]

Smart cities also promote healthier living by emphasizing the role of green spaces and encouraging walkable design to aid citizen health and wellbeing. Copenhagen plans to be the world's first carbon-neutral city by 2025. It has already cut emissions by 42%, and 62% of residents commute by bike. Frank Jensen, the city's lord mayor, has said, *"I want Copenhagen to be a green leader – also in the future. So, we will certainly have very ambitious targets after 2025. Therefore, I am willing to look at all smart solutions, which can make our city greener"* [5] In our research, we found that 63% of citizens are willing to use healthcare-based smart city initiatives.

Citizen Engagement: According to a BBC survey of over 55,000 people across the world, 40% of young people (ages 16–24) suffered loneliness compared to 27% of those aged 75 or more.[6] This is a significant challenge, as many among this Gen Z population will be making their way to cities for their studies or first job. Developing citizen engagement can help combat loneliness, as it gives citizens a voice and encourages a sense of belonging.

The UK is the first country in the world to create a position of "Minister of Loneliness" and has launched a £11.5 million

"Building Connections Fund," which support projects that prevent or reduce loneliness.[7] In Iceland, "Better Reykjavík" is an online platform that connects the city's citizens to their council. The platform is used for crowdsourcing solutions to the challenges faced by the city:

- Citizens get to decide how to spend nearly 6% of the city's investment budget.
- 700 citizen ideas have been implemented and nearly 12.5% of the population have participated in the voting process. In 2019, nearly 37% of the voting population participated in the eighth annual idea-generation process.[8]

Enabling citizen participation improves the sense of belonging and emotional well-being. We found 71% of citizens who have interacted with smart city initiatives feel happier in terms of their sense of belonging. But for citizens who have not used smart city initiatives, this drops to 47%. Similarly, 74% of citizens have a higher level of emotional well-being. But for those who have no smart city experience, this drops to 53%.

Public security: City surveillance, aided by smart technology, can help reduce crime, and 46% say it has improved neighborhood safety. Technology, for example, can help authorities respond to emergency situations faster. In the US, the city of Oakland installed a "Gunfire locator," with microphones positioned across the city. The microphones detect gunfire and then triangulate the position, allowing the nearest patrol car to get their quickly. Usually, the location of gunfire is detected within 30 seconds. As a result, crime rates have dropped in the areas where the solution is used. In 2012 there were 671 firearm incidents per square mile. Now, this has dropped to 228.[9,10]

Transport and mobility: Smart transport and mobility solutions save commuting time and effort for citizens. They can also make transitions between different modes of transport more seamless, using one-point ticketing systems and app-based identification and payment. The city of Hamburg in Germany is developing a smartphone app that:
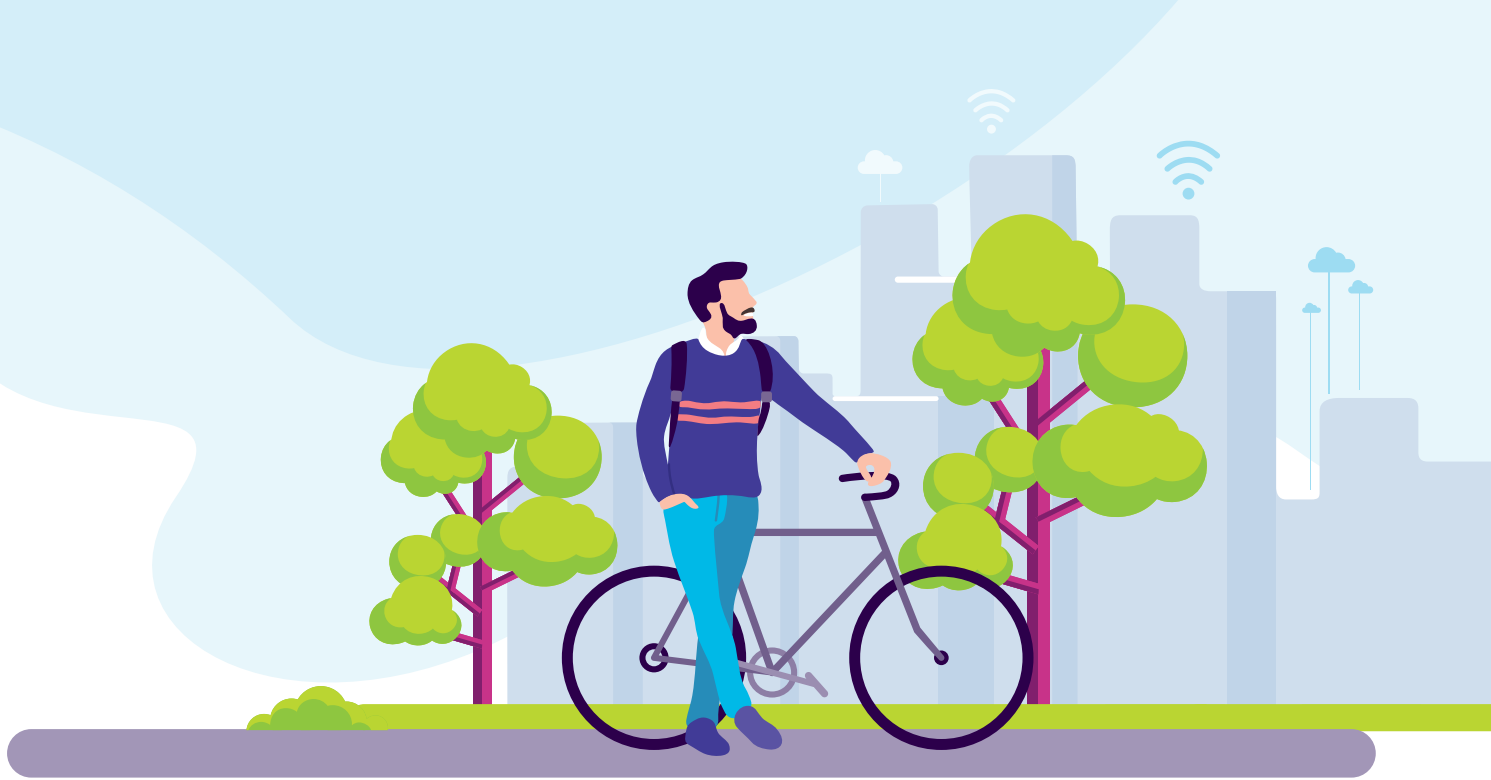
- Detects the current location of a passenger to "check-in" to a bus or train
- The passenger can show a bar code in the app instead of a ticket and the app automatically detects that the journey is over after the passenger leaves the bus or train
- In this way, an entire day's trips can be processed without the need to purchase a ticket.[11]

The city of Helsinki has implemented "WHIM," a single, cross-mobility app encompassing all public transport, bike sharing, and carsharing options in the city.[12]

Our research shows that citizens have seen significant improvements in both their commute time and efficiency and productivity at work thanks to transport- and mobility-focused initiatives. Examples include:

- Carnegie Mellon University and Pittsburgh city engineers have deployed an artificial intelligence-based system that enables traffic signals to communicate with each other. Each traffic signal makes its own decision by sensing the approaching traffic flow and coordinates traffic movement with nearby signals. This has reduced average travel time by 25%.[13]
- Copenhagen has installed intelligent traffic signals that prioritize bikes and buses over cars. This system can potentially reduce bus travel time by 5–20% and cycle travel time by 10%. Copenhagen has also built a citywide network of protected bike lanes.[14]
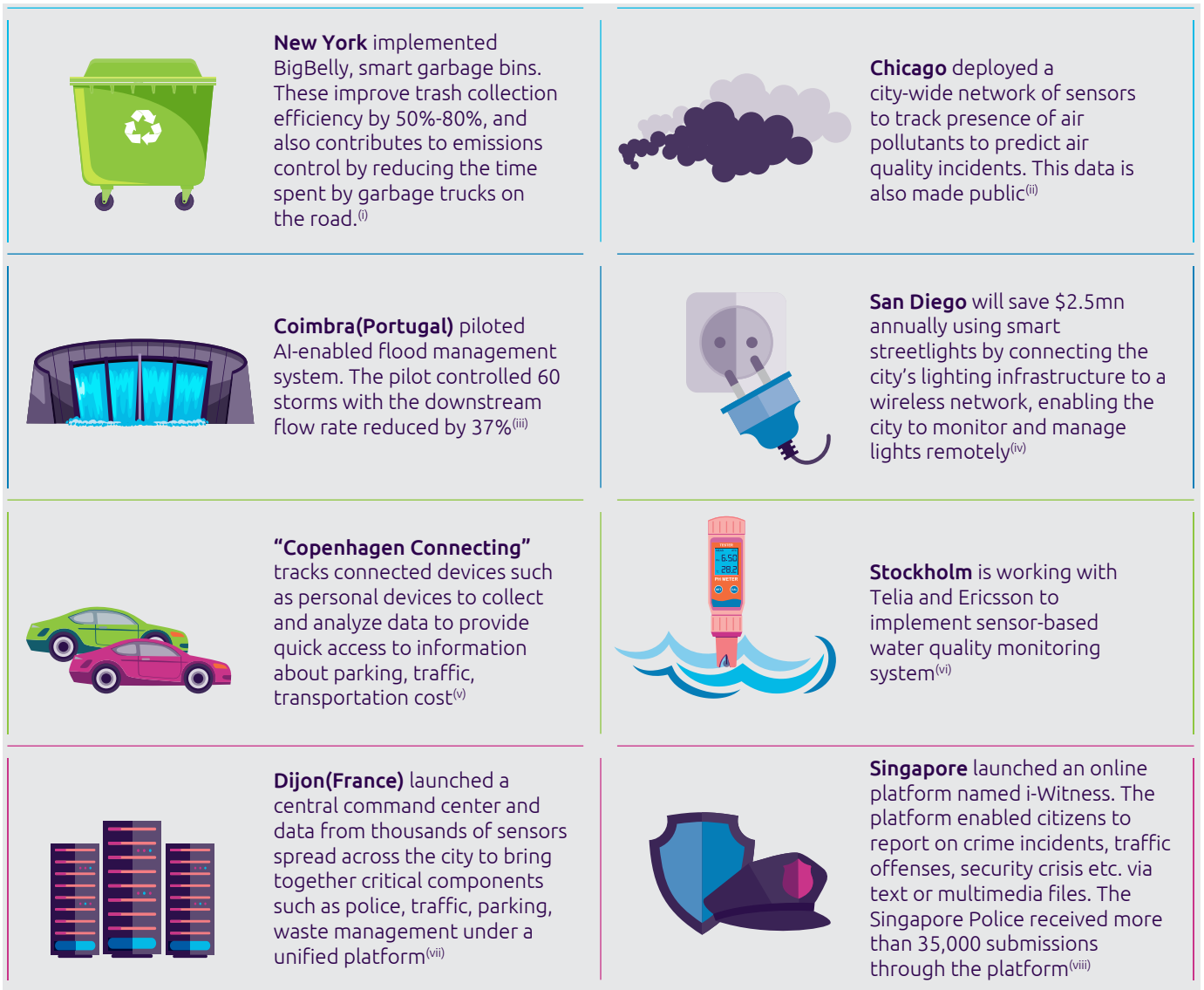
Multiple cities across the world are creating cycling-friendly infrastructure and encouraging commuters to bike to work. Transport for London is using video sensors with artificial intelligence capability at 20 locations across London to detect the volume of different modes of transport, especially cyclists and pedestrians. This data will be used to assess demand for new cycling routes in the city. City of London authorities have set a target of 80% of the commute in the city to be made by walking, cycling, or public transport by 2041.[15] Overall, 64% of citizens are willing to use smart city initiatives for transport and mobility

58%

of citizens want to live in smart cities because they believe that the city will be more sustainable

Figure 5. Smart city initiatives are already being implemented in major cities

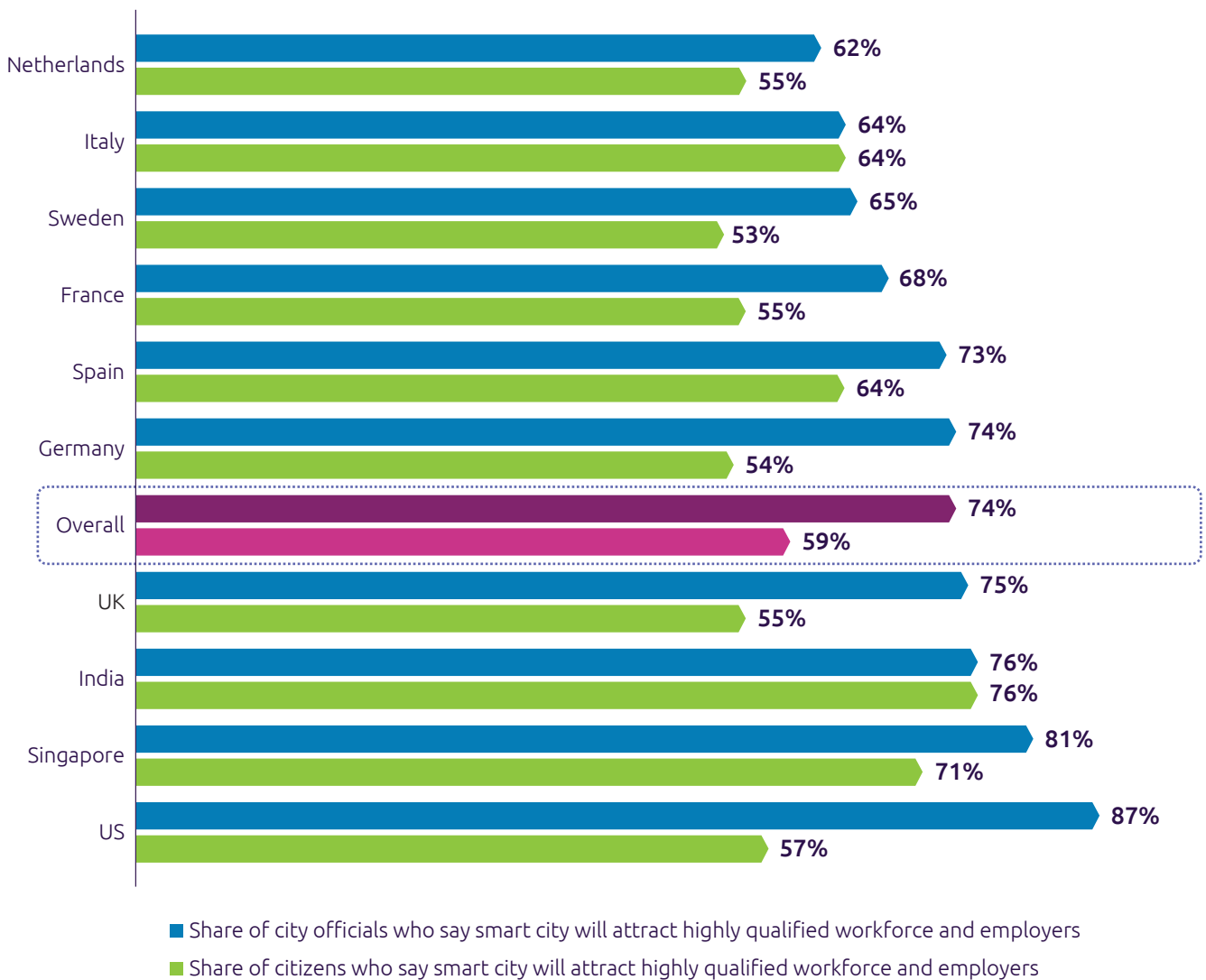## Examples of smart city initiatives benefits

New York implemented BigBelly, smart garbage bins. These improve trash collection efficiency by 50%-80%, and also contributes to emissions control by reducing the time spent by garbage trucks on the road.[i]

Chicago deployed a city-wide network of sensors to track presence of air pollutants to predict air quality incidents. This data is also made public[ii]

Coimbra(Portugal) piloted AI-enabled flood management system. The pilot controlled 60 storms with the downstream flow rate reduced by 37%[iii]

San Diego will save $2.5mn annually using smart streetlights by connecting the city's lighting infrastructure to a wireless network, enabling the city to monitor and manage lights remotely[iv]

"Copenhagen Connecting" tracks connected devices such as personal devices to collect and analyze data to provide quick access to information about parking, traffic, transportation cost[v]

Stockholm is working with Telia and Ericsson to implement sensor-based water quality monitoring system[vi]

Dijon(France) launched a central command center and data from thousands of sensors spread across the city to bring together critical components such as police, traffic, parking, waste management under a unified platform[vii]

Singapore launched an online platform named i-Witness. The platform enabled citizens to report on crime incidents, traffic offenses, security crisis etc. via text or multimedia files. The Singapore Police received more than 35,000 submissions through the platform[viii]

Source:

i. NY-Engineers, How New York Is Becoming A Smart City, September 2018, This efficiency is realized by reducing the frequency of garbage collection and effective scheduling for pickup, also leading to lower emissions.
ii. Harvard, How Cities Are Using the Internet of Things to Map Air Quality, April 2017.
iii. Prevention Web, Adaptable, scalable and cost effective local solution to urban flooding prevention, November 2018.
iv. GE, From Light To Bright: San Diego Is Building The World's Largest Municipal Internet Of Things, October 2017.
v. Here, An introduction to smart transport, April 2019.
vi. CEO Water Mandate, Using smart technology to monitor Stockholm's water systems, November 2017.
vii. JDN, In Dijon and Angers, the all-in-one smart city, March 2020.
viii. OSAC, "Singapore 2019 Crime & Safety Report," July 2019.

Cities that adopt smart city initiatives will attract talent and businesses

Close to three-quarters (74%) of city officials believe a smart city will attract a highly qualified workforce and provide an attractive destination for startups and established businesses, and 59% of citizens said talented workers and businesses will migrate to other smart cities (Figure 6). Cities may see reverse migration, with citizens and businesses moving to other smart cities that offer better prospects. The remote working that has become the norm during COVID-19 may continue post-pandemic too, leading to greater levels

of migration to communities that are seen as better options. Matthias Wieckmann, head of Digital Strategy, Hamburg, says *"Smart cities are important globally from an industry-driven perspective, for companies to develop smart city solution and thereby tapping this relatively new market segment. If this leads to competitive, citizen-centered products that help us to improve urban services, drive technological development and give local companies a competitive edge, cities will profit in many ways. Better services for cities and citizens will attract companies and talent, thereby increasing employment, resources and well-being in the city."*

Figure 6. Smart cities will attract talent and investments

■ Share of city officials who say smart city will attract highly qualified workforce and employers
■ Share of citizens who say smart city will attract highly qualified workforce and employers

Smart city initiatives help fight COVID-19

Technology has enabled cities to address multiple challenges during the pandemic. In our research, 68% of city officials say that smart city initiatives – such as apps that connect people to their nearest healthcare facility or provide remote patient monitoring – have helped them manage the COVID-19 crisis effectively. There are numerous examples of this in action:
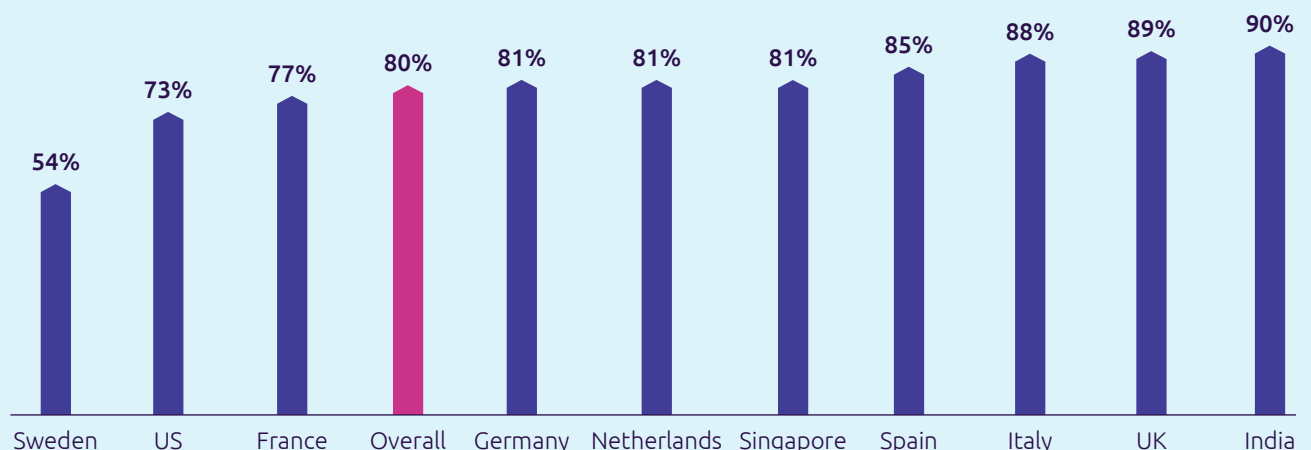
- The University of Newcastle is analyzing the effectiveness of the UK government's social distancing measures through pedestrian sensor data. (i)
- South Korea is using the country's smart city data hub to accelerate contact tracing – identifying those

who have interacted with an infected person. The smart city hub is used to request contact details for people who may be infected by tracking their movement. (ii)
- Airports in Rome are using smart helmets with augmented reality and thermal scanners to screen multiple visitors simultaneously while maintaining a safe distance of 8–15 feet. (iii)

City officials acknowledge the value of smart city initiatives in disaster management

Figure 7. The vast majority believe disaster management must be ingrained in a smart city plan

Sweden 54% | US 73% | France 77% | Overall 80% | Germany 81% | Netherlands 81% | Singapore 81% | Spain 85% | Italy 88% | UK 89% | India 90%

Source: Capgemini Research Institute; Capgemini Smart Cities Survey, April 2020, n=310 city officials

Smart city initiatives also find multiple implementations in disaster management:

- **Buenos Aires** made use of IoT-enabled sensors in their drains to monitor flood situations across 1,500 kilometers of pipeline. The sensor data – along with weather reports and other data – helps the city predict floods and has helped clear all of their 30,000 storm drains even in heavy rainfall conditions. (iv)
- The cities of **Los Angeles** and **San Francisco** use artificial intelligence in their "One Concern" platform. The platform allows them to assess the impact of a disaster by modeling potential disasters and predict the damage. (v)
- **Cincinnati's** fire department uses predictive analytics to prioritize the circa 80,000 requests that the department receives every year and recommend a response. (vi)
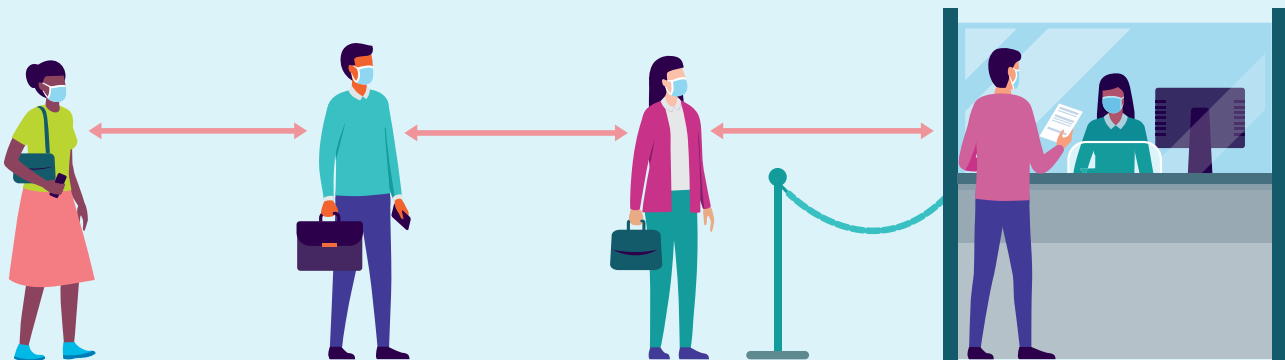
(i) Forbes, "How Smart Cities Are Protecting Against Coronavirus but Threatening Privacy," April 2020.

(ii) TechRepublic, "How smart city tech is being used to control the coronavirus outbreak," March 2020.

(ii) Venturebeat," Italian airport leads Europe in adopting AR thermal scanning helmets," May 2020.

(iv) Smart Cities Council, Manage Disaster and Build Resilient Smart Cities, July 2018

(v) Harvard, Three Emerging Technologies To Improve Emergency Management, June 2018

(vi) Harvard, Three Emerging Technologies To Improve Emergency Management, June 2018

What do citizens want from a smart city?

In this section, we look at how citizens are prepared to embrace smart city initiatives: from what digital channels they use to interact with civic agencies to which areas they prize and are willing to pay for.
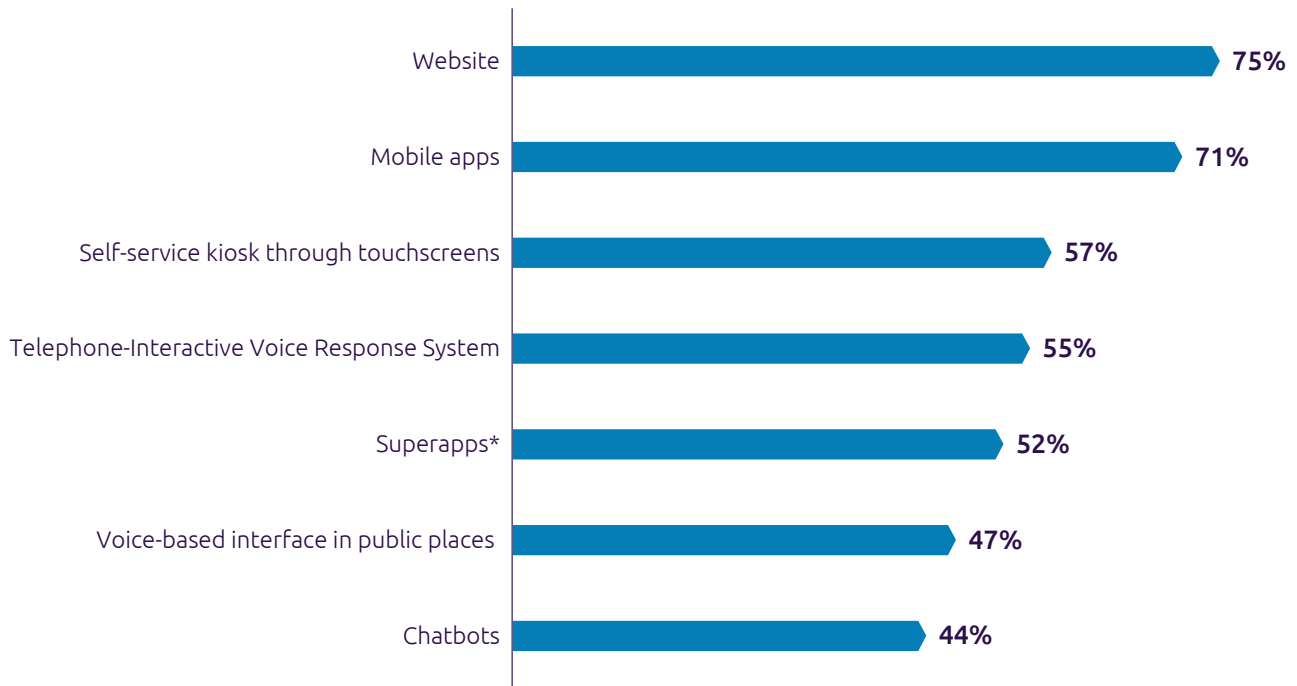
Citizens are becoming smart citizens

As consumers of smart city infrastructure, citizens must accept and understand how to digitally interact with smart city initiatives. As Figure 8 shows, citizens are already making extensive use of digital channels to interact with civic agencies – not only websites and apps but also kiosks and voice-response systems. Digital mediums enable a two-way communication with city authorities to report broken infrastructure, crime, or transport requirements help to

resolve citizen challenges. For example, the government of Australia has set a deadline of 2025 to get all their services online.[16] While initiatives such as these make such services more easily available to a large share of citizens, it also raises important questions on the digital divide in the society.[17]

City officials must ensure that citizens who are unaware/unable to access services digitally are provided with enough tools and means to access these services. Focused training and digital skilling for citizens who need it is one of the ways to go ahead. For instance, Singapore launched a "Seniors Go Digital" program to support and train senior citizens in adoption of digital technologies. This includes small group-based learning sessions along with financial aids for citizens who cannot afford devices.[18]

Figure 8. High adoption of digital channels by citizens to interact with civic agencies

Website — **75%**
Mobile apps — **71%**
Self-service kiosk through touchscreens — **57%**
Telephone-Interactive Voice Response System — **55%**
Superapps* — **52%**
Voice-based interface in public places — **47%**
Chatbots — **44%**

Source: Capgemini Research Institute, Smart Cities Survey, April 2020 (n=10,000 citizens).
Percentages represent share of citizens that interact using the given mediums once or more a month.

- A unified app which provides access to multiple services like bill payments, shopping or multiple apps within an app e.g. WeChat, Grab.

We found that nearly half use digital mediums once a month or more with websites being the most popular medium of interaction used by three-fourth of citizens. More than 50% are satisfied with the digital channels they use for interaction. While chatbots are the least-used digital medium, they can be used for repetitive tasks, such as providing details on city services. The city of McAllen in Texas created a smart speaker app that provides details about city services and is available on Alexa and Google.[19] In 2016, the state of Utah was one of the first states in the US to adopt Amazon Alexa so that citizens can use it to practice their driving license exam.[20]
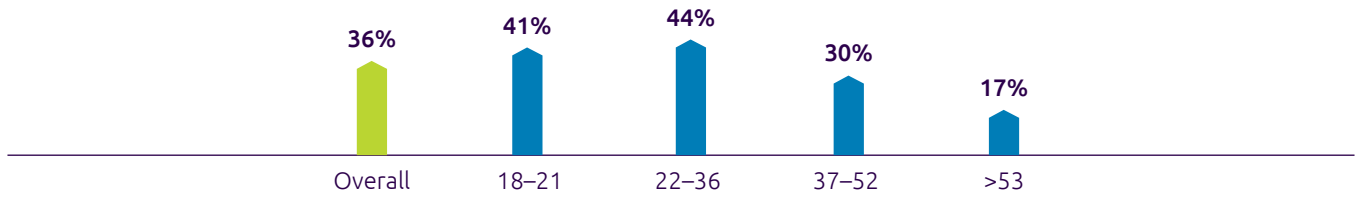
Citizens are willing to pay more for smart city initiatives

Citizens want a better urban existence, and some are even prepared to see the cost of living in a city increase to deliver this goal:
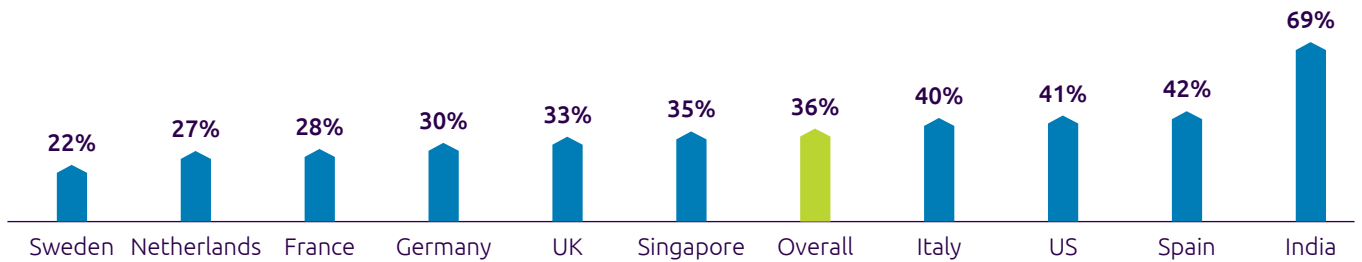
- As Figure 9 shows, over a third (36%) are willing to pay more for using smart city initiatives. This figure is higher for Millennials (44%), Gen Z (41%) and citizens in the $80,000+ higher income bracket (43%).
- For the citizens who are willing to pay more, the choice for payment is split across usage-based pay (38%), subscription-based payment (37%), and one-time lump-sum payment (25%).

I would be willing to pay more to access smart city initiatives because I want to live in a highly developed and connected city

Overall	18–21	22–36	37–52	>53
36%	41%	44%	30%	17%

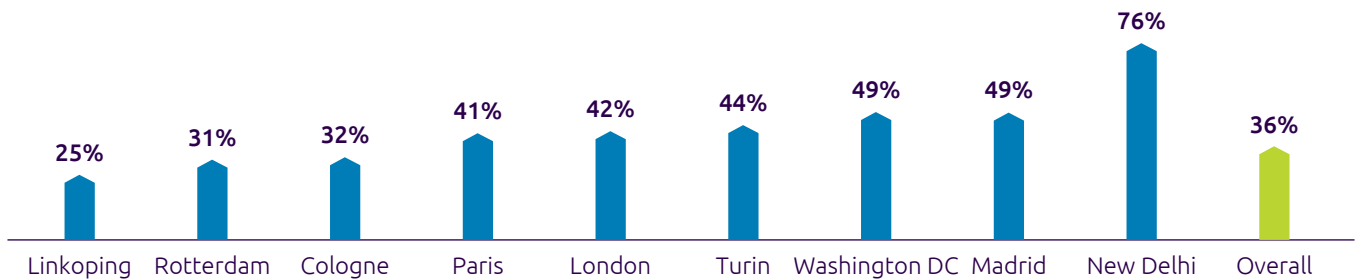## I would be willing to pay more to access smart city initiatives because I want to live in a highly developed and connected city

Sweden	Netherlands	France	Germany	UK	Singapore	Overall	Italy	US	Spain	India
22%	27%	28%	30%	33%	35%	36%	40%	41%	42%	69%

I would be willing to pay more to access smart city initiatives because I want to live in a highly developed and connected city-highest per country
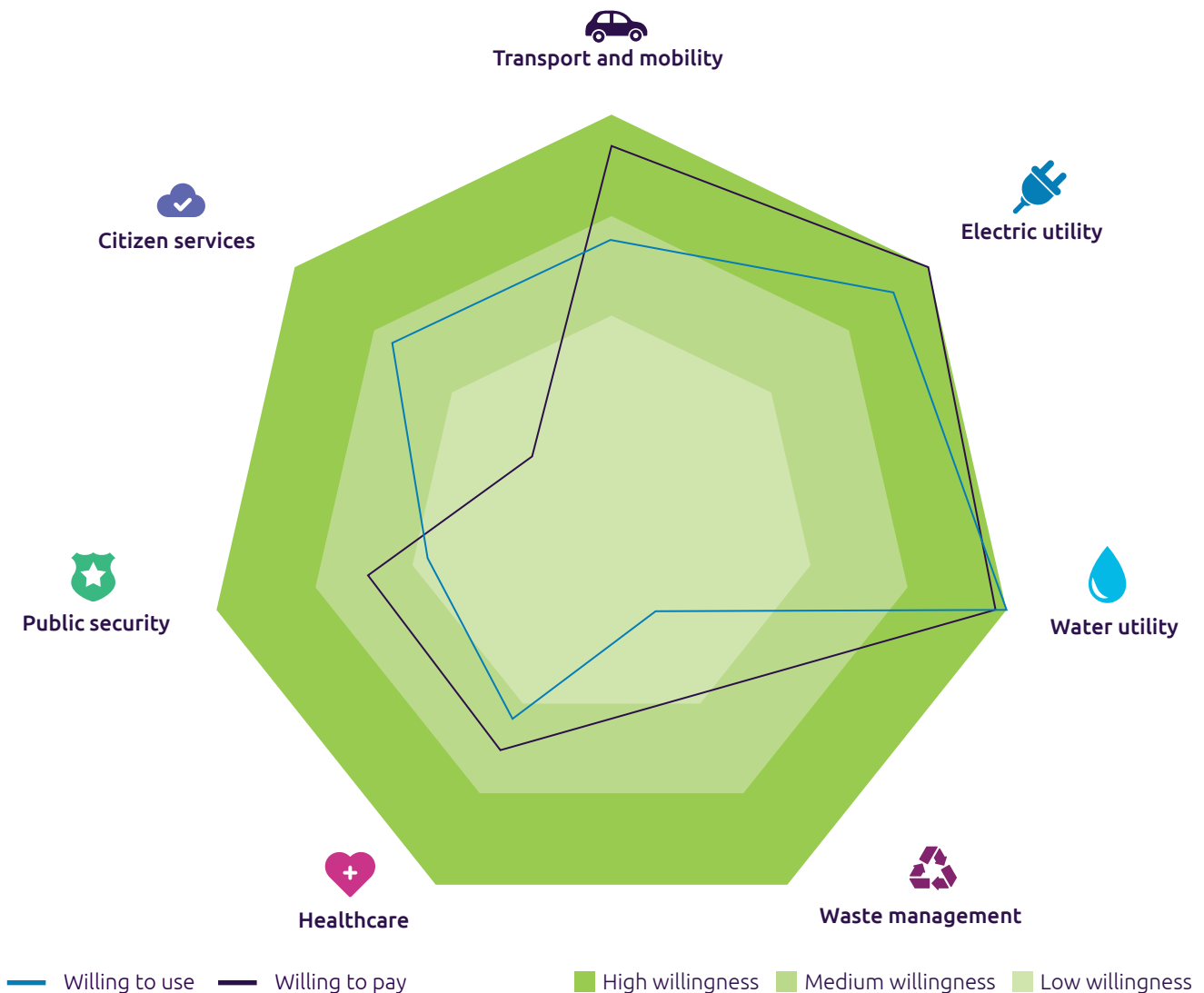
Linkoping	Rotterdam	Cologne	Paris	London	Turin	Washington DC	Madrid	New Delhi	Overall
25%	31%	32%	41%	42%	44%	49%	49%	76%	36%

To look deeper into citizens' willingness to use smart city initiatives and pay more for them, we analyzed 39 use cases across seven areas (see Figure 10). We found that:

- The core transport, utility, and health services that already consume a sizable share of citizen income – show a higher willingness to pay, as these are areas where citizens want improved services. Citizens are also able to view the data related to these services.
- But wider citizen services – such as social welfare schemes, business licenses, permits, or accessing citizen records or e-governance – is an area where they are not willing to pay.

This may be because these initiatives may not be so high in the hierarchy of needs of citizens as the initiatives where they already pay, such as transport, and areas where they see some value, such as public security and healthcare. Super apps, where most citizen services are available in a single place, could help citizens get seamless access given the willingness of citizens to use smart initiatives in this area. For instance, citizens of Singapore use a single app for multiple citizen services. The Moments of Life (MOL) app allows citizens of Singapore to access multiple services, from birth registration to tax management in one place.[21]

Figure 10. High level of citizen interest in smart city initiatives

Urban services where citizens are most willing to pay more for smart city initiatives by city

USA
- Washington, DC — Water utility
- New Work — Water utility
- Los Angeles — Water utility
- Boston — Water utility
- San Franscisco — Water utility

UK
- London — Water utility
- Manchester — Electric utility
- Bristol — Water utility
- Birmingham — Water utility
- Leeds — Electric utility

France
- Paris — Water utility
- Toulouse — Electric utility
- Marseille — Water utility
- Lille — Water utility
- Lyon — Transport and mobility

Germany
- Berlin — Transport and mobility
- Munich — Transport and mobility
- Dusseldorf — Transport and mobility
- Frankfurt — Water utility
- Hamburg — Water utility
- Cologue — Transport and mobility
- Damstadt — Transport and mobility

Netherlands
- Amstardam — Transport and mobility
- Rotterdam — Transport and mobility
- The Hague — Electric utility
- Utrecht — Electric utility
- Eindhoven — Electric utility

Italy
- Rome — Citizen services
- Milan — Healthcare
- Florence — Citizen services
- Turin — Public security
- Naples — Water utility

Spain
- Madrid — Citizen services
- Barcelona — Citizen services
- Valencia — Citizen services
- Malaga — Healthcare
- Seville — Citizen services

Sweden
- Stockholm — Electric utility
- Gothenburg — Electric utility
- Malmo — Citizen services
- Linkoping — Electric utility
- Helsingborg — Electric utility

India
- New Delhi — Water utility
- Mumbai — Transport and mobility
- Chennai — Citizen services
- Bengaluru — Transport and mobility
- Hyderabad — Water utility
- Pune — Transport and mobility

Legend:
- Water utility
- Electric utility
- Transport and mobility
- Citizen services
- Healthcare
- Public security

> "We're collecting a lot of data after 18 months in market and we are currently in our infancy as it relates to insights. Our challenge right now is how do we take that data and harness it to provide better and more personalized service to our customers."
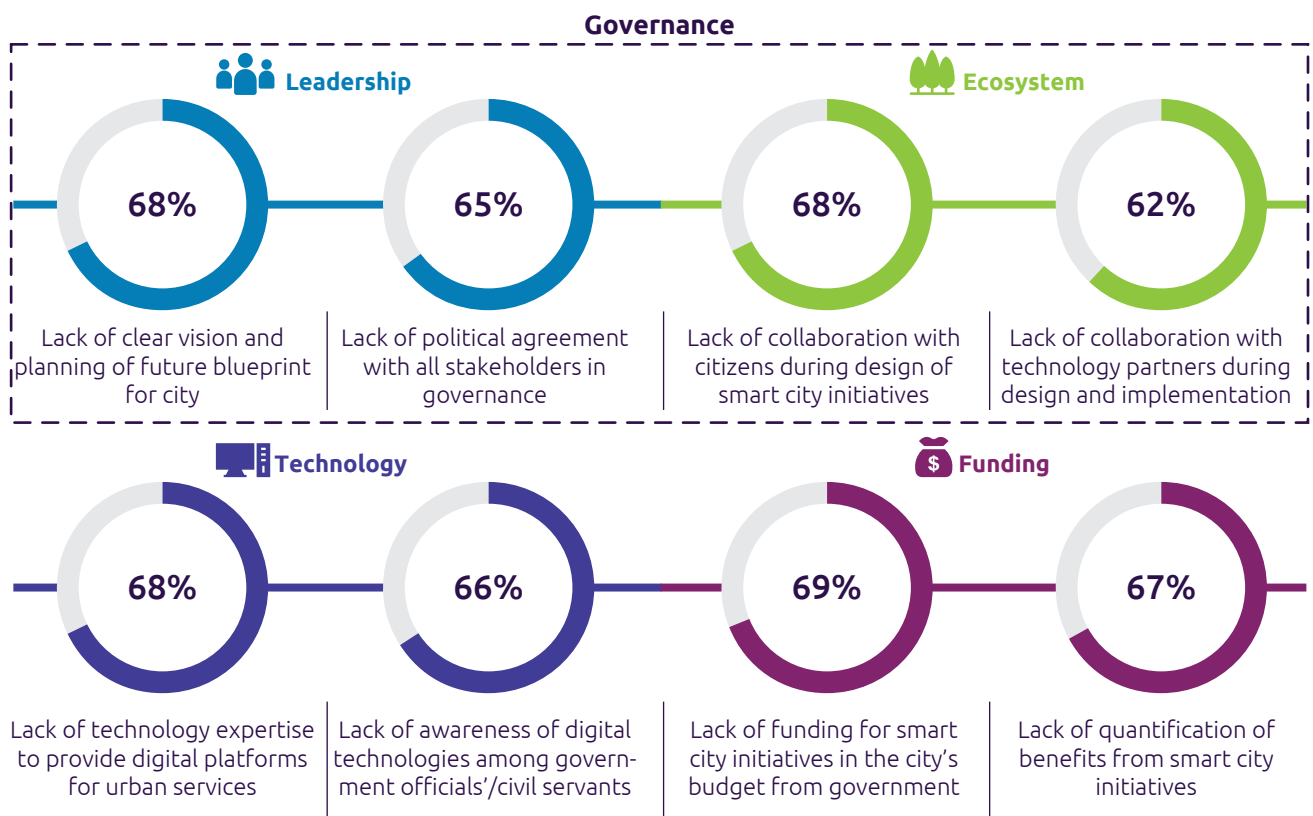
Lynn Blake,
VP, Mobility, Groupe PSA

What challenges stand in the way of success?

Although smart cities offer solutions to a number of the traditional pain points of the city experience, serious challenges to implementation exist, from finding funding to the need for citizens to trust how their data is used. As Figure 11 shows, there are multi-dimensional challenges: tech, funding, leadership, and process.

Figure 11. Smart city implementation challenges

Governance

Leadership

68% — Lack of clear vision and planning of future blueprint for city

65% — Lack of political agreement with all stakeholders in governance

Ecosystem

68% — Lack of collaboration with citizens during design of smart city initiatives

62% — Lack of collaboration with technology partners during design and implementation

Technology

68% — Lack of technology expertise to provide digital platforms for urban services

66% — Lack of awareness of digital technologies among government officials'/civil servants

Funding

69% — Lack of funding for smart city initiatives in the city's budget from government

67% — Lack of quantification of benefits from smart city initiatives

Source: Capgemini Research Institute, Smart Cities executive Survey, April 2020 (n=310 city officials).

Key challenges include:

- **Technology and data challenges:** City officials struggle to find the tech expertise needed: 68% pointing to the "lack of technology expertise to build digital platforms" as a major challenge. At the same time, they are also concerned that government officials and civil servants lack awareness of digital technologies.
  At the same time, there are also data challenges. Rich data, along with intelligent analytics, will allow cities to harness the true potential of smart initiatives. However, this entails addressing citizens' privacy concerns, with 63% saying that the privacy of personal data is more important than improved urban services. There are also major issues in managing and capturing data: 43% of officials point to the lack of technological infrastructure for database management and 39% to lack of funding for collecting and storing data. Harnessing the data is another hurdle that cities and service providers face. Lynn Blake, VP, Mobility, Groupe PSA adds, *"We're collecting a lot of data after 18 months in market and we are currently in our infancy as it relates to insights. Our challenge right now is how do*

we take that data and harness it to provide better and more personalized service to our customers."

- **Funding challenges:** More than two-thirds (69%) of city officials say that funding initiatives from the city's budget is a major challenge. Estimating benefits and quantifying the impact is critical to secure funding. However, it is also very challenging: 67% of city officials say that a major hurdle is the lack of quantified benefits.
- **Leadership Challenges:** While ad-hoc implementation will still deliver some benefits, a holistic approach means you can leverage the synergies of different initiatives. We found that 64% of city officials said that the isolated implementation of different smart city initiatives was a major challenge, and 68% pointed to the lack of a "clear vision and future blueprint'.

- **Ecosystem challenges:** City officials say that they struggle to access an innovation ecosystem. A holistic approach that includes different stakeholders is imperative for a smart city: 68% of executives said that lack of collaboration with citizens during design of initiatives is a major challenge. Almost two in three (62%) city officials cite lack of collaboration with technology partners as a challenge
- **Connecting with Citizen Needs:** City officials around the world are not fully in sync with what citizens believe to be the most critical initiatives. We analyzed the need for smart city initiatives from the perspective of both citizens and city officials, looking at seven areas that ranged from waste management to healthcare, and found a mismatch in multiple geographies (see Figure 12)

Figure 12. Smart city initiatives as viewed by citizens and city officials

Moon chart legend
○ Lowest ◖ Low ◖ Medium ◖ High ● Highest

■ Citizen willingness to use smart city initiatives
■ Need of smart city initiatives as per city officials
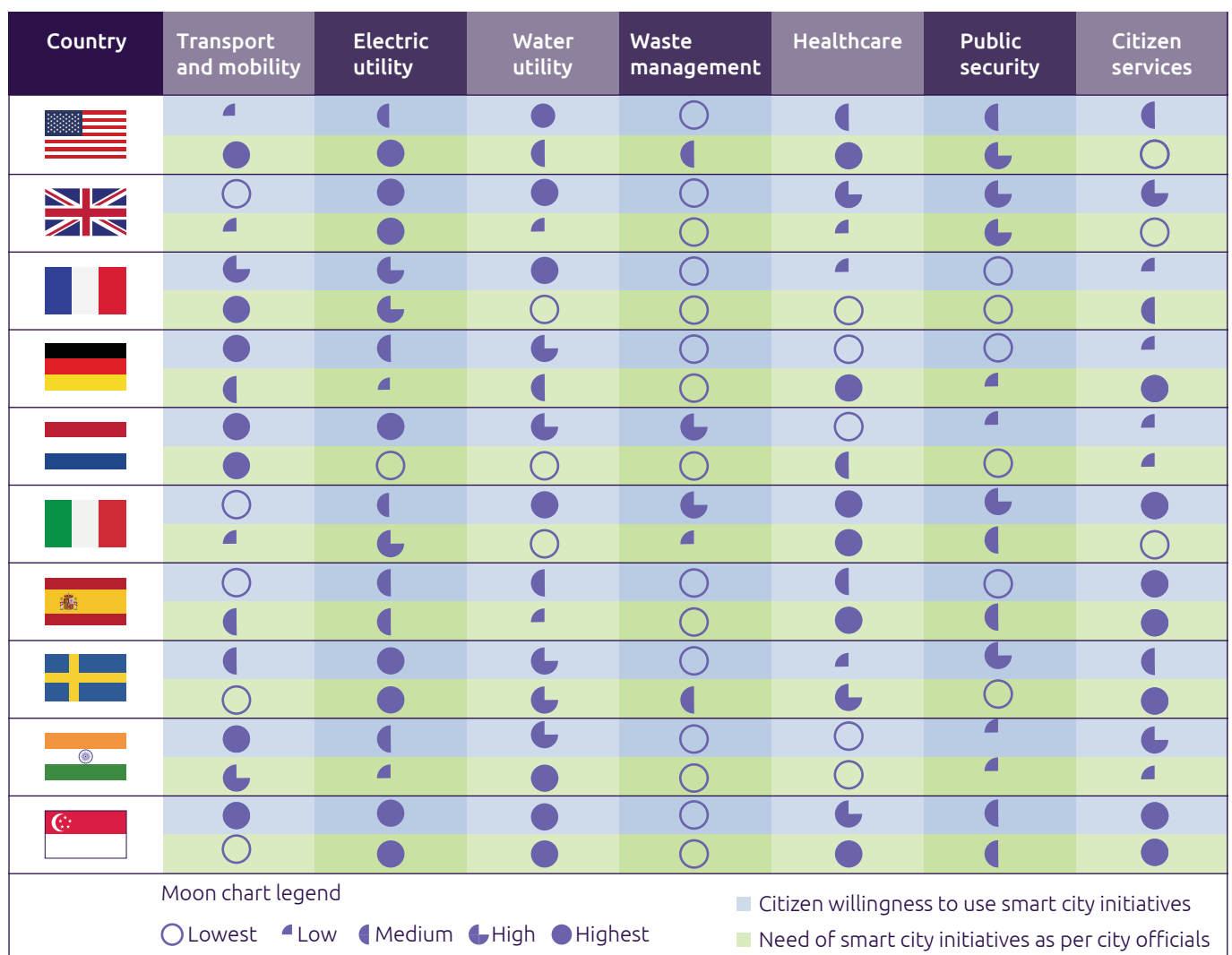
Source: CCapgemini Research Institute, Smart Cities Citizen Survey, April 2020 (n=10,000 citizens), Capgemini Research Institute, Smart Cities Survey, April 2020 (n=310 city officials).
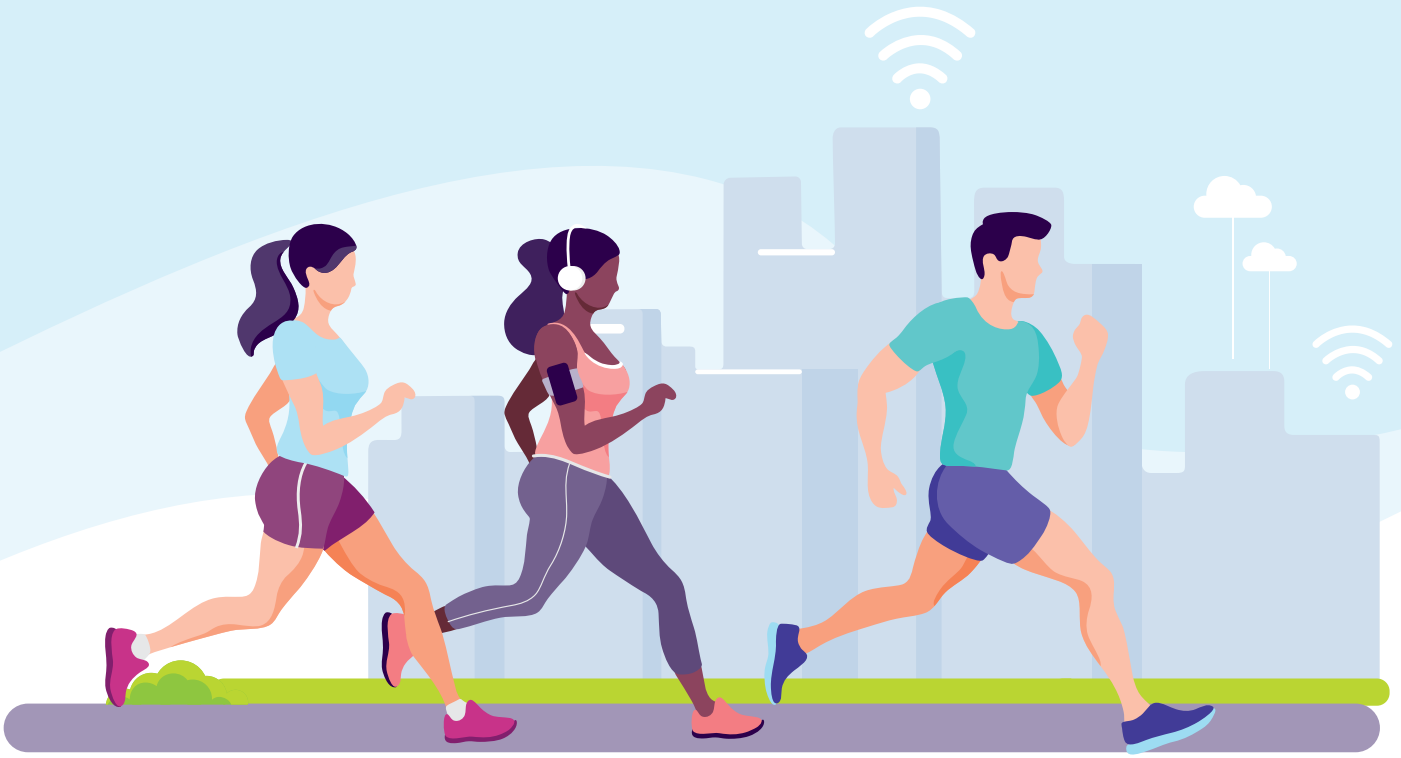
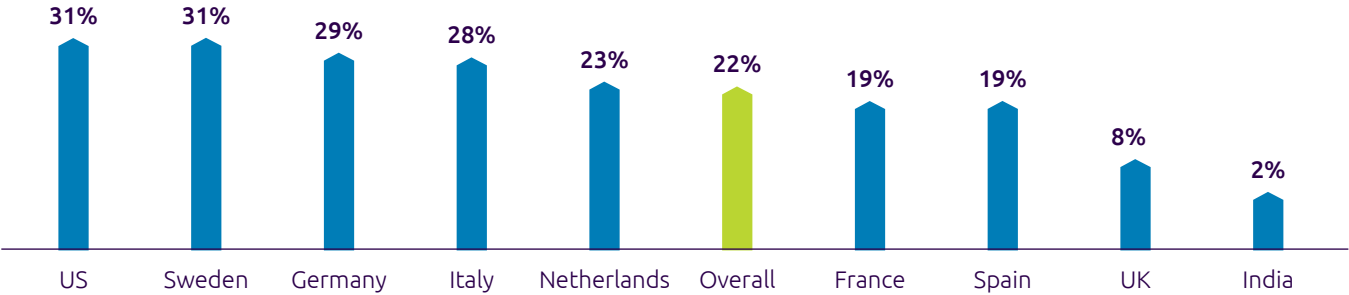# How can cities accelerate smart implementation?

Our research shows that only one in ten officials says their city is in the advanced stages of implementing a smart city vision (9%) and only 22% have started implementing a few smart city initiatives (see Figure 13). Smart city initiatives are evenly spread across multiple areas with the greatest level of implementation in transport and mobility. However, even here, only 28% of city officials say they are already implementing, whereas 35% say they are not aware of anything or confirm that nothing has been implemented. It is clear that an accelerated approach is required if smart city programs are to meet citizens' considerable appetite for solutions and services

Figure 13. Smart city initiatives need a major push

Share of city officials who agree with the below statements

15%	32%	22%	22%	9%
We have just started the process to ideate and create a smart city plan	Our city administration is working to create a smart city plan	Our city has published a plan document/ vision to become a smart city	Our city has published a plan document/vision to become a smart city and has started a few initiatives	Our city is in advanced stages of implementation of the smart city vision

Share of city officials by country who say their city has published a plan document/vision to become a smart city and has started a few initiatives

US	Sweden	Germany	Italy	Netherlands	Overall	France	Spain	UK	India
31%	31%	29%	28%	23%	22%	19%	19%	8%	2%

Share of city officials on level of implementation of smart city initiatives
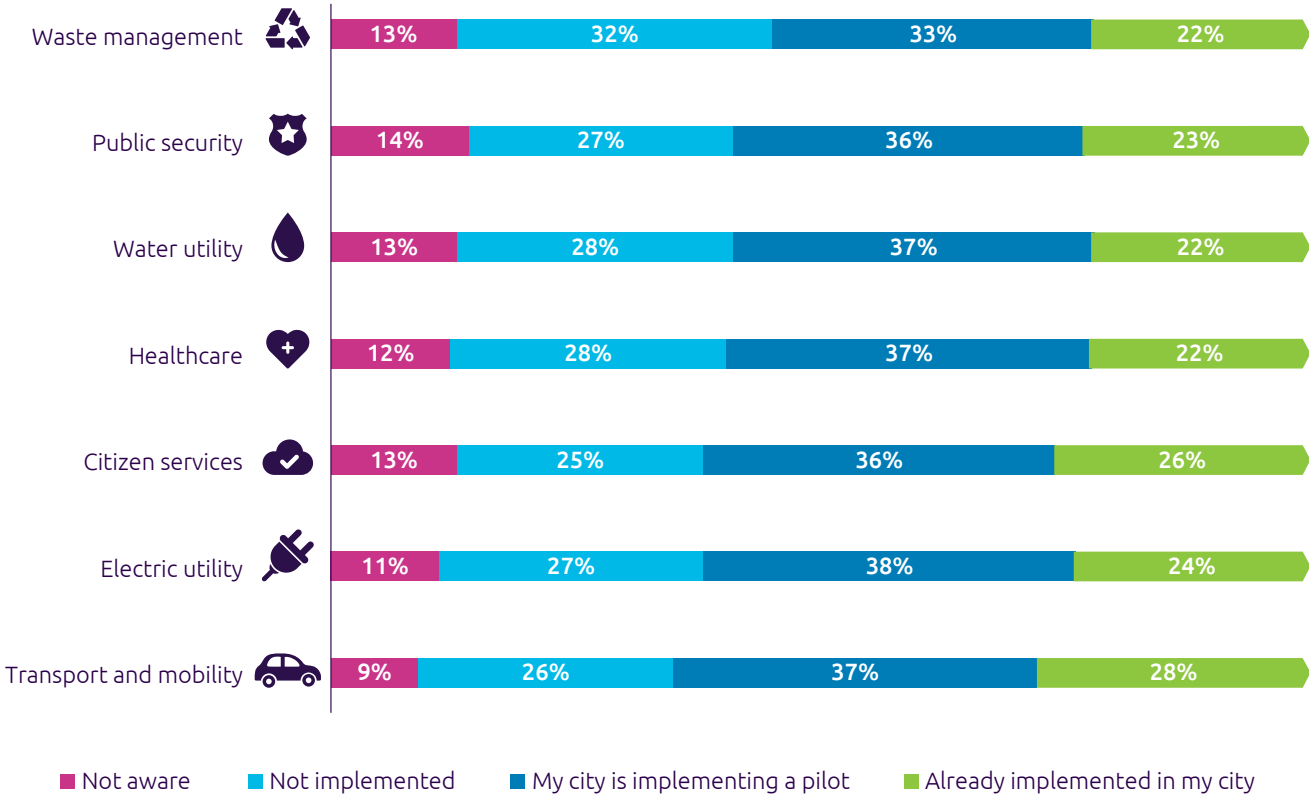
	Not aware	Not implemented	My city is implementing a pilot	Already implemented in my city
Waste management	13%	32%	33%	22%
Public security	14%	27%	36%	23%
Water utility	13%	28%	37%	22%
Healthcare	12%	28%	37%	22%
Citizen services	13%	25%	36%	26%
Electric utility	11%	27%	38%	24%
Transport and mobility	9%	26%	37%	28%

■ Not aware   ■ Not implemented   ■ My city is implementing a pilot   ■ Already implemented in my city

Accelerating implementation requires close collaboration between key stakeholders – city officials, citizens, and external parties (such as startups, academic institutes, or venture capital funds). It also requires a focus on three drivers: trust, innovation, and data.

In our experience, three development areas will be key:

1. Create a smart city vision with sustainability and resilience as cornerstones.
2. Empower city officials to act as entrepreneurs and at the same time ensure data protection and trust.
3. Build a culture of innovation and collaboration with citizens and external entities.

Figure 14. Smart cities framework
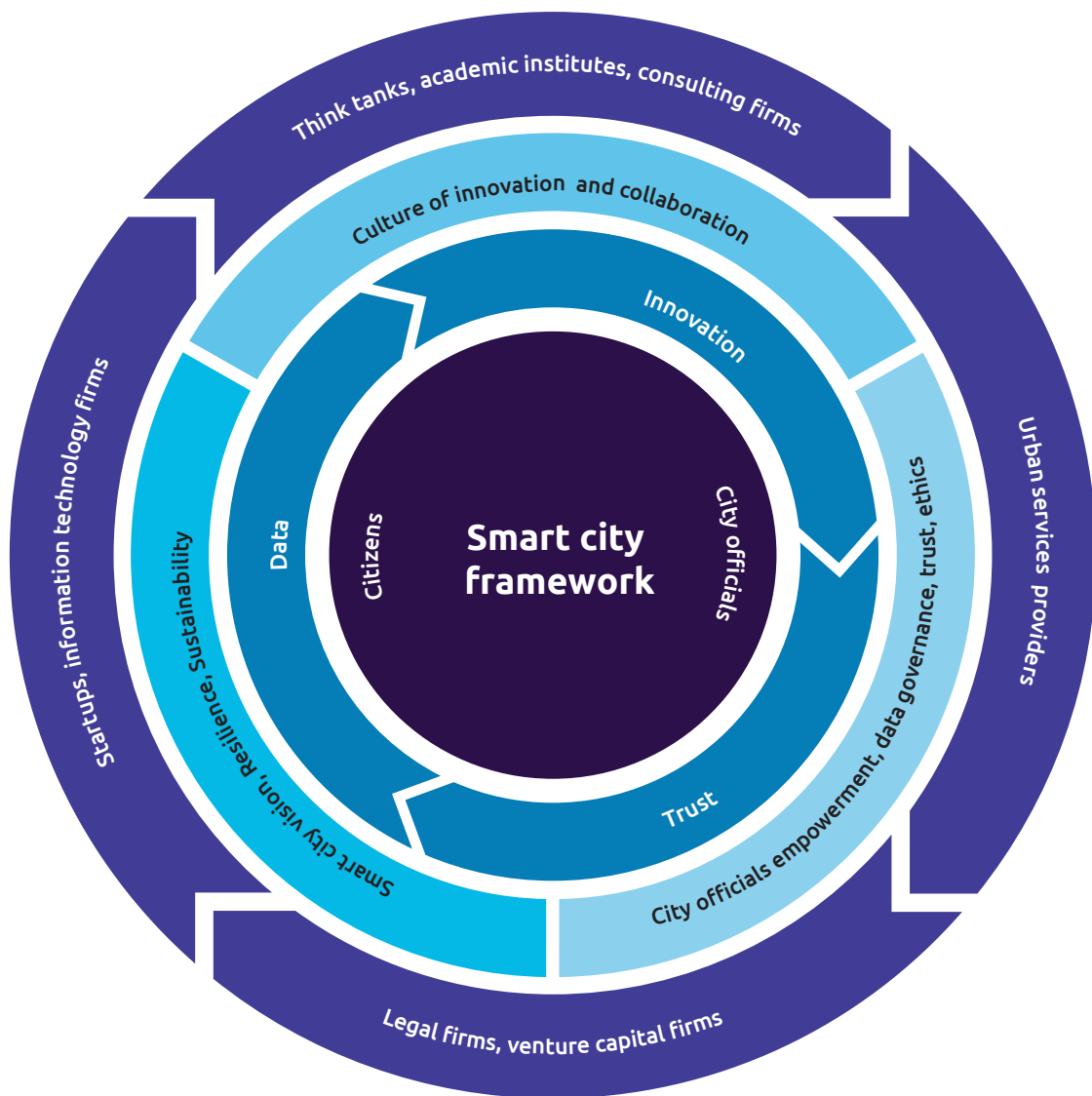
> "We can't develop new facilities or infrastructure that are not built with their sustainability in mind from the start. That's going to be a prerequisite for anything we do for the future."
>
> Martin Gull,
> CDO, City of Helsinborg

1- Create a smart city vision with sustainability and resilience as cornerstones

We found that close to half of city officials (47%) admit their city does not have a smart city strategy document or comprehensive transformation plan. A clear vision and strategy are critical to avoiding ad-hoc smart initiatives, which in turn lead to siloed developments that then become difficult to scale. Cities must build their vision on the foundations of sustainability and resilience to ensure they thrive into the future. Martin Gull, CDO, city of Helsingborg, says, *"We can't develop new facilities or infrastructure that are not built with their sustainability in mind from the start. That's going to be a prerequisite for anything we do for the future."*

Weave sustainability initiatives into the smart city plan

Our research shows that sustainability must be a key focus area for city officials:

- Looking back over the past three years, 42% of city officials believe that sustainability initiatives have been lacking and more than three-quarters believe the situation has not improved today.
- More than half (52%) believe that sustainability challenges will only intensify in the future.

Technology will be key to sustainability. We found that 41% of executives believe that cities becoming more unsustainable over the next 5–10 years is one of the top five consequence of not adopting digital technology. In addition, 58% of citizens say that technology-enabled smart city initiatives will help make cities more sustainable. For instance, air pollution is a major issue for most large urban areas, and a recent study found that pollutants near busy streets can be 10 times worse than background levels at air monitoring stations.[22]

Ensure resilience measures are built into the smart city plans

The importance of smart city initiatives for effective disaster management has never been more apparent than in today's pandemic situation. We found that 80% of city officials say disaster management must be ingrained in a smart city plan. The majority (57%) of city officials also believe that a command center is a critical asset. These centers optimize emergency response, gathering data from various sources to issue timely warnings and provide a coordinated response to major incidents. Command centers that monitor the entire city for routine activities – such as traffic, utilities, or public security – can also easily be converted to effective command centers for emergency/disaster management.

COVID-19 led to multiple cities using smart city initiatives to manage the crisis. For instance, the city of Bengaluru, India, repurposed its command center within 24 hours into a corona war room. The war room was used to track patients and draw up containment plans using heat mapping technologies.[23] Similarly, the government of West Java, Indonesia, recently launched a command center that is also used as a COVID-19 response hub.[24]
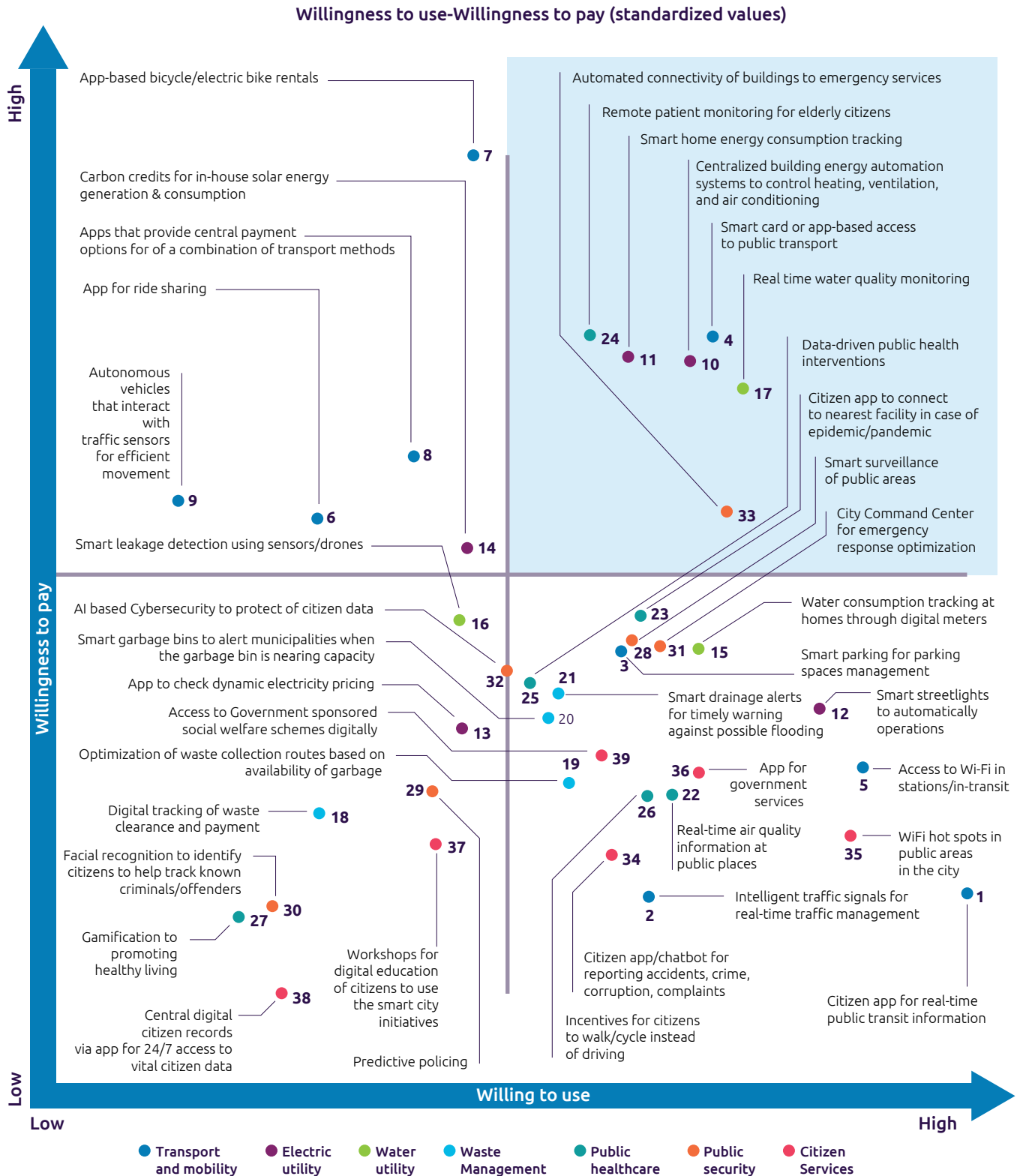
Identify high-potential use cases

To ensure authorities direct resources to the highest-potential use cases, and identify the value drivers underpinning ROI/the business case, we analyzed a long list of 39 use cases. These are spread across a range of areas – transport, utilities, public security, healthcare, and citizen services (see the Appendix for the full list) – and we assessed them against two criteria:
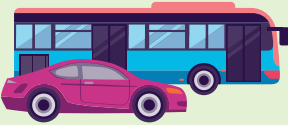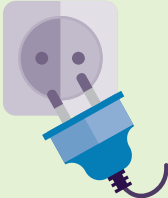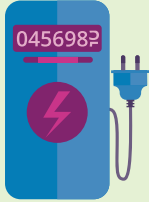
- Whether citizens are likely to use the solution
- Whether citizens are willing to pay more for the solution.

The resulting analysis identifies six use cases that are more likely to see sustained use while generating revenue, from app-based access to all transport modes to real-time water quality monitoring (see Figure 15).

Figure 15. High potential use cases for smart city initiatives

Willingness to use-Willingness to pay (standardized values)

App-based bicycle/electric bike rentals — **7**

Automated connectivity of buildings to emergency services

Remote patient monitoring for elderly citizens

Smart home energy consumption tracking

Centralized building energy automation systems to control heating, ventilation, and air conditioning

Smart card or app-based access to public transport

Real time water quality monitoring

Carbon credits for in-house solar energy generation & consumption

Apps that provide central payment options for of a combination of transport methods

App for ride sharing

24 **11** **10** **4** **17**

Data-driven public health interventions

Citizen app to connect to nearest facility in case of epidemic/pandemic

Autonomous vehicles that interact with traffic sensors for efficient movement **8**

9 **6**

Smart surveillance of public areas

33

City Command Center for emergency response optimization

Smart leakage detection using sensors/drones — **14**

AI based Cybersecurity to protect of citizen data — **16**

23

Water consumption tracking at homes through digital meters

Smart garbage bins to alert municipalities when the garbage bin is nearing capacity

28 **31** **15**

3

Smart parking for parking spaces management

App to check dynamic electricity pricing

32 **21**

25

Smart streetlights to automatically operations

12

Access to Government sponsored social welfare schemes digitally

13 **20**

Smart drainage alerts for timely warning against possible flooding

Optimization of waste collection routes based on availability of garbage

19 **39**

36

App for government services

Access to Wi-Fi in stations/in-transit **5**

Digital tracking of waste clearance and payment **18**

29

22

26

Real-time air quality information at public places

WiFi hot spots in public areas in the city **35**

Facial recognition to identify citizens to help track known criminals/offenders

37

30

27

34

2

Intelligent traffic signals for real-time traffic management

Citizen app for real-time public transit information **1**

Gamification to promoting healthy living

38

Central digital citizen records via app for 24/7 access to vital citizen data

Workshops for digital education of citizens to use the smart city initiatives

Predictive policing

Citizen app/chatbot for reporting accidents, crime, corruption, complaints

Incentives for citizens to walk/cycle instead of driving

High ← Willingness to pay → **Low**

Low ← Willing to use → **High**

● **Transport and mobility**   ● **Electric utility**   ● **Water utility**   ● **Waste Management**   ● **Public healthcare**   ● **Public security**   ● **Citizen Services**

Top 6 use cases citizens are likely to use and pay more

Smart card or app-based access to all public transport modes

Transport and mobility

To make public transport hassle-free, Berliner Verkehrsbetriebe(BVG), Berlin's public transportAuthority Launch Jelbi, a one stop app to access all public modes of transport such as subways, buses, trams and ferries. This also includes bikesharing, ride hailing, carpooling, taxis integrating multiple apps in a single place[i]

Real time water quality monitoring

Water utility

City of Stockholm is working with Ericsson and Teliato install sensors for real time monitoring of water quality. These could also be used for spill detection and leakages in the pipelines, while also monitoring water quality[ii]

Centralized building energy automation systems to monitor and control HVAC in public buildings

Electric Utility

City of London with their RE:FIT program targeting public buildings. Under this program, the city aims to reduce CO2 emissions by 60% of the 1990 levels by 2025 by retrofitting energy saving measures on these buildings[iii]

Remote patient monitoring for elderly citizens

Healthcare

City of Seoul launched U-Health (Ubiquitous Health) strategy to enable senior citizens to live independent lives in their own homes for as long as possible. This includes improving remote monitoring in elderly citizens by monitoring devices to a citizen's homes[iv]

Smart home energy consumption tracking

Electric Utility

Electric utility company, Duke Energy, has started installing 'Smart meters' in the Cape Fear region. These meters will enable consumers to track hourly consumption and where they could cut back to enable more savings.[v]

Automated connectivity of buildings to emergency services

Public security

Panorama Tower, the tallest building on the US East Coast implements many smart initiatives for people living and working there. These include safety measures such as access control and centrally integrated fire safety system.[vi]

Source: Capgemini Research Institute, Smart Cities Survey, April 2020 (n=10,000 citizens).
Please refer to the appendix for a complete list of use cases.

i.   Fast Company, "In Berlin, there's now one app to access every mode of transportation," February 2019.
ii. Digital Demo Stockholm, "How do we measure and maintain the quality of the most important natural resource we have – clean water?," December 2019.
iii. C40 Cities, "FIT Program cuts carbon emissions from London's public buildings," June 2017.
iv. IoTForAll, "Aging in the City: How Smart Cities Are Improving Accessibility," September 2019.
v.   WWAY TV3, DUKE ENERGY INSTALLS NEW "SMART METERS," January 2020.
vi. Siemens, "Is your building smart enough for the future?," February 2019.

> *"It is best to start with smaller, focused solutions that provide a good example and visibility rather than starting with a big overall solution for everything. It is easier to find partners, support and finance for projects that start from something small and have been shown to be useful."*

Matthias
Wieckmann,
Head of Digital Strategy,
Hamburg

2-Empower city officials to act as entrepreneurs and at the same time and ensure data protection and trust

Empower city officials to become smart city entrepreneurs

Even before their minds and attention turn to the challenge of smart cities, city authorities face multiple issues in running their own departments and "keeping the lights on." To move beyond business-as-usual activities – and build momentum – cities have begun appointing chief digital officers (CDOs) who are responsible for smart city initiatives (London, for example, appointed its first CDO in 2017).

One of the key characteristics of the role is working across departmental silos, ensuring the wider body of city officials participate. This means they need to embrace an entrepreneurial mindset: understanding the critical issues, coming up with ideas and pilots, scaling the successful pilots, and integrating these solutions with the city's ongoing operations. Empowering city officials across all levels to come up with ideas – and then supporting them financially to create the initial pilots – is one way to drive faster implementation. Martin Gull, CDO for the city of Helsingborg, adds, *"We provide innovation funds to every city department and provide financial opportunities for officials to run innovation projects. The innovation fund is not for regular development work you do every day. It is about taking the chance to test something unproven – something that we haven't done before in the city. Every city department has set up an innovation and idea screening process, idea facilitation, and idea coaching."*

Explore alternate funding approaches

Most smart city funding comes from national, state or local city governments. However, lack of government funding for smart city initiatives is a key challenge cited by 69% of city officials. In response, some city officials explore alternate sources of funding:

- 22% approach international organizations (e.g., European Union, World Bank). A few countries in Europe – such as Spain (46%) and the UK (31%) – have a higher-than-average use of this approach.
- 20% seek loans from banks/venture fundst

Another approach in a budget-constrained environment is to start with very small initiatives, and then test and expand them, identifying those with viability for funding. Matthias Wieckmann, head of Digital Strategy, Hamburg, adds, *"It is best to start with smaller, focused solutions that provide a good example and visibility rather than starting with a big overall solution for everything. It is easier to find partners, support and finance for projects that start from something small and have been shown to be useful".*

Governance to ensure protection and trust for how data is managed and used ethically

Almost half (46%) of citizens are aware of the benefits of sharing their personal data to power smart cities, but only

39% are willing to do so. This is indicative of a lack of trust: we found that only 39% of citizens trust the technology systems that urban utilities have in place currently, in areas such as transparency into how data is captured and used.

Building trust depends on designing ethical ways of collecting citizen data in compliance with individual freedom and data compliance laws. Digital principles must be laid out to clarify how the data is collected, anonymized, accessed, and shared. According to our earlier research, the use of artificial intelligence algorithms for smart city initiatives may lead to social and human biases and must include ethical principles to avoid this.[25] Eric Legale, general manager, Issy Media – which is leading the IT development strategy of Issy-les-Moulineaux, Greater Paris area – says, *"Smart City is increasingly associated with privacy problems, as sensors and data are associated with surveillance tools, and due to scandals reported by the media. This is the most important challenge to overcome for a trusted relationship between citizens and their city".*

The reluctance to share data can be overcome by putting in place governance mechanisms to enforce guidelines and robust security, and making citizens aware of these procedures. For instance, 55% of citizens would only hand over their data if they were aware of the encryption protections available. Sharing citizen data collected with urban services or private players ensures transparency in rules for sharing, data use, and data anonymization. Estonia launched one of the earliest open-sourced data sharing platforms, "X-Road." Using this system, various government and private entities can link their databases in a secure way – ensuring confidentiality, integrity, and interoperability between data exchange parties.[26]

The "London Datastore," launched in 2010, was one of the first initiatives in the world to enable free access to data to address the city's challenges. Sadiq Khan, the mayor of London, stated that transparency is a key pillar for the London Datastore, *"By responsibly opening up a huge amount of data held by our public sector partners and working with London's brilliant tech sector, we're helping to tackle some of the most urgent challenges facing our city as it grows. The next step is to create a shared approach for the city so we can all benefit from the innovation this will bring – while using the data we hold on Londoners' behalf transparently, safely, and securely".*[27]

Similarly Transport for London (TfL) collects citizen movement through wireless tracking across the London Underground to understand how public moves across the city and provide better services. However, TfL ensures the data is pseudonymized and encrypted to prevent identification of the device.[28]

3-Build a culture of innovation and collaboration with citizens and external entities

A forum to regularly review progress and take important decisions is key to accelerating implementation. While many cities do have governance councils, only 39% of city officials say smart city initiatives are implemented by a central governing body that includes the elected leaders,

"We provide innovation funds to every city department and provide financial opportunities for officials to run innovation projects. The innovation fund is not for regular development work you do every day. It is about taking the chance to test something unproven - something that we haven't done before in the city. Every city department has set up an innovation and idea screening process, idea facilitation and idea coaching."
Martin Gull,
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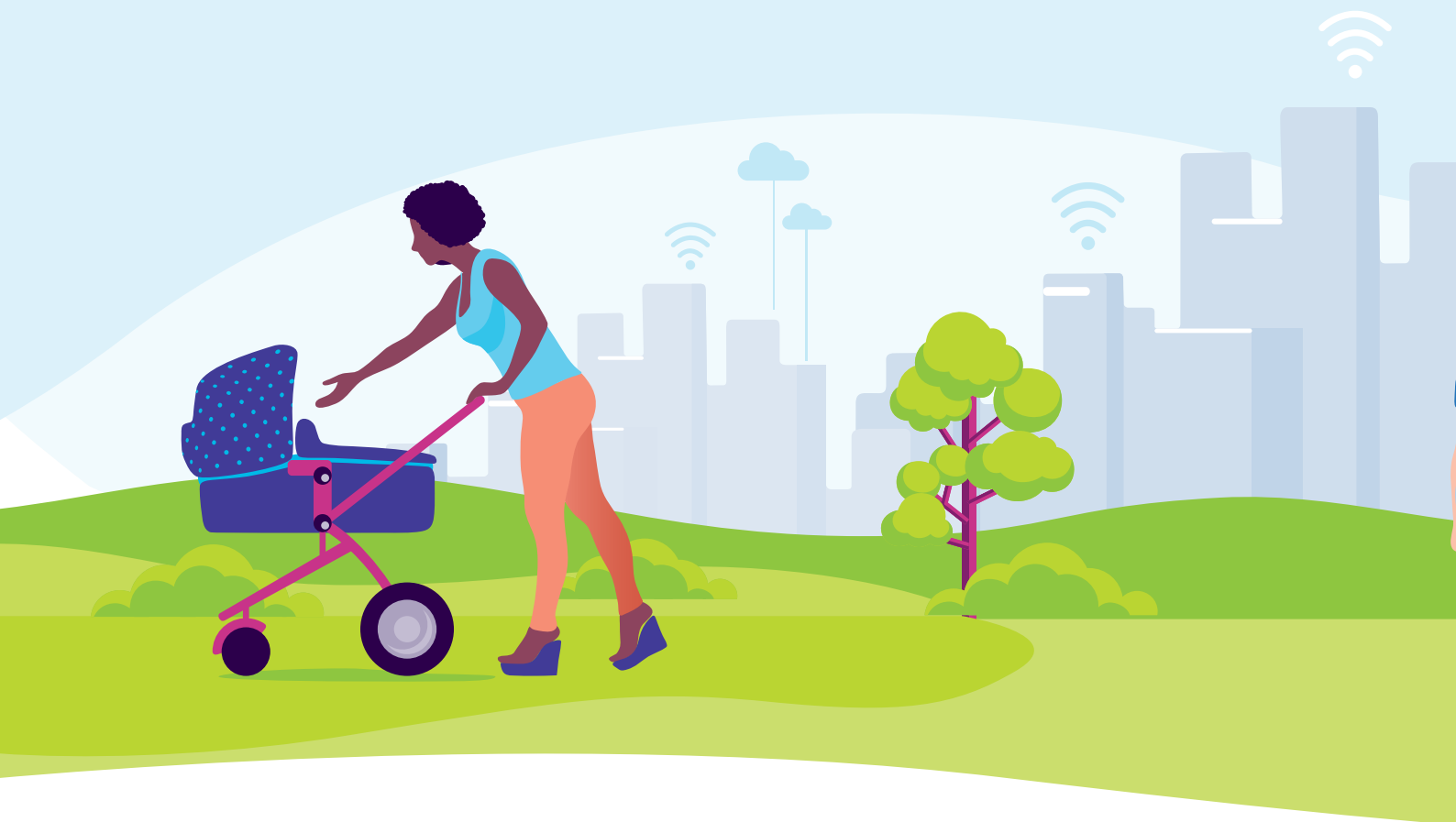
city administrators, urban service providers, private firms, and citizens. Martin Gull, CDO, city of Helsingborg, says, *"Smart cities are not just about technology, with big control rooms where multiple screens visualize what is going on. It is also about smart people who can collaborate to create a smart city together. This includes not only city officials but also external entities, such as citizens and local organizations. We are constantly working in different ways to stimulate other actors – beyond us – to contribute to the city."*

Increase citizen participation in smart city implementation

The citizen, as the consumer of urban services, must be an essential component of initiatives. While officials do elicit citizen opinion through surveys (62%) and citizen councils (66%), only one in three (33%) involves citizens in decision making. The lack of end-to-end citizen involvement is reflected in the diverging priorities of city officials and citizens, as Figure 19 shows. For example:

- 66% of citizens are willing to use smart initiatives in the water utility space
- But only 56% of officials feel there is the need for initiatives in this area.

Taking citizens' views to the next level by making them more involved in decision making and implementation will ensure that the gap between the two is bridged and mutual understanding strengthened. For example, the city of Tallinn developed the AvaLinn mobile app for urban planning. It enables citizens to provide feedback on development plans and the opportunity to co-create urban space with the municipality. Citizens can view the plan, comment on it, like or dislike it and submit their own ideas.[29] Singapore has also

"

"Smart City is increasingly associated with privacy problems, as sensors and data are associated with surveillance tools, and due to scandals reported by the media. This is the most important challenge to overcome for a trusted relationship between citizens and their city"

Eric Legale,
General Manager, Issy Media

created a virtual 3-D model of this city which provides real-time data from the city infrastructure which will be useful to identify challenges and implement new initiatives and will be available for citizens for access.[30]

Smart city initiatives also play a pivotal role in democracy by making citizens views heard. With COVID-19, more citizen interactions will be virtual and smart cities initiatives enable this interaction. Voting for elections will be an area which will be impacted a lot due to COVID-19. Estonia has already implemented systems that allow citizens to vote virtually. In fact, 44% of the votes for the previous election was cast using e-voting in Estonia.[31]

Collaborate externally, from design to implementation

The major reason for cities not having a smart city strategy document or comprehensive transformation plan is lack of clarity on who to approach externally to get help (68%). While large metropolitan cities may have the resources and in-house capabilities to create this strategic plan, many smaller cities may need external help, and collaboration with external parties will be key.

Overall, collaboration is seen as key, with three-in-four officials saying it is essential to involve external entities such as startups, academic institutes, and telecom firms (see Figure 19). However, it is also important to have basic expertise internally to understand the best way forward. Matthias Wieckmann, head of Digital Strategy, Hamburg, adds, *"Of course, cities need to possess and strengthen digital competencies in their administration, state agencies, public companies, and so on. But you don't need to know everything. You need the capabilities inside the administration to choose the right partner to cooperate with. City officials should not just buy anything that is offered, but should be able to decide which solution is the best for a city and its citizens."*

Figure 16. City officials want to collaborate with external entities
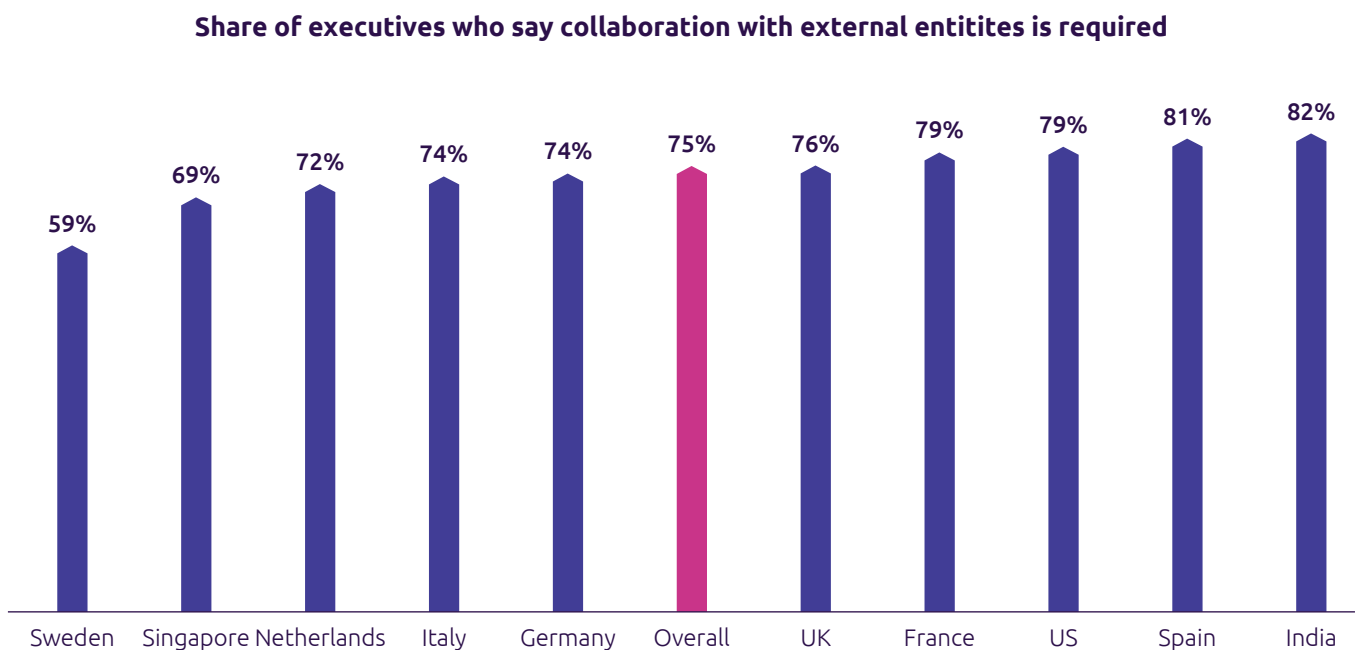
Share of executives who say collaboration with external entitites is required

59%	69%	72%	74%	74%	75%	76%	79%	79%	81%	82%
Sweden	Singapore	Netherlands	Italy	Germany	Overall	UK	France	US	Spain	India

The collaboration could be a win-win, with external entities sharing their expertise on smart solutions and cities sharing their knowledge on citizen behavior. London authorities, for example, are working with the Alan Turing Institute to manage the COVID-19 crisis, with a "trigger" communications campaign to help ensure people maintain social distancing. Greater London Authority CDO Theo Blackwell adds, *"Bringing together open data gives us another tool to understand how the capital is responding to public health measures, as well as how our high streets and shopping centers are doing, as we move from restrictions to recovery."* [32]

Establish innovation centers for smart city initiatives

Innovation centers bring together startups and technology firms with citizens and local businesses to understand local challenges and brainstorm solutions. The city of Helsingborg has established "HBG Works" as an innovation hub where city officials, citizens and entrepreneurs can meet to innovate, develop solutions, and receive the support needed for delivery and scalability. This innovation hub allows the best ideas to be scaled up after testing and provides a forum for citizens to contribute to the smart city initiatives. Initiatives from the HBG Works include a hackathon for digital inclusion for elderly and a healthcare app. [33]

Conclusion

In our urbanized world, technology-led interventions are essential for giving citizens the experience they need and want. The current city experience is broken – with social, environmental, and infrastructure challenges resulting in citizens threatening to leave their current city in pursuit of the more sustainable future promised by smart cities, as well as improved urban services.

However, innovative technology – and the funds to innovate and deliver – will not in themselves create a smart city. Success will be driven by a number of factors. You need to create a compelling smart city vision that has sustainability and resilience at its heart. City officials need to feel empowered to act as entrepreneurs. The use of citizen data must be governed by protection and trust. A culture of innovation and collaboration with citizens and external entities will also be key. Finally, it is critical to put citizens at the center of smart city initiatives, based on a deep understanding of the areas where they are willing to use smart city initiatives and their willingness to pay more to access smart solutions. After all, the citizens of a city are its greatest asset, and involving them in this endeavor will be key to its success.

Appendix A

We analyzed 44 smart cites use cases across the areas of transport and mobility, public security, healthcare, sustainability, electricity and water utilities, waste management, and citizen services.

Areas of smart city initiatives	Use cases for smart city initiatives	Citizens' willingness to use	Citizens' willingness to pay
Transport and mobility	Citizen app for real-time public transit information about delays and service disruptions	75%	35%
	Intelligent traffic signals to automatically update traffic signals based on real-time traffic (e.g., automatic lane clearances for commuter vehicles such as buses and vans)	66%	35%
	Smart parking to count available parking spaces in the neighborhood	65%	40%
	Smart card or app-based access for all public transport modes (e.g., metro, buses, ferries, etc.)	68%	46%
	Access to Wi-Fi in stations/in transit (e.g., at metro stations, bus stops, within metros, buses, etc.)	72%	37%
	App for ride sharing with people going to the same area (e.g., office, college)	56%	42%
	App-based bicycle/electric bike rentals for last-mile connectivity	61%	49%
	Apps that provide availability and payment options for a combination of transport methods, such as car and bike sharing, taxis and car rentals/leases, and public transport	59%	43%
	Autonomous vehicles (used for shared services on fixed routes) that interact with traffic sensors to autonomously move more efficiently	52%	43%
Electric utility	Centralized building energy automation systems to monitor and control heating, ventilation, and air conditioning (e.g., stadiums or offices using solar panels to minimize carbon footprint, lights based on motion sensors)	67%	45%
	Smart home energy consumption tracking (e.g., running heavy electricity consumption appliances at non-peak hours, automatic setting of temperature based on weather patterns)	66%	45%
	Smart streetlights to automatically turn on/off and reduce brightness based on ambient light	71%	38%
	App to check dynamic electricity pricing enabling different energy prices based on current demand and use household appliances accordingly	61%	38%
	Carbon credits for in-house solar energy generation and consumption to encourage green energy	61%	42%

Areas of smart city initiatives	Use cases for smart city initiatives	Citizens' willingness to use	Citizens' willingness to pay
Water utility	Water consumption tracking at homes through app-based digital meters	68%	40%
	Smart leakage detection using sensors/drones, enabling immediate response at home or in public places	61%	40%
	Real-time water quality monitoring	69%	45%
Waste management	Digital tracking and payment for waste disposal	56%	36%
	Optimization of waste collection routes based on availability of garbage to be collected, saving time and effort	64%	37%
	Smart garbage bins to alert municipalities when the garbage bin is nearing capacity and needs to be collected	63%	38%
	Smart drainage alerts for timely flood warnings	63%	39%
Healthcare	Real-time air quality information at public places	67%	37%
	Citizen app to connect to nearest facility in case of epidemic/pandemic(e.g., corona outbreak emergency care)	66%	40%
	Remote patient monitoring for the elderly (e.g., active and assisted living for elderly citizens through use of sensors/smart watches)	64%	46%
	Data-driven public health interventions – city level healthcare steps taken based on specific local needs driven by citizens' healthcare data – for example, regular monitoring of air quality due to traffic emissions and health drives, screening for deadly viruses (e.g., coronavirus)	63%	39%
	Incentives for citizens to walk/cycle instead of driving	66%	37%
	Gamification to promoting healthy living (e.g., 30 sit ups in front of a smart machine in a metro station/community center for a discount code/game tickets)	54%	34%
Public security	Smart surveillance of public areas – AI-enabled cameras capable of detecting and tracking abnormal or alarming situation in public areas	66%	40%
	Predictive policing: using data to predict crime in the near future based on data from recent incidents (e.g., burglaries, muggings)	60%	37%
	Facial recognition to identify citizens to help track known criminals/offenders	55%	35%

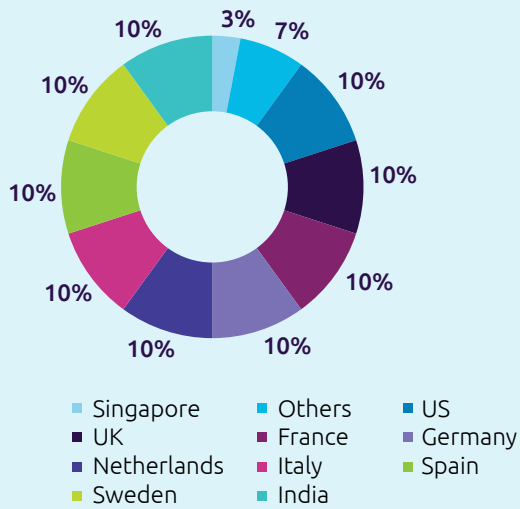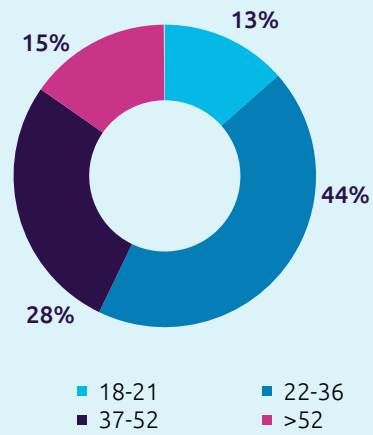| Areas of smart city initiatives	Use cases for smart city initiatives	Citizens' willingness to use	Citizens' willingness to pay
Public security	City command centers for emergency response optimization for gathering data from various sources and timely warnings with coordinated response during disasters, crises, or accidents (e.g., earthquakes, accidents, shootings)	66%	40%
	AI-based cybersecurity to protect citizen data	62%	39%
	Automated connectivity of buildings to emergency services (fire, police, hospitals) – dedicated panels for centralized emergency services access	68%	42%
Citizen services	Citizen app/chatbot for reporting accidents, crime, corruption, complaints such as streetlights not working, damaged roads, or citizen queries, provide information and get feedback for local development initiatives	65%	36%
	Wi-Fi hot spots in public areas in the city (e.g., metro stations, bus stops, parks)	72%	36%
	App for government services (e.g., birth/death certificates, local taxes, licenses, social welfare schemes)	68%	37%
	Workshops to educate citizens on how to use smart city initiatives	60%	36%
	Central digital citizen records via app for 24/7 access to vital citizen data	55%	33%
	Digital access to government-sponsored social welfare schemes for citizens in need (unemployed, disabled, etc.)	65%	38%
Sustainable development	Congestion tax on vehicles – a tax levied on vehicles that pass through a congested area during peak times (e.g., vehicles passing through downtown during morning rush hour)	49%	33%
	Smart lockers – lockers placed in public places that can be authenticated and operated by a smartphone	55%	39%
	App-based, real-time availability of food kitchens and shelters for the homeless	56%	38%
	App-based points/discounts for not using or returning plastic bags/bottles for recycling, which can be redeemed for paying utilities bills or museum tickets	65%	40%
	Coupons for childcare access for the underprivileged	58%	40%

Research methodology

Citizens survey

For this research, we conducted an extensive consumer survey of more than 10,000 citizens spread across 10 countries in the following cities
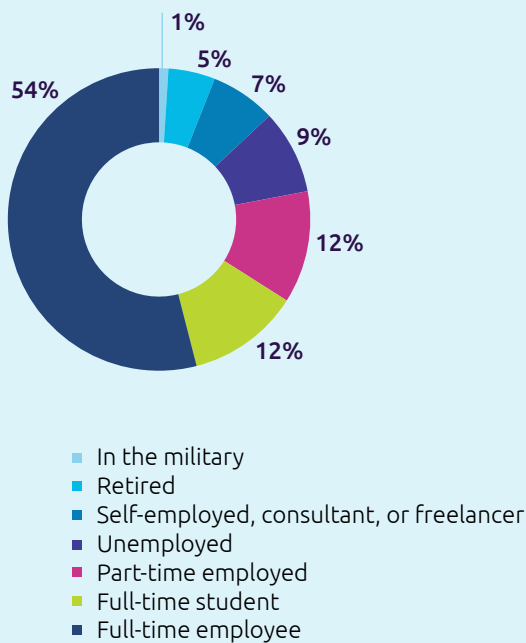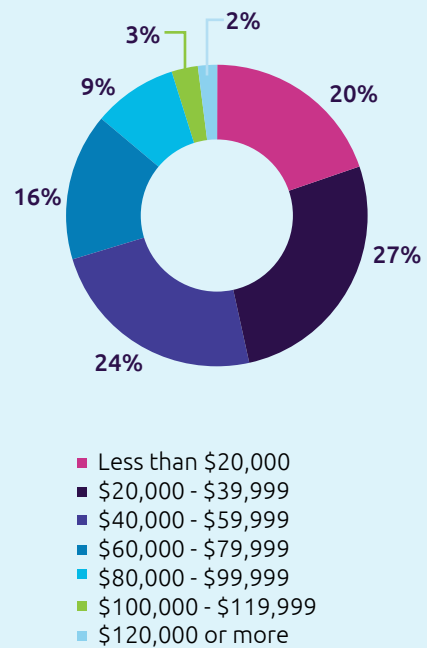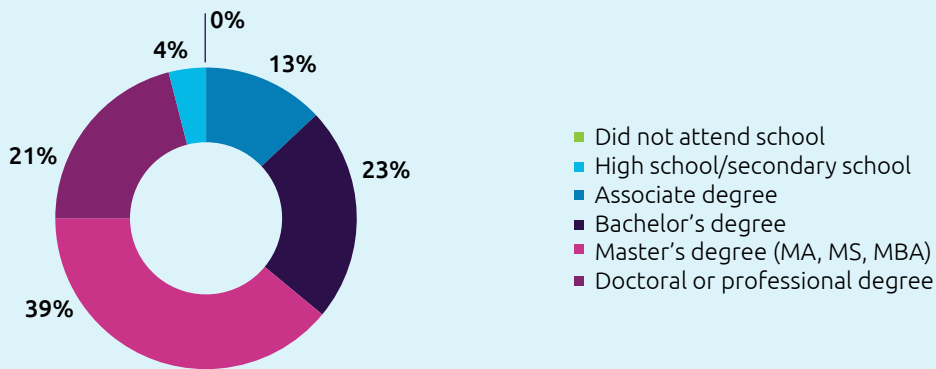
France
Angers
Dijon
Lille
Lyon
Marseille
Paris
Toulouse

Germany
Berlin
Cologne
Darmstadt
Dusseldorf
Frankfurt
Hamburg
Munich

India
Bengaluru
Chennai
Hyderabad
Mumbai
New Delhi
Pune

Italy
Florence
Milan
Naples
Rome
Turin

Netherlands
Amsterdam
Eindhoven
The Hague
Rotterdam
Utrecht

Spain
Barcelona
Madrid
Malaga
Seville
Valencia

Sweden
Gothenburg
Helsingborg
Linkoping
Malmo
Stockholm

UK
Birmingham
Bristol
Leeds
London
Manchester

USA
Boston
Los Angeles
New York
San Francisco
Washington, DC

Others
Espoo
Geneva
Helsinki
Oslo
Singapore
Tampere
Vienna
Zurich

By Country

■ Singapore	■ Others	■ US
■ UK	■ France	■ Germany
■ Netherlands	■ Italy	■ Spain
■ Sweden	■ India	

3%
7%
10%
10%
10%
10%
10%
10%
10%
10%
10%

By age

13%
15%
44%
28%

■ 18-21	■ 22-36
■ 37-52	■ >52

By work status

1%
5%
7%
9%
12%
12%
54%

- ■ In the military
- ■ Retired
- ■ Self-employed, consultant, or freelancer
- ■ Unemployed
- ■ Part-time employed
- ■ Full-time student
- ■ Full-time employee

By income

2%
3%
9%
16%
24%
27%
20%

- ■ Less than $20,000
- ■ $20,000 - $39,999
- ■ $40,000 - $59,999
- ■ $60,000 - $79,999
- ■ $80,000 - $99,999
- ■ $100,000 - $119,999
- ■ $120,000 or more

By education

- 0%
- 4%
- 13%
- 21%
- 23%
- 39%

- ■ Did not attend school
- ■ High school/secondary school
- ■ Associate degree
- ■ Bachelor's degree
- ■ Master's degree (MA, MS, MBA)
- ■ Doctoral or professional degree

Executive survey

We complemented the citizen survey with an executive survey of city officials spread across 10 countries. We also interviewed senior city officials (CIO/CDO) across major cities for this research.

By country

- 5%
- 8%
- 8%
- 8%
- 8%
- 10%
- 10%
- 12%
- 13%
- 17%

- ■ Singapore
- ■ Italy
- ■ Netherlands
- ■ Spain
- ■ Sweden
- ■ France
- ■ Germany
- ■ UK
- ■ India
- ■ US
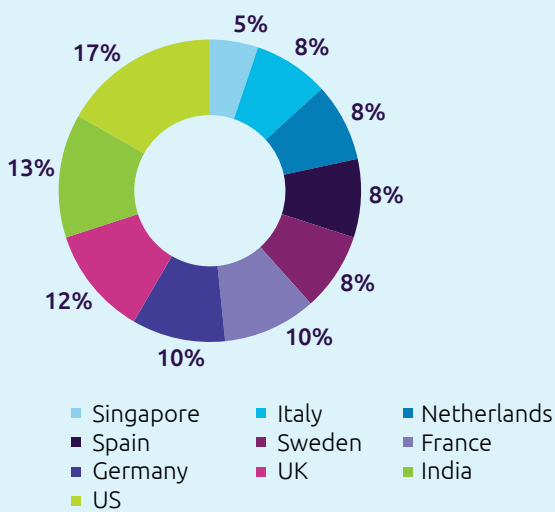
By citizen service of employment

- 7%
- 11%
- 14%
- 17%
- 52%

- ■ Citizen Services
- ■ Public Security
- ■ Healthcare
- ■ Transport and Mobility
- ■ City Administration
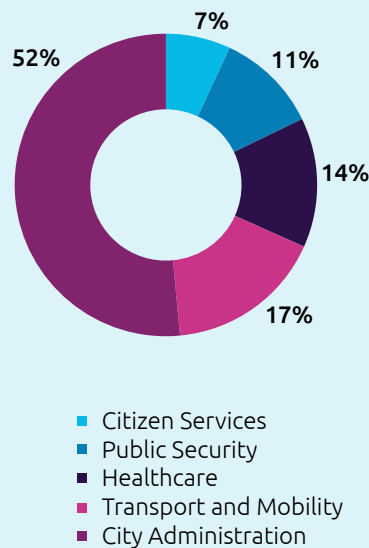
Capgemini helps communities become smart territories.

An approach in three phases:

Our approach is to help the community in developing its smart territory strategy and tools. To these ends, we rely on resources that have already successfully worked on similar implementations, such as the Dijon Métropole project. Our team is also working on a new architecture to provide a more sustainable integrated system.

- Smart Territory design

The first phase consists of defining with the community its global strategy. The final deliverables of this phase are a roadmap, including a plan for building solutions. The time spent on this stage is very important because it makes it possible to set up the best practices linked to the GDPR, cybersecurity, and the sizing of the hardware infrastructure to be developed. It makes it possible to highlight the main issues the different actors (citizens, firms, associations, institutions, deputies, etc.) face in their daily lives. The last exercise is the calculation of potential ROI and study of business case to reveal the importance of the long-term strategy.

- Smart Territory Tech Foundation

This second phase is dedicated to building the data territory platform. At the heart of a cloud or on-premises environment, our platform based on open-source technical bricks is the nerve center of the digital transformation of the territory. The idea is to benefit from an interoperable system that can communicate with all data sources independently of the communication protocol used. That's why the platform is in constant relation with IoT equipment, external information systems (e.g., platform of private partners), internal information systems (e.g., software already in place in the information system of the community), or other sources, such as open data or a mobile app dedicated to citizen relations, for instance.

Once the data has been integrated, a data lake within the platform can manage it at different levels (real time vs historization). A rule engine makes it possible to enrich the data and create workflows to manage it. APIs are also present to expose the data outside with strong authentication rules. This confers an ideal ecosystem to develop AI use cases.

- Smart Territory Services

The main aim of a smart territory strategy is to bring new services to citizens and other actors. To these ends, we developed a mobile app that is GDPR compliant and offers individual and general services to citizens. From a smartphone, citizens can access information and functionalities regarding waste management, economic development, mobility, environment, reporting on anomalies in the area, e-administration, and sharing between inhabitants.

For the community agents, we developed a hypervisor that provides a 360° view of the area in real time so that each event can be treated with a predefined procedure. The procedures include steps to follow and for each step, the contact coordinates to use. Our proven solution recently obtained the JO2024 label.

These solutions are made to evolve with futures needs of the communities.

References

1. CNBC, "Two-thirds of global population will live in cities by 2050, UN says," May 2018.
2. CNBC, "Two-thirds of global population will live in cities by 2050, UN says," May 2018.
3. CNN, "Toyota is building a 'smart' city to test AI, robots and self-driving cars", January 2020
4. UKAuthority, "King's College London develops air pollution app", March 2019
5. FastCompany," How Copenhagen plans to reach carbon-neutral status in just six years", August 2019
6. World Economic Forum, "Reading this alone? Recent surveys reveal the curious truth about loneliness", October 2018
7. MarketWatch, "Two years after hiring a Minister of Loneliness, people in the U.K. are still lonely", January 2020
8. Citizens Foundation website," Better Reykjavík", 2019
9. Los Angeles Times, "Use of high-tech tool to locate shooters may greatly expand in California under proposed bill", March 2017
10. Smart City Lab, This is how emergency systems work in a smart city, February 2020
11. Future Hamburg, "Check-in, Check-out Project", September 2020
12. Bloomberg CityLab, "Helsinki's MaaS App, Whim: Is It Really Mobility's Great Hope?" October 2018
13. Carnegie Mellon University," Surtrac Allows Traffic To Move at the Speed of Technology", October 2019
14. Wired," Copenhagen's New Traffic Lights Recognize and Favor Cyclists", February 2016
15. UKAuthority," TfL harnesses AI in planning for cyclists", January 2020
16. ZDNet, Australian government to bring all services online by 2025, November 2018
17. Capgemini Research Institute, "The Great DIGITAL DIVIDE Why bringing the digitally excluded online should be a global priority", May 2020
18. The Strait Times, More help for seniors and hawkers to adopt digital technology, June 2020
19. Government Technology," Texas City Rolls Out New Smart Speaker App for Residents", January 2020
20. Government Technology," 7 State or Local Governments Using Amazon Alexa", September, 2017
21. Straits Times," More personalized services in updated Moments of Life app "February 2020
22. The Conversation, Air quality near busy Australian roads up to 10 times worse than official figures, April 2020
23. The Economic Times,"45 smart city command and control centres turn into Covid-19 war rooms", March 2020
24. GovInsider," Explore West Java's Command Center in VR", June 2020
25. Capgemini Invent, "Data, territories and citizens Rethinking the operational model of the territory to reconcile data and democracy", June 2020
26. E-Estonia, X-Road
27. ComputerWeekly, "Sadiq Khan calls for evolution of London Datastore", January 2020
28. ComputerWeekly, "TfL launches wireless device tracking to gather Tube data", July 2019
29. BalticUrbanLab," Stakeholder involvement app AvaLinn utilized in Tallinn", September 2018
30. Reuters, "Virtual Singapore project could be test bed for planners - and plotters", September 2018
31. ZDNet," Online voting: Now Estonia teaches the world a lesson in electronic elections", March 2019
32. UKAuthority, "Data partnership to support London's coronavirus recovery", May 2020
33. HBG website: https://hbg.works/

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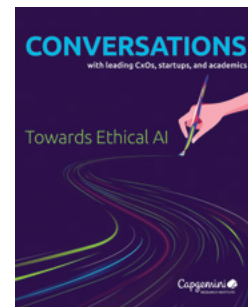

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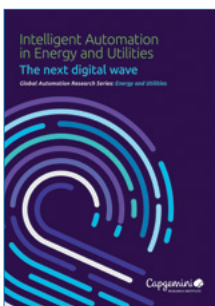

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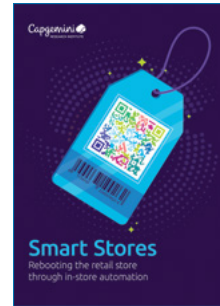
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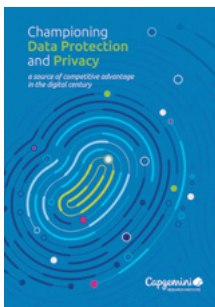
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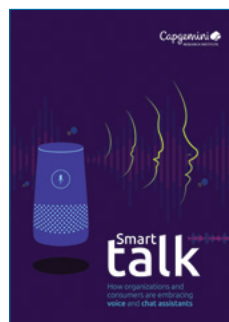
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AI Powered Enterprises

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