



Forces of change: Smart cities

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The next generation of urban evolution is here. Moving beyond just connected infrastructure and smarter things, the smart cities of tomorrow engage governments, citizens, visitors, and businesses in an intelligent, connected ecosystem. The goal: better city services and a higher quality of life. This evolution, *Smart City 2.0*, enhances citizens' experience and city decision-making using the 3Ds—data, digital, and (user) design.

Although the focus of cities remains the same—creating livable environments where people and businesses can thrive—the ways to achieve that goal are evolving. Increasingly, cities are putting data in the hands of end users to drive better decision-making. They tap into the collective intelligence of their constituents to create solutions around some of the toughest urban problems. They adopt a platform approach that enables constituents to use technology to reimagine core city operations.

These shifts democratize the development of cities and upend the traditional roles of governments, businesses, and residents. With governments evolving into solution enablers, businesses becoming more participative, and a growing cadre of citizen co-creators, tomorrow's smart cities will be more connected, networked, and collaborative.

What is our view of smart cities?

RECENTLY, many cities have upgraded their infrastructure, using sensing technology and data analytics to better manage urban assets such as public transit, wastewater systems, and roads. This “connected infrastructure” vision comprises what is known as Smart City 1.0—physical assets networked via sensor technology that generate streams of valuable data from “smart” parking meters, streetlights, and even trash receptacles.

For cities that have yet to progress along the smart city journey, this is still a powerful vision. Connected sensors that collect data can help cities to optimize the performance of their physical infrastructure, and are a key part of what it takes to build a smart city.

Today, however, we are beginning to see the dawn of the next generation of urban evolution—Smart City 2.0—as some of the more advanced cit-

ies have begun to move beyond mere infrastructure, tapping the wisdom of their residents and visitors. Ultimately, the smart cities of tomorrow will involve not just government, but citizens, visitors, and business in an intelligent, connected ecosystem built on a sensor-based physical infrastructure.

Beyond improving infrastructure, Smart City 2.0 focuses on enhancing the citizen experience by operating at the intersection of the 3Ds: data, digital, and human-centered design. The goal is to enable better decision-making through the use of data for all stakeholders—government, business, and residents.

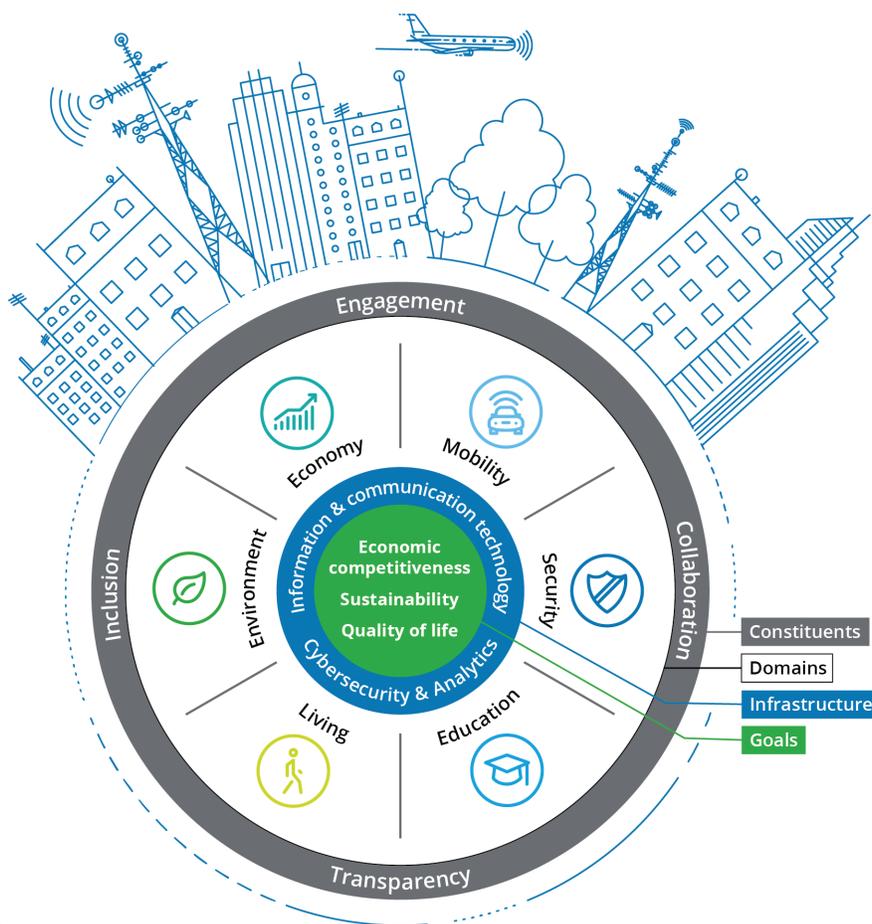
The focus of any smart city should be its people, providing benefits such as:

- A better quality of life for residents and visitors
- Economic competitiveness to attract industry and talent
- An environmentally conscious focus on sustainability

These three goals—quality of life, economic competitiveness, and sustainability—can provide the foundation for a smart city initiative. Deloitte’s smart city framework (figure 1) offers a lens through which technology can seed change in six urban domains: economy, mobility, security, education, living, and environment.¹ This framework can help cities as they move along their smart city journey.

The SmartSantander project in Santander, Spain, provides an early peek into how data and

Figure 1. Deloitte smart city framework



Source: Deloitte.

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citizens can together transform a city in a more environmentally sustainable, economically attractive, and responsive environment that provides a better quality of life to its residents.² In addition to the 20,000 sensors the city has installed, residents can turn their smartphones into sensors by downloading the “Pulse of the City” (PoC) app. Becoming, in essence, mobile intelligent sensors for the city, citizens play the role of “prosumers” in the Smart-Santander project.

City officials can analyze data in real time to adjust energy use, the number of trash pickups needed in a given week, and even how much water to sprinkle on the lawns of city parks. Critically, citizens can also tap into that data via the PoC app and

use it for their daily needs. Commuters can access real-time traffic information to plan commutes and know when the next bus is due. An asthma patient can plan her day to avoid areas of high pollution, while a driver can use the app to track the progress on requests filed for road maintenance. The city has also made the information available to developers to create consumer services. For example, Smart-SantanderRA, an augmented reality mobile application, includes information on more than 2,700 beaches, parks, and other city sites.³

This two-way flow of information allows the city to unleash tremendous value, creating an information ecosystem that benefits all participants.⁴

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Why do smart cities matter?

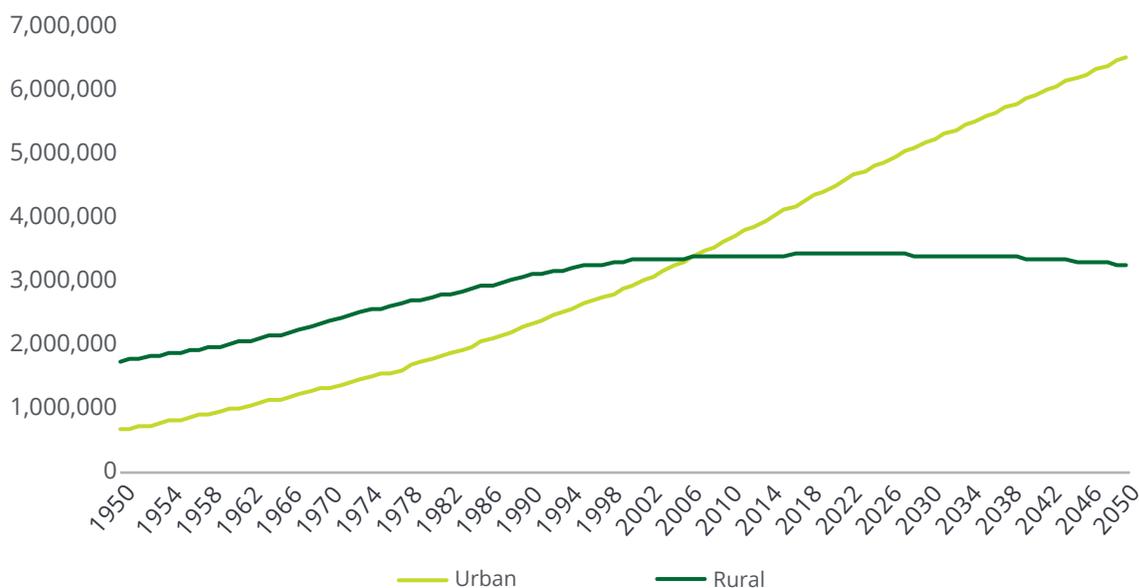
SMART cities matter because cities are important. Urban centers have long been engines of economic growth and opportunity. A World Bank analysis of 750 cities around the globe found that from 2005 through 2012, economic growth in 72 percent of cities outpaced their respective national economies.⁵ By 2025, the world’s top 600 cities are expected to account for 60 percent of global GDP. London today accounts for almost a fifth of the United Kingdom’s gross product.⁶ In the United States, the Northeast corridor (Boston to Washington, D.C.) and the Los Angeles metropolitan area together account for nearly a third of the national GDP.⁷

The world is seeing a continued concentration of population in cities. Cities that aren’t equipped to handle growth can experience negative impacts on

their environment—and residents. This challenge is becoming increasingly relevant as many urban centers around the world undergo explosive growth. Over the next three decades, the rate of urbanization is expected to grow steeply (figure 2)⁸. Currently, more than half of the world’s population lives in towns and cities, and by 2050 this number could swell to about 66 percent, adding more than 2.5 billion people to the urban population.⁹

Rapid urbanization puts tremendous pressure on population centers, and presents a challenge for cities to provide environmental sustainability and ensure the physical security and safety of residents. Economic advances represent little actual progress if they degrade the air, water, and soil. In addition, the threat of rising crime rates, poverty, and civic unrest make cities fragile. To avoid these

Figure 2. Urban and rural populations of the world, 1950–2050 (in thousands)¹⁰



Source: United Nations Department of Economic and Social Affairs, Population Division, World Urbanization Prospects (2014 revision).

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challenges as much as possible, most thriving cities seek sustainable, but also resilient, growth. Smart city technology represents part of the solution.

Further, governments aren't the only entities facing the challenges of urban growth; businesses are also affected by the same factors as they reassess their ability to drive continued growth. To attract the educated talent they need, businesses need cities to be livable. In addition, companies are increasingly taking an active role in being good corporate citizens, which means being an active partner in the urban ecosystem.

Finally, smart cities are pivoting toward their most important constituent: people. The economic clout of cities is an important factor that attracts talented individuals to migrate to urban centers.

Cities are responding by finding ways to prompt better decision-making, not only by government but by business and residents, tapping into the collective intelligence of the city.

Enabling smarter decision-making

Smart cities enable not just smarter *things*, but smarter *decisions*. A truly smart city uses technology to promote better decision-making for city officials and its residents.

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Installing sensors that collect data for optimizing the performance of physical devices is one part of what it takes to achieve the smart city. In Amman, Jordan, for example, the city has adopted a data-driven approach to streamlining the waste management process.¹¹ City officials can now monitor factors such as waste tonnage per district and complaints resolved, and track vehicles through a new fleet management system. Garbage trucks that once returned nearly empty are now redirected to routes where full trucks have skipped collections.

Cities are applying similar smart infrastructure to street lights, water use, traffic management, and more. Thanks to new data generated by sensing infrastructure, the city can make smarter decisions.

Achieving collective intelligence: The new urban ballet

Collective intelligence is nothing new. Groups of people, including families, armies, and business teams, have always exhibited varying degrees of collective intelligence. Collective intelligence is manifested even in groups of animals: Swarms of insects and flocks of birds are capable of aggregating the information gleaned from individual group members to find food and nesting places.¹²

Thomas Malone, the founder of the MIT Collective Intelligence Center, points out that Internet technology enables new forms of collective intelligence that were impossible only a few decades ago. The automated world of the Internet of Things (IoT) allows us to take Malone's point still further. Citizens equipped with mobile phones capable of capturing, transmitting, and receiving information form a digital sidewalk ballet, contributing localized bits of knowledge, ideas, and opinions that lead to smarter decisions.

Consider one experiment in Boston. The city's usual food safety process, in which health inspectors selected restaurants randomly for further scrutiny, was not optimal. At the same time, the city's Data Portal hosts data sets available for public

use on restaurant food safety inspections and other aspects of city life. To better target the restaurants in need of attention, the city partnered with Yelp and Harvard Business School to sponsor an open competition and made available both Boston's restaurant inspection data and Yelp's restaurant reviews dating back to 2006 to more than 700 contestants. The goal was to develop an algorithm that would predict health violations and enable city officials to better target restaurants for inspections.

The participants analyzed the text of the reviews, including common words and phrases, and the Harvard economists evaluated the submissions against the city's actual inspections covering 364 restaurants conducted in the six weeks following the competition. The verdict: Using the winning algorithm would have made inspectors 30–50 percent more productive in finding violations.¹³

Human-centered design also promotes collective intelligence, and is central to the smart city movement. For instance, by using a mobile app and social media to aggregate citizen complaints, the city of Buenos Aires was able to become more responsive and improved on almost all quality of life parameters.¹⁴ Similarly, the city of Boston's Street Bump app uses sensors in phones to map bumpy roads and empowers drivers to report potholes themselves. In other words, city data + smart citizens = better city decisions.¹⁵

Rise of city-as-a-platform

This new information-sharing partnership between the city, residents, and business can be thought of as the “city-as-a-platform.” Consider a few examples of this type of approach and the improved decision outcomes that it can generate:

- In 2013, the city of Amsterdam sought to expand its 11 existing air quality measurement sta-

tions. The city wanted a street-level hyperlocal measurement of air quality that the existing infrastructure did not support. What's more, the existing air quality measurement apparatus was too expensive to be scalable. The city decided to take a different route to tackle this problem,¹⁶ launching the Amsterdam smart citizens' lab. The lab provided a platform for citizens, scientists, engineers, and designers to develop low-cost, easy-to-build-and-maintain sensor kits to measure temperature, humidity, light, sound, carbon monoxide, and nitrogen dioxide. Citizens were active participants and were taught how to upload data to the online platform.¹⁷

City data + smart citizens = better city decisions.

- The Greater London Authority created the London Dashboard, a centralized data repository available to Londoners free of charge. The data is organized around key public services, enabling Londoners to develop the raw data into new data sets, apps, and websites—while encouraging transparency and better management by city authorities.¹⁸

These examples provide a peek into the concept of city-as-a-platform: the role of government shifts from “doing things” to enabling participation in civic innovation. As cities start to leverage decentralized expertise, they can embrace a new way of governance in which constituents utilize technology to reinvent—and sometimes overhaul—core processes.¹⁹

What are the impacts of smart cities?

Implications for government

EVOLVE AS A CONVENER OF PROBLEM-SOLVERS

In the drive to smarter cities, city governments can foster the creation of environments in which ecosystem innovators—including government, businesses, social entrepreneurs, and individuals—can thrive. Governments help build platforms, recruit an ecosystem of partners, hold partners accountable for targeted outcomes, attract new investment, open up services to choice, and manage crowdsourced campaigns and competitions.²⁰ This requires them to assemble an ecosystem of partners across government, established businesses, startups, the academic sector, and the nonprofit world.

BUILD A GOVERNANCE STRUCTURE

Because they unite a diverse ecosystem of stakeholders, smart cities require clearly defined governance. City leaders, regional governments, transportation districts, corporate and nonprofit partners and, depending on the funding model, state and federal agencies may all participate in establishing and executing a smart city vision. Stakeholders should be able to articulate their responsibilities and ensure that appropriate information flows to the right decision-makers. Establishing accountability up front and creating mechanisms to drive timely decisions are also critical.²¹

DEVELOP SUSTAINABLE AND INNOVATIVE FUNDING STREAMS

Financing constitutes a major obstacle for many smart city initiatives. Many innovative projects struggle to get off the ground due to lack of funding. However, cities can address this challenge through

creative approaches to fund smart city projects that depart from traditional models of infrastructure finance.

Public-private partnership (PPP) models will play an important role in smart city financing and funding. However, the success of the model will depend on how risk and reward are reallocated between public and private entities.²² Some novel approaches already underway can provide a path forward.

As one approach, cities can take stock of their assets and identify resources that can be monetized. Understanding the relative value of the asset to both the city and to the private sector is critical. For instance, through its LinkNYC program, New York City is replacing its legacy phone booths with more than 7,500 digital kiosks that provide citizens with free high-speed Wi-Fi, wayfinding services for visitors, and sensors for monitoring environmental data. The advertising revenue from such kiosks would be used to cover the costs of installation, equipment maintenance, and digital advertising.²³

Implications for the private sector

ALIGN TO SMART CITY GOALS

The smart city movement provides an opportunity for both for-profit and nonprofit partners to engage with governments. Cash-strapped city governments are always exploring opportunities to partner with the private sector. Thus, organizations need to be proactive in finding mutually beneficial opportunities.

For example, Columbus, Ohio, developed strategic partnerships with private entities while it was still contending for the Smart Cities grant. Private partners both inside and outside of Ohio have continued to contribute to the Smart Columbus Acceleration fund. For its part, the federal government grant indicated to potential investors that the Smart Columbus initiative was viable, well-developed, and likely to succeed, encouraging businesses to not only fund initiatives but also explore their own growth opportunities in the form of user fees, access to data, and others.²⁴ Ultimately, the city was able to multiply its initial funding of \$50 million to more than \$500 million by building a large ecosystem of smart city partners.

Implications for residents

RESIDENTS AS CO-CREATORS

While citizens are the ultimate beneficiaries of any smart city initiative, citizen participation can also be engaged to help develop citizen-centric solutions. Residents can be an important source of data generation, solution development, and testing for both governments and businesses.

Co-creation of policies is one area where residents who are most affected by a policy can work alongside its designers. For example, the Australian Center for Social Innovation tackled the issue of “chaotic families” (domestic violence, child abuse, and substance abuse) by co-designing a solution called “Family by Family” with the people they sought to support. Such co-creation approaches allow policy designers to build better prototypes and test them in real-life scenarios, increasing effectiveness.²⁵

CITIZENS AS SENSORS

Co-creation is not limited to just the policy arena, however. With the growing ubiquity of wearable and connected devices, citizens can co-create data itself. For instance, the FixCascais app in Cascais, Portugal, allows citizens to photograph and report incidents and problems to municipal services.²⁶

Data gathered through these types of programs can not only inform decision-making in cities, but enable better customization and experiences for residents.

Louisville, Kentucky, for example, had gained a reputation as one of the worst cities for breathing disorders.²⁷ To address the problem, the city developed AIR Louisville, a public-private partnership that uses data analytics to inform the public on triggers that aggravate asthma. The technology behind the project, a sensor that attaches to an asthma inhaler, was brought in by Propeller Health, a manufacturer of sensors.

The sensor collects data about the surrounding environment each time an individual uses the inhaler. Consumers can view reporting data through a smartphone app. The user can then better identify personal respiratory triggers—time of day, location, temperature, pollen count, and pollution. This data is also communicated to health care providers, enabling them to tailor a personalized plan for managing participants’ asthma and chronic obstructive pulmonary disease. In its first year, AIR Louisville helped participants to reduce their asthma rescue inhaler use by 82 percent and more than double their number of symptom-free days.²⁸

EMPOWERED CITIZEN CONSUMERS

Armed with the right data and tools, citizens can become more proactive, connected, collaborative, and participative in the smart city movement. Some of the earliest examples are already visible in the sustainability space, where energy agencies spearhead efforts to simplify electricity bills and visualize data from the smart grid.²⁹

Opower, a company working in energy sector, creates home energy reports using a mix of utilities data on user consumption pattern and crowd-sourced data from energy users themselves. It then gamifies the experience for users by allowing them to complete challenges, participate in groups, and earn points and badges tied to reduced energy use.³⁰ In doing so, they help consumers make better decisions for themselves, while contributing toward energy policy goals that benefit the public good.

What should you do next?

HERE are a few ways cities, businesses, and citizens can kick start their smart city journeys.

Government

- 1. Start with a compelling business case.** Present an idea city residents can easily understand and articulate.
- 2. Run the effort as a portfolio.** Rather than a single, huge project, create a portfolio of projects, each with its own business case.
- 3. Employ a phased approach with a series of “small wins.”** Demonstrating success early is important, so organize resources to make this happen.
- 4. Communicate throughout the journey.** Don’t underestimate change management and communications—changing a culture and mindset takes time.
- 5. Focus on results.** Pick three things to announce as successes one year from now to demonstrate progress.

Businesses, nonprofits, and social enterprises

- 1. Look for opportunities to partner with cities.** Look for initiatives that match organiza-

tional goals. The growing ecosystem of partners in Columbus, Ohio, shows us how nongovernmental players can play an important role in driving smart city initiatives.

- 2. Look beyond just financing smart city initiatives.** Identify opportunities that could add value to both the city as well as business. Balancing the risk and reward between public and private entities will be critical.

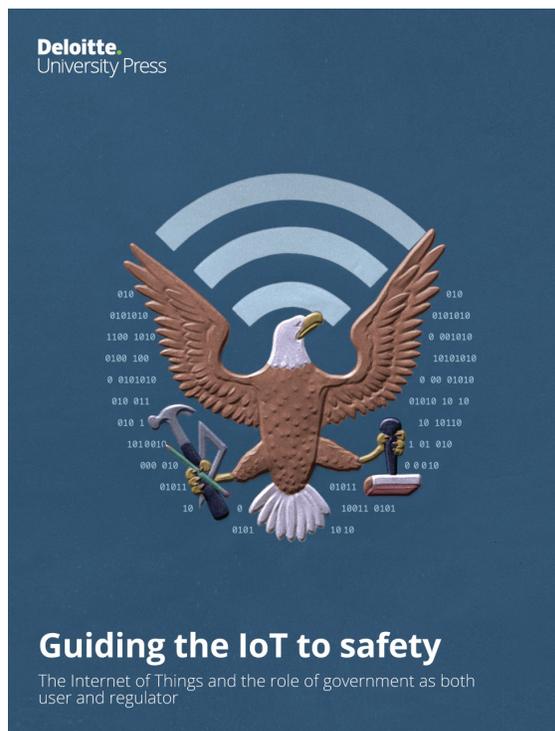
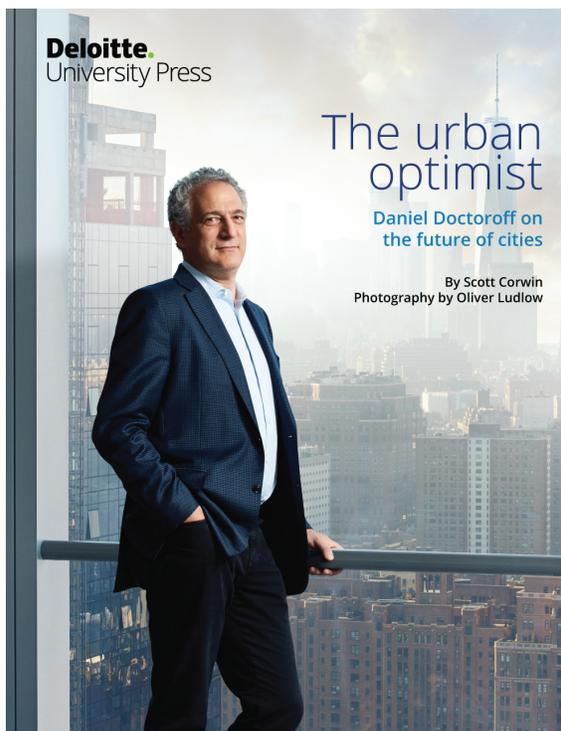
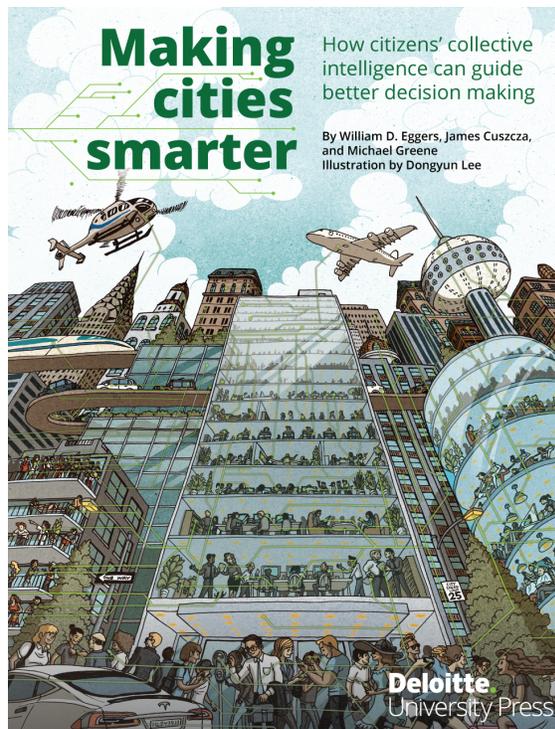
Citizens

- **Take a proactive role** as co-creators in shaping smart city policies and initiatives.
- **Be conscious and vocal** about the change that smart city transformation will entail. Garner better understanding around emerging technologies and identify their implications to security and privacy.

In an era of explosive growth, emerging technologies will shape the way cities change. Increasingly, residents and businesses will take a central role in driving the future of our cities, with governments enabling their participation.

Smart City collection overview

To read more on this topic, visit the [Smart City collection](#) on Deloitte Insights.



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ACKNOWLEDGEMENTS

The authors would like to thank **Mahesh Kelkar** from Deloitte Center for Government Insights for his contribution in driving research and development of the POV, **Mark Cotteleer** and **Brenna Sniderman** from the Center for Integrated Research for their invaluable insights and review, and **John O'Leary** from the Center for Government Insights for editorial support at critical junctures.

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