



WHITE PAPER

The Evolution of Smart Cities: Delivering on the Promise

Published 1Q 2020

Commissioned by Verizon

Eric Woods

Research Director

Ryan Citron

Senior Research Analyst

TABLE OF CONTENTS

Table of Contents	1
Section 1	3
Executive Summary	3
1.1 The Evolving Nature of Smart Cities.....	3
Section 2	5
Smart Cities Today	5
2.1 A Global Movement, Local Momentum.....	5
2.2 US Cities Are Stepping Up.....	7
2.3 One City’s Journey: How Plano Is Shaping Its Smart City Future	9
Section 3	11
Vision, Innovation, Outcomes	11
3.1 A New Phase for Smart Cities.....	11
3.2 Vision.....	12
3.3 Innovation.....	13
3.3.1 Smarter DC: Aligning Innovation and City Goals	13
3.4 Outcomes.....	14
3.5 Smart Cities and the Fourth Industrial Revolution	15
3.5.1 Traffic Management in the Age of 5G and Autonomous Vehicles	16
Section 4	17
Delivering On The Promise of Smart Cities	17
4.1 Business Model Innovation	17
4.2 Beyond Pilots: The Bridge Between Innovation and Outcomes	18
4.3 Building Capacity: New Partner Ecosystems.....	19

4.4	A Platform Approach to Technology	19
4.5	A Holistic Perspective on City Challenges: City as a Service	21
4.6	Conclusion and Recommendations	22
Section 5	24
Scope of Study	24
Sources and Methodology	24

Section 1

EXECUTIVE SUMMARY

1.1 The Evolving Nature of Smart Cities

The importance of cities to the development of a sustainable, global economy that can increase prosperity, address climate change, and ensure the well-being of all communities is widely recognized. Local leaders around the world are committing to digital and low carbon strategies as they prepare their communities to meet economic, environmental, and social challenges. Cities are also recognizing the need to ensure social and digital equity when deploying new technologies.

The ideas and principles behind the smart city movement continue to evolve as cities and their partners better understand the requirements, the opportunities presented by new technologies, and how to address the challenges. The task now is to show how citywide deployments of smart city solutions can deliver real improvements to services and to people's lives. There are many signs that this shift is happening:

- **Internet of Things (IoT) deployments in cities are ramping up:** Connected street lights are creating new urban network platforms; smart meters and smart grids are enabling new urban energy systems; transportation and mobility are being transformed through digitization, electrification, and automation; and citywide networks are supporting urban innovation on a massive scale.
- **Cities are developing new ecosystems that integrate the public and private sector, universities and research bodies, and voluntary and community organizations:** This development has many facets including the creation of new business models, the establishment of research and innovation platforms, and support for new forms of citizen and community engagement.
- **Smart, sustainable, and digital approaches are becoming embodied in city planning, infrastructure projects, building developments, and service design:** The spread of smart, connected devices and the growth of urban data analytics is transforming many operational areas and opening the door to a vast array of yet-to-be-defined new services.

Two-thirds of the 50 largest US cities have a smart city strategy in place.

Cities need to demonstrate that innovative technologies and new approaches to service delivery can:

- Have a positive and measurable impact on key city challenges in areas such as transportation, public safety, health, and social equity.
- Benefit all communities, create more equitable cities, and reduce the digital divide.
- Be based on stable, proven, and replicable business models.
- Enable cross-sector innovation and collaboration without producing a new generation of siloed solutions and stranded assets.

Cities also need to be prepared for the next wave of technological disruption and the implications of the Fourth Industrial Revolution, which are likely to have an even greater impact on how cities work. Cities, service providers, and technology companies all have a role to play in this shift, as do state and national governments. The ability of the whole smart city value chain to cooperate to address barriers and to maintain momentum will be crucial.

The task now is to show how citywide deployments of smart city solutions can deliver real improvements to services and to people's lives.

There is no single model for the smart city, nor is there a final endpoint. Cities committed to making the best use of technology to serve their citizens are embarking on a journey shaped by local priorities and conditions. There are, however, lessons to be learned from more than a decade of smart city activity across the world.

The aim of this white paper is to examine the challenges and barriers that cities face as they evolve their smart city programs, highlight cities that are addressing those issues successfully, and provide guidance for cities looking to accelerate the adoption of smart city solutions. Navigant Research, a Guidehouse company, has drawn on its extensive smart cities research program and discussions with cities and their partners for this paper.

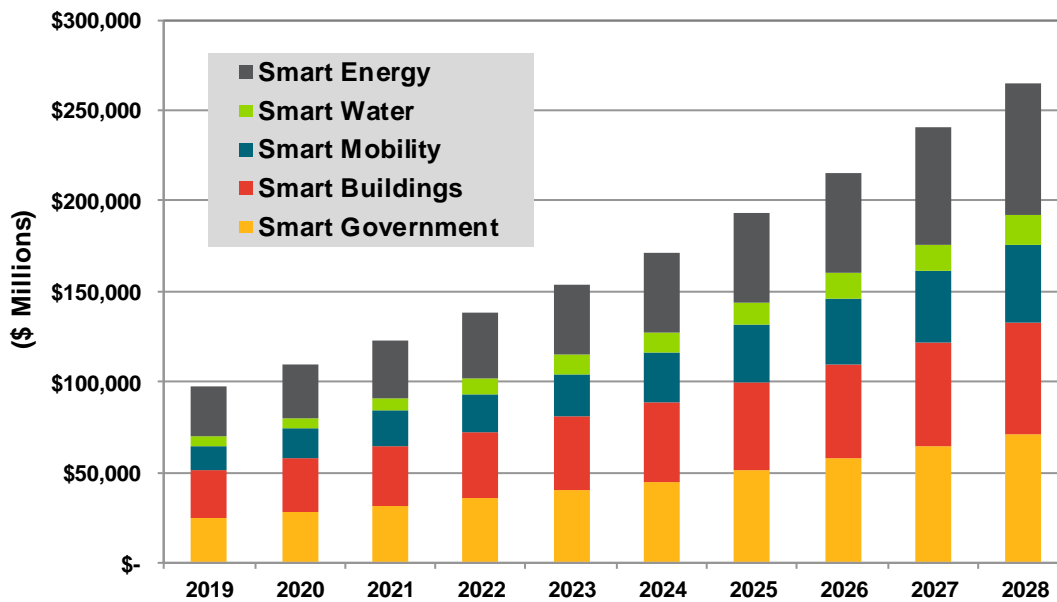
Section 2

SMART CITIES TODAY

2.1 A Global Movement, Local Momentum

Navigant Research is tracking smart city projects in around 300 cities across the world. Many other cities are developing their strategies and deploying new technologies to improve urban services. This momentum behind smart cities is reflected in the expanding market for smart city solutions. Navigant Research estimates that almost \$110 billion will be invested in the global smart city technology market in 2020 and annual investment will reach \$265 billion by 2028. The US market alone is expected to be worth \$30 billion in 2020, and more than \$65 billion annually by 2028.

Chart 2-1. Annual Smart City Revenue by Industry, World Markets: 2019-2028



(Source: Navigant Research)

The smart city technology landscape is broad. Almost any digital or infrastructure innovation has potential applicability to the urban environment. The efficiency and responsiveness of emergency services, for example, are being enhanced by better public safety monitoring, data analytics, and interagency communications. Sectors such as transport and urban energy are being transformed by a combination of policy initiatives and new technologies, while new solutions are emerging in previously undervalued operational areas such as street lighting, parking, and waste management. The growing use of artificial intelligence (AI), the deployment of 5G networks, and the development of autonomous

vehicles will further accelerate the transformation of city services. An overview of some of the most important smart city solutions is provided in Table 2-1.

Table 2-1. Examples of Smart City Applications and Technologies

Industry	Smart City Applications	Key Technologies
Smart Energy	Smart metering, demand management, renewable energy integration, microgrids, vehicle-to-grid support, energy as a service, community energy	Smart meters, distribution automation, grid analytics, demand response systems, energy storage, energy management systems (EMSs), grid communications
Smart Water	Water system upgrades, consumption monitoring, wastewater treatment, environmental safety systems, flood management	Smart water meters, sensor and communication networks, water and wastewater monitoring and management systems, water system analytics, flood detection
Smart Mobility	Traffic monitoring and management, congestion management, road user charging, mobility as a service, public information systems, smart parking, integrated traffic light management	Intelligent traffic management, adaptive traffic control, EV charging systems, road use pricing systems, sensors networks, monitoring and management parking, traffic monitoring, predictive analytics, public portals and smart apps, open data platforms, connected and autonomous vehicles
Smart Buildings	Intelligent building control, building energy efficiency, building retrofits, building-to-grid integration	Building EMSs, building automation management systems, building Internet of Things (IoT), building analytics, energy performance management, grid integration, intelligent lighting systems
Smart Government	Public safety, social care, smart street lighting, smart waste management, environmental monitoring, city management, citizen portals, open data	Sensor networks, city communication networks, cloud computing services, data analytics and AI, digital twins, data platforms, connected lighting

(Source: Navigant Research)

2.2 US Cities Are Stepping Up

Of the 50 largest US cities, 38 have a smart city strategy or significant projects underway, seven are planning or scoping a smart city strategy, and only five have no current program or any significant projects.¹ Atlanta, Charlotte, Chicago, Boston, Kansas City, Los Angeles, New York, San Diego, and Washington, DC are examples of cities that have established extensive programs.

Smarter DC is a district-wide smart city framework to develop and share best practices and take an outcomes-based approach that supports mayoral priorities and city challenges.

Cities are not only developing strategies and launching pilot programs—substantial investment in new solutions is taking place in several key sectors.

- **Building on smart street lighting investments:** Many US cities have recognized the financial and environmental benefits of moving to smart street lighting, including Chicago, Los Angeles, and San Diego. The city of Beverly, Massachusetts, for example, has deployed 3,500 connected lights using Verizon’s smart lighting controls and cellular network.
- **New approaches to urban mobility and traffic management:** As a response to growing traffic congestion, US cities are deploying an increasing number of projects focused on smart transportation networks, including smart parking and smart traffic signal and management systems. According to the Los Angeles Department of Transportation (LADOT), the city’s advanced traffic management and monitoring system has reduced travel times by 12% and increased vehicle speeds by 16%.²
- **Advancing urban data analytics:** US cities such as Boston, Chicago, and New York continue to be among the global pioneers in developing new approaches to using analytics to improve city services. Initiatives such as New York’s Mayor’s Office of Data Analytics are being replicated by other cities in the US and around the world.
- **5G cities:** The US is a global pioneer in 5G network deployment, and cities such as New York, Sacramento, and San Diego are among many seizing the chance to be at the forefront of the next revolution in urban communications. Sacramento, for example, is partnering with Verizon to evolve a model fit for the next phase in smart city development. The city is working with Verizon to establish a test bed for 5G

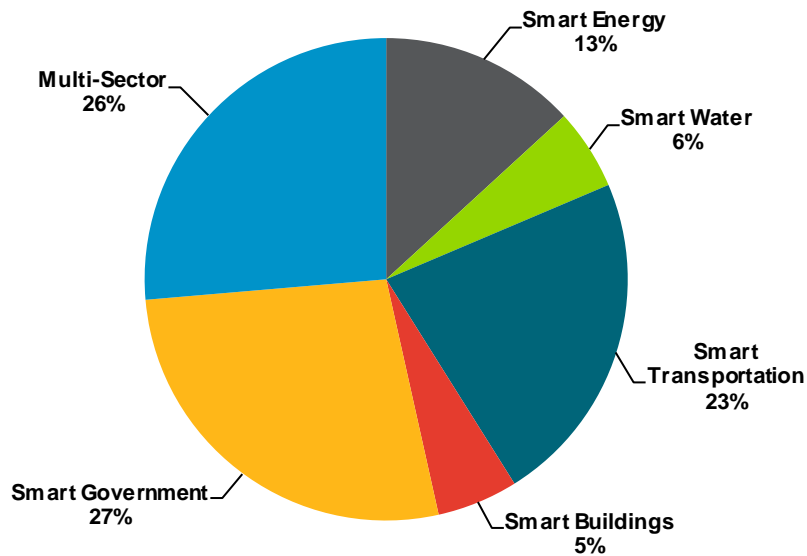
¹ Navigant Research, *Smart City Tracker 2Q19*, 2Q 2019.

² City of Los Angeles, Department of Transportation, “About Us,” <http://trafficinfo.lacity.org/about-atsac>.

deployment and to develop an ambitious smart city program spanning a range of city applications in areas such as traffic management and public safety.

- **Leading on climate change:** US cities have stepped up to take a leadership role on carbon emissions reduction, which further spurs investment in clean energy, low carbon transportation, and energy efficient buildings. US cities are already leaders in the deployment of smart meters, smart grids, and distributed renewable energy.

Chart 2-2. Smart City Projects by Primary Industry Sector, North America: 2Q 2019



(Source: Navigant Research)

The next phase in the evolution of smart cities is the most important and possibly the hardest. It requires the transition to a market that enables cities to select and deploy robust solutions as part of an adaptable and responsive city service platform. This transition builds on insights and lessons learned from the initial phases in smart cities development but also requires a step change in thinking about how solutions are specified and deployed.

2.3 One City’s Journey: How Plano Is Shaping Its Smart City Future

The city of Plano, Texas, provides a good example of a US city looking to smart city solutions to help address local challenges. In a Navigant Research webinar, Mayor Harry LaRosiliere identified issues shaping the city’s emerging smart city strategy.³

Plano’s story reinforces the important point that smart city developments are always rooted in local conditions and priorities and that each city must find a route that best suits its needs. In the case of Plano, the context is set by its rapid evolution from a Dallas suburb to a city of almost 300,000 people and a significant employment center in its own right. This brings common city-scale challenges such as the need to ensure public safety, a topic that “always rises to the top” according to the mayor. But as with many successful cities, transportation is “the key pressure point.” For Plano, that includes a daily influx of 60,000 people and the need to manage traffic flowing from other communities through Plano to Dallas. Plano is also preparing for the future of transport: FedEx is piloting automated delivery robots in the city, and Uber has identified the region as one of the first sites for the Uber Elevate aerial ridesharing service.

Plano is formulating a smart city strategy that will help it identify the solutions and partners it needs to meet current and future challenges. According to Mayor LaRosiliere, it is important that the city understands its own needs before defining a future strategy. He also believes it is important that the city looks at the immediate and the incremental benefits that can be achieved through such a program—not just focus on “bright and shiny objects.” So, the city is looking at easy wins in areas such as the city’s 911 system and better access to city services, alongside longer-term projects in areas such as traffic management.

Mayor LaRosiliere also highlighted the importance of collaboration. Creating a spirit of collaboration among all stakeholders is fundamental to any smart city program. First, cities need to invest in building internal communications and trust if they are to develop a cohesive approach to smart city development. Then they need to work with a range of other agencies to deliver better outcomes. Transportation provides a good example of the need to work with state and local agencies on a regional approach. There is also significant opportunity to work with other cities and learn from their experiences through organizations like the United States Conference of Mayors.

Creating a spirit of collaboration among all stakeholders is fundamental to any smart city program.

³ Navigant Research, *Smart Cities Evolution: From Vision to Scale*, July 2019, <https://www.navigantresearch.com/webinars/smart-cities-evolution-from-vision-to-scale>, July 2019.

Finally, the city needs partners in the private sector that it can work with to deliver on its long-term vision.

The theme of collaboration was also echoed in the webinar by Bill Bratton, former New York City Police Commissioner and Los Angeles Police Chief. He pointed out how the digitization of the city landscape—from smart street lights to intelligent traffic controls—combined with ubiquitous communications changes the physical landscape in which policing takes place. He stressed that this drives the new focus on collaboration. The Commissioner sees technology creating a seamless web that enables law enforcement to work with other agencies, businesses, and citizens in new ways to improve public safety.

Section 3

VISION, INNOVATION, OUTCOMES

3.1 A New Phase for Smart Cities

The evolution of smart cities is entering a critical new phase. Where the first phase focused on creating a smart city vision and the second on innovation, the third phase is focused on delivering outcomes that make a significant impact on major city challenges. Achieving that impact requires proven solutions to be deployed at scale across cities and communities in an effective and efficient manner.

Thinking about smart cities in this way is not to prescribe some simple pathway that all cities will follow in linear fashion, nor is each phase ever completed. But the relationship between the three elements is implicit in any overall smart city approach—how to balance vision, innovation, and outcomes in a way that maintains progress and can demonstrate real and growing value to cities and communities. Cities deploying solutions at scale will continue to evolve their vision of the future city and support new waves of innovation and experimentation. What is important is to understand the distinct characteristics, requirements, and objectives of each phase and how they are interconnected.

Figure 3-1. The Evolution of Smart Cities



(Source: Navigant Research)

3.2 Vision

Initial smart city programs spring from diverse starting points, including mayoral leadership, city consultations, government mandates, public-private sector collaborations, R&D projects, and challenge competitions. Whatever the initial impetus, the focus should be on establishing a common vision based on an understanding of city priorities and key assets, founding collaborations and partnerships, and conducting early pilot projects. The following are key features of any shared vision for smart cities:

- A holistic perspective that understands the interconnectedness of many city challenges and their solutions
- A framework for collaboration across city agencies and an initial partner ecosystem
- A forward-looking roadmap for the city and for the role of technology in achieving its aims
- A set of shared principles around city goals (e.g., for digital inclusion or sustainability) and technical platforms (e.g., adherence to open standards)
- Realistic, actionable, and measurable goals

The most successful cities have not only produced a guiding vision for a smart city, they are embedding these ideas into their programs for service improvement and capital investment. There is strong leadership from the top and clear accountability for delivering the plan.

The most common failing with smart city strategies is a lack of momentum and insufficient alignment with a city's real priorities. A change of administration or the absence of ongoing funding can leave ambitious programs to wither from neglect. Programs too focused on the potential of technology in the abstract and not tied to specific city issues also often fail to evolve with city needs.

Ultimately, the success of any smart city vision is only realized through specific projects and innovations that have an impact on the quality of life in the city or other key metrics. Vision statements and smart city roadmaps can provide shared goals and clear targets but must also be matched by a commitment to build on successful pilots and implement solutions at scale.

The ultimate proof of the value of smart city solutions is the delivery of better outcomes in priority areas such as public safety, transportation, health, social equity, and environmental quality.

3.3 Innovation

Pilots have an important role in enabling cities to understand the potential of technology and innovative approaches to service delivery, city operations, and infrastructure management. A proliferation of pilots and demonstration projects characterized early smart city programs. In recent years, those projects have themselves evolved and the innovation phase has become increasingly more sophisticated.

Many early pilots were too small in scale and too focused on technology issues to offer a clear path to future deployment. Those pilots also often lacked support for further development when the initial funding ran out. Smart city pilots now focus on larger scale demonstrations, the assessment of benefits and outcomes, citizen engagement and co-creation, and the exploration of potential business models.

Leading cities are looking to align pilots with core city challenges, required outcomes, and operational needs. Cities like Amsterdam, Barcelona, Bristol, London, Lyon, and Singapore have established broad portfolios of innovation projects that address key priorities. Similar approaches are being implemented in US cities like Atlanta, Boston, Charlotte, Columbus, Dallas, Los Angeles, New York, Sacramento, Spokane, and San Diego. One example is the creation of broad-based city innovation networks that are tied to longer-term infrastructure investment. Cities like San Diego and Sacramento are looking into developing next-generation communication networks and city platforms that will enable a rolling program of smart city innovation.

3.3.1 Smarter DC: Aligning Innovation and City Goals

Washington, DC is developing a portfolio of smart city initiatives with the goal of improving city services, supporting economic growth, and addressing a range of city challenges. Led by the Office of the Chief Technology Officer (OCTO), Smarter DC is an interagency program that explores how new technologies can best be used across the district. The program is focused on supporting and embodying the city's core goals of being resilient, sustainable, equitable, transparent, and collaborative.

OCTO places a strong emphasis on partnerships between city agencies, the federal government, universities, business improvement districts, the tech community, neighborhood organizations, and other stakeholders. OCTO's key aims for the Smarter DC program include the following:

- Align technology innovation to support citizen inclusion, digital services, more efficient city operations, and improved quality of life.
- Ensure there is a common strategy across district agencies, other government entities, academia/research communities, industry partners, and other stakeholders to harmonize activities and drive better participation and faster progress.

- Develop a district-wide smart city framework, share best practices, and take an outcomes-based approach that supports mayoral priorities and city challenges.
- Help create an environment of collaboration, cooperation, and shared opportunities that maximizes the value of investments and drives efficient use of district infrastructure and resources.

These considerations will be key as the district looks to deploy smart technologies at scale. For example, it is looking to upgrade all 75,000 street lights under its management to energy efficient LEDs with smart controls. As part of the procurement process, city officials have been reaching out to the community through a series of local meetings to explain the benefits of the project and elicit feedback. The project, which will be delivered via a public-private partnership, will include support for additional smart city applications and will extend the city's Wi-Fi coverage.

3.4 Outcomes

The ultimate proof of the value of smart city solutions is the delivery of better outcomes in priority areas such as public safety, transportation, health, social equity, and environmental quality. This means that smart city initiatives need to deliver results at a scale that can have a long-term impact on the quality and efficiency of city services. Innovative technology and new approaches to service delivery can positively impact key city metrics, but to achieve this they must implement solutions that:

- Benefit all communities, help create more equitable cities, and reduce the digital divide
- Are based on stable, proven, and replicable business models
- Enable cross-sector innovation and collaboration

Key steps in this evolution include the following:

- Create closer ties between a city's strategic vision, innovation programs, and the needs of operational teams. Leading cities are looking to align innovation projects with their strategic approach to urban design, new capital projects, and city management.
- Develop a platform-based perspective on the deployment of new digital technologies across multiple service areas. A system of systems approach is essential if the benefits of cross-sector smart city solutions are to be fully realized.

Technology innovation must be matched to real-world experience in the transformation of urban services and an understanding of what that entails in terms of organizational, operational, and political capacity.

- Expand city partnership ecosystems. Innovation partnerships need to evolve to become transformational partnerships that are focused around delivering better outcomes, not just technology demonstrations.

Above all, technology innovation must be matched to real-world experience in the transformation of urban services and an understanding of what that entails in terms of organizational, operational, and political capacity. To improve scalability, cross-sector approaches need to be built into standard operating models, city planning, common procurement processes, inter-department collaborations, and partnerships with the private sector.

3.5 Smart Cities and the Fourth Industrial Revolution

The evolution of smart cities is not happening in isolation from broader technological and social changes. Smart cities can be seen as the embodiment of the massive opportunities and challenges presented by what the World Economic Forum has called the Fourth Industrial Revolution. The combination of ubiquitous communication, new energy solutions, innovations in transportation, and the digitization of almost all aspects of society mark a massive change in economies and societies. To this can be added the challenges of mitigating and adapting to climate change. Klaus Schwab has identified three reasons the resulting changes need to be understood as a Fourth Industrial Revolution:⁴

- **Velocity:** The new technologies and their impacts are developing at an exponential rather than linear rate; moreover, they are deeply interconnected, meaning that they are producing combinatorial advances that are often hard to envision in advance.
- **Breadth and depth:** The combination of digital technologies and new technical innovations in almost all fields is driving a paradigm shift in economy, business, society, and personal life.
- **Systems impact:** The transformation encompasses entire systems across cities, countries, companies, industries, and society.

All these characteristics are relevant to the further development of smart cities, which are becoming living laboratories for the Fourth Industrial Revolution.

⁴ Klaus Schwab, *The Fourth Industrial Revolution*, World Economic Forum, 2016, <https://www.weforum.org/about/the-fourth-industrial-revolution-by-klaus-schwab>.

3.5.1 Traffic Management in the Age of 5G and Autonomous Vehicles

Traffic and transportation management provides a good example of how the next wave of disruptive digital technologies—including artificial intelligence, 5G networks, and automation—will also shape new thinking about city operations.

The work Verizon is doing with Mcity (mcity.umich.edu) provides an insight into the future transformation of city transportation infrastructure. Mcity is an advanced mobility research center established by the University of Michigan and an extensive network of industry partners. Verizon deployed its 5G Ultra Wideband network at the Mcity Test Facility where it is testing new solutions for autonomous and connected vehicles that will improve pedestrian safety and avoid car accidents. 5G-connected cameras have been installed at every intersection inside the test track to help identify traffic and pedestrian patterns to prevent collisions.

The demonstration builds on a combination of advanced 5G communications—for low latency, secure communications—and Verizon’s Intersection Safety Analytics (ISA) capabilities. ISA can measure traffic patterns among motorists, pedestrians, and cyclists to provide insights on a range of dangerous behaviors and conditions. Looking forward, the convergence of ISA and video analytics, 5G networks, and advanced vehicle-to-vehicle and vehicle-to-infrastructure communications will be critical to ensuring the safety of all road users in the age of automated transportation.

Section 4

DELIVERING ON THE PROMISE OF SMART CITIES

Several elements are required in order to move smart cities to the next level, spanning organizational change, partnership models, innovation programs, and technology strategy. Key developments that are helping make this a reality include the following:

- Flexible approaches to project financing and procurement
- Close integration of innovation projects with city strategy and operational needs
- New partnerships across a diverse set of key stakeholders, including the private sector, universities, and community organizations
- Platforms that enable collaboration, data sharing, and integration across services and with a wider ecosystem of stakeholders
- Holistic perspectives on city needs and the potential for new technologies to address them

Each element builds on the lessons of the last decade and also contributes to the shift in thinking needed to deliver results at scale. These developments, and the way some of the leading cities are addressing them, are examined in more detail in the following sections.

4.1 Business Model Innovation

Given the constraints on public resources, it is not surprising that finance is commonly stated as the biggest barrier to smart city development by city leaders. The financial challenge is particularly relevant as cities look to scale projects and place them on a long-term commercial footing. Innovative business models such as new forms of public-private partnerships, energy savings performance contracts, flexible as-a-service offerings, and advertising-based funding are being used to help accelerate the adoption of smart city technologies.

These approaches need cities, suppliers, and the financial community to continue to work on aligning expectations, particularly around the benefits of innovation on service delivery. Above all, there is a need to understand how to value the diverse quantitative and qualitative benefits derived from transformative smart city solutions and to feed those assessments into the underlying economic and financial models for investment.

Procurement processes also need to change. Cities are working with regulators and suppliers to find new ways to enable innovation in contracting for solutions and services. This includes a stronger focus on desired outcomes rather than acquiring specific technologies at the best price. Many cities are now looking at how to embed innovation into the procurement process. A cross-department perspective is important—how can

resources be better shared, what common platforms can be used, how can the proposed solution meet diverse needs across the city?

4.2 Beyond Pilots: The Bridge Between Innovation and Outcomes

Leading cities have laid strong foundations for innovation, both technically (in terms of test beds and platforms) and culturally (in terms of a trusted ecosystem of partners). The challenge is to integrate this innovation culture with the day-to-day operations of the city.

- Los Angeles has been a leader in deploying several smart city solutions at scale, including smart parking and smart street lighting. The city is now building on these projects by exploring how it can use its lighting network to support a range of other innovations.
- Barcelona—one of the trailblazers for smart cities globally—is showing how a city can evolve from an innovation focus to truly transformational urban programs. Initiatives such as the comprehensive Barcelona Digital City program (ajuntament.barcelona.cat/digital) and the creation of Superblocks (www.bcnecologia.net/en/conceptual-model/superblocks), a new approach to car-free urban design, are ingraining smart thinking into core city services.
- In the UK, Bristol established a city operating center that is closely aligned to its ambitious citywide innovation program, Bristol Is Open (www.bristolisopen.com)—a multi-network, multi-partner city test bed that is trialing new urban solutions aligned to the city’s operational priorities. The aim is to ensure innovation projects are focused on priorities facing the city and that there is a pathway from pilot to broader implementation.

Leading cities are looking to align innovation projects with their strategic approach to urban design, new capital projects, and city management.

An important element in this transformation is developing citywide capacity to harness new technologies effectively. Initiatives such as New York’s Mayor’s Office of Data Analytics and Boston’s Mayor’s Office of New Urban Mechanics are providing cross-government support to innovatively use data to solve complex city issues. As IoT device deployment accelerates, such programs are becoming increasingly important.

4.3 **Building Capacity: New Partner Ecosystems**

City leaders are looking to expand and deepen their public-private sector partnerships. This includes looking at new funding models, new approaches to risk sharing, and a focus on building capacity. Cities and their partners also need to collaborate on cross-cutting issues such as cybersecurity, data privacy, and continuous innovation.

Cities are also looking at partnerships that can help develop their infrastructure and enable a new range of services. Verizon and the City of San Diego are collaborating on a multi-million-dollar deal to accelerate 5G deployment in the city. In addition to deploying 5G infrastructure and equipment including light poles equipped for small cells, Verizon will install traffic monitoring technology at five intersections to improve traffic flow and road safety.

Developing this ecosystem is important if cities are to build the capacity they need to deliver on a smart city transformation program. Another notable development is the increasingly close relationships that smart city programs are developing with universities. Universities can provide research support and are often active players in defining projects, securing funding, defining strategies, and contributing to or providing program leadership.

Cities need to engage local communities in all aspects of their smart city program, from initial strategy to project design and deployment. Leading cities are developing new models to involve their communities, emphasizing the co-creation of services and digital inclusion programs that show the local value of better data and smart technologies.

4.4 **A Platform Approach to Technology**

While the smart city may be shaped by technology innovation, the barriers to scalable deployment are rarely seen as technology itself. However, as solutions are deployed more widely, a more strategic perspective on the role of new urban technologies is required, particularly regarding the expansion of IoT-based solutions that are digitizing many city operations for the first time or in radically new ways.

In response, cities are developing more cohesive strategies to deploy new technologies. Growing investments in open data, IoT-based solutions, and data analytics are driving interest in integrated city platform development. Cities are also looking at more integrated approaches to their strategic communication needs: deploying or planning citywide low power networks, vying to be test beds for 5G technologies, and looking at future fiber needs to support these ambitions.

Smart city platform development is part of a wider transformation in urban infrastructure and services that is driven by the deployment of IoT solutions and other smart city technologies. Citywide sensor networks, ambitious data platforms, and integrated approaches to issues like urban mobility, energy management, and public safety are laying the foundation for city platform strategies.

A city platform provides the integrated capability to coordinate data, applications, and services at one or more levels across operational domains for multiple stakeholders. Diverse sets of platform technologies enable the smart city. The capabilities these technologies offer can be combined in multiple ways to create a smart city platform suited to specific needs.

The smart city platform is not a single product category; rather, it is an umbrella concept for diverse offerings and bespoke city approaches. The shape such a platform takes for each city will be determined by the city’s specific needs and circumstances.

Figure 4-1. The Smart City Platform



(Source: Navigant Research)

4.5 A Holistic Perspective on City Challenges: City as a Service

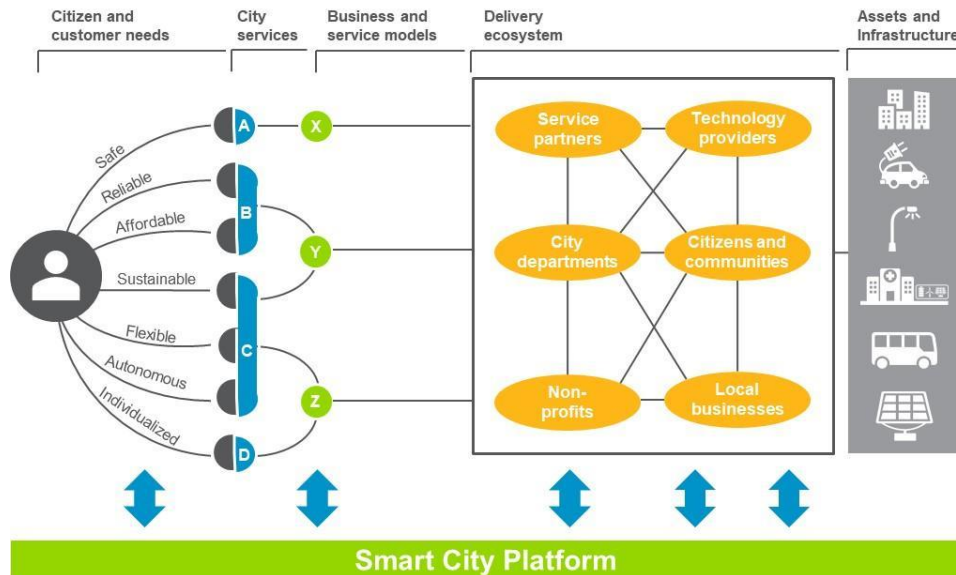
The need for city platforms is driven by changes in business and service models as much as technological development. Cities need to develop capabilities that allow them to manage resources and deliver services in the world shaped by platforms such as Uber, Airbnb, Amazon, Google, or Facebook.

To realize the multi-sector and combinatorial benefits of smart city solutions, holistic perspectives on program design and benefits measurement are needed. The nascent concept of the city as a service encapsulates thinking about how cities can use platform technologies to offer more flexible and personalized services through in-house delivery, cooperation with a range of delivery partners, and greater citizen and community participation in co-creation of those services.

The main driver behind city as a service concepts is the delivery of more flexible, personal, and innovative services for city residents, businesses, visitors, and employees.

As Figure 4-2 shows, the transformation of traditional service delivery models requires platforms that enable cooperation between cities, service providers, technology companies, citizens, and local businesses.

Figure 4-2. The City as a Service: Platform-Enabled Value Creation and Service Innovation



(Source: Navigant Research)

The city as a service idea is taking many forms. For Columbus, Ohio—building on its Department of Transportation Challenge Fund program—an important enabler of diverse projects has been the Smart Columbus Operating System (SCOS), an evolving system that will be a key hub for mobility and other data that underpin Columbus’s smart city aspirations. The city of Espoo in Finland is using the city as a service concept to underpin new forms of co-creation and community engagement, including its urban lab, Espoo Innovation Garden. The city is rethinking how services are delivered and how assets can be better used to deliver citizens real needs. Hamburg, Germany, is taking a more technical approach. It built its own Urban Data Platform to coordinate and integrate data from multiple digital initiatives across the city. In Catalonia, Spain, the regional government is using cloud computing services to institute a range of government as a service capabilities to enable even the smallest town and communities to have access to smart city innovations.

The main driver behind city as a service concepts is the delivery of more flexible, personal, and innovative services for city residents, businesses, visitors, and employees. Uber, Airbnb, and other disruptors have shown how commercial services can be transformed through platform offerings. Cities are striving to make sure they benefit from such innovations while maintaining appropriate control over the quality of services through new regulations and the refinement of city policy. City leaders see the emergence of shared platforms as enabling new service delivery models in the city that put citizens first. Such approaches can provide more flexible access to city services, enable new forms of co-creation with communities, and allow the city to better use its assets.

4.6 Conclusion and Recommendations

The success of the smart city concept reflects its ability to encapsulate the many elements involved in the evolution of urban infrastructure, operations, and services under the pressure of new technology. The challenge is to show how citywide deployments of new solutions can have a real impact on urban challenges and improve outcomes in critical areas.

Despite the immense diversity of cities, there are important lessons to be learned from early leaders and how they are evolving their smart city programs to the next phase. Key recommendations

There is no single model for the smart city, nor is there a final endpoint. Cities committed to making the best use of technology to serve their citizens have embarked on a journey shaped by local priorities and conditions.

for cities looking to accelerate their smart city journey include the following:

- Ensure smart city pilots and demonstrations are aligned to local priorities.
- Engage with city communities to define smart city goals and objectives and to design new services.
- Invest in building a network of trusted partners spanning public and private sector stakeholders, universities, and local communities.
- Balance short-term incremental benefits that maintain momentum with a long-term strategy for a platform-based approach to innovation and service delivery.
- Develop more integrated approaches to city issues—across transport, energy, health, housing, and other service areas. This development also requires more coherent strategies for data sharing, communications infrastructure, and common city platforms.

The opportunity presented by smart cities is multi-faceted, combining transformation in distinct operational areas (such as public safety, transportation or street lighting) but also pointing to the potential for new systemic approaches to many previously intractable urban issues. Developing the vision, skills, and funding models to make these links is critical to delivering on the smart city vision. Only by doing so will it be possible for smart city solutions to play a part in an urban transformation that can make significant improvements to the health, safety, sustainability, and prosperity of all cities and their residents.

Section 5

SCOPE OF STUDY

Navigant Research prepared this white paper, commissioned by Verizon, as a guide to the evolution of smart cities and the implication for city strategies. It provides an overview of the current state of smart city developments, key uses cases and city examples, and recommendations for city leaders, managers, and other stakeholders looking to accelerate local smart city programs.

SOURCES AND METHODOLOGY

Navigant Research's industry analysts utilize a variety of research sources in preparing Research Reports. The key component of Navigant Research's analysis is primary research gained from phone and in-person interviews with industry leaders including executives, engineers, and marketing professionals. Analysts are diligent in ensuring that they speak with representatives from every part of the value chain, including but not limited to technology companies, utilities and other service providers, industry associations, government agencies, and the investment community.

Additional analysis includes secondary research conducted by Navigant Research's analysts and its staff of research assistants. Where applicable, all secondary research sources are appropriately cited within this report.

These primary and secondary research sources, combined with the analyst's industry expertise, are synthesized into the qualitative and quantitative analysis presented in Navigant Research's reports. Great care is taken in making sure that all analysis is well-supported by facts, but where the facts are unknown and assumptions must be made, analysts document their assumptions and are prepared to explain their methodology, both within the body of a report and in direct conversations with clients.

Navigant Research is a market research group whose goal is to present an objective, unbiased view of market opportunities within its coverage areas. Navigant Research is not beholden to any special interests and is thus able to offer clear, actionable advice to help clients succeed in the industry, unfettered by technology hype, political agendas, or emotional factors that are inherent in cleantech markets.

Published 1Q 2020

©2020 Guidehouse Inc.
1375 Walnut Street, Suite 100
Boulder, CO 80302 USA
Tel: +1.303.997.7609
<http://www.navigantresearch.com>

Navigant Consulting, Inc., n/k/a Guidehouse Inc. (Navigant), has provided the information in this publication for informational purposes only. The information has been obtained from sources believed to be reliable; however, Navigant does not make any express or implied warranty or representation concerning such information. Any market forecasts or predictions contained in the publication reflect Navigant's current expectations based on market data and trend analysis. Market predictions and expectations are inherently uncertain and actual results may differ materially from those contained in the publication. Navigant and its subsidiaries and affiliates hereby disclaim liability for any loss or damage caused by errors or omissions in this publication.

Any reference to a specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not constitute or imply an endorsement, recommendation, or favoring by Navigant.

This publication is intended for the sole and exclusive use of the original purchaser. No part of this publication may be reproduced, stored in a retrieval system, distributed or transmitted in any form or by any means, electronic or otherwise, including use in any public or private offering, without the prior written permission of Navigant Consulting, Inc., Chicago, Illinois, USA.

Government data and other data obtained from public sources found in this report are not protected by copyright or intellectual property claims.

Note: Editing of this report was closed on December 24, 2019.