



# Accelerating the Digital Transformation of Smart Cities and Smart Communities



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# SMART CITIES AND COMMUNITIES

## CONNECTING SYSTEMS AND SILOES FOR OUTCOME-BASED DIGITAL TRANSFORMATION

Cities around the world face many challenges, such as global competition for talent and business investment, rapidly growing and aging populations, increasing concerns over climate change, economic inequality and the digital divide, and keeping pace with technology innovations that have changed resident expectations for personalized, mobile government services. To address these complex, systemic challenges, cities must architect Smart City initiatives to connect disparate operations and siloed processes, starting with smaller, focused, department-level projects and growing, step by step, to a unified city ecosystem.

Smart Cities are, by design, municipalities that address these challenges via a process of digital transformation (DX); in fact, the mission of Smart Cities can be described as “outcomes-based digital transformation.” This means using new methods of innovation and creativity, and new sources of information, to enhance experiences, increase sustainability and resilience, and improve financial and operational performance. IT that uses a combination of cloud, mobility, and data analytics has the power to provide new solutions to long-standing urban challenges and enable new experiences for residents and communities, visitors and tourists, and local businesses.

## The Value of Connecting Systems and Siloes

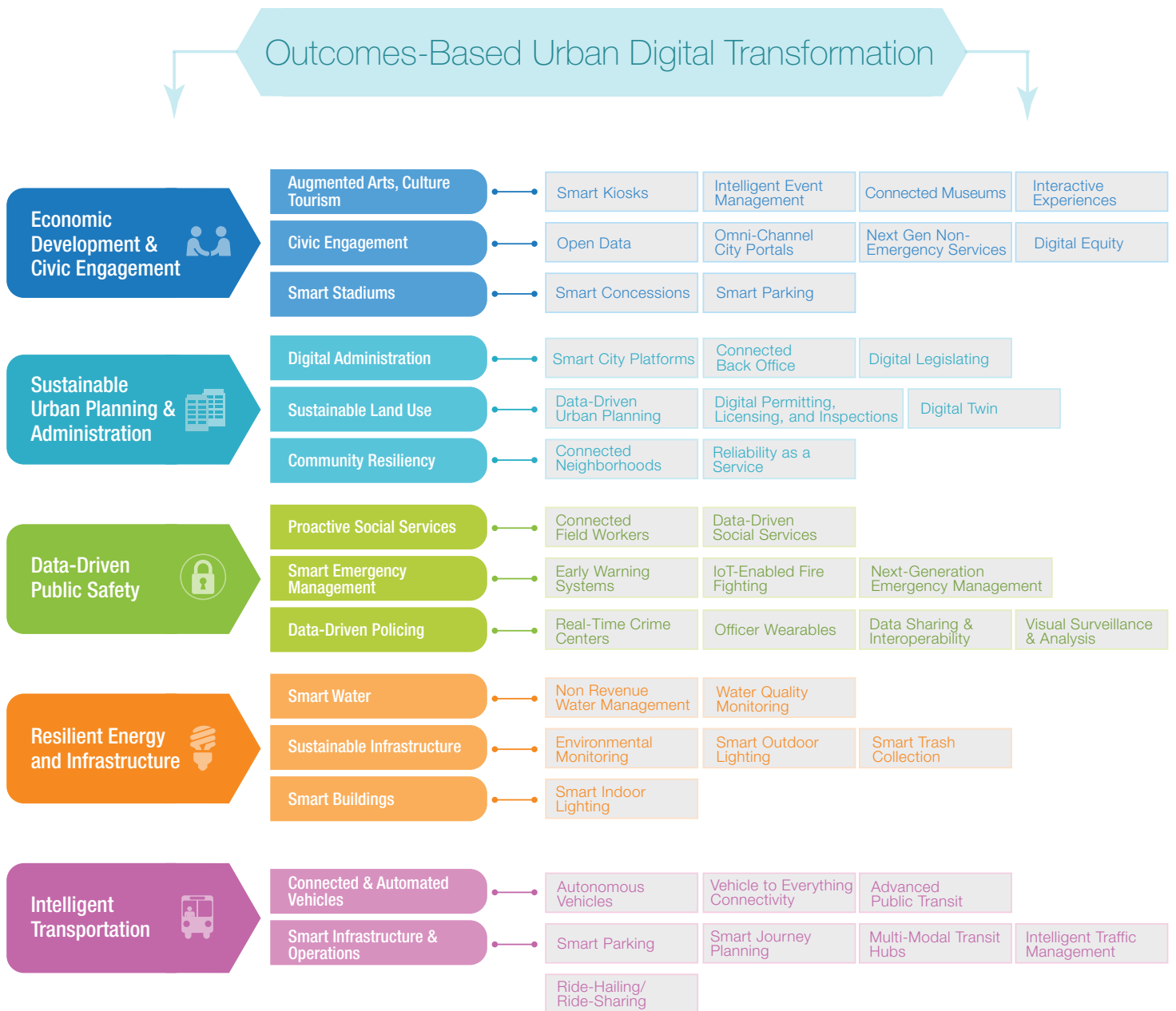
Smart Cities focus on economic growth, sustainability, and operational efficiencies using innovation, community engagement, and a connected ecosystem of partners to improve the quality of life for residents. Emerging technologies and technology innovation are key to producing these outcomes. More specifically, Smart Cities must harness the data from smart devices, high-speed networks, cloud infrastructure, rapidly developed and intelligent applications, and a variety of analytical tools to develop new insights as well as new products and services. Insights derived from data that are new, more granular, more timely, and more accurate help cities understand root causes of issues and the complex systems that are involved with challenges such as traffic congestion or neighborhood crime. This insight is key to finding new ways to address and solve these urban challenges.

However, cities remain agency- and department-based organizations, often with siloed IT systems, budgets, and initiatives. This means that most Smart City investment is for specific projects, led and operated within a siloed department, and may lack the systemic insight needed for these complex challenges. IDC's research shows that departments account for over 40% of Smart City project decision making and 30% of project funding. While the IT department and innovation offices are heavily involved in project development, it isn't an easy process to connect initiatives — and their related IT systems — across departmental boundaries. This is further complicated by the growing number of projects that will be started or scaled over the next few years. IDC has identified 41 Smart City use cases that will be most heavily funded over the next one to three years (see Figure 1).

IDC's research shows that **departments** account for over **40%** of Smart City project decision-making and **30%** of project funding.



**FIGURE 1** Funding Initiatives Over Next One to Three Years

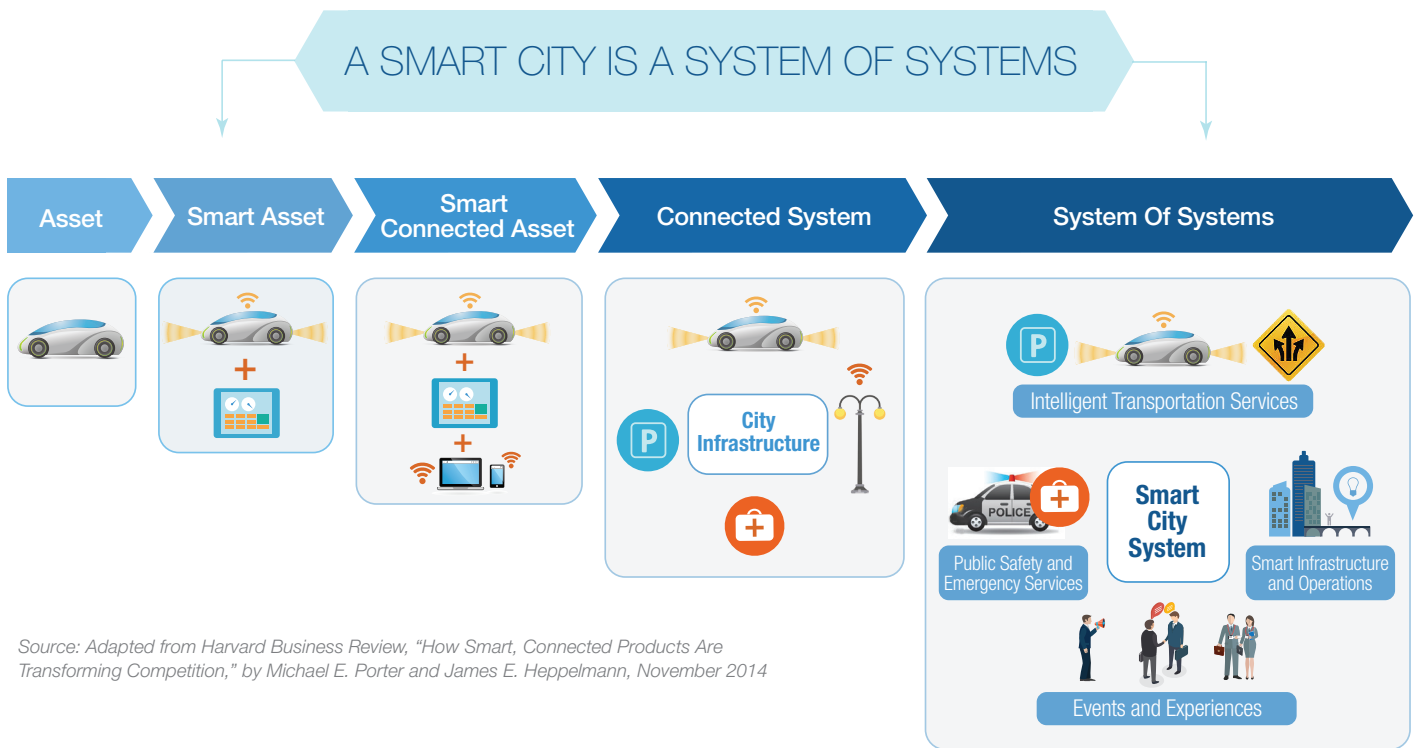


Source: IDC, Smart Cities Digital Transformation Taxonomy, 2017

Siloed initiatives, while potentially achieving desired department-level outcomes, must be extended to be truly transformative. In this context, the process of extending and scaling initiatives means having cross-departmental insight and a unified city view along with the ability to rapidly develop and test new applications. This scale can be achieved in many ways, at times through true systems integration but more and more via interoperability based on open standards, open data, open source technologies, APIs, and cloud-based platforms. Few cities will go out and buy a “platform,” do a massive citywide cloud migration, or suddenly be able to shift from proprietary legacy systems. The key is to develop and test new, small Smart City initiatives for easier future scalability with other projects, beyond specific programs and across departments.

A McKinsey Global Institute report, *The Internet of Things: Mapping the Value Beyond the Hype*, states that 40% of the value of the Internet of Things (IoT) in cities is enabled by systems interoperability. Figure 2 illustrates the importance of this concept of scale and interconnectedness in Smart Cities, using urban transportation as an example. As physical assets, like cars, become “smart” and digitally enabled with embedded software, they transform into “smart assets,” such as connected and autonomous vehicles. These cars then connect to networks and become part of a system of other smart things, which can share, communicate, and work together. Cities are, by definition, systems of interconnected physical and human systems, and this is what makes digital transformation challenging. The ICT systems must mirror the physical and human systems to also work as systems of interconnected systems as this provides the basis for solving systemic and complex urban problems.

**FIGURE 2** The Value of Connecting Systems: Intelligent Transportation



Source: Adapted from Harvard Business Review, “How Smart, Connected Products Are Transforming Competition,” by Michael E. Porter and James E. Heppelmann, November 2014



As shown in Figure 2, smart, connected cars and intelligent transportation not only improve daily life, such as school and business operations and public safety, but also provide information to other systems and ultimately to residents, police officers, and drivers using additional intelligent edge devices such as acoustic sensors, video cameras, and environmental sensors. This means that the impact of events, from routine traffic congestion to accidents to man-made or natural disasters, can be mitigated by a coordinated response.

This interconnectedness must be part of an articulated enterprisewide Smart City strategic plan supported by dedicated leadership teams. One of the first steps toward a Smart City is to understand and communicate the value of these connected systems to stakeholders — whether the city council or department heads, city employees, or the community at large — so that Smart City initiatives are funded, supported, and properly implemented.

## Moving Toward a System of Systems: Key Areas for Progress

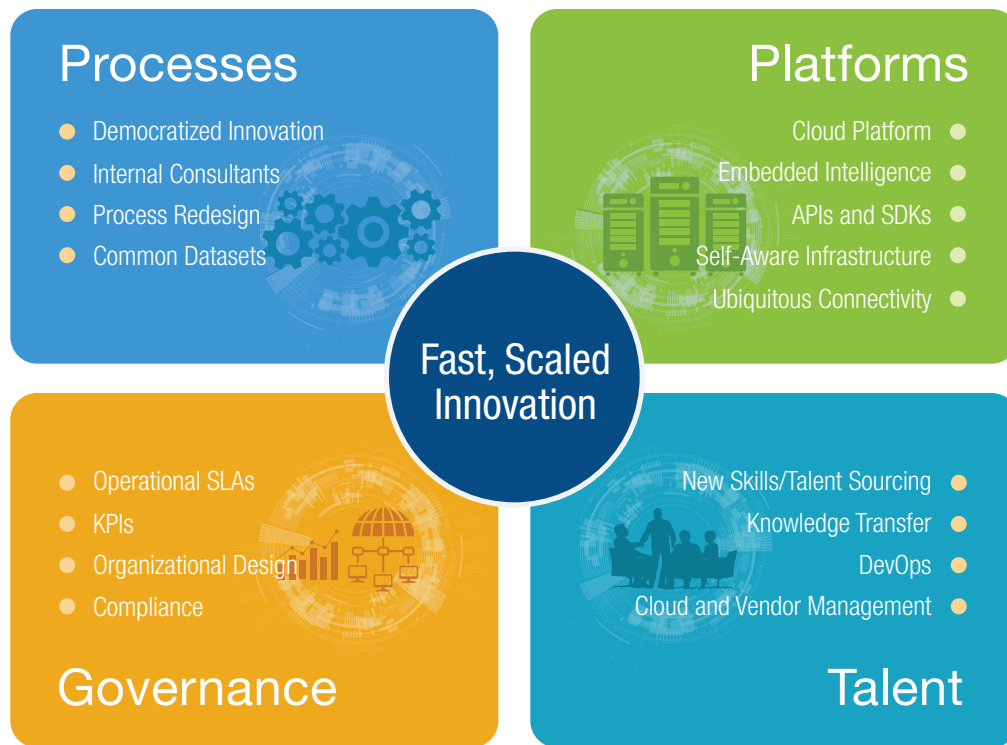
The terms “Smart Cities” and “digital transformation” bring to mind fast-paced progress that takes advantage of technology innovations and disruptive new business models. However, the reality is that, despite several years of growth in awareness of the opportunities of Smart Cities, most municipalities are still struggling with putting ideas to reality; often with difficulty in securing funding, determining which solutions or vendors to use, or scaling initiatives. While city leaders are having more nuanced and detailed

discussions around challenges and solutions, and successful initiatives from which to draw best practices are increasing, the fact is that cities are still slowly changing and innovating. And, there are still more questions than answers on how to navigate complex, transformative change, including managing the risk of investing in new technologies when things change so rapidly. IDC's research points to four areas

fundamental for cities to both accelerate and scale Smart City transformation (see Figure 3):

1. Processes
2. Platforms
3. Talent
4. Governance

**FIGURE 3** Elements to Scale Smart City Capabilities



Source: IDC, 2017

These four areas combine considerations about scalable data and infrastructure with important issues like work processes and needed skills, procurement roadblocks, and a broader vision of how a transformed Smart City can behave

in the future. In particular, this white paper addresses four elements of each of these areas that are vital for deriving maximum value and impact from Smart City initiatives:

- **Platforms — cloud platforms:** A cloud-first platform strategy enables improved privacy, interoperability, security and secure data sharing, scalability, and fast, agile app development and testing. A platform on which many applications can run also offers these capabilities for specialized, domain-specific applications as well as provides access to the most up-to-date technology.
- **Talent — new skills and talent sourcing:** With a shortage of needed skills, and an aging workforce, “reskilling” workers and updating workplace policies are important changes to consider.
- **Processes — democratized innovation:** Cities must understand their risk profile and implement ways to manage risk so that they can be innovative, think up new solutions and services, and test these services in a fail-fast, iterative way.
- **Governance — compliance:** Compliance implies meeting or complying with a policy, law, or guideline. However, in some cases, cities actually lack updated policies to deal with the Smart City IT environment. Policies around data use, privacy, cybersecurity, and accessibility must be created.







## Platforms — Cloud Platforms

As IDC talks with city leaders around the globe about their definition of a “Smart City platform,” a very broad definition emerges, one that is distinct from the traditional meaning of a technology platform. In these interviews, which often target innovation officers and department heads, the functionality and business outcomes of a platform are described, more than IT capabilities. These decision makers describe solutions that connect devices and collect, combine, and manage data from different city domains and service providers to provide a unified view of a city. This is often coupled with a discussion about the need for security, open standards, and interoperability to enable this unified view of city operations — the vision of interconnectedness.

Smart City solutions need to be considered with an eye toward future scalability and interoperability with other systems so that they can ingest any data type from any source or location and provide digital data streams that can be accessed and used by all types and levels of employees. IDC believes that a cloud platform is the key future-proofing technology investment that provides the security, interoperability, and flexibility that city customers want while also offering a financially sustainable model for deploying Smart City solutions.

Given the prevalence of the term “platform” by a variety of vendors, it is worth restating that a cloud platform is, at its core, an environment that runs on secure, highly scalable infrastructure and enables application development, runtime services, middleware, business logic, and data analytics and insight; it allows applications to be developed and to run as well as provides improved data management and analytics. As such, cloud platforms can be used to rapidly deploy new applications, either in-house or via an ecosystem of providers, such as vertical specialists and local suppliers. They also provide the ability to securely ingest data from any location, data source, or type and make it accessible to different users and analytic applications.

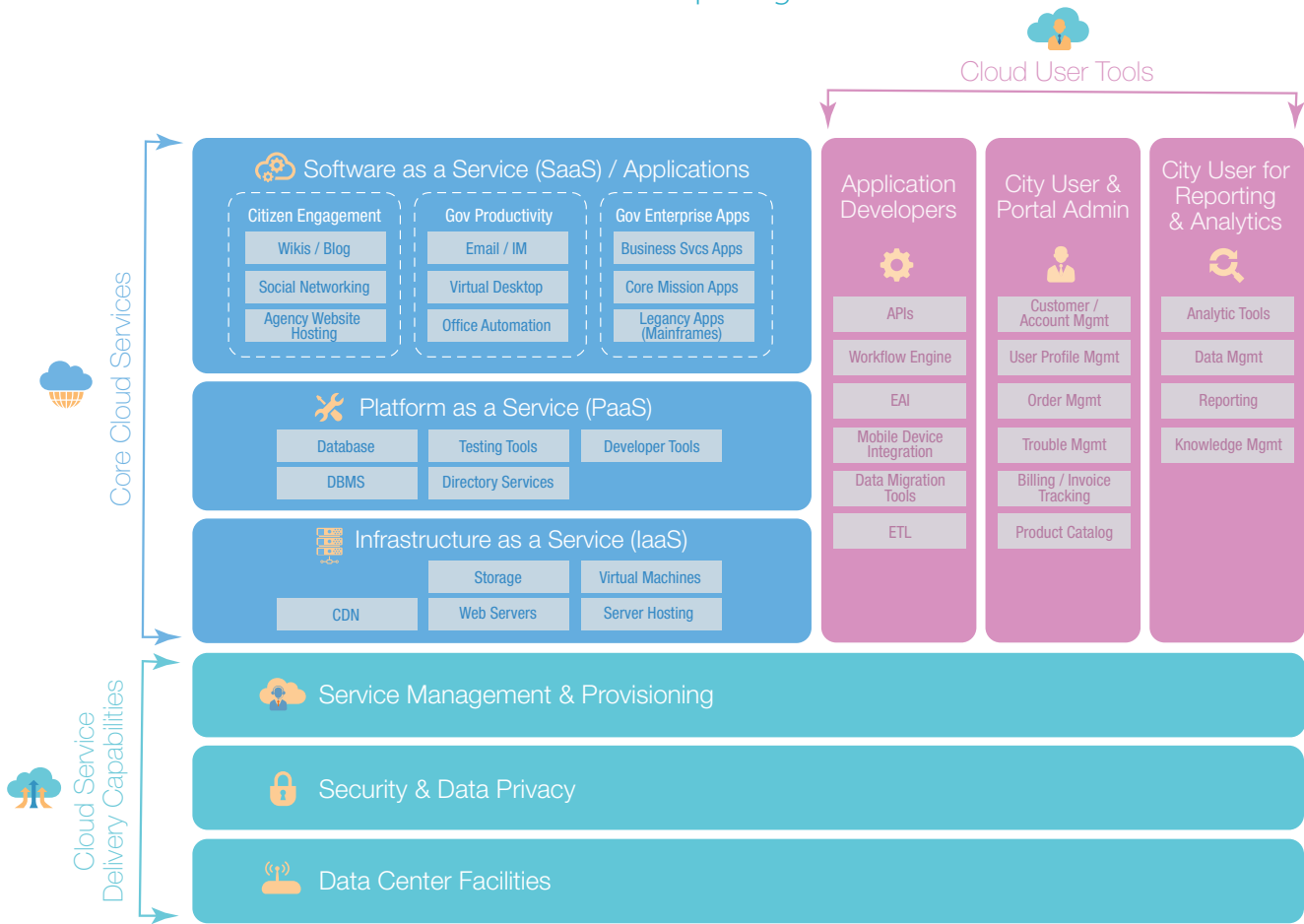
Underpinning these capabilities are the reasons that the cloud is important, as opposed to a traditional, on-premise platform. Cloud platforms from trusted providers offer cost containment, interoperability, security, and the flexibility to take an iterative approach to new service innovations.

Let's discuss a few unique, important capabilities that a cloud platform provides, specific for Smart Cities:

- **Scalability and agility in the context of innovation and risk management.** It is common knowledge that cloud, by definition, provides infrastructure, platform, and software services via a usage subscription model. This structure provides the flexibility cities need to fulfill their missions, align with citizen expectations, and deliver transformative services. Cloud platforms allow cities to rapidly, and more affordably, deploy and test new software by enabling betas to go “live” at a small scale, and if they are successful, to rapidly scale up, and if they are not, to be quickly ended. This can be done also with an eye toward costs because users have a clear understanding of the cost to test and scale a service via a pay-as-you-go model. In this way, a cloud platform provides a way to manage the risks and costs of an iterative, innovative process.
- **Interoperability as a foundation for analytics and intelligence.** Interoperability between proprietary systems and open standards–based applications is a key feature of cloud platforms because the cloud can help bring together disparate data sets and apply analytics to this combined data for better insights. A cloud platform ingests and stores data to enable analytics; the scalability of a cloud platform means that it can take in data not only from any source, format, or location but also at any speed, such as real-time or near-real-time IoT data types. This IoT data from the edge is key to understanding the urban environment and the visualization tools and dashboards, which can be customized with the availability of widgets and can produce meaningful insight and management summaries of data. A cloud platform also provides access to outside experts via app developers, SaaS vendors, systems integrators, and other IT companies that it attracts and nurtures. These companies build value-added and differentiated solutions on top of the platform that provide the use cases described in Figure 1.
- **Improved security.** Security and privacy are top concerns for city leaders, especially given recent distributed denial-of-service (DDoS) attacks, ransomware attacks, and large-scale hacks that took advantage of various types of vulnerabilities. City officials must address concerns among residents not only about the use of their personal data by government entities but also about the protection of this data and the systems that use and store it from access and misuse by hackers and other bad actors. Cloud platform providers can offer a high level of security with dedicated security teams and state-of-the-art datacenters compared with on-premise legacy systems. Providers with government cloud offerings focus on the hardware, storage, and network infrastructure security necessary for advanced threat management, vulnerability management, data privacy, and policy enforcement (see Figure 4).



**FIGURE 4** Government Cloud Computing Framework



Source: IDC, 2017

## Talent — New Skills and Talent Sourcing

When thinking of connecting systems, one must consider the systems all the way from the cloud platform to the edge point at which a worker delivers a service. In Smart Cities, new services often result in new work processes and new types of devices and applications, which can be both exciting and daunting for employees. For example, work orders that come directly from residents via mobile apps, smart parking systems that show violations on demand, and intelligent assistants that take over mundane and repetitive service requests all require workers to be retrained, change workflows, and adopt new mindsets. High retirement rates (in some cases, up to 40% of a workforce) and the competition for skilled workers in areas such as analytics, cybersecurity, and cloud supplier management (also in high demand in the private sector) require that Smart Cities consider “reskilling” existing workers and updating workplace practices to align with workforce demographics and preferences.



## Global Workforce Demographics

Today, the global workforce is:

- **Highly diverse.** Today's government workforce is diverse across ethnicities, gender, and age, though generally, the workforce is older across all geographies.
- **Skilled and specialized.** Globally, the workforce is becoming more "skilled" and specialized. These skilled workers want higher wages, good benefits, and modern work environments. Often, they are also attracted to interesting projects that can show they are making an impact on the lives of residents.
- **Global and connected.** Workers move around more frequently and in search of better job opportunities, and many developing countries are producing at least as many skilled, educated workers and managers as developed countries.
- **Remote.** Working from remote locations no longer prevents employees from communicating with their colleagues, allowing teams to collaborate with greater ease across locations and offer flexible work options, such as working from home.

Although all these demographic changes have potential positive implications for Smart Cities and workers alike (more opportunities, greater flexibility, etc.), they also come with potential negative repercussions:

- The dearth of experienced leaders
- A lack of cultural knowledge from non-native employees and a lack of institutional knowledge from younger employees
- Inconsistent educational standards with workers from different origin countries
- A desire for work perks that may be hard for cities to offer, such as working remotely, flexible hours, or higher compensation

The “talent crunch” is profound. On the one hand, 40 million workers in the industrialized world are unemployed, according to recent estimates by the International Labour Organization, yet executives and managers tasked with hiring new workers often say they are unable to find the right people with the proper skills to fill their vacancies.

Meanwhile, the sources from which talent might be recruited are also realigning. Forecasts show that over the next decade, new, and sometimes unlikely, regions in the world, such as emerging economies in Asia/Pacific and Africa, will generate a surplus of talent. In contrast, other regions, such as the United States and much of Europe, will confront the need to undertake a critical “reskilling” of labor to meet new demands for more advanced skill sets.

Beyond the challenge to hire and retain workers, implementing Smart Cities technologies can result in significant changes in work processes that challenge existing workers, from supervisors to line staff. An example of this can be seen in smart parking in which the workers tracking parking violations and reading traditional meters typically followed a schedule and route to manually check on vehicles and write out tickets. With a change to multispot payments, sensor-based parking, or mobile payments, walking or driving a scheduled route is no longer necessary, tickets may be generated electronically, or new on-street systems may need to be learned. Supervisors will need to reconsider how to use staff time, while workers may be concerned about the security of their jobs. All of these need to be effectively managed in

order to take advantage of increased worker productivity and operational efficiencies. Municipal workers, who for years may have been dealing with the same IT systems and work processes, now need the expertise and training to deal with the fast pace of ongoing disruption in technology and business models.

## Processes — Democratized Innovation

Cities, like most government organizations, are risk averse. Few want to be the leaders, some want to be fast followers, and many adopt a wait-and-see attitude to new ideas, products, and services until they have been proven to work and deliver desired value and outcomes. This makes sense given that local governments are responsible for spending taxpayer money, and failure is seen, at the very least, as waste and, at most, as ineptitude or even corruption. This results, unfortunately, in rigid procurement structures that not only combat favoritism but also innovation and a consistent lack of expertise in risk management and innovation management.

Cities need to understand and increase their risk tolerance and learn how to manage risk and innovation. The two go hand in hand; if organizations can manage innovation and risk better, then it is possible to take more risk. But by definition, being innovative requires:

- Exposing oneself and one’s organization to failure
- Trying new things
- Using an iterative process built upon success and failures over time



There are concrete ways that have proven successful in managing the risk of innovation. They include hiring someone institutionally in charge of innovation, like a chief innovation officer, and supplying that individual with a team of experts who understand how to deploy iterative processes for designing and trying new ideas and who can serve as internal consultants for all the departments in a city. These innovation managers should begin to think like financial portfolio managers in terms of managing risk. They will address questions like how to pilot new ideas in short periods of time at minimal capital cost. Cities are moving in this direction today in terms of hiring innovation managers, but many do not have teams or expertise, beyond legal and contracting support, to truly bring ideas in from city workers and the community and test and fail fast in an iterative, learning environment.

Involving the community in decision making also reduces risks because agencies get feedback directly from customers in terms of their needs and also as people who have innovative ideas themselves. Furthermore, community involvement is an educational tool so that people are involved in the process of trying new ideas, and they fully understand initiatives.

Finally, innovation requires some level of procurement reform. Oftentimes, this means forming quasi-governmental organizations or partnerships that operate outside of traditional procurement rules, which can be an effective workaround and also a way to find needed funding for new ideas. This can take shape as jointly run nonprofit organizations whose mission is to serve the community and the city, MoUs for trying new ideas between cities and the private sector, neighborhood-based “labs” to test ideas at a hyper-small scale, or private sector–funded centers of excellence or innovation labs, which hold all the risk for trying new ideas. Risk is also lowered when shared, not just with the private sector but with other cities. Master purchasing agreements that may lower the cost of new products, or ensure common standards for service delivery, also should be considered. These are all important tools to bring innovation, at lower risk, to municipalities.

## Governance — Compliance

Oftentimes, in talking with regional and local government organizations, the opinion is that technology suppliers will provide key capabilities, like security, because it is a key customer need. While in many cases, this may be true, technology implementation should reflect policy, especially in the case of government solutions. If policies and guidelines are clearly provided, then technology suppliers will write the code to comply with those policies. A clear example of this occurs with data sovereignty laws that vary from country to country; cloud-hosted data in one country will follow different policies and, therefore, have a different architecture than cloud-hosted data in another country. In many cases with Smart Cities, policies have not been put in place to articulate the rules that cities want suppliers to follow. This includes a lack of explicit privacy and data management policies, policies around the sale and use of data by private companies doing business for municipal governments, physical security and cybersecurity policies around edge devices, and policies for interoperability, accessibility for users with disabilities, and even sustainability.

There is movement in varying degrees, and different policies, at the national levels, with a focus on privacy. For example, Japan passed the Amended Act on the Protection of Personal Information (APPI), which went into effect in May 2017, and the EU has its General Data Protection Regulation (GDPR). However, they do not yet provide policies in all the areas mentioned previously. The hacking will continue until security improves, and Smart Cities need to work with higher levels of government, as well as their own local legal teams and policy experts, to put in place clearer information management governance policies around the creation, use, and retirement of data. For instance, data governance questions such as who owns, who analyzes, and who has access to data, as well as what are the rights of data owners and data subjects, will need to be addressed along with the rules for how data and physical devices are kept secure.





## Moving Forward: Addressing the Major Challenges and Roadblocks

Additional barriers impact the ability of cities to fully benefit from Smart City platforms and the development of interconnected systems. The first series of steps for any city is to directly address the major challenges most Smart Cities face, which include:

- **Prioritizing long to-do lists that have many competing priorities:** Develop a smart community vision and strategy/master plan that prioritizes key issues to address, identifies desired outcomes, and specifies time frames for action, funding sources, and key technologies/systems/skills needed. Link the individual initiatives and projects identified in the master plan with common technologies, processes, and systems to identify what technology infrastructure and resulting data should be leveraged and shared.













- **Getting initiatives funded:** Use internal and external resources to educate city council members, business associations, and the larger community on the value of Smart City technologies. Non-IT council members may not readily see the value in untested and newer investments; therefore, extra effort should be taken to educate and answer questions. These discussions should be focused not on technology but on outcomes. Consider new partnership organizations, master-level agreements, or working with other cities on a single RFP to improve purchasing power and negotiate better deals.
- **Short-listing suppliers:** Cities today face an endless stream of sales pitches on Smart City products and services, oftentimes from small vendors with little previous experience. Cities are not interested in buying an end-to-end solution or a monolithic integrated stack that covers device, connectivity, data, apps, and app development, nor is there a single vendor that offers such a thing. This means that the market will continue to be crowded with many suppliers to choose from and hard choices to make. Cities should look to vendors focused on providing users with flexibility and customization through their ecosystem.
- **Developing RFPs:** Without existing procurement templates or experience writing an RFP for a new, innovative offering, it can be hard to determine what the specifications need to be. Requests for information are an option to gather feedback and information on vendor capabilities, or even essential RFP requirements, but they also add yet another procurement task for suppliers. Join an industry group or association to assist with learning about how other cities structured RFPs and how they scoped requirements, especially around cybersecurity, open standards, and privacy. Bring together different organizations — vendors, multiple departments, utilities, and academics — to discuss RFP requirements prior to issuing the RFP.
- **Addressing the mix of old and new IT environments:** Cities should continue to request that vendors provide security, interoperability, strong open APIs, strong partnership ecosystems, and modular solutions with the ability to “experiment” via microservices. This includes hybrid cloud solutions that offer a mix of on-premise and cloud-based services. City buyers should place a premium on vendors that address these priorities, which will allow them to migrate to new solutions and transition to new operational models at their own pace. Legacy systems may be outdated, but they hold tremendous amounts of valuable data and have taken years of investment. A self-paced transition to new systems enables cities to maximize the return on both new and past investments.

- **Solving the talent crunch:** Today's global inadequacy of hireable skill sets for emerging technologies, such as cognitive computing, next-generation security specializations, or even competent cloud consultants, means that such specialized skills will be rarely available and will be in high demand in the short to medium run globally. Considering the time it takes to find and train the next-generation workforce to match talent shortages, IDC recommends that cities emphasize retooling and upgrading the skill sets of their existing workforce. This not only provides opportunities for existing staff but also allows cities to retain long-standing institutional knowledge that is not easily passed on to new workers or replaced.
- **Providing accessibility as more services turn digital:** As more municipal services become digital and mobile, there are increasing accessibility concerns. For people with disabilities, new infrastructure may cause accessibility challenges (e.g., smooth touchscreens may be challenging if a person cannot see, and websites with lots of images may be poorly translated into voice). With cities as multicultural hubs, language can also be a barrier to access, and services must be able to be translated into many languages; this also helps tourists and city visitors. Accessibility also includes those who cannot afford smartphones to access key mobile apps, don't have a credit card for online payments, or need to monitor data usage for their monthly mobile phone bills. Given that only 48% of the world has internet access, even shifting services online can present major access challenges with large pockets of underserved communities in cities as well as metro areas.
- **Managing risk and innovation:** City leaders, in their mission for outcomes-based digital transformation, must be able to take calculated risks. One aspect of risk management is to set up an internal advisory organization that can help with risk management and innovative processes for all departments and has expertise in this area. This is largely the function of newly formed Smart Cities teams that are often part of innovation initiatives. Another aspect of risk management is to craft milestone timelines that are short and focused, such as six-week "sprints," so that failure or success is quickly identified, and progress can be continuously reported.

# The Call To Action

While addressing city challenges can feel daunting, there is a path forward. Figure 5 provides a checklist of clear next steps that cities can take to continue, and even accelerate, their Smart City progress.

**FIGURE 5** Respond Directly to City Complexities

-  Develop Smart City strategic plan and top 10 priorities list
-  Educate city councils, community groups, business associations on value of initiatives
-  Ask potential partners and suppliers to test their products and services; focus on flexibility in testing and scaling new ideas
-  Do a lot of pre-RFP research
-  Retrain existing workers for needed new skills
-  Keep accessibility options – physical and sensory, financial and language accessibility - as important design considerations
-  Focus on the physical and cybersecurity of expanded security perimeter; this includes physical security for edge devices and cybersecurity of IoT/ edge infrastructure
-  Create policies for privacy and data management to ensure needed compliance from suppliers
-  Design and architect interoperable platforms
-  Manage innovation and risk like financial portfolio managers

Source: IDC, 2017



Smart Cities work to solve large, complex problems in the major economic and cultural hubs in the world. This cannot be expected to be an easy or short-term task, but it can be made less complicated with step-by-step progress along a clearly articulated long-term road map.



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