IDC TECHNOLOGY SPOTLIGHT

# The Power of the Platform in Smart Cities

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*The mission of a Smart City is outcomes-based digital transformation. Smart Cities focus on the outcomes of economic development, 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 systemic outcomes; more specifically, Smart Cities must harness the data from smart devices, networks, cloud infrastructure, and applications and analytics to develop new insights as well as new products and services. This Technology Spotlight discusses the importance of Smart City platforms as a key mechanism to integrate smart technologies, enable the rapid delivery of new applications, and create a connected Smart City ecosystem.*

## Introduction: What Is a Smart City Platform?

Used by state and local governments, a Smart City platform is one whose purpose is tied to specific systemic environmental, social, and financial outcomes. These platforms, often Internet of Things (IoT) platforms, are evolving rapidly, and their architecture is becoming more sophisticated, but they are still in the early stages of deployments in government organizations. At a basic level, Smart City platforms are cloud-hosted 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 holistic view offers new insights to city departments and/or third parties and provides improved management and control as well as a better understanding of the need for new products and services. Beyond this core functionality, these platforms are used to rapidly deploy new solutions, either in-house or via an ecosystem of providers such as vertical specialists and local suppliers. This is an important aspect of Smart City platforms because the variety of legacy and SCADA systems in place across departments and the variety of siloed industrial functions such as transportation systems and water and energy delivery are barriers to rapid innovation.

The architecture of a Smart City platform varies from vendor to vendor, but the following components are all part of an integrated system:

- **Device management** is for endpoint provisioning, remote configuration, data monitoring, software updates, and error reporting. Device management ensures the ongoing ability of the endpoint to send and receive data. Software is often deployed via an agent client installed on endpoints.
- **Connectivity management** ensures data flows from the edge to the cloud and is managed and secured in transit with encryption capabilities. This is often limited to IP communication for most vendors via a cloud gateway, which communicates bidirectionally with endpoints through various protocols and REST APIs. For deployments relying on cellular connectivity, a handful of IoT platform vendors provide SIM management, including billing and SIM alerts. Partnerships are common and required for vendors to provide full connectivity management.

- **Data management** is the most tasking but most valuable feature of Smart City platforms. Data is processed and analyzed through a "rules engine" that draws out meaningful data according to a set of parameters or business "rules" for advanced analysis. Some platforms are equipped with advanced analytics that consist of mapping data against a predictive model. Advanced analytics through machine learning and predictive analytics tools will be of growing importance but are rarely available as a standard feature of an IoT platform today.
- **Visualization tools and dashboards,** which can be customized with the availability of widgets, can produce management summaries of IoT data. They can trigger events and send notifications to end users.
- **Application enablement** is often supported via open APIs and provides assistance to third parties (e.g., app developers, systems integrators, SaaS vendors). With APIs fully documented, third parties can push and customize platform data according to their requirements. Few vendors can provide application development and support rapid app development tools as part of their platform.

Smart City platforms fulfill many tasks. Sensor and device data can be overwhelming because of its volume, connectivity methods, data format, and frequency. The ability to handle this data is not native to traditional IT platforms. The only way to standardize and cope with all the data generated by connecting billions of unconnected objects is by having a Smart City platform with a robust software base able to function at scale and at speed to compute and analyze various data sources and formats. Such a platform includes the flexibility to allow relatively easy integration with other cloud enterprise applications and be fully integrated with the rest of the IT infrastructure.

## The Benefits of a Smart City Platform

### *How Can Smart City Platforms Help Solve Big Urban Challenges?*

Cities around the world face many of the same challenges due to growing and aging populations, increasing concerns over climate change, and technology innovations that have resulted in rapidly changing citizen expectations of personalized, mobile government services. Addressing these challenges is made more difficult by issues such as aging physical infrastructures, limited budgets for capital expenditures, rising water and energy consumption, new sustainability goals and regulations, and rising income and digital access inequalities.

It seems impossible to expect a Smart City platform to address these complex challenges, but in fact the Smart City platform helps place city infrastructure and services in a larger transformative context. This transformation is under way via the IoT as physical assets become "smart" and digitally enabled with embedded software. These "smart" assets then connect to networks and become part of a system of other smart things that can share, communicate, and work together via a platform. Ultimately, these systems form a system of systems that encompass an entire city. This system of systems, which provides the basis for solving systemic and complex urban problems, is shown in Figure 1, adapted from work developed by Harvard Business School Professor Michael E. Porter and PTC CEO Jim Heppelmann and published in the *Harvard Business Review* in November 2014.


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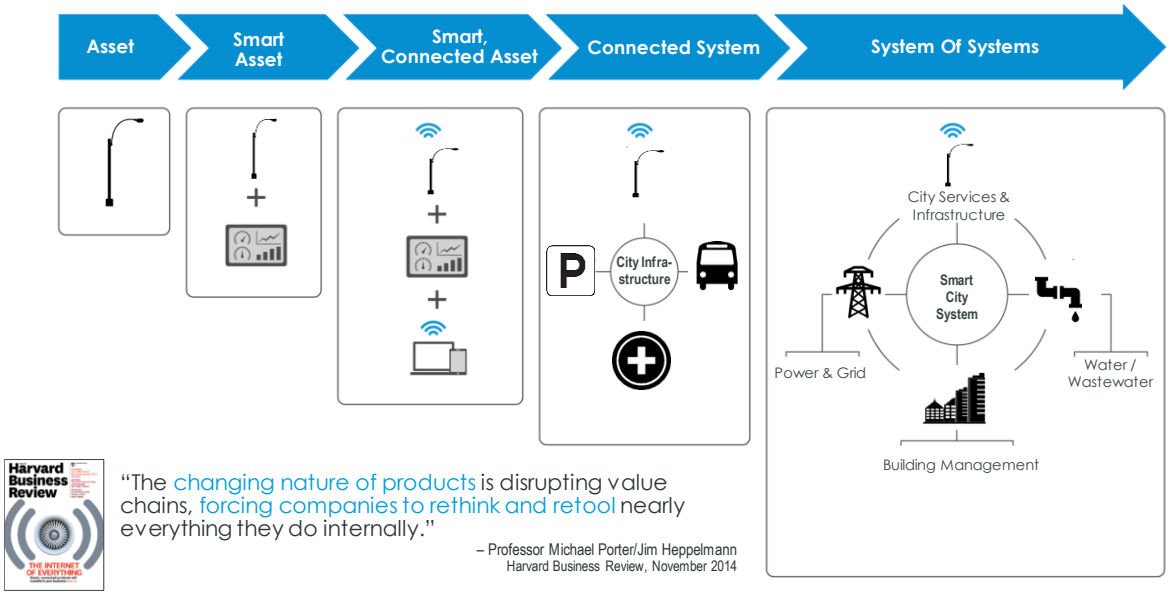
## FIGURE 1

### A Smart City Is a System of Systems




Source*: Harvard Business Review*, "How Smart, Connected Products Are Transforming Competition," by Michael E. Porter and James E. Heppelmann, November 2014

Figure 1 highlights the importance of the ecosystem in Smart Cities, where systems are interconnected and one part impacts the whole. For example, if the power grid goes down, the water supply is reduced, or roads are cut off, the effect ripples through an entire urban area and can cripple the operations of schools and businesses as well as impact public safety and health. Conversely, if these separate systems are proactively coordinated, and supported with integrated data, the benefits can improve the entire city. A McKinsey Global Institute report, "The Internet of Things: Mapping the Value Beyond the Hype," states that 40% of the value of IoT in cities is enabled by systems interoperability. As shown in Figure 1, smart, connected lighting not only saves energy and operational costs but also provides information to other systems and ultimately to residents, police officers, and drivers using additional environmental and acoustic sensors and cameras. This means that the impact of an event, such as an accident or an attack, is mitigated by a coordinated response. Adding the ability to rapidly test and deploy innovative applications on the platform enables new services to be offered, such as mobile phone apps that allow tourists to light a historic path through a city area or lights that can trigger video cameras in the event of an emergency. These examples illustrate the convergence of industrial operations and IT that is becoming more important in Smart Cities and how the platform supports this convergence.

In this context, it is evident that the success of Smart City platforms largely depends on the ability of the platforms to attract and nurture app developers, SaaS vendors, systems integrators, and other IT companies to build value-added and differentiated solutions on the top of the platform. Openness becomes a top commandment for such a collaborative model to survive. Smart City platforms that feature open and fully documented APIs as well as open and extensible tools and use industry standards should provide the most value to users.

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IDC has talked to many cities about their understanding of a Smart City platform. City IT buyers have a consistent and sophisticated understanding of the potential of a Smart City platform, much in line with IDC's definition. These cities describe platforms as bridging physical and digital data and supporting processes that flow from sensors and devices to action by workers. Given the challenges cities are facing, such as multiple complex, proprietary legacy systems, many are looking for solutions that are based on open IT — modular, innovative, interoperable and, at times, open source — to address their platform needs.

Today's platforms support application developers by providing public API access to the services offered by the platform. Some vendors also offer libraries and full software development kits (SDKs). Just a few provide application development environments to further accelerate the creation of applications. As the Smart City IoT market increasingly moves toward the adoption of loosely coupled PaaS architectures (many built using open source technology and supporting more standardized communications protocols), both the speed of deployment and the up-front costs can be improved. However, the following need to be further developed:

- Open platforms with full interoperability (ideally using industry standards) to support third-party innovation
- Dedicated app marketplaces to make available market-ready industrial apps

### *The Platform Approach Matters: Architecting for Scale*

System interoperability must be a strategic priority when architecting a city's Smart City platform approach. Approaches to platform deployment range from the more tactical (i.e., using the platform for implementing point solutions) to the more strategic (i.e., starting with small, select projects viewed as components of a holistic system that is being designed to drive citywide outcomes).

Cities often start with a tactical approach because it seems cheaper in the short run and provides a quick fix to a specific problem. The resulting solutions are often tightly coupled proprietary technologies, leaving little opportunity to reuse the components for other applications. Such an approach is slower and costly to build and maintain because it produces a siloed platform with unintegrated data. It can result in higher costs of data transmission, storage, and system management; significant resources focused on IoT plumbing; no ability to reuse code and share development efforts across solutions; and a higher chance of architecture failing at scale.

A strategic approach views distinct projects as part of a developing unified system and architects a platform for use across projects, departments, systems, and third-party offerings. Code is shared for common use cases, software development resources are focused on creating high value-add application business logic, and solutions are designed to leverage existing IT investments in cloud infrastructure and connectivity, allowing for faster prototyping and implementation of solutions at scale.

## Considering PTC

The Smart Cities space is a strategic growth area for PTC and its ThingWorx platform as the company extends its view of industrial IoT, historically focused on manufacturing, and broadens it to key industrial areas in the urban environment: power and grid, water and wastewater, building management, and city services and infrastructure.

PTC's ThingWorx platform has several important features that are central to a Smart City platform: a broad and deep partner ecosystem, rich options to communicate with any device, dashboarding and KPI capabilities, and rapid application delivery and capabilities to run analytics at the edge.


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The ThingWorx platform and its broad partner ecosystem allow cities to deploy Smart City solutions quickly, either in-house or via a partner. ThingWorx partnerships include the following:

- **Sensor, edge communication, and embedded device players:** Libelium, Intel, HPE, Cisco, Monnit
- **Communication service providers:** Vodafone, Sigfox, CenturyLink, Sensus (FlexNet meter networks)
- **Systems integrators and value-added resellers:** Deloitte, Capgemini, Tech Mahindra, TCS, Accenture, Infosys
- **Cloud platform and business systems players:** AWS, Microsoft Azure, GE Digital, OSIsoft
- **Solution and service providers:** Aquamatix, Smoove, Itron, WiseUP, DEPsys, All Traffic

Given that cities are focused intently on tracking metrics across key program areas such as water, infrastructure, energy, and waste, one very valued capability in the ThingWorx platform is that it offers role-based dashboards and KPIs across siloed systems. The platform can be leveraged citywide or across the broader public sector within a given region (supporting adjacent universities, hospitals, etc.) to broaden the value of the investment.

While many vendors feature a centralized cloud back-end engine able to digest, process, and run basic analysis on data gathered from endpoints, PTC ThingWorx also has edge services running close to the device for local analytics or for geographical areas with poor connectivity.

ThingWorx provides a citywide IoT platform that more fully leverages a city's physical assets, gateways, and cloud and communication networks; it also onboards solutions faster and creates value through a "system of systems." It does this via some key differentiators:

- **Kepware acquisition:** PTC now provides native industrial connectivity that seamlessly delivers communication and translation support for over 150 different protocols commonly found in industrial settings.
- **Deployment model agnosticism:** ThingWorx can run on any cloud (native AWS, Azure cloud) or on-premise platform.
- **Open IT platform:** Leveraging an open IT platform allows for data interoperability and compatibility among hardware, sensors, and other technologies such as open data; using ThingWorx, organizations can connect to any device, any cloud, or any existing software system.
- **Visual modeling capabilities:** A drag-and-drop user interface and the ability to engage in visual modeling allow for rapid application development.
- **Augmented reality:** Through its Vuforia acquisition, PTC enables cities to communicate with citizens in new ways by delivering digital, interactive views of the physical world via a cell phone, a tablet, or digital eyewear.

PTC has long been a company that places a premium on its partners and partner relationships; their success is PTC's success. In Smart Cities, where many partner offerings are in early stages, PTC's support via the company's close working relationships is essential to onboarding these solutions quickly to provide value to Smart City customers.

### *Challenges*

There are still barriers in place that impact the ability of cities to fully benefit from Smart City platforms. Challenges include security and privacy concerns, a lack of industry standards, and a dearth of use cases to demonstrate a return on investment.

- Security and privacy are top concerns for city leaders, especially given recent DDoS and ransomware attacks due to endpoint and device vulnerabilities. City officials are responding to concerns by residents about the use of their personal data and privacy, and Smart City platforms must address these issues. The stringent security technology required by Smart Cities, particularly around device authentication, advanced threat management, data privacy, and policy enforcement, is in development by most IoT platform vendors. IoT platform security requires more than a single vendor strategy, and cities should look to vendors that have partnerships with security specialists.
- Cities operate many different verticals or domains, including public safety, transportation, lighting, and environmental monitoring. A successful Smart City platform must be cross-industry; however, a lack of common industry standards often leaves siloed "intranets of devices," impeding innovation and growth.
- There is the issue of up-front costs versus the total cost of a solution. Up-front costs are cited by cities worldwide as one of the biggest barriers to adoption; thus many suppliers offer free "pilots" or low-dollar quotes "to get a foot in the door." This practice makes it harder for cities and states to understand how to budget for the real amount of infrastructure needed to realize platform benefits, and it makes it harder to measure the return.

In addition to these key challenges, the Smart City platform market is becoming more congested, with many vendors marketing their platform capabilities. While the offerings vary widely, it can be hard to differentiate one set of capabilities from another.

## Conclusion

No vendor today offers an end-to-end solution or a monolithic integrated stack that covers device, connectivity, data, apps, and app development, nor is this likely to be the case in the future. Instead, cities should look to vendors focused on providing users with flexibility and customization through their ecosystem. A Smart City platform is the hub of such an ecosystem, where applications, products, and services, verticalized by industry, are readily available to end users.

Cities should continue to request that platform vendors provide security, interoperability, strong open APIs, strong partnership ecosystems, and modular solutions with the ability to "experiment" via microservices. They should also place a premium on vendors that address these priorities.

To achieve full Smart City platform implementations at scale, buyers should:

- Find the city champion to pull together the resources to develop a strategic platform approach. This will help cities articulate their vision and business case for investment over the short term and the long term as well as define key vendor requirements.
- Once this strategic platform approach is developed, use it to select a vendor that can grow with your vision, meeting key requirements today. Vendor selection is an important decision given how central Smart City platforms will be to the delivery of services to constituents, residents, and businesses.
- Understand that no one vendor can provide an entire Smart City IoT platform, so choose providers with existing partnerships and vendors that can partner and work with your existing suppliers.


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