

# Internet of Everything in the Public Sector: Generating Value in an Era of Change

## Top 10 Insights

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## Introduction

In 2013, Cisco released groundbreaking research concerning a market transition of tremendous importance, which we call the Internet of Everything (for more information, please visit <http://internetofeverything.com>).

The latest wave in the Internet's evolution, IoE is the networked connection of people, process, data, and things. It represents the confluence of multiple technology trends: mobility (ubiquitous high-speed mobile networks, smart devices, and apps); cloud computing; social networks; instant collaboration with anyone, anywhere; data analytics; and finally, an explosion in connected "things," via inexpensive, intelligent sensors. IoE brings these elements together through standards-based IP networks, and Cisco projects that it will generate a staggering \$19 trillion in value over the next 10 years.

By adopting network technology solutions, government organizations can realize their share of the \$4.6 trillion in IoE-related public sector Value at Stake.

Public sector organizations can capture as much as \$4.6 trillion of this Value at Stake (<http://bit.ly/1aSGIzn>). Already, some forward-thinking organizations – federal, state, and local governments; healthcare organizations; educational institutions; utilities; and non-governmental organizations (NGOs) – are seizing the opportunity. They are using IoE-enabled solutions to increase efficiency, reduce costs, and, most important, improve the lives of citizens. Their innovations are delivering positive, measurable results, some of which have the potential to transform entire sectors of the economy.

Moreover, these organizations are taking bold action during challenging times. Global recession, fiscal austerity, and calls for lower taxes have reduced the financial resources of public sector organizations, just as the demand for public transportation, education, healthcare, social insurance, and services of all kinds is expanding. Yet for public sector organizations, the consequences of failing to do more with less – and of losing the fight to attract businesses and citizens – are immense.

Cisco sought to understand how leading jurisdictions in the public sector are using IoE to take advantage of new opportunities, and to solve their most pressing

### Public Sector Jurisdictions Surveyed for this Report

Jurisdictions surveyed by Cisco and Cicero Group include the following:

#### Cities

- Amsterdam, the Netherlands
- Barcelona, Spain
- Chicago, Illinois
- Guayaquil, Ecuador
- Hamburg Port Authority, Hamburg, Germany
- Nice, France
- Oslo, Norway
- Rio Operations Center, Rio de Janeiro, Brazil
- San Antonio, Texas
- Santander, Cantabria, Spain
- Seoul, South Korea (TOPIS)
- Stockholm, Sweden
- Waterfront Toronto, Toronto, Canada

#### Healthcare Organizations

- Ontario Telemedicine Network, Ontario, Canada
- Sault Area Hospitals, Sault Ste. Marie, Ontario, Canada
- UVA Center for Telehealth, Charlottesville, Virginia

#### Museums

- Cleveland Museum of Art, Cleveland Ohio
- Fernbank Museum of Natural History, Atlanta, Georgia

#### State / Province / County / Country

- Australia
- Delaware
- Dubai RTA
- Hagihon Company Ltd., Jerusalem, Israel
- Ontario Lottery and Gaming, Ontario, Canada
- San Mateo County, California
- South Korea Smart Work Centers

#### Universities

- Elon University, Elon, North Carolina
- San José State University, San José, California

problems. To this end, Cisco and Cicero Group, a leading data-driven strategy consulting and research firm, conducted a global study of IoE capabilities across 40 leading public sector organizations. These jurisdictions span the globe, and represent each level of government, as well as nonprofit groups. The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and represent the cutting edge of public sector IoE readiness and maturity. In-depth profiles of these jurisdictions are available for download from the following website: <http://internetofeverything.cisco.com/sites/default/files/publicsectorimpact>

The in-depth interviews we conducted with government leaders, department heads, and technical experts revealed common approaches that leading jurisdictions have taken to attain IoE excellence. The insights below summarize these approaches, with concrete examples from many of the jurisdictions we studied. They also provide a roadmap for change, which Cisco hopes will inform and inspire others to develop their own IoE strategies and solutions.

### Insight No. 1: Public Sector Organizations Are Leading IoE Innovators.

Many believe that public sector organizations are a step behind when it comes to adopting innovative technologies. Our study suggests that this belief is, in part, mistaken. The public sector is an excellent proving ground for IoE because of the size of many government institutions, the number of people they serve, and the difficult problems they must solve. The 40 jurisdictions we studied rival the best private sector firms in the vision, scope, and execution of their IoE initiatives. And all organizations – public and private – would do well to emulate their examples.

- **Vision:** Leading jurisdictions use IoE to transform how, where, and to whom they deliver services. By envisioning the possibilities of IoE, they are overcoming traditional barriers, such as limited funding and scarce expertise. The University of Virginia (UVA) Center for Telehealth, for example, is using video conferencing and networked medical devices to provide patients in rural Virginia with medical examinations and services in 40 specialties. The telehealth service has conducted some 40,000 clinical interactions, saving patients 8.9 million miles in travel, and serving those who otherwise might not have received care. UVA Telehealth does not stop at the state border: its doctors mentor physicians and examine patients in disadvantaged communities in Africa, Latin America, and the Caribbean.
- **Scale:** Because public sector organizations have broad authority over large sectors of society and the economy, they are able to launch IoE initiatives with impressive scale and transformative potential. The Unique Identification Authority of India (UIDAI) has signed up 620 million people for a biometric verification program that is improving delivery of benefits and services, while setting the stage for wide usage of biometrics-based financial transactions.
- **Execution:** The ability of IoE leaders to execute – by planning, implementing, and delivering measurable results – is impressive, especially given the

Cities already control many services upon which citizens rely. They can use technology to make those services more efficient as they create new opportunities for revenue.

complexity of many of these initiatives. Seoul City's Transport Operation and Information Center (known as TOPIS Center) provides an excellent example. TOPIS Center analyzes data from a variety of sources, including road and video sensors, GPS, taxi credit-card readers, citizen and driver reports, Wi-Fi networks, and closed-circuit television. It then leverages this data to reduce traffic congestion and improve the efficiency of the public transit system. Through mobile apps and systemwide digital signage, transit riders can see when buses will arrive, plan the most efficient way to reach their destination, and receive real-time updates. In addition to reducing congestion, the satisfaction rate for public transportation has grown from less than 50 percent to 85-90 percent.

### **Insight No. 2: Cities Use Comprehensive Strategies To Generate IoE Value.**

Cities are well positioned to improve the quality of citizens' lives through IoE. They already provide (or source) many of the services upon which citizens rely, including transportation, law enforcement, education, water, and (sometimes) Internet connectivity. Funding shortfalls and increasing citizen expectations are forcing cities to consider how they can use technology to deliver these services more efficiently and find opportunities to increase revenue. Cisco's IoE Value at Stake analysis (<http://bit.ly/1aSGIzn>) underscores the opportunity and imperative for cities to use IoE, and projects that cities are poised to generate 60 percent of IoE's citizen benefits. The leading cities we studied are launching ambitious IoE strategies to capture their share of this value. These strategies provide an overarching IoE vision, establish priorities for selecting and funding projects, and help cities launch multiple IoE initiatives concurrently.

The City of Amsterdam's Smart City strategy typifies this approach. It includes 47 IoE projects, such as smart energy grid systems, streetlighting, parking applications, building management, and public Wi-Fi. Many of these projects span multiple city departments and involve private sector stakeholders. At the center of Amsterdam's IoE strategy is an open IT infrastructure that will provide a platform for IoE-based innovations for years to come. With this infrastructure in place, Amsterdam can develop and test multiple new services rapidly (see Insight No. 3 below).

### **Insight No. 3: A Powerful Network Expands the Art of the Possible.**

Whether they are pursuing a holistic IoE strategy or building IoE capabilities one step at a time, public sector organizations need a strong network platform that can support multiple initiatives.

Like Amsterdam, the City of Guayaquil, Ecuador, has articulated an IoE strategy to reach ambitious goals. Mayor Jaime Nebot plans to make Guayaquil a digital city, even though only 44 percent of citizens have Internet access today. The expansion of network connectivity throughout the city, and to public institutions, is at the heart of the mayor's multi-pronged strategy. Guayaquil is connecting citizens with government services through centrally located kiosks, providing free Wi-Fi through

A powerful, flexible network is essential if organizations are to execute and scale multiple loE solutions.

50 hotspots near educational institutions, and has connected hospitals and clinics to provide telemedicine services. In expanding its network, Guayaquil is providing a foundation not only for better government services, but also for “digital citizens” who can compete for jobs in the global economy and generate higher tax revenue.

Figure 1. Telemedicine Services in Guayaquil, Ecuador.



Source: Municipalidad de Guayaquil

As with large jurisdictions, single facilities need a powerful, flexible network to execute their loE strategies. When Sault Area Hospital in Sault Ste. Marie, Ontario, constructed a new facility, Chad Carter, the enterprise architect, wanted a network that could unify all of the systems in the hospital, from patient monitoring and administration to telephony and lighting. “We started off with a mandate of ‘everything on the network,’” Carter said. “We went from a PBX environment to a fully IP-based, voice-over-IP environment. We actually layer [our patient monitoring] right onto our hospital network, right alongside patient systems and administrative systems – everything, including telephony, all on the same network.”

Unlike Guayaquil and Sault Area Hospital, some jurisdictions have not put an overarching loE strategy into place per se. Yet a robust IP-network foundation will enable them to pursue opportunities as they arise. As stakeholders see the positive impact of loE solutions, they will develop more of them, especially when they do not need to build and maintain separate network architectures for each one.

The City of San Antonio, Texas, took advantage of funding from a single loE-oriented project to install a fiber-optic network backbone and wireless mesh network that extends connectivity throughout the city. The network capability extends far beyond the needs of a single solution, however, and has provided a platform for San Antonio to develop a variety of loE-based capabilities for multiple departments, once funding and government support were in place. These include a networked traffic-light system that has greatly facilitated smoother traffic flow (prior to the traffic-light synchronization, the city estimated that \$2 billion was lost due to longer commutes,

Once decision-makers see what is possible – through pilot programs and prototypes – they are more likely to invest in full-scale implementation.

higher fuel expenses, safety issues, and other factors); Wi-Fi-based mobile technology for police cars; and a program that enables San Antonio residents to attend court hearings remotely.

**Figure 2.** A Court Kiosk in San Antonio, Texas.



Source: City of San Antonio, Texas

#### **Insight No. 4: Scalable Pilots Build Support, Momentum, and Expertise.**

Leading loE jurisdictions use pilot projects and prototypes strategically to rally support among key stakeholders. The originators of an loE project often have a clear vision for what the technology can deliver, and pilots provide an opportunity to share that vision with others. Once decision-makers can see the possibilities, they are often more willing to invest in a full-scale implementation, and to champion it with others whose support is necessary. Jane Alexander, chief information officer for the Cleveland Museum of Art, used pilots to help museum executives and board members understand how interactive displays and mobile technology could attract people who do not typically visit museums, such as families with young children. The pilot paved the way for the museum's Gallery One initiative, which has driven a 70 percent increase in overall attendance, and a 30 percent boost in family memberships.

Pilots are also essential for ensuring that loE initiatives deliver positive results once they are fully implemented. Many successful public sector loE leaders follow two best practices when designing pilots. First, the pilots use scalable technologies and delivery methods. This ensures that work done to design, test, and troubleshoot the solution will be applicable once the project goes live. Second, scalable pilots are used to measure quantifiable impacts that can then be leveraged to evaluate the business case for a full rollout.

The City of Nice, France, is taking this approach with its Connected Boulevard program, which includes applications that monitor parking, lighting, air pollution, and

solid-waste levels. Nice is using the first year of the program to determine which applications it will implement citywide.

### Insight No. 5: Data Analytics Magnify the Impact of IoE.

Data analytics are helping advanced public sector organizations generate insights that improve efficiency, save money, and conserve scarce resources. For example, Hagihon, Israel’s largest municipal water utility, uses a smart water management and conservation system that combines sensors with advanced analytics. The system uses algorithms to identify irregularities that indicate a leak or flow problem. Hagihon can then fix the leak before it causes an interruption in water service. The combination of sensors and analytics has significantly decreased water loss, while increasing profitability and improving customer service.

Mobile apps – whether in-house or third party – are becoming a key driver of citizen engagement and innovation.

Another example is Santander, Spain, which is analyzing data delivered from a network of more than 25,000 sensors that monitor traffic volumes, public transportation options, noise and particulate levels, lighting demands, water quality, and parking availability. This data is transferred to an analytics platform that allows it to be “linked together in a more transversal and efficient way,” according to José Antonio Teixeira Vitienes, general director of innovation for the Santander City Council.

Figure 3. Stockholm Is Applying Analytics to Manage Traffic.



Source: City of Stockholm, Sweden

IoE solutions that gather and analyze data from multiple sources (sensors, mobile devices, payment systems, databases) can also make near-term predictions. Several of the jurisdictions we studied are developing sophisticated analytics capabilities as the next step toward deriving more value from IoE. Analytics are especially valuable for using data drawn from multiple sources to make near-term predictions. Stockholm, for example, is developing a system that will use data

Successful IoE initiatives take “people and process” issues into consideration. Said a Dubai official, “You need to understand and involve the customer as much as possible.”

gathered from its traffic congestion system, video cameras, weather patterns, and accident records to predict when traffic problems are likely to occur.

As Daniel Firth, chief strategy officer of the City of Stockholm Traffic Administration, explains, “Instead of waiting until an incident happens and then implementing our traffic management systems, we can force-feed these problems before they happen and start using management tools – the traffic signals, message signs, and such – to make sure the problem doesn’t occur, or to reduce the impact of the problem.”

### **Insight No. 6: It’s an App, App, App, App World.**

Both citizens and government employees now interact with IoE services primarily through mobile devices. And many public sector entities are putting mobile apps at the center of their IoE strategies, whether they are developed in-house or through third parties. Here are a few examples:

- Dubai has the most ambitious mobile government initiative among the jurisdictions we studied. The goal is to launch 200 mobile government services in the next two years. Dubai is focused on enabling mobile transactions and payments to make it easier for citizens to conduct business with the government.
- Santander, Spain, has launched multiple smartphone apps to improve the daily lives of citizens, and to help them play a larger role in how the city is run. The smart parking app, which uses data from the city’s network of sensors, has reduced downtown traffic congestion by 80 percent. And citizens have embraced several other apps with enthusiasm, including SmartSantander RA, which has been downloaded by nearly 15 percent of city residents. The app provides information about the locations of city buses, traffic, and cultural events. Another app, City Pulse, allows residents to notify city management of incidents or issues that require attention.
- The Ontario Lottery Commission is developing a mobile gaming app that will help it compete with offshore gaming companies for the estimated \$400 million per year in gaming revenue that is spent by residents on offshore gaming sites.
- The City of Chicago benefits directly from an ecosystem of outside application developers who use city data to develop new services and applications. For example, a private developer created SweepAround.us, a private app built on city data that alerts citizens when street cleaners are coming so they can move their cars to avoid tickets or towing. Another app uses crime and accident data to determine the safest routes by which to walk to school. City officials admit they do not have the resources to analyze this data and develop user-friendly apps themselves, but they see them as a helpful extension of the services and information that the city already provides.
- Several jurisdictions are expanding their wireless networks to help make it easier to use mobile apps, including video-rich content. In California, San José State University is undertaking a large-scale improvement of the university’s Wi-

Fi network, including the installation of an additional 1,800 access points – an increase of nearly 300 percent. The network expansion will help students view lectures and instructional videos via mobile devices.

### **Insight No. 7: IoE Solutions Must Address People and Process, Not Just Data and Things.**

In addition to technology, successful IoE initiatives take “people” and “process” issues into consideration. These include encouraging employees to embrace new roles, using training and recruiting to obtain needed skills, and, critically, to design solutions around how citizens can most easily access services and interact with the government.

Transparency and online data sharing encourage direct and immediate feedback from citizens.

Dubai’s Roads and Transport Authority (RTA) has launched wide-ranging transportation initiatives that include driverless metro service, payment systems for transit and tollgates, and smart parking meters. The RTA has tackled both people and process issues by incorporating customer input throughout the development and deployment phases. As the RTA’s CEO of corporate technical support services, Abdulla Al Madani, states, “You need to understand and involve the customer as much as possible, because something that you think is right might be something that the customer really doesn’t want.” Dubai’s Smart City Initiative is yielding success: Traffic fatalities have dropped from about 20-22 per 100,000 citizens to fewer than four per 100,000. And the percentage of the population using public transportation has grown from 6 to 12 percent.

The Hamburg Port Authority (HPA) is in charge of paving the way for the efficient, resource-friendly, and sustainable implementation of infrastructure projects in the Port of Hamburg, Germany. The HPA is the contact point for all kinds of questions concerning waterside and landside infrastructure, the navigational safety of vessel traffic, port railway facilities, port property management, and economic conditions within the port area. On the technology side, the HPA consolidated and expanded its core network and implemented a network of sensors. The HPA also made numerous process and workflow changes to ensure that the information generated by its IT systems could be used effectively. Now, when a ship comes into the harbor, HPA’s systems detect it, and ship pilots and cargo handlers are given relevant information automatically. The right people receive data at the right time so they can initiate the proper processes.

As Dr. Sebastian Saxe, chief information officer, Hamburg Port Authority, describes it, “The Internet of Everything incorporates the technology, tries to build a control process, and includes people in this process in order to build more intelligent systems .... If you try to approach this type of model and you leave out processes and people, you are going to be left with half-truths, or an incomplete solution.”

IoE technologies bridge disparate teams, by enabling effective cross-department collaboration and data sharing.

### **Insight No. 8:** **Transparency and Open Data Drive Stakeholder Engagement.**

By providing more direct feedback and reporting links among public sector entities and the people they serve, IoE is transforming the ways in which public sector organizations do business. In the past, the types of services that governments deliver – such as safety, security, parks, and recreation services – were not subject to immediate and direct feedback from citizens. IoE is changing the dynamic between citizens and government. Citizens can now go online or use mobile devices to provide feedback or make complaints. Governments can engage with citizens by sharing information and addressing their concerns. Government executives can also hold their departments accountable for solving problems brought to light by citizen comments. As an example, the City of Chicago publishes huge amounts of information online, including financial reporting, crime statistics, operational data such as snow removal and road repair efforts, and resident complaints. The resulting level of transparency fosters increased accountability and motivates employees to deliver results. Data sharing is also at the heart of the city's strategy to develop an application-development ecosystem (see Insight No. 6 above).

Transparency can also be used to showcase an organization's effectiveness, and to garner support. Water For People is a nonprofit group that provides safe drinking water and improved sanitation in the developing world. The organization developed a mobile monitoring and reporting app called FLOW that documents the status of its programs. Water For People uses this technology to track its installations for 10 years after implementation. It collects feedback from the community to ensure that its services are as beneficial and meaningful as possible, and to address any issues immediately. Data on how its projects are performing is available online, so that residents in the area, government officials, and donors can monitor progress and results. According to Ned Breslin, CEO of Water For People, FLOW helps them educate key stakeholders, and improve the sustainability of their projects.

FLOW also allows Water For People to constantly improve its own services. Bad feedback is welcomed as a learning opportunity; and through statistical analysis, those lessons are applied to changes and decision making that will further help communities. The FLOW program is so effective that it has been adopted by more than 300 similar organizations.

### **Insight No. 9:** **IoE Is a Catalyst for Breaking Down Organizational Silos.**

Leading jurisdictions have found that “stovepipes” – a perennial problem among public sector organizations – must be broken down if IoE initiatives are to succeed. But the IoE initiatives themselves can serve as a catalyst for effective cross-department collaboration and data sharing, as different groups come together to support their success. Rio de Janeiro, for example, has developed a coordinated information and operations center in which city officials covering transportation, policing, utilities, and emergency services deliver coordinated responses to a range of emergencies and adverse events. In addition, these agencies now share data in real time, which gives them a fuller picture of the events to which they respond.

Such coordination and data sharing pays dividends when the city faces natural disasters or hosts large events, such as Carnival or the upcoming World Cup and Summer Olympics. According to city officials, having this central resource and data-coordination center has been tremendously helpful to both city operations and to the general public.

**Figure 4.** Rio Operations Center Integrates Information from Multiple Government Agencies and Private Sources To Improve City Safety and Incident Response.



Source: Centro de Operações Rio

Strong leadership and top-down vision can drive IoE implementations, even when technical hurdles threaten to slow momentum.

The County of San Mateo in California has utilized IoE to coordinate communications among a host of cities and transport agencies that share responsibility for transportation management along the Highway 101 corridor south of San Francisco. By adopting a common “smart corridor” approach, the county was able to develop a solution that coordinates traffic efforts on arterial routes running parallel to the highway. Now, if incidents on the highway cause severe traffic congestion, drivers can be directed to secondary routes via automated, digital message signs. At the same time, traffic-light timing along the arterial routes is adjusted to accommodate the added traffic flow. Before IoE, it would have been virtually impossible to coordinate such efforts in real time across the more than 10 different jurisdictions along the corridor.

### **Insight No. 10:** **Senior Leadership and Tangible Public Benefits Are Essential for IoE Success.**

Leading IoE jurisdictions were nearly unanimous in citing the importance of strong senior leadership to get IoE projects off the ground and direct them through political and technical challenges. For senior leaders to champion IoE projects, especially those requiring major funding and coordination, they must be convinced that the public will benefit.

To innovate faster, create a better quality of life for citizens, and make the best use of scarce resources, public sector organizations will need to be hyper-aware, predictive, and agile. loE is the way to do it.

Barcelona's Smart City encompasses 83 projects across 12 different service areas, with more on the way. Individual departments and midlevel executives can drive interest in such loE solutions. But for big projects to become a reality, top government leaders must get behind them – in Barcelona's case, this came from a newly elected mayor. As Julia Lopez, coordinator of the Smart City strategy, states, "This would not have been possible if we did not have top-down political vision. You can start thinking bottom-up, but the big, final push was at the political level. If you don't have political willingness, it is impossible." The public benefits of Barcelona's loE projects have justified the mayor's support. These include a smart water program that delivers \$58 million in annual savings, a \$50 million annual increase in revenues from smart parking, and 47,000 new jobs.

Figure 5. Connected Trash Bins in Barcelona.



Source: City of Barcelona

A major reason that loE projects must generate tangible public benefits is the cost and commitment they can require. For example, in the case of the Waterfront Toronto group, contractors are expected to maintain world-class infrastructure continuously for the next 30 years.

Waterfront Toronto is a collaborative effort among the federal, provincial, and municipal levels of Canadian government to revitalize a 2,000-acre stretch of Toronto Harbor. Waterfront Toronto has a 30-year plan to transform the aging harbor into one of the world's leading intelligent communities. An integrated fiber-optic network infrastructure and smart solutions are at the heart of the plan, which seeks to attract residents and new businesses to the area. Both Waterfront Toronto and its technology partners understand that a revitalization project of this magnitude requires long-term leadership and commitment.

"In the Waterfront context, our network provider has to actually keep the network within the top seven in the world in terms of both price and performance on a wholesale basis for the next essentially 30 years," said Kristina Verner, director of intelligent communities for the Waterfront Toronto revitalization project. "So, in that period of time, the neighborhood will not fall behind in terms of their connectivity,

which is tremendous. How else can you get creative to make sure that what you're future-proofing today is actually going to be valid a dozen years down the road?"

Finally, strong leadership is required to overcome the technical roadblocks that inevitably arise as innovations are developed and scaled. Several of the IoE leaders we interviewed expected challenges and embraced the process of trial and error. The importance of persistence is magnified as technological complexity increases. As Kyung Soon-lee, deputy director of Seoul City's TOPIS Center, explains, "In establishing our TOPIS Center, we had numerous cases of trial and error. For instance, one sensor that we'd selected was not the best fit for our system technologically. Sometimes policies were against us, and we didn't have the right technical environment. For TOPIS Center to be this sophisticated, we went through many hurdles."

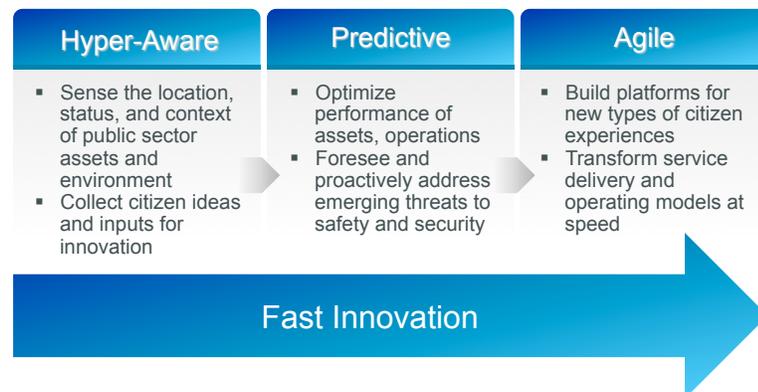
**What To Do Next:  
Starting the Journey**

Leaders cite the importance of a broad perspective on technology and the problems it can solve. Creativity is key.

IoE represents an unprecedented opportunity to transform the public sector in terms of how it operates and how it provides services to constituents. It creates both the need (rising expectations from citizens) and the means (a platform for fostering and delivering new capabilities) to accelerate innovation.

Earlier Cisco research (<http://bit.ly/N090Dc>) and our ongoing conversations with customers on the topic of IoE reveal there are three essential attributes for an IoE-ready organization: it must be 1) hyper-aware, 2) predictive, and 3) agile (see Figure 1). These are the traits public sector organizations will need to innovate faster and achieve their desired outcomes, whether that is making services more convenient for citizens, making optimal use of scarce resources, improving the sustainability of a jurisdiction, providing assistance to those in need, and defending against threats.

Figure 6. The IoE-ready Organization: 3 Key Attributes.



Source: Cisco, 2014

By developing pilot projects that allow early testing and analysis, the leaders we interviewed were able to solve difficult problems and improve the lives of citizens through IoE.

As the preceding Top Ten Insights illustrate, the IoE solutions adopted by our example jurisdictions – whether based on data analytics, agile network infrastructure, collaboration tools, or other IoE technologies – are clear drivers of these three core attributes. In addition, many of the best practices for developing IoE programs were common among the jurisdictions we studied.

These best practices provide helpful guidance for any organization that is considering, or already developing, an IoE solution. But what should a public sector or nonprofit group do to get started? In what follows, we offer concrete steps organizations can take to embark on their own IoE journey. These steps have been distilled from the experiences of the IoE leaders we interviewed, and the lessons they learned from their own projects.

**1) Develop an action plan to accomplish your objectives.** Establish a process for prioritizing potential IoE initiatives based on the problems that need to be addressed and your starting point. Several jurisdictions created formalized criteria for evaluating and selecting IoE projects. The ability to articulate the public benefits, and to prove them through metrics, were key criteria for the jurisdictions we studied, as they help generate support both internally and with the public. Also, consider starting with initiatives that have generated benefits for other jurisdictions, such as smart parking and other transportation-based projects. Transportation authorities often have the requisite budgets and authority to launch scalable pilot projects, and metrics of success are relatively easy to develop and communicate to stakeholders.

**2) Select technology partners who have IoE vision and expertise.** Most of the IoE leaders we interviewed said that working with experienced technology providers helped them envision what their IoE solutions could accomplish, and use technology in ways they had not considered. In some cases, this was a formal public-private partnership in which private sector groups contributed needed infrastructure and funding to get things started. In other cases, jurisdictions selected technology vendors that possessed vital technical expertise and industry knowledge.

**3) Build the network foundation you need for multiple projects.** For IoE initiatives to succeed in the long term, public sector organizations need a strong network foundation. Otherwise, they run the risk of developing “point solutions” that cannot easily scale or share data. Since collecting and analyzing data from multiple sources expands the benefits of IoE, the inability to integrate data can blunt the impact of individual solutions and lead to disappointing results. Furthermore, building a separate network for each IoE initiative is inefficient, costly, and discourages experimentation. Many successful IoE jurisdictions constructed a network platform based on a robust fiber-optic backbone and widely available Wi-Fi access. From such a platform, they can launch multiple IoE projects at once, and are able to share data to create new sources of insight and value.

**4) Start piloting.** By developing pilot projects that allow early testing and analysis, the leaders we interviewed were able to solve difficult problems and improve the lives of citizens through IoE. Nearly all of them cited the importance of using pilots and prototypes to obtain stakeholder sponsorship, prove the business case, and get the technology right. Pilots should be scalable, and have clear metrics of success

that can be used to decide whether they should be fully implemented. We also saw that perseverance in the face of technical (and political) challenges can be the difference between smashing success and premature failure.

**5) Be open to the possibilities.** IoE has the capacity to transform what public sector organizations do, and how they do it. The IoE leaders with whom we spoke discussed the importance of maintaining a broad perspective, with regard to both the problem to be solved and the technology that will solve it. The limitations of a particular technology can often be overcome with creativity and knowledge of the alternatives.

Once the building blocks of a solution are in place, benefits can come from unexpected places. The IoE journey may start with a specific problem, but the clear value in sharing and analyzing data, breaking down silos, and driving stronger citizen and employee engagement can lead to new and greater impacts.

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