Smart Cities and the Internet of Everything: The Foundation for Delivering Next-Generation Citizen Services

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INTRODUCTION

Smart City development is a question of *when* not *if,* a question of *how* not *what.* Why? Because we live in a world experiencing economic turmoil, climate change, aging populations, and rapid urbanization. But we also live in the midst of tremendous technological innovations that have the potential to address the issues that challenge every city.

Smart Cities are a future reality for municipalities around the world. These cities will use the power of ubiquitous communication networks, highly distributed wireless sensor technology, and intelligent management systems to solve current and future challenges and create exciting new services. Smart City officials will be essential visionary leaders who drive Smart City progress using public-private partnerships to invest in scalable projects, smart regulation to connect city laws to new digital realities, and innovation clusters to create jobs and vibrant economies.

Smart City technologies integrate and analyze massive amounts of data to anticipate, mitigate, and even prevent many problems. This data is leveraged, for example, to intelligently reroute traffic and reduce accidents, identify crime hot spots and target resources for crime reduction, and connect citizens at work or out on the town. Smart Cities proactively provide services, notifications, and information to citizens such as where to find a parking spot or a new local shop or even to monitor air pollution. Smart Cities connect citizens to local government and encourage more direct participation, interaction, and collaboration. And Smart Cities provide solutions that are economically and environmentally sustainable. This is the potential future for every city and town.

This White Paper discusses trends driving Smart City growth, the vision for the Smart City of the future, and the maturity cycle that cities can progress through to become a Smart City. It includes real-world examples of cities on the path to a Smart City and lays out concrete actions that leaders can take to move toward a well-managed Smart City.

Trends Driving Smart City Growth

Urbanization, demographic shifts, and the rapid advancement of new technologies are shaping the way city leaders create and deliver public services. Following are the key trends driving the need for innovative approaches to city operations and service delivery:

- **Cities are in a steadily increasing global competition for talent.** To remain competitive, cities need to attract and retain talented and skilled workers. Smart Cities often have a leg up on the competition with their strong innovation ecosystems and industry expertise. Such environments attract start-ups and young professionals – spurring further economic growth, jobs, and innovation. This in turn prompts further growth in other sectors such as real estate and entertainment. IDC Government Insights believes that Smart Cities will benefit from continual economic development.

- **Growing urban populations stress city infrastructure and resources.** Every major city has traffic congestion because cities cannot continue to build physical infrastructure to keep pace with rising demand and usage. This applies not only to roads but also to schools, hospitals, and city resources like police officers and water supply. With finite resources and limited budgets, cities must build smarter, using technology to more efficiently manage and use existing infrastructure as well as for planning for future growth.

- **Climate departure makes energy efficiency an urgent issue.** Climate departure, as described in a recent article in the journal *Nature,* is the point at which a city's coldest year will be hotter than any year on record before 2005. The Earth will pass climate departure in 2047, according to the study, but cities like Lagos, Nigeria, will pass this point in just 16 years. The International Energy Agency (IEA) estimates that urban areas contribute over 67% of global greenhouse gases, and this is expected to rise to 74% by 2030. It is estimated that 89% of the increase in CO_2 from energy use will be from developing countries (IEA 2008). As such, cities have a vital role to play in improving energy efficiency and reducing carbon emissions. There are many options for increased urban efficiency, like more efficient street lighting, green buildings, increased public transportation use, and reductions in traffic.

- **Cities must provide services that span the digital divide.** Citizens' expectations for interacting with and accessing government services are changing rapidly. Younger people expect to have the city in their pocket – to find a cab, locate the next bus, find a nearby restaurant or event, report a pothole or broken streetlight, apply for their driver's license, or tweet to their government representatives. They want consistent, personal service via their smart device. This trend challenges city leaders to create new channels for service delivery while maintaining traditional ones like call centers and office hours. Cities must meet the needs of the elderly or lower-income citizens who may have limited access to technology as well as the younger generation of always-connected citizens.

- **Proliferating technology equals exploding amounts of data.** Security footage from video cameras, transponders collecting highway tolls, and sensors attached to bridges, parking spots, water pipes, street lights, and waste bins provide new data about city operations. According to IDC's *2013 Digital Universe Study,* this digital data is expected to double every two years from now until 2020. How cities leverage and share this data will be a competitive differentiator. Big data and analytics will turn the vast amount of data into valuable and usable information and knowledge. Cities that have opened their data to the public have spurred the creation of new business; these businesses develop applications using city data and provide innovative citizen services while creating exciting new jobs.

The Smart City of the Future and the Internet of Everything

Let's take a look into the near future to see how these trends will affect city development. Figure 1 shows how technologies like big data and analytics, mobility, social media, and cloud provide a foundation for meeting city business goals and creating valuable services.

FIGURE 1

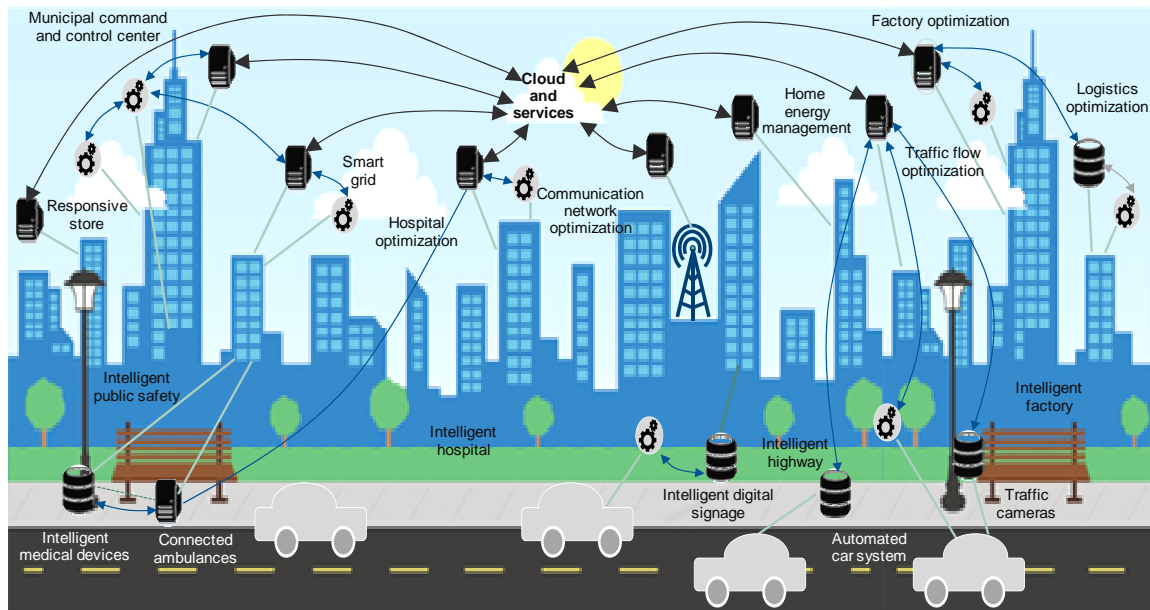### Smart City of the Future Value Architecture

Source: IDC Government Insights, 2013

Figure 2 illustrates the vision of the future city, a city with a pervasive overlay of information and communication technology (ICT) connecting things, organizations, and people. For example, sensors connect cars to transportation management centers that analyze day-to-day traffic flow data and provide what-if scenarios in case of events or accidents.

This vision of the future is what Cisco calls the Internet of Everything (IoE). The IoE connects people, data, things, and processes in networks of billions or even trillions of connections. These connections create vast amounts of data, some of it data we've never had access to before. When this data is analyzed and used intelligently, the possibilities seem endless.

FIGURE 2

A City with a Digital Overlay

Source: IDC Government Insights, 2013

Today, less than 1% of things that could be connected are connected to the Internet or intelligent systems. IDC projects that by 2020, there will be 212 billion "things" in the world and that by 2017, 3.5 billion people will connect to the Internet, 64% of them via mobile devices. People and connected things will generate massive amounts of data, an estimated 40 trillion gigabytes, that will have a significant impact on daily life; it will enable faster response times to medical or public safety emergencies and save lives, it will improve the quality of citizen life by providing direct and personal services from the government, and it will uncover new information about how our cities work, thus enabling city leaders to use resources more efficiently and save money while providing superior services. There are three key ways in which the IoE will significantly impact our lives, as described in the following examples:

- **The IoE will automate connections.** Today, people must proactively connect to the network or Internet via mobile devices like smartphones and tablets and to other people on the network via social media sites like Facebook and LinkedIn. Citizens must proactively call a 311 call center for a complaint or 911 for an emergency. Imagine if people were connected automatically to systems of services instead. Wearable computers in clothing or watches, or sensors in pills that are swallowed, could automatically send patient information to doctors and nurses. This would allow a sick or an elderly person to manage his or her healthcare from home rather than a hospital or nursing home, getting automatic reminders to take medicine or immediate preventive care for changes in health status. For example, weight gain in cardiac patients is often an early indicator of returning heart problems. Connected scales from the home can be used to alert a doctor of a change in patient weight so that quick action can be taken to prevent another heart attack.

- **The IoE will enable fast personal communications and decision making.** Now imagine that intelligence is embedded within sensors or devices. This means the device itself will filter out relevant information and even apply analytics, so in the case of the connected scale, only when a certain threshold of weight gain is crossed will doctors and nurses be alerted. In other cases, embedded intelligence allows for real-time decision making that can save lives. Consider firefighters wearing sensors that let them know if the CO_2 in a building has reached lethal levels. This type of data not only will enable faster, better decision making but also will help government workers, doctors, and citizens more efficiently manage their time. Instead of doctors searching through files or ordering a battery of tests, information would be sent to them directly from patients to help make decisions. Patients will have faster response times from doctors based on such highly personalized information. This is another example of how the Internet of Everything will completely change the types of services that are offered and also how they are delivered to citizens.

- **The IoE will uncover new information.** With the deployment of so many sensors and other information-gathering devices, city managers will be able to understand their city as never before. This is happening already. An interesting example is the use of acoustic sensors that are calibrated to detect gunshots. Some cities in the United States have deployed these sensors in areas of gun violence and discovered some shocking information. Police departments had historically assumed that residents called the police 80% of the time when shots were heard. And thus the police thought they had a fairly accurate measure of street gun violence. In San Francisco, after the sensors were in place, the police discovered that residents called the police only 10% of the time when shots were heard. In Oakland, California, the 911 call rate for shots fired was only 22%. Prior to the sensors, these police departments were operating on highly inaccurate information about the level of gun violence in certain neighborhoods. With this new information, police can now plan their patrols differently and better target areas to reduce gun violence.

These examples highlight some of the exciting ways the IoE will transform city life and help cities become Smart Cities.

IDC Government Insights' Smart City Maturity Model: Stages of Development

The framework of the IoE is a foundation for Smart Cities that rely on connections and information to transform the quality of life of citizens. But like the IoE, a fully optimized Smart City is still a future vision. Many city leaders are grappling with how to take advantage of the IoE and develop as a Smart City. To help cities along in this journey, IDC Government Insights created the Smart City Maturity Model.

Most city leaders are concerned with similar issues of economic development and job creation. Most face similar challenges in aging, outdated, or undeveloped technology infrastructures; siloed information and processes; and many bureaucratic and cultural factors that influence the rate of progress. Because of the commonalities among cities, it is possible to map the stages of maturity that cities traverse on their journey to an optimized Smart City.

Navigating transformative change is a long-term and complex process. Cities need to be able to assess their current situation and determine the critical capabilities needed to enable a Smart City. IDC Government Insights' Smart City Maturity Model defines stages of maturity and key technology and nontechnology areas to help cities:
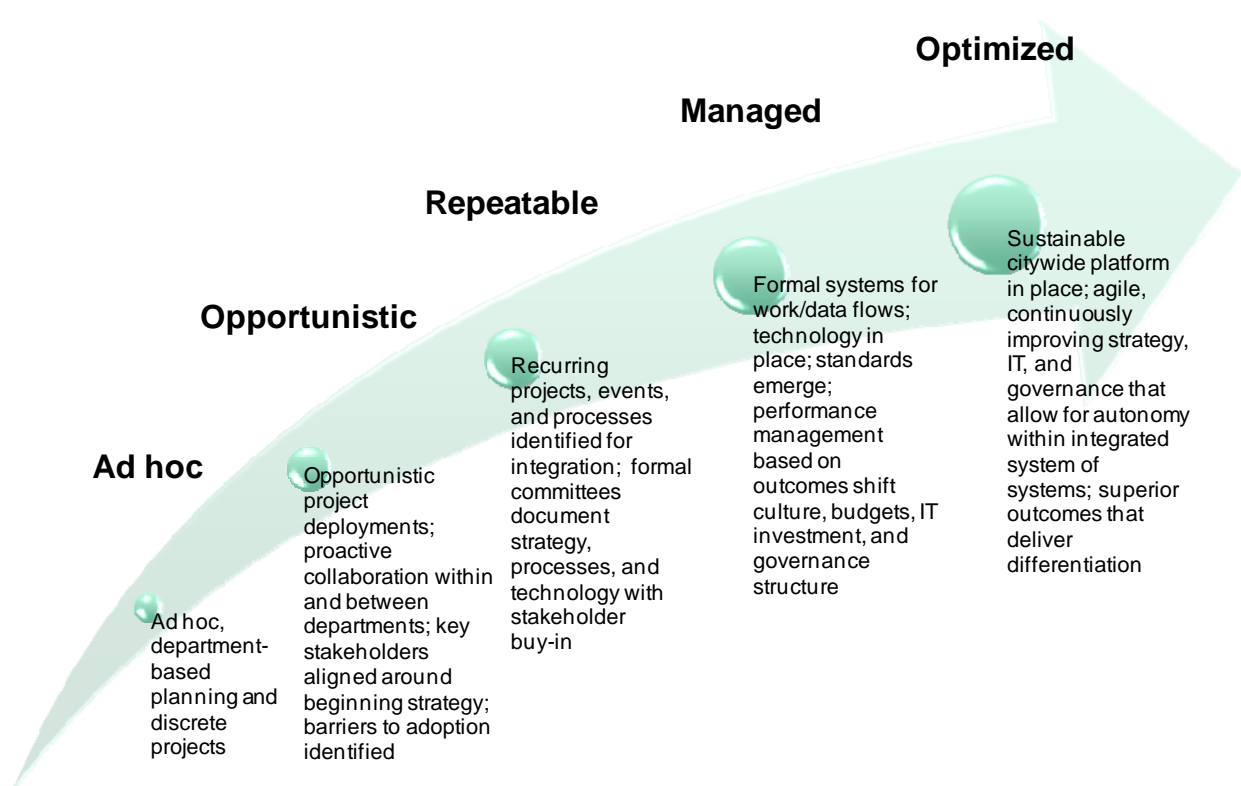
- Begin to assess Smart City current competency and maturity

- Define short- and long-term goals and plan for improvements

- Prioritize technology, partnership, staffing, and other related investment decisions

- Uncover maturity gaps among departments and business units or between functional and IT groups

The five stages described in Figure 3 provide a vision for how cities can progress in their Smart City development.

Figure 4 provides a summary of the key characteristics, goals, and outcomes of each of the stages.

FIGURE 3

Stages in Smart City Development

Source: IDC Government Insights, 2013

FIGURE 4

IDC Government Insights' Smart City Maturity Model at a Glance

	Ad hoc	**Opportunistic**	**Repeatable**	**Managed**	**Optimized**
Key characteristic	Siloed	Intentional	Integrated	Operationalized	Sustainable
Goal	Tactical services delivery	Stakeholder buy-in	Improved outcomes	Prediction and prevention	Competitive differentiation
Outcome	Proof-of-concept and business case development via ROI from pilot projects	Cross-organization deployments and development of foundational strategy and governance	Repeatable success in project process and outcomes across multiple organizations	Enterprisewide strategy, process, data, and so forth bring improved service delivery via adaptive sense-and-respond systems	Agility, innovation, and continuous improvement in service delivery bring competitive advantage

Source: IDC Government Insights, 2013

Based on extensive city research, IDC Government Insights believes that currently there are no managed or optimized Smart Cities. However, many cities have already invested in Smart City initiatives – spending time and money either researching solutions or piloting or deploying discrete projects.

The reasons for Smart City investments vary by city but often begin with the need to reduce operational costs. High water costs from aging infrastructure may lead a city to invest in water sensors for leak detection and more rapid repairs. Citizen complaints about commute times or parking availability in central business districts can lead to investments in real-time traffic information systems or in smart parking meters or parking sensors. IDC Government Insights finds that most cities are deploying these projects department by department (per the ad hoc stage in the Smart City Maturity Model) and using them to prove the business case for further investment. However, Smart City initiatives rely on cross-department connections and scale to realize their full potential. For example, parking solutions are most effective when combined with a citizen engagement strategy to foster the use of mobile parking applications, and systems to help the police department better monitor violations. This requires collaboration between transport authorities, IT, public safety, and offices in charge of customer service. The question city leaders are now asking IDC Government Insights is how to accelerate project progress and leverage the investments they have already made.

Progressing Toward a Smart City Reality

IDC Government Insights defines five best practice areas, and the key success factors within each, that need to be addressed in order to make the Smart City concept fully operational. Figure 5 details nontechnology success factors like vision, leadership, innovation, and citizen engagement as well as technology success factors like infrastructure, architecture, and the use of data.

FIGURE 5

Smart City Key Success Factors

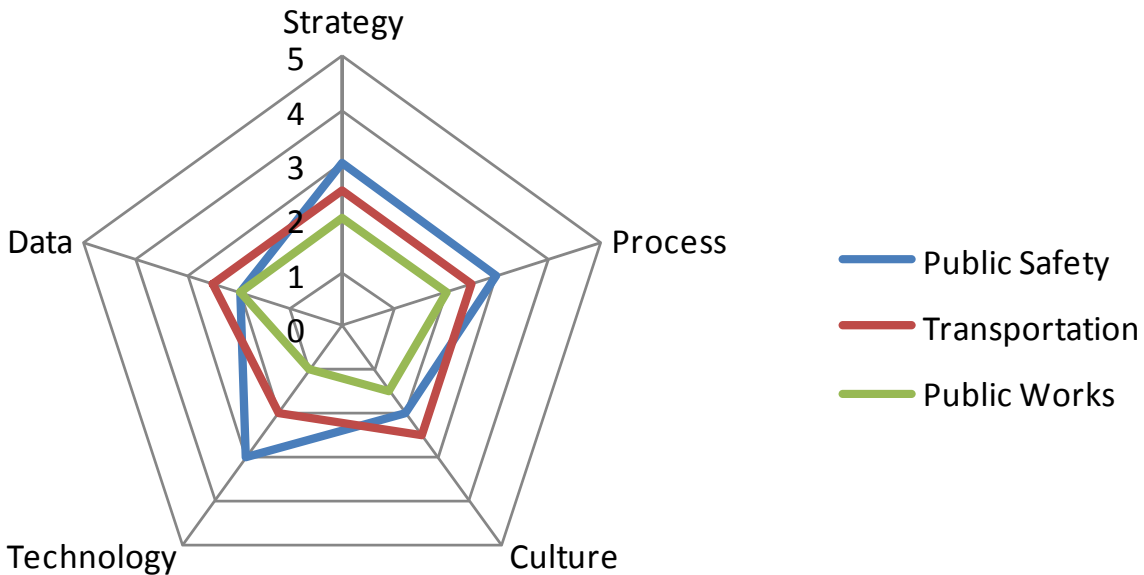| Category	Best Practice Areas	Key Success Factors
Nontechnology	Strategy	▪ **Vision:** Specific social, economic, and environmental goals and objectives defined by city leaders based on citizen and business needs ▪ **Leadership:** High-level city leaders who drive the implementation of the vision ▪ **Business case:** The financial rationale for the vision
	Culture	▪ **Innovation:** How well a city experiments and innovates with new ideas and technologies ▪ **Citizen engagement:** How well a city uses citizens and stakeholders as resources (Open data is a foundation of engagement.)
	Process	▪ **Governance:** The structure for implementing change at the city level (organization, budgeting, performance measures) ▪ **Partnerships:** Levels and types of partnerships
Technology	Technology	▪ **Architecture:** Design of technology assets to be leveraged across city verticals ▪ **Adoption:** Penetration of broadband infrastructure and data capture devices like sensors, cameras, and so forth
	Data	▪ **Use:** Analysis and display of data for use for improved services and decision making ▪ **Access:** How data is shared and accessed by workers and citizens

Source: IDC Government Insights, 2013

These success factors should come as no surprise. The key point, however, is that they must be addressed in concert with each other to effectively accelerate Smart City development. Figure 6 shows IDC Government Insights' assessment of the maturity levels of three city departments — public safety, transportation, and public works — in the best practice areas. The numbers, 1 through 5, correspond to a maturity level (1 = ad hoc and 5 = optimized). The baseline assessment shows that transportation departments, when analyzed at the worldwide level, typically fall between the ad hoc stage and the opportunistic stage in the data best practice area, while public works and public safety are still in the ad hoc stage. At the same time, transportation departments are less mature in the

process best practice area than public safety. Note that there is uneven maturity not only between each department but also within each department, which slows down overall Smart City development.

FIGURE 6

Current City Baseline by Department

Source: IDC Government Insights, 2013

Nontechnology Success Factors

Barcelona, Spain, one of Cisco's Smart+Connected cities, provides an excellent example of how city leaders, in this case the mayor's office and city council, can articulate a far-reaching vision and begin to put it into practice.

Barcelona: Iconic City Leadership Drives Vision

Barcelona, the capital of Catalonia, is Spain's second largest city. With approximately 1.6 million inhabitants, the city is at the heart of a metropolitan area of 5.5 million people. Despite the economic challenges facing Spain, the Barcelona area has fared relatively well and the local economy has remained resilient. In Standard & Poor's annual review of Barcelona, the city upheld its intrinsic "AA" rating (the specific rating the agency would give if Barcelona wasn't influenced by Spain's debt) compared with its official "BBB" rating conditioned by Spain's economy as a whole. *The Financial Times* reports that foreign investment in Catalonia is second among all regions in Europe, with 4,095 new jobs created in the first half of 2013, and Ernst & Young reports that foreign investment was up 16% from 2012 to 2013 behind only London and Paris. According to the city, this can be attributed to Barcelona's position as an innovation hub and efforts to promote strategic projects closely linked to the knowledge economy and mobility infrastructures.

The Vision

In July 2011, Xavier Trias was elected as the mayor of Barcelona. He began to enact his Smart City vision, which has three fundamental pillars:

- **Local projects:** Focusing on the better use of technology to improve the lives of citizens

- **International vision:** Creating a scalable platform to ensure that Smart City projects are rolled out in a replicable way

- **Technology standardization:** The development of the City Protocol (launched in July 2012) to drive how technology standards should be developed specifically for cities

What Was Done

Trias reorganized the city council and created the Urban Habitat department (the "Smart City" department), a new structure combining the urban planning, environment, IT, and infrastructure and transportation departments under the leadership of Deputy Mayor Antoni Vives. The purpose of this new organization was to break down the traditional silos that inhibit the delivery of next-generation citizen services. For example, the department now coordinates all of the services on a city street, from lighting to parking to road repairs, as opposed to different departments having responsibility for each area. This change involved a redefinition of processes, responsibilities, and communication channels and an investment focus on technology innovation.

While more than 20 projects are under the Smart City umbrella, 3 projects are critical to the success of the Barcelona City Council's efforts in this area:

- **High-speed communications network:** The backbone for this is a fiber-optic and WiFi network as the platform to improve service delivery.

- **Sensors platform:** This is an internal system for city council operations to break down traditional information silos existing between water, energy, and transportation. This platform will help foster collaboration across these departments and result in cost savings for the new Urban Habitat organization.

- **CityOS:** This service delivery platform will allow external parties from the private sector, academia, and industry to innovate with Barcelona. These innovations would focus on applications and solutions to further the three fundamental pillars outlined previously.

The Role of Municipal Leadership: Strong Leadership, Vision, and Governance Make the Difference

Trias, with his vision and leadership, has started Barcelona on a path to a higher level of Smart City maturity. Key to this effort was to institutionalize his vision by reorganizing departments and creating the Urban Habitat department as well as supporting these changes with smart regulation. For example, the current government passed a bylaw called MES (Mobility, E-Government, Smart City) that institutionalizes the long-term vision of the Barcelona Smart City.

Technology Success Factors: The Network Is the Foundation

When we consider the IoE and the Smart City, the importance of network infrastructure becomes apparent. Smart Cities must be built upon a pervasive broadband network to connect all parts of a city, and data must be sent faster, securely, in real time, and in unprecedented volumes. "Network infrastructure must be a key investment to prepare for our 2020 digital universe," states IDC in the *2013 Digital Universe Study*.

Lake Nona, Orlando, Florida, the first designated Cisco Smart+Connected city in the United States, demonstrates how the network enables the next generation of citizen services.

Lake Nona: A Culture of Collaboration and Innovation Builds for the Future

Lake Nona is a 7,000-acre (28 sq km) master-planned community being developed within the city limits of Orlando by the Tavistock Group, an international investment firm. Lake Nona is a mixed-use community with homes for 25,000 planned residents. At the heart of Lake Nona is the Lake Nona Medical City, a 6-acre life science cluster with medical schools, research centers, and healthcare providers.

The Vision

The US$2 billion project is a long-term legacy project for Tavistock, and the company approached it with an eye toward the next decade and with the desire to make Lake Nona a global role model for other cities. One of the foundations of this strategy was to view technology infrastructure as an essential utility like water or electricity. A high-bandwidth, high-capacity network with virtually no limits was the basis for providing next-generation services to Lake Nona's residents, workers, and visitors. Cisco is helping build Lake Nona over the next 15 years to show what services are enabled by unlimited connectivity, computers, storage, and bandwidth.

What Was Done

The mantra of the Lake Nona leadership is that collaboration will foster innovation, and innovation is required to realize the vision. Tavistock brought together leaders from the hospitals, research centers, and business community to determine the future needs of Lake Nona. The heads of human resources, the CIOs, and other representatives sit together on councils to provide their input on the needs of employees and citizens and how to use technology to meet these needs. Bringing together the expertise, interests, and perspectives of department heads from different organizations, as opposed to each organization operating independently, has enabled Lake Nona to prioritize projects that are highly valued by citizens and workers in Lake Nona and focus on their rapid deployment.

Tavistock knew from experience that a project that spans 15 years needs a "maniacal drive" from leaders to push concepts and designs to actual implementation. The Lake Nona Institute, a nonprofit that governs the city's health, wellness, and technological initiatives, was formed to also help create and move the vision forward.

The Value Created

These councils, while working together in their expertise areas, needed a partner to coordinate the councils and pilot solution areas. Cisco became that partner and the expert in how to use the technology infrastructure in six original pilots focused on healthcare, safety and security, learning and education, community operations, intelligent workspaces, and innovation and experience.

Two of these pilots demonstrate the impact technology will have on the lives of Lake Nona residents:

- **Patient-centric healthcare:** Lake Nona, using Telehealth solutions from Cisco, is enabling devices in the home to connect to hospitals. A doctor-patient visit can happen at home using Cisco's HealthPresence solution. A doctor, for example, can remotely look at a patient's skin through a dermascope, or listen to the patient's heartbeat, all while communicating via a two-way video.

- **The flipped classroom at Lake Nona High School:** The flipped classroom reverses the traditional teaching model where the teacher gives a lecture to the class and students process and practice what they learned through homework. In the flipped classroom, the teacher instruction is provided online, outside of the classroom, via prerecorded lessons, and the class time is used for the process and practice. This method allows students to learn at their own pace at home, supported by two-way videos or online chats to talk with peers and the teacher, and then use class time to discuss the lesson and learn through activities and interaction.

The Role of Municipal Leadership: A Culture of Collaboration Is Essential

Collaboration with the mayor of Orlando has been instrumental in keeping the construction of Lake Nona on schedule. The mayor is in line with the community vision and has removed roadblocks for its development. For example, he set up an onsite permit approval and inspection office so that during construction, when inspections or permits are needed, a city worker is immediately available to help. This has reduced the time for approvals from days or weeks to hours.

Realizing the Smart City Vision

Developing a Smart City vision and putting it into practice is neither a simple nor an easy task. Important questions for city leaders include:

- **How does your city embrace innovation and new ideas?** Cities need to be willing to experiment, try new ideas, take calculated risks, and collaborate with different departments and stakeholders outside of government. This, of course, potentially exposes leaders to failure. However, cities must begin to embrace a process that builds upon successes and failures over time in order to determine what really works.

- **How do you find additional funds for investment to bring ideas to scale?** Cities need to think creatively about funding Smart City initiatives. Cities have a strong tendency toward business as usual around the budgeting process. Long-standing programs are funded without review or alignment with Smart City strategies, and departments often need to fight for budget without a mandate of interconnection or collaboration with other departments.

  Traditional means of funding, like grants from central governments, mean cities rely on the vision of these government agencies to determine what types of projects are funded. This inhibits cities from funding the projects that they want to and that best fit into their unique vision.

- **What types of services should you consider first?** Along with the uncoordinated budgeting and funding process, many city departments are managing duplicate assets. To bring investments into alignment across departments, cities need leaders who will promote a digital master plan that spans the entire city. Building a digital master plan should be one of the first services a city considers for its Smart City development. This is not simply a 10-year budget plan; rather, it requires a bottom-up view of the key challenges the city is facing and the services needed to address these challenges.
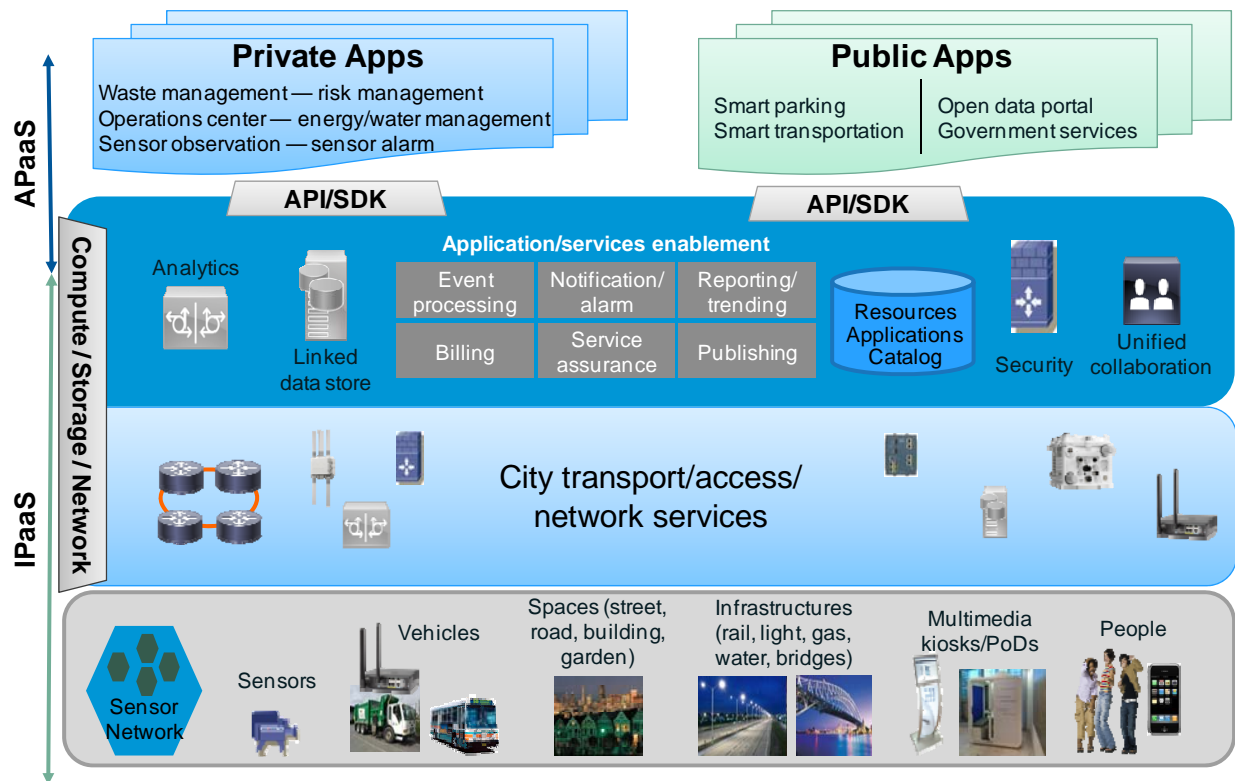
City Infrastructure Management

Cities should consider developing a master plan around a converged network design in which a single unified network is used. Cities might have different networks deployed around different applications — separate networks for video surveillance, environmental monitoring, water meters, parking management, or streetlight management. Not only do these separate networks each have ongoing operational expenses, but the information from each is collected in silos. The comparison can be made to a national highway system; we don't use a different road system for cars, trucks, or emergency vehicles because it is much more efficient to use a unified road network. The same applies for data flowing over the network; multiple networks are less efficient than a single unified network.

With an eye toward providing all citizen services on a single unified network, Cisco is offering a new service called City Infrastructure Management (CIM). It is designed to help cities build this converged network. Cities can start with one application, like a video surveillance system, and then add other applications like a parking management system or streetlight system on the same network.

A diagram of the CIM framework is shown in Figure 7.

FIGURE 7

City Infrastructure Management: A Multilayered Architecture

Source: Cisco, 2013

Cisco also recently launched a citywide WiFi service as a component of the CIM. Citywide WiFi is convenient for citizens who want to connect to the Internet, but it has value beyond that. WiFi services enable connected services like automated parking management in which sensors and mobile apps help direct drivers to open parking spaces or improved public safety with IP-enabled video surveillance. These connected services bring in tremendous benefits. For example, better parking management helps reduce traffic congestion in business districts, citizens spend less time searching for parking spots, CO_2 emissions are reduced, and the city is able to improve collections from parking violators. In this case, the network provides the foundation for innovative city services, with anytime, anywhere Internet access for citizens, better citywide data collection, and support of local businesses.

Songdo: Public-Private Partnerships Sustain Implementation of Long-Term Digital Master Plan

The Challenge

South Korea has had rapid industrialization and economic growth since the 1960s when it was one of the world's poorest nations. Today, it has the highest ICT infrastructure penetration per resident in the world. To continue its growth, in the mid-1990s, South Korea began a plan to leverage its central location in the Asia/Pacific region to encourage foreign investment and develop an air-based economy.

The Vision

The Incheon Free Economic Zone (IFEZ) was created with the aim of becoming Northeast Asia's leading international business city. Its vision is to use advanced technology to build an environmentally sustainable community while advancing the area's economic development and opportunities for its citizens. A key aspect of this vision is the new city of Songdo, which is a mixed-use area of 1,500 acres built on land reclaimed from the Yellow Sea. Currently, Songdo has 27,000 residents and 30,000 workers, with projections for up to 75,000 residents living in the international business district (IBD), 150,000 in greater Songdo, and 300,000 workers. The Songdo project is one of the largest in the world, with US$40 billion in investment over a 10-year period.

What Was Done

Gale International is the private developer of the largest component of Songdo – Songdo's downtown international business district (Songdo IBD). Gale created the blueprint of the Songdo IBD with Incheon city planning professionals and design and engineering partners like Kohn Pedersen Fox and Arup. Gale worked closely with Cisco to make the Songdo Smart+Connected community fully operational using a digital master plan as the blueprint. Gale and Cisco began by asking, "What kind of experience do the residents of Songdo want to have? What would attract citizens to the city?" Cisco worked to define the architecture to provide these services to residents. The result is a city that provides the services citizens want the most, ensuring the real estate has an enhanced value. This increases return for investors as well as for the city via an expanded tax base.

Residents of Songdo enjoy a wide range of sustainable services, such as:

- Songdo is the first city in Asia to follow USGBC LEED (Leadership in Energy & Environmental Design)–certified design and development standards for an environmentally sustainable water, waste management, and green IT infrastructure.

- Each apartment block has its own integrated operations center that manages the buildings, lights, doors, and energy of common areas as well as advanced video surveillance for fire and leak detection and faster response times to incidents.

- Home automation systems also contribute to energy efficiency with a touchscreen operating console that allows residents to monitor and control home lighting, cooling, and heating; unlock their doors; or even call for an elevator.

- Homes are equipped with Cisco TelePresence, a real-time video communications system that enables residents to opt in for services like home tutoring, English-language classes, and a home healthcare system.

The Role of Municipal Leadership

The city of Incheon had the vision to see how a master-planned community, based on advanced technology, could provide a high quality of life for residents in Songdo. The city also had the vision to bring in outside expertise from Gale, Cisco, and many private partners. A key aspect to the implementation of the Songdo IBD master plan is the partnerships between the Incheon Free Economic Zone Authority (IFEZA) and private partners.

The joint venture u.Life Solutions LLC brings together Cisco's Smart+Connected Communities expertise, Gale's Smart City development experience, POSCO's experience as general contractor for large-scale construction projects, and LG CNS' expertise as a leading Korean systems integrator. All the needed expertise in one entity has facilitated delivering the vision as each partner invested funds, time, and intellectual capital into this massive infrastructure project. This has driven the project forward while allowing it to withstand changes in leadership and weather economic cycles.

Next Steps for City Leaders

To progress through IDC Government Insights' Smart City Maturity Model from an ad hoc or opportunistic stage to a managed Smart City, or even to begin a Smart City journey, cities can take some specific next steps:

- **Get involved.** The Internet of Everything and Smart Cities have the potential to be the most significant catalysts for change during this century. A recent TED Talk by Benjamin Barber, author of the book *If Mayors Ruled the World: Dysfunctional Nations, Rising Cities,* discusses the impact city leaders can have on solving cross-border problems like immigration, climate change, and pandemics. Barber believes that mayors are best positioned to solve these issues as opposed to nations because it is difficult for nations to get beyond trade agreements, national security, and competitive positioning to come to transnational agreements. Barber, however, points out that mayors have no such limitations and are pragmatists by nature. IDC has researched many examples that prove Barber's point, examples of city leaders collaborating on solutions for issues like climate change. In the United States, for example, 1,017 cities have signed on to meet or exceed Kyoto Protocol targets to reduce greenhouse

gas emissions (U.S. Conference of Mayors 2008). City mayors and council members – from the Covenant of Mayors in Europe, the Clinton 40, ICLEI, the City Protocol, and other organizations – are taking charge of the future, coming to common agreements on solutions, and sharing best practices.

Another key area for active engagement is with organizations working on the development of standards so that devices, networks, and other areas of technology can "talk" to each other. Lack of interoperability and standards limits data sharing, which in turns limits how data can be correlated and analyzed. This ultimately will inhibit cities from realizing the full potential of the Internet of Everything. Many international and national standards bodies, like the International Organization for Standardization and the International Telecommunication Union, have formed study groups on sustainable cities and Smart Cities. City CIOs and IT staff should join and actively participate in these groups.

At the 2012 Smart City Expo World Congress in Barcelona, Deputy Mayor Antoni Vives called Smart Cities a movement. Right now it is a small movement, but it's growing rapidly. This means that city officials, industry analysts, academia, and vendors are very interested in connecting with other like-minded people. City leaders should join Smart City groups on LinkedIn, follow urban thinkers on Twitter, and participate in international conferences to share experiences and ideas for city innovations. These can be great resources for learning what has worked in other cities, what challenges other leaders have encountered, and how these challenges were overcome.

▪ **Articulate your vision.** What is the ultimate vision for your city? What are your city's strengths, and where are your city's weaknesses? To become a Smart City, a city should have an explicit Smart City mission statement and a digital master plan around sustainable urban development and specific citizen services. The general characteristics of an overarching Smart City mission should include goals about sustainable economic development, a culture of innovation, open data, cross-department collaboration, and key services to provide a higher quality of life for citizens. This vision should be developed with a cross-section of stakeholders from multiple city departments and agencies as well as citizen and business groups.

▪ **Align governance structures with the vision.** Leaders must have a clear and consistent vision of what their city should be but also the commitment and skill to make the changes to achieve this vision. It is clear that leaders cannot execute the vision alone. They require a group of people within the city who can communicate and coordinate the vision across many departments and with external stakeholders. Centralized innovation groups, like Boston's Office of New Urban Mechanics, can take charge of piloting new ideas and working with the community. Other new structures, like Barcelona's Urban Habitat or Rio de Janeiro's Operations Centre, can be equally effective organizations that enact and support the city vision. The key for all these groups is that they have high-level political support and funding and that their projects are aligned with the goals of internal clients.

▪ **Build stakeholder ecosystems around specific issues.** Cities should actively work to develop issue-based ecosystems around areas like open data, intelligent transportation, smart buildings, or citizen engagement. IDC Government Insights believes that the first step is to align internal stakeholders. This is what IDC Government Insights sees happening in the opportunistic and repeatable stages of the Smart City Maturity Model. In the opportunistic stage, leaders begin to organize stakeholders across departments or agencies, bringing them together to develop a common language and to define the goals and desired outcomes of initiatives.

The next step is to bring in external stakeholders. Many cities already work with private partners and academia around issues like intelligent transportation or economic development, but oftentimes, ideas are not applied. The city should take responsibility to ensure that new ideas are on the table; work to bring community groups, academics, IT vendors, and urban planners and developers together around urgent city issues; and then push pilots and test cases for practical application. Various city departments and agencies have to work together with external partners to achieve the coveted managed Smart City state.

- **Reinvent partnerships.** A main source of funding for Smart City pilots comes from central or international government grants. Not only are these funding sources limited, but they fund projects defined by the central government as opposed to the projects most needed by a city. The private sector offers another funding option as long as the private partner and the city share the same project vision, as we saw with Songdo and Lake Nona. Private partners can also help determine use cases and sustainable business models, which are other ways in which private investment and partnerships can help cities realize their Smart City vision.

  Partnerships are critical for Smart City deployments to access not only private financing but also expertise. Partnerships between city government and private entities allow for cities to share the risks and gains from projects, and they formalize relationships to withstand changes in city leadership. Public-private partnerships align the goals among stakeholders and keep everyone invested over the life of the project. While many cities are wary of the higher returns private investors want, partnerships are a key way to accelerate progress. Private partners will push city partners to move at a faster pace, while city partners can remove roadblocks, like zoning requirements or permits, to implementation.

- **Embrace open data.** Government transparency is increasingly important to citizens, but it is a missed opportunity if you make data sets public without a broader strategy to crowdsource ideas, access the talents of your local developer community, and enable businesses to use the data to develop commercial services. IDC projects that cities with strategic open data initiatives will have 50% more mobile applications developed for citizens by the private sector. To capitalize on this, cities need to provide machine-readable information and mobile information through Web APIs. It also requires education on data and promoting its use to build services. In the United States and the United Kingdom, we have seen the use of challenges and hackathons where small prizes are granted for the best citizen-developed app or business idea. This relieves cities of some of the burden of app development, brings in new ideas from the community, and fosters a vibrant digital sector.

- **Execute**. Urgency in execution is necessary to remain ahead in the global competition among cities. Think big, start small, and execute fast.

Conclusion

IDC Government Insights believes Smart Cities will be the places where most people will want to live and work. These dynamic municipalities will use information technology as the foundation for new and better services, improved stakeholder collaboration, and greater efficiency. These communities will support sustainable growth, civic engagement, and smart economic development. As described in the case studies, many leading municipalities around the world are already implementing a Smart City vision. Those cities that are not considering the exciting potential of Smart City transformation risk being left behind. Now is the time to start on your Smart City journey.

About IDC

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