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Helping CIOs Understand "Smart City" Initiatives

by Doug Washburn and Usman Sindhu
for CIOs

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Defining The Smart City, Its Drivers, And The Role Of The CIO

by Doug Washburn and Usman Sindhu
with Stephanie Balaouras, Rachel A. Dines, Nicholas M. Hayes, and Lauren E. Nelson

EXECUTIVE SUMMARY

Cities are becoming "smarter," as governments, businesses, and communities increasingly rely on technology to overcome the challenges from rapid urbanization. What makes a "smart city" smart is the combined use of software systems, server infrastructure, network infrastructure, and client devices — which Forrester calls Smart Computing technologies — to better connect seven critical city infrastructure components and services: city administration, education, healthcare, public safety, real estate, transportation, and utilities. The concept of the smart city is pushing the CIOs in federal, state, and local governments and their technology teams to further evaluate emerging technologies and engage with key stakeholders within and outside of their organizations. To successfully deliver on the smart city vision, CIOs should have a clear understanding of what the smart city is, its key drivers, and their role in it.

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NOTES & RESOURCES

Forrester interviewed Alcatel-Lucent, Cisco Systems, and IBM and incorporated knowledge from client inquiries.

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DEFINING THE SMART CITY AND ITS DRIVERS

To quote Wellington E. Webb, former mayor of Denver: "The 19th century was a century of empires. The 20th century was a century of nation states. The 21st century will be a century of cities." And Forrester believes that the smart city — or at least components of it — will be a model for the world's cities into the future. Forrester defines the smart city as:
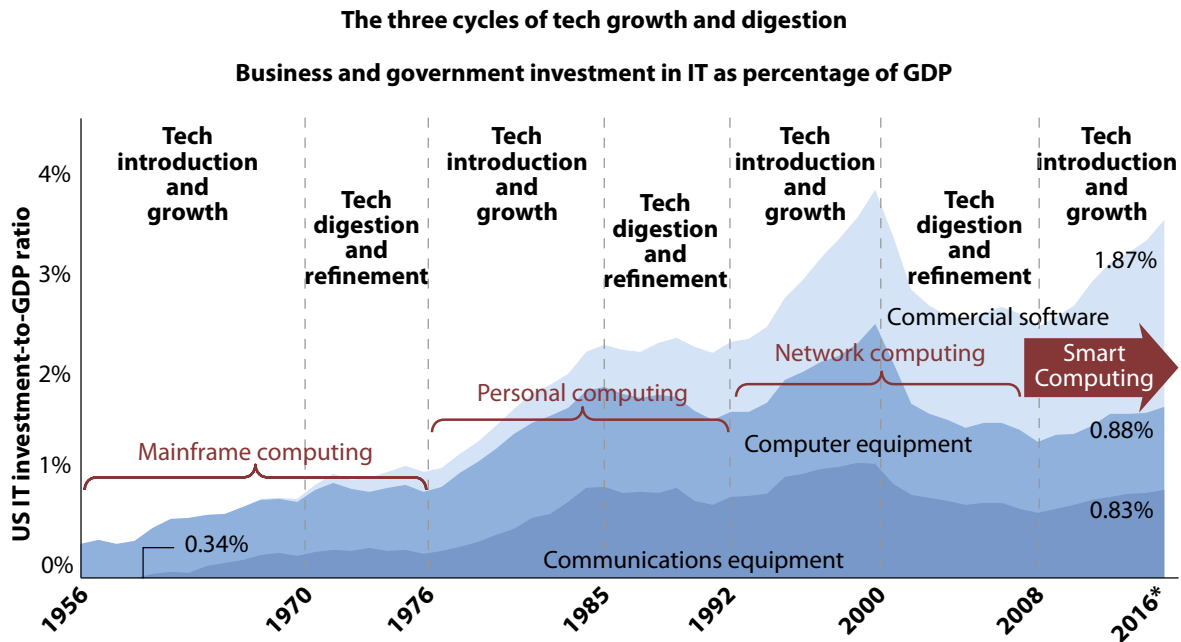
> *The use of Smart Computing technologies to make the critical infrastructure components and services of a city — which include city administration, education, healthcare, public safety, real estate, transportation, and utilities — more intelligent, interconnected, and efficient.*

Forrester defines Smart Computing as:[1]

> *A new generation of integrated hardware, software, and network technologies that provide IT systems with real-time awareness of the real world and advanced analytics to help people make more intelligent decisions about alternatives and actions that will optimize business processes and business balance sheet results.*

What makes a city a smart city is its use of Smart Computing to deliver its core services to the public in a remarkably efficient manner. Forrester predicts Smart Computing to be the next major cycle of technology adoption and digestion, lasting for the next seven to eight years, with investment growing at twice the rate of the overall economy (see Figure 1). Unlike previous technology cycles that were mainly horizontal (e.g., mainframe computing, personal computing, and network computing) or only focused on improving IT service delivery like cloud computing, Smart Computing will have a highly vertical industry focus — such as city administration, education, healthcare, transportation, and utilities — and cities are the microcosm where all of the industries intersect.

Figure 1 The Major Technology Adoption And Digestion Cycles Since The 1950s

The three cycles of tech growth and digestion

Business and government investment in IT as percentage of GDP

Source: US Commerce Department for 1956 to 2008; Forrester Research forecasts for 2009 to 2016
*Forrester forecasts

55590   Source: Forrester Research, Inc.

## Rapid Urbanization Is Creating Challenges And Opportunities

We're passing through a revolutionary period. The United Nations estimates that at some time between 2008 and 2009, the world's urban and rural populations became equal.[2] And beginning in 2019, it's expected that more people will live in cities than in rural areas. According to a 2007 to 2008 United Nations World Urbanization Prospects study, ". . . the population living in urban areas is projected to gain 3.1 billion, passing from 3.3 billion in 2007 to 6.4 billion in 2050" (see Figure 2). The rapid growth in population poses new challenges for city services and infrastructure, but at the same time, it creates new economic opportunities and social benefits for people. The smart city promises to capitalize on its economic opportunities and social benefits while alleviating the pains of urbanization, which include:

- **Scarcity of resources.** As more people migrate to urban areas, it will strain cities' already limited resources and services like energy, healthcare, housing, and water. In addition, not only are these resources and services limited in supply, they are often poorly managed. As a result, there are inconsistencies in how they are distributed and contained. Freshwater consumption is expected to rise 25% by 2030 due largely to the increase in population.[3] Many cities around the globe already suffer from a high cost of living and a lack of basic healthcare and education. Better management of these resources is a key component to making cities smarter.

- **Inadequate and deteriorating infrastructure.** A recent report by the American Society of Civil Engineers (ASCE) gives a D grade to America's infrastructure.[4] Most of the key infrastructure components, like bridges, drinking water, energy, roads, schools, transportation, and water, score anywhere from a C to a D. Across the globe, the condition of many of these infrastructure components in cities is not adequate to provide services to rapidly growing populations. This is especially the case in the cities of developing countries, where service outages and interruptions are a daily occurrence. For example, Achim Steiner, executive director of the United Nations Environment Programme (UNEP), explains that "[t]he 45% or so of people in India hooked up to a power grid suffer chronic, daily electricity outages."

- **Energy shortages and price instability.** The US Energy Information Administration (EIA), a policy-neutral analytical agency within the US Department of Energy, anticipates that the "World marketed energy consumption is projected to increase by 44% from 2006 to 2030."[5] The EIA expects that energy demand from emerging economies — such as the BRIC countries (Brazil, Russia, India, and China) — will increase by 73% during this time frame, far outpacing the 15% increase from developed economies like Australia, France, Germany, Japan, the United Kingdom, and the United States. Large urban populations are a major driver of this trend, and cities often struggle to adequately meet demand due to a lack of supply as well as inefficient transmission and distribution systems to the end customer. Price increases and instability are regular occurrences and are caused by: 1) high capital costs to develop new-generation capabilities; 2) mandates for more sources of renewable forms of energy — which are often more costly; and 3) the tendency for nations to import energy, oil in particular.

- **Global environmental "weirding" and human health concerns.** To quote *The New York Times* columnist Thomas L. Friedman, "The rise in average global temperature is going to lead to all sorts of crazy things — from hotter heat spells and droughts in some places, to colder cold spells and more violent storms, more intense flooding, forest fires, and species loss in other places."[6] Friedman refers to this scenario as "global weirding" — a tweak to the term "global warming" — to depict the negative environmental outcomes from modern life, in particular, urban life. Negative human health impacts are linked to environmental impacts — such as air pollution from burning fossil fuels — that can be exacerbated in cities. The US Environmental Protection Agency (EPA) expects climate change to contribute to air quality problems: "Respiratory disorders may be exacerbated by warming-induced increases in the frequency of smog (ground-level ozone) events and particulate air pollution. Ground-level ozone can damage lung tissue, and is especially harmful for those with asthma and other chronic lung diseases."[7]

- **Demand for better economic opportunities and social benefits.** It's important to remember that the ultimate driver of rapid urbanization is overwhelmingly opportunistic — the pursuit of improved economic opportunities and social benefits. As traditional manufacturing and agricultural jobs become increasingly automated, outsourced, or obsolete altogether, larger cities hold the promise of employment in increasingly service-based economies. Likewise, larger

cities offer critical infrastructure and services that are scarce or completely unavailable in rural areas, from public transportation to healthcare and education. While urbanization and the opportunities its citizens seek out are certainly not new — from the Middle Ages in Europe to the Industrial Revolution in the 1800s — the rapid pace of today's migration is unprecedented. And the promise of the smart city is to help ensure that the economic and social benefits of urbanization are actually realized by curbing its negative consequences.

Figure 2 Rapid Urbanization Is Causing Cities To Outgrow Rural Areas
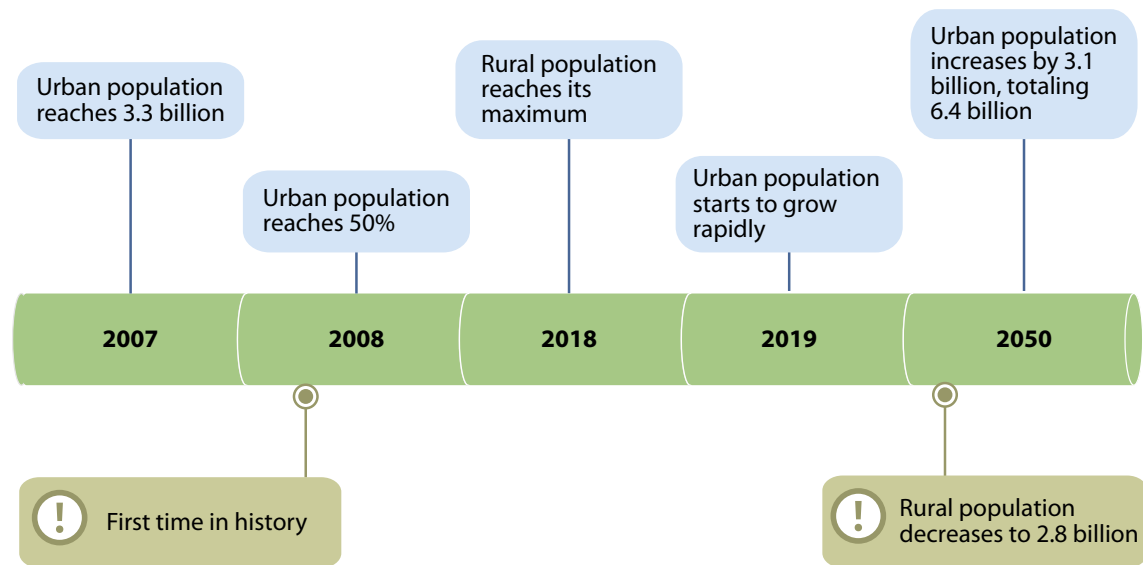
55590   Source: Forrester Research, Inc.

THE SMART CITY IS A COLLECTION OF SMARTER CITY INFRASTRUCTURE AND SERVICES

The smart city is a collection of Smart Computing technologies applied to the seven critical infrastructure components and services. While CIOs in existing cities oftentimes take a staggered approach to realizing the smart city vision — by prioritizing initiatives around healthcare, transportation, or utilities — CIOs in newer cities have the luxury of pursuing it from inception.

The Seven Critical Infrastructure Components And Services Of A Smart City In Action

Civic leaders and CIOs are applying Smart Computing technologies to seven critical infrastructure components and services: city administration, education, healthcare, public safety, real estate, transportation, and utilities (see Figure 3). To help CIOs visualize the smart city, we offer the following real-life examples of the smart city in action around the world:

• **City administration: Streamline management.** An efficient city administration that provides services to its citizens and fosters businesses is essential to today's service-based economy. A

smart government service is informed about its city's condition and is able to reach its citizens effectively. A core component of this function is using communication and collaboration technologies to manage city operations. A city operation center manages services like healthcare and education. At the same time, it provides reliable infrastructure in the form of green buildings, efficient transportation, and utilities.

In the United States, for example, President Barack Obama is pushing for "Open Government."[8] This initiative focuses on using information and communications technologies to make political decisions transparent to citizens. Moreover, it uses data and scientific analysis in all phases of the decision-making process to improve the economy and quality of life. What does this mean for citizens? Affordable healthcare, clean environment, business opportunities, and more jobs. Another example of this model is South Korea's new city, Songdo International Business District, which promotes free economic zones to foster business and employment growth.[9]

- **Education: Increase access, improve quality, and reduce costs.** The heightened use of technology in education will increase access, improve the quality and experience, and reduce costs. For example, the introduction of PCs and the Internet will increase access to educational resources for those in rural areas or those who cannot be full-time students. Likewise, the use of digital content and collaboration technologies can improve the quality of education, at more convenience, at a lower cost. An excellent example of this is the newly launched Jack Welch Management Institute — a nearly completely online Master of Business Administration (MBA) program backed by the former General Electric (GE) chief executive Jack Welch.[10] The high-quality education — based on the business principles Welch popularized teaching managers and executives in GE's Crotonville classroom — comes at a significantly lower cost: Students can get an MBA for just over $20,000, compared with the $100,000-plus price tag for most brick-and-mortar MBA programs.

- **Healthcare: Increase the availability and provide more rapid, accurate diagnosis.** A smart healthcare system is built on scalable storage systems and a communications platform. With this type of IT foundation, patient records are electronically stored and shared wherever they are needed. This data not only is used for disease diagnosis but also facilitates future research. The communication platform enables quick response to emergency services. Videoconferencing technologies facilitate remote medical center services to patients' homes, for those who can't travel to hospitals. For example, a public healthcare service provider in Spain, Servicio Extremeño de Salud, centralized the patient information system and made it available to all the hospitals and local healthcare centers and offices in the region. It was able to connect almost 13,000 professionals, with the scheduling system managing 9 million outpatient visits per year.[11]

- **Public safety: Use real-time information to respond rapidly to emergencies and threats.** With more people living in the city, police, fire, and other public safety personnel need to respond more quickly to emergency situations as well as stay on top of the overall crime

rate. Smart public safety initiatives around the world are experimenting with communication technologies to feed real-time information to fire and police departments. For example, New York City brought crime down by 27% by gathering data in a central location and relaying real-time information to officers in an instant. NYPD has a 911 real-time dashboard that provides a single view of emergency needs and its resources. The department can access event notifications through a Web portal, emails, and handheld devices. Essentially, cities are planning to make a public safety network that includes a first responder network, emergency dispatch and coordination, closed-circuit television (CCTV) and video analytics, the ability to create a virtual command center, and real-time geolocalization information.

- **Real estate: Reduce operating costs, increase the value, and improve occupancy rates.** Smarter real estate — from office buildings to manufacturing plants to shopping malls and residential homes — delivers a myriad of financial and environmental benefits. The well-established US Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) certification encourages the use of Smart Computing technologies such as building management systems to automate heating and cooling and sensors to power down lights when not in use.[12] Studies find that LEED-certified buildings decrease operating costs by 8% to 9%, increase building value by 7.5%, improve return on investment by 6.6%, increase the occupancy ratio by 3.5%, and increase the rent ratio by 3%. And compared with other buildings, LEED-certified facilities stand out with 26% less energy consumption, 13% lower maintenance costs, 27% higher occupant satisfaction, and 33% less greenhouse gas emissions.

- **Transportation: Reduce traffic congestion while encouraging the use of public transportation.** Offering faster and more convenient public transportation alternatives is already on most cities' road maps to reduce congestion and related financial and environmental impacts. But these initiatives require significant capital and time. An interim step that raises funds for new public transportation while encouraging the use of existing public transportation is congestion pricing, which is enabled through Smart Computing technologies.[13] Congestion pricing uses price to signal when drivers should consider taking mass transit, reschedule their trip, or pay a higher fee for driving. This system uses an electronically collected toll system to charge drivers more to use the most congested roads at the most congested times. A successful example of this is London, England, which in 2003 began charging a premium to drive into the city's congested business district. After introducing congestion pricing, London found a 30% average drop in congestion, 37% average increase in traffic speed, 12% drop in particulate matter and nitrogen oxides, and a 20% decrease in fossil fuel consumption and CO_2 emissions.

- **Utilities: Deliver only as much energy or water as is required while reducing waste.** A smart utility infrastructure — for energy and water — entails making existing systems efficient and finding new ways of producing and delivering water, gas, and electricity. Due to the scarcity of resources, it's imperative to implement smarter ways in which energy is conserved, delivered, and managed. Cities around the world are implementing "smart grids." A smart grid is a grid

system that is interconnected with Internet Protocol (IP) enabled sensors, supervisory control and data acquisition (SCADA) systems, heating ventilation and air conditioning (HVAC) systems, distribution systems, transformers, and metering technologies.[14] Malta, for example, has become a smart grid country. It is integrating Smart Computing technologies in both its water and power systems to identify water leaks and electricity losses in the grid. Moreover, there are 250,000 interactive meters monitoring electricity use in real time. The result? Citizens and businesses can look at water and energy consumptions and manage use accordingly. They are also planning to replace carbon-intensive fuel oil with renewable energy for future needs.

Figure 3 Smart City Blueprint
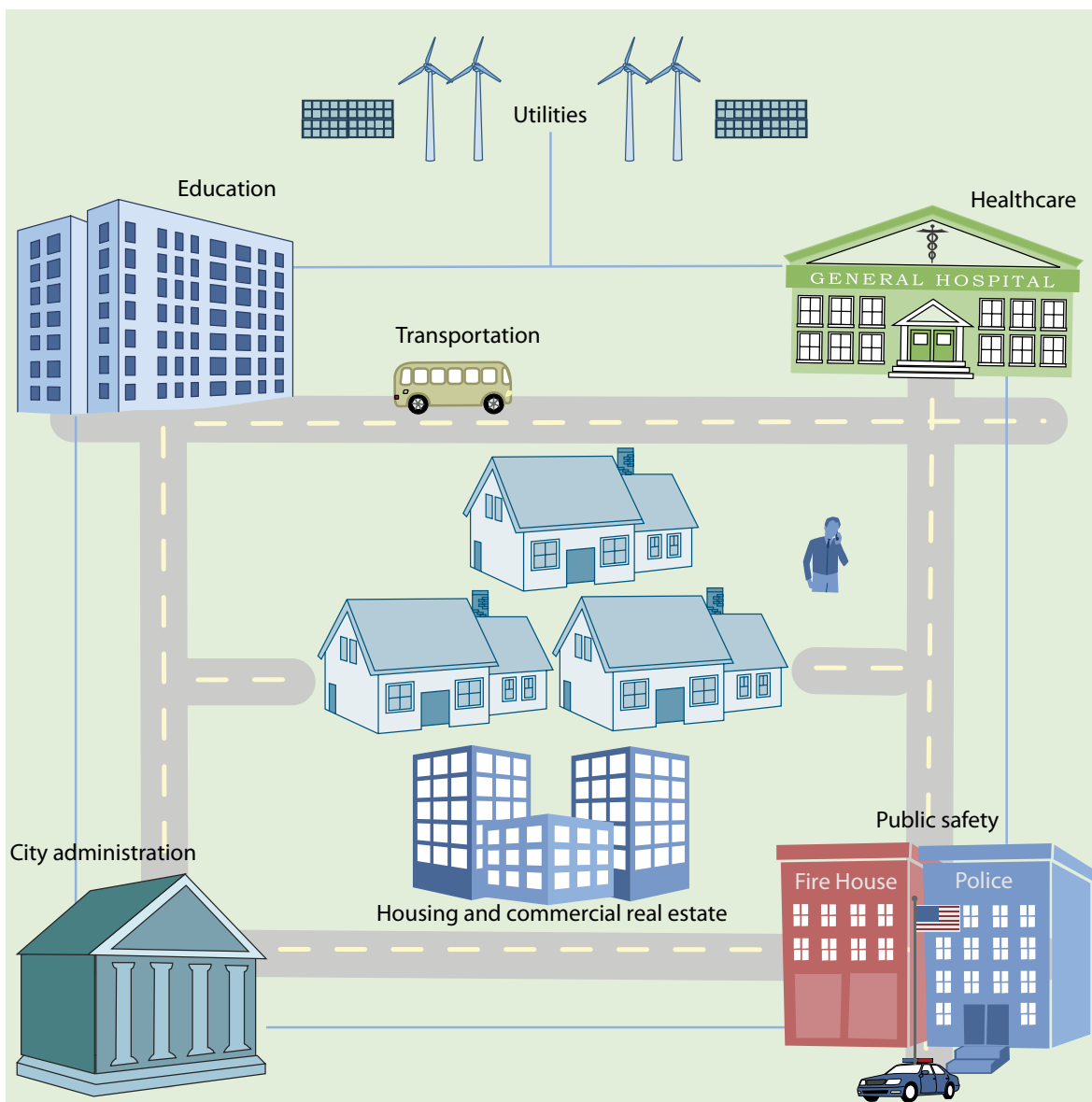
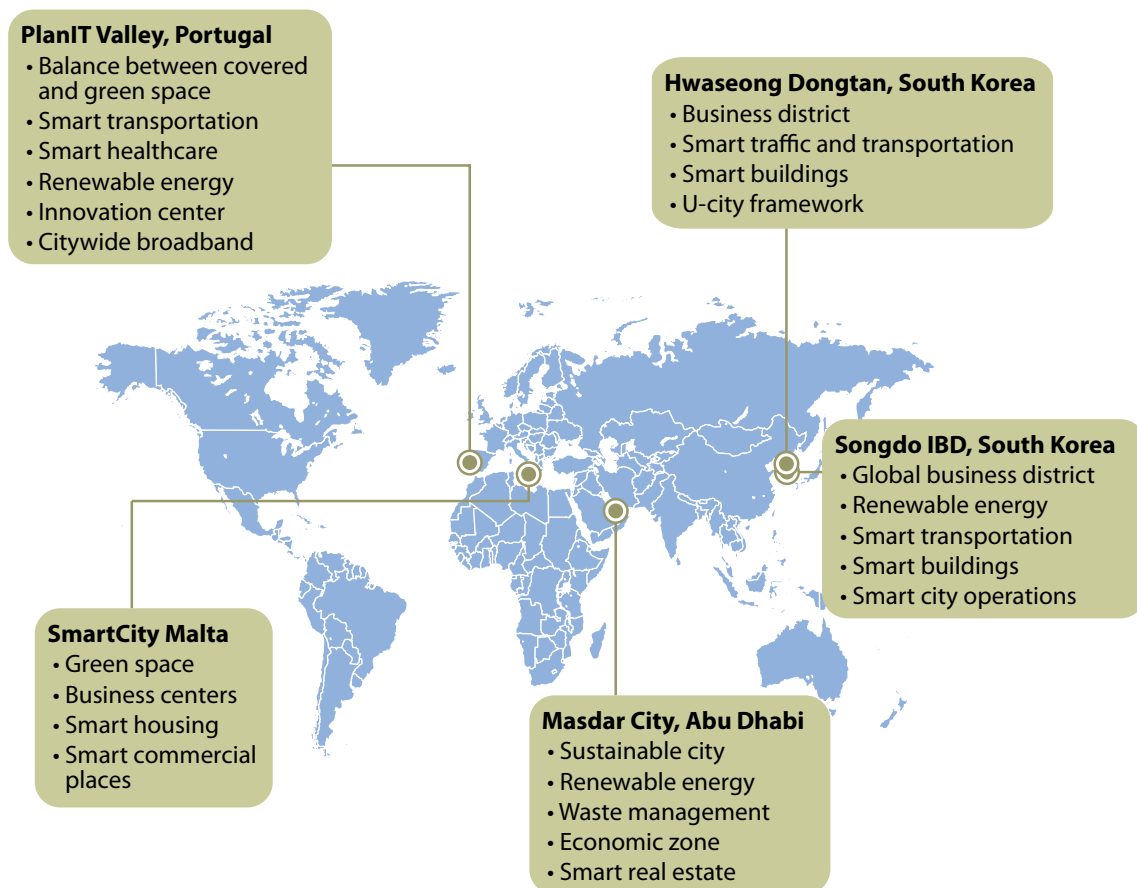55590   Source: Forrester Research, Inc.

New Cities Can Tackle The Smart City Vision From Inception

Across the globe, existing cities are revamping their critical infrastructure and services and prioritizing projects in a staggered fashion — but there are newer cities that have the luxury of incorporating the Smart City vision in its entirety from scratch. These cities have many things in common, such as a free economic zone, renewable energy, smart buildings, smart transportation, broadband connectivity, balance between green and covered spaces, and strategic geographic placement. There are some notable examples around the globe, namely: 1) Songdo IBD, South Korea; 2) Hwaseong Dongtan, South Korea; 3) Masdar City, Abu Dhabi; 4) PlanIT Valley, Portugal; and 5) SmartCity Malta (see Figure 4). These cities deploy various information and communication technology components like radio-frequency identification (RFID), embedded systems, Wi-Fi, WiMax, LTE, ZigBee, machine-to-machine communication, asset management, energy management, unified communications, and collaboration.

Figure 4 Examples Of The Brand New Smart Cities

PlanIT Valley, Portugal
• Balance between covered and green space
• Smart transportation
• Smart healthcare
• Renewable energy
• Innovation center
• Citywide broadband

Hwaseong Dongtan, South Korea
• Business district
• Smart traffic and transportation
• Smart buildings
• U-city framework

Songdo IBD, South Korea
• Global business district
• Renewable energy
• Smart transportation
• Smart buildings
• Smart city operations

SmartCity Malta
• Green space
• Business centers
• Smart housing
• Smart commercial places

Masdar City, Abu Dhabi
• Sustainable city
• Renewable energy
• Waste management
• Economic zone
• Smart real estate

55590   Source: Forrester Research, Inc.

THE THREE TIERS OF CIOs IN THE SMART CITY — INDUSTRY DICTATES INVOLVEMENT

In reality, a CIO's level of involvement in planning, implementing, and delivering on the smart city concept varies, depending on industry. Forrester has identified three high-level tiers to help CIOs determine their level of involvement (see Figure 5):

- **Tier 1: CIO of a city.** CIOs of cities are ultimately going to be the most involved and most responsible for developing and coordinating an integrated vision of the smart city in its entirety across the seven critical city infrastructure components and services. Ultimately, this requires city CIOs to define the smart city, understand what components of the smart city are most compelling to key city stakeholders (citizens, businesses, and government), and how close or far each critical city infrastructure and service is to this vision — all of which is framed through a technology lens (e.g., what does it mean to my IT investments, people, and process?). This is a very tall order, which extends far beyond any CIO's own sphere of influence and immediate knowledge. So, like an enterprise architect, a city CIO must act as the coordinator of resources and buy-in for a collective technology vision.

- **Tier 2: CIO of a critical city infrastructure or service.** CIOs of critical city infrastructure and services will have a similar level of involvement in planning, implementing, and delivery to city CIOs — but only for their own industry-specific domain of the smart city. And if elements of a smart city are mandated — such as smarter grids, smarter real estate, or smarter healthcare — CIOs of a particular critical city infrastructure and service will be affected more or less equally. This will force heightened collaboration with industry peers and even competitors, which may actually be helpful, for example, to collectively develop standards, voice concerns, influence regulation, and dictate time frames for completion.

- **Tier 3: CIO of a "consumer" of critical city infrastructure or services.** All other CIOs, who are consumers of critical city infrastructure and services — such as a CIO of a retailer, manufacturer, or financial services firm — bear the responsibility of taking advantage of smart city improvements to actually realize any of its benefits. For example, consider innovations made available from the smart grid — such as real-time, granular views into energy consumption and pricing. With this information, CIOs can encourage their data center staff to reschedule non-critical, but processing-intense — and therefore energy-intense — activities during daytime hours, when the price-per-kilowatt is higher, versus at night, to reduce costs.

Figure 5 The Role Of CIOs In Planning, Implementing, And Delivering The Smart City Vision

	Plan	Implement	Deliver
Tier 1: CIO of a city	• Be versed on smart city developments and best practices. • Develop a comprehensive smart city vision, road map, and regulatory framework with key IT, political, and corporate stakeholders. • Assess how "smart" your city's critical infrastructure and services are today. • Prioritize smart projects. • Develop new business models and funding options. • Identify skills gaps to city administration projects.	• Allocate funding to purchase and implement smart technologies for city administration projects. • Modernize legacy infrastructure and networks. • Assist in distributing funding to broader smart city initiatives. • Hire staff, develop staff, and align internal process to implement and deliver on city administration projects. • Partner with industry stakeholders, system and technology integrators. • Measure progress. • Develop metrics and SLAs.	• Roll out smart city administration services. • Assist in the rollout of broader smart city rollouts. • Educate citizens and stakeholders on smart city benefits and how to take advantage of them. • Continue to develop business models to fund and monetize smart city initiatives. • Measure progress, value delivered, and SLAs of city administration and broader smart city services.
Tier 2: CIO of a critical city infrastructure or service	• Be versed on smart city developments in your city and industry best practices. • Collaborate with city IT, political leaders, and industry peers to develop a smart vision, road map, and regulatory framework. • Assess how "smart" your organization is today. • Design your organization's "smart" technology and system road map. • Prioritize smart projects. • Develop new business models and funding options. • Identify skills gaps.	• Allocate funding to purchase and implement smart technologies. • Modernize legacy infrastructure and networks. • Hire staff, develop staff, and align internal processes to implement and deliver smart technology projects. • Work with city planners, technology partners, and system integrators to deploy solutions. • Measure progress. • Develop metrics and SLAs.	• Roll out smart city services in your respective domain. • Educate customers, citizens, and other stakeholders on smart city benefits and how to take advantage of them. • Continue to develop business models to fund and monetize smart city initiatives. • Measure progress, value delivered, and SLAs of smart services.
Tier 3: CIO of a "consumer" of critical city infrastructure or services	• Be versed on smart city developments in your city. • Understand what smart city initiatives mean to your organization. • Develop a technology plan to take advantage of smart city initiatives. • Understand financial incentives available for smart city investments.	• Invest in technologies that take advantage of smart city services. • Align people, processes, and incentives to take advantage of smart city investments. • Develop metrics and SLAs to measure the value of smart city investments.	• Take advantage of smart city services in your organization. • Educate your organization on smart city benefits and how to take advantage of them. • Measure the value delivered from smart city investments.

55590 Source: Forrester Research, Inc.

CIOs ARE ENABLERS OF THE SMART CITY — INSERT YOURSELF INTO THE CONVERSATION

The smart city vision is more than just technology investments and people. It requires a level of collaboration and decision-making that extends far beyond any CIO's direct sphere of influence — particularly around elements like funding, governance, and standards interoperability. With that in mind, CIOs should position themselves as critical enablers of the smart city and influence the conversation to ensure a technology-advocate perspective. In particular, CIOs should ensure that they are part of the following conversations in the following ways:

- **Funding: CIOs should help build a long-term business case and gain consensus.** Despite projections of increased federal spending, one of the biggest hurdles in making infrastructure smarter is the lack of adequate funding. For example, the United States' infrastructure budget is only 2.4 % of the overall pie. And unfortunately, 12 out of 13 large cities in the US face a budget deficit for the year 2009 to 2010.[15] This creates a difficult environment for CIOs — city and otherwise — looking to implement smart city projects. What's most important in the short-term is for CIOs to involve themselves in the early conceptual and planning phases in order to understand their city's "smarter" vision and the level of technology investment required.

- **Governance: CIOs should provide project management expertise.** A critical component of delivering on the smart city vision is management — particularly governance. Many of the obstacles result from a lack of governance that ensures city officials, CIOs, and technology integrators collaborate through a project's entirety — not just at design and implementation, but post-implementation as well. CIOs can help with project management activities that span planning, implementation, and delivery phases of smart city rollouts. Moreover, CIOs — in conjunction with their sourcing and vendor management staff — can be a liaison in managing relationships among system integrators and outsourcers that play an important role in the implementation of technology.

- **IT skills: CIOs must train staff and redefine responsibilities.** A smart city concept redefines city operations and how stakeholders interact with one another. For example, when disparate systems like smart meters, building management systems, and HVAC systems interconnect, they form a network that needs to be managed by multiple constituencies (e.g., facilities teams, IT teams). This crosses traditional boundaries and budgets, requiring CIOs to ensure that staff are properly trained, and even redefines their roles and responsibilities to maximize benefits from these new investments and capabilities.

- **Compliance standards: CIOs should help develop best practices for interoperability.** It's almost impossible to achieve a standard or a compliance framework that works with all the parties in the ecosystem. There are already a myriad of regulatory standards, industry standards, and management frameworks that organizations use — and the smart city is only

going to increase what's currently available.[16] CIOs are often tasked with adopting standards that are consistent with their industry. They can incorporate a wealth of knowledge in the smart city ecosystem by providing best practices that help shape a compliant environment. If CIOs are involved early in the planning phase of this ecosystem, they can help create agreed-upon frameworks that are specific to geography and industries of the region. Adoption of these agreed-upon frameworks will provide best practices and ease future management of city resources. In turn, the best practices will provide an interoperable environment for technologies to share data in a seamless fashion.

- **Security and risk management: CIOs should lead practices for secure communications.** Security and risk practices are extremely important for the confidentiality and integrity of the data being transmitted. Often, information security is not a priority when infrastructure rollouts happen. For instance, smart grid deployments are known to have security holes that can put grid infrastructure at risk. When critical infrastructure components interconnect and share data with consumers over public or private networks, they need to be protected against risks that would jeopardize data integrity. CIOs and CISOs are tasked with managing the threat landscape at many levels. Hence, they should lead the effort to encourage other CIOs to implement security and risk best practices in the ecosystem.

SUPPLEMENTAL MATERIAL

Companies Interviewed For This Document

Alcatel-Lucent

Cisco Systems

IBM

ENDNOTES

[1] The technology industry has entered a new cycle of tech innovation and growth, which we are calling "Smart Computing." We chose to call this new generation of technology "Smart Computing" because it adds to existing technologies new capabilities of real-time situational awareness and automated analysis. As a result, technology moves beyond just proposing task solutions — such as executing a sales order — to sensing what is happening in the world around it, analyzing that new information for risks and possibilities, presenting alternatives, and taking actions. See the December 4, 2009, "Smart Computing Drives The New Era Of IT Growth" report.

[2] According to the World Urbanization Prospects report, the proportion of the population living in urban areas will have reached 50% by 2008. The numbers are a bit different for less developed regions, where this proportion is expected to be reached by 2019. The urban population is expected to grow after 2008 at a rapid rate. By 2020 in developing countries, the urban population will outgrow the rural population. And the trend will continue until 2050. Source: The United Nations, February 2008 (http://www.un.org/esa/population/publications/wup2007/2007WUP_Highlights_web.pdf).

[3] Agriculture accounts for two-thirds of water use globally, and it is predominant in developing countries. Almost 60% of the water is wasted due to leaks and inefficient techniques. This is attributed to the waste of water due to inefficiencies. As population grows at a rapid rate from 2030 to 2050, and many urban areas absorb the bulk of this population, freshwater resources will be needed tremendously. To read the full report, visit the Pacific Institute Web page: http://www.pacinst.org/reports/business_water_climate/full_report.pdf.

[4] The 2009 "Report Card for America's Infrastructure" grades 15 categories of infrastructure. According to the report, the US core infrastructure scores anywhere from a C to a D. The picture is alarming for many components, including bridges, schools, drinking water, hazardous waste, and rail. According to the report, $2.2 trillion is needed to revamp this infrastructure. For a complete analysis, see "Report Card for America's Infrastructure" (http://www.infrastructurereportcard.org/).

[5] The Energy Information Administration (EIA) predicts that the strong long-term economic growth in the emerging economies will drive the fast-paced growth in energy demand. The combined economic activity from these emerging economies — classified by the EIA as non-OECD (Organisation for Economic Co-operation and Development) countries — measured by GDP in purchasing power parity terms, is expected to increase by 4.9% per year on average, compared with an average of 2.2% per year for the more developed economies of OECD countries. Source: Energy Information Administration, "International Energy Outlook 2009" (http://www.eia.doe.gov/oiaf/ieo/highlights.html).

[6] Thomas L. Friedman is a *New York Times* columnist and author of *The World Is Flat: A Brief History of the Twenty-first Century* and more recently, *Hot, Flat, and Crowded: Why We Need a Green Revolution — And How it Can Renew America*. The term "global weirding" was originally coined by Hunter Lovins, co-founder of the Rocky Mountain Institute, as an extension to the term "global warming." Source: Thomas L. Friedman, "The People We Have Been Waiting For," *The New York Times*, December 2, 2007 (http://www.nytimes.com/2007/12/02/opinion/02friedman.html?_r=1).

[7] The effects that climate change will have on human health will invariably fluctuate by region, depending on a myriad of factors including social, political, economic, environmental, and technological factors that are unique to a specific region. Likewise, the extent and impact of such climate change will also vary by region and its ability to adapt with this change. Source: The US Environmental Protection Agency, "Climate Change — Health and Environmental Effects" (http://www.epa.gov/climatechange/effects/health.html).

[8] On President Obama's first full day in office, he issued an executive order and several memoranda that aim to make government process more open and transparent and "close the revolving door between the federal government and lobbyists." This move toward transparency is positive for environmental protection because it will facilitate greater participation and will make it more difficult to exclude informed stakeholders from voicing their opinions during the policy-making process. Source: Remi Moncel, World Resources Institute, "President Obama's Open Government: Welcome First Steps," January 23, 2009 (http://www.wri.org/stories/2009/01/president-obamas-open-government-welcome-first-steps).

[9] A free economic zone is designated as an area where companies are taxed very lightly, or not at all, to encourage development or for some other reason.

[10] Jack Welch, *BusinessWeek* columnist and former CEO at General Electric (GE), announced his MBA program at the Jack Welch Management Institute, which will focus on business principles he taught to managers and executives in GE's Crotonville classroom. Classes were scheduled to begin in the fall of 2009. Source: Geoff Gloeckler, "Jack Welch Launches Online MBA," *BusinessWeek*, June 22, 2009 (http://www.businessweek.com/bschools/content/jun2009/bs20090622_962094.htm).

[11] The IBM solution enabled hospitals, medical care centers, and administrative offices throughout the region to retrieve up-to-date patient information, equipping healthcare providers with better tools to serve their patients. More specifically, this solution was able to better connect almost 13,000 professionals, while reducing costs of paper and other media. Source: IBM, "Servicio Extremeño de Salud (SES) Improves Patient Care With An Integrated Healthcare Information Management System" (http://www-935.ibm.com/services/us/index.wss/casestudy/gbs/a1024303?cntxt=a1000453).

[12] The overall green building market (both nonresidential and residential) is forecast to increase substantially over the next few years, from today's $36 billion to $49 billion, to $96 billion to $140 billion by 2013, while the value of green building construction is projected to increase to $60 billion by 2010. Source: The US Green Building Council, "Green Building Facts" (http://www.usgbc.org/ShowFile.aspx?DocumentID=5961).

[13] Cities around the world are beginning to implement congestion pricing systems that will reduce traffic congestion and cut traffic in heavily used areas. One example is the system now established in London, which has dense central business districts; to encourage motorists to avoid driving into the city during peak times or to use alternate forms of transportation, the city now charges them when they drive into the center. Source: Environmental Defense Fund, "Congestion Pricing," June 1, 2007 (http://www.edf.org/page.cfm?tagID=6241).

[14] With the recent federal stimulus package driving further incentives toward action, utilities are actively pursuing a series of "smart grid" technologies that better interconnect data, sensors, and devices across the delivery network to help overcome current power delivery constraints while accommodating alternative, renewable sources of power generation. For more information, see the October 19, 2009, "Smart Grid Technologies: Coming To A Utility Near You" report.

[15] A study done by the Philadelphia Research Initiative about the budget deficit faced by 13 major US cities presents an alarming picture. Analysis shows that these cities are facing budget gaps between 5% and 20% of their general funds, and they are cutting services and personnel in response. Source: "Tough Decisions and Limited Options: How Philadelphia and Other Cities are Balancing Budgets in a Time of Recession," May 18, 2009 (http://www.pewtrusts.org/our_work_report_detail.aspx?id=52092).

[16] In the United States for example, a variety of standards are used depending on the industry and vertical. Large organizations use standards like International Organization for Standardization (ISO), IT Infrastructure Library (ITIL), and control objectives for information and related technologies (COBIT) to measure technology maturity and risk associated with them. There are also government guidelines and standards like the Federal Energy Regulatory Commission (FERC) and North American Electric Reliability Council (NERC) in the utility space. Financial services are inundated by the influx of numerous standards like the Payment Card Industry (PCI) Data Security Standard (DSS), the Sarbanes-Oxley Act (SOX), and the Gramm-Leach-Bliley Act (GLBA). With all these standards out there, it makes it practically impossible to choose one; however, it presents an opportunity to implement agreed-upon best practices.

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