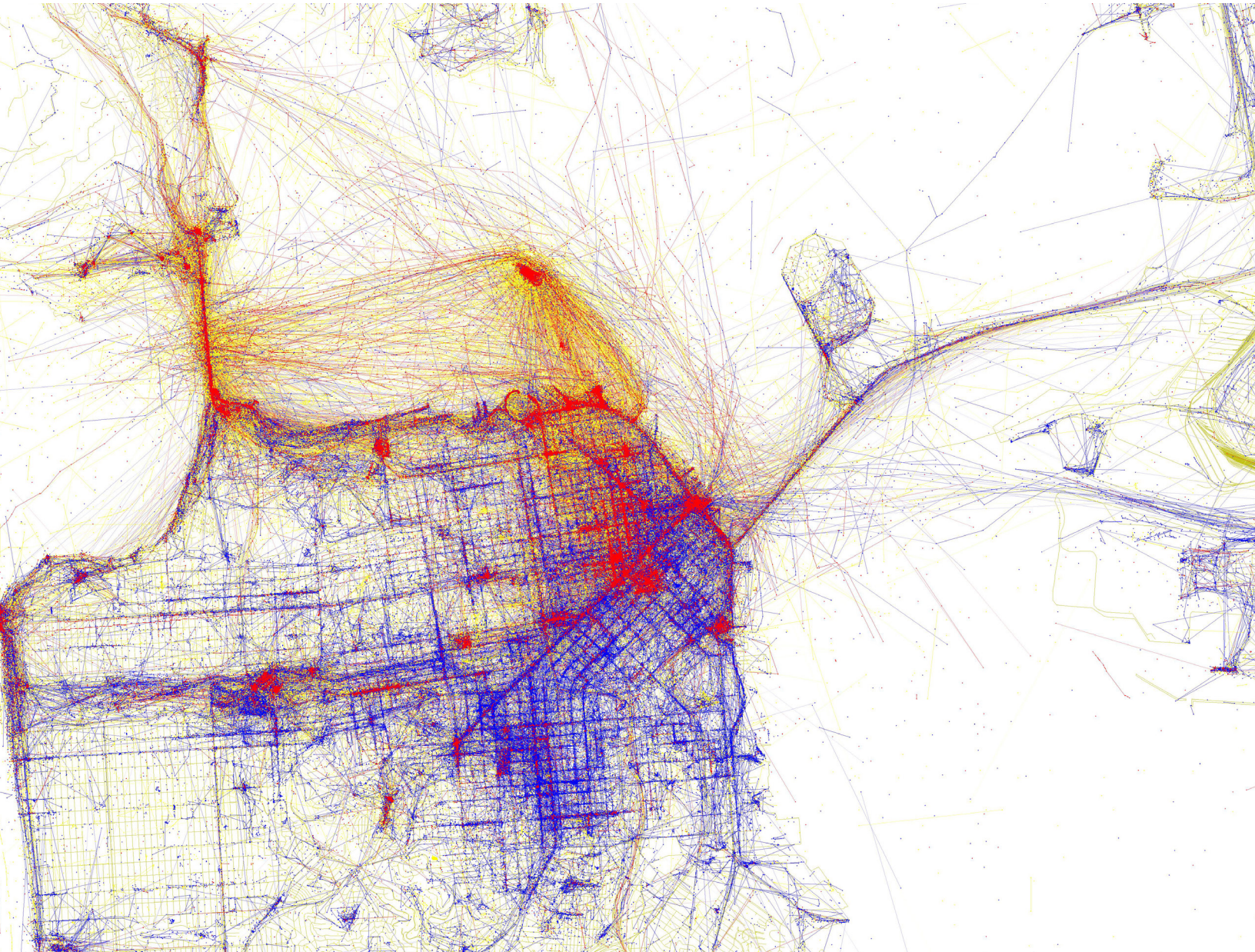
INSTITUTE FOR Sustainable Communities

USDN urban sustainability directors network

NUTTER CONSULTING

Getting Smart About Smart Cities

USDN Resource Guide



Acknowledgments

Getting Smart About Smart Cities was compiled for the Urban Sustainability Directors Network (USDN) by Nutter Consulting and the Institute for Sustainable Communities.

Elliott Bent, Michael Crowley, Melanie Nutter, and Claire Wheeler researched, wrote and reviewed this document. Lindsey Chamberlin designed all materials.

ABOUT THE INSTITUTE FOR SUSTAINABLE COMMUNITIES

Since its founding in 1991 by former Vermont Governor Madeleine Kunin, ISC has led 99 transformative, community-driven projects in 30 countries. ISC specializes in developing and delivering highly successful training and technical assistance programs that improve the effectiveness of communities, their leaders, and the institutions that support them.

ABOUT NUTTER CONSULTING

Based in San Francisco, CA, Nutter Consulting helps cities, nonprofits, foundations and businesses leverage innovation strategies and smart cities tools to meet their sustainability goals. Led by Melanie Nutter, former Director of the San Francisco Department of the Environment and former Deputy Director for Speaker of the House Nancy Pelosi, Nutter Consulting specializes in advancing carbon emission reduction and climate adaptation efforts through program development, strategic planning, public policy development, communications, media strategy and coalition building.

ABOUT THE URBAN SUSTAINABILITY DIRECTORS NETWORK

The Urban Sustainability Directors Network (USDN) is a peer-to-peer network of local government professionals from over 120 cities across the United States and Canada dedicated to creating a healthier environment, economic prosperity, and increased social equity. This dynamic network enables sustainability directors and staff to share best practices and accelerate the application of good ideas across North America.

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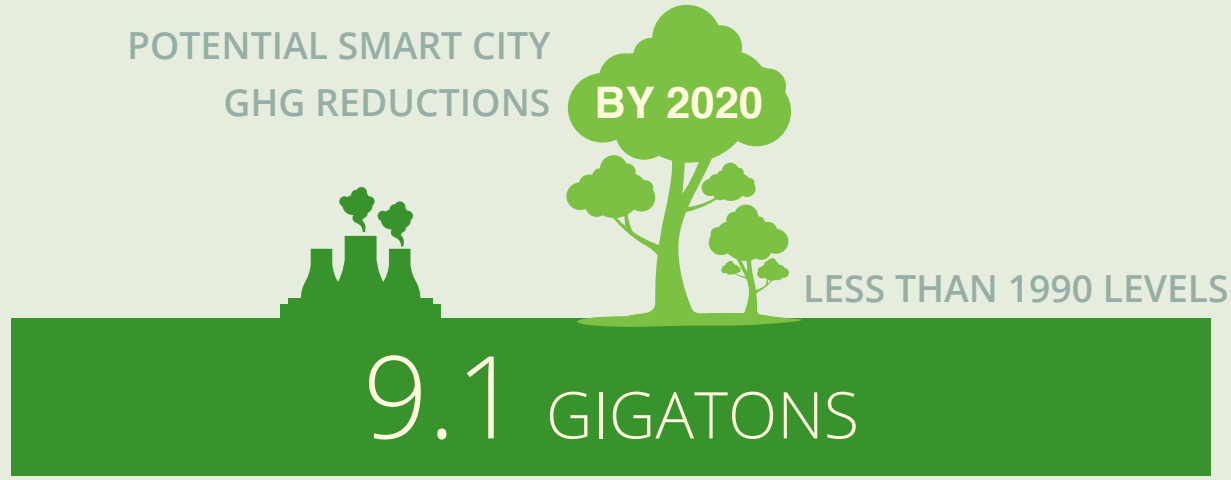
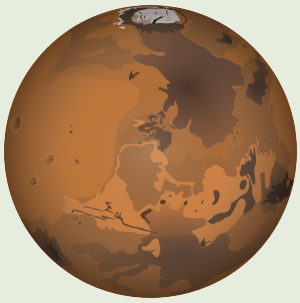
POTENTIAL SMART CITY GHG REDUCTIONS **BY 2020**

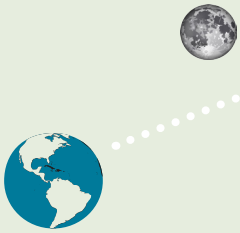


THE AMOUNT OF DATA IN THE WORLD IN 2010

1.2 PETABYTES

ENOUGH DATA TO STACK DVDS TO THE MOON & BACK





BY 2020

20 MILLION PETABYTES

THE STACK WILL BE HALFWAY TO MARS

1.9 BILLION DEVICES

CONNECTED TO THE INTERNET TODAY

IN 4 YEARS THAT NUMBER WILL GROW TO

9 BILLION

Top infographic: GeSI SMARTer 2020: The Role of ICT in Driving a Sustainable Future; The Boston Consulting Group and the Global e-Sustainability Initiative (GeSI), 2012. http://www.smart2020.org/_assets/files/03_Smart2020Report_lo_res.pdf

Middle infographic: The Digital Universe Decade – Are You Ready? IDC iView, John Gantz and David Reinsel, 2010. http://www.emc.com/collateral/analyst-reports/idc-digital-universe-are-you-ready.pdf

Bottom infographic: Here's Why 'The Internet Of Things' Will Be Huge, And Drive Tremendous Value For People And Businesses, Business Insider, 2013; Emily Adler. http://www.businessinsider.com/growth-in-the-internet-of-things-2013-10

USDN Innovation Fund: Advancing Smart & Sustainable Cities Project Working Group

Photo credit: Brian Koprowski, https://www.flickr.com/photos/chewbackski/13059800693

Supported by grant funding from the Urban Sustainability Directors Network Innovation Fund, the Advancing Smart & Sustainable Cities Project is a collaboration of high-level sustainability, technology & innovation practitioners from within 12 US & Canadian city governments intended to identify "smart city" tools and develop approaches that will best advance sustainability goals and increase citizen engagement. The project's ultimate goal is to develop the voice of the city customer in the nascent smart city market by providing guidance to city staff in developing smart city strategies; and by communicating the needs of municipal governments in the use, and rollout of, smart city technology to the wider smart city industry.

Toward that end, the project explores the following:

- Issues and decisions involved in creating smart city deployment strategies for local governments
- The benefits and challenges of implementing such strategies
- Definitions of smart cities and related frameworks

The first USDN Smart Cities Summit was held at the Presidio Graduate School in San Francisco on August 6-8, 2014. The summit brought together the project's 12 participating cities, including Sustainability Directors, Chief Technology Officers, Innovation Officers, and select private sector representatives to share experiences and best practices, and to agree on next steps to advance partnerships between public and private sectors.

This resource guide is an initial step in identifying shared challenges, opportunities and promising practices in using smart city technologies and strategies that were discussed during the summit. The guide also provides an initial knowledge base that will function as a working foundation for sustainability, innovation, and IT professionals as they delve deeper into the smart cities arena.

Advancing Smart and Sustainable Cities Project Working Group

Boston, MA
Boulder, CO
Burlington, VT
Chicago, IL
Columbia, MO
Houston, TX
Palo Alto, CA
Raleigh, NC
San Francisco, CA
Seattle, WA
Vancouver, BC
Washington, DC

Most of the current literature on smart cities focuses on the marketplace (i.e. new apps, tools, and technologies), and is written primarily for private sector practitioners. It is our belief that in order for municipal governments to realize the full potential in this emerging market, they must first address fundamental "change management" challenges associated with the adoption of new technologies and ways of doing business. This guide addresses this issue by supporting city government practitioners in navigating issues such as the disruptive nature of big data and Information and Communications Technology (ICT), the proliferation of innovation within the public sphere, and the intersection between sustainability and smart cities.

The project is managed by Nutter Consulting in partnership with the Institute for Sustainable Communities (ISC). Participating cities include Boston, MA; Boulder, CO; Burlington, VT; Chicago, IL; Columbia, MO; Houston, TX; Palo Alto, CA; Raleigh, NC; San Francisco, CA; Seattle, WA; Vancouver, BC and Washington, DC.

Smart Cities: An Emerging Field

By 2050, the global population is expected to grow to over nine billion, and 80 percent of that population will reside in cities. Today, cities are home to just over half of the global population of seven billion. Meanwhile, cities comprise just two percent of the Earth's land mass and are responsible for the consumption of 80 percent of the Earth's resources. The accelerating growth of cities and their disproportionate consumption of physical and social resources are unsustainable, as are the traditional systems cities rely upon to deliver resources. While urbanization continues to contribute to increased carbon emissions globally, local action is critical for achieving a low carbon future. In the absence of binding international climate action as well as limited leadership in many state governments, cities are now taking the lead and developing strategies to address climate change impacts. In many respects, cities are our best hope for tackling climate change. This guide outlines the possibilities that ICT, big data and other "smart" technologies present as potential transformative means for achieving a citizen-centric, low carbon future.

Cities have always been complex. As new methods for creating, communicating, and using data continue to emerge, information and infrastructure become more interconnected and the complexity of cities is elevated. Increasingly, cities are employing digital systems to communicate with citizens and stakeholders, utilizing data and information for planning and service delivery, and honing the digital skills required to participate in society and be economically successful.

For cities to become both smart and sustainable – more environmentally sound, economically prosperous and socially just – they must integrate the use of big data and ICT both into daily processes and in the pursuit of their pressing goals.

Defining Smart Cities

There is currently no universally accepted definition of a smart city; approaches vary as widely as the culture, priorities, and histories of cities themselves.

However, this is not for lack of trying. Many entities have proposed definitions:

Smart Cities Europe

Investments in human and social capital and traditional (transportation) and modern (ICT-based) infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory government.

– Caragliu, Bo, and Nijkamp, Smart Cities in Europe, 2009

British Standards Institution

The effective integration of physical, digital and human systems in the built environment to deliver a sustainable, prosperous and inclusive future for its citizens.

– Smart City Framework, 2014

Smart Cities Council

A smart city uses information and communications technology (ICT) to enhance its livability, workability and sustainability.

– Smart City Readiness Guide, 2013

Boyd Cohen

While some people continue to take a narrow view of smart cities by seeing them as places that make better use of information and communication technology (ICT), the cities I work with all view smart cities as a broad, integrated approach to improving the efficiency of city operations, the quality of life for its citizens, and growing the local economy.

– Fast Company article, "What Exactly Is a Smart City?", 2012

A smart city is one that uses technology to transform its infrastructure and make better use of energy and resources. Information and communications technologies (ICT) can be deployed to create new, intelligent ways of making our urban centres more resource efficient and reduce their carbon footprint. ... Smart cities are not simply those that deploy ICT. They combine new technology with smart new ways of thinking about technologies' role in organisation, design and planning.

– The Smart Solution for Cities, 2011

ARUP

Cisco

Over the past few years, the definition of "Smart Cities" has evolved to mean many things to many people. Yet, one thing remains constant: part of being "smart" is utilizing information and communications technology (ICT) and the Internet to address urban challenges.

– The Internet of Everything for Cities, 2013

Academia

The smart city provides the conditions and resources for change. In this sense, the smart city is an urban laboratory, an urban innovation ecosystem, a living lab, an agent of change.

– Anthony Townsend, Urban Futures, 2013

As a starting point, the project's working group advanced the following initial definition:

> *"Smart cities" solutions use advanced information and communication technologies to collect, communicate, and analyze data to improve the design and operations of a city's core systems and programs, as well as citizen engagement, for greater efficiency and effectiveness, thus improving the city's sustainability, resilience, bottom line and quality of life.*

For urban government practitioners, this definition is as much about new ways to integrate sustainability practices across departments and sectors as it is about new tools and technologies. It represents a completely new approach to creating a sustainable city that treats data as a foundational tool for making smarter decisions.

Smart city solutions will always be as diverse as the cities they serve. Yet urban governments have much to gain by promoting a cohesive vision of smart city deployment that articulates the specific needs and opportunities of the public sector.

Big Data and the Internet of Things

The proliferation of data is nothing new to cities. In a recent article by Dr. Anthony Townsend, Research Director at the Institute for the Future, he recounts how, during the population explosion of the Industrial Revolution, the US census reached crisis level.[1] By 1880, it took 1,500 clerks eight years to record a population of 50 million people. Townsend says that this was the start of the late 19th century "control revolution" where information processing lagged behind industrial development, especially in manufacturing and transportation. By 1890, Herman Hollerith, a former census clerk, had invented a punch-card tabulating machine that allowed the census to be completed in just six weeks, with 60 people. Hollerith's new technology eventually gave rise to the International Business Machines Corporation – otherwise known as IBM.

Townsend finds "striking" parallels between the 1880 census and the data crisis cities are facing today, with "booming cities spinning out of control and the application of new technologies to measure and control them." For example, the International Data Corporation (IDC) reports that in 2010, the amount of data in the world (what they call the "Digital Universe") grew by about 62 percent from a year earlier, reaching about 1.2 million petabytes: roughly equivalent to a stack of filled DVDs long enough to reach the moon, twice.[2] The amount of data continues to grow rapidly; IDC estimates that by 2020 the digital universe will be 44 times larger than it was 2009 – enough data to get that stack of DVDs halfway to Mars.

This explosion of "Big Data" is fed, in part, by the growth of what is called "the Internet of Things" (IoT): the infusion of data-collecting sensors and actuators in common, everyday objects such as parking meters, pacemakers, and thermostats. According to Business Insider, 1.9 billion devices are connected to the Internet today: by 2018 that number will grow to 9 billion, "roughly equal to the number of smartphones, smart TVs, tablets, wearable computers, and PCs combined."[3]

Unlike the invention of the punch-card tabulating machine, technical solutions alone cannot solve disruptions caused by big data. This is partially because the data revolution is just one of many disruptive drivers affecting modern cities. Shocks and stressors associated with climate change, inequity, and sustainability are challenging the way cities are built and operated, while at the same time inspiring new possibilities in the urban space.

1.2 million petabytes

The amount of data in the world grew by about 62 percent in 2010.

Big Data and Internet of Things

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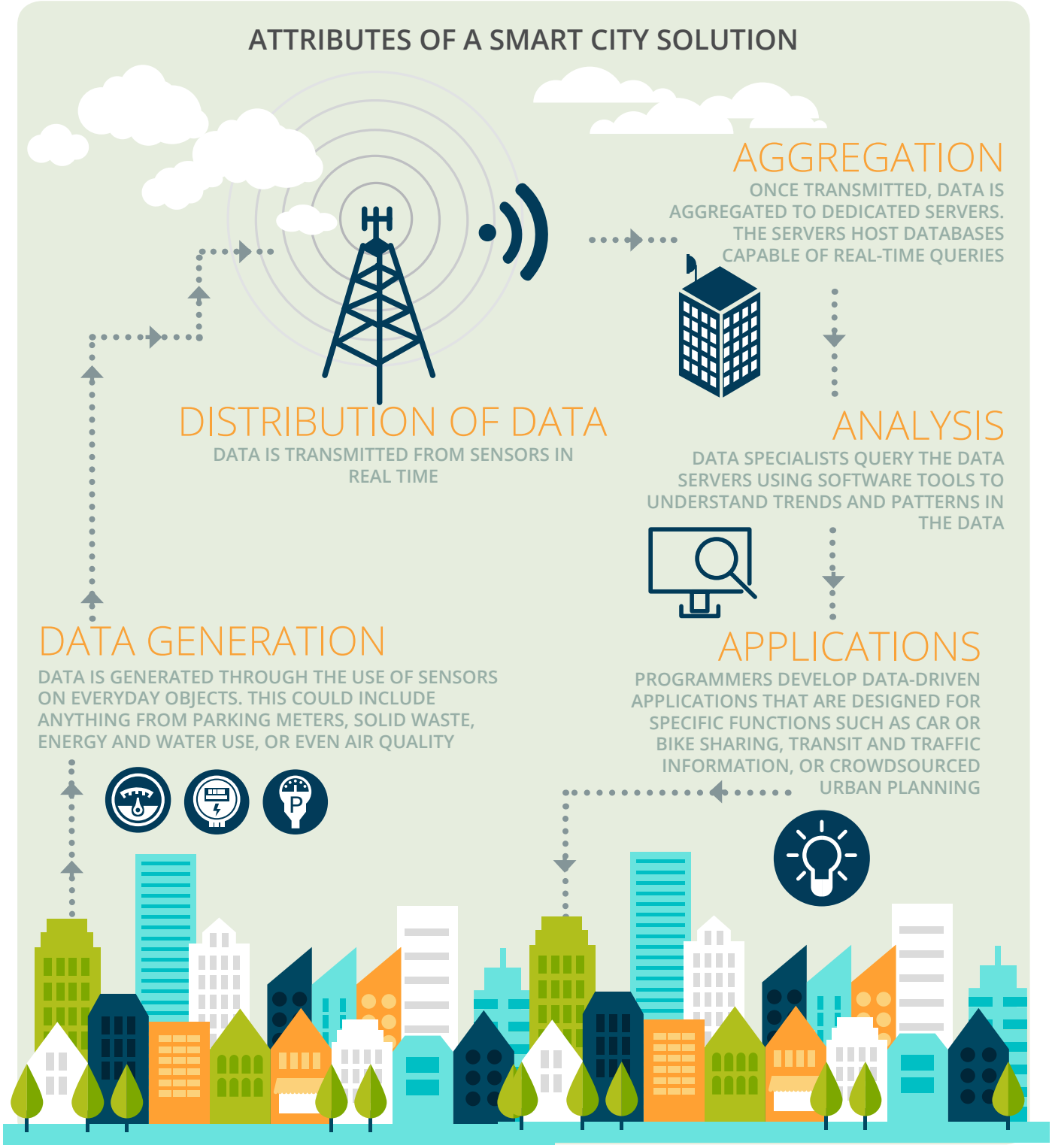
1 Urban Futures – An Atlantic Perspective; Dr. Anthony Townsend, 2013. http://www.gmfus.org/wp-content/blogs.dir/1/files_mf/1392826781UrbanFutures_PierceEtAl_Jun13_web.pdf.
2 The Digital Universe Decade – Are You Ready?, IDC iView; John Gantz and David Reinsel, 2010. http://www.emc.com/collateral/analyst-reports/idc-digital-universe-are-you-ready.pdf.
3 In Appendix 1, you may read a sector-by-sector breakdown of the report. Here's Why 'The Internet of Things' Will be Huge, and Drive Tremendous Value For People and Businesses, Business Insider; Emily Adler, 2013. http://www.businessinsider.com/growth-in-the-internet-of-things-2013-10.

The Smart City Technology Stack

Regardless of how we make our cities smarter, local government practitioners all face the same perplexing behemoth: a rising tide of data being generated, collected, and analyzed both within and outside the walls of city hall. The implications of this data deluge, especially on the sustainability of cities, are just becoming known.

While the definition of a smart city varies with local conditions, every city shares the same range of available technologies and tools. Smart city technologies are broadly categorized in five interrelated infrastructure elements, starting from simple data collection through the use of sensors all the way to sophisticated software tools that analyze the data. The following is an overview of each infrastructure element:



Data Generation: Data is generated through the use of sensors on everyday objects. This could include anything from parking meters to garbage cans. Data generation technologies include:

- Radio Frequency Identification (RFID) Tags – Small wireless trackers that can be attached to anything from consumer products, to livestock and pets, which provide location data.
- Smart Meters – Meters that provide real-time data on energy and water use. Smart meters often include sub-meters that measure particular uses, such as plug loads, lighting, or HVAC equipment.
- Traffic Sensors – Sensors embedded in road infrastructure that provide real-time data on traffic congestion and road conditions
- Global Positioning System (GPS) Trackers – Satellite-based sensors that report exact geo-location of objects, from buses to shared bikes, to cell phones.
- User-Generated – Data generated by everyday urban dwellers such as pothole information or comments on a city plan through their smart phone or other means.

Distribution of Data: Data is transmitted from sensors in real time. Data distribution technologies include:

- Wireless – Transmission of data using radio wave frequencies including, Satellite, WiFi, Cellular, or Bluetooth.
- Wired – High-speed "always on" internet connection through fiber-optics, cable, DSL, or Broadband over Powerline (BPL).

Aggregation: Once transmitted, data is aggregated to dedicated servers. The servers host databases capable of real-time queries.

Analysis: Data specialists query the data servers using software tools to understand trends and patterns in the data.

Applications: Programmers develop data-driven applications that are designed for specific functions such as car or bike sharing, transit and traffic information, or crowd sourced urban planning.

Smart Cities 1.0 vs. 2.0

1.0 – For the past few years, a smart city referred to an idealized, technologically-driven, largely automated city that was developed from the top down in conjunction with a large data and technology company: referred to here as smart cities 1.0.

2.0 – As the smart cities space has continued to evolve, cities are supporting the idea of creating smart cities to address a range of issues but with a new and important twist – smart cities 2.0 are ones that put "people first" and stress technology as a tool to use only in service of citizens.

This list of technologies provides common understanding for determining what solutions can be categorized as "smart." For example, many cities are passing energy disclosure ordinances that require commercial building owners to report the energy efficiency of their properties. While requiring the disclosure of energy efficiency data is an important step toward achieving more efficient buildings, it is not by itself a smart city solution. An example of "smart" energy efficiency arises when a building energy disclosure ordinance is coupled with the following:

1. Energy use data generated through meters (data generation)
2. The data is transmitted in real time through a broadband connection (distribution of data)
3. Data from multiple buildings is aggregated in a dedicated data server(s) (aggregation)
4. Aggregated data is analyzed for trends and patterns such as peak loads, high energy users, and efficient energy users (analysis)
5. Software applications are developed to enable smarter decisions on energy efficiency across all commercial buildings in the city. For example, a "heat map" can be created showing which buildings have the lowest utility costs. This information can be used to drive the energy efficiency market.

The technologies that most sustainability professionals use most regularly are data generation and indicator tracking. In cities, data has been collected from waste collection carts, bike trips, and – through increasingly sophisticated water and energy sub-meters – in buildings. The next step for many cities is to understand how these initiatives' individual, ad hoc, and siloed uses can become more interoperable and interlinked for greater impact.

Emerging Smart Cities Frameworks

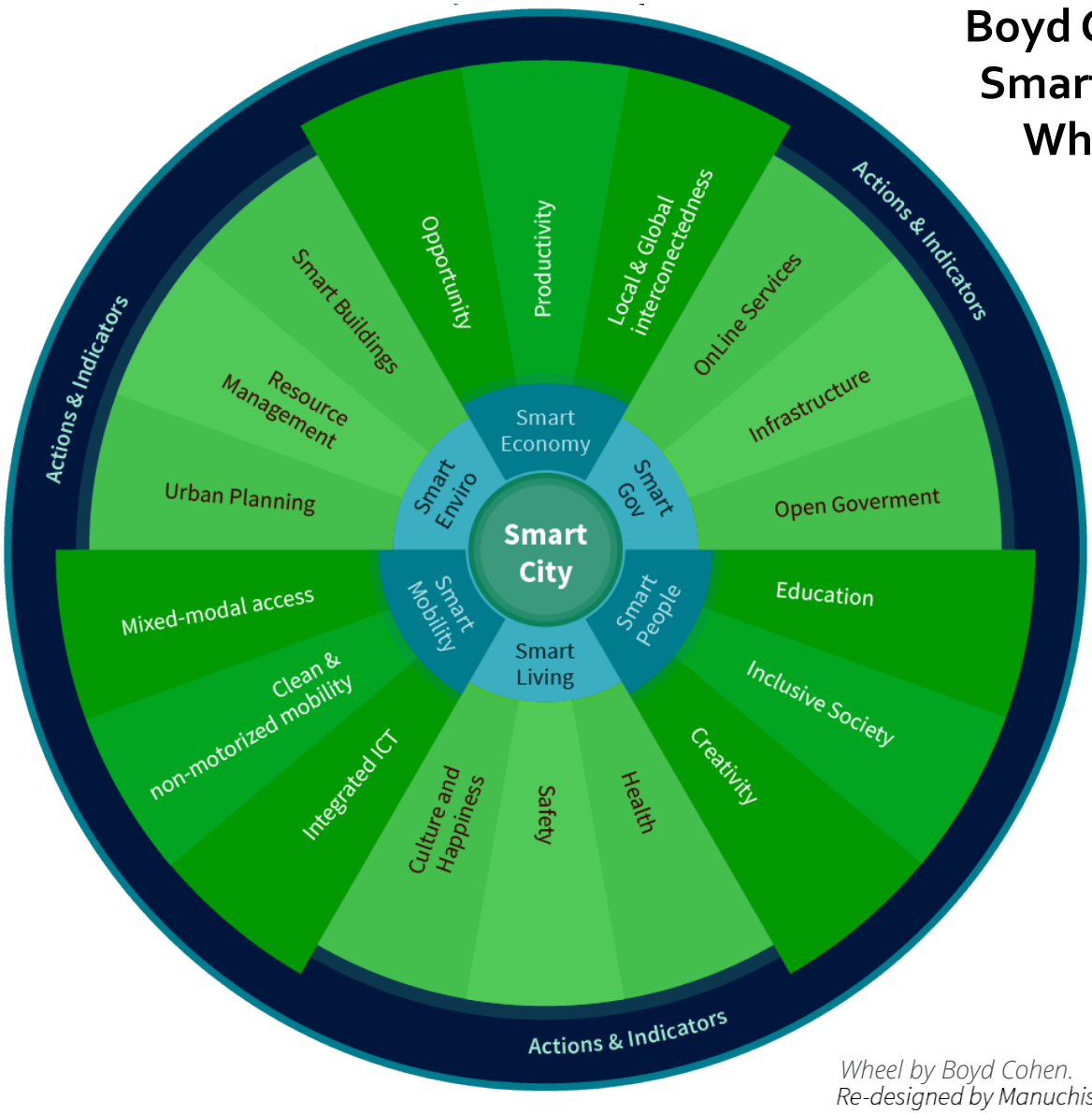
For the past few years, a smart city referred to an idealized, technologically-driven, largely automated city that was developed from the top down in conjunction with a large data and technology company: referred to here as smart cities 1.0. There were challenges and pitfalls with this approach. Many of the best examples of smart cities existed in new cities that were built from the ground up in countries like China and India. Ultimately, these examples were more like a pristine showroom floor rather than real, thriving cities. In addition, the top-down approach to smart cities can conflict with many city government structures because they often require proprietary platforms that inhibit innovation and market competition. The pervading criticism of smart cities 1.0 is that top-down solutions tend to focus on showcase technology, not on the people who live in the cities. As the smart cities space has continued to evolve, more and more cities are supporting the idea of creating smart cities to address a range of issues but with a new and important twist – smart cities 2.0 are ones that put "people first" and stress technology as a tool to use only in service of citizens.

There are several emerging smart cities frameworks that embody a 2.0 "people first" orientation. For example, Boyd Cohen, an urban and climate strategist, developed a "Smart Cities Wheel" that provides a framework to consider six components of what makes a city smart:

1. Environment
2. Mobility
3. Government
4. Economy
5. Society
6. Quality of life

The framework can be used to benchmark how comprehensive or people-centric smart city approaches are.

Boyd Cohen Smart City Wheel



Wheel by Boyd Cohen.
Re-designed by Manuchis.

The Intersection of Smart Cities & Sustainability: Key Approaches and Promising Practices

Big data & ICT are additional tools in the sustainability director toolbox for achieving sustainability goals – from gaining real-time information about energy and transportation systems that help target greenhouse gas reduction activities, to fostering wide-scale culture change through crowdsourcing apps. But currently cities are only just scratching the surface on the potential of smart cities to reduce GHG emissions. In 2008, the Climate Group and Global e-Sustainability Initiative (GeSI) SMART2020 report looked at the value of ICT specifically as a tool to reduce GHG emissions by 2020. It found a 7.8 gigaton (Gt) opportunity, valued at $790 billion a year. A 2013 updated report from GeSI, SMARTer 2020, increased this estimate to 9.1 Gt in GHG reduced – 16.5 percent below 1990 levels – and $1.9 trillion in financial savings.

GHG Savings & Economic Potential of Smart Cities

Smart Cities technology has the potential to reduce GHG emissions to 15.5 percent below 1990 levels with $1.9 trillion in financial savings.

Below are some initial findings regarding the intersection of key sustainability verticals and ICT.

Energy: Power Sector

In the SMARTer 2020 report, ICT is named as key to integrating renewables by addressing intermittency challenges as well as for modernizing and optimizing aging grid infrastructure. In the US, "ICT adoption in the power sector could yield 2.0 $GtCO_2e$ in abatement (or 22 percent of total estimated abatement total) by playing a critical role in the creation of a more dynamic power market with supply and pricing responding to changes in demand." Opportunities to reduce energy use and make the aging grid more efficient and reliable – most notably with the integration of renewables is projected at 197 $MtCO_2e$ of reductions and power grid optimization is projected at 91 $MtCO_2e$.

Buildings

Smart Buildings are defined as "a facility that utilizes advanced automation and integration to measure, monitor, control and optimize building operations and maintenance."
The SMARTer 2020 report states that in the US "ICT can abate 1.6 $GtCO_2e$ (18 percent of total) in this sector by providing occupants with the systems required to support the generation of renewable energy and incorporate it into the building's power supply." The integration of intelligent building automation systems is also referenced as part of this abatement potential.

Transportation

According to IDC Government Insights, intelligent transportation systems include traveler information systems, public transportation systems, parking management, traffic & transportation management, tolling and congestion pricing systems. The SMARTer 2020 report did not highlight the specific potential for transportation emission reductions in the US.

Water

The water utility industry is focused on using data from smart meters, sensors, and other intelligent devices to help forecast supply and demand, optimize capacity, detect leaks, enable conservation programs, and optimize assets and resources. Smart metering, real-time communications, analytics, and process optimization are largely the functions of smart city devices according to IDC Government Resources.

The "smart water grid" uses smart meters instead of traditional water meters to gather water use data at more frequent intervals (hourly vs. every few months) creating more real-time analysis and adjustment opportunities both for the water utility and for the customer.

Due to the current drought and water shortage in California, cities are reviewing and in some cases adopting smart water meters to address conservation and water management. The California state-mandated goal is to require cities to cut water consumption by 20 percent by 2020. The San Francisco Public Utilities Commission, the local water agency for San Francisco, is investing $56 million to put new meters in early 180,000 homes and businesses early. The goal is to help residents and businesses conserve water.

While the sustainability potential of smart cities is large, there is a lack of data that shows how real or accessible these benefits actually are. Without a business case with strong examples, leadership in city governments can be reluctant to make strong commitments. Available research has shown promise but more work is needed to compile specific pilots and examples in cities where sustainability directors have seen tangible impacts and results. This work – developing a sustainability technology toolkit – is being proposed as a Phase 2 project with the USDN Innovation Fund.

In other cases, leaders who do make commitments to a smart cities vision can easily get too far ahead of staff capacities. In either case, practitioners often feel a creative tension between the promise of big data and capacity for governments to fulfill that promise.

Meanwhile, disruptions stemming from big data are occurring everywhere, regardless of local government commitments. There is increasing demand for everything from user-centric government web services (which require more integrated departments), to crowdsourcing apps like Uber and Airbnb that are disrupting long-standing rules and regulations. As big data and the demands that go with it grows, city sustainability and information professionals must navigate emerging opportunities through effective change management and a focus on tangible outcomes that advance sustainability goals.

The following sections outline seven key considerations and promising practices to advancing smart cities initiatives gleaned from an online survey and in-person interviews with USDN cities.

1. Connect Government Departments through Digital Strategies

Nearly all participating cities reported that smart city and sustainability initiatives lay bare the difficulties of working within decentralized governments. Historically siloed, most city agencies have been established to focus on a specific mission, service or purpose within the city. Moreover, city departments tend to establish separate data and management systems with little cross-departmental coordination. This limits governments' ability to scale cross-cutting initiatives and innovations, and often results in isolated, legacy operations and data systems. When it comes to smart cities, sustainability directors and information technology directors converge on a shared purpose: to find synergies across departments, sectors, and even jurisdictions that can advance technology and sustainability goals simultaneously. Given this context, most practitioners recognize that instead of diving into technological solutions, a better place to start is to find common interests and clear connections across departments.

Start With Culture Change

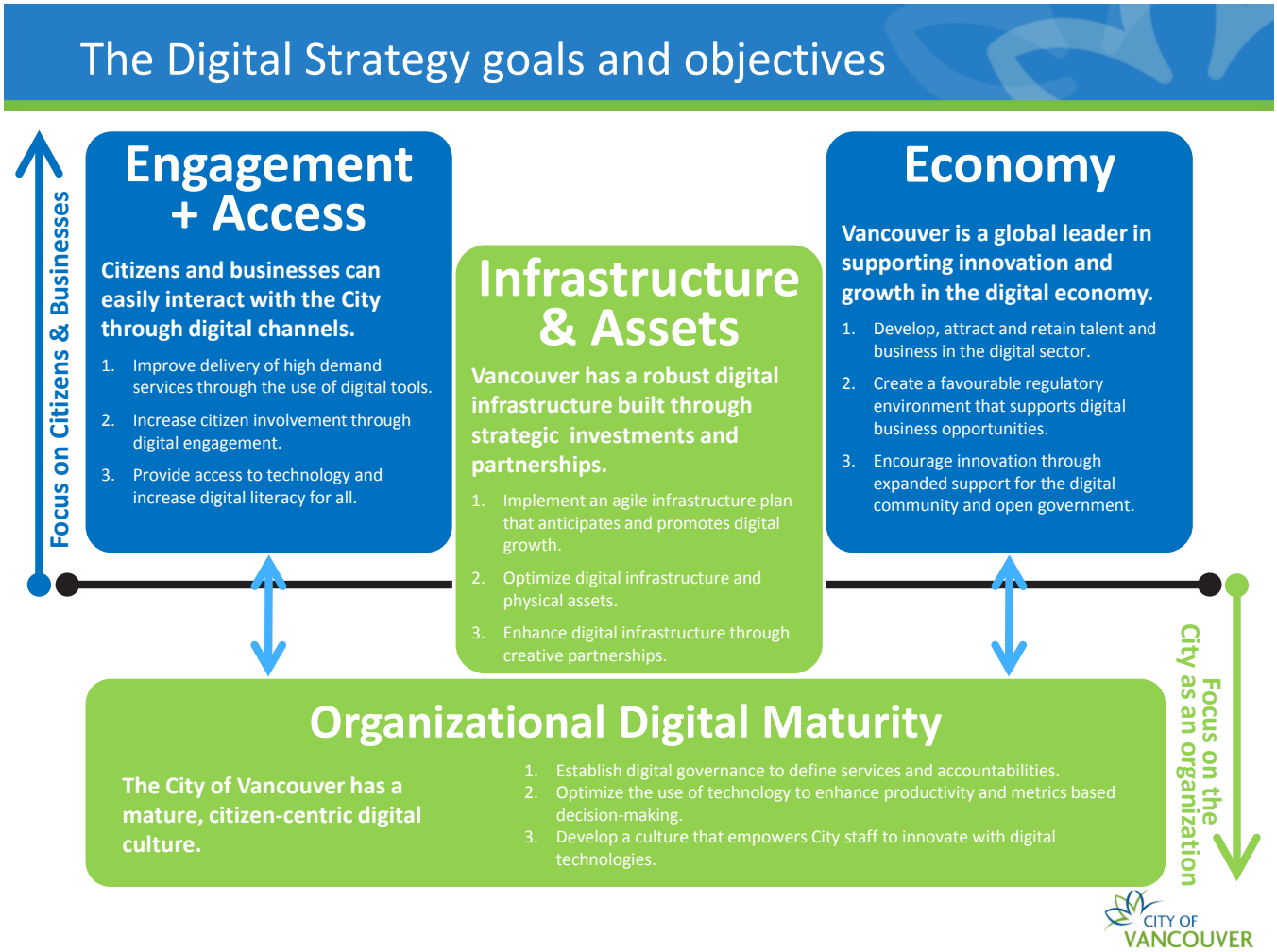
Cities need to drive change upstream of the data platform: that is, work on internal culture change with data owners across the city (from the public, private and voluntary sectors)[...] and to tackle barriers to opening up data. These barriers are as much cultural ones as they are technical ones (given the strong tradition of internal silo-based control of city data) and require sustained leadership over several years.

– *Smart City Council's Framework Guide*

Promising Practices

Establishing a Citywide Integrated Data Management Framework: Reflecting on decentralized departments, **Jennifer Green, Sustainability Coordinator with the City of Burlington, Vermont** stated frankly: "This is our problem. The electric department manages our smart grid system, the telecom office manages our fiber-optic network, I oversee sustainability data, and we will soon launch a new IT department." Green recognizes that smart city initiatives have the potential to unite these departments, but prior to unification of departmental data, understands the need for a common, more integrated data management framework.

Developing a Citywide Digital Strategy: The **City of Vancouver** is implementing a digital strategy designed to create a seamless, user-centric online platform for citizens to navigate city services. In the process, they're making the case for traditionally siloed departments to come together around common, citizen-based needs and discover new cost savings and efficiencies. Once this strategy is fully implemented, the stage will be set for more integrated smart cities applications that could, for example, overlay housing, energy, and transportation data for a fuller picture of livability costs. The **City of Chicago** also released a technology strategy in 2013 to help government be more effective while offering a roadmap for data driven decision-making.



2. Embrace New Staff Capacities and the Changing Role of IT

Many city leaders consider IT staff as service providers to other departments, not as advisors helping create and drive strategic priorities. With the rise of ICT, big data, and data analytics, this is becoming increasingly problematic as more vendors are approaching a range of city departments with new technological solutions. As sustainability departments embark on new data and technology projects, they are recognizing a new role for IT and in the process building new staff expertise.

Promising Practices

Creating Leadership Roles for IT: The increasing demands for data and technology has driven **Tony St. Romaine, Columbia's Assistant City Manager & Acting IT Director**, to embrace his city's IT department as innovation partner. Columbia's first step in this direction was to advertise a business analyst position to act as the liaison between its sustainability and IT departments. Many cities including the **City of San Francisco** and the **City of Chicago** have hired Chief Data Officers to oversee their open data initiatives and the growing number of data related projects.

Recruiting Support Staff that Link IT and Sustainability: **Boulder, CO** and **Boston, MA** recently hired dedicated sustainability data managers responsible for centralizing all sustainability data in the city and act as a "connector within the IT community." According to **David Driskell, Boulder's Executive Director of Community Planning and Sustainability**, the new position represents a shift in their approach to implementing the city's Climate Action Plan from championing stand-alone actions to a more integrated approach – what Driskell calls a "new normal." The **City of Vancouver, BC** has created a new staff position called a Chief Digital Officer to implement their digital strategy and is not based within the city's IT Department.

3. Develop Partnerships with the Tech Sector

Most cities agree that good partnerships are needed to bridge the gap between government and the private sector. Because local governments often do not have the capacity or desire to operate as an exclusive "provider" of smart city solutions, their participation with private industry – for example, through the provision of data or convening of stakeholders – is often essential. The quality of that partnership between city and industry is critical to success. As **Chris Osgood, Co-Chair of Boston's Office of New Urban Mechanics**, put it, the best partnerships "come with groups who are interested in developing and exploring new solutions with us rather than just selling to us."

Advanced Partnerships

As *Chris Osgood, Co-Chair of Boston's Office of New Urban Mechanics*, put it, the best partnerships "come with groups who are interested in developing and exploring new solutions with us rather than just selling to us."

Promising Practices

Prioritizing Cross Sectoral Partnerships in Setting a Vision and Priorities: Stimulated in part by outside smart city interests, **Boulder** recognized the need to bring together stakeholders to discuss smart city priorities. They convened a wide range of institutions, including internal departments, the private sector, universities, and federal laboratories to discuss the role of data in improving city programs and services. According to Driskell, this was a vital step in developing a shared vision and setting clear priorities for the use of smart city technologies.

Establish Feedback and Co-Creation Opportunities with Technology Partners: As an IBM Smarter Cities grant recipient, the **City of Houston** worked with IBM to analyze lessons learned from initial pilot projects, and designed follow-up engagements that were ultimately more flexible and understanding of the city's needs. They have since established a highly functional working relationship that includes helping the city reimagine recycling and waste initiatives. **San Francisco's Chief Innovation Officer, Jay Nath** established a program called the Entrepreneur in Residence Program that issued a call to startups to help city agencies address existing problems and co-create solutions. Over 200 startups applied to the program, and six were chosen to work with agencies like the San Francisco Airport; the Department of Public Health; and the Police Department to develop solutions that both help the city agency function more efficiently and serve its citizens better – all while proving market opportunities for new startups who can bring these solutions to market.

4. Master the Art of Innovation and Rapid Adoption

As city staff begin to reimagine their goals and initiatives through a smart city lens, they are working to identify problems that are at a scale where entrepreneurs can innovate. At the same time, outside groups tend to expect change faster than cities can prudently accommodate, especially as private sector solutions are not always designed for the unique needs of city government. **Barbara Buffaloe, Columbia, MO** observed that there is a need for governments to better understand and adjust to emerging smart cities technologies by being "mindful about how to manage change." Some cities are addressing this disconnect head-on by focusing on new innovation practices that tailor the creative process to the needs of cities.

Promising Practices

Identify the macro problem to address as well as dissect into micro issues: **Jay Nath, Chief Innovation Officer at the City of San Francisco**, remarked that while solving a large problem like homelessness is high on everyone's priority, asking innovators to tackle the whole issue is unrealistic. Instead, innovation happens best in high-leverage "bite sized chunks." When examining homelessness in cities, one might find that wait times for shelters are too long. Devising innovative ways to reduce those wait times could have ripple effects that help solve larger issues.

Bridging the Public & Private Sectors

As sustainability managers begin to reimagine their cities through a smart cities lens, they are working to identify problems that are at a scale where entrepreneurs can innovate. At the same time, outside groups tend to expect change faster than cities can prudently accommodate, especially as private sector solutions are not always designed for the unique needs of city government.

Establish Innovation Centers: The art of good innovation is spreading quickly with a growing number of "Chief Innovation Officers" in cities throughout the county. This presents a strong opportunity to unite sustainability managers and innovation officers to advance the smart cities market. For example, the Environment Department in **Boston** works regularly with their new Office of Urban Mechanics – a joint venture in Boston and **Philadelphia** to create an "innovation incubators." The offices focus on "fail fast" innovation where new ideas are tested quickly to enable faster learning and therefore result in more robust solutions. The city has already made progress on using technology to increase citizen participation, building energy efficiency and boosting educational outcomes.

5. Engage Citizens through Open Source Apps

More cities are turning to crowdsourcing applications like MindMixer and SeeFixClick to engage citizens in government, and they are publishing open data sets to drive government innovation by civic hackers. In some cases, citizens are approaching government with existing challenges and new solutions. Either way, these initiatives represent a significant change in the way local governments interact with their citizens, as new platforms are rolled out, cities are experiencing new challenges and even unintended consequences.

Promising Practices

Create Open Data Initiatives: Many cities including **San Francisco**, **Boston** and **Chicago** have created policies or programs that encourage city agencies to track and release existing, non-sensitive data sets to the public. City agencies maintain a wealth of data sets that, when released to the public, can be used by citizens or entrepreneurs to create useful applications for the community. For example, 600 data sets have been released in San Francisco and dozens of apps have been created. Although the open data movement has helped make government more transparent and collaborative and has resulted in some useful applications, publishing a broad range of general open data sets takes a lot of time and resources, and can lead to new but hodgepodge innovations. Now, there is a concerted effort among cities to create and manage systems that are better at aggregating crowdsourced data, while being more targeted and strategic about the data sets they make available.

Barry Hooper, Green Building Specialist at the San Francisco Department of the Environment notes that smart city data related efforts are "very siloed which is emblematic in a way. The city may be the cornerstone of open data but the people who founded that initiative were mostly focused on the end result of getting the data out to the private sector. And only within the last six months has the city been addressing how it's available internally to city employees." He mentioned the city hired a new Chief Data Officer and that she is focusing on "what isn't going right and why"

regarding the city's data policies. She is also functioning as "a convener" to help break down departmental silos regarding data collection, management and dissemination.

Tap Into Community Talent and Resources to Create Tech Solutions: In addition to the benefits of community engagement as well as increased quality of life, another promising aspect of civic technologies is the potential economic development opportunities that arise when deployed. **Raleigh, NC**, like many cities, is realizing this potential by tapping into their vibrant civic hacking community and startup industry. The city benefits from HQ Raleigh, a nonprofit that provides a shared workspace for over 80 purpose-driven businesses. Every year, HQ and the city host CityCamp – an "un-conference" that "brings together government, business, neighborhood, nonprofit, and academic communities to work toward next generation solutions for local municipalities." CityCamp awards prizes to the best civic hacking projects pitched at the event. **Jen Baker, Sustainability Analyst** with the City of Raleigh explained that by participating in the local hacking culture the city provides "a kind of test case for a lot of these companies," and a willing partner in a living laboratory for sustainability-focused smart city initiatives. For example, in 2012, the RGreenway app was the winning concept at CityCamp. It uses city GPS data to create a recreational guide for Raleigh's greenway system, including crowdsourced bike routes that are safer than those on Google Maps.

Photo credit: Steve Rhodes, https://www.flickr.com/photos/ari/5094352079/

6. Focus on Data Privacy

While there is a clear benefit to making city data available for smart city technologies, cities need to be mindful of risks to privacy of citizens and businesses. As **Barbara Buffaloe** put it: "How can you collect and make data organized and actionable without being invasive or creepy?" Cities are rightfully cautious about how data is made public and they are establishing, publishing, and enforcing privacy rules and regulations meant to keep up with rapidly changing smart city applications. The Smart City Council advises rules that define the following:

- Which data sets are owned by which stakeholders
- What rights and protections are afforded by ownership
- Which data sets are private (requiring authorization prior to sharing)
- Which data sets can be shared with the city or authorized third parties
- How data can be shared if defined protocols for making information anonymous are followed[4]

"How can you collect and make data organized and actionable without being invasive or creepy?"

– Barbara Buffaloe

Promising Practices

Proactively Establish and Publicize Privacy Policies: In **Columbia**, a sunshine law guides their privacy policy. This has proven to be an important part of their program, as there is a concern in Columbia about "big brother" when it comes to government. So before they opened data sets to the public, they spent a lot of time communicating with stakeholders, and had multiple commissions review how the data was presented. In **Raleigh**, specific privacy laws govern which types of information can be released. Because private user data cannot be used, the city has focused its smart city initiatives on internal processes rather than external projects.

Establish Privacy Protection Procedures: In **Boulder**, the IT department coordinated a detailed review of data schema and record refresh plans before publishing their open data website. This included developing licensing terms including terms of use, attribution and a disclaimer. The city collaborates with other local governments as a founding member of OpenColorado (http://opencolorado.org/) – a group that shares public information and transparency strategies.

7. Reinvent Innovation-Friendly Procurement Systems

Government procurement rules are designed to ensure fairness, transparency and to guard against cronyism and corruption. But they can also create unnecessary constraints for adopting helpful, innovative technologies, or staying up-to-speed in rapidly evolving markets. Several cities are re-examining procurement systems in light of the smart city and cleantech markets, and creating new systems that are both more conducive to innovation and sensitive to transparency and equity needs.

4 Smart Cities Readiness Guide; Smart Cities Council, 2014. http://smartcitiescouncil.com/resources/smart-cities-readiness-guide.

Promising Practices

Create Special Procurement Channels: In **Washington, DC**, procurement laws designed to ensure protection of citizens via transparency can have the unintended consequence of slowing down or even halting procurement contracts. The law allows bidders who lose contract awards to protest the final decisions, which sometimes leads to the blocking of legitimate competitors' contracts. Also, the procurement process in the District can be very slow. DC's complicated procurement process can take six to nine months. When funds must be spent within 12 months, sometimes there is not enough time to complete the actual work. Recognizing the delays in contract procurement, the District Department of the Environment created a Green Building Fund Grant Program for highly innovative projects. The grant allows the city to move more quickly than the traditional procurement process and fast-track highly strategic sustainability initiatives. The grant is currently funding projects to perform quality control for its energy benchmarking program, create a "smart buildings plan" for the city, drive innovation in the green appraisals market, green real estate listings for residential properties, and develop the DC Smarter Business Challenge – a green business competition platform. **Bill Updike** notes that the grant is similar to the USDN Innovation Fund, but exclusively for district projects.

"This is our problem. The electric department manages our smart grid system, the telecom office manages our fiber-optic network, I oversee sustainability data, and we will soon launch a new IT department."

– Jennifer Green, Sustainability Coordinator with the City of Burlington, Vermont

The **City of San Francisco**'s Innovation Office developed a procurement procedure for pilot projects that last for two years or less. Pilots are initiated by a written Pilot Agreement Request submitted to, and reviewed by, the Office of the City Administrator. The city was successful at developing pilots with Yammer, DocStop123 and CityZenith using this method. Additional procurement of services with pilot project providers are still subject to the city's traditional procurement requirements.

Create Accessible Platforms: For some cities, the challenge is often about justifying cost and demonstrating community impact of purchasing decisions. A key consideration in the **City of Columbia** is to ensure new platforms and technologies can meet the city's standards for accessibility. This includes ensuring accessibility for residents without smartphones or laptops, but also creating web-based service platforms that work with accessibility devices like screen-readers. They do this by incorporating Section 504 of the Americans with Disabilities Act (ADA) in their contract language. Still, **Barbara Buffaloe** stresses the "need to be able to show the payback, whether it is financial return or community impact, to justify the expense of smart city projects with the Council."

Conclusion

Smart city technologies and big data represent an opportunity to bring together sustainability, IT and innovation agendas in a way that can be truly transformative. This is due to their similar focus on cross-cutting issues, diverse coalitions, and sharp focus on efficiency, origination, and sustainability. Working together, sustainability and IT departments have the potential to address long-standing issues in local government by experimenting with, and adopting, technologies that have the potential to bridge silos and accelerate sustainability goals.

Perhaps the most promising aspect of the current smart cities movement is its focus on people-centered innovation. Early smart cities efforts lacked this focus, and instead attempted to implement top-down technologies in closed platforms that were not open to collaborative innovation. New smart city approaches balance top-down and bottom-up approaches, and take advantage of crowdsourcing and open data sets. City leaders who embrace well-balanced approaches are fostering cultures of civic innovation and public/private partnerships.

There are already many good ideas and initiatives underway in the smart cities field. The USDN Smart Cities Working Group alone has uncovered dozens of initiatives – from energy efficiency to transportation and public engagement – that constitute a highly transferable toolkit of promising practices. Yet, this resource guide only scratches the surface. There are many other cities to learn from – especially in Europe and Asia – and many other challenges to address. It is our hope that the USDN Advancing Smart & Sustainable Cities Project represents the first step to creating a united learning environment where innovation can flourish and lessons learned can be shared.

Collective learning among cities will be especially important as the smart cities field continues to grow and mature. We are only on the cusp of the explosion of big data and the IoT, but the private sector is already poised for significant smart city investments. Some cities find themselves needing to "catch up" to a still nascent market, navigating an inundation of investment and partnership opportunities and the bottom-up revolution of disruptive technologies. It is up to cities to define for themselves how they would like to participate in the field, what pitfalls to be aware of, and how they can use smart city technologies to meet their sustainability goals and reduce carbon emissions locally.

Yet it is clear that a growing number of US and Canadian cities are beginning to foster new innovation, are open to a constant influx of new ideas, and are building the capacity to adapt to the change smart cities will create. The emergence of ICT and big data has been a wakeup call for cities that the smart cities wave is coming. The inevitable role of technology in society, the transformative potential of ICT and big data, and pressing sustainability challenges that cities face have all helped to drive initial acceptance of a more digitized government. In order for both cities and technology companies to benefit in the smart city marketplace, cities need to be part of the co-creation process in these early stages. Ultimately, smart city technologies need to deliver on the envisioned benefits to meet the needs of the customers they serve – the citizens of the cities themselves.

"A smart city requires trust. Significant benefits can be achieved by making data more open, more interconnected and available in real-time. But it is essential that any moves in this direction retain the trust of citizens, by placing the security and privacy of their personal data at the heart of the city's approach to service management."

– Smart City Framework. Guide to Establishing Strategies for Smart Cities and Communities; British Standards Institution, 2014.

Glossary of Terms

Selected terms & definitions from the British Standards Institution (BSI):

http://shop.bsigroup.com/upload/PASs/Free-Download/PAS180.pdf

Application – structures, data elements and program modules needed for performing a specific functionality.

Big data – high volume, high velocity, and or high variety of information assets that require new forms of processing to enable enhanced decision making, insight discovery and process optimization.

Broadband – high-speed, "always on" internet access.

Data center – dedicated space where ICT infrastructure is hosted and operated on behalf of one or a number of organizations.

Digital infrastructure – integrated software and hardware required for digital communications allowing reception of data and information services delivered externally, and for the transmission of digital data and information.

Gamification – the use of game thinking and game mechanics in non-game contexts to engage users in solving problems. – *Wikipedia*

GIS: Geographic Information Systems – GIS tools are used to gather and analyze data about the surface of the earth. The data can be used to create charts, maps, and 3D models of the earth's surface. – *http://www.techterms.com/definition/gis*

ICT: Information and Communication Technologies – ICT refers to technologies that provide access to information through telecommunications. Similar to Information Technology (IT), ICT focuses primarily on communication technologies including the Internet, wireless networks, cell phones, and other communication mediums.
– *http://www.techterms.com/definition/ict*

Innovation – changes made to something established, or a new introduction as new methods, ideas, or products, to achieve desirable outcomes that result in small but significant improvement.

Integration – the process of combining software components, hardware components, or both into an overall system.

Interoperability – ability of systems to provide services to and accept services from other systems and to use the services so exchanged to enable them to operate effectively together.

Internet of things (IoT) – state where things (e.g. objects, environments, vehicles and clothing) have more and more information associated with them and may have the ability to sense, communicate, network and produce new information, becoming an integral part of the Internet.

M2M: Machine to Machine – refers to technologies that allow both wireless and wired systems to communicate with other devices of the same type. M2M is considered an integral part of the Internet of Things and brings several benefits to industry and business in general as it has a wide range of applications such as industrial automation, logistics, Smart Grid, Smart Cities, health, defense etc. It is mostly for monitoring but also for control purposes. – *Wikipedia Open data – content or data that is free to use, reuse, and be redistributed, subject only, at most, to the requirement to attribute and/or share-alike.*

Open innovation – paradigm that assumes that firms can and should use external and internal ideas, and internal and external paths to market.

Open platform – software system based on open standards. For example, published and documented external application programming interfaces (API) that allow the software system to function beyond the scope of the original programmer's specification, without requiring modification of the source code. Using these interfaces, third parties can integrate with the platform to add functionality.

Predictive analytics – statistical and analytical techniques used to develop models that predict future events or behaviors.

Public private partnership (PPP) – business relationship between a private sector company and a government agency for the purpose of completing a project that will serve the public.

Smart – the application of autonomous or semi-autonomous technology systems to achieve greater utilization of resources, limiting or reducing per capita resource consumption to maintain or improve quality of life.

Smart city – effective integration of physical, digital and human systems in the built environment to deliver a sustainable, prosperous and inclusive future for its citizens.

Smart city indicator – measures of the impact and success of smart city initiatives, programs and projects.

Smart city system – system of digital infrastructure and digital services to monitor, manage and control physical and social resource.

Smart grid – electricity network that uses ICT to integrate the actions of all users connected to it – generators, consumers and those that do both – in order to efficiently deliver sustainable, economic and secure electricity supplies.

Smart operations management – real-time proactive management of a city's resources and space.

Smart system – distributed system that incorporates functions of sensing, actuation and control.

Appendix 1: USDN Smart Cities Resource List

Dropbox Link to documents: http://goo.gl/yIgcBw

Below is a list of useful resources compiled to help orient municipal sustainability professional to the smart cities landscape.
** indicates the highest priority resource in each category if you have limited time to review.*

Smart City Landscape

Smart Cities: Infrastructure, Information, and Communication Technologies for Energy, Transportation, Buildings, and Government: City and Supplier Profiles, Market Analysis, and Forecasts
Author: Pike Research | Pages: 96 | Year: 2013
Research report presents an analysis of the global smart city market including an examination of government and industry initiatives for smart cities and related investments in smart energy, smart water, smart transportation, smart buildings, and smart government. Global forecasts of the smart city market for 2012-2020 are also included. The report aims to offer a strategic examination of the market with a focus on key economic, business, and social drivers, technology issues, regulatory factors, and the competitive landscape.

Smart Cities and the Internet of Everything: The Foundation for Delivering Next-Generation Citizen Services*
Author: IDC Government Insights | Pages: 18 | Year: 2013
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.

Urban Futures – An Atlantic Perspective
Author: Dr. Anthony Townsend | Pages: 30 | Year: 2013
The third chapter of this academic paper explores how technology has long been a critical component of urban policymaking and how the use of technology over the past decade has expanded dramatically in two potentially beneficial, but arguably opposed directions: top-down applications to create new efficiencies in urban management, and bottom-up approaches to map preferences, needs and priorities of city residents.

Smart Cities Market Scan Report
Author: O-H Community Partners | Pages: 26 | Year: 2011
Market Scan assesses the value proposition, emerging trends, and key players within the smart city market and identifies potential opportunities to leverage smart city technologies and strategies to advance urban sustainability goals. Includes a review of key firms operating in the smart city space, the industry, a general public literature review, as well as secondary research to support case studies.

Energy Use & GHG Emissions Reduction

Advanced Energy Technologies for Greenhouse Gas Reduction
Author: Advanced Energy Economy| Pages: 48 | Year: 2014
Report details 40 different advanced energy technologies and services that states can consider as they develop compliance plans to reduce emissions under EPA's Section 111(d) carbon standard.

SMART 2020: Enabling the Low Carbon Economy in the Information Age*
Author: The Climate Group | Pages: 183 | Year: 2013
Report demonstrates the potential role the Information and Communications Technology (ICT) sector could play in mitigating climate change. It explores and calculates the actual GHG savings that the industry could yield through smart city solutions in the arenas of transportation, logistics, buildings, and power grids.

BIG Data & Internet of Everything

Big Data, Big Promise*
Author: The Center for Digital Government | Pages: 34 | Year: 2013
Report explores how to take advantage of the big data explosion including defining big data, the business case, data infrastructure tools, challenges related to big data, and best practices and tips for participating in the big data revolution.

Emerging Trends in Urban Informatics
Author: McKinsey | Pages: 4 | Year: 2012
Article explores three trends around how city administrators are using urban informatics: Using existing city data to improve service delivery; building new data for better operational and planning decisions; and Increasing public engagement to improve problem solving.

A Planet of Civic Laboratories: The Future of Cities, Information and Inclusion
Author: Institute for the Future/Rockefeller | Pages: 6 |
Map highlights future innovations that will harness urban data to reduce poverty and promote inclusion. The forecasts aim to inform and inspire thinking about how technological and social trends may converge to create new opportunities while exposing tensions that may arise.

Smart City Strategy & Planning

Creating a Comprehensive Digital Government Strategy
Author: Govloop | Pages: 20 | Year: 2013
Report provides a snapshot of what a digital government is and the path agencies can take to craft a comprehensive digital strategy. It draws upon a survey of 94 members of the GovLoop community who are currently adopting emerging technology at the state, local and federal level of government. This report includes insights based on interviews with government leaders and industry partner experts.

Smart City Framework: Guide to Establishing Strategies for Smart Cities and Smart Communities
Author: The British Standards Institution | Pages: 60 | Year: 2014
Guide intended for use by leaders, at all levels and from all sectors, of smart city programmes. It provides practical, "how-to" advice, reflecting current good practice as identified by a broad range of public, private and voluntary sector practitioners engaged in facilitating UK smart cities.

Smart Cities Readiness Guide*
Author: Smart Cities Council | Pages: 281 | Year: 2013
Guide is intended for mayors, city managers, city planners and their staff. It helps cities help themselves by providing objective, vendor-neutral information to make confident, educated choices about the technologies that can transform a city.

Understanding the Private Sector Position

A Vision of Smarter Cities
Author: IBM | Pages: 20 | Year: 2009
Pervasive information and communication technology means that there is much greater scope for leveraging technology for the benefit of cities: instrumentation, or digitization, of a city's system means that the workings of that system are turned into data points and the system is made measurable; interconnection means that different parts of a core system can be joined and "speak" to each other, turning data into information; and intelligence refers to the ability to use the information created, model patterns of behavior or likely outcomes and translate them into real knowledge, allowing informed actions.

The Internet of Everything for Cities
Author: Cisco | Pages: 21 | Year: 2013
Paper uncovers lessons from several Cisco pilot projects that can be used to inform projects, platforms and implementation strategies.

What's Next for your City – A CityNext Whitepaper
Author: Microsoft | Pages: 14 | Year: 2013
Aims to help cities to operate more efficiently and serve citizens as "One City" across eight critical functions: energy and water; buildings, infrastructure, and planning; transportation; public safety and justice; tourism, recreation, and culture; education; health and social services; and government administration. This paper uncovers key challenges for cities in these areas and makes the case for CityNext's people-centered solutions.

Smart City Case Studies

Global Innovators: International Case Studies on Smart Cities
Author: Department for Business, Innovation & Skills (UK) & ARUP | Pages: 58 | Year: 2013
This study of six cities (Chicago, Rio de Janeiro, Stockholm, Boston, Barcelona, Hong Kong) focuses on how these cities are addressing their challenges, and how they are adapting their organisations to deliver new digital services to their citizens. Common themes include leadership models, risk management & innovation, cross-departmental solutions within government, procurement, stakeholder engagement, data analytics, and accessibility.

Melbourne Smart City
Author: ARUP | Pages: 49 | Year: 2010
Outlines many of the opportunities for cities afforded by contemporary technologies, indicating how the 'smart city' approach might fundamentally transform the way that cities are governed, operated, interacted with and experienced, particularly with the focus on reducing greenhouse gas emissions and sustainability. Offers a vision and roadmap for Melbourne's smart city strategy based on a workshop conducted by ARUP.

NYC Digital Road Map
Author: City of New York | Pages: 68 | Year: 2011
Outlines a path to build on New York City's successes and establish it as the world's top-ranked digital city, based on the Road Map's four core areas of Access, Open Government, Engagement, and Industry.

Smart Cities: Transforming the 21st century city via the creative use of technology
Author: ARUP | Pages: 32 | Year: 2010
Report presents a high level approach to the 'smart city' approach to urban management and offers practical case studies for mayors and city administrations to consider how smart cities can help deliver climate change adaptation and resource efficiency.

The Smart Solutions for Cities
Author: ARUP | Pages: 28 | Year: 2011
Report provides an overview of the vast array of emergent technology options and possibilitie. The core message is that now is the time for cities to take ownership of this issue. While industry has developed services that cities could procure, either through public private partnerships or in more traditional ways, cities need to be informed users of smart concepts.

Appendix 2: Smart Cities Frameworks

The following is a review of leading smart city frameworks, grouped by either benchmark and indicator support, or roadmap and strategy development support. Each resource listed below provides a different tool and intended use; practitioners can mix and match approaches from each resource to tailor their own strategy from these established best practices. There are many other smart city frameworks available – the six frameworks summarized are particularly relevant to US cities.

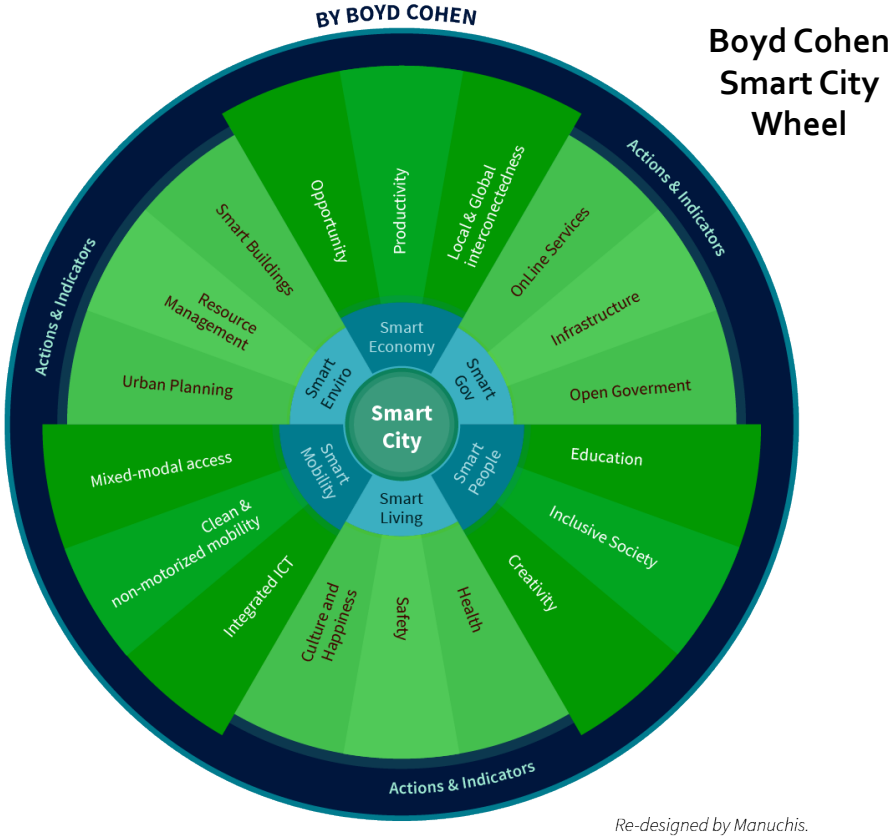
Title	Year Published	Sponsoring Organization	Author(s)	Audience	Featured Tool(s)	Intended Use
BENCHMARKS AND INDICATORS						
Smart City Wheel		The City of Buenos Aires and the City of Barcelona	Boyd Cohen	City governments	A "Smart Cities Wheel" that provides a set of indicators to identify key components of a smart city	Benchmark tool to evaluate smart city strategies
Smart City Maturity Model		IDC Government Insights		City governments and the private sector	A "Smart City Maturity Model" that identifies the development stages for smart city programs	Guidance for assessing current smart city maturity, define short- and long-term goals, prioritizing investments, and uncovering organizational maturity gaps
Smart City Case Study Framework		Graduate School of Information, Yonsei University; Stanford Program on Regions of Innovation and Entrepreneurship	Jung Hoon Lee	Smart city researchers, city governments and the private sector	A smart cities framework and maturity model based on three case studies	Benchmark tool for major smart city domains and governance maturity
ROADMAP / STRATEGY						
Smart Cities Readiness Guide	2013	Smart Cities Council	Input from companies, academia, and experts	City government, including mayors, city managers, city planners	"Smart Cities Framework" that aligns key "city responsibilities" (e.g., built environment, energy, public safety) and "technology enablers" (e.g., instrumentation and control, connectivity, interoperability, etc.)	Guidance for defining smart cities, developing a smart cities roadmap, ad identifying key drivers, barriers, and benefits
Smart City Framework	2014	UK Department for Business, Innovation & Skills and the British Standards Institution	Chris Parker, CS Transform Limited, and a multi-sector steering group	UK city governments, including elected leaders, senior executives, and other stakeholders	"Smart Cities Framework" focused on enabling innovative use of technology and data and organizational change	A "how to" guide for developing smart city guiding principles, roadmap, and vision; city-wide governance; benefit realization strategy; and critical success factors

Title	Year Published	Sponsoring Organization	Author(s)	Audience	Featured Tool(s)	Intended Use
ROADMAP / STRATEGY						
Journey to the Smart City	2013	Group Partners			A smart cities visual framework that was created as a "quick synthesis" of presentations at the OVUM SmartCities13 conference in London in April, 2013	A reference for the following components of smart city strategies: • Knowing your city • Guiding principles • A vision for a smarter city • A blueprint for a smarter city • The interdependent program for delivery • The measurable impacts • The ambition & purpose

Benchmark and Indicators

Smart City Wheel by Boyd Cohen

The Smart Cities Wheel is a holistic framework for considering key smart city components. The wheel is comprised of six dimensions (in blue) each with three key working areas that contain specific indicators and actions. The wheel includes an index that provides additional indicators for each working area.

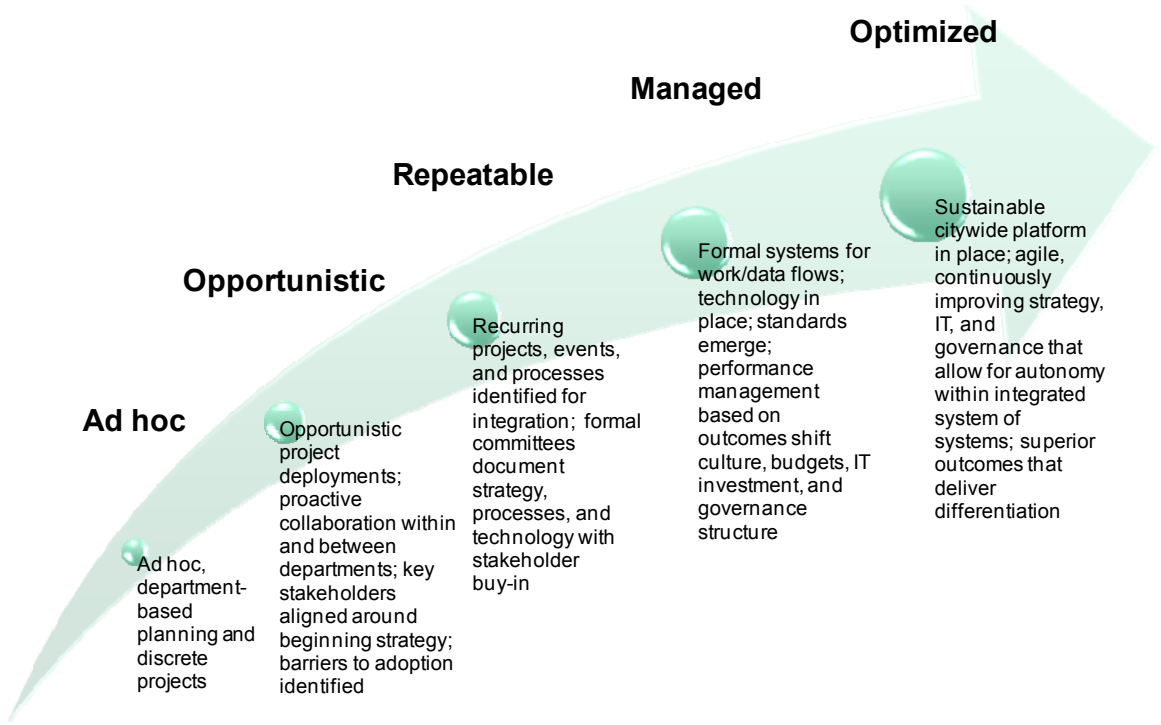


Re-designed by Manuchis.

Smart City Maturity Model by IDC Government Insights

IDC Government Insights' Smart City Maturity Model provides a framework of stages, critical measures, outcomes, and actions required for organizations to effectively advance along the successive stages of competency toward data and event-driven decision-making. City leaders can also use the maturity model as a tool to develop a common language, improve intra- and inter-group collaboration in defining and executing a Smart City strategy, and promote and encourage the use of emerging technologies and Smart City solutions.

Stages in Smart City Development



Source: IDC Government Insights, 2013

IDC Government Insights' Smart City Maturity Model at a Glance

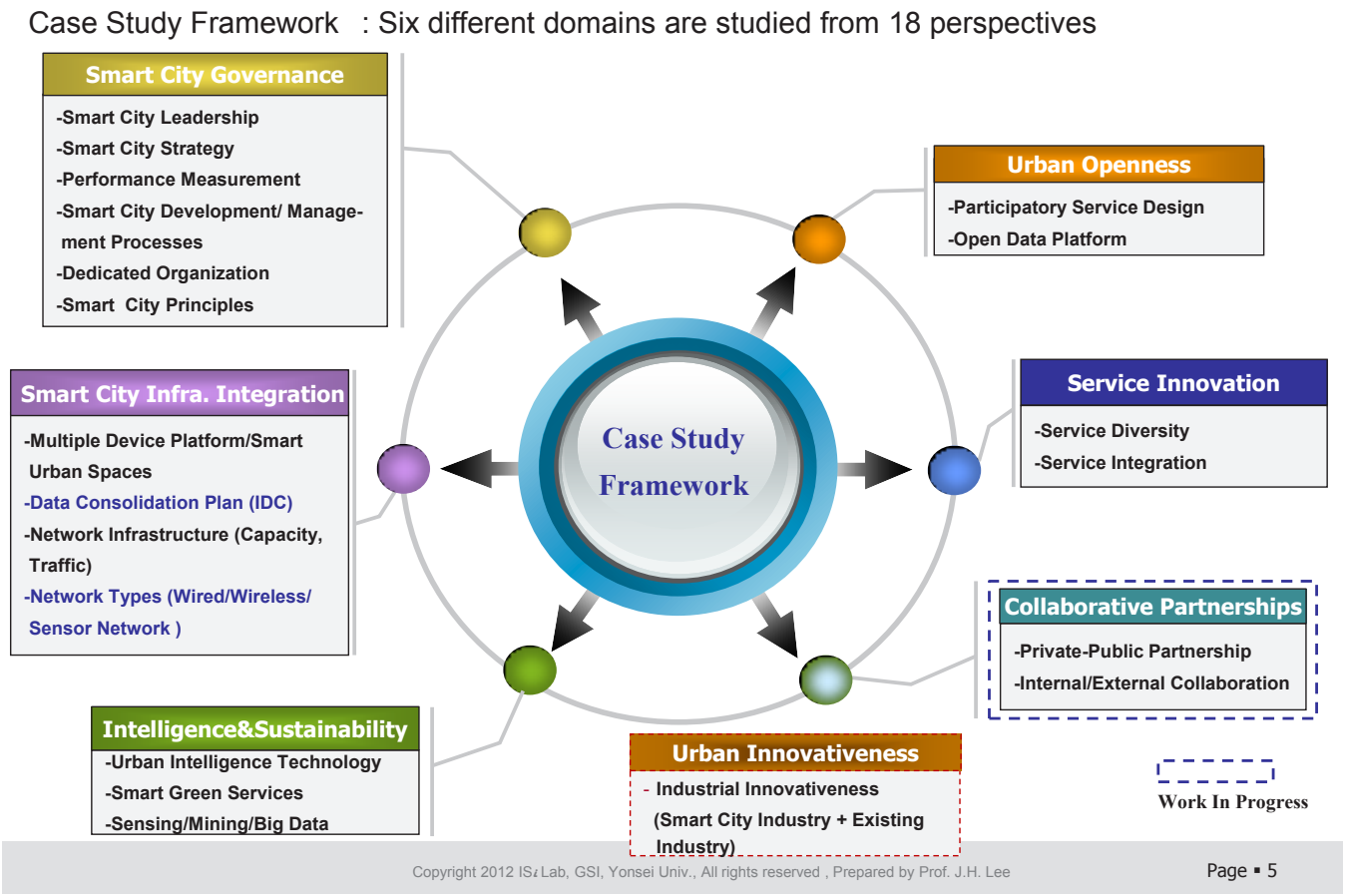
	Ad hoc	Opportunistic	Repeatable	Managed	Optimized
Key characteristic	Siloed	Intentional	Integrated	Operationalized	Sustainable
Goal	Tactical services delivery	Stakeholder buy-in	Improved outcomes	Prediction and prevention	Competitive differentiation
Outcome	Proof-of-concept and business case development 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

Roadmap / Strategy Support

Smart City Case Study Framework by Jung Hoon Lee and Marguerite Gong Hancock

This framework provides a conceptual framework to guide smart city practices around the world, compare three cities' – Seoul, San Francisco, and Amsterdam – approaches to smart cities, and to provide a maturity model to identify gaps in a city's smart cities practices.



Smart City Governance

Smart City Governance Maturity Level

Note: CIO (Chief Innovation Officer or similar position); R&R (Roles & Responsibilities); PMS(Performance Management Sys.)

Scale Factor	1	3	5	7
Smart City Leadership	No leadership engagement & no interest in Smart City Initiatives	Smart City leadership involved on a case-by-case basis in decentralized way	Centralized Smart City leadership exists under CIO (within IT dept)	Strong centralized Smart City leadership exists & CIO's R&R are clear
Smart City Strategy Formulation	Services develop in decentralized way in absence of Smart City strategy	Integrated/centralized smart city strategy exists based on a bottom-up approach	Top-down smart city strategy is aligned with city's specific strategic initiatives	Formalized top-down smart city strategy revised on a regular basis according to a comprehensive strategic perspective (AS-IS/TO-BE)
Dedicated Organization	Functions exist in IS division or elsewhere within the city hall, but no dedicated team for Smart City has formed	Independent dedicated small team of working (coordinating) closely with others city teams	Dedicated smart city team has diverse roles yet not established within organization	Dedicated team has diverse roles & skills & is well established within organization
Smart City Development/ Management Processes	No standard processes; each agency takes decentralized approach in developing & managing smart city projects	Smart city processes follow conventional IT development/management processes, which are centralized	Formalized smart city processes exist but not in detail (i.e. are at an early stage) & not yet recognized by related agencies	Formalized processes for different types of smart city projects are clearly defined and well established within the organization
Performance Measurement	No performance indicators for smart city development	Indicators use IS performance indicators or partly exist in other form	Smart City PMS is uniquely developed, but only used internally by Smart City team	Smart City PMS updates regularly and widely used and publicly announced
Smart City Principles based on municipal ordinance	Absence of principles for Smart City planning /development / management, inc. R&R	Smart City principles limited to certain divisions	Smart City Principles as utilized by Smart City team based on municipal ordinance; principles not used by other divisions	Smart City Principles based on municipal ordinance widely used by Smart City team & other divisions

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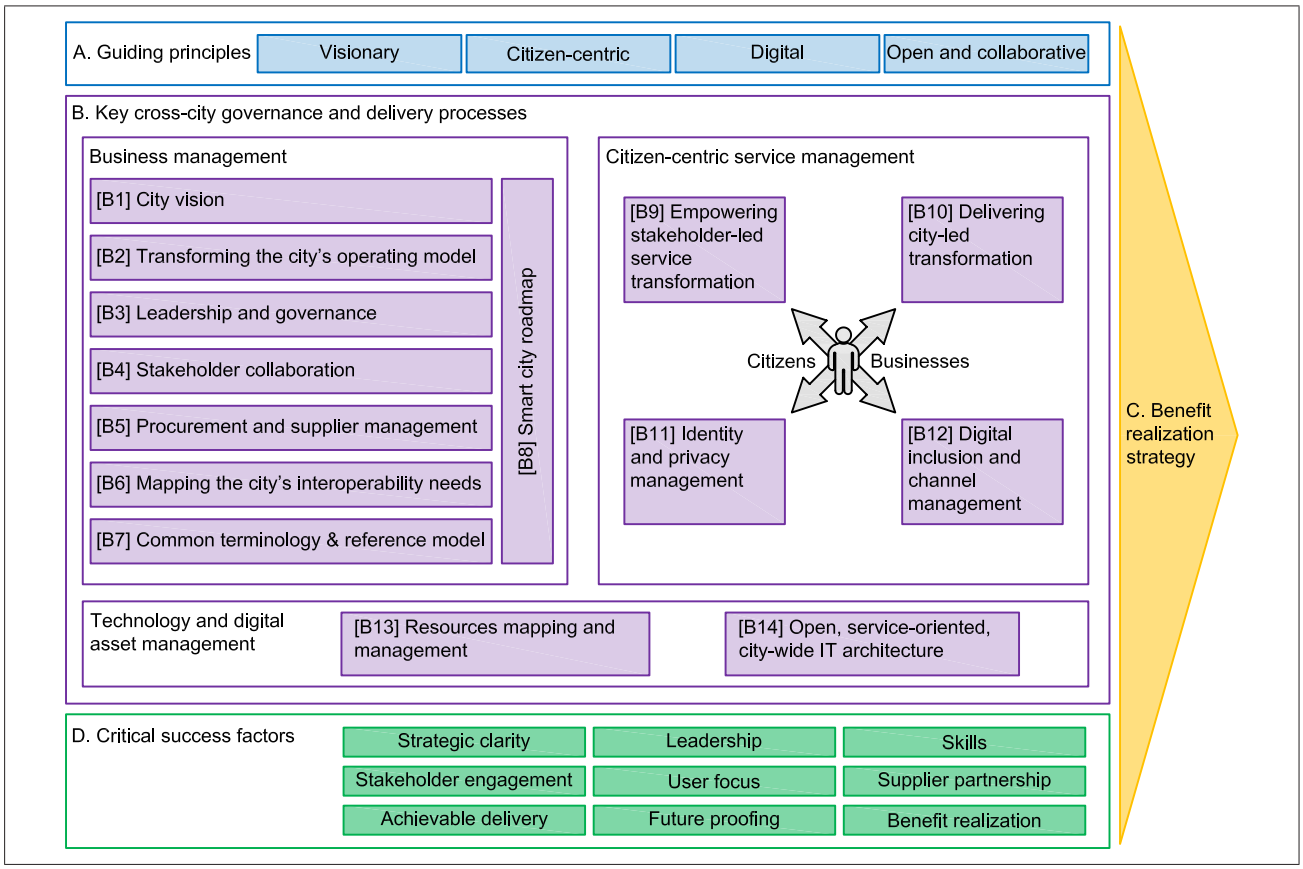
Smart City Framework by British Standards Institute

This framework provides guidance to cities to develop smart cities strategies. It is intended to unify different sector-based approaches into a "whole-city" strategy.

A visual representation of the framework is below. At the top level, it has four components:

1. Guiding principles: a statement of values which city leaders can use to steer business decision-making as they seek to implement a smart city strategy;
2. Key cross-city governance and delivery processes: a set of practical guidance notes on how to address city-wide challenges of joining-up across city silos ("business management");
3. Benefit realization strategy: guidance on how to ensure that the intended benefits of a smart city strategy are clearly articulated, measured, managed, delivered and evaluated in practice;
4. Critical success factors: a checklist of issues which a city should regularly monitor to ensure that it is on track in the successful delivery of its smart city programme, and that it is managing the major strategic risks effectively.

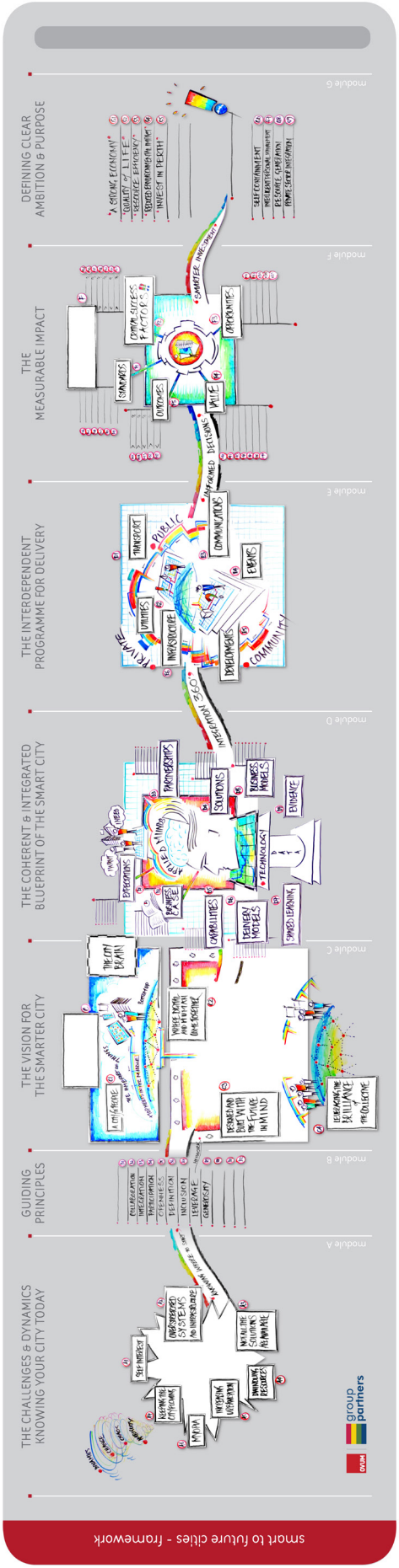


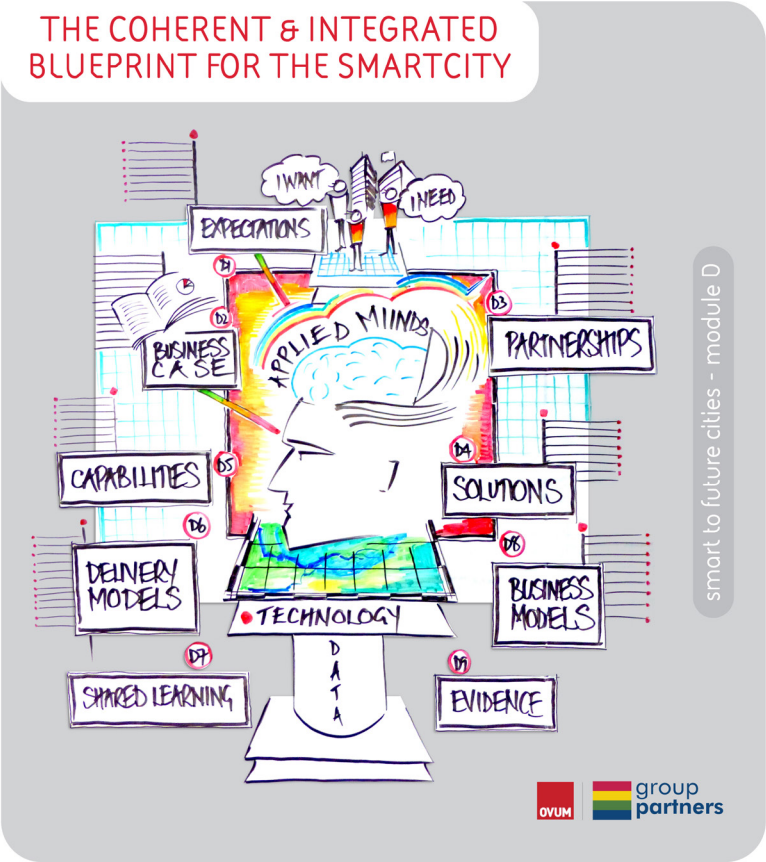
The Journey to the Smart City by Group Partners

The framework was created by Group Partners as a quick synthesis of the presentations given to the audience by the opening speakers. It represented a small part of what was discussed at the recent OVUM SmartCities13 conference in London – a rapid synthesis of the varied perspectives that were being shared at the start of the day.

The Modules from Left to Right

- 'Knowing Your City'
- Guiding Principles
- A Vision For Smarter City
- The Blueprint For A Smarter City
- The Interdependent Programme For Delivery
- The Measurable Impacts
- The Ambition & Purpose


THE CHALLENGES & DYNAMICS KNOWING YOUR CITY TODAY
GUIDING PRINCIPLES
THE VISION FOR THE SMARTER CITY
THE COHERENT & INTEGRATED BLUEPRINT OF THE SMART CITY
THE INTERDEPENDENT PROGRAMME FOR DELIVERY
THE MEASURABLE IMPACT
DEFINING CLEAR AMBITION & PURPOSE
module A
module B
module C
module D
module E
module F
module G
group partners
OVUM
smart to future cities - framework


THE COHERENT & INTEGRATED BLUEPRINT FOR THE SMARTCITY
I WANT
I NEED
EXPECTATIONS
D1
BUSINESS CASE
D2
APPLIED MINDS
D3
PARTNERSHIPS
CAPABILITIES
D5
D4
SOLUTIONS
D6
D8
DELIVERY MODELS
TECHNOLOGY
BUSINESS MODELS
D7
D9
SHARED LEARNING
DATA
EVIDENCE
OVUM
group partners
smart to future cities - module D

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nutterconsulting.net

PARTICIPATING CITIES