



SMART SOLUTIONS:

Technology Serving Communities



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Smart Solutions: Technology Serving Communities was made possible through the generous financial support of IBTS and contributions of its staff.

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Item number: e-44070

ISBN 978-0-87326-432-7

Cited Internet sources were valid as of May 2017. Because URLs and websites are constantly changing, we cannot vouch for their current validity.

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Preface

Communities—cities and counties working with their residents and employees and the private sector—are increasingly deploying smart technologies into their operational systems each day with little fanfare, coordination, or awareness of the impact these technologies have on their civic cultures. *Technology in Western Civilization*, a book on the evolution and impact of technology, notes that

“What distinguishes our age from the past is first our belated recognition of the significance of technology in human affairs; second is the accelerated pace of technological development that makes it part and parcel of our daily living in ever-increasing measure; and third, the realization that technology is not simply a limited or local factor but encompasses all of mankind everywhere and is related to all human endeavors.”¹

With publication of ***Smart Solutions: Technology Serving Communities***, we encourage public administrators to become more familiar with the trends in smart technologies and consider the possibilities, challenges, and impacts of smart technology solutions in their communities. This publication is written for public administrators, elected officials, and academics who desire a primer on “smart cities,” or emerging technologies. ICMA and the Institute for Building Technology and Safety (IBTS) offer *Smart Solutions* in a format featuring pertinent context, how-to guidance, diverse case studies, and relevant resource information on emerging technologies. *Smart Solutions* is intended to encourage further exploration.

This e-book is about “smart cities.” While we use the generic phrase “smart cities,” we write with the awareness that smart communities include both cities and counties and many special-purpose or regional districts. And we recognize that smart cities demonstrate how the appropriate use of technology in our communities can provide solutions and expand the capacities of our communities to better the lives of our residents and visitors.

Sensor-driven automatic smart grids, autonomous or flying vehicles, intelligent customer service analytical platforms, and genetically encoded new plant species for nutritional or medical purposes may all be considered outcomes of smart technology. These examples bring home that point that smart technology is not a distant ship on the horizon; this

ship has arrived in many of your communities, and its crew of advocates is already on “shore leave” in your organizations and communities today.

Smart technologies, when integrated with data analytics platforms and networked into smart community grids, offer the potential of expanding the fundamental capacity of local governments. For the first time in many workplaces, this is occurring in a demographically more complex workforce, with five generations employed at once, each with technological capabilities, preferences, and practical user knowledge not shared by all coworkers. And like other contemporary issues, often leadership in technology change can originate from employees or citizens in the form of a new lexicon—as “hack-a-thons” and “bring your own devices” demonstrate.

Public administrators are undoubtedly at the forefront of decisions about resource allocation and technology deployments in their communities. We know that readers of *Smart Solutions: Technology Serving Communities* will have a leading role in determining how smart technology will affect the future of their communities and lives of citizens. Our hope is that you find *Smart Solutions* a thought-provoking and informative primer for becoming a well-informed leader of smarter communities and for further exploring the possibilities.

A Roadmap: How to Use This Book

Smart Solutions: Technology Serving Communities has been designed as a reference tool for local government professionals considering implementing a “smart communities” approach, using technology to achieve greater efficiency and improved service delivery.

Local governments have much to win in exploring how they can take full advantage of data and technology in their daily operations. For example, as new software applications have come online, local governments have moved from sending field crews out with paper forms, which can be damaged or lost quite easily, to using pads and smartphones to collect data while in the field. Not only is the data more secure, but city hall staff have access to near real-time data for their jobs.

The structure of this book is designed to let you either follow the path as set forward in the table of contents or

“enter” the book at any subject matter point about which you are curious. The intention is to answer important questions local government professionals have about how a smart communities approach will benefit their community.

Smart Solutions: Technology Serving Communities also intentionally stimulates the development of new questions to help move the smart community discussion forward. Local governments have long collected and maintained community-related data, but are still learning how data and technology can be used to achieve greater innovation and realize better results in their work.

In the **Preface**, we introduce the idea of a “smart community” and highlight how that concept works at the community level.

Chapter 1. Overview looks at the history and background of how the “smart community” movement began and where it’s headed.

Chapter 2. Roles highlights the role(s) that need to be fulfilled in developing and designing an effective smart community.

Chapter 3. Getting Started helps local government professionals begin thinking what steps they need to take

to launch a smart community philosophy and how to best organize to achieve the results desired by the community at large.

Chapter 4. Process. Any technology initiative requires a critical understanding of how technology works before beginning. Equally important is a grasp of how the organization and the stakeholders in that organization work. Without support from the organization, it’s difficult to achieve the full results desired.

Chapter 5. Case Studies. Smart community projects take many different forms. The case studies in this chapter highlight the many ways that a local government can put into place a smart community initiative.

Chapter 6. Smart Questions. It’s been said that the best questions are ones that lead you to ask even more and better questions. These questions can be used to begin a dialogue on how your local government can become an effective smart community.

The two appendices move the discussion further by providing a quick take on technologies to keep your eye on and additional resources.

Throughout the book hyperlinks are in bold blue type.

¹ *Technology In Western Civilization: Volume 1. The Emergence of Modern Industrial Society—Earliest Times to 1900*, M. Kranzberg and C. W. Pursell, Jr. (Eds.), Oxford University Press, 1967.

Chapter 1

Overview

Futurist Arthur C. Clarke is attributed to have once said, “Before you become too entranced with gorgeous gadgets and mesmerizing video displays, let me remind you that information is not knowledge, knowledge is not wisdom, and wisdom is not foresight. Each grows out of the other, and we need them all.”

Clarke’s words continue to ring true as city and county leaders seek to enhance effective management and superior service delivery through the astute use of available technologies. This e-book speaks to the technology challenge all communities face. It aims to raise the consciousness of local government managers regarding what constitutes a smart community as well as to offer examples through case studies of how smart cities of all sizes are deploying new technologies to benefit citizens.

But first, some context.

Challenges of Urbanization

Throughout human history the human imagination and development of tools or technological innovation have been the great enablers of the success of human civilizations and the development of cities. In 2008, a United Nations report noted a decisive turning point in history occurred when the world population reached over 7 billion people with more than half (54 percent) of those people living in urbanized areas by 2012. By some calculations this represents the addition of 250 million people a day, or a population increase the size of London each month.¹

These urbanized areas use nearly 75 percent of the world’s energy and produce over 80 percent of the greenhouse gas emissions.² Urban buildings alone account for 40 percent of that energy usage.³ The serious challenges of this era in human history—including rapid urbanization, exponential population growth, climate change, natural resource scarcity, and expanding connectivity of the global village—have served as drivers of a “smart cities” movement around the world. These so-named smart communities are once again using human imagination and smart technology to design and operate more sustainable communities.

Improving Managerial Decision Making

City managers and elected officials recognize that smart technology and new analytical platforms can create the means of improving lives in urban places. Already automation and computerization have improved the efficiency and effectiveness of government services. The Internet of Things (IoT) impacts nearly every activity of daily life as the explosive growth of smart devices in homes and vehicles connects people and machines in data-producing networks.

Only in recent years has technology shown the prospect for improving managerial decision making through automated data collection, and the use of analytics is allowing administrators to gain greater knowledge and understanding of the places they inhabit. Rapidly developing artificial intelligence, cybernetics, and predictive modeling will further help us better design the communities we can imagine and more wisely manage them.

“Our intent is to shorten the distance between the technology haves and have nots and help readers learn from and build on the foundation of early adopters.”

While the future for smart communities is here today, the opportunity to implement smart technology is not evenly available among our global communities, nor is the magnitude and speed of change equally recognized by all public leaders. With this publication we are sharing the experience and understanding of some communities, large and small, that are forging a future enhanced by technology. Our intent is to

shorten the distance between the technology haves and have nots and help readers learn from and build on the foundation of early adopters.

Smart Cities Definitions

You can find many definitions of “smart cities,” or what is also referred to as “intelligent communities.” We are using the definition from the Smart Cities Council (SCC; www.smartcitiescouncil.com):

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

Many readers may prefer a more holistic descriptor, also found on SCC’s website:

“A **city** can be defined as ‘**smart**’ when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic development and a high quality of life, with a wise management of natural resources, through participatory action and engagement.”

“Smart cities projects **make cities work better**. They apply information and communications technology to accurately monitor, measure and control city processes, from transportation to water supplies, the location of city vehicles to the performance of electric grids.” Smart cities are about saving money, becoming more efficient and delivering better service to the taxpayer.”⁴

According to the Intelligent Communities Forum (<http://www.intelligentcommunity.org>),

“Intelligent communities” . . . seek to **make better cities**: places large and small, urban and rural, where citizens and employers thrive and prosper in the broadband economy. Intelligent communities adopt technology but do not make it their focus. Instead, they find vision-driven, community-based, technology smart solutions to their most urgent problems. These issues may differ place to place and include social equity, resource conservation, transportation, economic development, and urban architecture.”⁵

Lou Zachrilla, co-founder of the Forum, quipped at an Alliance for Innovation “Big Ideas” conference that “while people create technology, God created [human] intelligence” to use it wisely—a reminder that technology deployment is not the ultimate purpose; rather, inhabitable, smart sustainable communities are the goal.

Both the Smart Cities Council and the Intelligent Communities Forum use the term “cities” generically because both organizations recognize that many technology solutions are best deployed and used within a countywide, metropolitan, or regional context. Cliff Thomas, managing director of smart and connected communities at Cisco Systems, indicates that while density assists smart cities, the sweet spot for smart solutions is not the largest cities but cities with populations between 100,000 and 1 million. Thomas (presenting at the Stanford Business School’s Innovations of Smart Green Cities, What’s Working, What’s Not Conference) contends that worldwide these places contain over one-third of the world’s population. Geographic areas of any size can form what is called “technology ecosystems,” where even smaller communities in urban areas below 100,000 populations can receive benefit from smart technologies deployed by others.⁶

For the purposes of this book we use the terms “smart” and “intelligent” interchangeably and simply reference “smart communities” and “smart cities” as representing all types of government jurisdictions that share sense of community and concern for their future.

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Technology Innovations Enabling Smart Cities

Research institutions around the world are developing amazing technological applications for cities. Here’s a sampling:

- MIT’s Sensible Cities Lab, in a project called Trash Track, has worked with hundreds of citizens in Seattle, Washington, to install geocoded sensors on waste products to trace their disposal across the country.⁷
- IBM worked with the city of Rio De Janeiro, Brazil, in preparation for the 2016 Olympics to create a Rio Operations Center monitoring every aspect of

the city's 40 departments and urban environment with interconnected cameras, sensors, and weather monitoring using IBM's Deep Thunder localized weather-monitoring platform.⁸

- New York University's Interactive Telecommunications Program developed "Botanicalls," a microchip and moisture sensor that allows houseplants to tweet their need for water to willing caretakers in corporate offices.⁹

In a recent *Business Insider* article, venture capitalist Chris Dixon identified a list of 11 technologies—from self-driving vehicles to virtual reality, better food through science, and cryptocurrencies—that the private sector is already deploying that we can speculate will inspire local governments to deploy to become smart communities. For a complete list of these and other technologies and their applications, see Appendix A, Technologies to Watch.

Keeping the End in Mind: Smart Visions and Leadership

Successful implementation of smart solutions requires forethought and planning. As a critical community infrastructure, smart technology needs to be deployed as a part of a thoughtful, smart community vision. This requires an awareness of community needs and knowledge of threats and opportunities as well as the existing civic capacity to achieve a well-articulated smart vision.

“Smart technology needs to be deployed as a part of a thoughtful, smart community vision.

Quantifiable baseline knowledge of operational metrics and community indicators of the desired outcome are vital to smart solutions and systems development. Smart communities know what they are trying to create and the partnerships they need; they then develop strategies to incrementally achieve their goals.

Smart communities rely on **leadership that inspires and creates a flexible but comprehensive smart city vision and strategic plan** that incorporate technology for the community. Values of transparency, civic engagement, and collaboration and a focus on performance permeate community leadership and visioning processes.

Finally, three core beliefs seemingly underlie the adoption of a smart community vision:

1. Appropriate technology is the critical enabler that can be used strategically to solve community problems and improve services or governance.
2. Appropriate technology itself is value neutral, and when put in place, respects community values; it must be considered an essential public infrastructure.
3. Appropriate technology, open data, and analytics enable public leaders to create communities that enhance and empower the lives and health of citizens.

Examples of these visionary leadership and planning efforts are plentiful:

- Portland, Oregon, worked with IBM Smarter Cities Initiative to develop a 25-year smart city strategy.
- Chicago, Illinois, has developed the City of Chicago Technology Plan to describe its vision and plan for the interconnected and open data environment Chicago intends to develop in partnership with the private sector and citizens.
- Arlington, Virginia, began a broadband network by first connecting its community facilities, then expanding to support facilities and schools. Arlington then connected to businesses and industries to strategically provide community infrastructure to facilitate more economic development.
- Longmont, Colorado, located away from interstate highways and without an institution of higher learning, similarly acquired and used its hydroelectric plant and distribution system to reposition itself into a power and communications utility to deploy broadband throughout its community.

An Innovative Environment Supports Smart Cities

As the case studies in this publication reveal, smart communities purposely create or respond due to necessity or opportunity with an environment supportive of smart technology. Often this innovative smart environment becomes a brand or source of pride. Creating such a supportive environmental community system begins by:

- **Developing insights into a technology-enhanced community future.** This begins with the public leadership perceiving or discovering that a particular technology has

an application or can be adapted in an act of innovation and deployed to improve performance in a service delivery, infrastructure, or governance process.

- **Assessing community capacity and timeframes for deployment.** This involves assessing the fiscal resources needed for acquisition or necessary for a return on investment, verifying the technology's performance capability, and identifying sources of data. It also involves determining timeframes to efficiently deploy the specific technology.
- **Identifying partners and facilitating the collaboration necessary to implement the vision.** Collaboration is necessary to integrate the technology into existing operations and community systems. This may be through a public-private partnership or an intermediary agency, or through creation of an innovation hub or innovation district to shelter the process and encourage funding.

A Roadmap for Technology Deployment

Once a community has agreed upon its vision, strategy, and goals, a technical roadmap for the journey to becoming a smarter community is accomplished in three critical, cohesive steps.¹⁰

Data collection. The first step, as essayist and poet Ralph Waldo Emerson wrote, is to “know thy self.” This occurs when a city collects informational data about itself. The city collects data by creating electronic networks of sensors, monitors, and other machine-to-machine (M2M) or smart devices, such as utility meters, building monitors, and fueling systems.

Networked communication. Second, the city develops capabilities—from smartphones to broadband networks—that can communicate information in the form of wireless or wired networks of data about the community to its internal agencies and other collaborative partners. The Internet of Things (IoT) adds to the growing capabilities for such communication, such as smart utility, street, and building grids.

Descriptive and predictive analytics. And third, the community “crunches” the expanding data by using descriptive analytics to understand the data and what it means about the community. Leaders can then use predictive analytics to model what the future will be or what different resource allocation scenarios can alter future prospects.

Recognizing the neurological preferences in the human brain, visual analytics are increasingly used to assist

identifying relationships within data or to display it visually for enhanced understanding and communication to employees, elected officials, and the public.

Benefits of Being a Smart Community

The Smart Cities Council publishes a *Smart Cities Readiness Guide* for local officials that cites 17 benefits of smart cities under three categories: livability, workability, and sustainability.

- Smart communities are more **livable** because of the ease of access to civic participation, community functions, and government services; more transparent by sharing open data; and safer and more responsive with alerts and monitoring of situational changes in the community.
- Smart communities are more **workable** because technology fosters economic development by unleashing innovation, developing world-class infrastructure and protection through enhanced cybersecurity.
- Smart communities are more **sustainable** because they can monitor and optimize limited resources, improve interoperability, and reduce costs of infrastructure by sharing and reusing resources, conducting better computer simulations, and initiating fiscal forecasting.¹¹

The benefits are often practical. Think about the typical changes in solid waste operations that we've seen in the work lifespan of many managers today and the impact of those changes on citizens. Many managers remember (circa 1950s–1980s) when there were four or five employees on a garbage truck, and crews may have gone into the private backyards or alleys of residences to retrieve trash cans of any size and dump them in rear-end-loading garbage trucks. Then technology allowed for automated side loaders (circa 1980s and 1990s), and crews were reduced to one or two employees. Local governments made citizens move specifically designed containers required by this technology to their increasingly suburban front yards to be placed a specific distance from the curb. In that action public administrators ushered in the concept of co-production with citizens.

Communities started mandatory recycling nationwide in the 1980s, with citizens often sorting their own recyclables and taking them in separate containers along with their trash to the curb, creating alternative waste streams, new products, and reduced landfill overcrowding.

Smart technology exists now that can allow communities to likely have solid waste fixed routes served by automated driverless garbage trucks and containers in automatic carts to move household refuse curbside on appropriate days. We already know that cities in the world are currently being designed and constructed so that there are few or no trash trucks and pneumatic tubes take wastes from homes directly to centralized waste facilities as the trash is produced. Perhaps the future holds little human involvement at all as cyborg robotics crews accompany the truck to help with loading recycling trucks. Or perhaps camera-equipped drones will fly routes in front of trucks to determine and predictively change daily work schedules and routes based on what types or amounts of waste is generated citywide through analytical routing programs. This is one of many examples of practical, smart technology applications we can foresee and that are enabling the delivery of improved services to residents.

Human Values in Smart Communities

Many technologies can be disruptive to communities and have unintended consequences on human values despite our collective intelligence. What is technologically feasible may not always be best for the community, nor can legal frameworks protecting individual rights keep pace. Historically, rural Amish communities and some secular intentional communities around the country have sought community deliberation on which modern technologies will be embraced or are supportive of community values.

In today's urban society, with the rapid pace of change and the introduction of innovative technology, such community deliberation on the impacts of technology appears impossible or secondary in the face of market forces and consumer preferences. Machine-to-machine intelligent technologies are creating smart ecosystems affecting human behaviors. Most of us recognize how often our devices demand our attention, and surveys (including ICMA's 2016 Smart Cities Survey) show that budgetary limitations and discussions of economic feasibility tend to chiefly govern decisions to use smart cities technology.

Deploying smart technology may have negative impacts on the community that public managers need to anticipate and mitigate. Airspace filled with delivery drones may be a future zoning issue or violation of privacy. Militarized policing technology may alienate parts of a community. Autonomous vehicles and robotics can reduce public employment, remote

learning may threaten local learning institutions, sensor- and camera-based analytics can easily violate civic rights and privacy concerns.

Artificial intelligence critics fear the loss of human judgment at the moment of a critical ethical decision. Nevertheless, smart technology solutions, such as alternative shelters, can enhance compassionate social problem solving around such difficult issues as homelessness, and where successfully deployed, new infrastructure can create employment and economic growth.

Barriers to Smart Communities

Obstacles to smart city efforts were recently recognized in the **ICMA and Smart Cities Council's 2016 Smart Cities Survey Summary Report**, a survey of ICMA members. Chief among these barriers is the concern about how to finance the significant costs of technology acquisition and maintenance. Other issues cited as impediments to smart cities were difficulties overcoming institutional silos, integrating solutions with legacy systems, overcoming archaic procurement practices, and lack of a trained ICT (information and communications technology) workforce. A mitigating strategy to bridge these barriers is leadership that builds a common vision among competing agencies and neighborhoods to encourage collaboration for widespread deployment of analytical and infrastructure solutions.¹²

A Future of Empowered, Connected Smart Citizens

Inventor, author, and architect Buckminster Fuller said, "We are called to be architects of the future, not its victims."

The environmental, social demographic, and economic drivers of smart communities will become more paramount in future decades as urban spaces keep growing. The World Health Organization predicts that by 2050 the world's population will reach 10 billion, with nearly 70 percent of the population living in the world's urban areas.¹³ The global capacity to create and conserve resources to meet these challenges once again will depend on our human imagination and our willingness to develop and rebuild communities deploying smart systems in communities worldwide.

If we desire to have future-ready, resilient, and sustainable communities, public administrators can expect to have the opportunity to engage connected smart citizens in the governance process in ways never before available. There

are already more smartphones than people worldwide. In 2015 more than 25 billion smart devices were in use, and this number will double by 2020 with more explosive growth in undeveloped countries.¹⁴

Justin Cook, of IBM's Smarter Cities Initiative, indicates that we can expect the world to be increasingly "instrumented, interconnected, and intelligent" in the future, making systems thinking essential.¹⁵ Urban systems thinking revolves around more than utilities, buildings, and roads. Citizens, their behaviors, and their level of civic engagement are central to demands on urban and global systems. Smart cities will have smart citizens.

“ Smart cities will have smart citizens.

Imagine citizens using technologically powerful smartphones as minicomputers, enhanced with built-in artificial intelligence and remote learning, in local and global networks of citizens. These connected smart citizens will be better equipped to be citizen scientists, citizen journalists, citizen peace-keepers, and citizen environmentalists. This future level of global civic engagement and community capacity building will blend human imagination and technology in a way that has not been experienced in the history of the world.

Endnotes

¹ *The City of Tomorrow: Sensors, Networks, Hackers, and the Future of Urban Life*, C. Rotti and M. Claudel, Yale University Press, New Haven, 2016.

² Energy for Cities, ARUP, www.ARUP.com.

³ Presentation of Cliff Thomas, "Rise of the Smart City" at Innovations of Smart Green Cities What's Working, What's Not" Conference, June 2012, Stanford Business School.

⁴ Smart Cities Council Smart Cities Readiness Guide, <http://readinessguide.smartcitiescouncil.com>.

⁵ Intelligent Communities website www.intelligentcommunities.org.

⁶ Presentation of Cliff Thomas, "Rise of the Smart City" at Innovations of Smart Green Cities What's Working, What's Not" Conference, June 2012, Stanford Business School.

⁷ *The City of Tomorrow: Sensors, Networks, Hackers, and the Future of Urban Life*, C. Rotti and M. Claudel, Yale University Press, New Haven, 2016.

⁸ *Smart Cities, Big Data, Civic Hackers, and the Quest for a New Utopia*, Anthony Townsend, W.W. Norton & Co, New York, 2013.

⁹ Ibid.

¹⁰ Smart Cities Council Smart Cities Readiness Guide, <http://readinessguide.smartcitiescouncil.com>.

¹¹ Ibid.

¹² Smart Cities Survey Summary Report, ICMA, 2016, icma.org/2016smartcitysurveyreport.

¹³ Presentation of Cliff Thomas, "Rise of the Smart City" at Innovations of Smart Green Cities What's Working, What's Not" Conference, June 2012, Stanford Business School.

¹⁴ Ibid.

¹⁵ Presentation of Justin Cook, "Systems Thinking for Smarter Communities," Price School of Business, University of Southern California, November 2011.

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