SMART CITIES
INDIA READINESS GUIDE

The planning manual for building tomorrow's cities today

SmartCitiesCouncil India
LIVABILITY | WORKABILITY | SUSTAINABILITY

Smart Cities India Readiness Guide® 2017

The planning manual for building tomorrow's cities today

Acknowledgments

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The India Readiness Guide would also not have been possible without the help of the Council's Advisory Board, a collection of the world's foremost smart city thinkers, doers and vision- aries. Our 60-plus Advisors are listed on page 364 of this Guide's Appendix.

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Introduction To Smart Cities

Welcome to the Smart Cities India Readiness Guide. This document was assembled with input from many of the world's leading smart city practitioners — the members and advisors of the Smart Cities Council India and Smart Cities Council. It will help you create a vision for the future of your own city. Equally important, it will help you build an action plan to get to that better future.

Through the India Readiness Guide, the first and foremost goal is to give you a 'vision' of a smart city, to help you understand how technology will transform the cities of tomorrow and how people will contribute in enhancing and realising the transformation.

The second goal is to help you construct your own roadmap to that future. It suggests the goals to which you should aspire, the features and functions you should specify, the best practices that will gain you the maximum benefits for the minimum cost, at reduced risk, and the collaborative environment you should create to envisage and assimilate all aspects of smart cities together.

The India Readiness Guide is intended for mayors, city managers, city planners and their staffs. It helps cities help themselves by providing objective, vendor-neutral information to make confident, educated choices about the technologies that can transform a city.

Cities around the world are already making tremendous progress in achieving economic, environmental and social sustainability, in the creation of 21st century jobs. All of these are excellent ways to improve city living standards and economies. The concept of smart cities doesn't compete with these efforts. Instead, smart city technologies can support and enhance work already underway.

This introductory section defines smart cities and then explores the current environment and drivers of smart cities in India. Then it looks at the various supporting government missions. And, then it discusses some of the barriers cities may face and benefits it will bring.

Taking a holistic view of 'city'

Before we define the 'smart' piece, however, we should first deal with the word 'city'. Real-world smart city examples are rarely a city in the strictest term. Many are more than a single city, such as a metropolitan region, a cluster of cities, counties and groups of counties, a collection of nearby towns or a regional coalition. Other examples are less than a full-scale city, such as districts, neighbourhoods, townships, villages, campuses and military bases. Indeed, many municipalities are taking a neighbourhood-by-neighbourhood approach to modernisation. This Guide is designed to address all of these human ecosystems.

Because it is in common use, we will continue to use 'city' throughout this Guide. But we use it to mean all relevant examples big and small. Regardless of size, we are taking a comprehensive, holistic view that includes the entirety of human activity in an area,

including city governments, schools, hospitals, infrastructure, resources, businesses and people. As you'll read, smart technologies have matured to the point that cities of all sizes can afford and benefit from their implementation. For example, new cloud computing offerings allow even the smallest city to affordably tap into enormous computing power. So the lessons of this Guide apply regardless of size and you'll see real-world examples in the case studies featured throughout.

The transition to smart cities will be a long and gradual one. Ten years from now, the transition will have been made in the minds of citizens and decision-makers. We will have many smart city pilots providing new insights for future projects and developments.

The definition of a smart city

The advancement in technologies and open, collaborative partnerships will drive the speed and magnitude of changes. Collaborative innovation and integration is the key to transformation of smart cities, today and in the future.

A smart city uses information and communications technology (ICT) to enhance its livability, workability and sustainability. In simplest terms, there are three parts to that job: collecting, communicating and 'crunching'. First, a smart city collects information about itself through sensors, other devices and existing systems. Next, it communicates that data using wired or wireless networks. Third, it 'crunches' (analyses) that data to understand what's happening now and what's likely to happen next.

Collecting data. Smart devices are logically located throughout the city to measure and monitor conditions. For instance, smart meters can measure electricity, gas and water usage with great accuracy. Smart traffic sensors can report on road conditions and congestion. Smart GPS gear can pinpoint the exact locations of the city's buses or the whereabouts of emergency crews. Automated weather stations can report conditions. And the mobile devices carried by many city dwellers are also sensors that can — when specifically authorised by their users to do so — collect their position, speed, where they cluster at different times of the day and the environmental conditions around them. Smart phones also gauge an always-local, perpetually renewable but inherently limited natural resource — radiofrequency spectrum — that smart cities depend on and will ultimately need to manage.

A smart city, then, is one that knows about itself and makes itself more known to its populace. No longer do we have to wonder if a street is congested — the street reports its condition. No longer do we have to wonder if we're losing water to leaks — the smart water network detects and reports leaks as soon as they occur. No longer do we have to guess the progress of the city's garbage trucks — the trucks report where they've been already and where they are headed next.

Communicating data. Once you've collected the data, you need to send it along. smart cities typically mix and match a variety of wired and wireless communications pathways, from fibre-optic to cellular to cable. The ultimate goal is to have connectivity everywhere, to every person and every device. Interoperability is a key requirement.

THE THREE CORE FUNCTIONS OF A SMART CITY

Figure 1.1

Collect information about current conditions across all responsibility areas (power, water, traffic, weather, buildings, etc.).

Communicate information, sometimes to other devices, sometimes to a control center and sometimes to servers running powerful software.

Crunch data, analyzing it to present information, to perfect (optimize) operations and to predict what might happen next.

1. **Presenting** information tells us what's going on right now. In the aerospace and defence industries, they call this "situational awareness." Software monitors the huge flow of incoming data, then summarises and visualises it in a way that makes it easy for human operators to understand. For instance, a smart operations centre can monitor all aspects of an emergency situation, including the actions and locations of police, fire, ambulances, traffic, downed power lines, closed streets and much more.

2. **Perfecting** operations uses the power of computers to optimise complex systems. For instance, balancing the supply and demand on an electricity network, or synchronising traffic signals to minimise congestion, or selecting the ideal routes for a delivery fleet to minimise time and fuel costs, or optimising the energy usage of an entire high-rise to achieve maximum comfort, or to balance the grid with the optimal mix of renewable and traditional power sources at any given point of time.

3. **Predicting** what's next is perhaps the most exciting part of analytics. Singapore uses data to predict traffic jams while there is still time to minimise their effects. Rio de Janeiro predicts just where flooding will occur from a particular storm, so emergency crews know just where to go.

Smart cities collect, communicate and crunch data:

The city of Rio de Janeiro collects information from 30 different city departments about transportation, water, energy, weather, and other conditions. Then it communicates those conditions to powerful computers, which crunch the data and present it in a unified control center the city developed with IBM. Not only does the city gain full situational awareness, it can even predict some conditions in advance, such as where floods will occur during severe storms.

Crunching data. After collecting and communicating the data, you analyse it for one of these three purposes: 1) presenting, 2) perfecting or 3) predicting. If you've read about "analytics" or "Big Data," then you may already know about the astonishing things that become possible by analysing large amounts of data. Importantly, analysing data turns information into intelligence that helps people and machines to act and make better decisions. This begins a virtual cycle wherein data is made useful, people make use of that data to improve decisions and behaviour, which in turn means more and better data is collected, and thereby further improving decisions and behaviour.

OTHER SMART CITY DEFINITIONS

The Council defines a smart city as one that "uses information and communications technology (ICT) to enhance its livability, workability and sustainability." Other organizations have their own definitions. For instance, Forrester Research emphasizes the use of computing to monitor infrastructure and improve services: "The use of smart computing technologies to make the critical infrastructure components and services of a city – which include city administration, education, healthcare, public safety, real estate, transportation and utilities – more intelligent, interconnected and efficient."

The U.S. Office of Scientific and Technical Information also stresses infrastructure, explaining that "a city that monitors and integrates conditions of all of its critical infrastructures -including roads, bridges, tunnels, rails, subways, airports, seaports, communications, water, power, even major buildings – can better optimize its resources, plan its preventive maintenance activities, and monitor security aspects while maximizing services to its citizens."

Meanwhile, in 2010 IBM's Journal of Research and Development paid particular attention to the wide range of smart devices that collect information, calling it "an instrumented, interconnected and intelligent city."

These and other definitions are valid and helpful understandings of what smart cities are. The Council stands behind its comprehensive definition. But we mention these others so that cities that have planned and invested under these and other models will understand that we share complementary, not competitive, views of the smart city.

Livability, workability and sustainability are the goals:

Smart cities use information and communications technologies to achieve them. Seoul, South Korea – pictured here – is often cited as one of the world's most vibrant, sustainable cities.

As we'll see in more detail, a smart city is a system of systems — water, power, transportation, emergency response, built environment, etc., — with each one affecting all the others. In the last few years, we've refined our ability to merge multiple data streams and mine them for amazing insights. It is those insights — presenting, perfecting and predicting — deployed in a creative way that enhance the livability, workability and sustainability of a smart city.

The drivers of smart cities

Powerful forces are converging to make smart cities a growing trend all around the world. It is valuable for city leaders to understand what's behind this momentum and how it will play out in their region. Chances are some of the pain points described below will hit close to home.

Growing urbanisation. Cities deliver many benefits — greater employment opportunities, greater access to healthcare and education, and greater access to entertainment, culture and the arts. As a result, people are moving to cities at an unprecedented rate.

⣿ **Growing urbanisation:**

Cities provide lucrative employment opportunities, greater access to healthcare and education, and greater access to entertainment, culture and the arts. As a result, people are moving to cities at an unprecedented rate. By 2031, cities will account for nearly 70% of India's GDP and about 600 million people are expected to live in India's cities, according to the World Bank.

Cities can derive benefit by collecting, communicating and analysing information from a single department. But the greatest benefits come when data is connected with multiple departments and third parties. Many cities combine historic traffic data with information about population growth and business expansion to know when and where to add or subtract bus and train routes. Other cities correlate multiple data sources to predict crime the way we predict weather.

Although India is on the path to have a great number of people in cities in less than a decade, the proportion of Indian citizens living in cities is still low — 31% urbanisation rate compared to a rate of 54% (758 million) in China, 53% (134 million) in Indonesia and a whopping 85% (173 million) in Brazil. By 2031, cities will account for nearly 70% of India's GDP and about 600 million people are expected to live in India's cities, according to the World Bank.

Moreover, India's urban growth is largely concentrated in large cities with a population of 100,000 or more. Three of India's cities are among the top most populous in the world – Delhi (25 million) ranking in the top five, followed by Mumbai and Kolkata. As a result, the number of cities with a population exceeding 1 million has increased from 35 in 2001 to 53 in 2011, and is expected to be 87 by 2030. Conversely, population growth in smaller towns and cities (of below 100,000 people) has tended to stagnate and even decline — with the share of the population in towns decreasing from 31% in 2001 to 28%.

Growing stress. Such high concentration of people in Indian cities pose many challenges to municipalities and local authorities, among them mass migration, environmental and regulatory requirements, declining tax bases and budgets and increased costs — at the same time many cities are experiencing difficult growing pains ranging from increasing pollution, traffic congestion, poor healthcare, insufficient water and sanitation systems, crowding and sprawl to inadequate housing, high unemployment, and rising crime rates and security issues.

Inadequate infrastructure. Urbanisation is putting significant strain on city infrastructures that were, in most cases, built for populations a fraction of their current size. Much of the developed world has infrastructure that is near or past its design life, requiring massive upgrades. For instance, in 2013 the American Society of Civil Engineers gave the United States an overall grade of D+ for its infrastructure. Meanwhile, much of the developing world has missing or inadequate infrastructure, requiring massive build-outs. The 2012 blackout in India that left more than 600 million people without electricity is a prime example; the country has inadequate power generation to meet ever-increasing demand. The bottom line? McKinsey & Company estimates that cities will need to double their capital investment by 2025, to $20 trillion from today's $10 trillion per year.

Growing economic competition. India is facing a dual problem; in search of better employment opportunities and quality of life, there are two growing trends — mass migration to large Indian cities as well as the best talent leaving the country. This leads to severe competition between cities to secure investments, jobs, businesses and talent for economic success. Increasingly, both businesses and individuals evaluate a city's 'technology quotient' in deciding where to locate. A real challenge for cities with economies based on heavy industry is creating job opportunities that appeal to recent university graduates so that they will stay and help build the kind of high-quality workforce that new industries, for instance those in technology, demand.

Growing expectations. Citizens are increasingly getting instant, anywhere, anytime, personalised access to information and services via mobile devices and computers. And they increasingly expect the same kind of access to city services. In fact, a May 2013 United Nations survey of over 560,000 citizens from 194 countries revealed that their top priorities are a good education, better healthcare and an honest and responsive government. We also know that people want to live in cities that can provide efficient transportation, high-bandwidth communications and healthy job markets.

Rapidly improving technology capabilities:

The reduced costs of solar energy and renewables systems (distributed generation) are increasing adoption rapidly in homes and businesses. By balancing these new resources with the grid, cities can increase their energy sustainability.

Hundreds of millions of smart meters and smart sensors are now in place, producing data of value to a smart city.

• With the arrival of smart thermostats and building management systems, there are now millions of buildings with some of the pieces needed to be smart, on the cusp of being able to 'talk' and 'listen.'

• The reduced costs of solar energy and re-newables systems (distributed generation) are increasing adoption rapidly in homes and businesses. By balancing these new resources with the grid, cities can increase their energy sustainability.

• On the health and human services front, we're seeing better access to healthcare with in-home consultations via computers. Meanwhile, most agencies are switching to electronic records and many are using analytics to improve results.

• An increasing number of cities are starting to benefit from a large network of Near-field Communication (NFC) equipped point of sales with the rollout of contactless cards.

Growing environmental challenges. Cities house half of the world's population but use two-thirds of the world's energy and generate three-fourths of the world's CO2 emissions. If we are going to mitigate climate change, it will have to happen in cities. Many regions and cities have aggressive climate and environmental goals — goals that cannot be reached without the help of smart technologies. Smart cities are better able to address resiliency and adaptation to climate change.

Rapidly improving technology capabilities. Many of the smart city drivers listed above are negatives — problems that demand solutions. There are positive drivers as well, especially the rapid progress in technology. The costs of collecting, communicating and crunching data have plunged. What's more, much of the needed technology is already in place:

• Over the last decade, many regions have begun to modernise their electric power grids and their water and gas networks.