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Sustainability

## Rise of the Intelligent City

By Bruno Berthon and Philippe Guittat

As the world becomes more and more urbanized, the successful city of the future will need to aggressively pursue two goals: managing resources from a sustainable perspective and creating an attractive economic and social environment in which citizens, companies and governments can live, work and interact.

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A century ago, only about one in seven people in the world lived in a city. Today, half the population does, and that percentage is growing steadily every year. And as more and more people migrate to major urban centers, the influence of cities—their technologies, businesses, forms of government, resource consumption, the quality of life they enable and much more—rises significantly.

With their potential for personal and professional opportunity, creativity, economic stimulation and high productivity, large concentrations of people can have a positive influence on humanity. At the same time, however, massive urbanization also poses risks to the planet in the form of overcrowding, excessive carbon emissions and waste, and high rates of consumption of non-renewable resources. Thus, cities—municipal governments as well as the businesses and inhabitants that drive much of a city's economic growth—bear great responsibility for the effective stewardship of people and the environment.

This need to manage resources from a sustainable perspective coincides with another important goal: the need to create an attractive economic and social environment in which citizens, companies and governments live, work and interact.

Cities actually compete for citizens and enterprises, much as businesses compete for customers. What becomes increasingly important, then, is the overall attractiveness of a particular city and the experience it provides to citizens and businesses, as manifested in a wide range of important characteristics: the value of its services and the stability of its government, its economic and employment opportunities, its schools, the quality of its physical environment, its cultural and artistic resources, its institutions

of higher learning and other adult educational opportunities, its housing, its safety, its community involvement, and its openness and diversity.

These dual goals—encouraging environmental stewardship while also increasing economic and social attractiveness—are at the heart of an “Intelligent City.” And if your organization does business within or with a city—and yours probably does—you have a vested interest in helping cities become more intelligent and, thus, more successful.

### **More than technology**

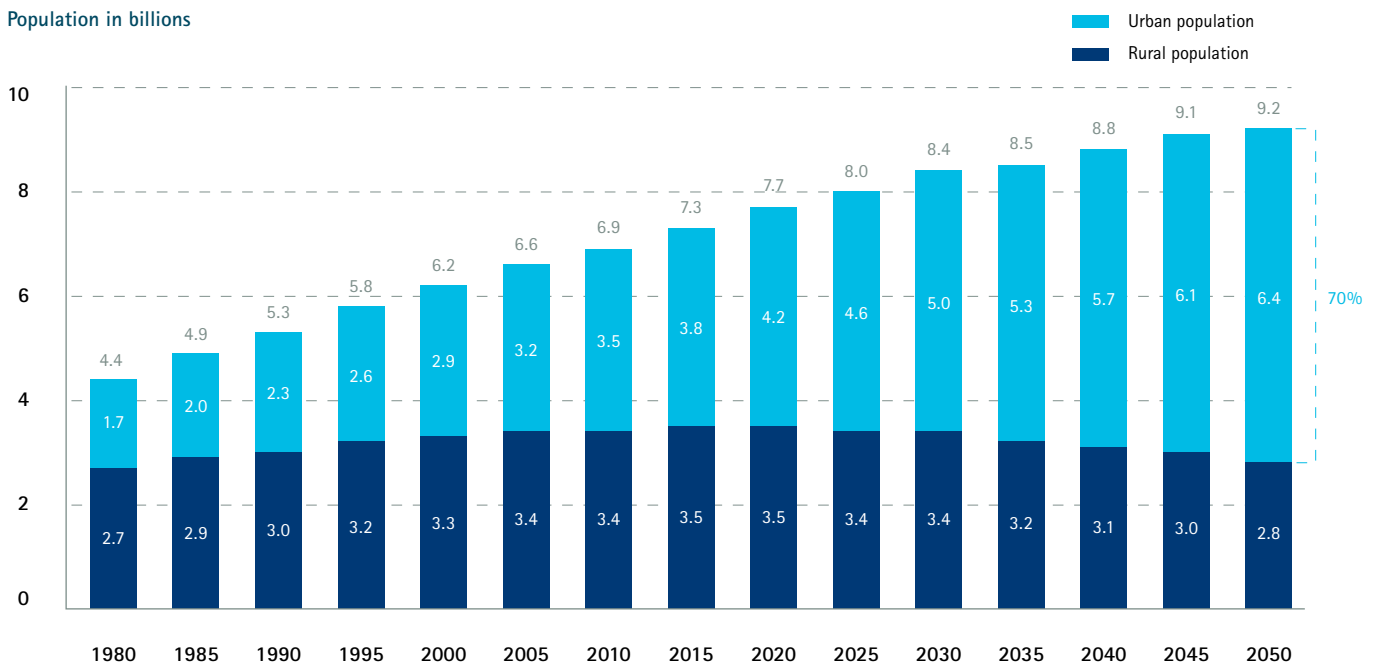
For a city, what does “intelligence” mean? One critical dimension is that cities increasingly deliver services that use so-called smart technologies, which can embed intelligence in a city's infrastructure to extend the effectiveness of services at a lower cost.

This kind of capability can now stretch across a city's services, from monitoring power generation and optimizing electricity and water usage to setting up open or gate-less tolling on urban roadways. In addition to these kinds of “machine-to-machine” capabilities enabled by telematics and RFID tags, other important technologies include smart grids to encourage better energy production and delivery; intelligent software and services; and high-speed communications networks connecting all related city, citizen and business services. These are all parts of a city's overall technology environment, something Accenture calls an “intelligent infrastructure.”

Yet at the same time, cities face difficult challenges in harnessing and integrating these technologies. They struggle with legacy systems that often hamper their integration efforts. Systems are commonly based on proprietary, closed infrastructures

## Urban tide

Just over 50 percent of the world's population currently lives in megacities and other urban areas. By 2050, according to United Nations projections, that number is expected to rise to 70 percent, increasing the urgency of making cities more intelligent, sustainable, attractive and livable.



Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects: The 2006 Revision and World Urbanization Prospects: The 2007 Revision, <http://esa.un.org/unup>

and technologies. Over time, information systems take on lives of their own and become costly to maintain; those within one city department cannot be easily integrated with those from other departments. The negative impact of this fragmentation can be felt in excess costs, diminished services and an infrastructure that is not agile enough to adapt to the needs of the future.

However, a technology-centric perspective alone will not make a city both sustainable and attractive. The integration challenge involves more than just the technologies; it includes the entire suite of city services and capabilities, including natural resource management, transportation, office and residential buildings, health and safety, waste management, education, culture, tourism and public administration.

In other words, the need for integration extends to everything that ultimately makes a city worth living in. Critically, this includes the organizational structure of the city and the way it is planned and managed. Leading cities around the world are actively pursuing innovations in bringing more intelligence to the suite of city services (see sidebar, opposite). But the real pioneers are doing more than just one-off initiatives; they are trying to coordinate technologies, services and management more effectively, in a more open environment.

### Carbon neutrality

To better understand both the benefits and challenges of becoming an Intelligent City, consider one pioneer: Amsterdam. The city is in the midst of an ambitious initiative to develop and implement sustainable

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and cost-effective programs to help it reduce its carbon footprint while also making it a more attractive place to live and work.

The program has three primary environmental objectives: achieving a 40 percent reduction in CO<sub>2</sub> emissions by 2025 compared with the 1990 baseline; getting 20 percent of its energy from renewable sources by 2025; and reaching carbon neutrality by 2015.

Accomplishing these objectives involves bringing together various technologies and approaches that include smart meters, electric vehicles and intelligent building design. These can promote energy efficiency in transportation, and in the construction and management of residential, commercial and government buildings. Underlying it all is a smart grid, which interconnects electricity networks with information and communications technologies, ultimately providing electricity more reliably, safely and affordably, with reduced carbon emissions.

By carefully approaching the work in phases, Amsterdam has been able to scale the program gradually, using the lessons learned during each stage or pilot project to inform subsequent efforts.

The city began with a two-year program to be implemented in three phases. The first of its smart grids, launched in 2009, included smart meter installations along with an innovative project called Climate Street—an area within Amsterdam's popular Utrechtsestraat shopping and dining area that features sustainable waste collection, highly efficient streetlights and tram stops that generate energy rather than only consuming it. City managers have been able to monitor energy consumption on Climate Street through the use of smart meters

and then share their findings with business owners.

One of the challenges faced by Amsterdam and cities pursuing similar initiatives is in integrating the various service domains across city departments, including energy, water, transportation and buildings. Enabling technology capabilities across city departments is also essential; this integration includes communications and data, sensing and control, and customer-facing hardware and applications.

These technology capabilities are a critical dimension of making a city intelligent. They allow it to maximize carbon reduction and support better coordination with other parts of city government overseeing employment, investments and tourism.

As cities like Amsterdam work to create the next generation of Intelligent City solutions, a more open approach to technology and management will be essential. The proper design, operations and management of an Intelligent City encompass not only technology but strategy, people and processes as well.

One of the most important characteristics of a truly Intelligent City is an interoperable and scalable platform, one based on non-proprietary code and interfaces. This infrastructure leverages open technologies and architectures, which means that interfaces can be readily created and maintained across all of a city's service domains.

The platform aggregates all necessary services in one smart system. This means that different areas and services of a city that need to tap into common capabilities can interact more effectively through a central hub.

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## Sustainable and attractive

Smart technologies and more environmentally conscious planning are resulting in a growing number of innovations in today's leading cities to increase their sustainability and attractiveness (see story). These innovations extend across the range of intelligent city services. Here are just a few examples.

### Housing and office buildings

To reduce the negative environmental impacts of construction and building operations, some cities are using building retrofits and certifications that can reduce energy and water use; they are also using smart metering and smart building technologies to help optimize consumption.

Chicago, for example, aims to retrofit 400,000 residential homes—that is, make the buildings more energy efficient by installing new lighting, replacing old windows and using other methods to reduce the overall carbon footprint—by 2020. Between 2004 and 2008, the Windy City saved \$6 million on energy costs because of office space retrofitting. Another aspect of smart buildings involves optimizing energy and water consumption for the people and businesses occupying the buildings. Cities such as Amsterdam, Sydney and Chicago have been testing advanced smart meters that give customers real-time information about how much energy they are using and what that usage costs.

Building codes, standards and certifications are other important aspects of creating smarter buildings. Many cities are mandating higher efficiency codes and standards for new construction and renovations. By 2030, for example, Seoul aims to require green building certificates for all new buildings. Singapore's goal is to have 80 percent of its existing buildings achieve a BCA Green Mark certification rating from the government's Building and Construction Authority by 2030.

### Natural resources management

In terms of the basic supply of natural resources, many cities are working to reduce the carbon intensity of the energy provided to their citizens and to improve the reliability and efficiency of their supply and delivery networks.

Traditional power plants are only 33 percent efficient; two-thirds of natural resources burned to produce electricity (mostly natural gas and coal) are lost in production, transmission and distribution. By developing the capacity for more decentralized generation, cities can significantly reduce energy losses. For example, the City of Sydney plans to establish a network of distributed generators that, by 2030, would produce 70 percent of the city's electricity supply by trigeneration, which is the process of converting natural and waste gas into electricity, heating and cooling.

More reliance on renewable energy—especially hydropower and wind power—is also an important part of the mix. By 2010, more than 100 countries had set targets for renewable energy, up from just 55 in 2005. Some of the more recent targets are in the range of 15 percent to 25 percent renewables by 2020, but some areas are already ahead of those goals. In São Paulo, for example, 56 percent of the state's energy consumption comes from renewables.

### Health and safety

Innovative information and communications technologies are transforming the ability of cities to provide remote healthcare to citizens, especially the elderly and other homebound residents. In Taiwan, for example, the government's Telehealth Pilot Project is exploring the benefits of providing telecare services, particularly to members of Taiwan's increasingly aging population. The project relies on the digital transmission of medical data collected from patients in community health centers, private homes and nursing homes.

New technologies are also a part of the project. Some patients are provided with a device that measures both blood pressure and blood glucose, along with a television set-top box that functions as a computer capable of uploading the test results to the Telecare Service Center. Registered nurses at the center then analyze those results and recommend additional care. One of the benefits of the program is that patients don't have to leave their neighborhoods—sometimes not even their homes—to get basic healthcare.

### Education and culture

This aspect of an Intelligent City refers to both public and private education systems, especially as enabled by new technologies. Also included are a city's cultural and recreational amenities, such as music, theater, sports and other leisure activities, and tourism. An equally important aspect of education in the context of an Intelligent City, however, is the need to engage citizens through education in how behavior change can improve a city's overall sustainability and environmental health.

Several cities are leading the way in how they educate and engage their citizens in sustainability goals. Melbourne, for instance, established frameworks and models by which the federal, state and local governments cooperatively work with the local community to address sustainability challenges. Based on this program, Melbourne was one of three cities to receive an honorable mention from the 2010 Lee Kuan Yew World City Prize—a biennial international award to recognize individuals and organizations that have made outstanding contributions to the creation of vibrant, livable and sustainable urban communities around the world.

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Consider how that interoperability helps deliver more effective smart traffic management solutions. Open tolling is currently being adapted by several leading cities as a way to control traffic more effectively. Sensors can help reduce traffic congestion (which reduces carbon emissions in the bargain) and generate additional revenues through congestion-based pricing.

For example, Stockholm and London have created special zones where they collect an additional fee from vehicles entering the congested city center. Singapore has gone one step further and launched a program for dynamic road pricing that adjusts the fees for road usage at different periods in the day in real time.

But to be effective, these traffic management programs have to coordinate with areas like urban logistics, mass transit and emergency services. Vehicles have to be equipped with technologies that integrate them into a smart grid. This is where the open platform comes in.

The platform also enhances the ability to add new services quickly, or to scale existing ones. Flexible, open interfaces facilitate data exchange and enable new contributions and services to be leveraged as applications on the platform.

For example, within the European Union, a number of private- and public-sector organizations are collaborating on an initiative called Cooperative Vehicle-Infrastructure Systems.

The goal of CVIS is to develop technologies that allow vehicles to communicate with roadside infrastructure and other vehicles, and to share data about traffic sta-

tus and road conditions. Elsewhere, the project is working on a market-ready, open platform on which additional applications can be installed as necessary—much as a smartphone easily accommodates additional applications.

The open platform also enables city services to be delivered in a leaner fashion. It can deliver infrastructure capabilities as a service, ready and adaptable to a city's unique needs, by integrating all relevant services in a single, Internet-enabled utility. This reduces the costs of city services not only by reducing the initial investment but also by lowering the operating and maintenance costs through usage-based charging.

Bottom line: This open, intelligent infrastructure can support the design and implementation of solutions that can be built faster and operated more efficiently, at lower cost, than those built on closed or proprietary architectures.

Smart technologies can be truly effective only if they are developed and implemented in a coordinated fashion across a nation or region. This fact is emphasized by Marie Donnelly, director of new and renewable sources of energy and energy efficiency innovation for the European Commission. Donnelly's organization is planning and executing programs such as the Smart Cities and Communities Initiative and Intelligent Energy-Europe, which seek to achieve "20-20-20" targets: 20 percent reductions in greenhouse gases, 20 percent improvements in energy efficiency and a 20 percent increase in the use of renewable energy sources.

The proper analysis of energy management flows and processes is critical to any technology design, says Donnelly: "That kind of

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# How to become an Intelligent City

The following are especially important factors to be considered while plotting a course toward becoming an Intelligent City.

## **Encourage and develop new forms of leadership and governance structures**

City and business leaders should be vigorous in embracing and championing the Intelligent City concept, highlighting challenges and successes in their communications with citizens and customers. City leaders need the confidence and support of business partners; in turn, businesses need the support of city leaders.

## **Align and engage all relevant stakeholders**

To successfully implement the Intelligent City vision, municipal leaders should work to align the interests and goals of each sector of the community—city agencies, private-sector partners and citizens. Yokohama's citizen engagement program, for example, is a best practice for how cities can create citizens who don't just passively comply with environmental regulations but actively seek to change their behaviors to pursue a shared goal that benefits the entire community.

## **Assemble the capabilities to drive an open, intelligent infrastructure**

City chief information officers should now begin exploring the technologies and concepts at the heart of open, intelligent infrastructures. Conferences and targeted conversations with technology vendors and integrators involved in implementing aspects of an Intelligent City can help lay a foundation of knowledge and experience that makes it easier to advance specific Intelligent City initiatives.

Pilots of initiatives—projects with a limited scope and controlled risks in a specific service domain such as transportation or energy management—can advance the development of intelligent infrastructures, enabling cities to learn from one another's experiences.

## **Create financial models that are up to the challenges and opportunities ahead**

Standard models for financing infrastructure investments are usually inadequate to the challenges of creating an Intelligent City, so new models and approaches are necessary. For example, savings-based models—using savings from maturing technologies such as smart meters—can fund other technology research and development along different parts of the intelligent infrastructure.

In most cases, public-private partnerships will need to fund the required infrastructure investments that will revitalize a city. For example, from 1990 to 2009, more than 1,400 public-private partnerships, representing roughly \$350 billion in capital, have been established across the European Union in support of the goals of Intelligent Cities.

Cities can be the catalyst for bringing together the public and private sectors to embrace new business and operating models, as well as better partnership models. Such an approach requires moving away from isolated initiatives executed by individual players to a coordinated effort among all public- and private-sector players. Strong coordination can align interests and balance risk-sharing among all parties.

Cities are increasingly banding together to leverage their collective influence, in their common belief that they are key to solving the world's carbon emissions challenges.

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analysis, encompassing energy flows across geographical areas, has generally not been done, but it is absolutely essential. If you don't have the energy management flow documented and then take control of that to identify synergies and optimize flows, it is much more difficult to achieve concrete goals."

#### **Sufficiently interconnected**

One of the issues Europe faces, for example, is its local energy grid system. Many centers of population are literally in the center of countries. By contrast, more renewable forms of energy—solar, or onshore or offshore wind—are often generated at the periphery. "So," notes Donnelly, "the grid itself and our processes need to be robust enough to make energy available where it is needed. We need to be sufficiently interconnected so that we can move energy around the European Union, efficiently and effectively."

Cities themselves are also increasingly banding together to leverage their collective influence. For example, in preparation for the 16th edition of the Conference of the Parties of the United Nations Framework Convention on Climate Change (COP 16) in Cancun in 2010, the C40—a group of 40 large cities around the world—united to claim a seat at the climate negotiations table based on their common belief that they are key to solving the world's carbon emissions challenges.

A critical benefit of the open platform is its ability to bring different public- and private-sector partners together for more effective collaboration and innovation. That collaboration is essential for advancing the goals of an Intelligent City.

#### **Covenantal approach**

One of the collaborative programs Donnelly is helping to drive, for

example, is called the Covenant of Mayors—a pledging system in which mayors agree to reduce carbon dioxide emissions in their own area by at least 20 percent by 2020. According to Donnelly, "This idea of a covenantal approach has taken off in an incredible way across Europe. We now have nearly 2,500 mayors who have signed on to these sustainability goals."

A related program, called CONCERTO, is now focusing on approximately 60 communities in Europe that are looking to implement intelligent-infrastructure solutions for better energy efficiency in building design, energy production from renewables and related areas. These communities are piloting various kinds of renewable energy programs, enabling others to learn from their experiences. The Smart Cities and Communities Initiative will scale up these efforts to the city level and apart from energy, it will include transport and ICT issues to encourage cities to adopt a comprehensive and innovative approach to city planning.

"This approach," says Donnelly, "really underscores the fact that developing and deploying new technologies to create both a more sustainable and attractive environment cannot be looked at in the abstract. It needs to bring experts together to learn from each other, and it needs to respond to the needs of both citizens and business. If you can do that, you can build a real groundswell of enthusiasm."

Another critical aspect of building and managing an Intelligent City is using the more open nature of the infrastructure to communicate and educate citizens—nurturing what Masato Nobutoki, director general of the Climate Change Policy Headquarters for the City of Yokohama, calls the "social system" of environmental change.

What is necessary, says Nobutoki, is to do more than just get the infrastructure ready; you have to also get the people ready.

Yokohama has been notably successful in understanding the critical role of education in executing recycling and waste reduction initiatives. In 2003, the city launched what it called its G30 Plan—"G" for *gomi*, which means "waste" in Japanese—with the goal of reducing combustible waste (which is processed separately from non-combustible waste in Japan) by 30 percent by 2010. The program was so successful that the city achieved its goal five years ahead of schedule.

Building on the success of G30, in 2008 the city launched the CO-DO30 initiative, a collection of ambitious citizen environmental education programs to reduce greenhouse gas emissions per capita by more than 30 percent by 2025. The name CO-DO30 was a natural fit with the G30 Plan—and program leads have seized on the fact that CO-DO30 plays on the Japanese word *codo*, which means "action." The word symbolizes the city's commitment to act on carbon reduction and become an "environmental action city."

Program leads also noted the phonetic similarities between *codo* and the English word *code*, which suggests "guideline." So in communications, they frequently stress that the real intent of the program is to take people from "code" to "mode." In other words, what the city really seeks from its citizens is not just a passive adherence to

guidelines and rules but an active agreement to change their modes of behavior.

"We would like to create a situation in our city," Nobutoki says, "in which the citizens gladly work to reduce their CO<sub>2</sub> emissions rather than simply being bound by the code's regulations."

Another part of the city's education campaign has been the Kids' Energy Conservation Challenge, a summer vacation program that encourages elementary school children to think creatively about becoming better stewards of the environment. Last year, 32,000 out of Yokohama's 120,000 school children between grades three and six enrolled in the program (fully 25 percent of the target group). Another initiative, Yokohama Eco School, or YES, enrolled an additional 32,000 students; more than 81 non-governmental organizations participated, teaching energy awareness and a greater understanding of the risks posed by climate change.

Yokohama's secret to success? Strong leadership and a commitment to spend time with citizens. Nobutoki notes that "people from our local government went to more than 11,000 meetings with citizen groups to explain the initiative and personally ask people to commit to the recycling program." In recognition of the success of this program, Yokohama was selected in 2010 for The World Bank's Ecological Cities as Economic Cities (Eco<sup>2</sup> Cities) initiative, which honors cities that are both ecologically and economically sound.

The Intelligent City is distinct from others by being both sustainable and attractive. Its environmental programs are driven by more than a moral obligation. Sustainability is important for its positive social consequences but also because it is a key factor in creating a livable environment—one conducive to the health and prosperity of a city and its citizens and businesses.

Every city is different and, therefore, there is no one "correct" way to go about developing the suite of capabilities necessary to become an Intelligent

City. One common way to begin, however, is to establish a starting point, based on the city's unique geographic, economic and political situation. From there, the city can assess different scenarios based on their projected costs, impacts and trade-offs of various programs, and begin to plan the technology, strategy, process, training, governance and management aspects of a development program.

Given the influence of cities on the health of the planet, the Intelligent City agenda is important for all citizens, regardless of where they live. If cities are to take focused, cost-effective actions to embed intelligence in all their services, they should work to put in place the right kind of foundation—an open, intelligent architecture capable of delivering smart services now and then scaling as the city's needs grow.

## About the authors

**Bruno Berthon** is the global managing director of Accenture Sustainability Services. He has worked with multinational companies across several industries, including consumer goods, retail, telecommunications and media, on their transformation agenda. During the last 16 years, Mr. Berthon has specialized in helping organizations address the challenges of globalization, large-scale operating model change, innovation and sustainability. Mr. Berthon is based in Paris.

bruno.berthon@accenture.com

**Philippe Guittat** is the global managing director for Accenture's Infrastructure and Transportation industry groups, responsible for creating value for clients across a variety of geographies and industries, including land and public transport, passenger rail transport and construction. Mr. Guittat also leads the company's work in implementing e-ticketing transformation programs for public transportation. A member of the company's senior leadership team, he has served as a key innovator of Accenture's High Performance Business in the transportation and automotive industries. Mr. Guittat, who is based in Paris, has held several technology leadership positions.

philippe.guittat@accenture.com

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