Building Livable Cities
— Emerging Worldwide Concept of Smart Cities —

The smart city concept is emerging as a new approach to urban development around the world. This movement aims to make cities easier to live in by utilizing IT to achieve efficient use of core public infrastructures, such as those for energy, transportation, and water, and to minimize their impact on the environment. 2011 saw a series of major natural disasters, with flooding in the Kingdom of Thailand as well as the Great East Japan Earthquake and other large earthquakes in New Zealand and the Republic of Turkey. Smart cities are also attracting attention because they show what forms could be taken by the new urban communities that will result from reconstruction. Meanwhile, as a nation that has honed its problem solving capabilities by overcoming challenges such as pollution, urban overcrowding, and oil shocks, Japan has a major role to play in making smart cities a reality. This article describes how Hitachi is applying its comprehensive strengths to take up this challenge and participate in the planning of smart city concepts around the world.

▌ Beginning of Aftermath

The Great East Japan Earthquake that struck in March 2011 has had a major influence on people's thinking about sustainable societies. This impact has extended well beyond Japan, and people around the world are using the lessons from the earthquake as a basis for rethinking things like energy policy, the nature of corporate activity, and the forms taken by the towns in which people live.

To support recovery work, Hitachi has, since immediately after the earthquake, been working on a wide range of proposals for forthcoming reconstruction based on the views of people from the affected areas. In October 2011, Hitachi held a private reconstruction support event in the Tohoku region where the disaster occurred. Yutaka Saito, Senior Vice President and Executive Officer, President & CEO, Infrastructure Systems Group and Infrastructure Systems Company, Hitachi, Ltd., who attended the event, recalls what the local residents who were present had to say, making the comment that he was "moved to hear their desire to draw on experience from the disaster and bring their towns back to life as safer and more prosperous places to live." Speaking from the perspective of someone engaging in managing Hitachi's public infrastructure business, he commented on how this reinforced the importance of building towns that are resilient to disaster.

"In other parts of the world, meanwhile, many emerging economies, while experiencing rapid economic growth, are also facing numerous urban problems associated with population increase. While it is fair to say that these problems are piling up, when you think about it, Japan also suffered from things like pollution and urban overcrowding, and experienced the pain of being a resource-poor country during the oil shocks. Despite this, Japan can also be thought of as a country that faced up to these problems from an early stage and overcame them."

With the construction of infrastructure proceeding at a rapid pace in many parts of the world, this has reinforced the view that

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Japan's accumulated problem solving capabilities should start being put to use.

▌ New Forms of Cities

Along with climate change in the form of global warming, growth in population and its increasing concentration in cities are recognized as global issues.

The world's population passed seven billion in 2011. According to United Nations forecasts, it will reach nine billion by 2050. This growth is particularly evident in urban populations, with an estimated 70% of the global population expected to live in cities by 2050.

The most pressing issue accompanying population increase is likely to be energy. Greater consumption of fossil fuels leads to increased greenhouse gas emissions. Inadequate energy supplies will impede things like obtaining water and increasing food production. There are particular concerns for the future of emerging economies experiencing rapid economic growth, as the concentration of populations in cities without provision of the required infrastructure will exacerbate shortages of electric power, water, and other services. Potential solutions include improvements to the efficiency of power generation, use of renewable energy, adoption of machinery and other equipment that have a reduced impact on the environment, and the promotion of resource recycling.

In addition to these standalone measures, there are also moves toward utilizing information technology (IT) to make city services flexible and sustainable. This is what is meant by a "smart city." This new type of city is also attracting attention as a solution to urban problems, not only in emerging economies, but also in developed economies that face issues such as rapidly aging populations and the obsolescence of existing infrastructure.

▌ Well-balanced Relationships

Demonstrations aimed at turning smart cities into reality have been getting underway in various parts of the world in recent years, and Hitachi has been involved in a variety of different projects.

Yutaka Saito uses the following words to explain the type of smart cities that Hitachi aims to create.

"The cities of emerging economies, where the concentration

of population is accelerating, tend to face a multitude of issues, including not only those associated with energy and resources, but also inadequate healthcare and education along with environmental degradation due to chronic traffic congestion, exhaust gas emissions, water pollution, and refuse. We respond to these issues by using IT to coordinate various different types of infrastructure, and minimize the impact on the environment by making effective use of resources. This is the aspect we refer to by the term 'eco'."

Meanwhile, the benefits experienced by the people who live in these cities have not been forgotten.

"In contrast, we use the term 'experience' to refer to those things people experience like comfort, safety, convenience, or enjoyment. Our aim is to create smart cities that provide a 'well-balanced relationship' between these 'eco' and 'experience' perspectives."

In other words, this can be thought of as a truly sustainable society that satisfies both economic and environmental considerations. Behind these words lie Hitachi's track records in the construction of the various different types of infrastructure required by cities.

Evolution in Symbiosis

In terms of public infrastructure such as energy, transportation, and water, Hitachi is putting forward a distinctive vision of how smart cities should be established. Common features in this vision are consideration of the aspects of "supply," "demand," and "storage," and a core model that involves using IT to make these operate in harmony.
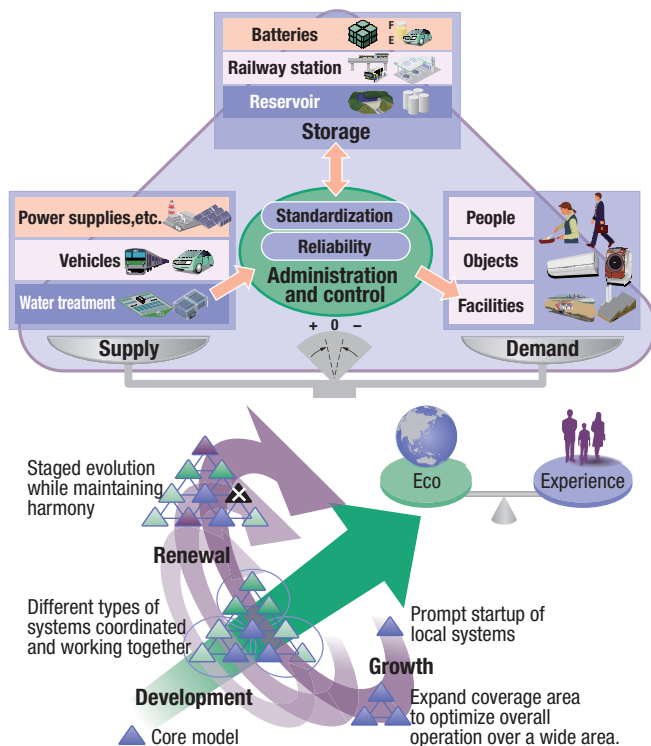
The core model, which involves "supply," "demand," and "storage" along with the use of IT for their administration and control, will evolve along with the processes of urban growth, development, and renewal.

In a particular city, the processes of growth, development, and renewal will repeat in accordance with the relevant stage. Advances in the next generation of public infrastructure will take place in a way that coordinates the operation of different systems, and it will be built to be sustainable. Systems based on this "symbiosis autonomous decentralized" concept will have the scalability to keep up with ever-evolving cities so that, even if the city experiences a major disaster, for example, the infrastructure can continue to function autonomously and with flexibility.

Consumer Perspectives

Cities also have service infrastructures such as healthcare, education, administration, and finance. These include the facilities in which machinery and other equipment are located as well as the services they provide, and can be thought of as encompassing the entirety of services to consumers. In the past, the more a service was dependent on its facilities, the more its provision was tied to a particular place. Hitachi aims to make these services smarter by considering them separately to their machinery, equipment, and other facilities and looking at them afresh in terms of the underlying needs of consumers.

"Take medicine and healthcare, for example. This field can be split into three phases: 'prevention,' 'diagnosis and treatment,' and 'rehabilitation and nursing.' Each of these phases is tightly tied to its associated facilities, such as clinics, hospitals, and day service centers, which makes coordination between them difficult to implement. However, by taking a fresh look from the perspectives of individual patients (consumers), it is possible to transform medicine and healthcare into an integrated service that manages patient data centrally and coordinates activities across the different phases."

This could give patients a feeling similar to having their own trusted personal physician who is always there to look after them, ready to provide care whenever the situation demands.
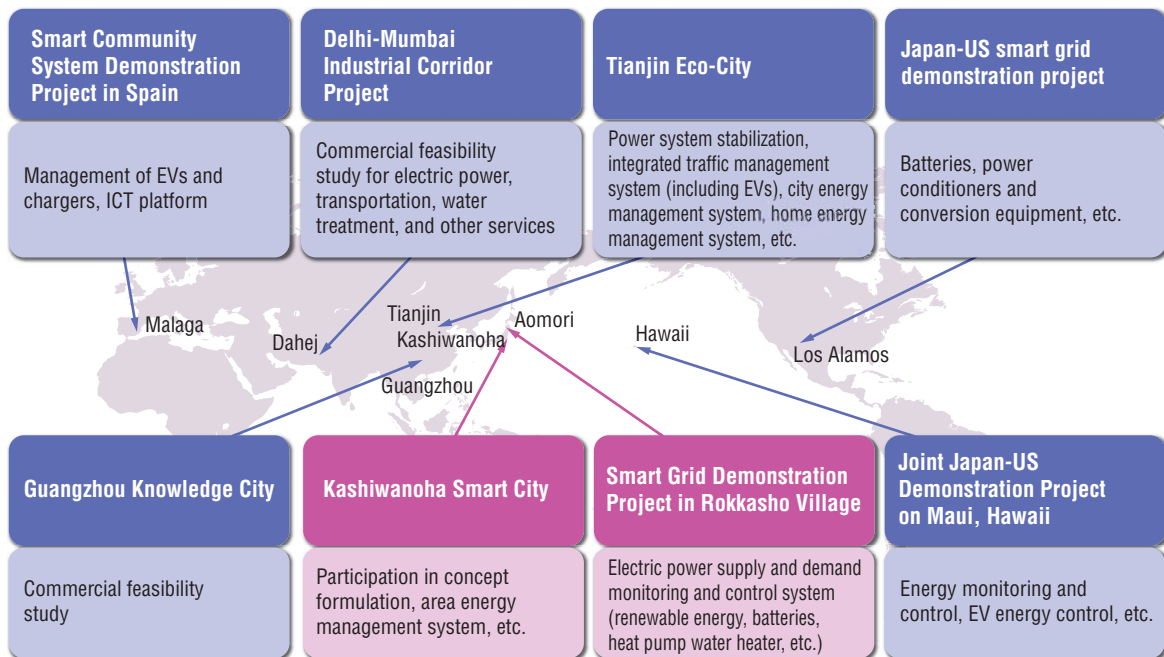
Understanding Distinctive Cultures

Hitachi defines "urban management infrastructures" as those mechanisms that link public and service infrastructures together. The deepening and integration of these three different types of infrastructure lead to the creation of smart cities. This requires the participation and interaction of the government, residents, businesses, and other entities that make up a city, along with working through consortiums formed out of industry-government-academia partnerships that possess various different capabilities and know-how.

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Smart Community System Demonstration Project in Spain	Delhi-Mumbai Industrial Corridor Project	Tianjin Eco-City	Japan-US smart grid demonstration project
Management of EVs and chargers, ICT platform	Commercial feasibility study for electric power, transportation, water treatment, and other services	Power system stabilization, integrated traffic management system (including EVs), city energy management system, home energy management system, etc.	Batteries, power conditioners and conversion equipment, etc.

Malaga Dahej Tianjin Kashiwanoha Aomori Hawaii Los Alamos Guangzhou

Guangzhou Knowledge City	Kashiwanoha Smart City	Smart Grid Demonstration Project in Rokkasho Village	Joint Japan-US Demonstration Project on Maui, Hawaii
Commercial feasibility study	Participation in concept formulation, area energy management system, etc.	Electric power supply and demand monitoring and control system (renewable energy, batteries, heat pump water heater, etc.)	Energy monitoring and control, EV energy control, etc.

ICT: information and communication technology
Major projects in which Hitachi is involved. This requires an adequate understanding of the distinctive culture of each location.

Ltd., who has a leadership role at the forefront of Hitachi's smart city business, had the following to say on this topic.

"Each of the world's cities has its own distinctive culture and its own set of needs and priorities. The construction of smart cities needs to proceed in a way that takes account of these city characteristics. We have a practical involvement in many different areas in a variety of urban situations, and we are an active participant in consortiums engaged in demonstrating smart city concepts in Japan and elsewhere so that we can feed this experience back into our technology and development."

The following sections look at some typical examples of demonstrations in which Hitachi is involved.

Smart Grid Demonstration Project in Rokkasho Village

A smart grid is a system for balancing supply and demand through coordinated management and control of the supply and demand for electric power, using IT to link together equipment from generation to load.

Hitachi is part of the Smart Grid Demonstration Project in Rokkasho Village, Aomori Prefecture, Japan, which seeks to create a town with zero emissions and satisfy the energy requirements of the project area using only renewable energy from wind and sunlight to generate power.

Weather-dependent energy sources such as wind and photovoltaic power need to be buffered using batteries or other devices. Hitachi is responsible for the electric power control center that manages energy across the project area in a way that makes it self-sufficient, performing overall management and control of the photovoltaic power generation, batteries, and water heaters.

Rokkasho Village has a closed grid based on renewable energy (a power distribution network independent of the main grid).

EV Charging Management Solution for Okinawa Island in Japan

Advanced Energy Company (AEC), which was established with investment by 26 companies from Okinawa Prefecture and elsewhere, is working on a plan to install fast and medium-speed chargers for electric vehicles (EVs) in Okinawa. The project is particularly suited to a tourist destination like Okinawa. While it initially involves adopting EVs for use as tourist rental cars, it also aims to expand use of EVs throughout Okinawa in the future as ex-rental EVs are passed on to the second-hand car market. The project has adopted an EV charger management solution from Hitachi.

User authentication, billing, and payments are handled through kiosks equipped with touch panels, which are installed at the charging facilities located around Okinawa Island.

AEC plans to have chargers installed at 100 sites in the future, and Hitachi's system based on cloud computing is contributing to efficient operation and future expansion through functions such as a remote monitoring service, and by making it easy to update the system.

Use of rental cars to encourage wider adoption of EVs throughout Okinawa Island. The features of the EV charging management solution include centralized processing and remote monitoring of multiple user kiosks.

Kashiwanoha Smart City in Japan

Work has started on Kashiwanoha Smart City, an urban development project in harmony with the environment. The project is based in a new railway station precinct built in Kashiwa City, Chiba Prefecture, and involves the local government, university, and real estate companies in cooperation with local residents and others. Hitachi is part of the joint venture that is undertaking the project.

The work at Kashiwanoha Smart City includes installing an area energy management system, which raises consumer awareness by "making visible" energy usage across the entire community. In the future, the plan is to establish systems that can operate autonomously and optimize the town's overall energy consumption based on energy demand forecasts.

Leading companies from a number of different sectors are part of the joint venture behind the Kashiwanoha Smart City project.

Water and Sewage Business in Republic of Maldives

Hitachi supplies equipment for water distribution and sewage treatment, seawater desalination, and industrial wastewater treatment and recycling systems. Its current activities are based on a philosophy of performing integrated management of these water treatment systems at a high level to make effective use of water resources for an entire region and protect the water environment.

Hitachi Plant Technologies, Ltd. has taken a stake in the local water supply and sewage company in the Republic of Maldives, and operates a broad-based water business covering everything from planning through to construction, maintenance, and billing. It also supplies water treatment and information and control systems.

Male Island in the Republic of Maldives in the Indian Ocean. Hitachi operates water supply and sewage services on Male and six other islands.

Japan-US Demonstration Project on Maui, Hawaii

Hitachi has been selected to manage experimental research as part of the Japan-US Demonstration Project in Hawaii for World-leading Smart Grids for Islands run by the New Energy and Industrial Technology Development Organization (NEDO) based on the Japan-U.S. Clean Energy Technologies Action Plan. It will be working on the demonstration in collaboration with the State of Hawaii, Hawaiian Electric Co., Inc., University of Hawaii, U.S. National Laboratories, and other parties.

Hitachi will conduct demonstrations that will include mitigating the effects of fluctuations in the output of photovoltaic power generation, ensuring the balance of supply and demand when EVs are introduced, the use of autonomous decentralized control to ensure reliable operation and system scalability, the configuration and operation of systems in a safe and secure way, and the performing of economic assessments. Future aims include establishing a business model for low-carbon public systems for island and subtropical locations.

Tianjin Eco-City seeks to create an urban development model that can be copied, is achievable, and is suitable for wider adoption.

Smart grid demonstration on Maui, Hawaii. There is a need to make efficient use of renewable energy on remote islands where the cost of electric power is comparatively high.

Tianjin Eco-City

The construction of next-generation cities is currently underway in China in collaboration with the government of the Republic of Singapore, with the aims of promoting industry and dealing with an increasingly urbanized population. One of these is Tianjin Eco-City, a large environmentally conscious urban development project.

Located on approximately 30 km² of land on the outskirts of Tianjin City, the project aims to construct a city of around 350,000 people by 2020 to 2025. Based on the concepts of minimizing resource use and making resource recycling more efficient, the project has set 26 key environmental performance indicators including having 20% of its energy supplied from renewable sources, 100% of the water supply to be of drinkable quality, 60% of waste recycled, and 90% green transportation.

In September 2010, Hitachi signed an agreement covering the implementation of home energy management systems, building energy management systems, and community energy management systems using photovoltaic power generation and batteries; the construction of a platform for management and control of EVs; and technical cooperation in the field of energy-efficient data centers. Work on these projects is now underway.

Guangzhou Knowledge City

Guangzhou Knowledge City is another project being undertaken in collaboration with the government of Singapore. The project aims to build a next-generation city with a population of about 500,000 in 2030 by attracting knowledge-based corporations with environmental and other advanced technologies, including creative industries, educational institutions, and healthcare.

Hitachi is the first Japanese corporation to become involved

Construction is underway at the Guangzhou Knowledge City, which aims to improve the industrial structure by attracting people, corporations, and other organizations. (Image supplied by Sino-Singapore Guangzhou Knowledge City Investment and Development Co., Ltd.)

Big Data solutions for human traffic analysis and management
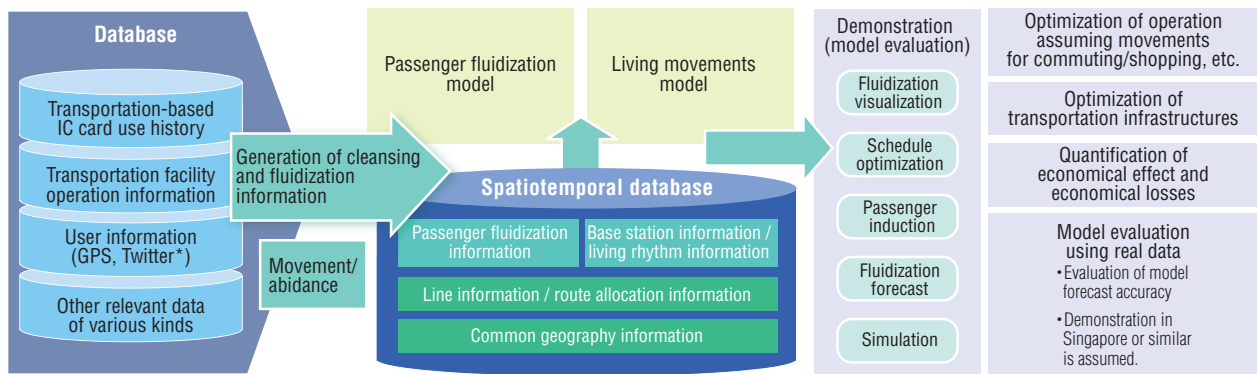
* See "Trademarks" on page 91.

in the project. Hitachi has established a business development office in Guangzhou and has commenced negotiations with the aim of supplying solutions such as energy management systems, renewable energy, IT platforms, and next-generation transportation systems.

Hitachi's Activities in Asian Belt Region

Hitachi Asia Ltd. established the Centre of Excellence (CoE) in Singapore in April 2010. Since then, the CoE has been actively developing and promoting potential urban solutions in cooperation with various business units with the aim of marketing and trialing these solutions in the Asian Belt Zone.

The CoE is playing a key bridging role in the Tianjin Eco-City project, in which a Singaporean consortium led by Keppel Corporation is a 50% equity partner of the Sino-Singapore Tianjin Eco-City Investment and Development Co., Ltd. (SSTEC). This has led to Hitachi winning an order for a home energy management system.

At the Sino-Singapore Guangzhou Knowledge City (SSGKC), the CoE made initial contact with Singbridge International Singapore Pte Ltd. in May 2010 in Singapore, leading subsequently to Hitachi, Ltd. signing a memorandum of understanding for a research and development feasibility study, and to its being invited to respond to a request for information. The CoE also facilitated a district energy feasibility study with Keppel-Tianjin DHCS Co., Ltd.

"In pursuit of business expansion, the CoE is now working with government agencies on various iconic urban development projects. One of the solutions that we are now offering to these projects is human traffic analysis and management that utilizes

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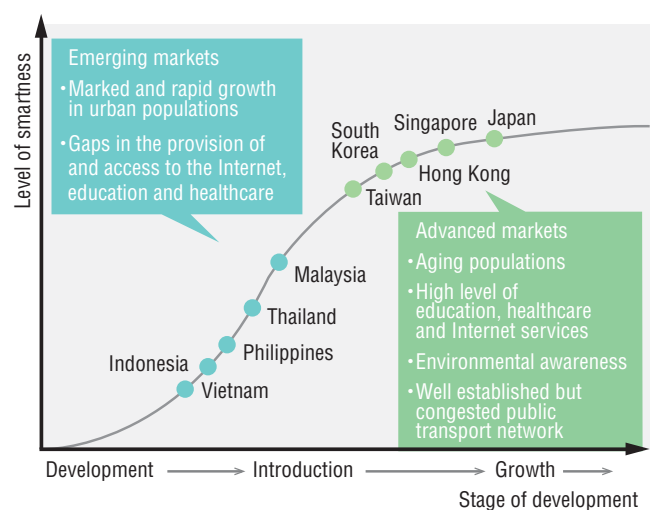
Source: UK Trade and Investment, "Smart Cities of the Future in Asia" (Feb. 2012)

Smart city development has reached various stages in Asia where it offers businesses both great opportunities and challenges.

Big Data," said Rick Lee, Senior Vice President, General Manager, Centre of Excellence, Hitachi Asia Ltd.

▌ Cities in which People can Shine

One issue highlighted by these demonstration projects is that of international standardization. When speaking of smart cities, the concept of "smart" carries a range of meanings, with differences from place to place. If the criteria are made clear, the current situation in cities can be assessed objectively, and the criteria can be used as a basis when applying the results of demonstration projects to other cities.

"Our aim is not only to reduce the burden on the environment, but also to use smart cities to achieve improvements in terms of comfort, safety, convenience, and enjoyment. We are accelerating our activities with the aim of building cities in which people can shine," said Yutaka Saito.

The cities of the world face numerous challenges that need to be overcome, and which involve major changes. The smart cities that Hitachi is seeking to create represent one solution, and they provide a glimpse of the attractive future for cities as well as of what cities in which people want to live might be like.