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Special Feature

Regional Revitalization Through ICT

Wildlife Damage Management Using ICT: Visualization of Data Over a Sensor Network/ Revitalization of Japan's Forests with ICT: Challenge of Satoyama Capitalism and Promise of IoT in Maniwa/ New Era City Infrastructure: Fukuoka City Wi-Fi, Free Public Wi-Fi Service/ Tokushima Satellite Office Project

Report

Overview of 2016 White Paper on Information and Communications in Japan

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BN Gyoen Bldg., 1-17-11 Shinjuku, Shinjuku-ku,
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Kaori Ohno
Naoko Ishida

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e-mail address: kikanshi@ituaj.jp

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The ITU Association of Japan (ITU-AJ) was founded on September 1, 1971, to coordinate Japanese activities in the telecommunication and broadcasting sectors with international activities. Today, the principle activities of the ITU-AJ are to cooperate in various activities of international organizations such as the ITU and to disseminate information about them. The Association also aims to help developing countries by supporting technical assistance, as well as by taking part in general international cooperation, mainly through the Asia-Pacific Telecommunity (APT), so as to contribute to the advance of the telecommunications and broadcasting throughout the world.

Wildlife Damage Management Using ICT: Visualization of Data Over a Sensor Network

Haruo Kaneko
Chief Technology Officer
Planning Policy Department, Planning Policy Division
Shiojiri City Hall (Nagano Prefecture)

1. Introduction

The city of Shiojiri is near the geographic center of Nagano Prefecture at the southern end of the Matsumoto Basin. Rich in historical associations, the area is surrounded by the Northern Alps to the west and the Central Alps to the south. Shiojiri has an average year-round temperature of 11.9C°, 26,000 households and total population of 67,000, and is committed to urban development under the slogan "the good life in a garden city with eyes to the future."

Favorably situated to move inland traffic from the Pacific coast on one side of Japan to the Sea of Japan on the other, Shiojiri flourished as a post town along the ancient Nakasendo route stretching from Kyoto to Tokyo. Today, as in centuries past, Shiojiri has evolved into a transportation hub with well-developed infrastructure: crisscrossed by JR (Japan Railways) lines, with the Nagao Expressway and other highways, and easy access to the Shinshu Matsumoto Airport.

Scenic beauty is unsurpassed, but the area falls within the Itoigawa-Shizuoka tectonic fault zone, which makes the area somewhat vulnerable to seismic activity.

2. Information-driven policy and wildlife damage management using ICT

Shiojiri began its transition to an information-based society in 1984 with the introduction of general-purpose business computers and first tentative steps to develop an autonomous system infrastructure. Since then, investment has continued to focus on information-driven initiatives and networks supporting IT to upgrade and develop Shiojiri as a convenient and congenial place to live.

About the time development of citizen data and administrative systems were completed, work began on the development of network—*e.g.*, the Internet—and server-based systems. More recently, efforts have focused on migrating from these earlier systems to smart systems that minimize impacts on the environment. Investment has thus continued to focus on a smart information-driven society that contributes to Shiojiri as a garden city in harmony with the natural environment.

The Shiojiri "Disaster Mitigation Project using Sensor Network" is based on the "2012 MIC-subsidized ICT-based Smart City Project," that was evaluated during a two-year pilot project. The Shiojiri project is supported by an ad hoc wireless network interconnected with a optical fiber communications infrastructure. The ad hoc network collects data directly from various sensors deployed throughout the community and stores the data on a server (see Figure 1). The sensor data can be accessed via the web from a Wi-Fi hotspot or can be downloaded as email and viewed on a personal handheld device such as a smart phone or a cell phone. Primary goals of the project were to determine if there were enough sensors to make specific administrative decisions, and to see how quickly local citizens in the community could be notified of the sensor-based information.

One initiative, for which we received the Special Regional Information Award from the MIC in 2014, was the "Wildlife Damage Sensor" that helps manage and deter wildlife from damaging crops. This system is designed to detect and capture wildlife in the Kitaono Ueda district of Shiojiri, a hilly and mountainous area where cultivated fields are immediately adjacent to forest lands. Until recently, we saw a sharp increase in damage

Table: History of Shiojiri's information-driven policy

1984	Introduction of general-purpose business computers, and construction of autonomous system infrastructure and City Hall LAN.
1996	Rollout of *Shiojiri Internet Service* for Shiojiri residents.
1999	Opened information base *Shiojiri Information Plaza*, implemented municipal public optical fiber network, and completed groundwork for Shiojiri ICT infrastructure (Inspired by Ministry of Posts and Telecommunications projects: *Project to Create an Invigorated Multimedia Society* and *Regional Intranet Infrastructure Project*).
2004	Signed partnership agreement with Shinshu University to collaborate on various research projects.
2007	Built first ad hoc wireless network with radio propagation range and radio repeaters for regional children tracking system using sensor tags employed by "Ministry of Internal Affairs and Communications (MIC) funded project of improved regional children tracking system of 2006." Constructed sensor platform that collects data very cost-efficiently from sensors deployed throughout the city plus several highly useful applications that use the sensor data in collaboration with Shinshu, Shizuoka, and Okayama Universities.
2012 2013	Won adoption of "Disaster Mitigation Project using Sensor Network" as implementation of "2012 MIC-subsidized ICT-based Smart City Project," and pilot project was conducted over 2 years.

Note: Ministry of Posts and Telecommunications (MPT) was merged to newly established Ministry of Internal Affairs and Communications (MIC) in 2001

Figure 1: Diagram of Disaster Mitigation Project using Sensor Network (2012 MIC-subsidized ICT-based Smart City Project)

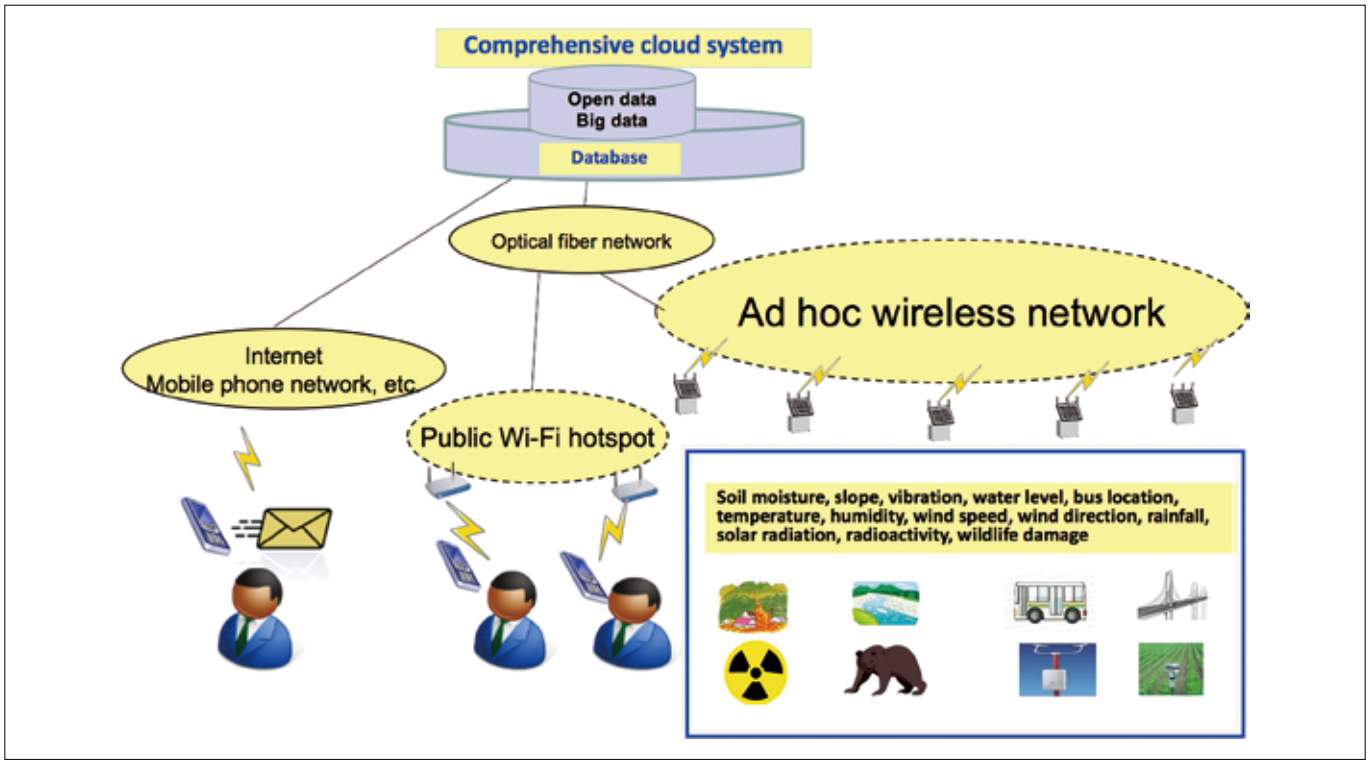


Photo 1: Wildlife detection sensor

Photo 2: Trap and capture sensor

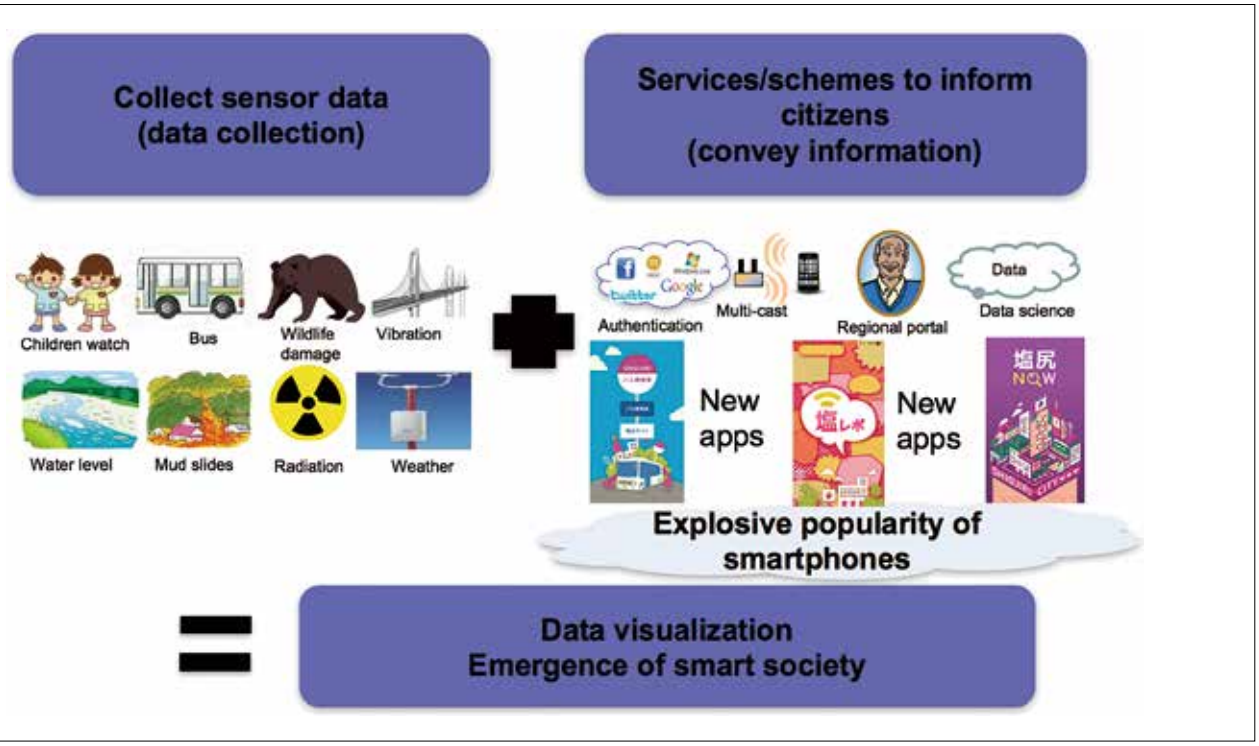
to potato crops and wet-rice paddies caused by wildlife in this area, and this project was conducted to see if IC technology might be useful in deterring wildlife or mitigating the damage to crops caused by wildlife. Two types of sensors are used by the system. First is a *wildlife detection sensor* shown in Photo 1 that detects infrared emitted from animals, then triggers a loud alarm or flashing lights to scare off the animal while at the same time sending an email notification to the local farmer or hunting club detailing the time and exact location of the intrusion. The second type of sensor is a *trap and capture sensor* shown in Photo 2 installed at places where animals are known to visit that sends an email notification to the local farmer or hunting club when an animal is caught. The wildlife damage control system has had a very beneficial impact. Before the system, farmers were becoming discouraged and disappointed when they came out the next day and found their crops trampled or eaten. The system now enables farmers to pinpoint the exact time and place that animals are getting into their fields, and the whole community is involved in doing something to eradicate the problem. With its proximity to forest land, the Kitaono

Ueda district has been especially vulnerable with as much as 85% of crop land damaged by wildlife, but the damage has been completely eliminated by implementing this simple system. Some of the farmers who were ready to call it quits due to the unending damage to their crops have had their confidence restored and are extremely happy with the results of the trial.

3. Indirect effects: use of Sensor Network and *Visualization of Information*

In addition to the "Wildlife Damage Sensor," we also demonstrated a number of other sensor applications over Shiojiri's "Disaster Mitigation Project by Sensor Network."

■ **Figure 2: Visualization of Data**



- Soil moisture sensors that detect moisture content of the soil at 20cm increments to anticipate mudslides.
- Tilt sensors that detect annual shifts in hillside slope in millimeter increments to anticipate mudslides.
- Vibration sensors that measure vibrations in bridges and other public structures to detect broken bolts and other structural problems.
- Water level sensors that measure the water level of lakes and rivers.
- Location sensors that measure the location of buses on circular routes through the city every 30 seconds.
- Weather sensors that measure temperature, humidity, wind speed, wind direction, rainfall, solar radiation, and radioactivity.

By collecting data from these various sensors over Shiojiri's optical network and ad hoc wireless network and storing the data in the cloud, we demonstrated that the system worked extremely well in everyday circumstances as well as in emergencies and disasters. The system gets valuable data into the hands of those who need the information quickly and efficiently. We also found that the system and sensors were more effective if the sensor data could be converted to a *visual* format.

We learned a number of valuable insights from the project.

■ Better to build the communications infrastructure for flexible adaptation rather than robust endurance to withstand disasters, for a major disaster will knock out any infrastructure no matter how robust.

- Costly infrastructure that is expensive to set up and maintain is limited, so better to build a simple communication infrastructure that can be expanded or adapted autonomously as needed.
- Setting up separate radio repeaters is simplistic and not very reliable, but a reliable and highly flexible infrastructure can be implemented by combining many of these simplistic structures.
- Optimum arrangement for disseminating sensor data is to store and maintain the data (bus route operational status, soil moisture data, water level data, wildlife damage data, and so on) at a data center, and distribute the information to users via the Internet.

■ On-going development initiatives (revitalizing local industries)

- A town or community can begin revitalizing its local industry by developing mobile applications, embedded software, sensor devices, and other equipment to work in conjunction with a network information infrastructure.

4. Future directions

This project was primarily focused on accessing sensor data over an ad hoc network, but we envision an explosive increase in the number and type of sensors used in combination with wireless devices in the years ahead as anticipated by the Internet of things (IoT). This will open the way to all kinds of beneficial services such as tracking young children and the elderly, providing security at greenhouses, or security for tractors and other farm equipment, and countless other services.

Meanwhile, research continues on the development of new sensors as a fundamental technology at Shinshu University, Shizuoka University, Okayama University, Seiko Epson Corporation, and at the Shiojiri Incubation Plaza (SIP), a development base for small and medium-sized Shiojiri businesses. Some of these new sensor technologies now under development

include a pH sensor for grape cultivation, a greenhouse hydroponic cultivation nutrient sensor, a home garden moisture sensor, a frost sensor, and a tension sensor for inside tunnels. Certainly these sensors prove useful in the IoT era that is now unfolding.

Turning to education, we are starting to expose children to technology at an earlier age by introducing technical subjects in the classroom and open-source language Ruby to elementary and middle school students.

It is clear that sensors will play an increasingly important role and will be the focus of increased research and development in the years ahead. Shiojiri is leading in this development by pursuing successive challenges to make the city a vigorous and congenial place to live. Shiojiri is moving aggressively to develop embedded software which is at the heart of the municipal optical fiber ICT infrastructure and Shiojiri Incubation Plaza (SIP), pursuing new business development such as inauguration of the Shinshu OSS Promotion Consortium organized around the Shiojiri Industry Promotion Corporation for developing application software and open source software, exploiting dynamic general-purpose programming languages such as Ruby, moving quickly to get new technologies out of the laboratory and into the marketplace through process management and by cultivating human resources through on-the-job training, by rolling out projects to rejuvenate the manufacturing sector, and numerous other initiatives.

5. Conclusions

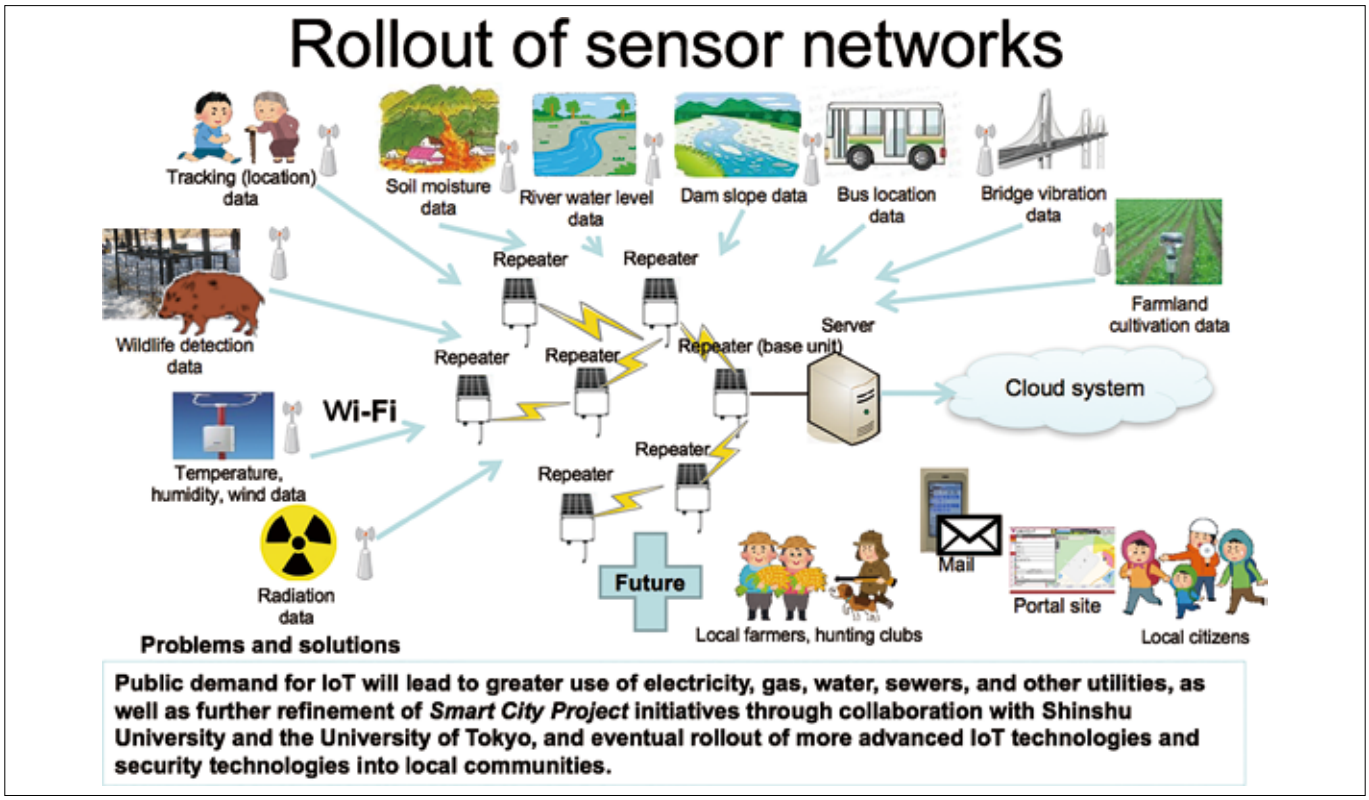
With the emergence of an information-driven society at the national level as well as the local level, we have witnessed the deployment of an extensive ICT infrastructure over the past decade. Japan now has one of the highest broadband penetration rates in the world, and ICT infrastructure is largely in place throughout the country. In terms of how information is utilized, there has been a marked shift away from open systems toward the cloud and other platforms which has made information far easier to access and has greatly increased the number of people using data. We are also seeing a rapid shift away from personal computers to mobile terminals (mobile phones and smart phones).

We have been hearing about the advent of the *local era* for some time now, but this will require greater autonomy for local governments and successful local management. This means that local governments must be able to secure financial resources without being dependent on the central government and have access to a fair allocation of people, things, and money derived from the strategic thinking of the modern era—in other words, the advent of the local era is closely linked to the revitalization of local communities. We can't afford to fail in this strategic pursuit.

Shiojiri's ICT policy has won the admiration of the international community, and Shiojiri was named one of the world's top 21 intelligent communities by the Intelligent Community Forum in 2015.

We have also taken the initiative to share the lessons and issues and insights learned through this project with the international community. For example, we delivered a presentation at the recent anniversary ITU WSIS + 10 event, transferred our wireless network technology to Himalayan mountain villages in Nepal, and collaborated in developing an e-agriculture application and other technologies for a Myanmar rural community redevelopment plan. It is this sort of activity that will spark revitalization of local government and local communities, and we are committed to stay the course until revitalization is achieved.

Figure 3: From Sensor Networks to Internet of Things (IoT)



Revitalization of Japan's Forests with ICT: Challenge of Satoyama Capitalism and Promise of IoT in Maniwa

Takashi Nogawa
Assistant Section Chief
Maniwa City Office

Tetsuya Maruta
Consultant
Nomura Research Institute, Ltd.

1. Introduction: State of Japan's Ailing Forestry Industry

Japan's forests cover some 70% of the land, making it one of the most heavily forested and richly endowed countries in the world. Moreover, the quantity of timber in its forests—the so-called *forest stock volume*—is increasing. Yet rural communities in the mountainous areas of Japan face a common set of problems as people migrate to the cities: rural communities become sparsely populated, increasingly elderly, and some communities are in danger of disappearing altogether. These villages and towns all across the country must figure out how to exploit their forest resources, how to diversify and expand the timber industry and other businesses, how to create jobs, and how to grow their local populations.

But developing forestry, the lumber industry, and other businesses that exploit forest resources is not easy. The general consensus among people close to the industry is that "there is no money in forestry." In the wake of World War II, forestry fueled the post-war building boom and was the star of the rural economy, but that all started to change about 1975 when the industry started to decline. Gross output from timber production fell from ¥967.4 billion in 1980 to ¥221.1 billion in 2013. Meanwhile, the number of forestry workers has also fallen off precipitously with only about 80,000 people working in forestry-related jobs today (roughly 0.1% of Japan's total workforce).

There are a number of reasons for this steep decline of the timber and other forest resource industries. Perhaps the biggest reason is that Japan liberalized its timber imports which opened the floodgates to cheaper lumber from aboard, and this coupled with the soaring cost of labor in Japan meant that domestic timber could no longer compete. At the same time, aesthetic and lifestyle changes in Japan reduced the demand for lumber products.

If the forestry and timber industries are truly on the skids, then one might question whether the introduction of ICT could have any impact that might turn this situation around. Yet there are 1000s of local communities scattered across Japan—the town of Maniwa in Okayama Prefecture among them—that are surrounded by majestic forests covering 70% of the country, and these towns must come up with a way to survive and flourish in their woodland surroundings. Now Maniwa and some other communities have embarked on the long road toward regional revitalization by leveraging the power of ICT to make the most of their local resources. Perhaps no one is going to get rich dealing in forest products, but we are starting to see a reawakening of a community where young people in their 20s and 30s and women can make a decent living from forestry.

2. Satoyama Capitalism: Maniwa Leverages Forest Resources Through Industry-Government Partnership

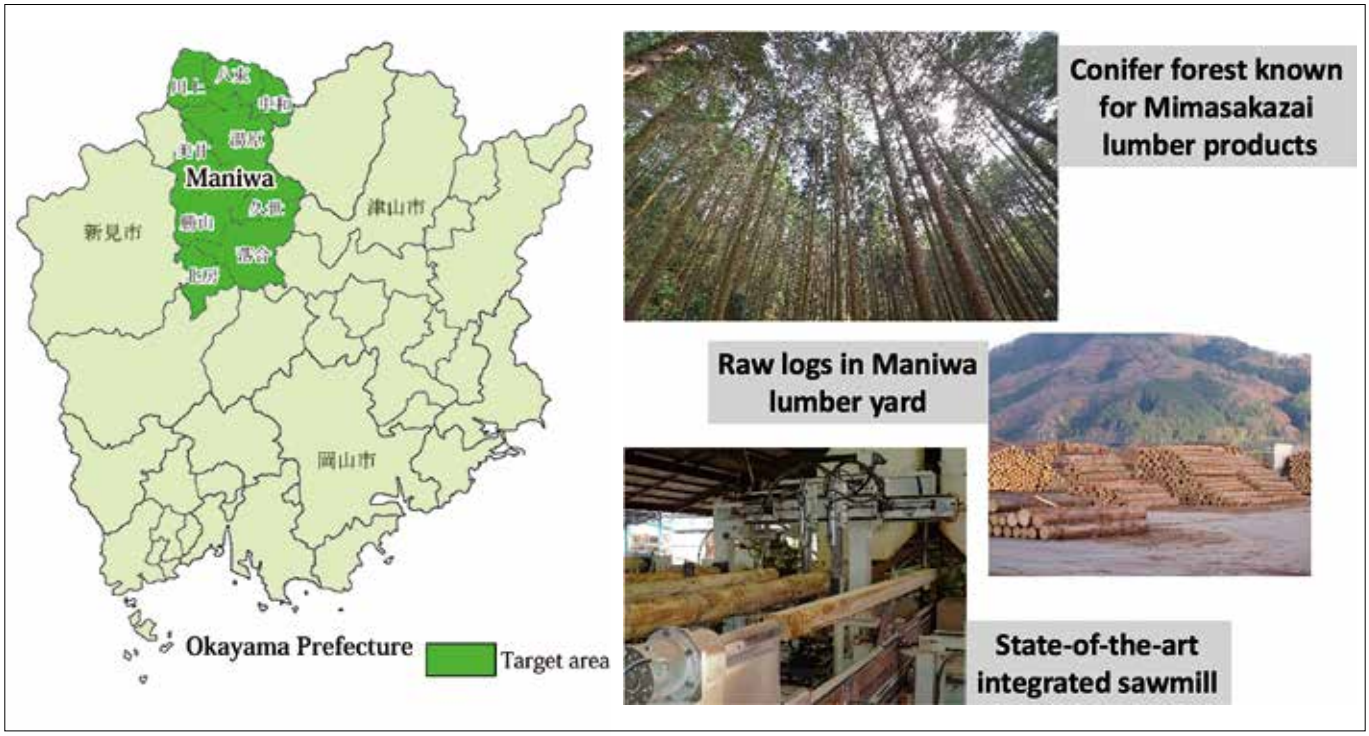
The modern city of Maniwa is in the northern part of Okayama Prefecture on the border with Tottori Prefecture, and was established in March 2005 through a merger of five towns and four villages all from the Maniwa district. After the merger, the population of Maniwa was about 50,000, but the population continued to decline as the elderly population increased and the birthrate declined. Over the five year period from 2005 to 2010, the population fell by about 10% for a loss of another 5,000 people. To come up with some sort of plan to deal with this harsh reality, leaders from throughout the community including some of the older officials from pre-merger Maniwa as well as younger management people joined forces and began searching for a solution. One proposal that came up repeatedly was the idea of bringing back and reviving the timber industry and other forestry-related businesses that had been the community's primary bread and butter in the past.

Roughly 80% of the land area within Maniwa's city limits is woodlands, and timber and lumber have been the key industries of the region. The area was extensively afforested in the middle Meiji years (late 19th century), and Maniwa's lumber industry evolved very quickly as a timber supply base for the Keihanshin region—the area including Kyoto, Osaka and Kobe—with the opening of the railroad in 1936. Today, Maniwa is still regarded as a leading center of forest products with 30 lumber companies concentrated in the area.

But Maniwa is not just about timber and building materials. Universities and research labs collaborate in R&D of nanotech materials and in harnessing electrical power and heat supplies as sources of energy, progress has been made in exploiting so-called woody biomass, and industry-academic-government interests have joined forces in a quest to break away from the old industrial structure of the past. Some of these more recent developments have been taken up and discussed in detail by Kosuke Motani in his best-selling book "Satoyama Capitalism" (Kosuke Motani and NHK Hiroshima, Kadokawa Shoten).

How ICT might be applied to Maniwa's forest industry also came up in joint industry-academia-government discussions. When timber is used as building materials, biomass, and various other ways, the next obvious question is how one harvests the timber that has all these practical uses. And in order to harvest a stable supply of lumber, one must have a fairly precise grasp of the amount of timber that is available in the area. Finally, when it

Figure 1: Mountainous Maniwa: location and scenes around town



comes to the actual logging, one has to know who owns the land, for the land owners and loggers have to work out how many board feet will be cut, allocation of costs and revenues, and a host of other factors. This requires detailed data revealing the distribution of forest resources and maps showing the land ownership status. Unfortunately, this information is not nearly as accurate as it should be, it is a huge headache to match up and collate paper maps showing the distribution of timber resources, and many if not most of the local people are not comfortable using this kind of data.

Basically, Maniwa needed was a scheme for collecting, digitizing, and storing data that clearly indicates how many trees are on what parcels of land, who owns the parcels, and then make that data readily available to all the stakeholders in the community. Some doubted that we could implement such a scheme, but we made good progress, and the project really started to come together around 2011.

We applied for funding as a Ministry of Internal Affairs and Communications (MIC) supplementary budget 2012 *ICT Smart City Project*, and our proposal to implement a demonstration scheme was accepted. The demonstration trial was completed in 2013, and now virtually everyone involved—government officials, forestry people, especially forestry cooperative staff—thinks the system is absolutely indispensible, and it would be impossible to do our work without it.

3. Deploy Forest Cloud and Drone (UAV) to Map Local Terrain

Working together with a major ICT-related corporation in Okayama Prefecture (Okayama Cyuou Sougou Jyouhou kousya: Okayama Central General Information Public Corporation), we developed two basic MIC *ICT Smart City Projects* proposals: First was the *Forest and Forestry Cloud* jointly used and managed by the Maniwa City Office and the Maniwa Forestry Cooperative, and second was a *Drone (UAV)* that uses remote sensing technology to efficiently survey and map current forestland terrain.

(1) Forest and Forestry Cloud to Visualize Local Forests

The Forest and Forestry Cloud uses geospatial information technology to superimpose forestland ownership data (owner's name associated with each section; also known as *current parcel number plots*) and other current updated data onto aerial photographs, then display the images. Essentially, it is a type of geographic information system (GIS). Note that the parcel numbers allocated to owners are also used as ID numbers for managing forestlands, so one can quickly ascertain the owner of a parcel from the ID number. And since the Maniwa Forestry Cooperative periodically updates past and present logging activity records, one can get a fairly accurate picture of the current state of forestlands. Now the availability of the Forest and Forestry Cloud make certain tasks much easier and efficient: one can immediately grasp who owns what parcel of land by simply glancing at the screen (a task that used to take several days), and landowners can quickly generate the drawings needed to accompany subsidy applications by simply printing out a screenshot of the contents (a procedure that used to take at least a day).

(2) Robotic Drone to Grasp Forestlands in Real Time

The Forest and Forestry Cloud is equipped with digital aerial photos of the whole area plus charts derived from the aerial photos showing the distribution of different tree species. Aerial photos provide excellent data for tracking the current state of forestlands or explaining current circumstances to owners or other stakeholders, but the photos can get out of date as trees mature, are

Figure 2: Forest and Forestry Cloud (forestry management information system): primary uses and division of roles by Maniwa City Office & Maniwa Forestry Cooperative

Maniwa City Hall functions

- ✔ Capabilities to make forest conservation operations more advanced and efficient including custody over forest roads, profit-sharing forests, applications for forest reserves, parcel number status maps, etc.
- ✔ Disaster-prevention measures such as custody of the antiflood control afforestation ledger, the erosion control ledger, etc.

Maniwa Forestry Cooperative functions

- ✔ Capabilities to make forest operations more advanced and efficient including custody of local forest operation history, management of logging roads, etc.
- ✔ Investigate forest management strategies that improve efficiency of using digital aerial photos and sensing data taken from by drones, etc.

Source: Okayama Cyuou Sougou Jyouhoukousya (Okayama Central Information Public Corporation)

Photo: Drone deployed for forestry management

Source: Okayama Cyuou Sougou Jyouhoukousya (Okayama Central Information Public Corporation)

logged off, or when the landscape is altered by natural disasters.

Maniwa thus conducted a demonstration trial of a drone (UAV) to assess the drone's performance in updating the aerial photos as required. The autonomous drone shoots a series of pictures along a preset flight path over the local terrain, and is thus capable of conducting a very efficient survey over a wide area. It does however have a number of drawbacks: the operator must have a certain amount of training to deal with problems that occur, and the drone can only fly within visible range of the operator on the ground.

In addition to the drone, we are also evaluating a LiDAR (Light Detection Detection and Ranging) system over part of the city for possible adoption as part of the *Satoyama Maniwa Forest Development Project* that was launched earlier this year. LiDAR is a surveying technology that provides highly accurate data on canopy heights, biomass, and species of forests by scanning the target terrain with multiple lasers.

By introducing these technologies over the entire Maniwa region, this will give us a far more detailed and accurate picture of our forest resources, permitting better stewardship and strategic logging of Maniwa forestlands.

4. Revitalization of Maniwa with ICT: Forestry × IoT = Regional Revitalization of Japan

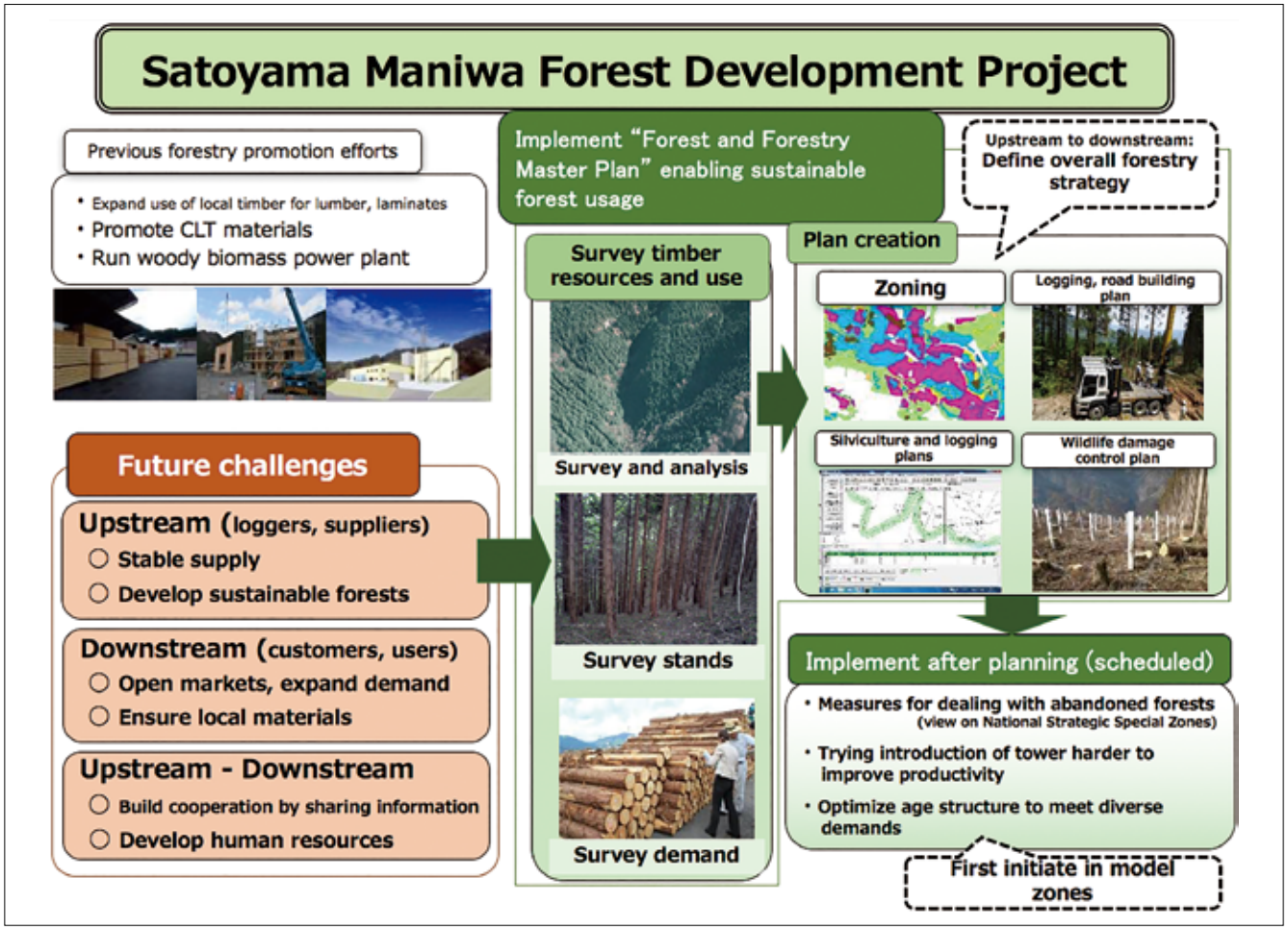
It has now been over three years since Maniwa began adopting ICT into its forestry management. Today, collection of forestry-related data on the cloud and by drone and other aircraft are largely taken for granted at the Maniwa City Office and the Forestry Cooperative. We know of some cases where local communities did not follow through with ICT after it was introduced through government programs and initiatives. In Maniwa, however, local residents were well aware of the benefits ICT could bring to its local forestry, probably because local operators had a long history of working with the government in solving local issues, and immediately began to build practical systems and put ICT into service in tangible ways.

Bringing ICT to Maniwa opened up enormous opportunity for the city to exploit its forest resources. In April 2015, the city completed a woody biomass power plant which provides an output capacity of 10 MW, more than enough to power all of the households in Maniwa. The plant consumes roughly 350 tons of small-diameter logs and slash per day, so clearly requires a stable supply of these logging products. ICT helps secure this supply of woody biomass through the Forest and Forestry Cloud and supply-chain management for biomass coming in from other sources.

With our ability to clearly visualize Maniwa's forests through the Forest and Forestry Cloud, we are now better able to strategically manage these resources, extract sustainable wealth from local forestlands, and this year we began drafting a "Satoyama Maniwa Forest Development Project - Maniwa Forest and Forestry Master Plan" so we can pass these resources on intact to the next generation. By partnering with Sumitomo Forestry Co., Ltd., the largest timber company in Japan, our goal is to create a model of forest management that can serve as a revitalization showcase for rural communities throughout Japan. The reason we can pursue this ambitious challenge is that Maniwa's basic forestry management data is largely digitized, so it can be readily analyzed and used for secondary purposes.

And Maniwa's commitment to ICT is not confined to just exploiting the city's forest resources. European countries with far higher per capita GDPs than Japan have moved aggressively to leverage ICT in their timber industries, and this has clearly contributed to the extraordinarily high productivities of these countries in forestry. For example, in Austria they have

Figure 3: Satoyama Maniwa Forest Development Project - Maniwa Forest and Forestry Master Plan



implemented real-time supply-chain management with land owners, loggers, and sawmills linked over a network and cloud technology. Another case in point is Denmark, where they have set up local heat supply systems in various places throughout the country that use wood chips, sawdust and other waste from lumbermills to heat homes and public institutions, and typically these systems use an ICT called smart metering for monitoring and billing purposes. Moreover, homeowners can easily adjust the temperature and amount of heat used in their homes using their smartphones.

ICT also shows enormous promise for safety management in logging operations. Cell phone reception is poor or nonexistent in mountain valleys, so what happens when you have an emergency, say an accident involving a chainsaw or heavy machinery? I believe the answer can be found in wireless network technologies. These technologies work even in places where conventional ICT cannot be implemented, and wireless networks are becoming more robust even as they continue to fall in price.

5. Conclusions

Over this past decade, the cloud and networks and sensors have continued to find increasing applications in the forestry sector, especially as their performance has improved and their prices have moderated. Maniwa is an excellent case in point, and the city's initiatives have played a crucial role in this development. The fact that the cloud and networks and sensors yield better performance at lower cost has really opened the way to the Internet of Things (IoT), and widespread penetration of IoT will only bring good news to those those rural communities struggling to revitalize their local economies by exploiting forest resources.

Cover Art

Hanaogi of the Ogiya (Ogiya Hanaogi), from the series Renowned Beauties Likened to the Six Immortal Poets (Komyo bijin rokkasen).

Kitagawa Utamaro (1753-1806)

New Era City Infrastructure: Fukuoka City Wi-Fi, Free Public Wi-Fi Service

Public Information Section,
Strategic Public Information Office,
Mayor's Office, Fukuoka City Government

1. Introduction

According to the Japan Tourism Agency's "Consumption Trend Survey for Foreigners Visiting Japan" (January - March 2014 quarterly survey), foreign visitors regard the Internet (accessed via smartphones) as the most useful source of travel information while staying in Japan, but the most useful information during visits to Japan comes from free Wi-Fi. A robust Wi-Fi environment thus serves as a major attraction in extending hospitality to a city's visitors, for Wi-Fi not only makes an unfamiliar town much more accessible to the visitor but also provides a way to broadcast favorable information about the city to the far corners of the earth using Facebook and other social network services, which promises to bring in even more visitors in the future.

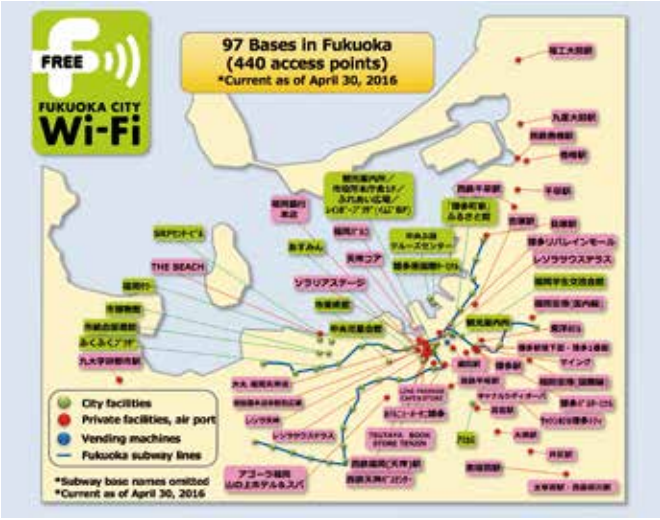
Fukuoka is now coming up on the fifth anniversary of the *Fukuoka City Wi-Fi Service*, a free public wireless LAN service that was initially rolled out in April 2012. Here we will provide a brief overview of the service and describe some of its unique features.

2. Deployment Background and Service Overview

Fukuoka is a compact port city favored by proximity to key cities on the continent, open sea lanes and air routes, an international airport, a Shinkansen depot and other large train stations, and a broad 2.5-km harbor. The economy is thriving with over 90% of Fukuoka residents employed in the tertiary wholesale, retain, and service sectors.

Given these favorable circumstances, Fukuoka is well positioned to increase the number of tourists as a short-term growth strategy by attracting visitors and increasing consumption in the city. Fukuoka is also committed to free wireless LAN service as a way of attracting foreign tourists as well as Japanese visitors by providing more convenient access to general information and safety information in the event of a disaster, and providing more efficient dissemination of information.

Figure 1: Fukuoka City Wi-Fi Base Map



April 2012	Launch service
June 2012	Complete installation of service in all subway stations
November 2012	Set up Fukuoka tourist facilities to start offering services in private facilities at convenient access points
April - June 2013	Launch service at eight Fukuoka JR Kyushu train stations
October 2013	Launch service at Nishitetsu Bus Terminal, and start providing service in large-scale commercial facilities
December 2013	Rollout service at Nishitetsu Fukuoka (Tenjin) Station
April 2015	Rollout Wi-Fi via vending machines featuring disaster prevention station capabilities

(1) Bases

Fukuoka's Wi-Fi service was launched on April 27, 2012 with 16 base stations set up in subway stations, tourist information centers, and other locations throughout the city. Note that this was the first deployment of Wi-Fi in a subway by a municipal government in Japan. During the four years since it was rolled out, we have continued to upgrade and expand the service so that today, as of April 30, 2016, the service is supported by 97 base stations (440 access points) deployed throughout the city (see Figure 1).

(2) Deployment

The Fukuoka city government initially established a committee in April 2011 to figure out how best to deploy the public wireless LAN, and came up with a scheme in which the city would be responsible for deployment in municipal facilities and a Public-Private Cooperative Group that included private-sector business leaders would be responsible for deployment of the service in private facilities. The city took the lead in organizing the project, but soon brought the private sector along as full partners in the project.

To hold down costs of deploying and maintaining the service, the new Fukuoka LAN service harnesses the Wi-Fi cloud environment and equipment of other legacy Wi-Fi services supported by the telco operators.

(3) Multilingual Capability

The service can be accessed in five languages: Japanese, Korean, two varieties of Chinese (simplified and traditional characters), and English.

(4) Automatic Authentication on Base Stations

As of August 2014, the service was implemented in such a way that users could remain automatically connected to the service for up to six months on a particular base station once users are registered on the service. Intuitive user-friendliness of the service was also markedly enhanced by enabling seamless migration from one base station to another.

(5) Security

Security measures are implemented in a way that maintains accessibility and convenience of the service without compromising a user's registration data or filtering parameters.

3. Functions Built Into the Service

(1) Portal Functions (Figure 2)

Users can access a wide range of information from the top page of the service including the Fukuoka City Wi-Fi homepage, disaster and crisis management information, and even a brief survey where users can provide feedback. After connecting to the Internet, the first page allows users to access the Fukuoka tourist site *YOKA NAVI* that opens doors to unlimited useful information (left). In the event of a disaster, warning or emergency information is delivered to users via the Pop-In Banner feature. And in the unlikely event of an extreme disaster, user connections may be interrupted as the service cuts over to emergency response mode, or the service may switch back and forth between normal mode and emergency response mode (right).

(2) Stamp Rally Function (Figure 3)

We came up with the Stamp Rally function to increase awareness of the Wi-Fi service, to promote use of the service, and to attract more people into the city. Essentially, the Wi-Fi Stamp Rally is a scheme enabling regular users to enjoy collecting unique stamps associated with each base station by logging onto the different Wi-Fi bases throughout the city.

(3) Pop-In Banner Function (Figure 4)

In December 2014, we added a Pop-In Banner capability that displays a banner above the Internet browser. By exploiting the banner feature, various messages can be displayed in rotation: information about seasonal events, security-related warning, and so on.

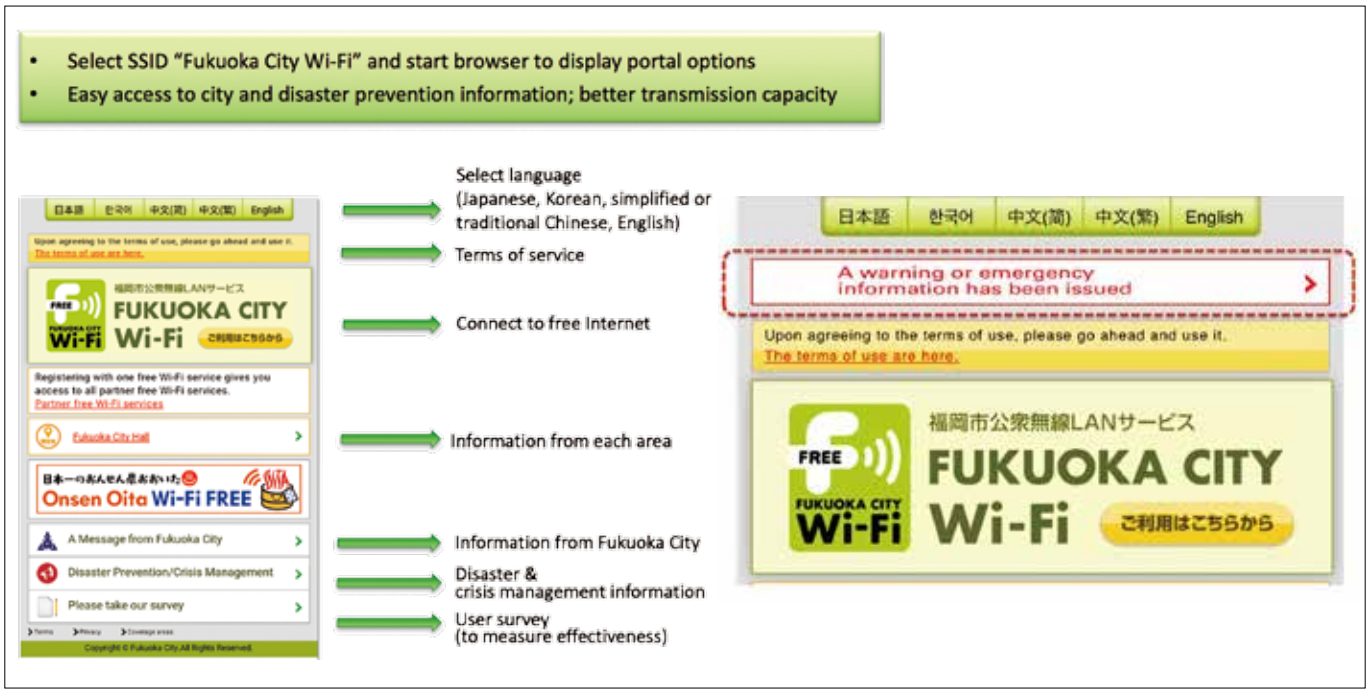
(4) Open Data

The service provides access to Fukuoka's Open Data Site for the number of authentications on each base and each date. See the Open Data Site here: http://www.open-governmentdata.org/ (Japanese site only)

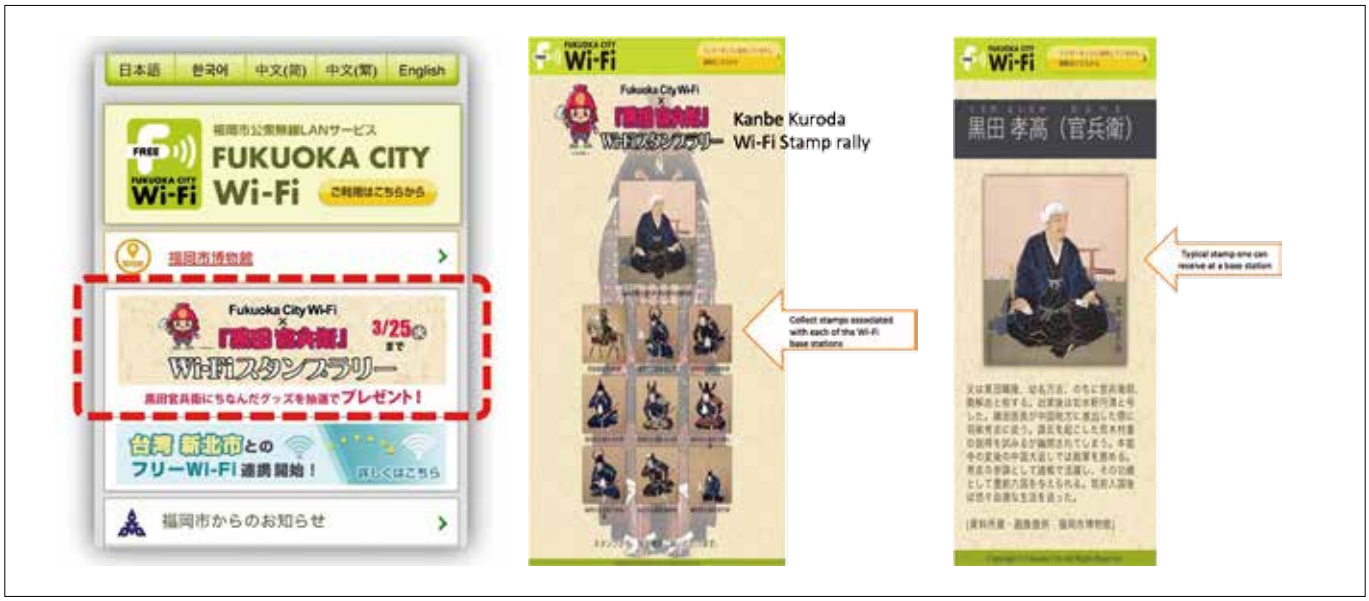
(5) Promotion to Encourage Use by Foreign Visitors

In August 2014 a new multilingual website supporting five languages was set up so that visitors can use Fukuoka City Wi-Fi service and local base stations even before they actually arrive in Japan. Currently, as of April 2016, the Fukuoka City Wi-Fi service has received approximately 2.77 million page views from countries all over the world. In addition, Fukuoka produced

Figure 2: Portal Functions



■ Figure 3: Stamp rally



■ Figure 4: Pop-up banner function sends security alerts and promotes ICT literacy

a series of public relations videos in five different languages in March 2015. More recently, the videos were upgraded to YouTube, and digital signage was installed at international terminals at the airport and Port of Hakata and on main streets.

See the multilingual tourist site here: http://wifi.city.fukuoka.lg.jp/en/

4. Effects

(1) Usage Status

From the date the service was first launched until today (March 2016), the total number of authentications on the service has been 28.18 million and the total number of foreign language views has been 45.32 million, and usage of the service has continued to increase year after year. Usage status of the service as of March 2016 reveals the following picture:

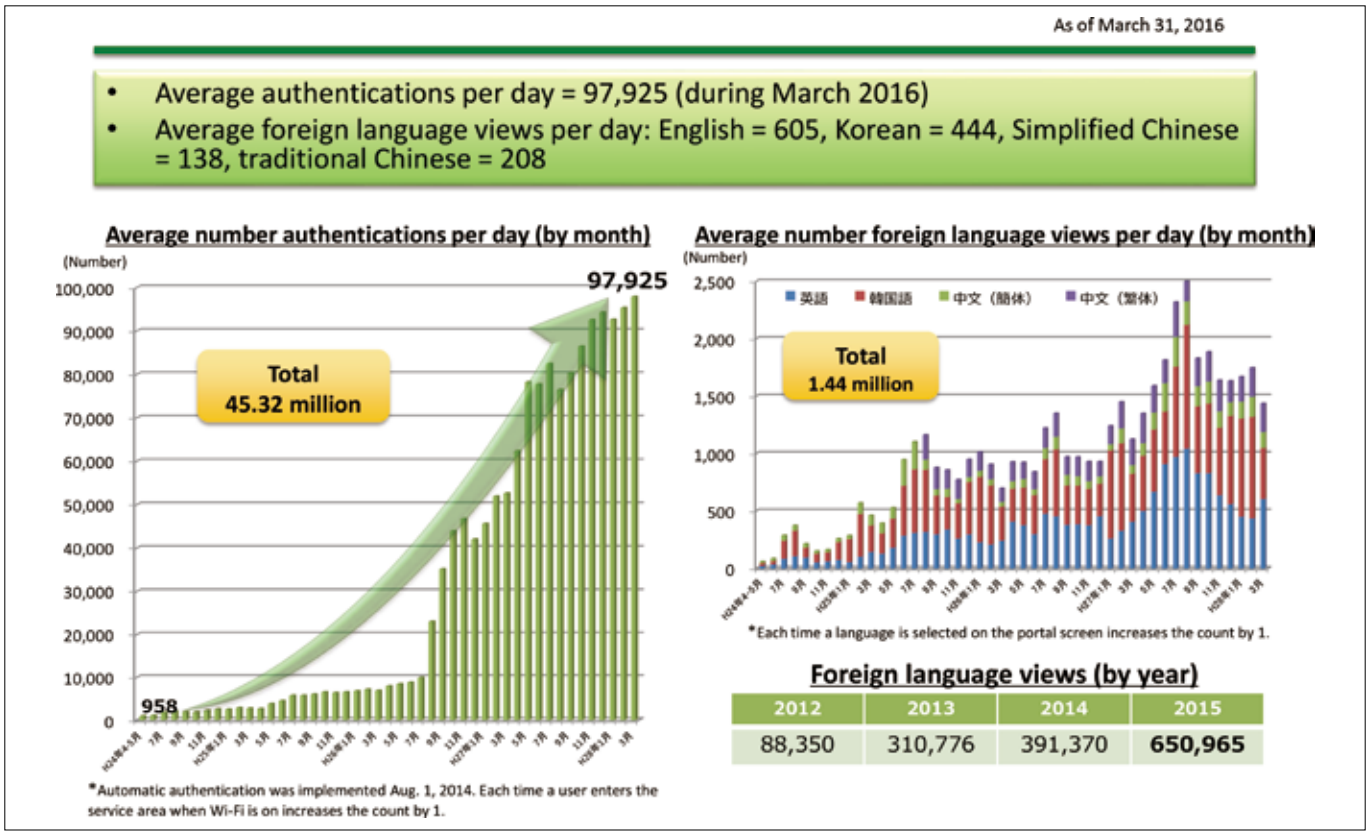
Average number of authentications	97,925 per day
Average number of users	22,410 per day
Number of foreign views	1,395 per day

(2) Economic Effects (Ministry of Internal Affairs and Communications trial assessment)

MIC *Study Group on Telework Leveraging Regional Potential and Wi-Fi Usage* [*1] conducted a study from 2014 to 2015 to assess the impact of the Fukuoka City Wi-Fi Service on the city's economy. The study concluded that the amount of revenues expended by foreign visitors to Fukuoka over the three-year period from 2012 to 2014 increased by close to ¥124 million, for a cost-benefit ratio of around 1.4.

*1 Study Group on Telework Leveraging Regional Potential and Wi-Fi Usage (Ministry of Internal Affairs and Communications), third handout, http://www.soumu.go.jp/main_content/000354251.pdf

Figure 5: Number authentications, foreign language views



(3) Fukuoka Tourist Statistics

In 2014 the number of visitors to Fukuoka revealed a year-on-year increase of 4.1%, with record breaking increases in the number of tourists for three years in a row.

For the first time ever, the number of foreign visitors arriving in Japan via the Port of Hakata and Fukuoka Airport topped 1 million in 2014, and reached a record-setting high of 2.08 million in 2015.

Moreover, the number of MICE *2 events held in Fukuoka has increased so that Fukuoka has only been second to Tokyo for the past six years running, and more cruise ships call at the Port of Hakata than at any other port in Japan.

2014	Number of visitors	18,550,000
2015	Number of foreigners entering Japan through Fukuoka Airport and the Port of Hakata	2,080,000
2014	Number of MICE events held in Fukuoka	336
2014	Number of cruise ships docking in Fukuoka	99

(4) Survey

To assess the effectiveness of the service, we included a user survey in the Wi-Fi service to evaluate and review the service while seeking to improve user satisfaction. The survey revealed that user satisfaction is around 82% (proportion of respondents stating that they were "satisfied" or "somewhat satisfied" with the service).

5 Future Development

Since the service was developed and deployed by the city of Fukuoka, the city is in a unique leadership position to undertake a range of proactive initiatives. Looking ahead, we will seek to establish a "more sustainable operating model" for the service, while leveraging the Stamp Rally and Pop-In Banner capabilities as advertising that would help ensure a steady revenue stream from the service. And in terms of leveraging ICT, new information transmission challenges lie ahead that involve incorporation of ICT technologies—digital signage, beacons, applications, and so on—with Wi-Fi, while making good use of city measures and building new business models by the private sector through analysis of Wi-Fi access data and other forms of big data.

We are also pursuing *integrated authentication* with Wi-Fi services provided by other telecom operators. Discussions are ongoing at the national level on how to simplify and unify usage activation procedures, but at the same time Fukuoka is pursuing discussions with other local governments and organizations while trying to achieve more convenient usability by implementing integrated authentication on the browser.

Fukuoka Website URL: http://www.city.fukuoka.lg.jp/wi-fi/index.html (Japanese site only)

*2 The term MICE is an acronym for Meeting, Incentive Travel, Convention, and Event/Exhibition events.

Tokushima Satellite Office Project

Regional Revitalization Promotion Division,
General Policy Formation Department, Tokushima prefecture

1. Introduction

A wave of venture and creator companies have been flooding into sparsely populated villages in the mountains of Tokushima Prefecture on the island of Shikoku, and converting old abandoned homes into trendy updated satellite offices.

The term *satellite office* refers to a smaller office that is located some distance from the corporate headquarters or the main office that is fully equipped for employees to do exactly the same kind of work as at the main office as a form of telework much like telecommuting from home or mobile work. Remarkable innovations in ICT technology (information and communication technology) such as web conferencing and cloud computing services have opened up a vastly more flexible way of working that is no longer bound by the constraints of time and space. Virtually anyone today can opt for a very cost-effective environment where one can share information with colleagues and clients in real time via stress-free communications without setting foot in the main office downtown. And living in the countryside has a whole range of benefits: it enables employees to really focus on their work in a quiet relaxing atmosphere, while at the same time giving them immediate access to the full range of outdoor activities, farming, or other pursuits surrounded by a rich natural environment in their off hours. In pursuit of an ideal lifestyle offering people the best of both urban and rural worlds, companies in the Tokyo metropolitan area are boldly trying to create a new style of working in a rural setting by establishing satellite offices in five cities and towns in Tokushima Prefecture on the eastern end of Shikoku Island.

Here we will briefly review the history and future prospects of the *Tokushima Satellite Office Project* that has attracted nationwide interest as a great success story in the government's quest to encourage more people to move from the cities to the countryside to promote *rural revitalization*.

Photo 1: Engawa Office / Plat-Ease Corporation

2. Project rollout: background and history

The project was first conceived and motivated by the Great East Japan Earthquake of March 11, 2011. The earthquake served as a wakeup call, for the rolling blackouts and paralysis of public transport and other vital services that left tens of thousands of commuters stranded in the city really highlighted the risks of concentrating too many businesses and people in the Tokyo metropolitan area, and underscored the importance of business continuity planning (BCP) measures to manage corporate risk.

One solution is the "decentralization of company operations," and indeed migrating business systems and corporate data to the cloud and building backup offices have become a very important aspect of corporate management.

Another solution that we will focus on here is an innovative trend to evolve a new way of working. There are too many companies that impose exceedingly poor work conditions on their employees—long commutes on packed trains and working long hours into the night in a concrete urban jungle—while seeking to inculcate new values and squeeze creativity from their workers. When employees get home too exhausted to enjoy leisure time with friends and family, we have to question the rationality of this work arrangement. Now we have begun to search for a more advanced type of company that involves a totally different way of working and provides a vibrant atmosphere where employees can realize their full potential and have fulfilling careers. Indeed, we are now seeing a paradigm shift that reflects a fundamental rethinking of how companies should be structured and how employees can lead meaningful lives.

Among the depopulated areas in Tokushima Prefecture, the *Tokushima Village Restoration Project* is focusing on a so-called *marginal village* (a village that has lost population to the point that more than half the locals living there are over the age of 65), with the goal of revitalizing the village while making best use of local resources.

Analyzing these sparsely populated districts in the prefecture, we find that compared to Japan's national average population gain of 35.8% over the 50-year period from 1960 to 2010, the population of Tokushima Prefecture fell by 7.3%, and the more sparsely populated parts of the prefecture actually plummeted by 53.8% [1]. We also observe that Tokushima has an extraordinarily high ratio of marginal villages where more than half village residents are older than 65. Compared to the national average of 15.5% of village, approximately 35.5% of Tokushima's hamlets are classified as marginal villages, some 2.3 times higher than the national average [2]. By other measures as well, Tokushima is

in serious trouble: the prefecture is 5th worst in terms of vacant or abandoned houses at 14.9% [3], the worst in the nation in terms of decommissioned or closed schools with 65 schools no longer in use [4], and the shuddering or idling of public facilities as the population continues to shrink is becoming a serious problem.

This paper will focus on a number of companies and employees who seized the opportunity to move from Tokyo back to this marginal sparsely populated community to inaugurate the *Tokushima Satellite Office Project*. Essentially, the project was an attempt by the Tokyo companies to try out an ideal working style by exploiting several strengths of the prefecture: the availability of valuable vacant homes and abandoned school buildings in the village that could be repurposed for the project in combination with very-high-speed broadband services deployed all thorough the mountainous prefecture providing ten times the throughput available in Tokyo.

In September 2011, ten companies from Tokyo moved into the prefecture and set up trial satellite offices in five different locations to explore the feasibility of the concept, and found that this arrangement did support stress-free continuous operations. The participating offices themselves were very enthusiastic about the project—"this work environment is like a dream come true," "the move to Tokushima put new energy into our employees," etc.—so the next year we moved on to full-scale deployment of the project in March 2012.

3. Satellite offices exceed expectations, evolve in diverse ways

The first satellite offices were set up as a kind of residential retreat where employees would be sent out for relatively short periods of time to figure out the optimum length of stay or service at a satellite office and also to figure out which employees would be best suited to work in rural communities. Next, we moved into a trial-and-error phase where the various companies tried all sorts of schemes, some of which they hadn't even considered at first when they were trying to lure employees to sign onto the project. For example, one company set up a *long-stay office* where local hires and transplants from Tokyo would commit for a prolonged period, another company established a *free office* system where employees could choose where they wanted to work during each season of the year, yet another company moved their headquarters to Tokushima and set up a satellite office in Tokyo, while yet another company spun off a new start-up firm that pursued a totally different line of work from the main office, and there were other permutations.

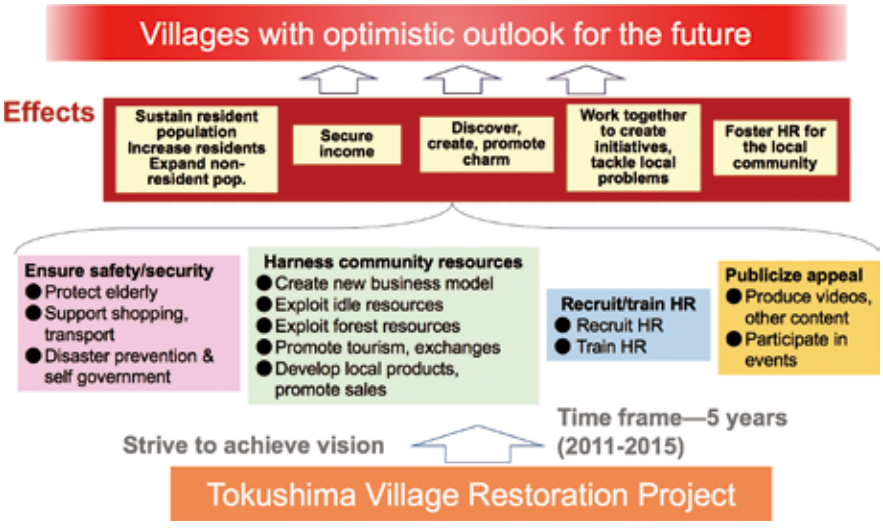
Many of the companies setting up in Tokushima are in the IT sector—software and system development, web design, and so on—but more recently, the satellite office trend has continued to expand to other types of businesses. An old sewing factory owned by the town of Kamiyama was refurbished and converted to the *Kamiyama Valley Satellite Office Complex*, a shared workspace and central facility for satellite offices from within and outside the prefecture. This complex attracted a very diverse range of businesses including IT companies, a 3D modeling engineering firm, an international patent office that deals mostly with intellectual property, an incubation consultant that helps entrepreneurs establish start-up ventures, a corporate manager from the U.S. has set up shop in the complex, and many more. The University of Tokushima and Meiji University have set up offices in the complex for their students to conduct field work, and an after-school club, the *Kamiyama Electronics Club*, sprang into existence for the children of people who work at offices in the complex. The complex has become a symbol of a new cosmopolitan Kamiyama; it provides a central meeting place where the increasingly diverse population of Kamiyama across all ages and vocations can get together and exchange ideas.

The town has drawn a lot of interest among companies that are thinking of setting up satellite offices, over 2,500 visitors a year come to Kamiyama to check out things for themselves, and the movement is picking up momentum as apparent from two new

Figure: Outline of the project

Tokushima Village Restoration Project

- **Basic concept**
  Focusing on a marginal village where more than half the population is over 65 years old, the Project strives for success stories by coming up with specific initiatives and measures (prescriptions) and by exploiting leading-edge high-speed ICT infrastructure and taking full advantage of village resources.
- **Overview**
  The Tokushima Village Restoration Project defines 36 specific measures for village restoration that are sorted into four basic categories: "ensure safety and security," "harness community resources," "secure and train human resources," and "publicize appeal of the project."
- **Project goals**
  In pursuing these project initiatives, the primary objectives are to create "villages with sustaining populations that can face new challenges and possibilities," "villages that pass down their own unique regional cultures and technologies," and "villages in which residents feel secure and have purpose to their lives." In other words, "villages with a bright optimistic outlook ready to embrace the future."



offices that opened up in quick succession in July 2015. Recently, a service center was established where companies can bring in some employees and try out their operations on location before they actually commit to resettle. Targeting companies that have shown interest by visiting Kamiyama, the trial service center provides a place where companies can set up shop for a while, conduct their normal business or work, and forge relationships with people in the local community. In other words, this provides a way for companies to experience what it would be like to establish a satellite office in Kamiyama without going through the hassle of negotiating with a homeowner or thinking about how much it would cost to remodel a building. Focusing on new corporations set up by managers of companies that recently moved into the area, the service center provides a full range of technical support ranging from telework expertise to building bridges with the local community.

Photo 2: Kamiyama Valley Satellite Office Complex / Green Valley Corporation

Photo 3: WEEK Kamiyama / Kamiyama Jinryo Co., Ltd.

Moreover, companies have more to gain than a sound business continuity planning strategy or mellow stress-free place for employees to work. CypherTec Inc. developed a line of encryption-based digital right protection products, but they had trouble recruiting enough good people in Tokyo because they were over-shadowed by a major high-profile company that was draining of the human resources, and this was wreaking havoc with their growth and their bottom line. CypherTec then came up with a novel approach of setting up a satellite office—*Minami Lab*—in the town of Minami in Tokushima Prefecture in the hopes that this would prove attractive to younger job applicants who wanted to get back to nature and to rural living. They worked out an arrangement reconciling work and individual privacy—*half X half IT* (where X signifies the individual's private pursuits)—which quickly drew the attention of younger creative recruits who were interested in surfing, fishing, and other outdoor activities. CypherTec's recruitment problem vanished as more and more applicants who identified with these values were drawn to the company, and within two years after launching Minami Lab, the company's workforce had increased three-fold. Company sales and profits have been in the black year after year, and the company's shrewd example motivated 12 other companies to set up satellite offices in Minami, and we expect to see even more companies move to Minami in the years ahead. The population of Minami continued to decline, but in 2014 something remarkable happened; for the first time since the village was formed through annexation of two smaller hamlets in 2006, more people moved into Minami than moved out, and Minami saw an increase in population.

And CypherTec is not alone. We have seen quite a few competent mid-career veteran engineers who reach a point in their lives where they want less stress in their work and apply to work in a satellite office which emphasizes sound balance between life and work. In fact, there have been cases where new satellite offices have been set up in a particular area because that's were valuable personnel live that the company wants to tap. Clearly Japan will require greater work flexibility in the years ahead that respects more diverse values, that prevents women from dropping out of the workforce when they have a baby, or to take care of children, or provide nursing care to someone in the household, and to provide women with greater job opportunities.

4. Make the most of cooperative partnership

Close collaboration among local residents, companies moving into the community, and government has made this project a tremendous success. Certainly the biggest factor is the natural charm and charisma of the local people. Kamiyama folk are good natured, they go out of their way to show hospitality to pilgrims on the Shikoku Pilgrimage, and they don't just dismiss ideas out of hand no matter how bizarre they may sound. Rather, they are always willing to jump on board and at least give the idea a hearing. They show tolerance, broad-mindedness, and comfortable flexibility toward new people, and it is these very qualities that have brought a diverse range of newcomers into Kamiyama to stay and to live.

Companies coming into the area convey the appeal of satellite offices through their unique activities, advanced information transmission capacities, and extensive personal networks. And the ability of these companies to attract more people into the area has helped promote the growth and prosperity of the community at large.

Finally, government serves as a moderate backup. They listen to opinions and issues raised by community stakeholders, then come up with a variety of reform measures: review of a car-sharing scheme, support for a subsidized program, and so on. By promoting a spirit of cooperation while giving full play to the natural abilities of all the stakeholders, this has helped ensure the success of the project.

5. Conclusions

Bringing satellite offices into the community is not going to generate the tax revenues nor the jobs that opening up a larger plant or factory might produce. But the goal here is not simply the economic impacts, but rather to attract the right kind of people into the community needed to sustain and rejuvenate the village into the future. Sensitivity to cutting-edge developments, personal networks that rarely penetrate to rural areas, imagination and action that transcend the stultifying atmosphere of rural backcountry areas are absolutely invaluable in their impact on the rural depopulated communities of Japan.

By enticing a few good people into the community who accomplish interesting things, this effectively opens the flood gates and brings in a lot more people. And this influx of new blood can have remarkable ripple effects in sparsely populated areas: organic food restaurants appear that could never gain a toehold before, suddenly there's support for guesthouses and a service industry, and the need to provide groceries and produce jumpstarts local agriculture. As leaders of the local community, things are really starting to happen around here that are turning around the problems of depopulation: farming is coming back as abandoned farmland is leased and put back into cultivation, community-supported agriculture is set up to harvest and distribute crops to city-dwellers, opportunities open up for local children to get hands-on work experience and classes on demand, companies contribute to make local education more engaging and interesting, tree farms have been nurtured back to health after long neglect due to the downturn in timber prices, and clever new design ideas that exploit forest thinnings have been developed, and a host of other innovative new ventures have sprouted up.

The project has now been up and running for about four years. From an outside perspective, one can see that we have rediscovered the charm and beauty of this place, and interaction between the newcomers and former residents has breathed new life into community. The combination of new and old wisdom and experience has really broken through the sense of futility and stagnation that pervaded this region until recently, and we have come up with truly innovative solutions that no one could have foreseen. Well, now we can envision such a future!

References
[1] Ministry of Internal Affairs and Communications Statistics Bureau, 2010 Census.
[2] Ministry of Internal Affairs and Communications and Ministry of Land, Infrastructure, Transport and Tourism, "Survey on the state of villages in depopulated areas," 2010.
[3] Ministry of Internal Affairs and Communications Statistics Bureau, "Housing and Land Survey," 2008.
[4] Ministry of Education, Culture, Sports, Science and Technology, "Survey on the utilization of closed schools and other facilities," 2010.

Table: Project overview

Feasibility study, 2011	Ten firms in the Tokyo metropolitan area conducted a study to determine the feasibility of setting up satellite offices in depopulated areas of Tokushima Prefecture: towns of Miyoshi, Kamiyama, Minami, etc.
Satellite office inspection tour, 2011 -	Tokyo firms conducted a satellite office inspection tour focusing on towns of Miyoshi, Kamiyama, Minami.
Organized *Tokushima Satellite Office Promotion Team*, March 2012	Organized the *Tokushima Satellite Office Promotion Team* consisting of representatives from the prefecture, the towns involved, NPOs, and the companies planning to set up offices. Discussed "how to upgrade system of acceptance" and "strategic dissemination of information." Launched a website to handle interest and inquires, and a PR booth at Tokushima Business Challenge Messe, and at various events in Tokyo and Osaka.
Established *Kamiyama Valley Satellite Office Complex*, January 2013	The prefecture, Kamiyama, and NPOs remodeled old sewing plant, and converted it into the Satellite Office Complex. ICT people, creators, and others got together and figured out how to exploit the space as a base for generating new business while upgrading and revitalizing the region.
Earned the 1st *Platinum Award* for excellence, July 2013	In the 1st Platinum Awards competition, took second place to win the Grand Prize out of 124 entries for all around best solution for difficult regional issues.
Developed shared concept of Tokushima (vs. Tokyo), September 2014	Based on fresh concept of new values from the perspective of Tokushima rather than Tokyo, made a strong appeal to the virtues and qualities of Tokushima throughout Japan and abroad.
Dispatch satellite personnel from Cabinet Secretariat Headquarters for Overcoming Population Decline and Vitalizing Local Economy, November 2014	Dispatch staff to Kamiyama to promote *regional revitalization* by encouraging influx of new people to the region. (1) Try performing office work over telework terminals (2) Conduct on-site surveys of satellite offices, immigrants, permanent residents (3) Promote understanding by bringing business owners and others to visit the town
Various activities to strengthen ties with the community	(1) Provide local volunteer guides and tablet computers with tourism apps. (2) Host intern camp for students from other prefectures, events of local middle and high school students to develop applications, live-talk events, and other activities to enlighten people to the possibilities of other modes of work. (3) Collaboration among satellite offices to design local business logo, product packaging, and help establish stores. (4) Develop projects in cooperation with local companies to promote use of forest thinnings to ensure verdant forestlands are left for future generations to enjoy. (5) Local housewives cooperated in offering tempting local specialty food products, and opened a cafe that brought people together. (6) Provide system for managing visitor data from the time they submit applications to a local NPO.
Monitor establishment of satellite offices, May 2016 to present	Many companies have moved into the prefecture including 13 to Kamiyama, 13 to Minami, 1 to Tokushima, 5 to Miyoshi, 1 to Anan, and 1 to Mugi. This has created employment for over 60 people.

Japan Battery Regeneration,Inc.

Applying Lead-acid Battery Regeneration Technology to ICT

Takeshi Kawabe
Managing Director & President
Japan Battery Regeneration, Inc.

Why we joined ITU-AJ

Our company's technology was well understood and welcomed by the ITU-AJ, and we were given a chance to exhibit in Japan Pavilion at ITU TELECOM WORLD 2015 held in Budapest last year. Indeed, we were honored to receive the Entrepreneurship Award at the event. We came to appreciate the importance of ITC activities, and realized that our technology for prolonging the life of batteries and regenerating old abandoned lead-acid batteries have a critically important role to play in ICT and electrification of rural areas of third world countries. We joined ITU-AJ with the idea of expanding our activities worldwide, contributing to the reduction of industry wastes, and protecting the global environment.

Introduction of our company and product

We produce and market an ITE activator for lead-acid batteries called *Super-K* (patented in the U.S., Japan, and China), and we offer proprietary technology for lengthening battery life and regenerating old-abandoned lead-acid batteries using *Super-K*. We are committed to providing the most cost-effective way of regenerating old lead-acid batteries.

Super-K was developed by Dr. Akiya Kozawa (ex-fellow at Union Carbide and former professor at Tohoku University) and his research group at Yamagata University and other Japanese universities. *Super-K* is supported by a great deal of chemistry-related research conducted over many years explaining how and why Super-K works, and a vast amount of actual test data compiled by research labs and businesses.

The lead-acid battery was the first type of secondary battery developed, and is the most widely used battery in the world with some 70% share of the secondary battery market. Lead-acid batteries are used to start auto engines, are employed in electric forklifts and golf carts, are used in Uninterruptible Power-supply System (UPS) battery backup systems, and countless other applications. Using *Super-K* and our battery regeneration technology, the life of a typical battery can be dramatically extended 1.5 to 2 times for a remarkable reduction of battery waste and battery cost.

Brief explanation of how the *Super-K* activator works:

By adding *Super-K* to the battery fluid (diluted sulfuric acid), it effectively inhibits hydrogen evolution at the negative electrode, thus enabling the battery to recharge more deeply, and reduces sulfation in the negative electrode. Sulfation is the number one cause of lead-acid battery deterioration, and *Super-K* effectively dissolves sulfation. *Super-K* can be used on new batteries or batteries currently in use to extend the life of the battery, or on old abandoned batteries to regenerate or recycle the battery.

Recent activities and topics

Testifying to the effectiveness of *Super-K*, a leading Tokyo transport company has been using *Super-K* for over ten years and has not had to purchase replacement batteries for the entire decade-long period. *Super-K* is also used by people who exploit solar power without relying on commercial electricity by employing their own lead acid battery based power generation systems. Finally, a subsidiary of Japan's largest logistics company has launched a battery regeneration service for electric forklift batteries using *Super-K* and our technology.

In overseas markets, Thai golf courses seized upon *Super-K* for its ability to dramatically extend battery life and regenerate old batteries. This slashed costs to buy replacement batteries while at the same time reducing industrial waste.

In a more recent initiative, we are committed to set up a battery regeneration center in Nepal as part of an APT-J3 project. Small-scale low-cost power generation stations are critically important for people living in rural or developing economies to leverage and exploit the power of ICT. Yet the cost of batteries can be a major hurdle in building such power generation systems. Low-cost good quality lead-acid batteries are indispensable, and we are in the perfect position to provide such batteries while regenerating old batteries. We have much to contribute to the green sustainable society through clean energy and responsible environmental stewardship.

Lead-acid batteries undergoing regeneration charging

= A Serial Introduction Part 1= Winners of ITU-AJ Encouragement Awards 2016

In May every year, the ITU Association of Japan (ITU-AJ) proudly presents ITU-AJ Encouragement Awards to people who have made outstanding contributions in the field of international standardization and have helped in the ongoing development of ICT.
These Awards are also an embodiment of our sincere desire to encourage further contributions from these individuals in the future.
If you happen to run into these winners at another meeting in the future, please say hello to them.
But first, as part of the introductory series of Award Winners, allow us to introduce some of those remarkable winners.

Akira Agata
KDDI Corporatoin
ak-agata@kddi.com http://www.kddi.com/english/
Fields of activity: FSAN (Full Service Access Networks)

Standardization of Next-Generation Optical Access Systems for Mobile Fronthaul Applications

It is a great honor for me to receive the ITU-AJ Encouragement Award (ICT Field), and I would express my appreciation not only to the Selection Committee but to all who have helped me along the way.

I began participating in the Full Service Access Networks (FSAN) meetings in 2014. FSAN is a group of the world's leading telecommunications companies working collaboratively to form a consensus on future optical access systems, and works together with ITU-T Q2/SG15 to develop standard specifications based on the consensus.

In FSAN, I have mainly been involved in discussions of next-generation optical access systems that offer higher speed (>40 Gbit/s) and lower latency (<0.5 ms) for mobile fronthaul applications. The background of this topic is the rapid growth of mobile data traffic caused by high-speed mobile devices such as smartphones and data-intensive applications. In order to meet the growing demand for wireless network capacity, deployment of the Centralized Radio Access Network (C-RAN) architecture has long been anticipated for its ability to enhance the signal quality of Long Term Evolution-Advanced (LTE-A) and other advanced features. The problem is that standard specifications for optical access links to convey digital baseband LTE waveform signals between central offices and antenna sites (which require the high-capacity and low-latency features mentioned earlier) have not yet been developed.

The primary goal of FSAN meeting discussions is to reach consensus on the necessary technical requirements for such an optical access system and to draft a technical white paper detailing the requirements by 2016. As an editor of the white paper, I am often called upon to lead discussions regarding technical details and requirements of mobile fronthaul networks.

The white paper is scheduled for release in 2016. This document will be a significant contribution to ITU-T Q2/SG15, which will ultimately define the actual international standard for next-generation optical access systems. I remain committed to advance the ICT field and to help consolidate interconnectivity and communication that improves the quality of life for people everywhere.

Kenjiro Arai
NTT (Nippon Telegraph and Telephone Corporation)
arai.kenjiro@lab.ntt.co.jp http://www.ntt.co.jp/inlab/e/org/ns.html
Fields of activity: 3GPP, TTC

Initiatives and steps toward IMS standardization [standards]

It is a great honor to receive the ITU Association of Japan (ITU-AJ) Encouragement Award, and I would like to express my appreciation to the ITU-AJ and to my colleagues for their support and encouragement.

I have served in a number of capacities on interface standards between international and domestic operator/carrier IP networks, which are critically important for migrating the PSTN to an IP-based network. Starting in 2010, I served on CT WG3 (CT3) of the 3GPP (The 3rd Generation Partnership Project), while also working for the TTC Signalling Working Group. Then in 2013, I took over as Vice-Chairman of 3GPP CT3, and in 2014 I became leader of the Session Initiation Protocol (SIP) SWG of the TTC Signalling Working Group.

The primary concern of 3GPP CT (Core Network & Terminals) is standardization of a protocol level specification (Stage 3) based on the service architecture specifications developed in SA (Service & Systems Aspect). Currently, one of the most significant study items is the IMS (IP Multimedia Subsystem), the platform supporting voice and a full range of other multimedia services. CT3 deliberations regarding IMS focus on IMS interconnection standards between different carriers, IMS-PSTN interworking standards, and standards for interconnecting networks that support different carriers and different protocols.

Going back to activities begun in 2010, we finally completed the 3GPP release of an IP network interface standard in 2013 that fully considers commercial viability as an interconnectivity standard. Also in 2013, a TTC standard was approved for seamless interconnection of mobile and fixed networks.

Currently, the 3GPP CT is working on standardization of a VoLTE roaming scheme, various IMS improvement and extension measures, and has stepped up deliberations on domestic (TTC) standardization of migration from PSTN to an IP network. I will continue to do my best to advance the cause of IMS-related standards for both international and domestic operators/carriers in the years ahead.

Kazuhito Ishida
QUALCOMM Japan Inc.
kishida@qti.qualcomm.com https://www.qualcomm.com/
Fields of activity: Wireless Power Transmission

Frequency harmonization and standardization of Wireless Power Transmission technologies

ITU-R Study on Wireless Power Transmission (WPT) technologies has involved a number of recent technical issues in QUESTION ITU-R 210-3/1 since its latest revision in 2012. In Japan, the March 2016 Ministerial Ordinance for partial revision of the Radio Act stipulated the first WPT-related Radio Regulation including frequency ranges for WPT technologies. Meanwhile, no clear-cut WPT definitions have been adapted in global radio communication regulations and/or standards. In country-specific or regional WPT studies, some radio administrations refer to existing technologies such as Short Range Devices. However, the technical requirements and conditions for coexistence with incumbent systems have not been specified for WPT. International or regional recommendations for frequency ranges and technical standards should therefore be drafted so as to maximize beneficial use of WPT without causing any harmful interference.

In 2014, ITU-R SG1 approved Report ITU-R SM.2303 "Wireless power transmission using technologies other than radio frequency beam." Currently, development of a Recommendation on frequency ranges for global or regional operation and Human Hazards of non-beam WPT systems for mobile devices is in progress. In addition, in November 2015 WRC-15 and CPM19-1 decided that "*Studies concerning Wireless Power Transmission (WPT) for electric vehicles*" should be addressed under Agenda Item 9.1, Issue 9.1.6 for urgent study by WRC-19. ITU-R SG1 WP 1B will be responsible for preparing the CPM texts for Issue 9.1.6. These developments represent significant progress for WPT development on frequency harmonization and for studies on the impact of WPT to radiocommunications systems.

Japan has been actively involved in WPT-related groups in ITU-R SG1 and in the APT Wireless Group, where I served as editor of key documents and as a coordinator as required. During this period, Japan made significant and timely contributions to discussions of the latest radio regulatory status and study results and their impact on WPT systems. These discussion results were well-incorporated in the Report and in the draft Recommendation, which reflects Japan's leading role in frequency surveys and technical studies of WPT.

During the same period, I assumed the role of Chairperson of the Standards Development Group (SDG) of the Broadband Wireless Forum WPT-Working Group (Leader = Dr. Shoki, Hiroki, (Toshiba Corp.)). Three WPT technologies for mobile devices were approved by the Association of Radio Industries and Businesses as national standard "ARIB STD-T113" in 2015. The SDG plans to explore additional technologies for standardizing and establishing new rule making for higher power non-beam WPT systems and beam applications.

Wuri A. Hapsari
NTT DOCOMO, INC.
wuri@nttdocomo.com https://www.nttdocomo.co.jp/english/
Fields of activity: 3GPP Radio Access Network Standardization

Creating standard specifications from service and customer perspectives

It is a great honor to receive the ITU-AJ Encouragement Award. The award recognizes my work in 3GPP (3rd Generation Partnership Project) with regard to the RAN (Radio Access Network) architecture for LTE/LTE-Advanced, RAN-CN node interfaces, barring mechanisms for VoLTE (Voice over LTE), and (e)MTC L2/3 specifications.

There are two important things I always keep in mind when pursuing standardization work: (1) standard specifications are created to realize functions that are needed in the actual market, and (2) standard specifications should be written so they can be implemented in real-life networks and terminals. Here is a summary of work I have done.

Many network and terminal vendors and operators from around the world participate in 3GPP standardization meetings, and bring proposals based on their own perspectives. With regard to standardizing functions needed in actual markets, ETWS (Earthquake and Tsunami Warning System) is an example of a function that is standardized based on Japan regional requirement. Warning messages for disaster alert need to be sent promptly to large numbers of users. I proposed a mechanism to significantly shorten the message delivery time that was adopted as part of the specification. As a result, the ETWS function is supported from the beginning of the 3GPP LTE specification (Release 8 specification).

In order to provide services that utilize standardized functions, the specification must be implemented in actual network equipment and terminals. However, not all implementation engineers are aware of the background and the motivation of each standardized function since they do not attend the standardization meetings. Therefore, specifications must be written clearly and accurately so that, the resulting behaviour will be the same irrespective of the specific implementation. One example is the standardization of the barring mechanism for VoLTE. The barring mechanism is necessary to ensure network reliability, especially when networks are congested. To ensure that users can still make voice calls even when the network is congested, the standard incorporates my proposal of a mechanism that allows separation of barring for voice data and for packet data. To ensure that the specifications are clearly written and can be finalized, and hence able to be implemented within a short period of time, I attended several 3GPP working groups and collaborated with vendors in drafting those specifications. This resulted into a timely VoLTE service launch with all necessary functions included.

Going forward, I will continue to contribute and work on standardization, especially in the study and specification of a 5th generation radio system taking customer demands, ever-growing service requirements, and lessons learned from LTE standardization into account.

Overview of 2016 White Paper on Information and Communications in Japan

Economic Research Office,
ICT Strategy Policy Division,
Global ICT Strategy Bureau,
Ministry of Internal Affairs and Communications

1. Introduction

The Ministry of Internal Affairs and Communications published the "2016 White Paper on Information and Communications in Japan" on July 29, 2016.

The special theme of this year's White Paper is "IoT, Big Data, and AI: New Values Created by Networks and Data," which details the current status of IoT, big data, artificial intelligence (AI), and other new information and communications technologies (ICT), and outlines the prospects these technologies have for changing the overall socio-economic structure of society.

Chapter 1, " ICT-based Innovation and Economic Growth," deals with the contribution paths of IoT, big data, AI, and other new ICTs to economic growth, and quantitatively examines the potential effects ICTs have on supply and demand side economic growth while varying examples, corporate status, etc. associated with the various paths. Non-monetary values (consumer surplus) brought about by ICT will also be examined. Chapter 2, "Analysis of ICT Industrial Trends in the IoT Era," examines the ICT industry which is expected to contribute to economic growth, and quantitatively assesses the scale and growth potential of ICT device and service markets and competitive environment while sorting out the overall structure of the ICT industry based on development of the IoT. Chapter 3, "New Products and Services in the IoT Era," will take up fintech, the sharing economy, and other new ICT devices and services, and analyze the current status and issues affecting these services by comparing awareness, utilization intension, and other factors based on the results of an international consumer questionnaire. This chapter will also introduce cutting-edge examples of ICT utilization in healthcare, education, and other public sectors, and during the recent Kumamoto earthquakes. Finally, Chapter 4, "ICT Progress and Future Work Styles," will examine the impact ICT has had on employment and work styles and discuss the rapid advances that have been made in AI technology. Then while comparing these conditions and the results of a Japan-U.S. workers questionnaire, we will consider the direction of education and human resources development that is required for changing skills in the years ahead.

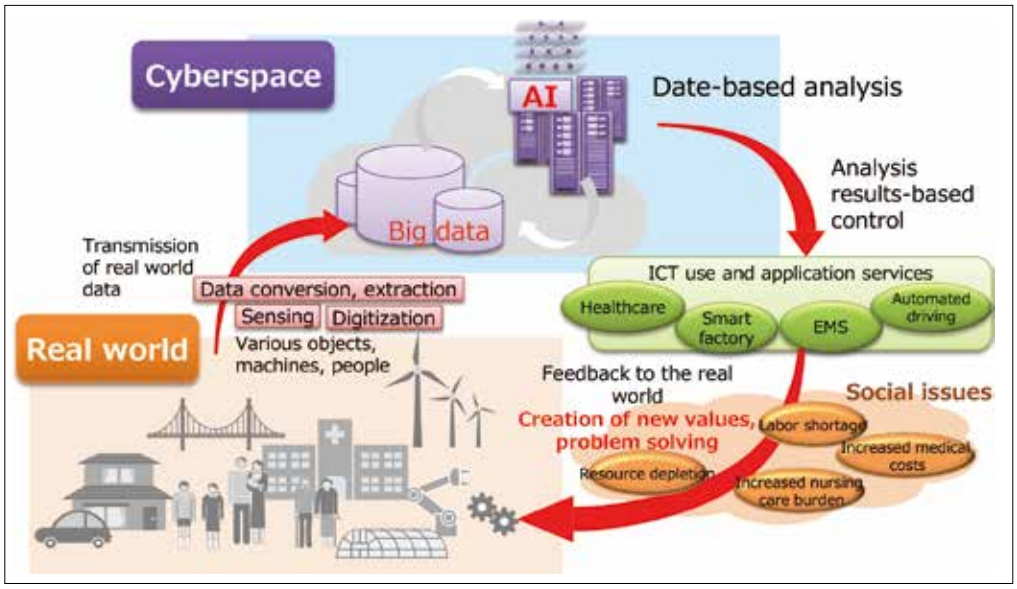
2. ICT-based innovation and economic growth

(1) ICT potential for solving issues facing Japan, such as the declining birth rate and aging population

Due to the aging of Japan's population amid extremely low birth rates, the working-age population started to decline in 1995, and Japan's total population peaked and started to decline in 2008. According to census figures compiled by the Ministry of Internal Affairs and Communications (MIC), Japan's total population in 2015 (excluding cases where age is not reported) was 125.2 million, and the working-age population (ages 15-64) was 75.92 million. The cohort of children aged 14 years and younger has continued to decline since 1982, which only highlights the relentlessly falling birthrates in Japan.

Japan's declining birthrate and aging population coupled with overall declining population will have an adverse effect on both supply and demand sides of Japan's economy, and could impede Japan's prospects for mid-to-long-term economic growth. Yet collecting (IoT) and accumulating (big data) and processing and analyzing (AI) a variety of data will enable us to better grasp current conditions, make predictions and forecasts, and manage equipment and services. This will contribute to economic growth, and should help create new value and solve issues (see Figure 1).

Figure1: New values created by IoT, big data, and AI



(2) ICT contribution to economic growth: specific paths and case example analysis

In light of nation's demographic circumstances, how might ICT contribute to Japan's economic growth? Here we analyzed four basic strategies—two addressing the supply side and two addressing the demand side of the economy—which were then subdivided into eight specific paths to bolster the economy over the next few years until around 2020 (See Figure 2).

The first strategy is to *improve productivity*, which is critically important in societies with decreasing populations. The White Paper underscores the significance of ICT for enhancing the productivity of companies, and here two specific paths contributing to the economy are discussed: *investment related to ICT* and *utilization of ICT*.

The second strategy is to *expand labor force participation and improve quality of labor*, and covers a range of initiatives including telework, exploiting ICT to replace labor, and employing human resources skilled in ICT.

Figure2: ICT paths contributing to the economy

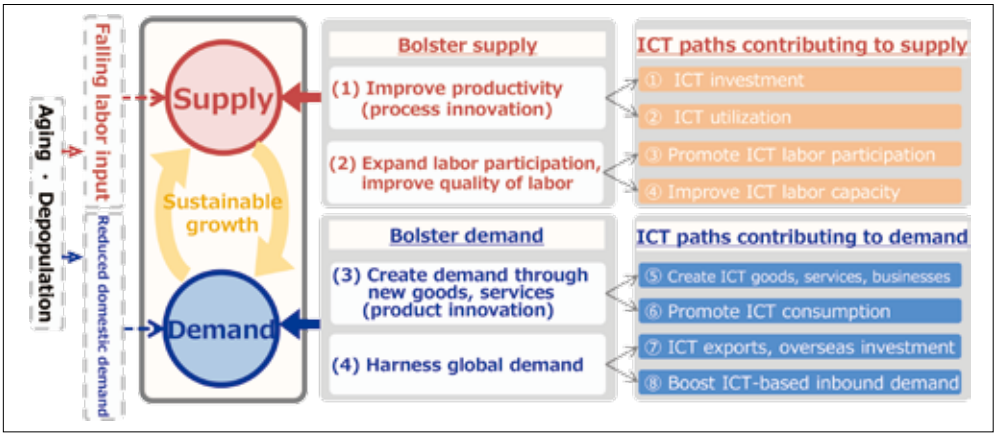
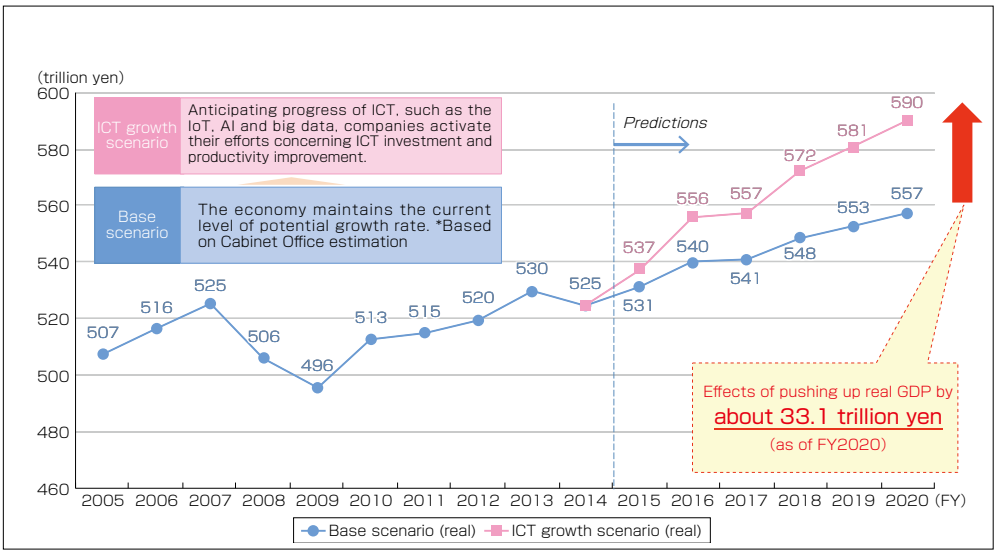


Figure3: Impact of ICT growth on real GDP



In addition to supply side capacity, sustained economic growth also must be supported by robust demand. Therefore, the third strategy is to harness ICT to *create demand for new products and services* featuring examples such as smartphones, telematics insurance, network shopping mixed with various types of statistics and estimates.

And finally, the fourth strategy is to *harness global demand*, which is further broken down into *exports and foreign investment and boosting inbound demand*.

(3) ICT contribution to economic growth: quantitative and comprehensive verification

Estimates of how much real GDP might be increased by investments in IoT, big data, AI, and other ICTs arrived at a figure of ¥33.1 trillion by the year 2020. Broken out by factor, the total factor productivity* contribution should increase, and ICT is expected to boost the total factor productivity contribution (see Figure 3).

(4) Multifaceted ICT contribution to the economy and society

ICT has also helped create considerable non-monetary values that is not captured by existing statistics. The White Paper covers three categories of non-monetary values—*consumer surplus, time saving, and information assets (word of mouth, reviews, etc.)*—and provide examples and quantitative estimates of each category. The paper also estimates the likely future impact of these types of non-monetary values on society.

3. Analysis of ICT industrial trends in the IoT era

(1) ICT industry structural reorganization brought about by IoT

In light of recent advances in Internet and sensor technologies, we are now beginning to see all kinds of devices, facilities, and other things interconnected to the Internet including home appliances, vehicles, buildings, factories, and much more. We can expect to see a vast increase in the number and variety of interconnected devices with the full arrival of the *Internet of Things* (IoT) era. According to projections by IHS Technology, close to 15.4 billion things (*i.e.*, IoT devices) were already connected to the Internet in 2015, and this number is expected to double to approximately 30.4 billion things by the year 2020.

How will this enormous increase in number of things and

* Factors other than production factors (labor, capital) that contribute to increasing added value. Specifically, it includes technology progress, improvement of workers' skills, and improvement in business management efficiency or organizational management efficiency.

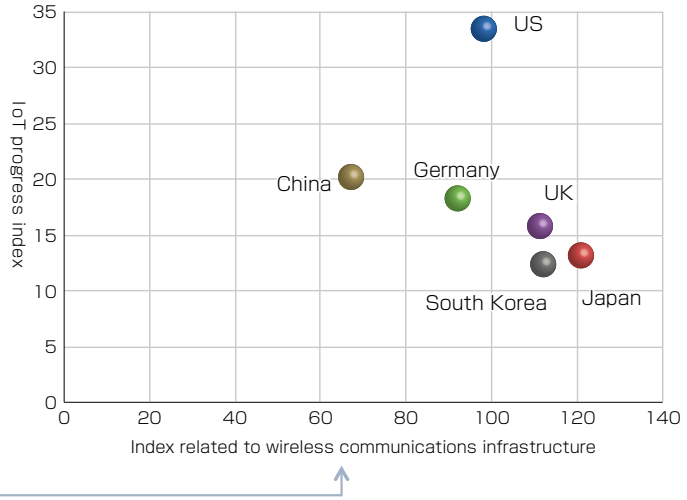
Figure4: International Comparison of IoT Progress

IoT progress index (based on a questionnaire survey of companies)	Weight
Process	
Rate of introducing IoT solutions	0.25
Amount of IoT-related capital investment by companies that have introduced IoT solutions (percentage of total sales)※	0.25
Product	
Rate of providing IoT goods/services	0.25
Amount of sales of IoT goods /services by companies that provide IoT goods/services (percentage of total sales)	0.25

※ Rather than the production cost reduction rate, we used amount of capital investment to align percentage of total sales.

Index related to wireless communications infrastructure (ITU*)	Weight
Mobile-cellular telephone subscriptions per 100 inhabitants	0.5
Active mobile-broadband subscriptions per 100 inhabitants	0.5

*Source: "ICT Development Index," ITC.

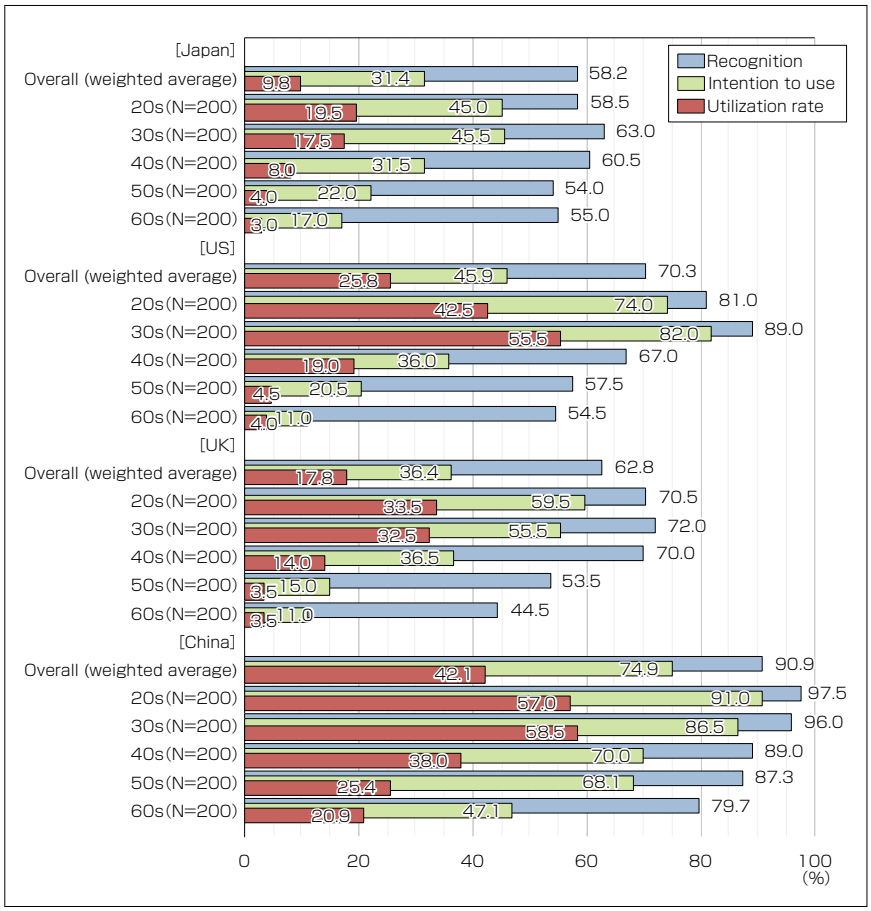


volume of data connected over the Internet change the structure of the current ICT industry and market?

First, we can expect new markets will emerge even as the existing ICT industry and market continue to expand and develop. Exploiting value added from big data collected by myriad devices, new markets will spring up providing all kinds of new services and applications. Breakthroughs in AI technology also have great promise for analyzing and applying big data derived from IoT, and this too will accelerate the emergence of IoT markets. Second, we can also anticipate competition to heat up among new value-added services and businesses made possible by the availability of big data. Rivalry will not just be among the traditional ICT players, but among new entrants from wholly different businesses and sectors who have found new ways to leverage ICT.

We thus envision an ecosystem taking shape in the form of a new ICT industry as existing ICT infrastructure and new ICT trends based on IoT, big data, and AI interact and affect each other.

Figure5: Recognition, intention to use, and utilization rate of asset management services



(2) Quantitative verification of the market size, etc.

If we classify the ICT industry in the IoT era into four hierarchical layers—*content and applications, platform, network, and devices and components*—it's apparent that the lower two layers (*network* and *devices and components*) have already achieved substantial global penetration. So, although the size of the mobile market is substantial, we should not expect rapid growth of individual-oriented devices like smartphones since the *devices and components* layer of the industry is down.

But now turning to the upper two layers of the industry—*content and applications* and *platform*—the market size for these areas is much smaller than the *network* and *devices and components* described in the previous paragraph, but the growth potential or growth rate is very high. This suggests that, for adding value to the ICT industry in the years ahead,

we should expect to see a shift to upper layers of the ICT industry.

(3) International IoT progress

Based on findings from an international company questionnaire, we first defined two indices—an index of national IoT progress and an index relating to the development of wireless communications infrastructure that serves as a key environmental factor in IoT progress—then assessed the performance of six nations (Japan, the U.S., the U.K., Germany, Korea, and China) based on these indices. We found that a relatively small percentage of companies identified Japan as having infrastructure-related issues that might affect IoT progress compared to other countries, and statistics also revealed that Japan's IoT progress index was low compared to the country's infrastructure development status. This shows that Japan needs better training of human resources, exposure of user companies to IoT use cases, and explicit measures promoting use of IoT (see Figure 4).

4. New products and services in the IoT era

(1) New services in the IoT era

Among new services symbolizing the arrival of the IoT era are fintech and the sharing economy. A user questionnaire was conducted in six countries (Japan, the U.S., the U.K., Germany, Korea, and China) to assess awareness, intention to use, and utilization rate of these new services, and Japan generally scored lower than the other countries (see Figure 5). While new ICT-inspired products and services should contribute to economic growth by creating additional demand, it is apparent that Japanese consumers are currently little aware of these developments and need more information and assurances to relieve anxieties about new technology.

(2) Smartphone penetration and ICT use and application

It is generally assumed that smartphones, other ICT terminals, and social media will provide the foundation for the adoption and spread of the new services mentioned in Section (1) above. Yet survey results among the six countries mentioned earlier revealed that smartphone usage in Japan at 60% was relatively lower than the other countries. Broken out by age, it was found that while 87% of young people in their 20s use smartphones, a far smaller percentage older people above age 50 use smartphones. This cohort is much more inclined to use feature phones.

(3) ICT use and application in the public sector

ICT can help solve societal problems, and the White Paper describes several examples from the public sector, including extensive reliance on ICT during the Kumamoto earthquakes in April 2016.

5. ICT progress and future work styles

(1) ICT progress and employment, working styles

Development of ICT will affect the job market in two ways: it will have an employment substitution effect in which ICT takes the place of jobs that are currently done by people, and it will have a job creation effect by increasing added value and creating new businesses.

First, regarding the way ICT takes the place of current jobs, a preceding study has revealed that ICT can substitute for some routine types of work (*e.g.*, accounting, manufacturing) but not very well for non-routine types of work (*e.g.*, research, sales) and manual jobs. However, we should note that recent advances in AI and robotics is reinforcing the view that machines may take over some non-routine intellectual work and complex manual jobs in the not-too-distant future.

Advances in ICT are also having a major impact on the way people work. Going beyond telework that allows people to work from home or anywhere without commuting into a central place of work, the sharing economy and digital fabrication have become widespread, which give individuals who are not affiliated with larger organizations more opportunities for on-demand type work. These new work arrangements allow people to choose more flexible employment that is better suited to their own circumstances, and should help restore the work-life balance in people's lives.

Figure6: Appeal of new ways of working (Japan and US)

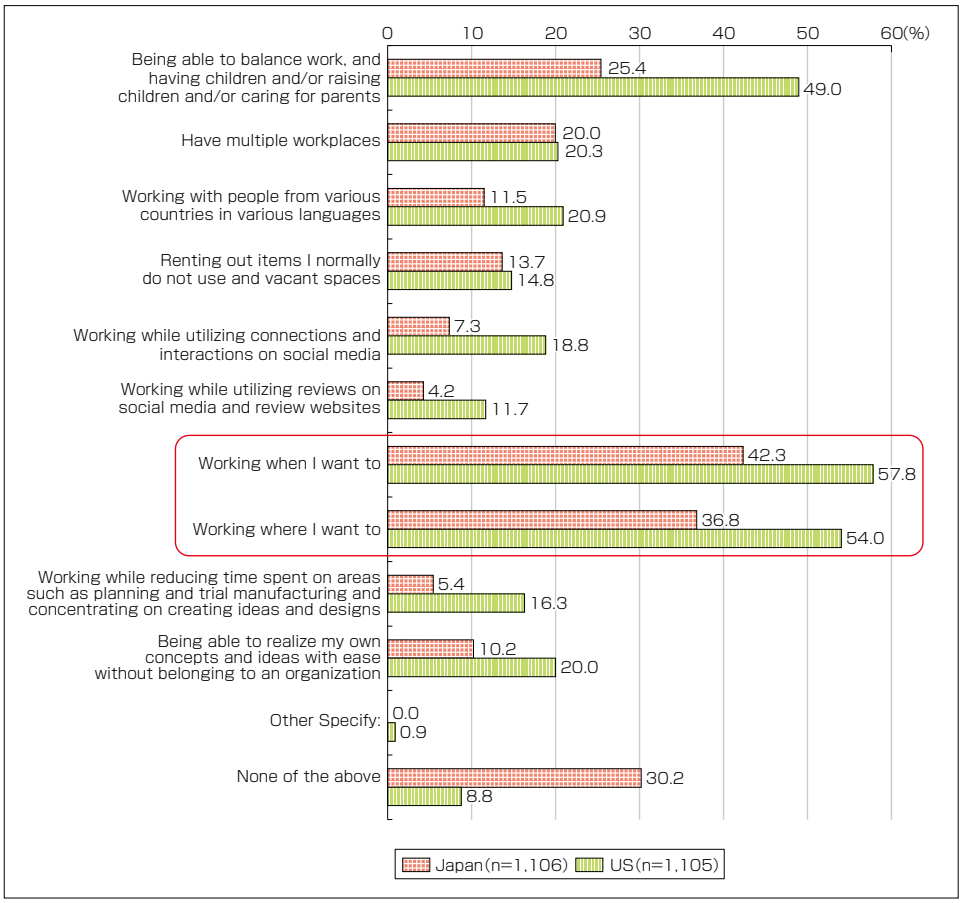
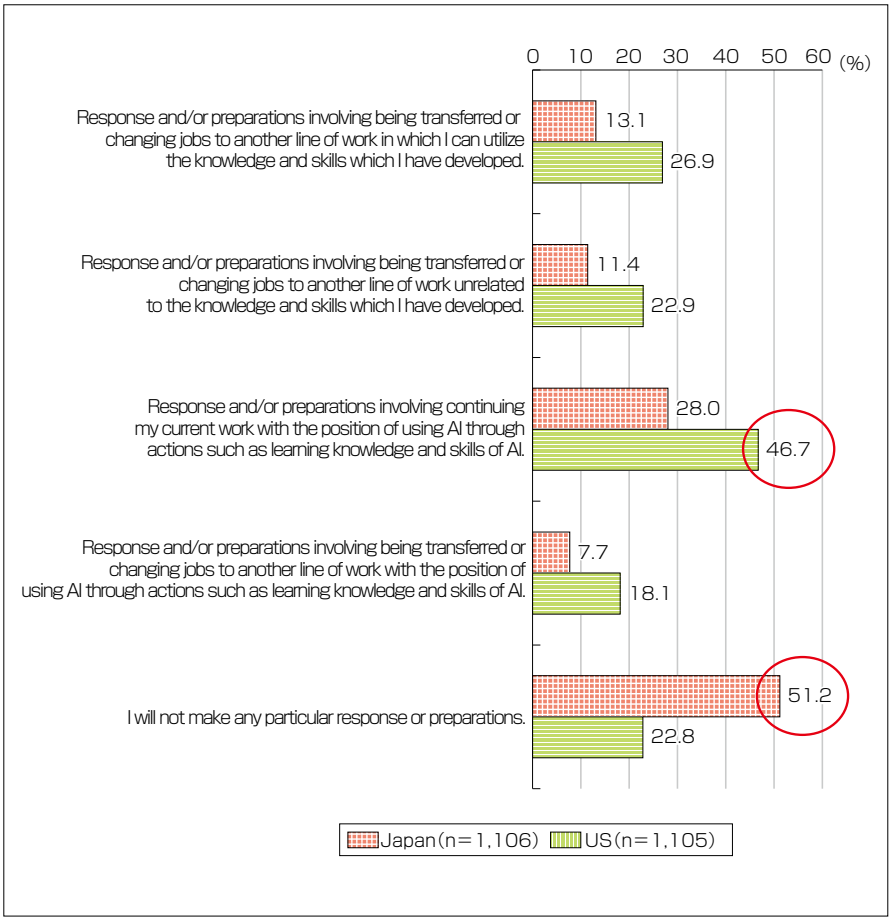


Figure7: Future response and/or preparations for penetration of AI



However, we polled Japanese and American workers regarding the appeal of these new work arrangements—telework, sharing economy, digital fabrication, and so on—and found that the Japanese were much less interested than their American counterparts. This led us to surmise that workers in Japan are less interested in pursuing alternative patterns or modes of working (see Figure 6).

(2) Present and future of artificial intelligence (AI)

Artificial intelligence (AI) is a relatively new phenomenon, for the term was first coined by John McCarthy, a computer scientist at an international conference at Dartmouth College in 1956. Generally, the term AI is applied to "science and technology concerned with machines or computer programs that perform tasks that normally require human intelligence," but among academics there is some variation in the definition. This might be attributed to the fact that "there is no commonly accepted definition of *intelligence or mental capacity* to begin with," so this makes it rather difficult to define AI.

Deep learning-based AI will open up a wider range of application areas by improving identification and prediction accuracy, and by merging different technologies this should provide sufficient functionality for practical use.

(3) Influence of AI progress on employment, etc.

There is general consensus that as AI becomes increasingly widespread, it will have the following effects on employment: it is generally thought that AI generates operational efficiencies, improve productivity, create new modes of work and new businesses, and fundamentally alter the volume of tasks that is the basis of employment.

We would expect that the volume of tasks associated with occupations introduced by AI will decrease as a result of improved efficiency and productivity of AI. But at the same time, AI has new work and employment effects, and we can anticipate an increase in the volume of tasks associated with new jobs associated with the deployment and spread of AI and new jobs used by AI that will be created. The ideal would be a society in which the volume of newly created tasks exceeds the volume of tasks that is lost, and clearly the creation of new jobs and businesses is a highly significant role of AI in the years ahead.

(4) Changes in the required skills and the types of human resources and education sought

There are various steps involved in exploiting AI, so we can expect that a wide range of human resources and capabilities will be needed when AI becomes commonplace and widely used.

What do Japanese and American workers think about how they respond and prepare for the future when AI becomes pervasive?

We found that many U.S. workers were fully committed to "acquire AI knowhow and skills so they would be well positioned to use AI to continue doing their jobs and work," and believed it was important to look ahead and prepare to exploit AI in their jobs and work of the future. Among the Japanese workers, we found that more than half the respondents said they "didn't plan to do anything special to respond or prepare for the advent of AI," yet were concerned that others might step up and exploit AI as it becomes widely disseminated (see Figure 7).

There can be little doubt that AI will become widely disseminated in our lives and in our work in the not-too-distant future. It is thus apparent that any nation that ignores AI does so at its peril, for ignoring AI will certainly have a detrimental effect on employment. A proactive stance is required to take full advantage of AI. This involves correct understanding of AI, training of professional resources who can engage in practical use of AI, more managers who can make sound decisions regarding deployment and use of AI, strong motivation and independence to achieve things by exploiting AI, creativity to develop novel new ways of incorporating AI in our daily lives and work, and so on. With a keen awareness of the issues at stake, we have witnessed a very rapid rollout of initiatives by the government and some forward-looking companies, and we can step up government-private cooperation in the future.

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