Efforts to Make Social Contributions through Businesses

NTT DATA Group strives to make social contributions through its businesses while working to promote a sustainable society by collaborating with its stakeholders.

CASE 01

Helping Address Issues Facing the Global Environment and Humanity by Utilizing Our "AW3D" Global High-Resolution 3D Map with the World's Highest Accuracy

Contributions to SDGs

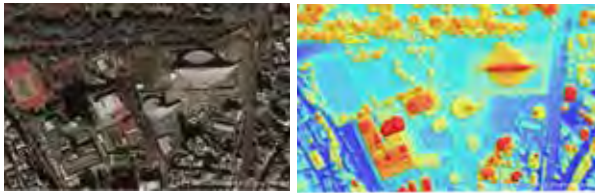
- Developing social infrastructure that is convenient, safe and secure
- Helping build sustainable cities and communities
- Developing infrastructure conducive to disaster management and natural disaster response
- Enabling stable energy procurement and promoting more efficient use of energy
- Realizing a society of health and longevity

If we were to express the concept of NTT DATA's AW3D Global High-Resolution 3D Map in one sentence, it would have to be this: Digitizing the whole earth for use in various simulations.

AW3D is a 3D map service provided jointly by the Remote Sensing Technology Center of Japan and NTT DATA by harnessing satellite imagery processing capabilities accumulated over many years. It uses satellite images from the Advanced Land Observing Satellite "DAICHI" (ALOS) belonging to the Japan Aerospace Exploration Agency (JAXA) as well as from the world's most advanced satellite, operated by American space technology company Maxar Technologies. Using the data sent from ALOS, which has an original image resolution of 2.5 meters, and that sent from Maxar's satellite, which has a resolution of 0.3 meters, NTT DATA processes the data to create 3D maps with a resolution of 5 meters and 0.5 meters, respectively. By combining a series of images sent from the world's most advanced earth observation satellites and the world's leading imagery processing technology, NTT DATA provides 3D data with accuracy equivalent to 1:2500 scale maps as well as image and extracted data. In July 2019, we started offering 2.5-meter mesh data sets of elevation data of global land areas and have completed the whole globe processing in October 2019. Moreover, we have already produced up to 0.5-meter mesh high-resolution data covering Japan and are providing it for any requested area. So far, AW3D has been used to create **maps in 120 countries across the world** for some 1,000 projects in the five short years since inauguration in 2014 inauguration, a fact that testifies to the effectiveness and reliability of AW3D.

It all started with the staggering amount of digital images —3 million in all—taken by ALOS during its operation in the five years after it was launched in 2006. Because turning such an enormous amount of images into data would take a long time, ways to accelerate and automate the process had to be developed. NTT DATA embarked on this challenge and successfully developed innovative technology by combining improved scalable computation capability, its **multi-view image processing technology** capable of simultaneously processing over 100 images of an area for improved accuracy, with **AI-based image analysis**. This technology has enabled us to provide our customers with high-resolution 3D maps in a speedy manner.

3D map of high-rise buildings in Tokyo's Minato Ward



3D map and orthorectified image of the Yoyogi area
© NTT DATA, Included ©Maxar Technologies,Inc.

Used for 3D maps in 120 countries across the world

AW3D is based on satellites capable of taking images with wide area coverage, which allows its users to enjoy greater efficiency and reduce the cost and lead time to about a quarter of that of a conventional method that uses aerial photographs. This feature makes it possible to create 3D maps that are highly practical and easy to use for people all over the world.

Multi-view image processing

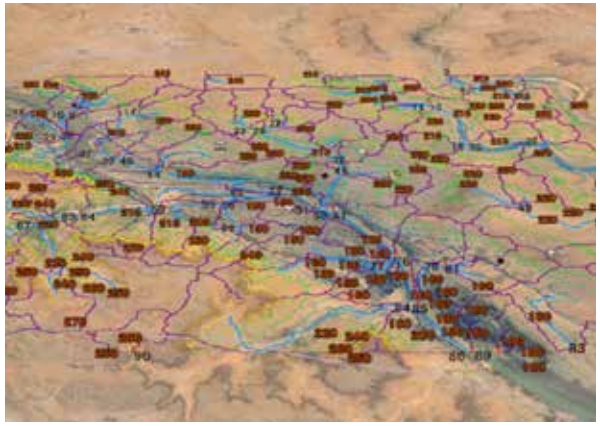
Multi-view Stereo Processing technology, developed by NTT DATA, is capable of minimizing errors by using an enormous number of images for each single area taken from various angles by several satellites. This feature enables the creation of 3D maps with errors as small as 0.3 meters at most.

AI-based image analysis

When extracting data of certain objects such as buildings from satellite imagery, using artificial intelligence can speed up the process for a much wider area. For autonomous driving, NTT DATA has focused on developing ways to automatically extract road markings in order to use the data to generate road network information.

CASE01

3D Topographical Data Forms the Foundation of Making Communities Safer and More Convenient



Analyzed image of the virus survey conducted in Niger

The Voice of the Stakeholder

The Japan Aerospace Exploration Agency (JAXA), as a core executive organization that technically supports aerospace development, strives to realize a safe and affluent society through collaboration with various partners. AW3D aims to promote industrial development at a higher level and expand the scope of space utilization through a partnership between JAXA, NTT DATA and RESTEC that allows them to combine and further improve their areas of strength. So far, AW3D has successfully provided solutions for various societal issues, including the provision of natural disaster damage prediction and implementation of water resource surveys. JAXA will continue to strive to make satellite technology a component of social infrastructure through this collaboration with the private sector so as to help create a sustainable society by providing solutions.

Mr. Takeo Tadono
Senior Researcher
Japan Aerospace Exploration Agency (JAXA)

Various application areas

AW3D can be used for a variety of applications including urban development, agriculture, plant construction/maintenance, airports/harbors, electricity, roads/railways, disaster prevention/response and forest/greenery management. The improved accuracy of AW3D has expanded its practical applications for projects in Japan and abroad that require large-scale maps. Even in Japan, where a variety of topographical data has already been created, AW3D has been increasingly used as an alternative to aerial or field surveys due to its advantages, including speed and the newness of information.

There have been numerous cases of AW3D application. In one case, AW3D was used to conduct simulations of radio wave propagation in order to decide where to install base stations of a cellular network. The world is now embracing the fifth-generation mobile communication system (5G), which requires the use of higher frequency radio waves. The higher the frequency of radio waves, the more straight they become. Such straightness may cause even seemingly insignificant objects such as tall trees in a park or house fences to affect the propagation of radio waves. Increasing the accuracy of simulation is needed to address this situation, which can be dramatically improved by overlaying accurately extracted data on buildings and plants onto the area's topographical data.

AW3D has also been used in wind farm construction projects for investigating wind flows from surrounding terrain and for simulating the volume of storm water discharge from mountains or landslide hazards in the event of a heavy downpour.

Helped identify poliovirus transmission routes

One case that has been very memorable for us is a project entitled "Identification of Poliovirus Transmission Routes by Understanding River Flow Paths." The World Health Organization (WHO) regularly samples surface sewage and tests for traces of poliovirus and has chosen to use AW3D to search for more suitable sampling points. The first survey site was Kano in Nigeria, in which analysis was performed on images taken of the site at a 5-meter resolution. The analysis revealed that the actual surface sewage basin was wider by some 2 kilometers to the west and about five times larger in area than originally thought. The reason for WHO to collect sewage samples is to check if they contain the poliovirus in order to prevent polio outbreaks. AW3D has been utilized by WHO to find more appropriate sites to perform the collection.

It is difficult for many developing countries to create 3D maps on their own. NTT DATA's AW3D has been adopted by such countries as a convenient solution for offering their citizens safe and secure living environments by providing national land development, disaster prevention and health services.

Yuki Shinohara
Manager
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Yukie Matsuoka
Assistant Manager
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Social Innovation Division

CASE 02

Automate Routine Business Processes to Make More Time for Creative Tasks with "WinActor®/WinDirector®"

Contributions to SDGs

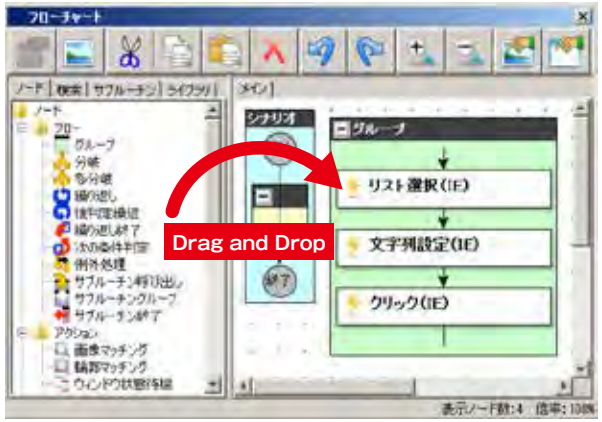
- Helping to address labor shortages
- Improving productivity
- Preventing/reducing human errors through automation

Robotic Process Automation (**RPA**) is a technology that has increasingly become the focus of attention as a promising solution for promoting workstyle reforms and productivity improvement. It is a solution that allows software robots to take over the execution of routine business processes, many of which are currently done by white-collar workers, thereby automating the tasks and improving work efficiency. NTT DATA's WinActor® is one of the first such solutions introduced to the RPA market in Japan that has been adopted by over 3,000 companies, achieving a high level of customer satisfaction. WinActor® is a 100% made-in-Japan RPA solution developed by NTT Advanced Technology Corporation using technology generated by NTT's laboratories. It learns how to operate as a flow (i.e., scenario) all applications, including the spreadsheet software Excel, browsers and individual business systems that can be operated from Windows-installed devices to automate the computer operations.

One of the most notable features of WinActor® is that it makes it possible for even non-technical personnel to create automation scenarios. On the scenario creation screen of WinActor®, some 400 "automation components (in a library format)" are pre-installed. For instance, if you want to automate the task sequence of "gather certain data from the host computer, deploy the data in Excel and carry out a predefined calculation, reflect the calculated results on the host computer and send the Excel file to a pre-designated employee," all you need to do to create the scenario is to drag and drop the necessary automation components for the sequence such as "Collect," "Deploy in Excel," "Calculate," "Reflect" and "e-mail" to the Scenario Creation Screen.

You can run WinActor® either on computers or servers. Thus you can start small by using it on a personal computer and, as you find out for yourself how useful the solution is, smoothly convert its use to a larger scale by expanding it to other devices and thereby turn it into a centralized, server-based solution to be used by all employees across the company as necessary.

If you decide to introduce WinActor® on a large scale to use it for many robots, **WinDirector®**, a robot developed by NTT DATA to control and manage WinActor®, will make all the difference. WinDirector® will enable you to use many WinActors® efficiently and safely as a unified solution.



WinActor® Screen: Create a scenario easily by using drag and drop

OCR×RPA

NTT DATA started offering optical character recognition (OCR) solutions more than 50 years ago. In recent years, thanks to the advancement of AI-based OCR technology, it has become easy to convert handwritten and other paper-based information to digital formats, resulting in the rapid spread of sophisticated automation combining AI-based OCR and RPA solutions. Our AI-OCR for LGWAN*1, which was launched in August 2019, has gained a lot of attention as a promising solution for promoting the automation of business processes in local governments.

WinDirector®

As a customer adopts WinActor® and promotes its use across the organization, it becomes increasingly necessary to manage the execution schedule of many scenarios, ensure security including by managing user access rights, and manage the operation status of WinActor®. WinDirector® is a robot that can meet all these needs. WinDirector® helps lower the barriers for businesses to introduce RPA on a large scale, making it easy for them to improve efficiency and productivity across the organization.

Visualization of work processes

When introducing RPA, it is critical to identify to which work processes RPA may be applied. This may sound easy, but identifying such processes accurately is a difficult task. To support this task, NTT DATA has been developing tools for finding routine tasks that can be automated through collaboration with its partners. We carry out this kind of development based always on the needs of frontline workers. This is one reason why WinActor® has been widely embraced by its users.

* WinActor® is a registered trademark of NTT Advanced Technology Corporation.
*1: LGWAN: Local Government Wide Area Network, a network that interconnects local governments across Japan.

CASE02

A software robot solution not for saving manpower but for making time for creative tasks

Tens of thousands of people have taken the WinActor® operation training course

The Voice of the Stakeholder

Daito Trust Group has adopted NTT DATA's WinActor® across the organization to promote and realize employee workstyle reforms since 2017.

Daito Corporate Service, a special subsidiary company established by Daito Kentaku Group to provide job opportunities to people with disabilities, executes business processes mainly entrusted by other companies across the Group.

Our company hires people with disabilities through collaboration with employment support offices for persons with disabilities. For job seekers who have no experience in program development, we offer practical training in RPA. Those who have successfully completed the training are actively working as members of our RPA team, which was inaugurated in January 2019 to help apply robotic process automation to as many as 700 business processes.

Mr. Koji Sumita
Psychiatric Social Worker
Shared Service Section
Shinagawa Service Department
Daito Corporate Service Co., Ltd.

Overcoming disparities in information technology literacy

Being a solution for automating routine business processes, RPA has been widely regarded as a software designed to cut back on manpower. This perception, however, is wrong. The essence of the solution is the idea that "freeing people from routine manpower-reliant business processes gives them greater scope to exert their creative abilities." Also, by combining RPA and AI, we can help narrow disparities in information technology literacy between people with digital literacy and those without who have been unable to enjoy the benefits of information technology services. For instance, if you combine an AI speaker with RPA, all you need to do is to speak into the AI speaker to make a request, such as "Calculate and settle expenses" or "Reserve a hotel in Tokyo" and WinActor® will take care of the rest. Moreover, by combining a chatbot with RPA, users just have to type their requests into a chat window, such as "Book a seat on the earliest available flight to Fukuoka," which will also be automatically taken care of by WinActor®.

Efforts to address labor shortages and provide a new means of career formation

NTT DATA strives to co-create various services and businesses by coupling its strength based on the 350-strong network of authorized WinActor® dealers with RPA. As one example of such efforts, an authorized dealer whose main business is temporary staffing began providing training to its registered staff on scenario creation skills using WinActor® and dispatching the trained staff to its customers. Once dispatched, these workers perform accounting operations and enable the automation of work tasks at their workplaces, helping to address labor shortages and promote workstyle reforms.

The foundation for the effective utilization of RPA is the implementation of **Business Process Visualization**. This means to visualize (make into a rule) business processes that have become so reliant on experienced employees that no one else understands them. Such visualization can also improve the efficiency of the business processes and make it easier to hand them over to other employees.

Upon building this foundation, we provide people with opportunities to build a "two-way" career by helping them not only pursue traditional career building that aims to improve work skills and but also acquire information technology utilization skills that enable them to use their RPA and other skills for proactively improving business processes. By increasing the number of such people with a two-way career, we can help our customers improve their business processes seamlessly and enable them to devote more time to core and creative tasks.

NTT DATA also focuses on developing RPA experts by putting in place training courses to teach RPA skills as well as an official system to certify RPA skill levels. Recently, we've seen some home-based workers and persons with disabilities successfully improving their employability by acquiring WinActor® skills.

Momoka Kidokoro
RPA Solutions Group
Digital Solution Section
Social Innovation Division

Akiko Muraoka
RPA Solutions Group
Digital Solution Section
Social Innovation Division

CASE 03

Commercial Farming Support Platform that Assists Smart Farming

Contributions to SDGs

- Helping address labor shortages
- Improving productivity
- Promoting automation/efficiency

In April 2019, NTT DATA started making commercially available a commercial **farming assistance platform** (cloud service) to be used exclusively by agricultural organizations including agricultural cooperatives and agricultural corporations.

The platform supports of some of the commercial farming business processes conducted by producers and agricultural organizations, ranging from production planning and confirmation and approval of cultivation records. By having producers input their crop growth status information through smartphones and tablets and making the data accessible by agricultural organizations' personnel, the platform not only visualizes the status of crop growth at the producers' farms but also promotes communication between producers and agricultural organizations in order to improve the quality and efficiency of commercial farming activities. Furthermore, the platform is the official farm management system certified and recommended by the Japan **GAP** Foundation and can thus be used to implement the Good Agricultural Practices (GAP) and obtain GAP-related certifications.

Producers have long used paper forms to write down and submit production plans or cultivation results to agricultural organizations. With this platform, however, this will be a thing of the past. Just by inputting necessary data using your smartphone or tablet, your forms will be created automatically and become ready for submission to agricultural organizations. It will also make it possible for agricultural organizations' personnel to see the input data any time to check on the observance status of the applicable pesticide use standards and estimate harvest shipping periods and volumes, etc.

When developing this platform, we devoted every possible effort to make the platform easy to use by commercial farmers, whose ICT skills tend to be modest. For this purpose, we involved producers from the planning stage and let them try out the system and give us comments on its usability, while continuing to revise the design based on feedback gathered from them, including their observed behaviors when using the system. As a result of these efforts, we succeeded in developing a system that producers can use easily and that won't interfere with their daily farming activities. The data input by producers can also be used for their own farming activities.

The platform is offered for an organization-wide flat-rate license fee. The monthly fee for a customer with up to 100 licensed users is 50,000 yen. The platform has already been introduced to and operated by JA Groups in Ibaraki and Kagawa.

Using the platform at a farm

The platform screens on a smartphone

Farming support platform

A farming support platform is a platform aim to realize efficient, high-value-added, labor-saving, and low-cost agricultural production, efficient and sophisticated management and business operations, and visualization of tacit knowledge, know-how, and the like. Agriculture has been marked as part of the Japanese government's growth strategy, and smart agriculture utilizing IT is being promoted as a way to address various issues,

GAP

GAP stands for Good Agricultural Practices, or the management of agricultural production processes, which represent efforts to ensure sustainable food safety, environmental preservation and occupational safety. By recording the efforts and improvement initiatives conducted for these purposes and obtaining government certifications for them, the relevant crops will be approved for government procurement as Safe & Reliable farm produce.

Use fertilizers and pesticides in appropriate places and quantities

NTT DATA also develops solutions for evaluating growth stages of crops by utilizing artificial intelligence and image analysis technology and for identifying the type of pest or weed found on a farm, which have been offered to our customers as optional functions of the platform. By using these solutions, even inexperienced farmers can apply fertilizer or control pests at the proper timeing.

CASE03

A Communication Tool that Assists with All Aspects of Farm Management including Downstream and Upstream Processes

Using a drone for farming

The Voice of the Stakeholder

We have been using the platform for some six months now. At the time of adoption, we thought that it would be rather difficult to spread the use of the platform in our area but were nevertheless determined to find ways to promote its use among our member farmers. We shared our thoughts and suggestions with the NTT DATA team, held countless discussions with them and, based on those discussions, they made many improvements to the solution.

We hope to further promote the use of the platform at our member farms and help pass the networks and know-how of our farmers on to future generations so as to keep our area thriving as a sustainable production area for many years to come.

Mr. Hiroshi Ichikawa
Chief
Commercial Farming Planning Promotion Section
Hokota Japan Agricultural Cooperative

Revitalizing Japan's agriculture sector

Agriculture has been designated in Japan's growth strategy as one of the key industries to lead national growth. As such, many efforts are being made to realize smart farming using ICT to address various issues including improving productivity and work efficiency in a bid to increase farmers' incomes across the country. The use of ICT in agriculture, however, has so far been limited. Therefore, there has been a great deal of demand for effective and easy-to-use ICT-based solutions that can be introduced across the agriculture sector.

ICT is characterized by its ability to become more effective and useful as the amount of data expands by the digitization of data previously unavailable in digital form. In the agriculture sector, farmers' experience, know-how and hunches in many areas have not been digitized, and have only been passed down from father to son as family secrets. Introducing ICT into these areas may be able to bring about benefits such as improvement of work efficiency and acceleration of new farmers' skill acquisition.

A mechanism to enable the easy use of various functions

Proclaiming itself a "platform to support commercial farming," the platform aims to offer services beyond the currently available production planning and cultivation result recording functions. NTT DATA aspire to turn it into a true ICT-based platform for all areas of commercial farming including upstream and downstream farming processes. In our efforts to reach this goal, plans are underway to start offering a Sales and Distribution platform in 2021 and a Food and Agriculture platform in 2023.

By using the platform, farmers will become able to try new things including determining the appropriate timing for watering based on the automatically collected crop growth status data and adjusting the timing and quantity of shipments in accordance with the latest price information on farm produce in consumer markets. Nowadays, simply developing systems demands increasingly higher levels of technology, which makes it difficult for us to come up with solutions that are easy to use for producers working on farms. Even under these difficult circumstances, we can support the growth of Japan's agriculture sector by applying NTT DATA Group's vast know-how fostered through developing systems for many types of industry and various lines of business.

In addition to the platform, NTT DATA has started in Minami Soma, Fukushima, a verification testing project in smart farming useful for farm management in which various experiments are conducted. These include one that uses NTT DATA's "airpalette® UTM" drone operation control software package to simultaneously operate several drones capable of receiving highly sophisticated GNSS signals transmitted from a Quasi-Zenith Satellite for identifying the growth status of crops and **applying fertilizers or pesticides in appropriate places and in just the right amount**. NTT DATA believe that the findings from these experiments can also be used to raise farming productivity in developing countries and thus contribute to improving global food security.

Hidetoshi Ookawa
Manager, Food Business Planning Group, Third Financial Sector

CASE 04

"CAFIS" A Platform that Provides Continuous Support for Cashless Payments in Japan, 24 Hours a Day, 365 Days a Year

Contributions to SDGs

- Developing social infrastructure that is convenient, safe and secure
- Helping reduce environmental impact

CAFIS (Credit and Finance Information Service) is a comprehensive payment platform that relays transactions linking stores and **public payees** that accept credit cards with credit card companies and financial institutions. Foreseeing the imminent expansion of Japan's credit card market, NTT DATA began offering this service in 1984. It has now grown to become "infrastructure" for cashless payments in Japan.

For the 35 years since its inauguration, CAFIS has responded to emerging demands by offering a variety of cashless payment-related support services and expanding its solution portfolio to keep pace with the diversification of methods offered in a cashless economy. Currently, we offer over 30 CAFIS-based services. Recently, we started offering services such as CAFIS Arch, a cloud-based payment platform, CAFIS Pitt, a smartphone-based cashless payment platform, and Code-based Payment Gateway (GW), a widely publicized service for unifying settlement processes of many different code-based payments.

CAFIS Arch is a cloud-based comprehensive payment platform capable of processing payments by credit cards, debit cards, various electronic money services, contactless payment transaction using IC chips and payments by inbound travelers using payment services offered in their own countries. It also supports payments by the new, widely publicized JPQR, an unified barcode and QR code system. CAFIS Pitt is a smartphone-based payment platform that can be easily installed inside credit card member companies/stores' smartphone applications. Like the ".Pay"*1 service offered by TOKYU CORPORATION and NTT DATA, CAFIS Pitt is a white-label service that can be rebranded by credit card member companies/stores to create their own original payment services.

For each CAFIS service, we have obtained security certifications from organizations such as the Information Security Management System (ISMS) and the Payment Card Industry Data Security Standard (PCI DSS), global standard for payment card companies, in order to allow credit card member companies/stores to adopt a variety of payment methods **safely and securely**.

*1 ".Pay" is a credit card payment solution offered by Tokyu Corporation and NTT DATA since April 2018. It's the world's first cardless payment solution that can be used both in online and physical stores.

CAFIS in use

Supporting public institutions that collect taxes/fees

Among all public fee/tax payment services available today, CAFIS is the only platform that supports three payment methods of (1) direct debit from savings account, (2) payment by requested bank transfer and (3) credit card payment. Line Pay has now been added to its portfolio of services, making the platform all the more convenient.

Offering services for 35 years since its inauguration

Thirty-five years after its inception, CAFIS now boasts an extensive network connecting all credit companies and financial institutions in Japan and stably processes as many as 800 million transactions a month via 850,000 terminals for shared use, POS terminals in credit card member stores, and online shops, working 24 hours a day, 365 days a year.

Ensuring safe and secure introduction

In 2012, CAFIS adopted a dual-center structure by establishing data centers in both Tokyo and Osaka. Based on this structure, it offers uninterrupted service and has successfully ensured service continuity in times of major disaster. It has also introduced a multi-carrier format to its networks to secure multiplicity and redundancy.

CASE04

“Beyond the Payments”—Providing Services to Realize a World Where Consumers Can Enjoy Safe and Stress-free Shopping Anywhere

Electronic signature enables paperless payment

CAFIS terminal in use

Leading the popularization of cashless payments

In the beginning of 1980s, at the dawn of the history of credit cards in Japan, all credit card companies had their own terminals for credit card processing. Therefore, if shops wanted to accept several different credit cards, they had to have separate terminals for each of them. Furthermore, credit card companies and processing terminals were connected by telephone line, placing a large economic burden in the form of high connection charges on credit card member stores located outside the Tokyo area. What’s worse, the processing terminals in those days did not support Point of Sales (POS) systems and there was no infrastructure to relay credit data between processing centers of major companies that were using POS and processing centers of credit card companies.

To solve these issues, CAFIS was launched as a shared-use service that relays credit information by interconnecting credit card terminals, stores and credit card companies’ processing centers. CAFIS dramatically improved the convenience of credit card use in Japan, a very cash-oriented country, leading to the popularization of ensuing cashless payment services across the nation.

The popularization of CAFIS also helps enhance internet governance and the value of data in today’s information-oriented society, eventually contributing to global environment preservation. Spreading the use of the payment platform, which is safe, speedy and lightweight, will undoubtedly ensure governance and improve the value of data. It will also provide consumers and store clerks with smooth and convenient shopping experiences, resulting in the stimulation of consumer spending.

Introducing more services to address future issues

CAFIS also aims to mitigate the environmental burden on society as a whole through its portfolio of services. For instance, the CAFIS Payment Slip Storage Service has eliminated the issuance of paper-based payment slips for customers to sign, thus making it possible to complete a direct debit procedure without using paper or a seal. Also, with CAFIS Arch, we succeeded in substantially reducing the use of paper, movement of goods and mobilization of people through measures such as adopting cloud computing and improving the efficiency of business processes. Based on our estimate, annual CO_2 emissions can be reduced by 53% following the adoption of CAFIS services.

NTT DATA has developed information systems for many types of industry and various lines of business. The comprehensive findings we have gained from past projects can be promptly utilized for addressing new issues and building the foundation for developing future systems from the customer’s perspective. Under the slogan of “Beyond The Payments” and striving to offer additional services other than payment solutions, NTT DATA aims to turn the world into a place where anyone can enjoy safe and stress-free shopping anywhere, whenever they feel like shopping and making payments.

Maki Fukushima
Deputy Manager
Business Promotion Development Office
Cards & Payments Services Division

Makoto Tomita
Manager
Arch Solution Group
Cards & Payments Services Division

CASE 05

AI Diagnosis Support Solutions

Contributions to SDGs

- Realizing a society of health and longevity
- Developing social infrastructure that is convenient, safe and secure
- Helping to address labor shortages

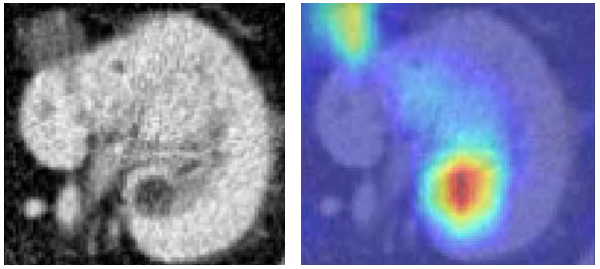
Growing demands for image-based diagnostic assistance using AI

The demand for medical imaging-based diagnosis using X-rays, computer tomography (CT) and magnetic resonance imaging (MRI) has been increasing year by year. Image-based diagnosis has also been regarded as an effective tool for detecting many diseases including cancer at an early, treatable stage and is thus expected to bring a significant advancement to preventive medicine if some kind of mechanism is established for allowing people to periodically receive detailed medical screenings using CT or MRI. However, making a medical image-based diagnosis is a time-consuming task for which a radiologist must check thousands of images. With the pervasive **shortage of radiologists** seen across the world today, it is becoming increasingly challenging for doctors to make prompt diagnosis. To help resolve this societal issue, we decided to work on the development of an AI-based system to assist medical image-based diagnosis.

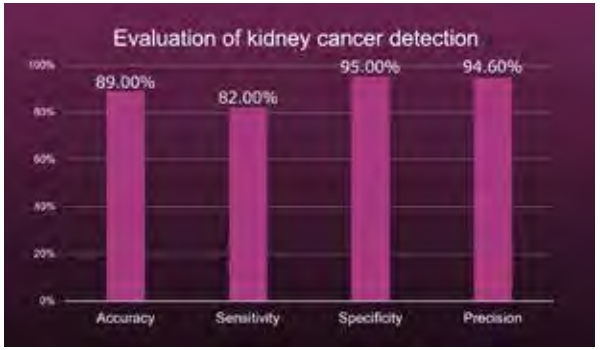
At the start of the project, we conducted validation of an AI-based diagnosis tool for emphysema using CT imaging at Deenanath Mangeshkar Hospital, an 800-bed hospital in Pune, India during the spring of 2018. We discovered that a broader range of emphysema cases were detected by the AI-based diagnosis tool than by doctors and that the AI-based diagnosis tool could also identify future risks.

Features of NTT DATA's image-based medical diagnosis assistance solution using AI detecting all abnormalities

During the validation process at Deenanath Mangeshkar Hospital a new point of view on the single target disease AI-based diagnosis tool was raised by the radiologists. They pointed out that diagnosis for diseases other than emphysema would still require examination by a radiologist and, therefore, the AI-based diagnosis tool would not contribute significantly to the improvement of diagnosis efficiency. It was also found that, in the false positive cases detected by the AI-based diagnosis tool, the patients had pulmonary tuberculosis, a disease rarely seen in developed countries. These findings revealed two issues: (1) AI-based diagnosis would not help shorten time to diagnosis insofar as it is targeted at specific diseases; and (2)



Example of abnormality (stone) detected by NTT DATA AI medical imaging diagnosis support solution



Results of the demonstration experiment conducted from March 2019 in collaboration with University of Miyazaki Hospital

Shortage of Radiologists

As CT and MRI technologies advance, the number of medical images taken for diagnosis has continued to increase. Despite this, the number of radiologists has not grown, resulting in the current situation in which Japanese society is facing a serious shortage of radiologists, with only 0.35 radiologists per 1 million people and 0.085 radiologists for each CT or MRI scanner in Japan.

Image-based medical diagnosis assistance using AI

Most of the AI-based medical solutions currently being developed by AI companies are specialized in certain diseases and aim to prevent serious disease symptoms from being overlooked. For improving the efficiency of diagnosis, it will be vital to promote efforts to utilize AI for assisting diagnosis not only of serious diseases but of health conditions in general.

Learning data

The source of learning for artificial intelligence is data. Therefore, for developing AI that will detect various abnormalities it is necessary to prepare data that includes information on all the relevant abnormalities. We need to collect data from a variety of hospitals, as the types of disease commonly treated are also different by hospital.

CASE05

Providing More Accurate and Diverse Services to Improve Diagnostic Efficiency

misdiagnosis could occur due to the differences in diseases commonly seen among patients in different countries. We therefor decided to start the development of an **image-based medical diagnosis assistance solution using AI** that can address these issues. In developing the solution we collected data from several countries including the U.S. and Japan in order to achieve the completeness of abnormality-related data. This was also important in order to have **learning data** that is not affected by a difference in the prevalence of diseases by country and in image processing technology by device. Combining this data with AI technologies we succeeded in developing the solution.

The solution is equipped with three functions: (1) detecting abnormalities; (2) discovering the locations of abnormalities; and (3) tagging the discovered abnormalities with disease labels.

This solution has also been proven to possess general-purpose versatility that can be used globally, in a demonstration experiment conducted in collaboration with the Miyazaki University Hospital from March to November 2019. Specifically, the experiment aimed to verify that the solution created with learning data accumulated in the U.S. could also detect kidney abnormalities in patients in Japan in the same way. According to the experiment results, the sensitivity and specificity of abnormality detection were found to be very high. Especially among cancer patients, the sensitivity and the specificity were as high as 82.4% and 95.3%, respectively, accuracy levels that were roughly in line with the test results from the U.S. patient group.

In today's global society, doctors have more and more occasions of attending patients from other countries. Our solution features a versatility that enables it to be quickly adopted for diagnosis purposes without being limited by patient nationality or area of residence. As such, the importance of the solution is expected to increase as society continues to become increasingly global.

Aiming to provide new social and medical services based on the image-based medical diagnosis assistance using AI

NTT DATA Services provides some 1,100 medical institutions in North America and surrounding areas with the Unified Clinical Archive (UCA), a cloud-based medical imaging archive solution.These institutions include various types of medical service providers ranging from clinics and university hospitals to medical imaging centers, each of these having needs characteristic to their business models.

Under these circumstances, discussions are underway regarding the possibility of offering the solution in ways that emphasize its prioritization function that can have various applications. For instance, if the AI is integrated with the solution, determining the diagnosis priority of patients based on the severity of their medical conditions, doctors will be able to diagnose them in order of urgency. This practice is likely to improve the patients' recovery or survival rates and may thus provide benefits to both patients and doctors. Furthermore, by identifying points of abnormality beforehand, a radiologist whose area of specialization is appropriate for the case can be assigned, enabling the prompt provision of accurate diagnosis. For health checkups, if we can offer the function for discerning patients who are healthy from those who need to be examined more carefully, the solution will help establish a mechanism for efficiently providing advanced medical screening services using CT or MRI scans, which is expected to bring significant benefits in terms of preventive medicine.

To contribute to such new societal initiatives including the promotion of preventive medicine, we are planning to start offering a service to provide customers with AI-based diagnosis support tools by harnessing our experiences obtained through the years of providing UCA to hundreds of customers.

NTT DATA will strive to offer the solution to doctors and medical professionals not only in the U.S. but also in more countries across the world in order to relieve their burden and promote the health of people everywhere.

The Voice of the Stakeholder

NTT DATA's AI-based solution is a truly unique and innovative tool in that it does not only target specific diseases. At times, doctors are required to diagnose cases that are outside their areas of specialization. In these situations, a tool that provides us with alerts covering all kinds of abnormalities is very useful. It can also play a significant role in the triaging of patients with acute medical conditions. I feel privileged to have been given the opportunity to work with NTT DATA to help promote their R&D efforts and contribute to the advancement of medicine.

Dr. George Shih
Co-founder of MD.ai
Associate Professor /Certified Radiologist
Cornell University

Takashi Okada
Manager
Advanced AI Technology Group
Evolutional IT Center
Research and Development
Headquarters

Daria-Antonia Bunu
Advanced AI Technology Group
Evolutional IT Center
Research and Development
Headquarters

CASE 06

"AMLAD®" A Digital Archive Application that Helps Develop a Platform for Preserving Digitized Historical Documents and Making Them Available to the Public

Contributions to SDGs

- Helping protect and enhance preservation of cultural and natural heritage sites across the world
- Enabling the provision of quality education
- Developing social infrastructure that is convenient, safe and secure

In March 2018, NTT DATA completed the digitization of 3,000 handwritten documents of historical importance owned by the Vatican Library (Biblioteca Apostolica Vaticana). It also developed DigiVatLib, a platform to allow the Library to preserve the digitized images of the documents and make them available to the public, by using AMLAD®, NTT DATA's digital archive solution. **The Vatican Library** was established in 1451, or around the middle of the 15th century, by Pope Nicholas V. The Library has a massive collection comprising some 1.1 million works including numerous historical books, documents and illuminated manuscripts, some of which are more than 2,500 years old. The collection includes, among others, some 8,200 pieces of rare, one-of-a-kind handwritten manuscripts or codices such as the Codex Vaticanus.

In the past, the Vatican was torn between two conflicting goals it wished to achieve: addressing the critical need to preserve the Library's rare materials and making them available to the public as important assets representing the history of mankind so that people across the world could read them. To solve this dilemma, the Vatican decided to digitize the manuscripts and chose to adopt AMLAD® for the task.

Kicking off in March 2014, the project involved us scanning 3,000 manuscripts one page at a time using a scanner specially developed for this purpose. Digitized images of the pages were then converted into formats suitable for long-term storage and registered in DigiVatLib together with their metadata. NTT DATA completed all of the planned digitization processes in March 2018 and now carries out maintenance work for DigiVatLib.

Many libraries, museums and archives around the world have recently taken an interest in this project at the Vatican Library and have contacted us to inquire about the possibility of creating their own digital archives with AMLAD®.

The Vatican Library

This project at the Vatican Library aims to digitize the Library's entire collection comprising some 80,000 codices, amounting to about 40 million pages. The total volume of the data is expected to be a whopping 45 petabytes.

©Biblioteca Apostolica Vaticana
Website of the Vatican Library's Digital Archive

AMLAD® helps enhance the value of digital assets

AMLAD® is a digital archive service capable of providing a mechanism for storing all data formats including text, image, video and audio and enabling users to easily search and view the stored data using their own devices such as personal computers and smartphones. NTT DATA has incorporated many functions into AMLAD®, including not only multi-directional search but also various data linkage methods and flexible administrative functions, by utilizing its cutting-edge archive technologies fostered through the project it completed for the National Diet Library in Japan.

The Vatican Library

An example of the manuscripts to be digitized

©Biblioteca Apostolica Vaticana
Digitization work in progress

CASE 07

Projects to Verify the Feasibility of Predicting the Onset of Lifestyle-related Diseasesby Using AI-related Technologies

Contributions to SDGs

- Realizing a society of health and longevity
- Developing social infrastructure that is convenient, safe and secure

Many initiatives have been implemented in Japan for disease prevention and health promotion as part of efforts to extend the years of healthy life of its citizens. Lifestyle-related diseases in particular have become a major social issue that brings with it an increase in national health spending and a decline in employee productivity for business organizations. This situation makes it necessary for the country to improve the lifestyle habits of its citizens and grasp their health risks in order to prevent the onset of lifestyle-related diseases.

As part of such efforts, NTT DATA and NTT are conducting an assessment project that uses AI to predict the onset risk of lifestyle-related diseases (i.e., diabetes, hypertension and dyslipidemia) in order to allow insurance companies to utilize the resultant data. This project aims to verify the effectiveness of prediction technologies so that insurance companies can develop new plans and products, assess insurance applicants and help improve the health of their policy holders.

Since its inauguration in 2018, this project has been evaluating the feasibility of applying prediction technologies to the stages of product development, underwriting assessment and policy holders' health promotion among many insurance companies. Specifically, the project has focused on identifying issues for purposes such as "finding items and standards that are necessary to understand health risks" and "promoting policy holders' health." For instance, in analyzing medical checkup data, it used to be difficult to conduct highly accurate data analysis when using data with blanks and omissions taken from patients who only receive medical checkups irregularly, data on a limited period of time from patients who only have medical checkup data for that period, or the small amounts of sample data available on the onset of rare diseases. To address this situation, we developed as a part of corevo®, NTT's AI-related technology portfolio, **a method for conducting highly accurate analysis** even with uneven and scant data, making it possible to predict the future onset probability of lifestyle-related diseases based on the data from medical checkups. This prediction technology has been adopted for the medical checkup data analysis service offered to selected customers using Health Data Bank, NTT DATA's cloud-based health management solution, and has been achieving high prediction accuracy. Especially for diabetes, one of the lifestyle-related diseases, we have achieved the high prediction accuracy of 90%.

The projects will also benefit insurance companies. It has been the usual practice for insurers to develop products and assess insurance applicants based on the calculation results of future onset risk of diseases, but the adoption of NTT's disease onset risk prediction technology will change this practice altogether. Insurers will no longer need to collect and analyze a vast amount of data from medical checkups and health insurance claims or to take measures to deal with sensitive personal information as stipulated in the amended Act on the Protection of Personal Information.

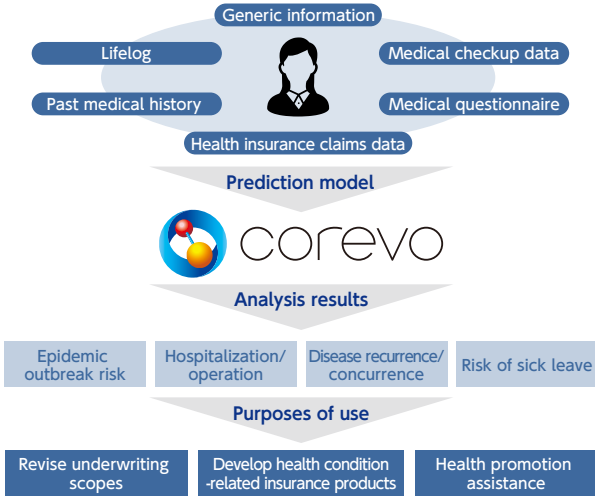
NTT DATA is planning to start providing its prediction technologies as commercial services in 2020, with a view to continuing its efforts including the development of a disease onset prediction model for senior citizens and an individual contract-based data analysis service.

A method enabling highly accurate analysis

What makes the highly accurate prediction possible is a technique called "Learning to Rank." Instead of the traditional learning method based on the classifications of "pre-onset" and "post-onset," the project has adopted the Learning to Rank technique to compare disease onset probabilities and made it possible to use the data of pre-onset persons whose available data cover only short time frames.

NTT's AI-related technology portfolio, "corevo®"

"corevo®" is the name given to the portfolio of efforts by NTT that utilize AI developed through a series of its R&D initiatives. The name "corevo" is coined from the term "co-revolution." The corevo® portfolio is comprised of four kinds of AIs: (1) Agent-AI that uses cues in information contained in human outputs to grasp people's intentions and emotions; (2) Heart-Touching-AI that deciphers the mental and bodily responses of humans to understand their unconscious mind, cognition and instincts; (3) Ambient-AI that deciphers humans, objects and environments and instantly predicts and controls them; and (4) Network-AI that optimizes the entire social system by connecting several AIs. By promoting the cross-sectional use of this portfolio, we can help create new social services, businesses and values.



CASE 08

"Mitaka Data Center EAST" A Data Center that Has One of the Largest and Most Advanced Features in Japan While Achieving Excellent Environmental Performance

Contributions to SDGs

- Helping reduce environmental impact
- Enabling stable energy procurement and promoting more efficient use of energy
- Developing social infrastructure that is convenient, safe and secure

In April 2018, NTT DATA began operating Mitaka Data Center EAST, its 16th data center in Japan. The Center is equipped with functions required to serve as the foundation for enabling the **digital transformation** of all companies in any type of industry and any business category, including the gathering and accumulation of data; computerization of data and adding value to it; and promotion of collaboration for co-creation.

One of the most notable features of Mitaka Data Center EAST is its excellent environmental performance. Servers installed at data centers usually give off a lot of heat. Compressors and cooling systems in the centers needed to mitigate the heat consume vast amounts of energy. In Mitaka Data Center EAST, however, we succeeded in reducing energy consumption by actively using cool outside air.

The Center has a unique physical form in which the building's perimeter length increases in proportion to the floor height. This shape was the result of adopting the "through-the-wall air-conditioning system using hot aisle capping," a system that enables efficient cooling of the hot servers by taking in cool outside air from underfloor spaces. In this system, the periphery surface of the building provides air passages, which makes it easier to let the heated air out in higher floors as the floor's periphery surface increases in proportion to its height.

On the Center's roof, solar power panels with a total generation capacity of 90 kW are installed, helping reduce CO_2 emissions by 28,528 kg per year. The reduction is equivalent to an annual reduction in oil consumption of 353,609 liters.

The Center aims to achieve a PUE (Power Usage Effectiveness of the Center, calculated by dividing the Center's power consumption by the power consumed by its IT devices) of below 1.3 through taking various measures. Data centers in Japan typically have a PUE of 1.87. Thus, if we succeeded in achieving a PUE of below 1.3, it is expected to bring about significant energy saving effects, equivalent to a reduction in electricity bills worth some 1 billion yen a year. By cutting back on the electricity expenses for its air-conditioning systems, the Center contributes not only to the protection of environment but also to the reduction of customers' rack ownership costs.

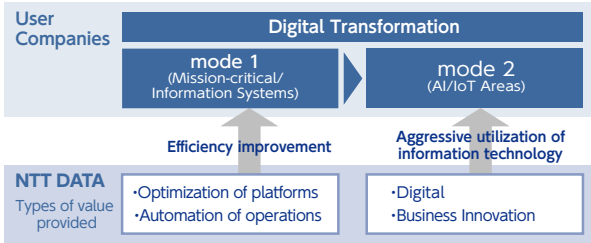
As these environmentally friendly features were regarded favorably in the process of acquiring LEED certification, a green building rating system overseen by the U.S. Green Building Council, Mitaka Data Center EAST in September 2018 obtained the latest version of the LEED Gold certification, becoming the first organization in the data center category in Japan to do so.

Digital transformation

Within the NTT DATA Group, the term "digital transformation" is defined as "promoting the use of digital in ways that contribute to our customers' businesses." Digital environments surrounding businesses are increasingly required to develop further and proceed to the next level because of market changes brought about by the drastic advancements in AI technology as well as the rapid increase in the number of IoT devices in today's world.

Mitaka Data Center EAST

- Gross floor space: 37,650 m²
- Number of installed rack units: Up to 5,600 units
- Structure: By installing horizontal seismic isolation devices and vertical vibration control dampers in addition to the bird cage structure of its outer periphery and truss structure over the roof, its horizontal and vertical accelerations are decreased by some 80% and 40%, respectively.
- Power supply: Equipped with emergency power generators that can operate for 72 hours without refueling
- Electricity usage per rack unit: Capable of supporting up to 20 KVA per rack unit
- Network: Multi-carrier compatible networks pulled in through service tunnels (dedicated underground tunnels)
- Security: Conforming to FISC and ISO 27001 guidelines



Conceptual Diagram for Realizing Digital Transformation

CASE 09

Aiming to Foster Culture of Innovation and Resolve Societal Issues through "Global Hackathon"

Contributions to SDGs

- Promoting sustainable agriculture
- Helping build sustainable cities and communities
- Developing social infrastructure that is convenient, safe and secure
- Helping to address labor shortages

The NTT DATA Group has some 123,900 employees all over the world. To provide our employees with a chance to collaborate, we hold a group-wide annual event called the "Global Hackathon" in which employees across the world share global societal issues and work together to devise solutions for them. Since its inauguration in 2017, the event has provided opportunities for our Group employees to actively learn about advanced technologies and nurtured a spirit of innovation among them through promoting exchange between technical specialists and the sharing of ideas. The specialists who become winners in the qualifying rounds held in different locations around the world get together for the final round of this technical competition, in which they are presented with some real global issues and collaborate to devise software-based solutions for the issues within the assigned time of 27 hours.

At the first meeting of the Global Hackathon, itelligence AG from Germany won the first prize for the "Farmbot" that they proposed as a solution for addressing the issue of **global hunger for 2050 expected to be brought about by the projected population growth.** Then, in 2018, in what became the second session of the event, NTT DATA Deutschland GmbH became the champion for its idea of "Disaster Relief Support using Geographic Information including Satellite Imagery." Winners of the events were given rewards including investment opportunities in research and development projects and support for promoting cooperation with relevant organizations in an effort to help commercialize their proposed solutions and spread them across the world.

"Farmbot," the proposal that won the first prize at the first event, is a solution combining a variety of plant cultivation management and fertilization control systems that supports the realization of smart agriculture with the use of the "Bot," a cultivation box developed by FarmBot in Germany. By connecting the data about vegetables being cultivated in Bots all over the world through the Farmbot network, the solution offers advice on various issues including the optimal places to distribute the harvested produce and ways of developing distribution networks for that purpose.

For "Disaster Relief Support using Geographic Information including Satellite Imagery," the winner of the second Global Hackathon, the team developed software to enable artificial intelligence to develop rescue measures and formulate the optimal operation strategies of relief teams based on satellite imagery of the affected areas and images taken by cameras installed in the areas while supporting the prompt payment of insurance premiums.

Global hunger predicted for the year 2050

The world's population is expected to grow to 10 billion by 2050, bringing about an increase in the global demand for food of up to 70%. "Farmbot" is a solution envisaged to address this dramatic increase in food demand by enhancing the cultivation of vegetables in urban areas and coming up with optimal ways of distributing crops.

Focusing on the themes of AI and SDGs in the second session

In the first Global Hackathon held in 2017, 270 teams from across the world participated in the qualifying rounds. Eventually, 14 teams won the qualifying competitions and made it to the final round in Barcelona, Spain. For the second event held in 2018 under the themes of artificial intelligence and the Sustainable Development Goals (SDGs), 330 teams from around the world joined the qualifying competitions, from which nine teams advanced to the final round in Munich, Germany.

Participants in the final round of the second Global Hackathon

Teams discussing the assigned issues in the second Global Hackathon

BOT: Culture Box by Farmbot

CASE 10

"Immigration Control System" for Improving Convenience for Travelers and Efficiency of Immigration Procedures Using Biometric Authentication

Contributions to SDGs

- Developing social infrastructure that is convenient, safe and secure
- Helping build sustainable cities and communities

everis Group (hereinafter, "everis"), NTT DATA's affiliated company in Spain, received an order from Aena SME S.A. (hereinafter, "AENA"), an airport service operator in Spain, for a project to introduce its Biometric Authentication-based Automatic Immigration Control System at four airports in the country. By July 2018, everis had completed the installation of 220 cutting-edge automatic gates at the airports and began operating them in sequence. This is the first project in Spain to introduce an automatic immigration system using biometric authentication. Going forward, the project is set to introduce another 81 automatic gates to three domestic airports including Seville Airport and start operating them by December 2019.

The system has so far been introduced to the four airports of Barcelona-El Prat Airport, Alicante-Elche Airport, Palma de Mallorca Airport and Menorca Airport. Of these airports, the largest number of 80 automatic gates were installed at Palma de Mallorca Airport, a project representing one of the largest installations of such gates at an airport anywhere in Spain.

Airports in Spain are said to be used by a total of **249 million people** annually. The introduction of this automatic immigration control system to the airports helps to improve convenience for airport users, make airport operations more efficient, and enhance security by reducing the time spent on immigration procedures down to 12 seconds per person through the prompt verification of travelers' identities by the use of advanced collation techniques for verifying the personal information recorded in passports and other documents, together with face and fingerprint-based biometric authentication methods.

The adoption of the system has allowed the Spanish police to change the way in which they provided border security and focus on immigration procedures for special cases that cannot pass through the automatic immigration control system (e.g., families with children, travelers requiring special visas). This system is also linked with the Schengen Information System, a database of security-related information including data on people who are sought in relation to criminal activities, and the Visa Information System, a database containing information on persons applying for visas, contributing the realization of advanced security through, for instance, helping to prevent criminals from fleeing their countries as well as to find terrorists.

249 million people per year

According to OECD data, Spain is annually visited by a total of 82 million inbound tourists, who spend a total of 87 billion euro (11 trillion yen) while in the country. Tourism accounted for 11% of Spain's GDP in 2016, the biggest ratio among the world's major economies. (For instance, in Japan, tourism accounted for 1.9% of GDP in 2016.) Prompted by the fact that Spanish airports are used annually by as many as 249 million people in total, Spain has been required to make its immigration procedures faster and more efficient to further improve the potential of its tourism industry.

The automatic immigration control system also enables self-boarding

With the automatic immigration control system delivered by everis, travelers will first need to pre-register at check-in counters at unmanned kiosks as they arrive at the airport. As soon as they finish the pre-registration process, the personal information recorded in their passport as well as their facial and fingerprint data will be sent to AENA's Biometric ID Manager. After that, as the travelers approach the security filter that lets them go through to boarding areas, several facial photos of them will be taken automatically and collated with the records kept in the ID Manager. When their identities are verified, the gate will automatically open to let them in. These processes will be conducted again at the boarding gates, allowing them to board their flights without having their boarding passes checked.

Menorca Airport


Biometric Authentication Gates at Menorca Airport


A video screen for biometric authentication

CASE 11

"Converting CO_2 into Renewable Energy" — NTT DATA Contributes to Environmental Impact Reduction through Participating in an EU-led Project

Contributions to SDGs

- Helping reduce environmental impact
- Enabling stable energy procurement and promoting more efficient use of energy
- Helping build sustainable cities and communities

Businesses are required to fulfill the important missions of developing environmental solutions and promoting their use in order to reduce the impact they have on the environment. To this end, i-deals, a subsidiary of everis Group, NTT DATA's group company in Spain, has participated in the **$MefCO_2$ project** supported by the European Commission (EC) through Horizon 2020, the EC-led framework for research and development inaugurated to promote pan-European research and innovative development projects, and has made significant contributions to the project's outcomes.

$MefCO_2$ project

$MefCO_2$ is a consortium in which nine organizations from seven countries participate. The names of the organizations and their specific responsibilities are as follows:
▶RWE Power(Germany): Construction and operation of the plant▶Carbon Recycling International (Iceland): Provision of methanol units ▶Mitsubishi Hitachi Power Systems Europe (Germany): Provision of system integration services and CO_2 conditioning units▶Hydrogenics Europe (Belgium): Development of technology for electrolytic cells ▶Cardiff Catalysis Institute (U.K.): Research on catalyst synthesis▶Slovenia Scientific Institutes (Slovenia): Verification of catalysts and reaction engineering▶University of Genoa (Italy): Thermoeconomic analysis and process optimization▶University of Duisburg-Essen (Germany): Simulation of processes▶i-deals (Spain): Management and coordination of the project

The $MefCO_2$ project aims to verify the technology—and its financial feasibility—for mixing carbon dioxide emitted from factories and power plants with hydrogen generated during the process of producing renewable energy to convert the mixture into new renewable fuels such as methanol or base chemicals that can be used for multiple purposes. The EU has been faced with two major needs: promoting decarbonization of its energy and industrial sectors and increasing the ratio of renewable energy use in its energy consumption. As a measure to reduce CO_2 emissions, carbon dioxide capture and storage (CCS), a process of capturing carbon dioxide emitted into the atmosphere and storing it underground, used to be regarded as a promising solution. However, as it turned out that the process entails significant costs and is thus difficult to be put to commercial use, processes that capture carbon dioxide and use it for other purposes instead of storing it underground have started to attract public attention as alternative solutions.

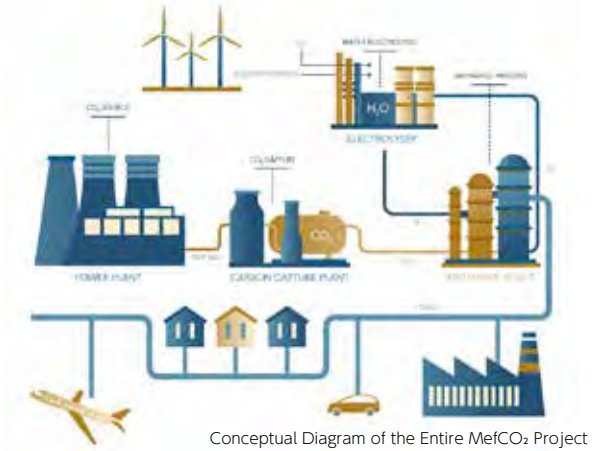
The technologies developed for the project have been demonstrated to have the capability of generating 1 ton of methanol a day and capturing 1.5 tons of carbon dioxide a day in the pilot plant built in Germany. Converting this amount on an annual basis gives about 400 tons a year. In the future, the company plans to expand the amount to some 50,000 tons a year.

For the $MefCO_2$ project, i-deals took up the role of managing and coordinating the entire project by drawing up business plans and following up on their progress, serving as a negotiator-cum-coordinator with the EU's relevant secretariats, and providing guidance on administrative procedures and financial issues. Being known as a technological broker, i-deals boasts a lot of experience and know-how on linking administrative agencies, businesses and technical specialists and supporting the introduction of energy-related technical innovations that can make significant contributions to society.

Combined with gasoline, methanol generated from the process will help reduce emissions of hazardous substances such as benzene and hexane. Methanol also has positive effects including emitting less particulate matter and nitrogen oxide compared with diesel, another unblended fuel. Methanol is also expected to have great potential for commercialization as it is widely used as an intermediate material for shampoos, textile fibers and plastics.

Developing new catalysts at the pilot plant

The project succeeded in significantly improving the generative reaction for hydrogen through measures such as improving the electrolyte membrane in the hydrogen generation process. In the methanol generation process, the project also successfully developed a new catalyst with a drastically improved conversion rate.



Conceptual Diagram of the Entire $MefCO_2$ Project

CASE 12

"COTO LABO Consortium" An Association of Companies for Promoting the Digitization of Experiments Related to iPS Cells, etc.

Contributions to SDGs

- Realizing a society of health and longevity
- Developing social infrastructure that is convenient, safe and secure

NTT DATA has been stepping up its efforts toward the enhanced utilization of IoT and AI in the field of life sciences.

As a part of these efforts, in November 2018, we concluded a capital and business tie-up agreement with iPS PORTAL, Inc. in Kyoto, which allowed us to acquire the company's shares through third party allotment. iPS PORTAL is the only company in Japan able to generate iPS cells from blood for commercial use and promotes iPS cells-related businesses in collaboration with partners that include universities, pharmaceutical companies and equipment manufacturers.

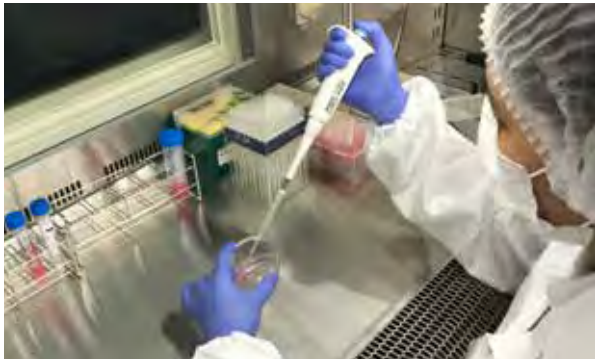
NTT DATA boasts a proven track record of utilizing data for projects in the fields of new drug development and healthcare and has technologies that utilize IoT and AI analytics. Going forward, we will strive to add new value to iPS cells by utilizing our IoT and AI technologies in research undertaken in life science fields such as new drug development and regenerative medicine.

COTO LABO Consortium

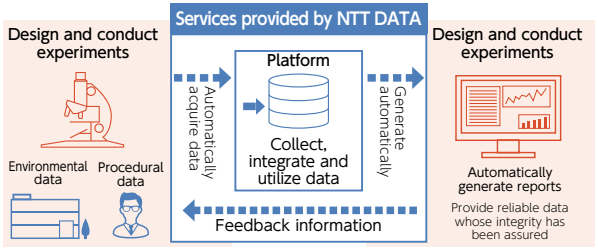
Participants in the COTO LABO Consortium include NTT DATA and seven other companies: iPS Portal, Inc; Earth Environmental Service, Co., Ltd.; Olympus Corporation; Kataoka Corporation; Shimadzu Corporation; TASEI Corporation; and Hitachi Industrial Equipment Systems Co., Ltd. The Consortium focuses on launching next-generation laboratories to facilitate smooth technological transfer by developing a system for securing the repeatability of experiments and enhancing the reliability of data by the end of 2019.

In May 2019, NTT DATA and seven other companies inaugurated the **COTO LABO Consortium** to provide laboratories for projects that use iPS cells (COTO LABO is an abbreviation for **"Communication Tool Oriented/Originated LABOratory Consortium"**). The Consortium aims to develop next-generation laboratories that are capable of improving the repeatability of experiments and efficiency of cell culture and other processes by promoting the centralized management and utilization of digitized scientific data including actions in research activities and analysis results in life science fields such as new drug development and regenerative medicine.

By integrating advanced technologies and techniques developed and held by leading companies in their respective fields into one laboratory system, the Consortium strives to offer new value that will help enhance the transparency, repeatability and efficiency of experiments. For this Consortium, NTT DATA offers all tools and services required for its IT infrastructure including platforms for gathering information from devices and building equipment provided by experiment equipment manufacturers as well as application platforms.



Conducting a culture process



Roles played by NTT DATA

Conceptual diagram of the utilization of services offered by NTT DATA for life science fields

Description of service		Envisioned applications in life science fields
1 Consultation on information use	・Upstream consulting on the uses of information ・Assistance via consultation for data development/management	・Chemical compound prediction assistance toward the promotion of efficiency of research for new drug development/medicine ・Support for research data analysis toward the realization of more advanced research for new drug development/medicine
2 AI / Analytics	・Data analytics ・Development of analytics design and analytical models, utilization and implementation of AI technology ・General contract for all analytical processes	
3 Data management	・Preparation of data (e.g., data survey/preparation, data cleansing, annotation and other preprocessing)	・Construction of platforms for processing massive amounts of data including vital and research data ・Development of research collaboration platform linking several research institutions
4 Platform for Utilization of Information	・Construction of analytical platforms (e.g., DWH, data lakes, data linkages)	
5 IoT- embedded development	・Construction and provision of IoT platforms (e.g., Designing architecture for mass data processing platforms, platforms for edge-side data processing) ・Development of embedded software (e.g., automotive software, mobile software)	