

**azbil
FIELD**

**The University Art Museum,
Tokyo University of the Arts**

**azbil
MIND**

Responding to changes in the market and in needs, the azbil Group presses ahead to raise customer value



Special Feature

Umami : The Essence of Japanese Food



Umami: The Essence of Japanese Food

Since its inscription on the UNESCO Intangible Cultural Heritage list in 2013, washoku, traditional Japanese cuisine, has been attracting attention increasingly from around the world. Umami is an indispensable part of Japanese cuisine. Here, we unlock some of umami's secrets.

The three properties of umami that are not found in other basic tastes

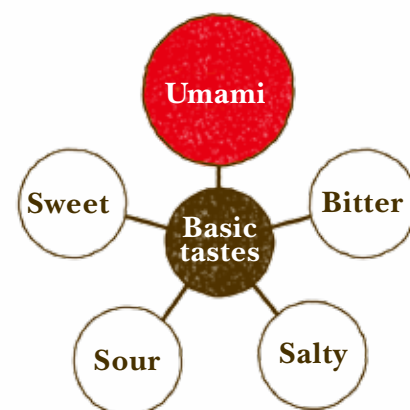
It had long been believed that there were just four basic tastes: sweet, sour, salty, and bitter. However, Dr. Kikunae Ikeda of Tokyo Imperial University (now the University of Tokyo) noticed that there was a taste that did not fit into any of these categories. In 1908, he discovered the main component in kombu dashi, kelp stock frequently used for Japanese cuisine, to be glutamate, and named it "umami." Following in Dr. Ikeda's footsteps, other Japanese chemists discovered the umami substances inosinate and guanylate. To date, some other umami substances have also been discovered.

Umami is not a vague concept. It is a distinct taste that can be considered one of the basic tastes. Here is an easy experiment to experience umami: Put a dried tomato or fresh cherry tomato into your mouth, chew it slowly about 30 times and try to notice the changes in the taste that spreads on your tongue. First, you would taste sourness and

sweetness as well as a grassy-like or earthy taste that is peculiar to tomatoes. Then, you would taste something different that lingers even after these tastes disappear. This is umami.

Umami has three properties: first, it spreads all over the tongue. While sweet and salty tastes are sensed in only a small part of the tongue, umami is sensed in a wider area, giving you the sensation that your whole tongue is coated with the taste. Second, it is long-lasting. Sour and salty tastes diminish immediately, but umami lingers for several minutes. The third property of umami is that it promotes salivation. It is widely known that sour taste promotes salivary secretion, but in fact umami taste triggers the sustained secretion of saliva for a longer period. The saliva secreted by sour taste is somewhat thin and watery, whereas the saliva produced by umami is more viscous and moistens the inside of the mouth more.

In 2004, it was confirmed that human beings had receptors for umami substances and scientifically proven that the ability to sense umami was common to mankind. Ex-



Five basic tastes

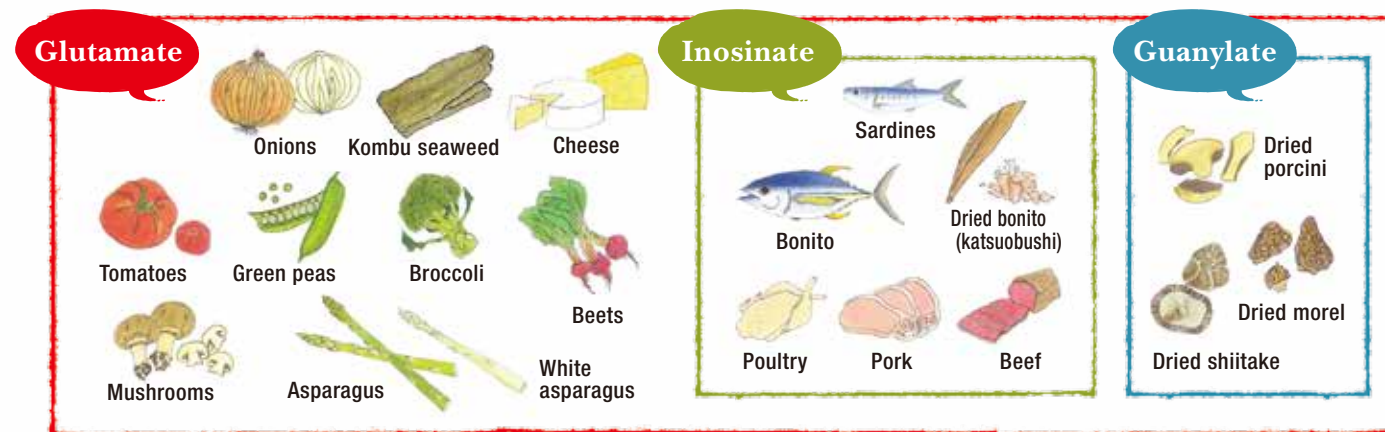
periments have confirmed that breast milk is rich in umami substances and babies like the umami taste. They also love sweetness, which is a sign of sugar, a source of energy for them. As sourness in fruit means that it might be unripened or rotten, babies instinctively avoid it by producing watery saliva to weaken the taste. Bitterness, a signal for poison, is also disliked. But umami is a signal for protein, one of the building blocks of body tissue, so babies actively try to take in the food rich in umami.

Umami synergy increased by the presence of multiple substances

The main umami substances are the amino

Where can we find umami?

Typical umami substances can be found in our familiar foods. Some types of vegetables, seaweed, and cheese are rich in glutamate, while meat and fish contain plenty of inosinate. Large quantities of guanylate are found in dried mushrooms.



©Hikari

acid glutamate and the nucleotides inosinate and guanylate. Umami is sensed far more strongly when glutamate is combined with inosinate or guanylate. This is referred to as umami synergy. The typical example of this combination is kombu and katsubushi, which is used for making dashi, the basic broth for washoku. Kombu is a type of seaweed that is mainly harvested from the sea around Hokkaido. It is usually dried to be used for kombu dashi. Katsubushi is dried and smoked bonito and is thinly shaved to be used for making katsuo dashi, another basic broth. When dashi contains glutamate and inosinate at the ratio of exactly 1:1, the umami taste becomes most powerful, 7 to 8 times stronger as compared with the broth containing only glutamate or inosinate.

An analysis of ichiban dashi, high-quality broth made from a combination of kombu and katsubushi, prepared by a venerable Japa-

nese restaurants has shown the presence of high levels of glutamate and inosinate, at the ratio of exactly 1:1. It seems that top restaurants know from experience the optimal proportion for the greatest umami.

There are many other types of stock equivalent to Japanese dashi in many regions of the world, such as French bouillon and shang tang in Chinese cuisine. Most of them are made by stewing a variety of ingredients for several hours. Therefore, they are rich not only in glutamate and inosinate but also in various amino acids, making the taste more complex.

Although umami is a key player in making a dish delicious, it is not the case that the greater the amount of umami components, the more delicious the dish. That depends on how other basic tastes are rounded in the dish. Umami cannot be the main character in all tastes, but it can highlight the flavors in a dish

if used skillfully. For example, animal fats can make a dish taste delicious, but they are high in calories. If you use umami well, you can highlight the intrinsic flavors of ingredients and make the dish delicious without depending on animal fats, such as butter or cream, making the dish healthier as well. Also, a study on hospital meals has found that making use of umami can help to reduce the salt content in meals by 30 to 40% without compromising palatability. In addition, it is suggested that umami can increase satisfaction and may be used to control food intake. Since umami helps to reduce calorie and salt intake, Japanese cooking that skillfully uses umami seems to be attracting increasing numbers of fans who recognize washoku as a healthy diet.

Umami can improve the taste of everyday meals as well as our health. By taking advantage of umami, we can make our lives richer and healthier.

Data and information provided by: Non-Profit Organization Umami Information Center

The University Art Museum, Tokyo University of the Arts



The University Art Museum on the Ueno Campus of Tokyo University of the Arts implemented energy-saving measures when replacing its aging heat source equipment by high-efficiency models. Temperature and humidity must be precisely controlled to protect the valuable cultural assets the museum houses, but energy efficiency is nowadays increasingly demanded by society. Azbil, with its extensive knowledge of site operations, satisfied these conflicting demands by introducing high-efficiency devices and a BEMS to provide optimal control operation.

Seeking the best way to replace essential but aging facilities and make them energy-efficient while protecting cultural assets

Tokyo University of the Arts (TUA), which is a national university corporation, has always played a leading role in developing Japanese arts and culture. Today, in cooperation with various domestic and overseas universities and institutes, TUA is attempting to nurture world-class artists and to establish an international brand, “Geidai.”

TUA established the University Art Museum in 1999 to house and display a collection of famous art works and graduates’ works inherited



A savic-net FX2 system installed in the central monitoring room. The system provides easily understandable visual data on the temperature and humidity of storage and exhibition areas, as well as data on the energy consumption of the equipment. Operating data is also collected.

from one of its predecessors, Tokyo Fine Arts School. Many important cultural assets are kept in the storage rooms of the museum building, which has four stories above ground and four basement levels. Among the museum’s holdings are antiquities like “E Ingakyo” from the Tempyo period (710–794 A.D.), which is the oldest Japanese painting and a national treasure, and “Maki (Chinese black pine) and Maple Trees” from the Edo period, which was painted on a folding screen by Korin Ogata (1658–1716) and designated as an important cultural asset by the Japanese government, as well as modern works of art, such as “Avalokitesvara as a Merciful Mother” by Hōgai Kano (1828–1888), which is also an important cultural asset, and “Jo-no-mai” (Dance Performed in Noh Play) by Shoen Uemura (1875–1949).

To store such vulnerable and sensitive pieces of cultural heritage, proper environmental control of the storage areas is indispensable. From around 2012, the heat source equipment at the museum was beginning to show signs of malfunction due to age, and the university began to discuss replacing it.

“Keeping these important assets in optimal

condition and protecting them from deterioration are key responsibilities of our museum. For that, we have to run the air conditioning equipment without interruption 24 hours a day, 365 days a year. On the other hand, the museum is also required to conserve energy as well as preserving cultural assets, and as a public educational and research institution, we at the museum need to take that into full consideration,” says Masato Satsuma, a professor at the University Art Museum.

The TUA’s Ueno Campus is classified as a “large facility” by the Tokyo Metropolitan Environmental Security Ordinance*1 and is obligated to achieve the CO₂ emissions targets imposed by the ordinance. Since the museum had been responsible for one third of the energy consumption of the entire campus, it was a high-priority building for energy-saving measures. “In replacing our facilities, the challenge was to satisfy the two conflicting requirements of a high level of environmental control, which is essential for the protection of our collections, and energy efficiency—and to achieve both within a limited budget,” says a member of the Facilities Division at TUA.



Comfort is maintained for the many visitors to the entrance hall and exhibition areas.

Implementing energy-saving measures and cutting investment cost with an ESCO plan

TUA decided to adopt an ESCO*2 plan to replace the aging equipment and issued a public invitation for proposals. As a result, Azbil Corporation was selected as its partner.

“Azbil’s idea was to introduce a BEMS*3 to achieve optimal control of air conditioning facilities while updating the heat source equipment. It aimed for an average energy reduction of 46.2 % over three years. We thought it would be hard to achieve,” says the Facilities Division staff member.

An application for a government subsidy, submitted jointly by TUA and Azbil, was approved by Japan’s Ministry of Economy, Trade and Industry, and the upgrade work began in September 2014. Heat source equipment was replaced with high-efficiency models, and various control functions were incorporated for purposes such as storage and exhibition, operating facilities efficiently according to the heat load, and taking in the proper amount of outdoor air to control the indoor CO₂ density. Also, as the BEMS, Azbil’s savic-net™ FX2 was installed.

Optimal environment for preserving cultural assets is ensured by constant temperature and humidity in storage areas

The University Art Museum began operating with its new facilities in April 2015. The energy efficiency of the entire museum building has improved even beyond the initial targets presented by Azbil, and CO₂ emissions for the entire Ueno campus have decreased below the limits set by the Tokyo Metropolitan Environmental Security Ordinance. At the same time, temperature and humidity of the storage areas are well maintained at 22 ± 0.2 °C and 55 ± 2 %, respectively.

“Much to our surprise, we are saving a large amount of energy, and yet the temperature

and humidity are maintained at a high and stable level,” says the Facilities Division staff member. “We expected that settings of temperature and humidity would always go up and down because the heat load must fluctuate as people come and go, but environment of storage areas is always steady at 22 °C and 55 %. So, we can ensure the optimal conditions to protect our cultural assets, which have to be kept constant. When we initially solicited proposals for upgrading our facilities, we were concerned that the energy-efficiency upgrade work would affect our valuable collections, but that concern was entirely unnecessary.”

Also, TUA decided to take advantage of Azbil’s remote monitoring service for integrated building management. “Azbil’s remote monitoring service center always monitors our museum, and if some equipment is not working properly, the problem is fixed right away, so we don’t need to worry. Also, the status of all facility operations is recorded and reported to us, so we hope that information will help to plan future energy conservation,” comments the staff member from the Facilities Division.

TUA is planning energy-saving measures for its other buildings and facilities. According to Professor Satsuma, “This museum is one of the institutions approved by the Agency for Cultural Affairs for exhibition*4 of its cultural assets. In a recent inspection, the temperature and humidity control in the storage areas was rated as “almost perfect,” thanks to Azbil’s advanced control capabilities and



The museum installed high-efficiency heat source equipment and a PARAMATRIX™4 digital controller to manage it. Thanks to optimal control of the equipment, energy consumption has been greatly reduced.



The museum receives many visitors to its Doctoral Program Final Exhibition in December and Graduation Works Exhibitions in January.

Tokyo University of the Arts (National University Corporation)



Location
12-8 Ueno Park, Taito-ku, Tokyo 110-8714, Japan
Founded
May, 1949
Undergraduate faculties
Faculty of Fine Arts, Faculty of Music
Graduate schools
Graduate School of Fine Arts, Graduate School of Music, Graduate School of Film and New Media, Graduate School of Global Arts



Masato Satsuma
Professor,
Tokyo University of the Arts

glossary

*1▶ Tokyo Metropolitan Environmental Security Ordinance

A Tokyo Metropolitan Government ordinance concerning the environment and pollution. To maintain a safe living environment for Tokyoites, the ordinance includes various regulations on pollution from factories, proper management of chemical substances, reduction of environmental impact by buildings, CO₂ emissions from automobiles, etc.

*2▶ ESCO (Energy Service Company) plan

A project in which an energy service company provides comprehensive energy services for a factory, office building, etc., and guarantees the results.

*3▶ BEMS (Building Energy Management System)

A system for minimizing the energy used by an entire office building, factory, district heating and cooling plant, etc., by automating the monitoring and control of energy-consuming facilities.

*4▶ Institutions approved for exhibition

Institutions, such as art museums or other types of museum, which have been pre-approved by the Commissioner for Cultural Affairs to exhibit their national treasures, important cultural properties, etc. The examination of institutions by this system is designed to promote the open use of cultural properties, so long as the institutions keeping them can maintain their quality while exhibiting them.

Responding to changes in the market and in needs, the azbil Group presses ahead to raise customer value

In FY 2017 the azbil Group embarks on its new medium-term management plan. With an understanding of the fast-paced changes in the market and in technology, we will proactively implement measures to meet the needs of our customers in all business areas. Guided by our Group philosophy of “human-centered automation,” we will provide safety, comfort, and fulfillment for our customers while helping to preserve the Earth’s environment.

A full-scale expansion into new areas of business is now in gear: pressing ahead with the new medium-term management plan

Since its founding in 1906, at the dawn of Japanese industry, our company has always improved its business by the consistent pursuit of automation technology.

The new medium-term management plan, extending from FY 2017 through FY 2019, has now begun. All of our business activities since April 2012, when the company changed its name from Yamatake Corporation to Azbil Corporation and began operations according to its three fundamental policies, have enabled the

company to prepare a solid foundation for its consistent growth. These three fundamental policies are (1) being a long-term partner for the customer and the community by offering solutions based on our technologies and products, (2) taking global operations to the next level by expansion into new regions and a qualitative change of focus, and (3) being a corporate organization that never stops learning, so that it can continuously grow stronger. The new medium-term plan retains these three basic policies in order for the azbil Group as a whole to move on to the next level. In concrete terms, we will press ahead with the reform of business structure and characteristics, and at the same time we will begin full-scale progress to cultivate new areas of business related to key concepts like *life cycle*, *new automation*, *environment*, and *energy*.

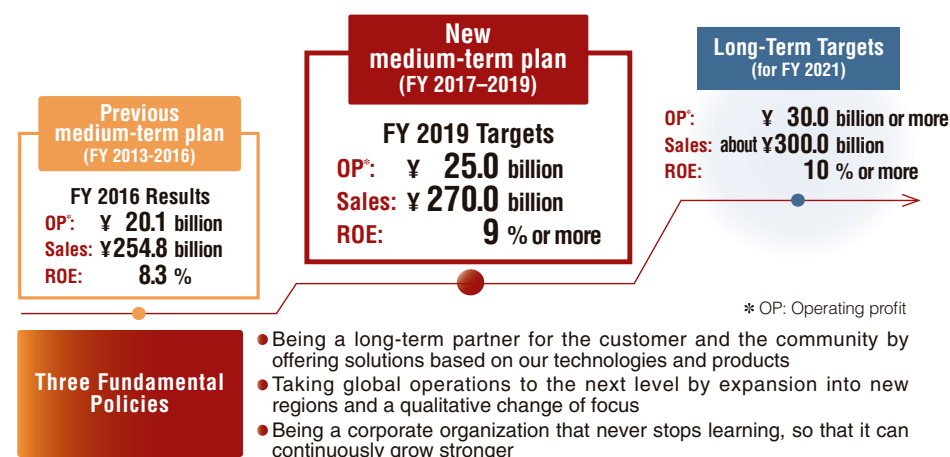
Implementing measures in response to market trends, we are committed to addressing problems faced by our customers

With regard to the building automation (BA) business, metropolitan-area redevelopment is currently in progress in preparation for the 2020 Tokyo Olympic and Paralympic Games, and after 2020 it will be time to repair the aging buildings constructed in the construction boom between the 1980s and the 2000s. Given these prospects, we expect that the demand for building automation will increase. With “work-style reform” in mind, we will set proper limits on work hours, allocate personnel appropriately, and prepare a complete system to cope with these changes. Also, the BA business will aim for continued growth around the world, drawing on the products and systems that have



Hirozumi Sone
President and CEO
Azbil Corporation

■ The new medium-term management plan as the second step toward achieving the long-term targets for FY 2021



been prepared during the previous medium-term management plan.

Since last year, the azbil Group's advanced automation business has had the three subsegments of CP,^{*1} IAP,^{*2} and SS.^{*3} They will each continue with their integrated systems encompassing all processes from marketing and development to production and the provision of services. In this way, the company is determined to best respond to customer needs in both mature markets and growing markets in the advanced automation area.

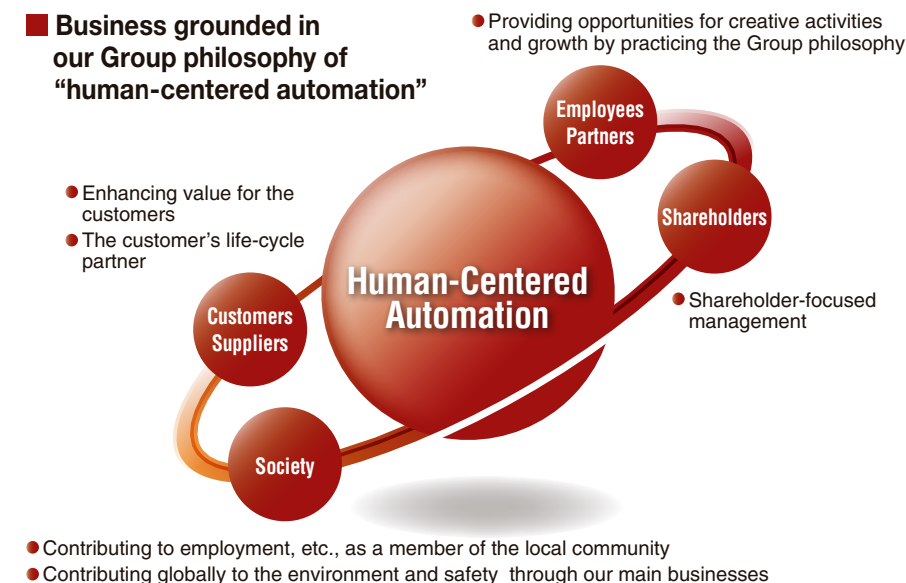
For the domestic petrochemical industry, the azbil Group will continue to enhance its maintenance and replacement service capabilities. In recent years, new needs have arisen for a higher level of safety and security at industrial plants, and we are considering how to apply our original technologies and how, in association with business partners connected with this industry, to press ahead with the provision of new value that can assist the activities of our global customers.

On the other hand, in the markets for semiconductor manufacturing and for high-performance material manufacturing, for example, there is an increasing need for our unique technologies. In such areas, therefore, we will allocate many resources and accelerate the development and implementation of new products and applications.

Life automation is the third pillar of our business, standing alongside the pillars of building automation and advanced automation. The Group aims to increase the strength of its life science engineering in the pharmaceutical and research laboratory markets, and also to strengthen its services for everyday living, such as central air conditioning for houses, and its services for essential infrastructure, such as water and gas supply. We understand that business development in the energy supply market, such as the market for natural gas, is particularly important as the market changes due to deregulation. Therefore, the Group will expand its product portfolio and services in this area, drawing upon Group synergies to meet the needs of customers.

In terms of global expansion, the Group has made progress in the preparation of

■ Business grounded in our Group philosophy of “human-centered automation”



overseas bases, in the development of products and services tailored for overseas use, and in the construction of a production system that enables us to provide local customers with products and services from close-by bases. We will further improve the sophisticated products and services that have been cultivated on site and adapt them to the various lifestyles of our global customers in order to expand the life automation business abroad.

Seeking new dimensions in customer value by proactive use of cutting-edge technology

Reducing environmental impact and saving energy continue to be important themes for our customers, and the Group plans to gain more expertise in energy management in order to meet these customer needs.

Also, the azbil Group is considering the best means of development to make use of cutting-edge technology like the Internet of Things (IoT) and artificial intelligence (AI), which are particularly important themes for us. Since the demand for products and services adopting these kinds of technology is expected to increase, we have installed a new business unit called IT Solutions Headquarters solely committed to the development and marketing of products and services using the most advanced technologies. The Group will strengthen its development and engineering personnel and increase the R&D budget.

In addition, we will continue to focus on management that satisfies our corporate social responsibilities so as to continue to increase corporate value. This is essential for the sustainable growth of the above-mentioned business activities. In recent years, measuring corporate value by the yardstick called ESG (environment, society, and governance) has become increasingly common. The azbil Group, however, has always been managed with a view to meeting its corporate social responsibility (CSR), which broadly interpreted is similar to ESG, since our fundamental CSR themes have been human-centered management, helping to preserve the Earth's environment, development of a full-Group management system that satisfies governance codes, and contribution to society. Since the aforementioned implementation of the “work-style reform” is part of our CSR efforts, we will also implement measures to improve the capabilities and motivation of employees. We will work toward establishing a system that encourages all employees to go about their work with a strong interest in increasing the Group's performance by providing customers with value.

*1: CP is an acronym for control products, and the name of the AAC business area providing components such as digital instrumentation equipment, microswitches, sensors, and combustion control equipment.

*2: IAP is an acronym for industrial automation products, and the name of the AAC business area providing components such as industrial instrumentation, transmitters (for pressure, etc.), and automatic control valves.

*3: SS is an acronym for solutions and services, and the name of the AAC business area providing control systems and maintenance services.

An approach to controlling equipment and systems on the basis of the predicted outcome, selecting the variables that will best control the equipment in order to achieve the target.

Optimally controlling equipment based on prediction

When operating equipment and systems, highly dependable control is required for safe and efficient operation. Automated control technology was developed as one such highly dependable method of reducing human workload. PID control,*1 for example, is a typical approach widely used to control the temperature of raw materials in the production process.

Predictive control is expected to further improve quality and productivity, reduce costs, and conserve energy. It refers, for example, to supply-and-demand-based production planning, considering what to produce and how much to produce in order to minimize waste. In another case, it simply refers to optimal control for highly efficient device operation. So long as devices or systems are controlled based on some kind of prediction, that type of control can be considered to be predictive control.

A typical application of predictive control is for managing building air conditioning. A variety of heat source equipment is used in buildings that use either gas or electricity as their energy source. Since air conditioning load varies depending on various factors as

day-time high temperature, the number of visitors to the building, etc., the building is maintained best by predicting the demand for cooling or heating load at a given time and operating the heat source equipment based on the unit price of the different types of energy and the operational specifications of the equipment.

On the other hand, in process-related production facilities like petrochemical plants, a method called *model predictive control* has been used since around 1980. It determines the best control method by back-calculating the amount of control based on a computer simulation of what will happen in a certain amount of time, using the measured values to model how the state (temperature, pressure, flow rate, etc.) of raw materials like petroleum will change given the operating conditions. Production facilities regularly use these calculations to achieve reliable operation and improved quality.

ICT development improves prediction accuracy, stimulating research into new areas of application

It is fair to say that the evolution of ICT*2 has an influence on the widening application of predictive control. As a result of the development of IoT*3-related technology capable of collecting values measured by devices via networks, we can now gather a variety of data and thus gain a detailed understanding of the object of control and the operating status of devices. At the same time, since we are now able to use advanced technology to analyze a large amount of such data, the accuracy of prediction has increased, and therefore the usability of predictive control has improved.

Research to apply predictive control to everyday life has al-

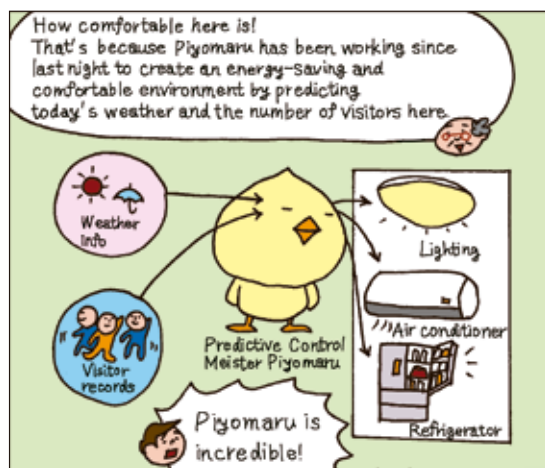
ready begun. For example, once traffic is congested, it takes quite a while for it to flow smoothly again. For that reason, there are now experiments that aim to prevent traffic jams by optimally controlling traffic signals based on past data. Also, research is proceeding to apply model predictive control to support systems for drivers and for more efficient train operation.

To achieve the vision of a smart city (eco-friendly city with efficient use of electricity and conservation of natural resources), accurate prediction of electricity supply and demand is considered to be the key to reliable control, especially for smart grids (next-generation power grids), which allow for optimization of the electricity supply. It is anticipated that predictive control will be adopted in various fields as a tool to help increase energy savings.

*1: PID control is a type of feedback control whose mechanism employs a combination of three types of control action, namely proportional, integral, and derivative.

*2: ICT is an acronym for information and communication technology. It includes systems and services that allow users to use information by means of computers and networks.

*3: IoT is an acronym for the internet of things. It describes a mechanism in which things, such as tools and devices, are connected with each other (networked) either directly or indirectly. It is also understood to refer in a broad sense to systems designed to add value to products using this mechanism.



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"Utility optimization software package for power plants with heat source equipment" is a system for boosting energy efficiency that is used by the energy production systems for factory heat-source facilities, district heating and cooling facilities, etc., to minimize CO₂ emissions and lower energy costs. The software greatly helps systems that produce energy (such as heat, electricity, and steam) to consistently supply heat, save power and energy, manage energy, and monitor operational trends in facilities.



Cover photo by Koji Mizutani, MERRY PROJECT Representative

azbil

<http://www.azbil.com/>

Yamatake Corporation changed its name to Azbil Corporation on April 1, 2012.

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