

Best Engine

Vol. 4

Special
Feature

A Prosperous Future Created by Innovation

ITOCHU Techno-Solutions Corporation

Best Engine

Vol. 4

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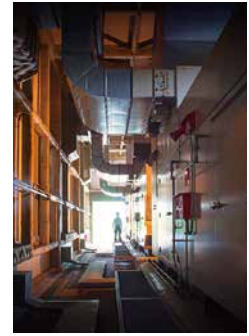
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Cover photo by
Masataka Nakano

Mejirozaka Data Center (MDC)—a high security, green data center where measures have been taken to achieve energy-efficiency as well as prevent noise pollution. The MDC is also built in an area known for its resilience against disasters.

Sontaku—a Literary Word Now in the Vernacular

I recently attended an internal social gathering and had an opportunity to hear speeches by new employees who joined the company fresh out of university. Everyone was bright-eyed and cut an impressive figure. What surprised me, however, was that despite belonging to the digital generation, they were all very familiar with age-old set Japanese expressions, whether it was one used to acknowledge an introduction at the beginning of a speech, or an expression for closing a speech by asking for the guidance and encouragement of those present.

These are like the stock expressions and phrases that are used as greetings in Japanese business letters. Although there are no corresponding expressions in English to these literary expressions, they say things like how pleased one is to learn of the recipient's continued good health and prosperity, or express appreciation for their continual thoughtful consideration. We use these phrases in Japan without giving it much thought. They just simply "feel right" to use. Personally, I think we could do with less formal expressions like these in business letters.

One of the words that is trending this year is *sontaku*. It is a word not used in everyday conversation. In fact, it seems that many people did not even know how it was written in kanji characters before now. According to a dictionary, it means "to surmise another person's feelings." I was taught the meaning of the word a long time ago, when I was talking to a person in legal affairs. I remember thinking that it was a word that symbolized the style of communication taken in Japanese society.

How does *sontaku* relate to work? I think that *sontaku*—surmising the feelings of others—is, in a way, nothing out of the ordinary. Whether it is in relationships within our own organizations or with clients, we act after surmising various things. I believe that business progresses with engaging in *sontaku* as part of a set with carrying out discussions and making confirmations. I have been talking for some time about creating an environment at CTC in which anyone can speak up about anything. Seen from a different perspective, this means that we do not want things to move forward simply based on *sontaku*—or a conjecture of what you think someone wants. Discussions must take place. Of course, once subordinates actually start saying whatever they want, it is only natural that the boss will wish that there was a bit more *sontaku* toward him/herself from his/her subordinates. But, I have a feeling that as far as companies are concerned, things are just about right when things are like that.

Satoshi Kikuchi

President and Chief Executive Officer
ITOCHU Techno-Solutions Corporation





Shinichi Sakane

President & CEO
Seven Dreamers Laboratories Inc.

Special  Dialogue

Hisashi Sawanobori

General Manager
Institute of Open Innovation Research “MIRAI”
ITOCHU Techno-Solutions Corporation

Special
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A Prosperous Future Created by Innovation

Conversation with the creator of “Laundroid”
—the fully-automatic laundry-folding robot—and the head of
CTC’s Institute of Open Innovation Research “MIRAI”



Smartphones, artificial intelligence and other technological innovations have been rapidly changing our lifestyles in recent years. How do such innovations enrich society? Shinichi Sakane, who leads Seven Dreamers Laboratories—the company that developed the world’s first automatic laundry-sorting and -folding machine—and Hisashi Sawanobori, General Manager of CTC’s Institute of Open Innovation Research “MIRAI,” talk about the present and future of technological innovation.

Coverage and text by Yuki Kondo



There is no end to technological development

Shinichi Sakane

President & CEO
Seven Dreamers Laboratories Inc.

Completed the doctorate program (PhD) in the Department of Chemistry and Biochemistry at the University of Delaware in 1999. Joined I.S.T. Corporation and served as director, and later as CEO. Also became president of Super Resin, Inc. in 2008. Resigned as CEO of I.S.T. in 2010. Became president & CEO of Seven Dreamers Laboratories, Inc. (of Silicon Valley) in 2011. Has held current position as president & CEO of Seven Dreamers Laboratories, Inc. (of Tokyo) since 2014.

This Is Indeed the Age of Innovations

—Mr. Sakane, Seven Dreamers Laboratories (“Seven Dreamers”), which you head, has been focused on creating things that the world has never seen before. In 2015, the company announced the Laundroid, the world’s first fully-automatic laundry-folding robot, attracting a great deal of attention. Meanwhile, CTC has been introducing a wide variety of services and solutions that utilize information technology. Mr. Sakane, you’re on the side of the innovator. Mr. Sawanobori, you are on the side of promoting business amid innovations taking place in information technology. Today, I hope to hear your views on innovation, as seen for your respective positions, and how innovation can enrich society. I’d like to start by asking how you see the current state of technology—in Japan and the world.

S. Sakane: Globally, I think new businesses that utilize various technologies are being created on an unprecedented scale. We’re seeing a trend to connect anything to the Internet through the Internet of Things (IoT)*1. In the world of automobiles, models loaded with functions that make them more like a “smartphone on wheels” than a vehicle are starting to appear. In contrast, Japan, unfortunately, has seen very little innovation emerging for

a long time. Perhaps it was because the momentum of the period of high growth was lost through the collapse of the bubble economy and the economic turmoil that followed the failure of Lehman Brothers. I don’t see this as being a permanent state. In fact, I feel new momentum finally arising in Japan regarding innovation.

H. Sawanobori: The ongoing changes in industry and society being brought about through the emergence of various new technologies are known as the Fourth Industrial Revolution*2. True to this name, I think that we are at a turning point in which technology greatly transforms the world. For example, artificial intelligence (AI)*3 is developing rapidly in addition to IoT. We’re



The “Laundroid,” which folds and sorts washed and dried laundry
Photo courtesy of Seven Dreamers

We are witnesses to huge changes

Hisashi Sawanobori

General Manager
Institute of Open Innovation Research "MIRAI"
ITOCHU Techno-Solutions Corporation

Joined ITOCHU Techno-Solutions Corporation in 1991. After being in charge of contact center solutions and data warehouse systems, supervised systems sales for the transport, consumer products and mass media industries. In April 2017, became head of the Institute of Open Innovation Research "Mirai," which aims to launch new businesses that utilize information technology.



seeing self-driving automobiles beginning to spread, and the birth of the Laundroid, developed by Mr. Sakane's company. I think the world is indeed about to undergo a significant change.

S. Sakane: Yes. It's as you say. Technological development is something that has no end. We human beings have ceaselessly innovated and brought about new products and services. I think this trend will accelerate even further in the future through a revolution of new technologies.

—In other words, we are living in an age of change. How are you responding to the changes going on in such an age?

S. Sakane: Our company chooses only those development themes that meet all of the following criteria. That is, it has to be for the development of "something that does not exist in the world," "something that enriches human lives" and "something that is technologically very challenging to achieve." We are particularly insistent on creating things that do not exist in the world. In fact, even if an item has not been commercialized as a product, we will exclude it as a theme if it has been mentioned in a paper, or another company has applied for a patent. It's no easy task to find themes that meet all of our criteria. However, holding firm to this belief ensures originality of the products that we create. We

believe that is Seven Dreamers' strength. When we find a theme for development, we take on that challenge no matter how difficult it may be, and we actualize that theme. We have the technological capability and enduring strength to enable this.

H. Sawanobori: Ever since the company was founded, CTC's business has been to combine various technologies from around the world and create optimal systems that meet client needs. If we can't achieve something through the technology that we already have on hand, we search worldwide for the most suitable technology, and we use it in combination to realize what is needed. What's more, we do more than develop systems. We also keep maintenance in mind to enable the stable operation of systems. I've spent many years at the forefront of sales, listening to client opinions and focusing on giving shape to their needs. We use such knowledge accumulated over the years in relation to various products as the base. We then link and combine various technologies and services to that base. This capability is our biggest strength. We recently established the Institute of Open Innovation Research "Mirai" as a means to utilize that strength even more directly. CTC Future Factory is one of the projects that the institute plays a leading role in. It is a platform that supports open innovation*4. We match Japanese and overseas venture companies and research institutions with our

clients, and assist the creation of new businesses and technologies. For example, we would bring a venture company, which possesses technological capabilities but is struggling to commercialize the technology, together with a corporation that not only has sufficient resources for launching a new business but also a clear objective. With CTC's information technologies and the ITOCHU Group network, I believe that we are perfectly suited for playing the role of matchmaker.

Having the Correct Theme and a Clear Goal

—In addition to the Laundroid, Seven Dreamers has also developed carbon golf club shafts and Nastent™, which secures an airway during sleep. They are innovations in completely different fields. How did you arrive at these development themes?

S. Sakane: Seven Dreamers' forerunner was a company that dealt in space technology. We set out to develop the carbon golf club shaft because we thought we could utilize the carbon material used in space in golf clubs. Meanwhile, the idea for



Made-to-order carbon golf club shafts, which employ a material used in space technology, are available to consumers.
Photo courtesy of Seven Dreamers



Nastent™ is a device that helps improve sleep-related breathing disorders as well as reduce snoring.
Photo courtesy of Seven Dreamers

Nastent™ originated because I have severe sleep apnea. As for the Laundroid, the idea started with a question that I posed my wife. I asked, "What home appliance do you wish existed?" and she immediately replied, "A machine that folds laundry for you." I take pride in the fact that none of the items mentioned existed before us, but I think Laundroid is the biggest innovation because there are no similar products.

H. Sawanobori: I understand that it took 12 years and many bumps and detours before Laundroid became what it is today. What was the driving force that enabled you to continue



The more opposition there is to an idea, the greater the conviction that the idea is original

engaging in this difficult challenge for such a long time?

S. Sakane: The most important thing is to have a clear goal. You, of course, need to know what kind of a product you're trying to make—what its function is. But you also need to have an idea of the concrete shape and size, at least to some extent. What's more, you need to have a target as to when development will be completed. I believe that these things are important for maintaining the motivation of a development team. With that said, real life does not progress as assumed. We ran into many walls during development of the Laundroid, but we soldiered on, telling ourselves, "Let's accomplish this, no matter what!" We got to where we are after repeating this many times. My pet theory is that the more people are against something, the better. This is because the more opposition there is to an idea, the greater my conviction becomes that the idea is original. Because of this, being in a situation where people found it hard to believe me became a source of inspiration and courage for me.

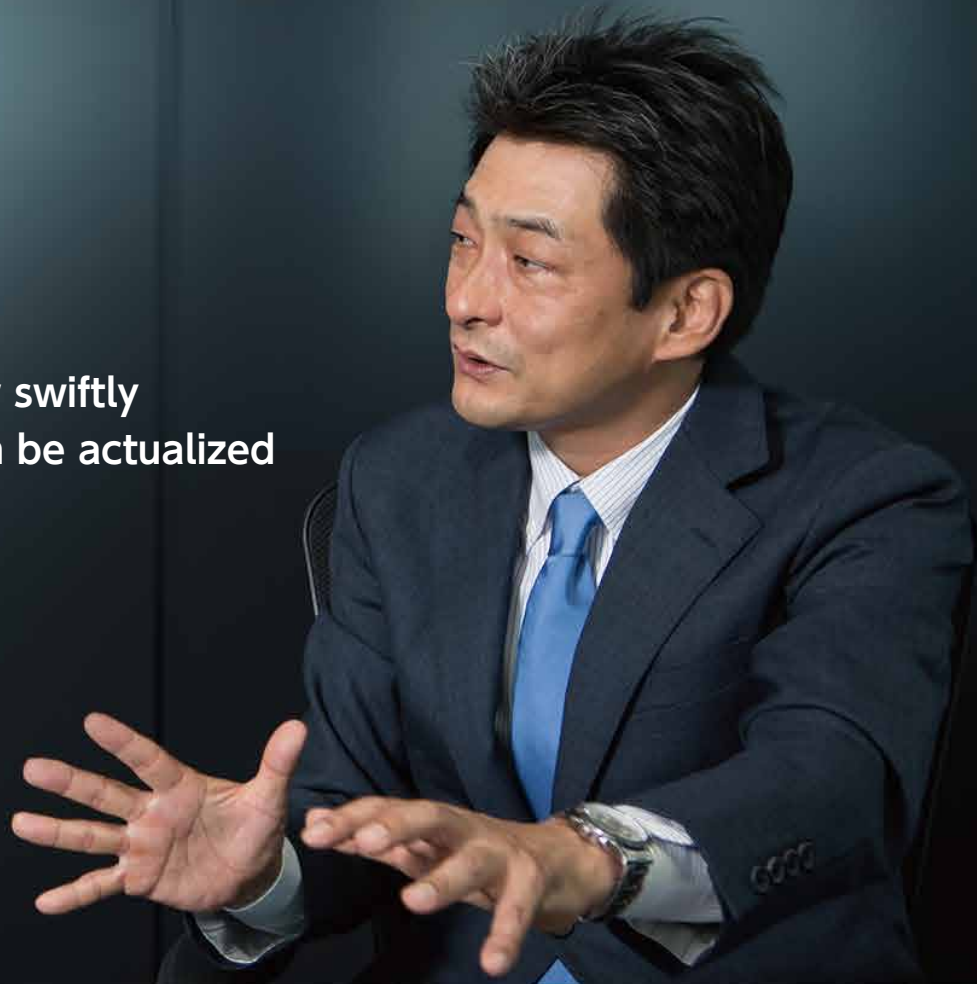
—What's the most important element for bringing about innovation?

S. Sakane: It's finding the correct theme. I believe that you'll

reach your goal without fail so long as you can do that. But, in reality, I feel this is where mistakes are often made, particularly in the case of large corporations. You need to have an unwavering core and select your theme accordingly after careful examination. Then, once a decision is made, you can't falter. You have to see the theme through to completion. My belief is that having that kind of absolute commitment is what brings about innovation.

H. Sawanobori: As the speed of change gets even faster, I, too, feel that the present state is such that it's difficult for innovation to arise from large corporations. For example, in the past, there was a clear demarcation between those who manufactured products and those who purchased them. Relationships were asymmetrical. Today, with the appearance of the Internet and technological advancement, that kind of demarcation is starting to disappear. In the past, many professionals needed to be involved to produce a movie. Today, a few amateurs can produce something with equipment that is readily accessible and release it by posting it on YouTube. Now that many different technologies are within easy reach, the most important thing is coming up with a new idea, and how swiftly you can actualize that idea. I do feel that the major corporations, who are our

The key is how swiftly
a new idea can be actualized



clients, have a sense of urgency about this. They feel the changing environment presents issues and that these issues have a direct impact on their business, so some kind of action needs to be taken. Because of this, there is an increasing number of companies that are trying out new approaches. This is especially true among leading manufacturers. There has also been an increase in companies that are entering new fields. They are launching internal organizations for creating new things and starting to achieve results.

The Edgier the Product, the Greater the Jump in Reach

—As new technological trends, such as AI, IoT and cloud computing*⁵ appear, one after another, what technology are you particularly keeping an eye on, Mr. Sakane, when considering bringing about innovation? Also, was there a specific technology that enabled the development of Laundroid?

S. Sakane: The core technologies for the Laundroid are AI, image analysis and robotics. They are all technologies that are benefiting greatly from the recent rapid increase in computing speed. Something else that's helped is the ability to link multiple computers with cloud computing. Meanwhile, even using today's state-of-the-art AI, it's still difficult for AI to correctly identify pieces of laundry because it's shape changes the moment it's picked up. We are still the only company that has accomplished a machine that can automatically recognize individual articles of clothing as being what it is—a T-shirt as a T-shirt, for example, or a pair of slacks as slacks—and fold them accordingly. I feel, based on that experience, that no matter how advanced a technology we may achieve, innovation will not arise unless it's combined with human ideas.

—I think that innovation involves not only the difficulty of developing a technology but also the difficulty of commercializing that technology.

S. Sakane: Identifying how to go about selling a technology that has been developed is just as difficult as developing that technology. It's especially difficult to figure out how to sell unprecedented items like the Laundroid because there are very few actual cases that can be used for reference. You have to feel your way forward through trial and error. I think the situation in which the Laundroid is being brought out into the world is similar to the situation when dishwashers first made their appearance on the market. However, that happened 40 years ago. You can't compare the marketing of that time to the sales channels that are available today. We have no choice but to think of our own ways to sell the Laundroid. Maybe figuring

that out is all part of the innovation that is taking place.

H. Sawanobori: I feel, based on experience, too, that the commercialization of products created through new technologies and ideas doesn't go quite as expected. In fact, large corporations are now shifting to a method called "lean startup." Under this methodology, a company utilizes its existing network while starting something off small as a business. They gradually expand the business while listening to user opinions. There are fewer cases now in which a huge amount of money was invested from the onset, only to fail because the product didn't sell when it was released. We are also seeing new ways of sales utilizing YouTube and other social media. This is an age in which television ads don't have to be used. You can create an interactive business by fully utilizing information technology. What's becoming important now is to have a structure that can respond immediately to changes in a business environment.

S. Sakane: The speed of the changes taking place in sales methods is really remarkable. The spread of the use of social media is having an especially big impact. When something new has been created, and you're selling it, there are several steps that lead up to purchases by consumers. To get them to buy a product, you have to start by getting consumers to know about the product, then generate consumer interest in the product, and finally boost consumer appetite for the product. It's the first step that's the hardest—how do you get consumers to know about the product? It's difficult because you have to make a great number of people the target. In going through the development and commercialization of the carbon golf club shafts, Nastent™ and Laundroid, in that order, we found that the edgier a product is, the greater the jump in reach over social media. In other words, the bigger the "Wow!" factor—the impact on consumers and the surprise they feel—the more information will spread on its own without money being spent by you. In that sense, I think it's become a really great age for our company.

The Achievement of More Innovations Will Make Society Richer

—If we suppose that the momentum of innovations will increase even further going forward, how will that change our society?

H. Sawanobori: Japan is relatively affluent and stable. However, if you look elsewhere, you will find that many major problems exist. They include poverty, educational divide and environmental destruction. However, if more innovation is achieved going forward as mentioned earlier, I think that there will be an increase in the problems that technologies will be able to solve. I believe that the society that results from that will

be even richer. CTC's mission is "Leveraging IT's potential to change future for the global good." We undertake our daily tasks with this in mind. Our hope is to solve the various issues raised in the UN's Sustainable Development Goals (SDGs) through our business and information technology, and help make society richer.

S. Sakane: I think that there should only be two kinds of battles and wars in the world—sports battles and economic wars. In the latter, large numbers will compete fiercely with each other to create new technologies and products. I believe that is how a healthy world should be. We must make things that are truly sought by people. Meanwhile, there are those who feel that it would be dangerous to allow AI technology to develop too far. However, I am totally for the development and further advancement of new technology. It's because I studied biology as a student and have felt just how sophisticated living organisms are, including we human beings. Compared to the mysteries of living organisms, man-made technology is still at a toy-like level. This includes cutting-edge AI. That's why I think there is no need for excessive concern. We should create more new technologies and products, and create a society that is even more convenient and affluent.

—Let's hope that innovation is something of value to us human beings.

H. Sawanobori: If you compare artificial intelligence and humans, the biggest difference is that human beings are not rational. I think that might be an important point. It's the element that makes human beings interesting and appealing. I don't think that will change, no matter how much technology develops. Robots may handle more and more of the "rational" tasks automatically, but the things that are not rational will be handled by none other than we humans.

S. Sakane: I agree. No matter how advanced artificial intelligence may be at present, it's still at a stage where it cannot easily distinguish a T-shirt from among a pile of clothes. No matter how much AI develops, I am quite sure that the role played by human beings will not change greatly from what it is today. With that said, when I look back on my forty-some-odd-years, I become keenly aware and appreciative of how much our lives have been enriched by technology. Our society has the potential to become even more prosperous. With that belief, I want to continue doing my best to keep on bringing about innovation.

H. Sawanobori: Innovation and information technology are both things for the benefit of us human beings. Our society will undoubtedly become even more affluent so long as we don't forget this. That's what I believe.



*1 The Internet of Things (IoT)

The Internet of Things (IoT) is the network of Internet-connected devices, which can include anything from furniture and home appliances to industrial machinery. It is a mechanism that makes information exchange and the control of connected-devices possible through a network. For example, air conditioners and televisions are connected to the Internet and can be operated using smartphones. With anything connected to a network in the future, IoT is expected to bring about major changes to society. For example, CTC has launched an IoT bathroom. Sensors make it possible for people to check the availability of toilet stalls without going there.

*2 Fourth Industrial Revolution

Refers to the currently ongoing revolution in the manufacturing industry through IoT, artificial intelligence, cloud computing and other new information technologies. It follows the First Industrial Revolution, which occurred during the 18th to 19th century. The Second Industrial Revolution, which began around the 19th and 20th century and involved mass production. And, the Third Industrial Revolution, which began in the late 20th century and involved computer-controlled manufacturing. The phrase is said to have started with the name "Industry 4.0" announced by the German government in 2011.

*3 Artificial intelligence

Refers to technologies in general that attempt to realize natural (human) intelligence with computers. Also known as "AI." With machine learning, in which computers learn on its own without being programmed, at its core, AI is expected to be used in various fields going forward. It has been said that about half of the jobs in Japan will be replaceable with AI or robots over the next 10 to 20 years.

*4 Open innovation

A method in which a company combines its technologies and ideas with those of other companies, research institutes, academia, government, and so on, to bring about innovation. Many Japanese companies have incorporated this method into their development of technologies, etc.

*5 Cloud computing

Refers to exchanging and storing data utilizing multiple computers that are connected to the Internet as well as utilizing services hosted on a cloud. Cloud computing enables advanced calculations that are not possible using just a personal computer or mobile terminal that is physically located in front of a user. It also allows the storage of data on other computer resources found on the Internet. Cloud computing is also referred simply as "the Cloud."

Python—the Programming Language for a New Age

IEEE Spectrum recently announced The 2017 Top Programming Languages, revealing that Python had jumped in popularity to the top slot. Python has now become a programming language that is highly favored across the globe. A Python instructor from CTC Technology Corporation's Technical Education Services describes Python, the programming language for a new age.



Naoto Hori

Education Planning and Marketing Department
CTC Technology Corporation

What's Python?

Python is a general programming language created by Guido van Rossum. It can be used as a scripting language to automate routine tasks. Recently, however, it is also being used in highly specialized fields, such as machine learning and deep learning—which sparked the artificial intelligence boom. Why is Python used by such a wide range of users? Several reasons are conceivable, but Van Rossum's personal philosophy is thought to be a big reason. In *Computer Programming for Everybody*^{*1}, a Python funding proposal sent to the U.S. Defense Advanced Research Projects Agency (DARPA), one of Python's goals was described as an easy and intuitive language just as powerful as major competitors. It also talked about how Python is a programming language suitable for educational purposes, but that, at the same time, it should also be an option for use by professionals.

Python is indeed suitable for educational purposes because the language allows programs to be written in plain English. What is more, Python takes a "batteries included" approach and comes with a standard library that contains various resources (i.e., "components" for building software). True to its goal, Python is indeed an easy and powerful language that can be used by anyone.

There are principles behind Python that respectively support its ease and power.

The Ease and Simplicity of Python

Like Ruby and Perl, Python is considered a lightweight programming language. Tasks can be implemented with short code, making it easier to handle. While Python is often compared to other programming languages, I do not feel that there is much difference with others in terms of grammar. Like Ruby, it is an object-oriented language. It can also be written in procedural language, like Perl. The major difference is in the principles behind writing programs.

For example, the philosophy behind Perl is "There's more than one way to do it^{*2}." In other words, there are different ways to write code for the same task. A similar philosophy can also be found in Ruby. Ruby borrowed the "good" functionalities of various programming languages, and, as a result, the same function can sometimes have many names in Ruby. Different options are therefore available, which means that once you get used to using the programming languages, you have the freedom of choice depending on circumstances. While this can be a good aspect of a programming language, beginners seem to feel that it makes things a bit difficult.

Meanwhile, in Python, the principle is that a similar program would generally be used when the required task is the same. If you consider readability, having a similar code across the board would make a program more straightforward and easy to

read. You could say it is suited for development by two or more persons.

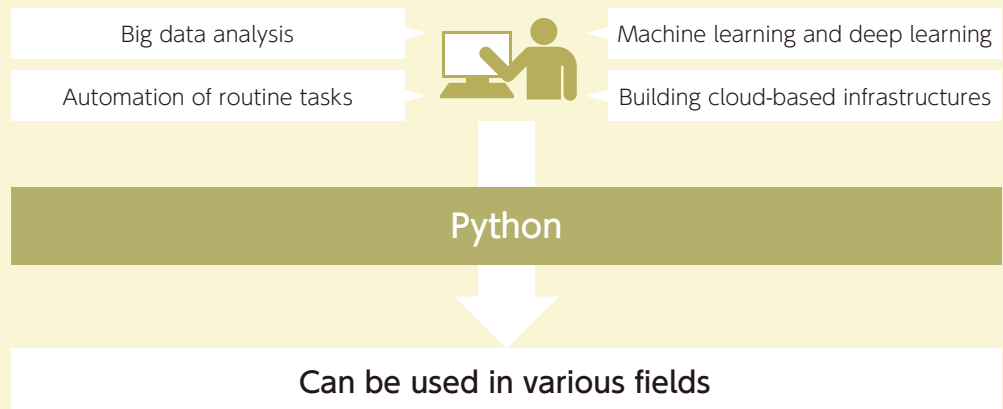
Python has two distinctive characteristics that make it a simple programming language. One characteristic is elegant syntactic elements. In Python, codes can be written using only commonly used keywords like "if," "else" and "while." Some programming languages use new keywords like "case" and "switch" when writing multiple conditions. However, having more than one way to write the same thing goes against Python's philosophy, so Python recognizes only minimal keywords. This allows code to be written with simple keywords, almost as if writing in plain English.

Another characteristic is the use of indentation to mark blocks of code. In Python, indentations are used by programmers to intentionally enhance the readability of a code. When first learning about programming languages, beginners might be too focused on writing the code itself and unable to think about how the code "looks." Python's emphasis on the use of indentations allows beginners to write easy-to-read code, just like experienced programmers. These aforementioned characteristics play very important roles in maintaining the simplicity of codes written in Python.

The Zen of Python

If you execute the Python command on a computer with Python installed and type

■ Areas in which Python is Used



"import this," you will see the Zen of Python^{*3}. It is a message consisting of 19 sentences that express Python's guiding principles, such as "Simple is better than complex" and "Beautiful is better than ugly." The Zen of Python is said to be a function that was added later as a kind of hidden command.

I always introduce these principles in my Python training sessions. When learning a new programming language, we tend to focus on grammar. However, understanding the principles behind a programming language can often help going forward. If you are going to learn Python, I recommend that you begin by learning the Zen of Python.

The Power of Python

As mentioned earlier, Python is a "batteries included" programming language. It includes convenient functionalities and other items that are commonly used in programs. Examples are date/time functionality, regular expression functionality, file access, and support of CSV files and JSON file formats. The standard library also includes HTTP access via networks and HTTP server implementation. HTTP clients and servers can be easily implemented through a few lines of code—no understanding of information technology mechanisms is required.

Meanwhile, NumPy^{*4} and SciPy^{*5} are popular, advanced numerical-computation

libraries for use in the big data analysis of recent years. The result of data analysis can be easily expressed as graphs using Matplotlib^{*6}, a plotting library. Popular resources for machine learning and deep learning include scikit-learn^{*7} and TensorFlow^{*8}, which was developed by Google.

Python has a long-standing community in the field of numerical scientific computation, which has been carrying out research and development. That is why Python has many specialized libraries. It is important to have an active community, as it brings about a virtuous cycle for strengthening available libraries.

The Future of Python

In the IEEE Spectrum ranking mentioned at the beginning of this article, Python outstripped famous programming languages like C, which laid the foundation for today's information technology, and Java. It is an indication of just how much worldwide attention Python is attracting.

Furthermore, because Python is easy to learn, the programming language is also drawing attention from infrastructure engineers. With the advent of cloud computing services, there has been an increase in matters that can be resolved through the use of programs. Engineers who had no need in the past to deal with computer programming are now learning Python out of need.

Python is often called a "glue language."

The scope of its utilization is expanding, precisely as if it is serving as a "glue" to attach itself to various fields. Python's momentum keeps on building, and its use is expected to continue spreading, without any let-up, as a glue language. Why not take this opportunity to learn Python, too?

*1 <https://www.python.org/doc/essays/cp4e/>
*2 <http://wiki.c2.com/?ThereIsMoreThanOneWayToDolt>
*3 <https://www.python.org/dev/peps/pep-0020/>
*4 <http://www.numpy.org/>
*5 <https://www.scipy.org/>
*6 <http://matplotlib.org/>
*7 <http://scikit-learn.org/>
*8 <https://www.tensorflow.org/>

The Utilization of ICT at Construction Sites

Enhancing Productivity by Sharing 3D Models in Planning, Design, Construction Work and Maintenance

There is a pressing need in Japan to improve and develop infrastructures as measures toward the aging of structures and against the worsening of disasters. Here is a look at CIM (Construction Information Modeling/Management), a construction production process management method that utilizes 3D models. It is attracting attention as a measure to make up for labor shortages in the field of construction arising from the nation's declining birthrate and aging population.



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The "i-Construction" Initiative —Aiming for Improvement of Productivity at the Construction Site

A construction boom is underway in Japan, including Great East Japan Earthquake reconstruction projects and infrastructure improvement for the Tokyo 2020 Olympic and Paralympic Games. While construction investment is increasing in the country, there is a pressing need in Japan to promote operational efficiency and improve working conditions at construction sites. This includes measures to deal with issues, such as the labor shortages being experienced by the construction industry, and industrial accidents.

In 2016, amid such circumstances, the Ministry of Land, Infrastructure, Transport and Tourism drew up the i-Construction initiative as a measure to improve productivity at construction sites. In addition to boosting productivity through the integration of information and communications technology (ICT), i-Construction contains measures to improve the industry's working environment, including safety and wages. Adoption of the use of drones and the automation of heavy equipment are some of the proposals being made in terms of applying ICT to the field of civil engineering and construction. Such ICT and 3D models are utilized in overall construction processes in CIM (Construction Information Modeling/Management), which is positioned as a core of the i-Construction initiative.

The Need to Utilize ICT in the Civil Engineering and Construction Field

Building information modeling/management (BIM) is a method that has become widespread in the

field of architecture. In BIM, attribute information—such as materials and costs—are added to 3D data on building design. A computerized model is then created, shared and used throughout all stages of a building's architectural life cycle—from design, construction to maintenance.

There are many cases in the field of civil engineering and construction wherein structures are built after clearing land from a natural state. Because of this, information on the terrain, geological conditions and surrounding environment must be considered in addition to the structure. Although inspections are carried out in advance, there are many things about a natural environment that cannot be foreseen and are not discovered until construction actually begins. Optimal construction methods need to be selected on a daily basis under changing conditions. The construction work is often extensive and takes place over a long period—there is more information that needs to be shared as compared to the field of architecture.

What is more, each process may be ordered separately to promote the fairness of contracting public works. The scope of those impacted by construction may often be widespread and include national and local governments, railroad companies, landowners and local residents—so there may be a variety of concerned parties. While the sharing of information is essential, information management methods may differ for each concerned party. For such reasons, the integrated utilization of ICT in all civil engineering/construction processes was slow moving, unlike BIM used in the field of architecture.

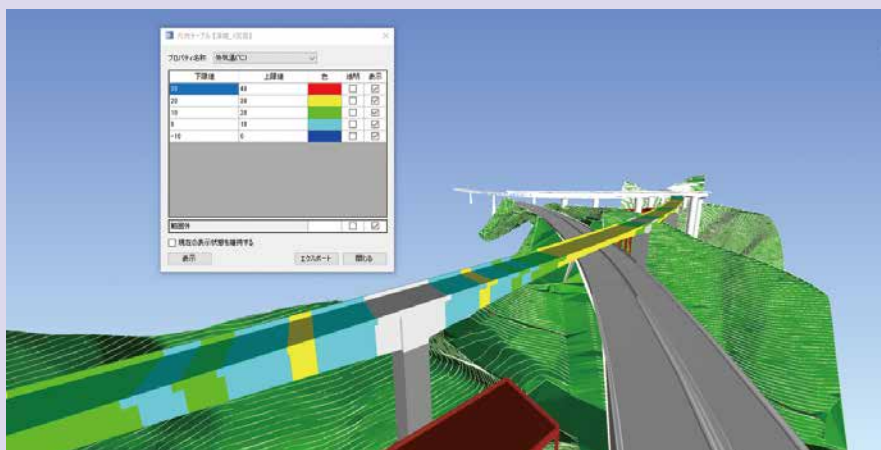
In the field of civil engineering and construction, 2D diagrams were used in the past and shared

among concerned parties. Construction work progressed with each individual imagining what the construction site would be like based on those diagrams. Because the image pictured in the mind of an individual was not always consistent with the image held by others, discrepancies sometimes arose in perceptions.

What Is CIM?

CIM is an application of BIM methods—which achieve the efficiency of architectural operations—to the field of civil engineering and construction, such as building bridges and roads. Led by the Ministry of Land, Infrastructure, Transport and Tourism, trials began in fiscal 2012 to utilize CIM at the design stage. The trial expanded each year in stages and became a central measure of the i-Construction initiative.

The 3D models used in CIM do more than create 3D computer graphic depictions that make shapes—such as those of structures (including beams and pillars)—and terrain (such as mountains and rivers) more easily understood than through 2D diagrams and drawings. The embedding of information on physical properties (e.g., whether it is made of concrete or steel), structures (e.g., the number of elapsed years, costs) and terrain (e.g., geological layer, rock facies) to each relevant part of the 3D model makes it possible for concerned parties to carry out their construction work based on a shared image and information. What is more, the shared image held by concerned parties can be further boosted by placing created 3D models in virtual and augmented realities. The amount of information displayed can be adjusted to enable the sharing of what is appropriate for people in



Screenshot from Navix+, CTC's software for managing architectural and construction-related 3D attributes
Photo courtesy of Obayashi Corporation

different positions, such as contractees or local residents. This is hoped to enhance the quality and safety of construction work.

What is more, unforeseen items are sometimes unearthed during construction, while procedures can often change due to continuing bad weather. If information such as the reason for changing construction procedures can be embedded in the 3D model as construction-related information, the information can be used when making decisions for implementing inspections and repairs during the maintenance process.

The focus of CIM was initially on modelling, and much of the discussion was on how to utilize the 3D models. Recently, the management aspect is in the spotlight. In other words, the use of CIM as a means for information management for the whole life cycle. Hence, CIM is now considered an abbreviation for Construction Information Modeling / Management.

CTC's Undertakings

Since the 1990s, CTC has been providing primarily general construction contractors with solutions that utilize ICT and 3D models, even before the government proposal of i-Construction and CIM. Since 2013, CTC has also been offering CIM-LINK, a platform for the sharing of diagrams, CIM-compliant 3D models, images and various documents between contractees, surveying companies, construction consultants, construction companies and others involved in a construction project. CTC also offers Navix+. It is a program that enables attribute information to be added on to 3D models—created using CAD or model-building software—according to the construction phase

(design, construction work and management). The attribute information used can be those edited using Excel or other programs, and includes information related to design, construction, surveying, inspection and repairs as well as images and documents.

In addition to such services, CTC provides the structural analysis of structures like bridges and tunnels as well as the parts used in various structures; non-destructive tests; analysis and consulting related to the ground-related issues such as seepage flow and consolidation; and cost simulation for the maintenance of structures. CTC offers one-stop engineering solutions in the field of social infrastructure, inclusive of construction.

Toward Widespread Use of CIM

While there are high hopes placed on CIM by both the government and construction industry, there are still issues that must be overcome for its widespread use by Japanese construction business operators, which number roughly 470,000. The major points for achieving widespread use are as follows*1.

- ① Data standardization
The spread of IFCs (Industry Foundation Classes)
A standard that ensures the compatibility of data is required. This is because items and data for 3D models are provided not by a single company but rather by various organizations involved in a construction project.
- ② Data linkage with drones and sensors
Drones and sensors will be widely used during construction and operation as means to measure structures and terrain. Accepting the

input of information from such devices and the automatic reflection of such information in a 3D model will lead to greater productivity.

- ③ Sophistication of simulation and analysis technologies
Large-scale 3D simulations, including those related to geological and ground conditions, is starting to become possible with the development of parallel computing. Because there will be an increase in the parameters that can be used in analysis along with sensor-derived data, more advanced simulations are in need.
- ④ Automation of construction work
Enhanced productivity and the safety of workers will be achieved by feeding back the results of analysing collected data to construction machinery and heavy equipment, and linking this to automated operations.
- ⑤ Health management of workers
Having workers utilize wearable and other devices during construction work and connecting the data to a CIM system will contribute to the design of reasonable work plans.

CTC will continue to exercise the collective strengths of the Group, enhance its CIM-related solutions—inclusive of artificial intelligence and IoT technologies—and help enhance the safety and productivity in construction and civil engineering.

*1 See "IV. Paradigm shift through infrastructure and informatics" in the "Revitalization of Japan through realizing Society 5.0," a policy proposal announced by the Keidanren on February 14, 2017.
<http://www.keidanren.or.jp/policy/2017/010.html> (in Japanese only)



Photo/D-Wave 2000Q,Canada D-Wave Systems

The D-Wave 2000Q quantum computer, released by D-Wave Systems of Canada on January 24, 2017 (U.S. time). D-Wave 2000Q utilizes the quantum annealing process.

This issue's theme is...

【Quantum Computers】

As artificial intelligence dominates the buzz of society, quantum computers are thought to be essential for its future development. The actualization of quantum computers was expected to take quite some time, but they have become a reality in an unexpected way. What are quantum computers? We'll take a look here, from the background of their development to their workings.

Text by Yuki Kondo

Making 100 Million-Times-Faster Computation a Reality

In 2015, NASA assessed a computer as having a speed 100 million times faster than conventional computers. It was a quantum computer developed by D-Wave Systems, a Canadian venture company. This meant that the quantum computer could complete in one second, a calculation that would take a conventional computer 100 million seconds—or about three years and two months—to complete. This news was met with great surprise as the actualization of quantum computers were thought to be several decades in the

future. The possibility that it could be applied to artificial intelligence was another reason for gathering significant attention.

The concept of using quantum-mechanical phenomena in computers was first raised in the 1980s by Nobel prize-winning physicist Richard P. Feynman. However, the concept did not seem easily achievable and remained primarily of only theoretical interest, even as remarkable progress was later made in conventional computers.

Recently, with semiconducting silicon chip technology finally pushed to a physical limit in the enhancement of integration density, it was no longer easy to achieve

the so-called Moore's law (i.e., that the integration density of a semiconductor doubles once every 18 months). As people began whispering that the further development of conventional computers had reached its limit, quantum computers came back into the limelight.

A Computer that Swiftly Solves Combinatorial Optimization Problems

Research was mainly carried out on the quantum gate method. Simply put, while the basic unit of information on a classical computer is a "bit," which can exist in only one of two states—a 0 or a

1—the classical bit becomes a quantum bit (or a qubit) on a quantum computer. Qubits can exist in both the classical 0 and 1 state, or both. Although the basic concept is the same, utilization of the quantum mechanical phenomenon—the superposition of states—allows parallel calculation of two states to be made at the same time. For example, if there are n qubits, then parallel calculations numbering 2 to the n -th power become possible. Theoretically, it achieves calculation speeds that are incomparably faster than classical computers.

However, the actualization of this kind of quantum computers was extremely difficult from the aspect of manufacturing technology—that is, the quantum gate method is very unstable and only a few qubits can be handled in a stable manner. Because of this, people believed that the quantum computer would not become a reality for quite some time to come.

However, quantum computers were actualized in an unexpected way. D-Wave Systems of Canada succeeded in developing a quantum computer by utilizing the quantum annealing method. This computer was specialized in solving combinatorial optimization problems. Solving combinatorial optimization problems is like figuring out the best route to follow when a home-delivery service truck needs to deliver packages to many different locations. While this problem may seem simple to solve, if the truck needed to make deliveries to 15 locations, that would result in a massive number of combinations in terms of the routes that could be followed—1.3 trillion, in fact. In other words, if circumstances become even slightly complex, it becomes impossible for a classical computer to solve a problem in a practical sense since it could take years to complete the calculation. What is more,

this kind of problem arises in various aspects of our daily lives and also comes into play in the core elements of artificial intelligence. Therefore, the development of a computer that can swiftly solve combinatorial optimization problems had great significance.

Quantum Annealing, Which Enables Solutions to Be Obtained at Once

What exactly is quantum annealing? Annealing ordinarily refers to making metal soft by heating the metal and maintaining a suitable temperature for a given length of time, then cooling the metal gradually. Quantum annealing is similar, at least in notion, in the way computation is made.

The computer developed by D-Wave Systems in 2015 had more than 1,000 qubits. If all qubits were specified as being one of either 0 or 1, you would get a single combination for a combinatorial optimization problem. A classical computer would compute each combination that meets the condition specified for the problem to seek the optimal solution. Quantum annealing takes a completely different approach to find the solution.

Qubits line the surface of a chip maintained in a superconducting state at an extremely low-temperature. By applying a transverse magnetic field control signal, all qubits become a quantum mechanical state of superposition of 0 and 1. The intensity of the transverse magnetic field is then gradually weakened, while, at the same time, the interaction that needs to be maintained between qubits to fulfil the problem's conditions is gradually strengthened. Then, by the time that the intensity of the transverse magnetic field reaches zero, each qubit naturally settles as one of either 0 or 1. The state of all qubits obtained in that way—in other words, the combination formed as a

sequence of 0 and 1—is the solution that is being sought. The transverse magnetic field serves a role like heat in the annealing process. Quantum annealing is dramatically faster than conventional calculations because the solution can be obtained at once.

Japanese Technology Is the Foundation

D-Wave Systems' announcement that it had successfully developed a quantum computer was met at first with scepticism by many experts. However, after seeing the obtained computations, no one could deny that it was indeed a quantum computer.

Will quantum computers replace classical computers straightaway in the future? The answer is “no.” The use of quantum computers for artificial intelligence would require a computer with a staggering number of qubits, which will not be easy to achieve. What's more, it is not yet clearly understood how correct solutions are obtained through quantum annealing, so there is still a mountain of matters that need to be researched or resolved. We have only reached the threshold of the world of quantum computers.

Incidentally, Japanese physicist Hidetoshi Nishimori was the first researcher to propose the use of quantum annealing to solve optimization problems. It was also the research laboratory of a Japanese company that first developed superconducting qubits. Japan has made a significant contribution to the core elements of a quantum computer. It is a field in which Japanese technology shows great promise in the future as well.

Main reference material
Ryoshi Compu Ta Ga Jinkokinou Wo Kasoku Suru
(Quantum Annealer Accelerates Artificial Intelligence)
by Hidetoshi Nishimori and Masayuki Ohzeki (Nikkei BP)



U.S. Trends in the Utilization of Public Clouds



Takuya Nagao

International Business Development
ITOCHU Techno-Solutions America, Inc.

Mr. Nagao has been researching IT trends in North America—with a focus on cloud computing—as well as searching for vendors that handle advanced technology, sending related information and referring firms to Japan. (He returned to Japan head office duties on September 1.)

The early commercialization of an idea can make or break a business in the U.S., where many venture companies prosper. Because of this, the concept of “cloud-first,” which presumes the use of public clouds, is widespread. This is a well-known fact. There is also a forecast that the public cloud market will grow at an average annual rate of 30% between 2016 and 2020*¹, with more than 60% of tasks that utilize information technology expected to be processed through a cloud-based data center in 2020*². Between 2006, when the use of public clouds began spreading, and around 2008, the use of public clouds was marked for external systems and systems where the resource demand, such as development environment, was difficult to foresee. Changes have taken place in cases of use, and today, using clouds for internal core systems has also become common. As in Japan, shifting systems, etc., to a public cloud is seen in the U.S. as being a security risk factor. However, the adoption of public clouds seems to be assessed in the U.S. as an inexpensive and swift way to launch new systems, which leads to a reduction of operational costs and loads, even if it means having to accept the risk factor to a certain extent.

The Issue of Cost Management

With the widespread use of public clouds, a new issue has recently arisen. That is, the optimization of company-wide costs being spent on public clouds.

In the case of U.S. firms, there are many lower-echelon internal organizations that have been granted authority or autonomy. Because of this, the utilization of public clouds has been led and promoted by divisions that are using the cloud. The management of public cloud resources and costs are being carried out separately by each division, making it difficult to understand the state of use across a company. Circumstances are such that primarily for reasons such as those listed below, it is difficult to identify what needs to be done to achieve optimization.

- Each division has tied individual contracts with cloud operators.
- Volume discounts are not being effectively utilized because contracts are being tied individually by divisions.
- Know-how for saving costs is not being shared throughout the company, and because of this, there are divisions that have tied inexpensive contracts and those that have not.

Cloud Management Platform

A new market called public cloud management is starting to develop in the U.S. to deal with such circumstances regarding cloud use. For example, CloudCheckr, with corporate headquarters in New York, provides a public cloud management platform. Its Enterprise plan starts at 2% of the cost for Amazon Web Services (AWS). The service makes the status of AWS utilization by the subscriber company easy to see, and analyzes ways to optimize costs. Some subscribers of this service have succeeded in reducing costs related to AWS use by between 30 and 40 percent. CloudCheckr is already being used by more than 500 companies, centering on American firms. A characteristic feature is that the service can be used not only to manage resources and costs but also security. CloudCheckr caused a buzz in May 2017 when it raised 50 million dollars (roughly 5.5 billion yen) in Series A funding.

Reducing cloud-related costs has an impact on AWS sales, so you might wonder what their relationship is like. However, AWS recommends the use of cloud services at optimal prices. In fact, CloudCheckr is introduced on the AWS site as an Advanced Technology Partner (APN).

Other companies offering similar services include CloudHealth Technologies and Cloudability. Going forward, major companies are expected to enter this market—not just the current startups. As a matter of fact, Microsoft purchased Cloudyn of Israel, which offers cloud management solutions, in June 2017. We are now hearing the word “cloud-first” often in Japan as well. As use of public cloud services progresses in Japan, issues similar to those found in the U.S. will likely arise in Japan, too. However, in Japan, times like that are when cloud integrators like CTC can play a major role.



An Amazon brick and mortar bookstore opened at the end of August this year in San Jose.

*¹ Gartner, Inc. press release
Gartner Says Worldwide Public Cloud Services Market to Grow 18 Percent in 2017
<http://www.gartner.com/newsroom/id/3616417>
*² Calculated by CTC using figures published in *Cisco Global Cloud Index: Forecast and Methodology, 2015-2020*.

News Pickup

Here is information on solutions and services, selected from CTC news releases, that are in the limelight.

Open Innovation

Support for the Lean Startup of New Businesses Through Open Innovation

CTC has launched CTC Future Factory, an open innovation platform that provides comprehensive support for business development, from the formation of new ideas to its commercialization. It helps match companies involved in open innovation as well as provides venues and opportunities for various workshops, etc. It also offers assistance in the consideration of joint research and commercialization. DEJIMA, a dedicated space with functions for bringing about innovations, is scheduled to open in the autumn of 2017.

IoT

Realization of Optimum Promotions Through Real-time In-store Customer Movement Analysis

CTCSP launched the provision of in-store solutions developed by Supreme System. Moptar is a real-time in-store customer movement analysis tool, and Reach is a tool for analyzing customer behavior in front of store shelves. Moptar detects customer movement in real time using infrared laser sensors, while Reach monitors and collects data related to customer hand movement at store shelves. It enables the collection of data and analysis of the state of customer movement inside stores, and the gauging of their interest level—something that had been difficult to quantify in the past.

AI

Provision of an Automated Voice Response Solution that Utilizes Artificial Intelligence

CTC has jointly developed BellCloud AI for IVR with Bellsystem24. The solution utilizes IBM Watson's natural language classifier. The solution enables callers to reach call center operators in a stress-free, smooth manner through interactive audio conversations. The combination of speech recognition technology and AI achieves not only highly satisfying customer response but also reduces costs by shortening average response time and enhancing productivity.

AI

Provision of NVIDIA's AI Supercomputer Commenced

In a partnership with NVIDIA of the U.S., CTC has commenced the sale of DGX-1, which is an AI supercomputer. DGX-1's hardware architecture has been optimized by NVIDIA for parallel computing and deep learning. It is an appliance product that realizes high-speed processing of image, audio and other data. CTC was certified as the first NVIDIA partner in Japan in the field of deep learning.

RPA

Automated Operation Services Utilizing RPA Launched

CTC System Management has launched operation services utilizing Comsquare's Patrol Robot Controller, a robotic process automation (RPA) tool. Patrol Robot Controller automates tasks, realizing automation of the operation of work terminals, in-screen searches and decision-making, which are normally carried out by humans. It also achieves flexible conditional branching. The menu of operational services will be further enriched going forward through the use of AI-based predictive detection of system failures and advanced judgement functions.

Global Info

CTC Group Company Established in Indonesia

With the aim of further expanding its business in the ASEAN region, CTC has established PT. CTC Techno Solutions Indonesia in Jakarta. As a subsidiary of CTC Global (in Malaysia), CTC Techno Solutions Indonesia will provide IT services in Indonesia as well as promote alliances with local companies. The new company will respond to customer IT needs, and collaborate with CTC Group companies in Malaysia and Singapore and the joint venture company in Thailand, to support customer businesses throughout the ASEAN region.

Please visit the following for further details.

<http://www.ctc-g.co.jp/news/>



Golf Digest Editorial Practical Golf Theory for Mental Toughness

(With the cooperation of Team Serizawa Golf Academy)

Nobuo Serizawa

Born 1959; age 57. A lifetime record of five Japan Golf Tour wins, including the Japan PGA Match-Play Championship (1996). One Japan PGA Senior Tour win marked since becoming eligible. Currently heads Team Serizawa, which he formed with professional golfers Hiroyuki Fujita and Katsumasa Miyamoto. Opened a golf academy at the Daihakone Country Club. Has many fans and followers and is known for his easy-to-understand golf lessons.



Get in the right mindset to make your practice sessions pay off

There are plenty of golfers who have trouble translating all their hard work at the driving range into success on the course. However, you can make the most of all that effort if you have the right mindset heading into practice. From tweaking your swing to getting a feel for your iron distances and improving your short game, Nobuo Serizawa has loads of tips on how to practice your way toward better results and show your best stuff on the course.

Watch yourself swing!

Amateur golfers often tell me that the hard work they put in during practice doesn't always pay off in their actual rounds. The way I see it, that problem generally has a lot to do with their mindset: those people are probably just going through the motions during practice instead of thinking about what they're trying to accomplish. When you're practicing, the important thing is getting your form down and your rhythm right. It's not just about how many balls you hit. Some people might try to hit several hundred balls at the driving range, but that's not necessarily the best approach. If you want to get the most out of your time at the driving range, you're better off hitting fewer balls—a hundred, maybe—with a proper practice swing before every one. Check your form, take your time, and be mindful; that makes practice much more worth your while. Practice is obviously a good way to improve your swing, but even the tiniest tweaks to your swing can take some serious work. When you try to set your hands just a couple of

centimeters up or down, it feels like you're moving your entire setup by a half a meter or so—the change can be so jarring that you want to go right back to what feels comfortable. You have to resist the urge, though; your swing won't get better unless you keep repeating the change, over and over, until that sense of discomfort goes away. Technology can be a big asset in that process. If you take video of your swing with your smartphone, for example, you can play it back to see exactly what everything looks like—and make sure that you're actually

changing the things you're trying to change. Watching that footage from time to time lets you track your progress, making your practice time really pay off.

Get a good grasp on your iron yardages

Practice is also a great way to figure out exactly how far you can hit most of the clubs in your bag (the 13 clubs besides your putter), too. Without a good gauge on those distances, it's impossible to attack the course with precision. As far as I know, only a handful of amateurs can get by on pure feel alone. The key is knowing the carry of every club. Roll is part of the equation, of course, but that distance depends on so many other variables—especially with irons. Hitting the green accurately is all about knowing how far the ball carries in the air. If your 6- and 7-irons have about the same amount of carry, you can keep your 6 in the bag and use the 7 to get more lift and place your shot closer to the pin. With that, you're in better position to knock some strokes off your score.

Another thing you have to remember



when you're at the driving range is that you're hitting in an ideal, unrealistic environment—the teeing grounds are flat, the artificial turf is smooth, the lie is perfect, the space is wide open, and the grounds are free of any obstructions. The conditions aren't even close to what you'll encounter on the course. Your 7-iron might fly 150 yards at the driving range, but you might only be able to get 145 yards out of it during an actual round. While the driving ranges in Japan might make it hard to simulate your green approaches, it's a good idea to think about how the length of your backswing can affect your club distances. Say you're using a sand wedge, and your shots go about 70 yards when you swing shoulder to shoulder. Going off that base distance, you can project that an armpit-to-armpit swing would go 60 yards and a shorter, hip-level swing would go 50 yards. When you learn how to adjust for swing length, you add another dimension to your game.

Practice under a little bit of pressure

When you hit the course, however, it's not always easy to replicate everything you've been doing in practice. You might find yourself on a tight fairway flanked by trees on both sides, for example, or facing a pond or dip that you're not sure you can clear in one shot. That kind of environmental pressure, which comes from visual cues, tends to mess with your normal swing. To get yourself over that hump, you have to practice like you're playing under actual course conditions. You could imagine that the net supports at the driving range are the boundaries of the fairway, for instance, which adds a little pressure to the situation when you're hitting drives. Environmental pressure doesn't just affect your swing, of course—the gap between the driving range and the sights you see on the course can also interfere with your stance. When you're waiting for your turn on the course, you can ground your club and get yourself oriented if you want;

that's not against the rules. That helps you get a better idea of whether your ball will go where you want it to. If something seems off, you can make stance adjustments before your turn comes around.

Uneven ground is the hardest part of playing on an actual course. When you get all the different elements right, adjusting to whether the ball is above or below your feet or closer to your left foot or right foot, it might be a good idea to take notes on exactly how you approached that specific shot. Golfers tend to panic when they hit an errant shot during a round, creating added pressure that contributes to more mistakes. If you find yourself in that kind of situation, take a deep breath, review your notes, and use that experience-based input to think about what you need to do to break the mistake pattern.

Anticipate potential situations to avoid potential risks

One more thing: most bad shots on the course happen because of lower-body fatigue, which hampers your movement. After you reach middle age, your muscles tend to be weaker than you think they are—and your lower body loses muscular strength at a much higher rate than your upper body does. Stiff legs force you to swing with your upper body alone, making for an outside-in swing and plenty of slices. If you feel like you're not getting much out of your legs, squat down as you bring your club from head level down to the ground (like a men strike in kendo), and then stand up slowly. With that, you can stimulate your leg muscles and loosen up your lower body.

Good practice sessions—and good scores—hinge on simulating the different conditions that you might encounter on the course. It's a lot like the business world, actually: anticipating potential situations and managing risk are vital to success.

Message from Hikari Fujita,

a Female Professional Golfer
Supported by CTC

Hi! Hikari Fujita here. When you're a year-round golfer, you end up having to play in the rain sometimes. Here are some tips for getting around rainy-day challenges.

Rainy conditions make it hard for golfers to get the carry they're used to, first of all, so people tend to make up for that distance deficiency by swinging bigger than normal—and that extra strain can lead to bad shots. To get your sweet spot on the ball with better regularity, it's best to go with a longer club and choke up a bit. Rainwear can constrict your mobility, too, which makes it important to know how much distance you can get out of your three-quarter and half shots.

Since raindrops on your club grips and faces can affect your shots, as well, remember to wipe your clubs often and have some extra towels and gloves with you.

For me, rainwear poses another challenge—the swish-swish sounds of the material can be distracting. That's why I always try to keep my rainwear to a minimum. When I'm playing in a tournament, though, I make sure to wear a distinctive ensemble so that people can see that it's me in the rain.

Next time you're heading out for a round in bad weather, do all the necessary preparations and know that you'll probably be in for more errant shots than usual. That'll help you stay relaxed and do your best on the course.



Hikari Fujita—born 1994. Started playing golf from age 3 with her father as her teacher. Passed the JLPGA pro test in 2013. First win as a pro was the JLPGA Kaga Electronics Rookies Cup. Achieved her long-sought win in a regular tournament in 2015.



Akihiko Mori

Science Writer

Mr. Mori has written articles related to emerging science and technology. Last year, he covered the Cybathlon held in Switzerland for Wired magazine. Cybathlon is an international championship for people with disabilities who use advanced assistive devices.

This issue's number is...

1.5 times bigger

Increase in skeletal muscle amounts

A High-yield Red Sea Bream—the Next-generation of the Up-market Fish Developed by CRISPR State-of-the-art DNA Editing Technology

CRISPR (CRISPER-Cas9) is a state-of-the-art genetic modification technology that was developed around 2012 by European and American research institutes and others. It is also known as gene editing since it allows targeted portions of DNA to be altered as if one were cutting and pasting text. Together with genomic analysis that utilizes information technology and artificial intelligence, eyes are focused on CRISPR as a part of a smart-cell industry in biotechnology. The smart-cell industry refers to the group of industries that utilize smart cells, which are finely-designed and expression-controlled cells.

Conventional genetic engineering technology, well known through genetically modified organisms (GMOs), like CRISPR, is also a genetic modification technology. However, the difference is in precision. For example, if trying to develop high-yield rice through conventional genetic engineering technology, the probability of the target modification falling into the right section of DNA is extremely low—said to be odds of about one in 10 thousand. Lower precision means that more trial and error is required, which increases industrialization costs.

Meanwhile, in regard to CRISPR's precision, one of its developers—Professor Jennifer Doudna of the University of California, Berkeley—said in a TED Talk that it was “a way for scientists to delete or insert specific bits of DNA into cells with incredible precision.” Some proponents have even written that its precision is “nearly 100 percent.” The technological innovation offered by CRISPR is one that has changed the results of genetic modification technology from a “product of chance” to a “dead certain” technology with very high-precision control. A major

advancement, indeed.

Those in the field of agriculture and stockbreeding are laying their hopes on CRISPR. In Japan, a joint research team from Kyoto University and Kinki University succeeded in “fattening up” red sea bream by 1.5 times. Skeletal muscle mass was increased by editing myostatin, which suppresses muscle growth, using CRISPR.

The latest development overseas was the actualization of high-yield tomatoes—the fruits of which do not fall from the branch—by the Cold Spring Harbor Laboratory using CRISPR.

There is also a lot of activity in industrial circles as well. In January 2017, Monsanto, which is a leading American seed and agricultural products company, concluded a licensing agreement with CRISPR licensor Broad Institute of MIT and Harvard for the use of CRISPR in agricultural applications.

Debate is ongoing on ethical grounds regarding CRISPR since it is making the realization of “designer babies” a more real possibility if it is applied to modify human genomes at will. With that said, with concerns over world population growth in the future, CRISPR provides technology that may result in the creation of highly-efficient agricultural crops with smaller environmental loads, or its application in the field of medicine by targeting genetic diseases. It is technology for which there will likely be greater expectations for the awarding of the next Nobel Prize.

Reference:

Genomu Henshu Towa Nanika: “DNA no Mesu” CRISPR No Shogeki (What is genome editing? The impact of the CRISPR DNA scalpel) by Masakazu Kobayashi (Kodansha Gendai Shinsho)

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<https://www.wired.com/2017/06/crispr-may-cure-genetic-disease-one-day/>

<http://news.monsanto.com/press-release/corporate/monsanto-announces-global-genome-editing-licensing-agreement-broad-institute>

Principal Group Companies

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