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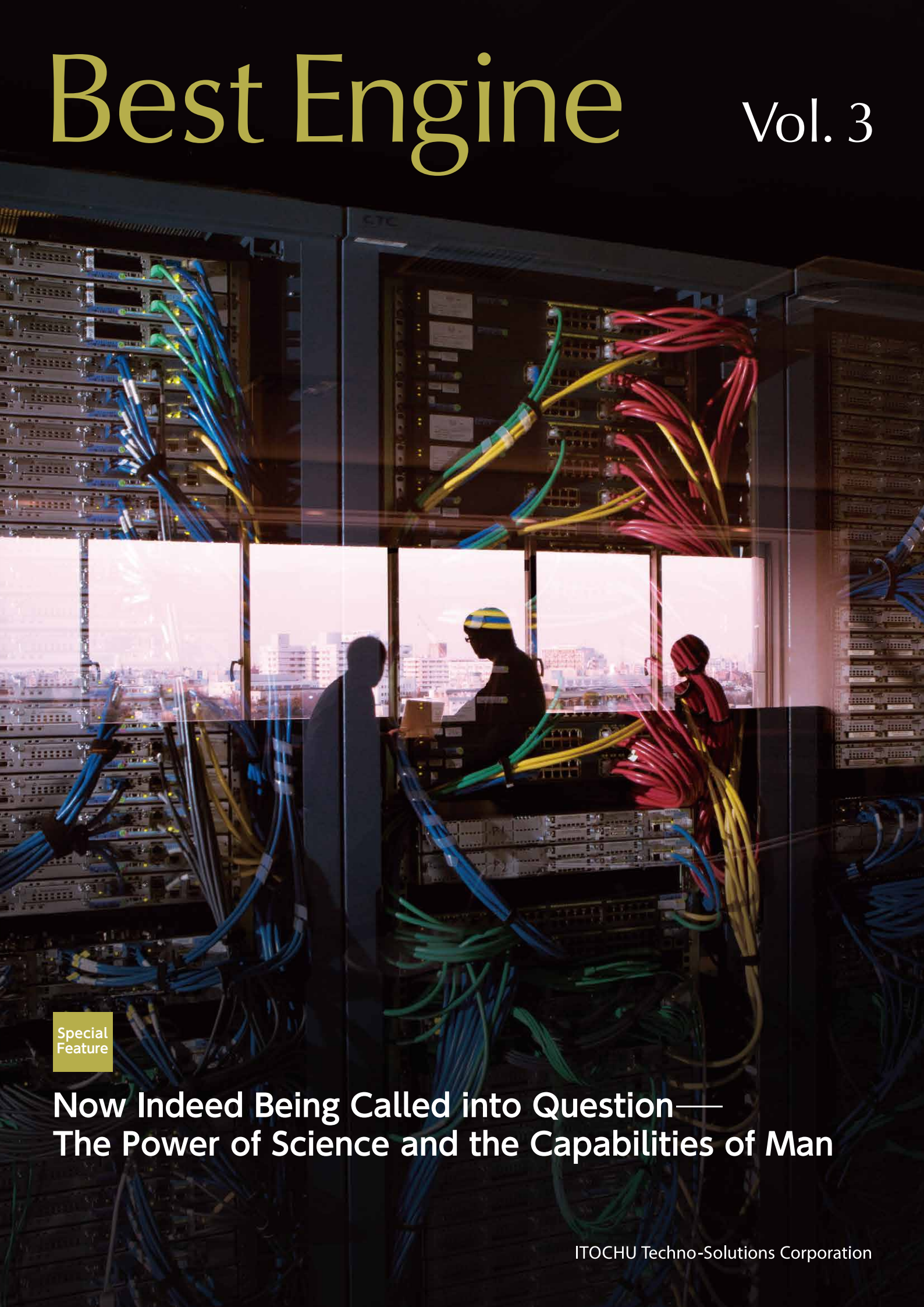

Special Feature

Now Indeed Being Called into Question—
The Power of Science and the Capabilities of Man

ITOCHU Techno-Solutions Corporation

Best Engine

Vol. 3

Cover photo by
Masataka Nakano

The CTC Technology Learning Center, with its state-of-the-art learning environment (Komazawa, Tokyo)

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The Four Seasons of IT

The Indigo Dyer Wears White Trousers (Japanese proverb)

The cutover to a new, in-house backbone system is imminent at ITOCHU Techno-Solutions (CTC). I personally acted as project owner, and we developed the new backbone system while going head to head with our vendor teams. We are normally on the other side of the equation, delivering leading-edge IT technologies to our clients. There was something that I noticed while involved in a project as the actual user. We devote ourselves to selling products and services that we have collected from around the world, but how are we as users? Have we become the proverbial indigo dyer, who wears white trousers because he is too busy dyeing the trousers of his customers? Are we ourselves directly testing the usefulness and effectiveness of new products and services so that they may be used by our customers?

The Internet of Things (IoT), artificial intelligence (AI) and financial technology (FinTech)—the IT industry is hastening the development of new technologies toward a new chapter in information technology. Countless companies are showing interest in the potential of such technologies, which could change the world as we know it. How can the numerous innovations that appear, one after another, be applied for business use? The best way to find out is to use it ourselves. I want to spread that kind of a mindset throughout CTC. So, every time I walk around the company, I ask people, "Do you have any good ideas?"

We are seeing various hackathons arise at CTC. Last year, one such event resulted in the development of an IoT service. It makes it possible to see whether a conference room or even a toilet stall is in use. (You obviously cannot see inside—only check their availability.) The service has just finished the demonstration test stage. Actual use helps us see its convenience. At the same time, it shows us things that could be improved. Such understanding broadens possibilities by giving rise to new ideas and applications.

In April, we will launch the Institute of Open Innovation Research "MIRAI." It is our lab for developing new businesses. It will brainstorm ideas for the utilization of technologies, and if there is something that looks promising, the company will showcase it. It will not be trousers, but we do hope to "dye" new technologies into CTC Blue. I hope that we will be able to unveil such new technologies here in our Best Engine newsletter soon.

Satoshi Kikuchi

President and Chief Executive Officer
ITOCHU Techno-Solutions Corporation

Special Feature

Now Indeed Being Called into Question—— The Power of Science and the Capabilities of Man

We are in an age in which society is about to undergo significant change through the development of scientific technology and IT. The age requires the capacity to undertake development based on an understanding of the essence of matters. What is the role to be played by science? A CTC engineer, who has spent many years at the front lines of science, and a science writer, who continues to observe science with a broad vision, discuss science, the future and what is most important in this day and age.

Coverage and text by Yuki Kondo

Kaoru Takeuchi
Science writer

Special Dialogue

Satoshi Ishikawa
Principal
ITOCHU Techno-Solutions Corporation

Kaoru Takeuchi

Science writer

Studied the history of science, philosophy of science and physics at the University of Tokyo. Later received a doctorate from McGill University. Has in-depth understanding of and a passion for science. Author of a great number of scientific reviews, essays and other works. Appears as host on NHK Educational TV's "Science Zero" program.

Know What's Inside a Black Box

S. Ishikawa: CRC Solutions, one of the predecessors of ITOCHU Techno-Solutions (CTC), was among the first in Japan to use a supercomputer. Since then, we have been involved for more than 50 years in carrying out analyses and simulations in the science and engineering fields.

We have been dealing with science for many years. We'd like to think anew about the role of science in these turbulent times—also known as a VUCA world*1. Mr. Takeuchi, I'd like to ask for your thoughts on science as it should be in this age, as well as various things about the world of the future. You have been keeping an eye, from a broad perspective, on science as a whole?

K. Takeuchi: We are currently living in momentous times when society is undergoing significant changes. In the background is the development of science and technology, such as in communications and computers. They are deeply related to the changes that are happening. I believe that the importance of science begins to stand out at times like these.

To begin with, science is at the root of the various technologies that we enjoy daily. Having possession of that "root" will be important if a company is to survive beyond the significant changes of the times. Without it, companies would not be able to create from scratch, whatever would make it possible to deal with changes—like if the world became a society of artificial intelligence*2, if quantum computers*3 became a reality, or if global warming caused a cataclysmic change in the global environment. This is a capability that Japanese companies are generally lacking, so I think that having long-term accumulation of expertise in the field of science will become an even greater strength for your company.

S. Ishikawa: Thank you. Our field has always been closer to engineering and technology than pure science. For more than 50 years, we have carried out software development in-house as well as the provision of services. Even in regards to structural calculations, fluid calculations and the calculation of electromagnetic fields, we don't use black box software programs obtained from outside the company. We have software that we developed in-house that we can reconfigure as needed. In that sense, I think we can say that CTC has continued to possess the "root" that you spoke of earlier.

K. Takeuchi: I think that "black box" is one of the key words of this age. As technology becomes highly developed,

*1 **VUCA world**
VUCA is an acronym used by the American military to describe an intensely uncertain, complex and ambiguous situation. It is short for Volatility, Uncertainty, Complexity and Ambiguity. Triggered by use of the acronym at the World Economic Forum's annual meeting in January 2016 (Davos), VUCA has become a managerial buzzword that is in frequent use.

*2 **Artificial intelligence**
Also referred to as AI, artificial intelligence refers in general to technologies that try to realize human intelligence through computers. With "machine learning" (computers learn and enhance their intelligence on their own) as a core element, AI is likely to be used in the future in various fields. Some say that 10 to 20 years from now, it will be possible to replace about half of the work performed in Japan with AI or robots.

Satoshi Ishikawa
Principal
ITOCHU Techno-Solutions Corporation

Has driven in the field of science and engineering, CTC's engineering services, such as nuclear power, as well as technologies in the field of resources and new energy sources. Supported safety assessments using simulations. Currently affiliated with the Science & Engineering Systems Division. As Principal, works to create innovations as well as develop human resources.

everything in today's world is becoming available as a black box. I believe that the spirit of science is not to handle things as they are—as black boxes. Instead, it is to try to make everything oneself, including what's inside the black box. I think that developing technologies with that kind of a spirt is what's being required of companies right now.

S. Ishikawa: CTC emphasizes the utilization of its original technologies, especially in the field of science and engineering. Said another way, the company creates the black box itself.

For example, even in architectural structural calculations, computations were traditionally carried out in the linear domain*4. However, in simulations carried out for disaster prevention, we need to examine super-giant earthquakes from now—huge quakes that we would consider "beyond the scope of assumption." That makes computations in the nonlinear domain*4 indispensable.

In such cases, we can make the required changes to a program because we have developed the software ourselves. In other words, we can make the black box. Things that are "beyond the scope of assumption" can happen in a VUCA world. That's why I feel the importance right now of having such capabilities.

The Possibilities Contained in Simulation Technology

K. Takeuchi: All things in the universe can be expressed mathematically. By highly developing simulation technology, we have tried to express everything mathematically to an extent possible. That was how today's computational society was formed. As computation technology develops even further in the future through the appearance of quantum computers and the like, we will become a super-computational society. When that happens, it will become run of the mill to carry out elaborate computations, inclusive of those in the non-linear domain, in every simulation. That kind of age is just around the corner.

S. Ishikawa: In terms of the world of simulations, the future will probably bring about an age of large-space testing. In other words, not only would it be possible to gauge each phenomenon with great precision, it would also become possible to simulate, with great accuracy, multiple phenomena as a whole—phenomena that take place while interacting with each other in a large space, as in the real world.

*3 **Quantum computers**
Computers that make use of quantum mechanics. In principle, a quantum computer could complete in a matter of minutes a computation that would require tens of thousands of years to complete using today's fastest computers. The world's first commercially available quantum computer was built by a Canadian venture firm in 2011. It has already been adopted by a number of leading companies in the United States. There is a possibility that artificial intelligence will develop dramatically through the use of quantum computers.

*4 **Linear and non-linear domains**
When expressing a phenomenon mathematically, if the relationship between the input value and output value can be shown using only addition and subtraction (i.e., as a linear function), that phenomenon is said to be in the linear domain. Otherwise, it is a phenomenon in a non-linear domain. Most phenomena that take place in real-life are in the non-linear domain. However, calculation in the non-linear domain is difficult using existing computers. For this reason, mathematical expressions are usually simplified for simulations so that it can be handled in the linear domain.

Take automobile crash simulations, for example. Up to now, the only choice was to simplify reality and carry out a simulation like a vehicle crashing into a wall. However, real crashes are more complex. It could involve two or more vehicles crashing at the same time. Sometimes they crash into another vehicle from the side. Sometimes they crash from behind. Sometimes, fires erupt when they collide. I think it would become possible to simulate and assess complex situations like that.

K. Takeuchi: The thing about technology and engineering is that you tend to see progress only after much trial and error. No matter how meticulously you design something and carry out repeated safety inspections, accidents will inevitably occur. What's important is that the cause of the accident is then carefully determined so that the problem can be eliminated. That improves the item and boosts safety. That's the world of engineering. The role played by simulation for such purposes is huge. In that sense, I think that the enhancement of simulation technology is of great importance to us.

In December 2016, a huge fire erupted in Itoigawa City, Niigata Prefecture. It burned for about 30 hours, ravaging an area of about 40,000 square meters (Fire and Disaster Management Agency figures). If simulations could be carried out while fires like that are raging to predict how they would spread, it might be possible to take countermeasures before everything catches on fire. That would be extremely useful.

S. Ishikawa: That's true without a doubt. CTC handles fires in its simulations, but given the speed of existing computers, it would not be easy to accurately assess how a phenomenon that is taking place over a wide area would be 10 minutes or even one hour later. But things like that might become a reality in the future if computation time becomes dramatically shorter through quantum computers.

The More Technology Advances, the More Human Wisdom Is Called into Question

K. Takeuchi: I said earlier that all things in the universe can be expressed mathematically. This is also like water when it flows. Water finds the shortest path for it to flow after instantaneously carrying out an enormous calculation of where that path is. Nature is always implementing atomic-level quantum-mechanical calculations from scratch. However, no matter how fast computations by computers may become in the future, we will never be able to use the same methods as nature to compute at the same speed as nature. Humans need to find another method that is unique to them, and that's "approximation."

What does this mean? We simplify calculations by omitting unnecessary portions. We do this based on our accumulated understanding of physical phenomena. This way, the answers we derive may not be 100% correct, but

we can nevertheless obtain sufficiently useful answers in a short amount of time. Carrying this out skillfully would enable calculations to be carried out ahead of nature. I believe that's the real thrill of simulations.

S. Ishikawa: What's important at that time is nothing other than human ingenuity, isn't it? To carry out effective approximation, you need to understand which elements are really contributing to a particular phenomenon, and focus on them. Put plainly, approximation can't be done without an understanding of the essence of things. It's not a matter of being able to do it simply by having the capability to carry out computations at extraordinary speeds using quantum computers. You can't carry out meaningful computations unless human beings—those that use the quantum computers—properly understand what needs to be done.

K. Takeuchi: Absolutely! I believe that the most important thing in computer literacy is to understand what's essential and what should be calculated. If you try to calculate everything without that kind of understanding, then you'll never finish your calculations. By contrast, if you can focus on just the essential elements, then you can re-enact reality with pretty good precision in a short amount of time. There will probably be an even greater need from now for people with that ability.

I do have a concern in relation to this—that the more advanced computers become, the more likely that a certain difficulty will arise. I have a feeling that we are entering an age in which things can, in a sense, be done without an understanding of what's essential. That is, even if you don't understand what's essential and end up doing unneeded, wasteful calculations, you could still complete them to an extent if you had a fast computer.

S. Ishikawa: Computer performance was not good enough in the past, so people had to do some thinking to compensate for it. For example, the computer game developers of yesteryear created some very interesting software that only took up a few megabytes. That's data capacity which is about the same in volume as that taken up by a single photograph these days. The U.S. Apollo Program of the 1960s got humankind to the Moon using computers that are like the desktops in use today.

I think that this was the result of people making a huge effort to understand the essence of matters deeply, because technology and resources were limited and nothing could be wasted. In those days, like it or not, engineers developed finely-honed perceptions of things. But, with high speeds and capacity so abundantly available today, we can do anything without having to devise ways to do things. That's actually a problem. It might be that the more computers advance, the more difficult it becomes for humans to acquire a capability for detecting what the essence of something is.

How Can We Develop the Capability to Understand the Essence of Things?

K. Takeuchi: There was a device called a slide rule*5 when I was a child. It's like a ruler that is used to carry out complex calculations. People who were proficient in using the slide rule were the people who could carry out scientific computations. I have heard that my teachers' generation used to "crank" computers by hand—that is, turn a crank handle on a pinwheel calculator to carry out calculations. The computational society has its beginnings there. But, things became more and more advanced and sophisticated so that today, people don't even know what a slide rule is.

When I was in university, and I took a class taught by a renowned celestial mechanician, he was astounded by how little we knew about such computation techniques. They were already unnecessary by the time that I was a student in the 1980s. I thought it was really amazing that the professors of old did in their head the things we do now using computers. But times like that are now in an even more distant past.

It might be more difficult for today's youths in the sense that technology was already very advanced by the time they were small children. Just about everything they needed has always been readily available to them. It's like they grew up in a world full of black boxes. I feel that they need to make a

*5 **Slide rule**
An analog computing device that made various functional computations possible. It utilizes logarithms to convert multiplication into addition. Invented in 17th century England.


Photo courtesy of Hemmi Slide Rule Co., Ltd.

greater effort than the people of the generations before them to understand the essence of things.

S. Ishikawa: It might be as you say. Even in using computers, if you don't know about the calculation methods (algorithms*6) that they use, you can't identify the essence of things or how the results were obtained. A recent trend is that the "how" is no longer understood. The algorithms are often used in black-box form without a proper understanding of the algorithms. That is a concern of ours.

Each algorithm has a scope of application. In other words, the range in which it can be effectively applied. When carrying out a simulation, you can get the proper answer even with a black box if an application falls within that range—the scope of application. But it doesn't work in a world in which things that are "beyond the scope of assumption" can occur on a frequent basis. To deal with things beyond the scope of assumption, you need to understand the algorithm itself so that you can expand it. That kind of capability is going to become increasingly necessary going forward. But the essence of things is becoming harder and harder to see due to technological progress. That's where the difficulty lies.

K. Takeuchi: As artificial intelligence (AI) becomes even more widely used in our world, there will be even more things that the public understands almost nothing about. And, if an AI starts to replace human beings in making the kinds of decisions that humans used to take, then we will end up living our lives in a huge black box.

I am opposed to this. It's all right for AI to be adopted as a system to prevent accidents and other events that occur due to careless mistakes made by humans. But I don't think that decision-making should be placed in the hands of AI. I'm sure there will be people who will say that things would be safer if even decision-making was entrusted to AI. But, I think this is related to what kind of society we want to live in.

I believe that many issues would arise in such cases. For example, what would we do if circumstances that are not good for a large number of people arose as a result of leaving things up to an AI? Whose responsibility would it be then? I believe that ultimate responsibility should be borne by human beings. There should always be a person responsible, and that person should bear the ultimate responsibility. My hope is that we will continue to have that kind of a society, now and in the future.

S. Ishikawa: I agree with you. Human beings should be making decisions at the end. That's why it is also very important that we can nurture people who can make decisions.

K. Takeuchi: What will be computed? What should we focus on? I think that decisions like that should be made by human beings. Today's youths must acquire a sense for taking decisions. The issue, however, is whether there

*6 **Algorithms**
A set of rules or a process for solving a specific problem. The word is often used in reference to complex problem-solving that requires the cuulation of simple calculations. The oldest algorithm in the world is said to be the Euclidean algorithm. This algorithm is used to find the greatest common devisor of two positive integers.

are people who can teach that.

For example, there are tricks that are required for using a computer very well, but there aren't many teachers who know those "tricks." There might be almost no teachers who can teach how computers are used with an understanding of the essence of computers, and an understanding of algorithms. Calculating something using a ready-made program, so that you just need to enter numbers and the computer will do the rest··· that's not the way things should be. Something must be done in that respect in our educational system. Otherwise, I think that Japan's future will be at risk.

"You Need to Feel a Desire to Create Happiness in Society through Your Work"

K. Takeuchi: Japan is indeed a society that is driven by companies. Even if we talk about the arrival of a "society of artificial intelligence," education in the classroom won't keep up with it. But companies are taking the initiative and promoting this kind of society. Whether it's a global company or a company in the field of IT, they're all making the next moves. I think it's that kind of an attitude held by companies that has made it possible for Japan to survive. On the other hand, there is the hollowing-out of education in Japan. The competency levels of the human resources being sent in to companies as workers are increasingly falling. I believe that this, more than anything, is the problem being faced by Japan.

S. Ishikawa: In Japan, it's difficult to foster human resources with broad visions who can think soundly on their own. Whether it's being active on the global stage or in Japan, in the field of science or elsewhere, companies and schools must think seriously about how they can nurture individuals who can think on their own and imagine many different things. Being able to do those things solidly will bring about new ideas. It will make it possible to do more than just use a black box. People will be able to create new things from scratch. It might be those kinds of human resources that are needed above all else right now in Japan. I think they will become a force for bringing about innovation here.

K. Takeuchi: Something else that I feel is the importance of engaging seriously in matters. For example, when writing a disaster prevention program and carrying out simulations, it's about whether the person doing it is earnestly thinking about saving people's lives. It's not enough to think of it just as a task and do things with an abstract image of it in your mind. You need, at the core, a sense of mission—that people's lives will be saved through the simulations that you are carrying out. You need to feel a desire to create happiness in society through your work. Without those things, I don't think you can do a good job even if you possess advanced computational skills.

S. Ishikawa: Indeed. We are particularly often involved in work that is related to human lives and safety. I feel that when doing so, our ethics and sense of mission as an engineer become very important. What kind of an impact will the results we come out with have on society? How important is it? When I carry out my work, I always tell myself that I should never forget to keep aware of these things.

K. Takeuchi: The simulations are carried out for the good of human beings. Artificial intelligence should also be for the good of human beings. It should never be the other way around. What should we do to ensure the happiness of humankind? Perhaps the more technology develops, the more our way of being will be called into question.

Behind the scenes: The creation of "MAMS," a solution that could rewrite the ABCs of distribution

With the ever-growing online shopping market fueling distribution demand, CTC has leveraged its many years of expertise in expansive network design to launch "MAMS": a solution that helps distributors make their delivery plans more efficient. Here is a closer look at the development and features of MAMS—a service capable of revolutionizing the existing distribution mechanisms and making people's lives even more convenient.

Shinichi Hasegawa

Director
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A solution rooted in the consumer perspective

In the distribution industry, success hinges largely on how quickly a company can get products to consumers. One of the challenges, however, is that companies often operate under internal structures that draw organizational lines between store divisions and Internet divisions—a setup that can make it hard to coordinate efforts to enhance consumer convenience.

The approaches to creating systems for services are changing, as well. Traditionally, corporate clients would lay out the specifications for their systems, and SI firms would develop the systems accordingly. Now, though, the focus is shifting to collaboration: Corporate clients are showing more interest in working together with SI firms to boost consumer-service levels and thereby provide high value-added services.

To help companies excel, CTC developed "MAMS"* (Mobile Asset Management Service). For a distributor, any effort to accelerate the product-delivery process and transport items to consumers on time depends on having the right personnel in place and assigning truck routes as optimally as possible. Considering that consumers want to get their purchases whenever and wherever they need them, CTC set out to design a system that would enable distributors to meet demands in a smoother, more efficient fashion.

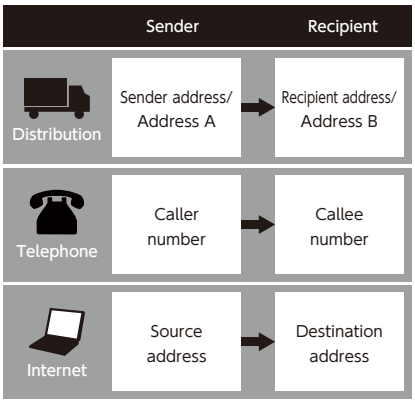
MAMS links existing backbone systems, EC sites, warehouse-management systems, product order-processing systems, and other systems in the cloud to create a fully integrated, efficiency-boosting framework. When a product order comes in, the employee responsible for the order enters a corresponding delivery reservation on a dedicated terminal. MAMS then processes the order in real time, automatically secures the necessary delivery staff, trucks, and other pieces of the process, and sends information on the consumer's desired delivery time to the delivery staff member's smartphone. By connecting and combining multiple systems, MAMS makes it possible to deliver products within consumers' time constraints.

Using communications expertise to benefit the distribution market

CTC's background in designing, building, and operating large-scale, mission-critical networks for major communications carriers—networks that need to be online and functional 24 hours a day and 365 days a year—has given the company a wealth of expertise in processing massive volumes of transactions efficiently.

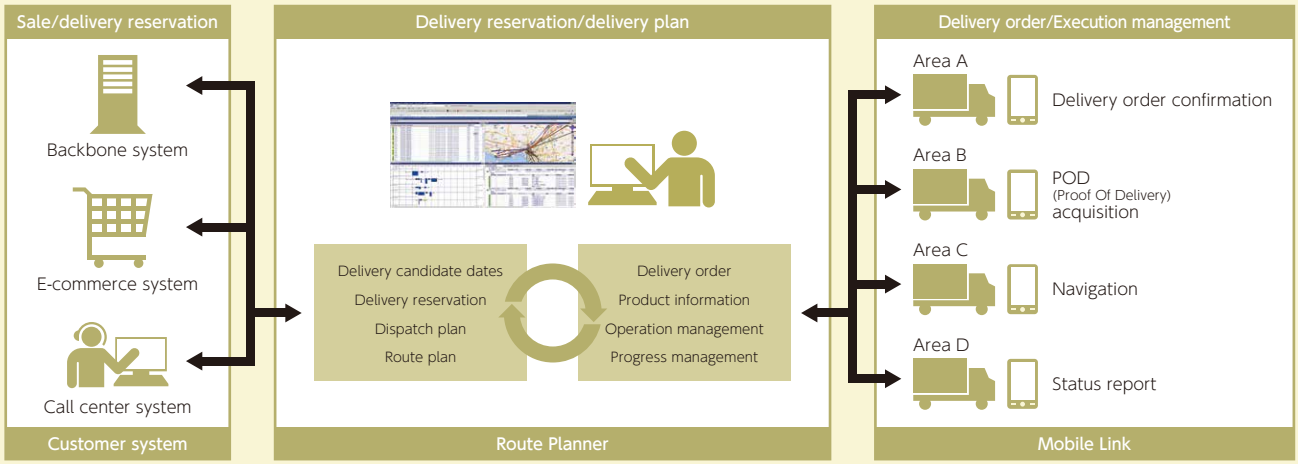
The basic concept behind communications comes from distribution: Just like distributors move an item from a sender to a recipient using information like postal codes and addresses, communications providers transfer information from one place to another via a similar protocol.

■Sending and receiving in the frameworks of distribution and communications



In telephone and Internet networks, users can communicate with others as long as they know the other party's details—even if the other party is on a different carrier. Switchboards and Internet exchange points help control telephone and Internet communications, allowing

■An overview of the MAMS platform



providers to look for open lines and make sure that connections follow the shortest routes.

In the distribution industry, which laid the foundation for communications frameworks, companies not only have to seek out openings across distributor lines (as communications providers do across carriers) but also need to find open spots within their own networks—and that can be a challenge. Many distributors determine delivery timing by phone, with the employee in charge of the delivery calling the relevant locations to finalize dates and times. That approach comes from the difficulties of operating across an expansive scope: Without distribution systems, companies have trouble keeping tabs on all their transportation resources on a day-to-day basis.

The MAMS service provides solutions to these long-standing issues in the distribution sector.

Leveraging its skills in both maintaining optimal database performance and safeguarding against communications data congestion, CTC has created a service that not only gives distributors up-to-the-second information on resource (truck and driver) capacity and availability but also makes it possible to reserve cargo space and arrival times based on availability conditions—all in real time.

A wide array of potential applications

In addition to streamlining the movement of vehicles, human resources, and other elements, the MAMS solution has potential applications in the far-reaching B2B arena.

As the following section explains, the service could make a big impact in the B2B field, helping companies manage their inventory reserves, adjust delivery times, and assign delivery vehicles.

❶ Providing an omnichannel platform for the B2B sphere

By seamlessly connecting the numerous sales and distribution channels in the B2B business world, including factory-retailer and manufacturer-retailer links, companies can put themselves in position to reap major business benefits. MAMS gives distributors a powerful asset for building an omnichannel B2B business structure: an online distribution platform.

❷ Enhancing supply-part sales and customer service

When companies work to resupply customers with parts and allocate engineers accordingly, success often depends on real-time inventory information and human-resource availability. MAMS does more than just help companies maintain stable business operations in the customer-service area, however. It also provides centralized control over everything from automatic service-demand identification to supply-part delivery, bolstering company performance in the "IoT" (Internet of Things) age—an environment where networks connect virtually everything imaginable.

Although MAMS currently covers a single-distributor scope, future developments will enable information sharing among multiple companies. That ability will give users even better ways of applying their availability information on various moving pieces in distribution networks. In the effort to give MAMS a broader range of functionality, CTC will tap into its "connecting and combining" capabilities to help corporate clients in manufacturing and other industries streamline operations, enable users to cut costs, and make consumers' lives even more convenient.

* MAMS (Mobile Asset Management Service): A mobile terminal-based solution that provides one-stop access to numerous services that distributors need, including product order entry, delivery scheduling, delivery resource planning, delivery execution, business reports, and cargo tracking.

Applying Blockchain technology, a vital support structure for the FinTech world

Blockchain technology, a prominent "FinTech" for powering new financial services, has the potential for applications in virtual currency, international small-sum fee payments, and a wide array of other services.
This article takes an in-depth look at the concepts and possibilities of Blockchain technology, drawing on the results of CTC's own experiments with the Blockchain-driven CTC Point System to paint a clearer picture of potential benefits.

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Key features of Blockchain technology

Blockchain originally served as a core system for Bitcoin, a form of virtual currency. Since launching in 2009 as an attempt to assess the credibility of a digital currency in a universally open environment, Bitcoin has developed a base of several million users—and the system has yet to suffer a single hack or crash. That exceptional, stable reliability has put the spotlight on Blockchain, the technology at the heart of Bitcoin operations.

At its core, a Blockchain is a database for storing Bitcoin transaction (TRX) information. The technology compiles information on individual TRX into a "block" and strings the blocks together into a "chain," creating a set of linked data.

What makes Blockchain technology unique is its distributed ledger, which puts the same ledger for each individual user on all the system's servers. Instead of using the conventional master-replica approach, then, the system makes every ledger a master—a reflection of the "universal equality" philosophy. Damage to an individual user's data thus has no effect on system-wide integrity, ensuring maximal reliability.

Blockchain technology also boasts a wide variety of other features that reflect the Bitcoin design concept, including peer-to-peer transactions (where users make transactions without going through a financial institution), encryption technologies, finalization rules (which prevent the cancellation of added blocks), and a mining system (a reward system that helps attract users).

Blockchain: Basic concepts

- Equality
- Simple recording
- High reliability
- Finality
- Confidentiality
- Motivation (Incentive)

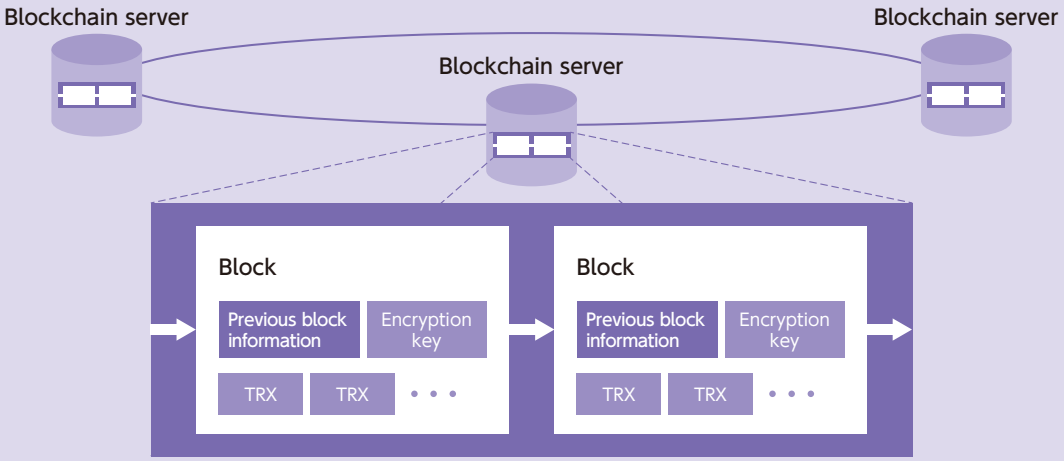
Blockchain 1.0 and Blockchain 2.0

Blockchain clearly has plenty of unique benefits, but the technology also has its weaknesses. The mining process, for example, consumes considerable amounts of time. The biggest issue, however, is compatibility: Blockchain technology only supports TRX data, making applications in areas outside the virtual currency realm difficult.

The Ethereum system*1 and other "Blockchain 2.0" developments seek to eliminate these weaknesses and enhance the scalability of the existing technology. Now that Blockchain 2.0 is starting to gain momentum, the original Bitcoin adaptation now goes by the name "Blockchain 1.0."

The biggest difference between the two existing Blockchain generations is the technology's versatility. Whereas Blockchain 1.0 focused primarily on creating records of TRX data, Blockchain 2.0 expands the technology's functionality by enabling program registration and execution—a feature that could allow for applications in securities trading, real-estate trading, and many other fields besides virtual currency. The programs that run in Blockchain 2.0 are called "smart contracts" (which might sound like social "agreements" but actually have no connection to legal provisions).

■An overview of the Blockchain concept



The CTC Point System

To assess the practicality of Blockchain technology, CTC developed a "CTC Point System" for use in shopping applications. The development team, knowing that deriving useful insight would require more than just simple experimentation, created a real-world testing framework by using the NFC*2 smartphone feature to enable point transactions via "touch" (near-field) operations.

Using Ethereum to develop its Blockchain system, the team tested the functions and came to the following conclusions.

The CTC Point System screen
("Touching" smartphones together triggers point transmission)

❶ High availability
Processing remains smooth and delay-free, even when roughly half of the Blockchain servers are down.

❷ Excellent distributed processing performance
The Blockchain servers synchronize quickly, and increased concurrency boosts overall processing speed.

❸ Potential for high-speed processing
Although Ethereum (several seconds per TRX) is faster than Bitcoin (around 10 minutes per TRX), the technology is still too slow for practical implementation.

The technology's excellent availability and distributed processing performance make it an ideal solution for various modes of remote payment processing, including international money transfer operations and B2B trading.

The future of Blockchain technology

Existing Blockchain systems still rely on web servers and relational databases. Security, too, is another important need. While expecting massive cost reductions might be overly optimistic, Blockchain's high availability, top-rate distributed processing performance, and ability to power stable systems at a reasonable cost hold significant promise for users.

Blockchain 2.0 gives users a versatile resource for providing services across a wide-ranging spectrum, as well. Currently, service scale basically determines the optimal Blockchain setup: Public arrangements (with shared servers) are best for small startups, while private Blockchains (with private, in-house servers) are ideal for larger services. With Blockchain 2.0, however, users get environments and tools for both public and private setups—and also stand to benefit from increasingly speedy processing operations.
As faster TRX processing and broader integration with different virtual currencies pave the way for viable new technologies, Blockchain technology is in position to make major strides into the future.

* 1 Ethereum: An open-source platform for distributed applications; using Blockchain consensus protocols, Ethereum ensures "correct transactions" in an environment where public nodes can randomly connect to other nodes.

* 2 NFC (Near-Field Communication): NFC is a set of protocols that enable two NFC-compatible devices to establish data communications when in close proximity to one another.

The IoT: Growing out of data analysis

The Internet of Things (IoT), a framework for converting physical "conditions" into data, traces its origins back to the spread of computing technology in the 1990s—and now finds itself on the cusp of major development.
This article profiles CTC's various services in the IoT sector, exploring the genealogy of data analysis along the way.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Manager

Noriaki Kobayashi
Manager

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What is the IoT?

The "Internet of Things" (IoT), as its name suggests, refers to the inter-networking of "things" ranging from TVs, refrigerators, and other appliances to car navigation systems, construction machinery, and virtually anything else. Networked sensors on physical devices provide real-time updates on device conditions, enabling people and organizations to implement proper action in a timely, optimal fashion. Sensors on car could tell users to replace a certain part before an impending failure, for example, while wearable devices could help people get healthy—and stay healthy—by collecting and offering information on their overall activity levels and well-being. According to estimates by IHS Technology, the number of Internet-connected "things" (IoT devices) is going to grow from 15.4 billion in 2015 to 30.4 billion in 2020, nearly doubling the size of the corresponding market in just five years. Considerable IoT expansion is on the horizon in the automotive and industrial sectors, where experts are forecasting particularly high growth rates.*1

How the IoT came to be

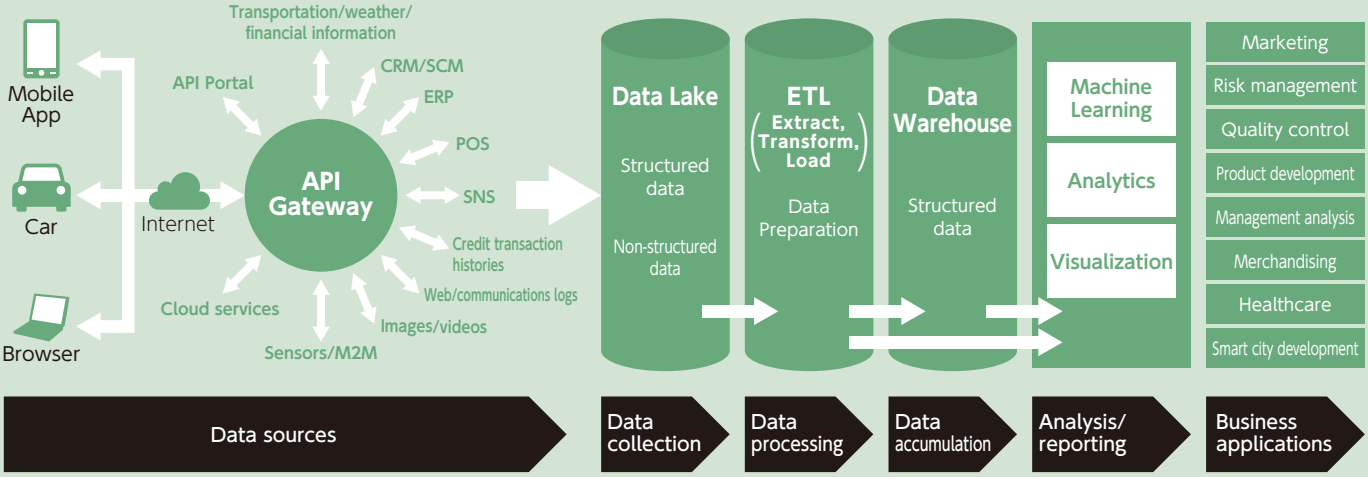
The IoT took shape through the fusion of two sweeping trends in the IT world: data analysis and device technology.

In 1990, American computer scientist William H. Inmon began proposing the idea of data warehousing.*2 Companies at the time used techniques like OLAP,*3 a multidimensional approach to analyzing data, in order to gather and utilize their stores of information as quickly as possible. In combination with traditional databases, however, there were limits on how well OLAP could perform. Then came the concept of the "data warehouse": a responsive, high-speed deposit of specialized data that gave users a better resource for utilizing and analyzing information. Data warehousing fueled OLAP's evolution as a "business intelligence"*4 technique for helping companies make decisions, growing as a user-friendlier, higher-performance, more expressive asset capable of analyzing wide-ranging corporate information. In the mid-1990s, with data-utilization techniques growing more and more sophisticated, companies began launching "data mining" efforts that involved applying statistical methods and other data-analysis approaches to data warehouses in an effort to make predictions and glean new findings. Data mining now plays significant roles in industries like distribution and finance, where the approach enables companies to estimate sales of products that often accompany sales of other specific products, track customer purchasing trends, and shape marketing policies. When dramatic improvements in computer performance unlocked the potential for massive data operations around 2010, companies gained the requisite capabilities for "big data" analysis—and developed the potential to collect and analyze data on specific conditions in real time. The IoT brings that type of data utilization to the next level, giving users a more robust framework for leveraging information.

Device technology has followed a similar path. As the "ubiquitous network" concept began to take hold in the 2000s, the idea of a "connected society"—where networks would link everything and everyone, anywhere and anytime—started to gain momentum. At a fundamental level, that notion represented the archetype for the contemporary IoT model. The original conceptualization envisioned an RFID-driven setup, but recent changes have altered the landscape: Cheaper devices with lower levels of power consumption, along with faster, more diverse networks, have helped expand the "ubiquitous" vision beyond RFID technology and make the IoT applicable across a broader scope.

Why, then, has the IoT become such a central fixture in today's IT world? One of the primary reasons is its potential power to revolutionize the structures of existing industries. With networks linking more and more physical entities, companies are now able to quantify and computerize virtually any conceivable situation—and thus give themselves a richer, more extensive base of data to accumulate and

■IoT system diagram



analyze. Rapidly evolving artificial intelligence (AI) technologies, likewise, are presenting users with incredible machine-learning possibilities. With AI automatically shedding light on previously hidden conditions and taking the necessary action, companies can streamline operations through automation more easily and effectively than ever before.

CTC's IoT services

The IoT comprises several elements, including data collection, data accumulation, data processing, and data analysis. Since the early 1990s, CTC has been forming teams of specialists in data warehousing, business intelligence (for visualization and analysis), and business analytics*5 to provide clients with effective proposals and implementation services. CTC organizations responsible for large-scale, diverse big-data utilization, such as Hadoop and NoSQL, have also recently been helping customers bolster their businesses through the power of data.

Having gained valuable expertise through its data analysis solutions, CTC is now launching endeavors into the IoT sector. "Data analysis" may sound relatively straightforward, but the actual workings are by no means simple. The ongoing proliferation of sensors and skyrocketing frequency of data acquisition are spurring explosive growth in the overall volume and diversity of data, making the process of preparing data for analysis purposes (data reduction) increasingly complex. CTC's "IoT Digital LAB," which went into operation last year, serves to enhance the data-reduction functionality of the original "Big Data Processing Lab"—the company's first organization for big-data verification. Customers working to iron out concrete IoT measures, for example, can take advantage of the new Digital LAB's lineup of individualized verification offerings. Customers trying to figure out optimal approaches to the IoT age can benefit from the team's industry-specific demonstration scenarios—resources that help companies get a clearer idea of what the IoT can do. The IoT Digital LAB is also propelling efforts in machine learning, AI, and "data preparation," which focuses on processing and formatting data for use in analyses.

The future of the IoT

As we explained above, the ongoing growth in the number of Internet-connected devices will continue to open doors for increasingly sophisticated data-utilization technologies. The "Industry 4.0" initiative in Germany, meanwhile, is already prompting companies to create product prototypes in digital spaces and adopt "cyber-physical systems"—capable of forecasting costs and turnaround times—based on IoT-driven data analysis. The very foundations of manufacturing are now in a state of transition. If the numbers of data-generating devices maintain their upward trajectories, society and business will likely follow a similar course as developments in automation and learning-analysis technologies make data processing even more efficient. With its powerful productivity potential, the IoT is in position to help Japan and other developed countries overcome dwindling birth rates. The corporate community will need to bolster its data-analysis technologies—so crucial to the IoT—if that potential is to come to fruition.

* 1 From the "2016 White Paper on Information and Communications in Japan, Part 1. Special Theme: 'IoT, Big Data, and AI: New Values Created by Networks and Data,'" published by the Ministry of Internal Affairs and Communications (http://www.soumu.go.jp/johotsusintokei/whitepaper/ja/h28/html/nc121100.html)

* 2 William H. Inmon defined a "data warehouse" as an integrated, time-variant collection of data in support of management's decision-making process; data is never removed or updated.

* 3 OLAP (Online Analytical Processing) performs multidimensional, high-speed analyses of data, giving companies a useful resource for creating sales charts and conducting market analyses.

* 4 Business intelligence (BI) denotes a set of concepts and techniques that companies can use to analyze corporate data for making business decisions. BI tools include data warehouses, OLAP, and reporting.

* 5 Business analytics are analytical techniques for refining business intelligence-based analyses to make future predictions and higher-quality business decisions.

AI drives cybersecurity forward

Shūichirō Sugita
International Business Development
ITOCHU Techno-Solutions America, Inc.

Focusing on the security field in North America, Sugita conducts trend analyses, identifies leading vendors, and introduces companies to Japan.

In Silicon Valley, a fertile hotbed for startups looking to spark "innovation," companies are using cutting-edge technologies to fuel breakthroughs in the cybersecurity sector. This article highlights some of the latest security trends in the North American market.

Targeted attacks put companies at risk

Recent years have seen major growth in the cybercrime world, with communities like the "Deep Web" and "Dark Web" linking hackers together to form criminal business networks.

Imagine that hackers have their sights set on a specific company. Drawing on their community resources, the hackers first buy information on the company's weaknesses, employee profiles, security devices, client membership data, and other sensitive items. The hackers then take inventory of the information, design an attack, and execute their plan via an array of new malware and other tools. That, in a nutshell, is how a "targeted attack" works. Even if the target company itself is secure and free of any information leaks, hackers can easily piece together leaks from the company's affiliates and other third parties to crack the company's safeguards. From the company's perspective, then, no amount of security measures—even the best ones available—can fully protect internal resources from unknown threats once inside information is out in the open.

New AI-driven technologies

A look at the various startups that have emerged since 2010 shows that most of the new companies are developing technologies around artificial intelligence (AI)—elements and concepts like machine learning, natural language processing, deep learning, for example. One of the biggest, most active areas of new startup activity is the security field, where entrepreneurs are busy exploring new approaches to endpoint security, cloud security, threat intelligence, and fraud prevention.

To explain why AI has become such a central focus in recent years, one can point to a shift in the basic approach to cybersecurity: Knowing that conventional security technologies might not be able to handle unknown threats, the security sector has started focusing more on technologies that enable users to quickly detect and stamp out invasions when they do occur. In the endpoint security realm, for example, developers have created machine learning-driven technologies that help detect unknown malware by performing deep-level analyses of malware behavior and attributes. Innovations in threat intelligence, meanwhile, collect information traded on the Dark Web and use AI technologies—machine learning, natural language processing, and more—to forecast potential attack methods. Overall, AI technology in the security sector serves to provide a better understanding of trends on the criminal side.

SentinelOne: Next-generation, AI-driven endpoint security

SentinelOne is a suite of next-generation anti-virus software that utilizes machine learning technology. What makes SentinelOne so unique is its range: In just a single product, the software not only protects users from unknown malware, exploits, and other threats but also boasts a feature for restoring systems to their original state in the event of an infection. Ensuring strong defenses against even the most novel attack techniques, SentinelOne uses AI to create "complex, airtight systems that hackers will hate to even think about targeting."

AI, on the road to becoming a de facto standard

Applications of AI technologies are poised to expand across the security sector, where unknown threats pose substantial risks. Moving forward, AI development could very well make a major transformation from simply finding optimal ways to safeguard company employees to designing ideal protection for consumers of new digital services like the IoT, FinTech, HealthTech, and more.

(CTC America's security technology survey fields)

Target	Entrance measures	Internal measures	Exit measures	External measures
Company (Employee)	Measures against unknown malware/exploits Measures against phishing	Measures against inside jobs Invasion detection/damage minimization/restoration latent risk reduction	Prevention of leaks to the cloud Prevention of leaks to mobile devices Prevention of leaks to other media	Tracking of criminal trends
Partner (3rd Party)	Measures against third-party invasions			
Business (Consumer)	Measures against phishing Measures against account takeovers Measures against vulnerability attacks Measures against control/embedded takeovers (IoT)	Business risk reduction ● Financial: Illegal money transfer detection/customer scoring ● IoT (Healthcare, Industrial): Invasion detection/restoration ● Retail: Brand protection ● Education: Content protection ● Government/media: Public information-protection measures		

News Pickup

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

Security

Endpoint Security Lineup Expanded

CTC entered into the first Japanese distribution agreement with the US company SentinelOne and began sales of solutions that protect endpoints such as client PCs and servers from both known and unknown threats.
The detection engine uses machine learning to analyze non-standard endpoint behavior and detect threats taking actions common to malware. Post-incident measures such as removing traces of threats and restoration to the previous state are also supported.

Seismic Protection

Server Rack Seismic Equipment Lineup Enhanced

CTCSP now offers the OCTO-Base seismic isolation system for IT devices from the US company WorkSafe Technologies, designed for level 7-class earthquakes on the Japanese seismic intensity scale. Seismic equipment is used by many companies as a low-cost way to prepare for earthquakes.
The OCTO-Base is an advanced version of the ISO-Base that is the de facto standard, offering the highest specifications in the industry as well as effective protection for IT devices placed in areas with soft ground or in upper floors of tall buildings.

Cloud Services

Providing TeamSpirit, a Cloud Service That Supports Working Style Reforms

CTC will begin providing "TeamSpirit" from TeamSpirit, Inc.—a cloud service that supports the diversification of the way we work.
TeamSpirit is a cloud service that integrates management of attendance, time sheets, expenses, man-hours, management approvals, and more to visualize the way employees work without the need to construct separate systems to track these elements one by one. CTC will provide comprehensive services from consulting and links to existing systems to supporting internal utilization and adoption.

AI

Partnering with GRID inc to Drive the Spread and Business Use of AI

CTC established a partnership with GRID inc to develop and provide AI services using ReNom, GRID's machine learning/deep learning framework.
The ReNom framework includes a variety of algorithms as libraries, allowing non-specialists to easily make use of AI by combining the libraries. This partnership will support customers' AI applications with the combination of GRID's AI know-how and CTC's comprehensive IT capabilities.

Cloud Services

Providing Analytic Services to Hotto Motto and Yayoiken's Plenus

CTC worked with Plenus Co., Ltd., operator of the "Hotto Motto" and "Yayoiken" brands, to implement Test & Learn® software from the US company Applied Predictive Technologies, Inc. Test & Learn® software offers cloud-based predictive analysis of cause-and-effect relationships of outcomes to support business decision-making and maximize ROI for initiatives.
The software will support the identification and implementation of effective initiatives from possibilities including menu optimization, introduction of new products, promotions, and more.

Global

Providing Comprehensive IT Services to Japanese Corporations Expanding into the US

CTC America has formed a partnership with SYSCOM (USA) INC., a company that has provided SI Services in the US for more than 25 years, to roll out a one-stop IT solutions business that combines the CTC group's track record in system construction and research efforts focused on the newest trends in Silicon Valley with SYSCOM's nationwide maintenance network. The new partnership will respond to customers' increasingly diversified IT needs and support business efforts in North America and around the world.

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.

Your Score Depends on Your Brain, Not Technique!

It's important to visualize what you will do with the ball and what kind of trajectory you're going to hit rather than swing the club without clear intention. Calm decision-making forms the foundation for that visualization, as visualizing results that are beyond your skill level leads to mistakes and a deteriorating score. Maintaining composure to leverage your strengths and make up for your weaknesses leads to improving your score. Serizawa, who racked up six wins despite a relative lack of strength and power among professional golfers, explains the secret to a better score.

Take on a Challenge Only When You Can Visualize Success

There are no weight classes in golf, and everyone competes on the same field. I wasn't blessed with a superior physique, so I would never have been able to compete against other professionals for this long without keeping a strong image of what I can do well—not power—in mind. In other words, as long as you have an accurate idea of your own abilities and play in a way that leverages your strengths and makes up for your weaknesses, you can compete with power hitters who produce 300 yard drives even if you can only manage 250 yard drives.

The primary obstacle that stands in the way of amateur golfers improving their score isn't physical or technical—it's the brain. That is to say, the way they think about and visualize their play is wrong. When competing, a professional will only choose shots he is 80 or 90% sure he can make. For example, if a pro finds himself in the trees with a narrow gap between branches, he takes on the challenge only if he can visualize making it through the gap successfully after considering club selection, how to hit, and how hard to hit. If he cannot visualize success, he will likely choose a safe shot to return to the fairway even if it means an extra stroke.

On the other hand, an amateur golfer who struggles to keep his score low has a tendency to want to do things he can't do, especially if he hasn't played many rounds yet. He will often try a shot with a low success rate even in practice or a shot he's never tried before, and unsurprisingly, will end up failing.

It's Important to Choose the Best Option out of What You Can Do

Also, I feel like the amateur has a tendency to focus on an "ideal par." In golf, you write the resulting number of strokes on the scorecard, but there's no need to write down how you got to that number. For example, a four you get with two strokes to reach the green and two putts has exactly the same value as a four you get after failing to reach the green even with three strokes and getting lucky with a greenside approach shot going in the cup. If someone is focused on the image of an ideal par and doesn't do well on the tee shot, he tends to make one of two equally extreme choices—decide he can't make par anymore and give up, or decide he will take any risk to reach the green no matter what. But if he is able to visualize reaching the green in three strokes and doing well with the putter to make par, there is less pressure on the second stroke. This creates the possibility for a great shot that reaches the green to turn things around. What's important is to select the best choice from among the things you're capable of doing in any given situation—this is the brain's job.

The reason you see many veteran players in their seventies and eighties keeping their scores under control despite not being able to blast long drives is that they know their own game. In that sense, it can be said they are visualizing well as they play. On the other hand, young, strong players often fall victim to reckless attempts due to a lack of visualization.

Visualize an Overall Image of 18 Holes Rather Than Getting Caught Up in Individual Shots

In addition to visualizing each shot you're about to take, it's also important to visualize your overall game for that day. A game of golf keeps going for 18 holes, so there are plenty of opportunities to make up for a mistake with one shot or a bogey on one hole. For example, you see many amateurs who just stop caring if they start off with a double bogey on the first hole. But there are still 17 holes remaining, and you never know what might happen if you don't give up. Now if this were a timed race, a fumbled start could cost you the entire race. But golf is different. Back when I was on the verge of finishing the first nine holes with a score in the thirties for the first time, I actually managed to do it in a round where I double-bogeyed the first hole. I think I might have been helped by the fact that the double bogey at the beginning wiped any thoughts of a score in the thirties from my head, allowing me to focus on each individual hole. Either way, if you can visualize your overall game across 18 holes, or at least visualize how you want to play, you won't get caught up in your successes or failures on each individual hole and should be able to maintain your concentration until the end.

I often have the opportunity to play with company presidents at pro-am tournaments and other events. In talking to them, I find that many of them have a very specific vision for the direction they want to lead their company. Through those conversations, I'm struck by how much business and golf have in common. Visualizing success is important, of course, but I think the process of calmly analyzing what to do and what you can do with your current abilities and making a decision is very similar to golf. I aspire to be able to visualize a birdie in any situation, be it in business or golf.

Message from Hikari Fujita,

a Female Professional Golfer Supported by CTC

Hello, I'm Hikari Fujita. I'm looking forward to spending 2017 with you. February is the coldest time of year—what do you do to get ready to golf in the winter? This time, I'm going to talk about some of the things I do to prepare for winter golf.

First, I wear thin, light winter wear. Wearing layers of outerwear makes it difficult to move and can affect your swing, so I recommend locking warmth in with a high-performance base layer, for example. Many people use adhesive heat pads, but there are cream versions that offer the same effect. These can be very useful, as they won't get in the way of your swing.

The ball doesn't fly as far in the winter, so I use more club and warm the ball in my hands between holes. The green can be frozen, so for my approaches I try to roll it with a putter or use a running approach. Also, your muscles can stiffen up in the cold, so try to make good use of gravity and the club's weight when you swing rather than depending on strength. If you learn to do that in the cold season, you can develop a good swing that takes advantage of the gear effect.

You will still sweat despite the cold, so be sure to drink warm liquids frequently and avoid pushing yourself too hard.

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.

IT Insight

Yuriko Suzuki
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Economic News Section
Asahi Shimbun

Joined The Asahi Shimbun in 2008. Joined the Tokyo Head Office Business Section in 2013 after working at the Aomori General Bureau and Misawa Bureau. Assigned to cover electronics and IT companies in 2015 after assignments to the Ministry of Economy, Trade and Industry and other areas.

This issue's number is...

64 layers

The number of layers in 3D NAND flash memory

As the spread of AI and IoT progresses, the demand for storage mediums continues to rise. To acquire, analyze, and use more information, a receptacle for that information will be necessary. 3D NAND flash memory is emerging as the primary player among semiconductor memory devices in that role.

Compared to hard disks, NAND flash memory has faster write and read times and offers high resistance to mechanical shock. 3D NAND flash memory is the "three-dimensional" version of this technology.

As the name suggests, data is saved in multiple layers that are stacked vertically. The more layers of memory cells there are, the more data can be saved. In practical use, there are 3D NAND flash memory chips with 48 layers and some with 64 layers. That said, this does not mean memory capacity increases by 48 times or 64 times. The 48-layer chip offers roughly double the memory capacity.

The key to greater memory capacity was once fitting as many cells as possible into a single layer. But shrinking the memory cells to increase density leads to cell-to-cell interference and errors. The 3D structure solves that issue and makes greater capacity possible.

Creating a layered 3D structure requires a high level of technological expertise, however. Increasing the number of layers increases the difficulty as well. Japan's Toshiba pioneered the creation of NAND flash memory and the 3D innovation, but South Korea's Samsung Electronics is now one step ahead. Samsung enjoys top worldwide market share and successfully mass-produced 64-layer chips late last year. Toshiba, in second place in market share, began production and shipments of its 48-layer chip last year and aims to mass-produce a 64-layer version in the first half of this year. R&D efforts toward more layers are underway, and Toshiba has announced intentions to increase the number of layers to 100.

The current players competing in the space are Samsung, Toshiba and its US partner Western Digital, a partnership between the US companies Intel and Micron Technology, and South Korea's SK Hynix. NAND flash memory is used not only in SD cards, USB memory, smartphones, and tablets, but is now seeing widespread use in data centers. Even further use is likely as the need for smaller sizes and greater capacity grows.

information

Notice of Group Company Consolidation

CTC Life Science Corporation (CTCLS), a provider of specialized IT solutions for the life sciences industry and especially the drug development research field, will be absorbed into CTC as of April 1, 2017 and make a new start as CTC's Life Science Division.
As the use of information technology accelerates in the healthcare field, IT applications in medical diagnosis and drug R&D as well as the use of IoT in telemedicine are making IT's role even more important.
This consolidation will combine CTC's experience in areas including large-scale system architecture, cloud services, and AI/IoT with CTCLS's highly-specialized knowledge and technology to enable us to provide solutions to issues faced by our customers in the life sciences/healthcare fields.

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http://www.ctct.co.jp/

CTC System Management Corporation (CTCS)
Sanban-cho Tokyu Building, 8-1, Sanban-cho, Chiyoda-ku, Tokyo
http://www.ctcs.co.jp/

CTCSP Corporation (CTCSP)
Komazawa Nakamura Building, 16-7, Komazawa 1-chome, Setagaya-ku, Tokyo
http://www.ctc-g.co.jp/~ctcsp/

CTC Life Science Corporation (CTCLS)
Higashigotanda Square, 10-2, Higashigotanda 2-chome, Shinagawa-ku, Tokyo
http://www.ctcls.co.jp/

CTC Facilities Corporation (CTCF)
1-2, Ninomaru, Tsuzuki-ku, Yokohama
http://www.ctcf.net/

CTC Business Service Corporation (CTCBS)
Kasumigaseki Building, 2-5, Kasumigaseki 3-chome, Chiyoda-ku, Tokyo
http://www.ctc-g.co.jp/~CTC-BS/

CTC First Contact Corporation (CTCFC)
Komazawa Nakamura Building, 16-7, Komazawa 1-chome, Setagaya-ku, Tokyo
http://www.firstcontact.co.jp/

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Best Engine

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