

Best Engine

Vol. 12

Special Feature

CTC ENGINEERING

The Science & Engineering Systems Division,
Which Tackles the Resolution of Social Issues
Using Computational Science
and Simulation Technology

Best Engine

Vol. 12



Cover illustration by
Miki Mohri

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The 6G Perspective

The speed of technical progress is accelerating. While 5G has only recently been commercialized in the world of telecommunications, preparations for the age of 6G networks are already underway.

I am of the mind that “6G” will become an important keyword in pressing ahead with corporate transformation (CX). In this case, it refers to the 6G perspective: Gender, Generation, Global, Group, Governance, and Green. When making some kind of corporate decision, I routinely try to look at matters comprehensively from these 6 perspectives.

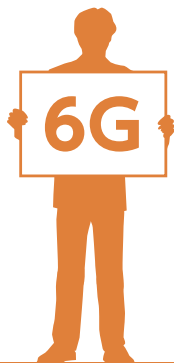
For example, if launching an internal committee, I consider whether there is a good balance in the ratio of men and women in the committee. Or, have the opinions of various generations been heard in decision making? Is the decision that is to be made still correct when compared with a global set of values or with environmental conservation standards? My hope is that each of our employees will also have their own evaluation criteria and incorporate autonomy in their daily behavior.

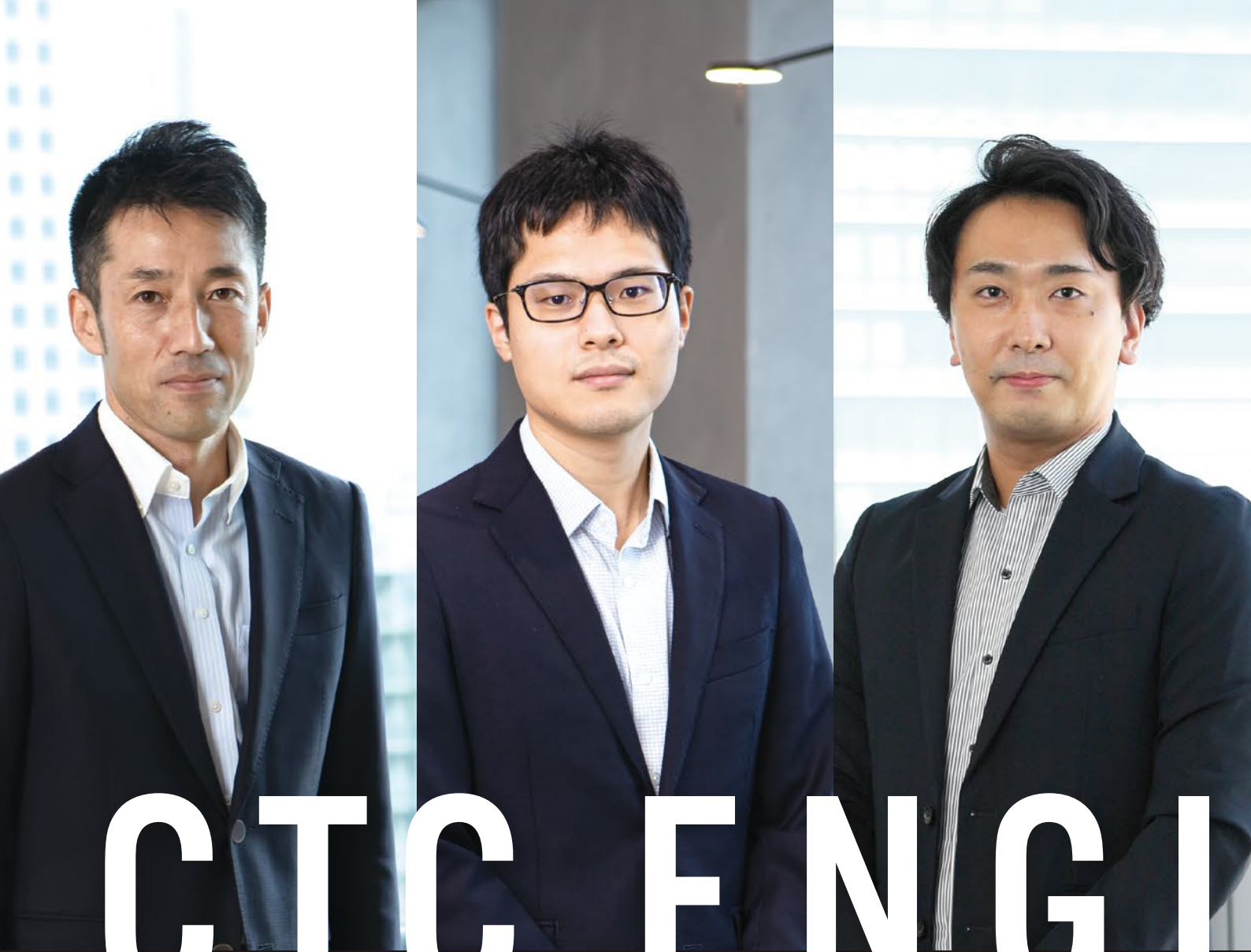
In this VUCA (Volatility, Uncertainty, Complexity, and Ambiguity) age in which the business environment changes at a dizzying pace and it is difficult to see what is to come, if a company is managed by the president in a top-down manner, like by a boss monkey at a zoo’s monkey exhibit, the limitations of the president become the limitations of the organization. Growth and development can be hoped for in a company that is run like the whole zoo, with diverse human resources freely exhibiting their individuality and characteristics. Even better if vertical divisions are done away with. With walls removed, if the company becomes like a safari park, not only will individual strengths be further released, but inclusion will also light a spark that will bring about the creation of more business ideas.

Last June, we moved into our new office where we adopted free address workspaces. In September, we completed the relocation and consolidation of our Group companies in the Tokyo district, creating a safari-park-like scenery where diverse employees gathered. Companies have a key role to fulfill in society. The 6G perspective is indispensable for ensuring that the new environment becomes one in which both CTC and its employees will achieve growth.

Ichiro Tsuge

President and CEO
ITOCHU-Techno Solutions Corporation





CTC ENGI

Special
Feature

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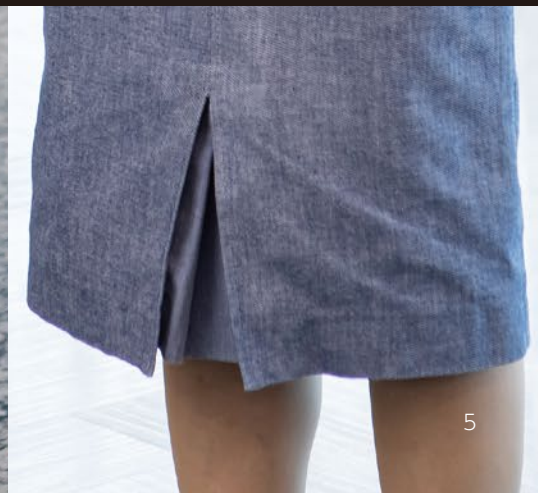
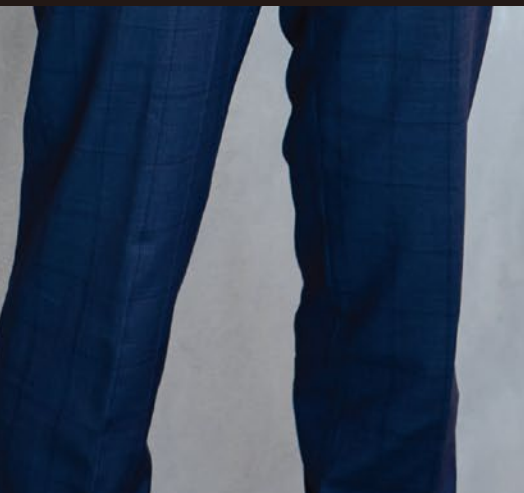




NEERING

The transformation of conventional manufacturing is now being sought with the world starting to steer itself toward carbon neutrality and the achievement of a decarbonized society. To support transformation in this and various other fields, CTC continues to develop solutions that utilize IT, analysis, and simulation technologies. Here, we will focus on the undertakings of the Science & Engineering Systems Division, which is at the center of such development.

Coverage and text by Yuki Kondo



Bringing About New Developments in Material Engineering Using ICME Technology, Which Significantly Minimizes Costs and Development Time

Support for engineering state-of-the-art materials is being provided through QuesTek Japan, a joint venture established in 2020. The aim is to contribute to reduction of the environmental load as well as through greater high efficiency.

—What is the main content of the material engineering business?

Fukuchi: We provide a broad range of various services related to material engineering, from the sale of software to consulting. Of particular focus at present is the provision of solutions based on integrated computational materials engineering (ICME). It is a technology that conducts material engineering and process optimization through the full use of databases, computational engineering, and simulation. In 2020, we established QuesTek Japan as a joint venture with QuesTek Innovations (QuesTek), a leading American company in this field. Our hope is to leverage QuesTek's technical strengths and CTC's distribution pipeline and expertise to broadly roll out state-of-the-art material development based on ICME.

—What is specifically different between conventional and ICME-based material engineering?

Fukuchi: Much of conventional material engineering was dependent on repeated trial and error based on experiments or the experience and instincts of seasoned engineers. In other

words, it was difficult to accumulate or pass on experience because it was not possible to understand the engineering process scientifically. That is why massive costs and great amounts of time were required each time that a material was engineered. Meanwhile, in the case of ICME, data obtained through experiments, measurements, and simulations is engineeringly analyzed to reach the optimal design. In other words, in ICME, the empirical process of engineering is replaced by a scientifically backed process. This results in enabling the accumulation of data and expertise, which makes the engineering of optimal materials possible at a lower cost and in shorter time.

—What will be QuesTek Japan's strengths?

Yamazaki: QuesTek was founded by Greg Olson (now a professor at the Massachusetts Institute of Technology), a pioneer of ICME. The company possesses extremely high technical capabilities and experience in ICME-related development. For example, QuesTek has a track record of completing the development of materials for use in airplanes –

CASE STUDY [QuesTek Ferrium® M54® steel]

More than Twice the Usual Life Span Achieved in Less than Half the Normal Development Period

QuesTek also handles the in-house development of new materials. One example is the Ferrium steel series for use in the aerospace, automobile, and energy industries. The series was developed using ICME methods to efficiently achieve optimal designs. Take Ferrium® M54®, for example. Its characteristic is ultra-high strength and high fracture toughness, and this steel is used in U.S. navy hook shanks (photo). As a result, the lifespan of the developed product became more than twice as long as conventional products, with a cost reduction equivalent to 3 million dollars and a machining process that was shortened by 20%. Development, from commencing the engineering process, is said to normally take about 20 years. However, QuesTek succeeded in getting the material used in flight in only 7 years.



which normally takes 20 years to complete – in only 7 or 10 years. What is more, it has accomplished numerous projects in the U.S. in additive manufacturing (3D printing), the use of which has spread to a broad range of fields in recent years. Because QuesTek Japan will be conducting material engineering based on the technology possessed by QuesTek, we believe that more than anything, QuesTek Japan's biggest strength is that it can utilize QuesTek's technology as is. From gaining an understanding of the technical challenges being faced by clients to solving problems, the role that will be played by CTC will be to provide our clients with solutions. This service is making the most of the experience and technical capabilities that we have nurtured through the years in the field of materials.

—As the resolution of environmental challenges becomes an urgent issue, how will the engineering and development of new materials contribute to the improvement of the environment?

Yamazaki: For example, improving the strength of a material used for an automobile part leads to lightening the weight of the car, and thereby lead to improvement of the car's fuel efficiency. Or raising the heat resisting temperature of turbine materials at a thermal power plant will improve thermal efficiency. What is more, even when making the same material, shortening the heat treatment time by improving the manufacturing process will reduce CO₂ emissions. So, material design development is closely linked to environmental challenges. That is something that we keep in mind at all times. In providing various solutions, what can we do to lighten the load on the environment while also meeting the requests of our clients? We undertake our work each time under the belief that fulfilling both matters sufficiently is the design development support that we should be engaging in.

—Tell us about the future direction of development.

Fukuchi: While we will still be largely dependent on QuesTek of the U.S. for ICME-based engineering itself, we are aiming to build a domestic technical structure in Japan in the future. When that is achieved, we will not only be able to respond more flexibly to customer needs but should also be able to engage more proactively in the resolution of environmental challenges and social issues. We will further accumulate experience and accomplishments toward the achievement of this.



Hiroyuki Fukuchi

Expert Sales, CAE Solutions Business Department

Majored in mechanical engineering at university. Joined CTC as a mid-career recruit in 2008. Since then, has spent over 10 years in the materials business field. Currently in charge of the launch of the joint venture with QuesTek Innovation.



Toshihiro Yamazaki

Materials Design & Engineering Department

Obtained a doctoral degree in engineering in the field of metal-material-related thermodynamic calculation and simulation. Constantly shares information with QuesTek engineers through regular meetings held from 7 a.m.

Aiming for More Efficient Composite Material Development Through a New Solution Utilizing Artificial Intelligence

As the need for lightweight and very strong composite materials increases, CTC introduced the use of surrogate models, etc., in the engineering process, creating a new solution that utilizes artificial intelligence. CTC is efficiently supporting the development of composite materials.

—Tell us about CTC’s efforts related to composite materials.

Yamada: Among the worldwide efforts of recent years toward the reduction of CO₂ emissions, the automobile industry is rapidly shifting toward electric vehicles. The shift from the traditional use of steel to strong, lightweight composite materials for the car body is also spreading. Composite materials are formed by combining different materials to make one material. In especially large demand are carbon fiber-reinforced plastics (CFRP) and glass-fiber reinforced plastics (GFRP) in which carbon or glass fibers are bound in plastic. CTC has been engaged in the development of solutions that mainly support the engineering and manufacturing of such composite materials.

—What are the provided composite material solutions specifically like?

Yamada: CTC began development of solutions related to

composite materials back in 2011. At the time, simulation analyses of composite materials were still not commonplace. We first began by feeling around the creation of composite material models. Gradually, we became able to create models of various forms with high precision, and we then used them as the basis to do such things as develop software that could estimate the characteristics of a composite material by entering the required parameters or develop solutions that linked measurement with analysis. One of our recent undertakings is the evaluation of fatigue levels. Simulation technology for evaluation and forecasting the fatigue levels of composite materials has not yet been established. However, CTC is aiming to satisfy client needs as soon as possible in this area as well.

—I understand that you are also involved in the development of solutions that utilize AI.

Yamada: One of the items that we are currently developing

CASE STUDY [Burst Analysis of High-Pressure Gas Cylinders Constructed of CFRP]

Understanding Strength Using Computer Models

Vessels for storing high-pressure gas are typically made of steel. However, an issue is that they are heavy and not easy to transport. Currently under development to solve this issue are gas cylinders constructed of carbon fiber reinforced plastic (CFRP), a composite material. The weight of gas cylinders can be reduced by about two-thirds as compared to those of the same size made of steel. Simulations are being carried out using computer models to evaluate the strength of high-pressure gas cylinders constructed of CFRP. The diagram on right shows the result of a simulation. When the internal pressure of the CFRP vessel is raised, the pressure becomes especially high on one part of the vessel body, resulting in bursting. The engineering of composite materials can be streamlined by replacing actual experiments with such computer simulations. At the same time, the environmental footprint can also be reduced.



is a solution that utilizes a surrogate model. A surrogate model is a model in which a conventional simulation model produced through computer-aided engineering has been substituted with a model created through machine learning. In other words, it is not a simulation model resulting from rigorous numerical computations. Rather, it is a model in which analysis is carried out in a way similar to data-driven machine learning. The utilization of a surrogate model makes it possible for an engineer to carry out the engineering process using their own “guesstimate” without consulting a CAE engineer repeatedly at the engineering stage. Although an accurate calculation using CAE will ultimately be necessary, the use of a surrogate model is expected to significantly boost the efficiency of engineering. A different example concerns the fact that each material has its respective material constitutive law in which its property is expressed as a mathematical formula. There is ongoing research probing the possibility of constructing the constitutive law of an unknown material through a neural network. My impression is that also continuing proactive R&D in new technologies like AI serves as the foundation of CTC’s technological capabilities.

—Tell us how you can contribute to solving current environmental issues by establishing new composite materials solutions and analysis technology.

Yamada: To begin with, composite materials are lightweight and strong. In that sense, their properties in themselves can contribute to environmental improvement, such as by linking directly to improving the fuel efficiency of automobiles. Additionally, establishing good solutions and analysis technology can contribute to solving environmental issues in the sense of lowering the burden on the manufacturing site. For example, in conventional automobile manufacturing, there is a repetition of the process of engineering an item and conducting tests using the actual item. However, advanced analysis technology will allow the number of tests to be reduced. That, in turn, leads to a reduction of the movement of physical items from one location to another, as well as a decrease in the number of items to be disposed of, which will lessen the environmental load. With the reduction of CO₂ emissions becoming urgent tasks, we would like to further promote the development of solutions while giving consideration to environmental impacts.

Gen Yamada

Materials Design & Engineering Department

Developed an interest in simulation engineering as a student and has been involved in the CAE field for 6 years. Has recently been focusing on building analysis technology for short fiber reinforced composites.



Giving a Boost to the Expanding Use of Renewable Energy from the Aspects of Both IT and Engineering

About 20 years have passed since CTC first commenced research in renewable energy technology. The accumulation of many years of R&D is bearing fruit as reliable technology consulting and the calculation of power generation forecasts.

—What is the main business content of the Energy Infrastructure Business Promotion Department?

Tachikawa: As we deal widely in the energy-related business, we are currently particularly focused in two areas: providing support for renewable energy business operators and providing digitalization support for electric power providers. In the case of the former, we provide evaluations to companies that want to launch wind or solar power generation businesses on the amounts of electricity they can expect to generate. We also clarify the business risks and offer technology consulting for the mitigation of those risks. In the case of the latter, our work includes integration of the data obtained from various sensors at a power plant and the provision of platforms that make it easier to detect signs of failure.

In addition to IT, we also possess engineering expertise, such as in simulation and data analysis. We have been involved in technology research in renewable energy for 20 years, from a time when the field was still in its infancy. We

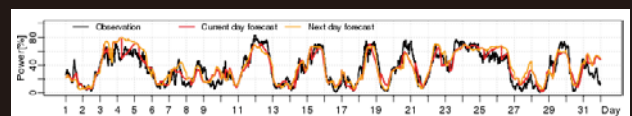
have developed an original business with the accumulation of such wide-ranging technologies as our strength.

—What is the background to CTC's early start in the research of renewable energy technology?

Hayasaki: CTC has a long history in weather-related businesses. We began undertaking the research and development of weather analysis simulation before it became commonplace. We achieved accomplishments such as being the first in Japan to launch a private weather information distribution site. Amid such circumstances, it was from about 2000 that wind and solar power generation businesses gradually began increasing. CTC was able to swiftly launch a business supporting this field because we already had an accumulation of meteorological expertise. And that brings us to where we are today. The many years of experience in the field are linked to our high reliability. We have an especially high share of technology consulting for wind and solar power generation businesses. In the

CASE STUDY [Wind Power Forecasting System]

Anticipating Power Generation Amounts That Change by the Minute According to Weather Conditions



The output of power generation using renewable energy changes depending on weather conditions. Output must be forecast in advance with high precision in order to achieve stable operation. CTC has developed an output forecasting system, which utilizes various meteorological data, for wind power generation. The graph on the left is a comparison of the output of a wind power plant in operation and its advance forecast. We can see that both the current day forecast (in red) and the next day forecast (in orange) are generally good forecasts of the observed output (in black). Going forward, the more that the use of renewable energy expands and its share of overall power increases, the greater the importance of high-precision output forecast will become. It is conceivable that the utilization of this kind of forecasting system will increase.

future, when fixed-price purchasing under the FIT (Feed-in Tariff) scheme is over, businesses engaged in power generation using renewable energy will need to develop more thorough power generation plans to sell electricity on the market. That will create an even larger demand for highly precise simulation and forecasting of renewable power generation, and so, I believe that our role will become even larger.

—Tell us about the digitalization support for electrical power providers.

Tachikawa: The characteristic feature of CTC's digitalization support is that it goes beyond the construction of platforms and systems. It goes as far as the provision of data analysis. In other words, we can offer a package that not only enables the detection of the signs of failures through the collection and visualization of various data, but also analyzes what kinds of factors are related to the failure. Furthermore, in the case of offshore wind powerplants, which are expected to expand in the future, it is more difficult to conduct maintenance as compared to those on land. The utilization of such platforms and IoT will enable the significantly efficient operation of offshore power plants. We consider our strength to be our ability to also provide solutions related to the operation of such power plants.

—The environment surrounding the energy field is changing dramatically, such as the trend of aiming toward carbon neutrality. What is the direction that CTC will be aiming for in the future?

Hayasaki: Of overall CO₂ emissions, it is said that 80% is caused by energy production. The use of renewable energy will expand in the future with certainty. With carbon neutrality now known by many as being a goal, growth in the demand for CTC's renewable energy support business is accelerating. On the other hand, an increase in the use of renewable energy inevitably makes the amount of overall generated power fluctuate. A new technical challenge will arise—that is, the need to continually adjust the amount of generated power to meet electrical demand. That will require the forecasting of power generation amounts with even greater precision and accordingly controlling demand. This will probably bring about a need for even higher engineering and IT technologies. We will further boost our technological capabilities while looking ahead to the future.



Nobuyuki Hayasaki

Executive Engineer and Deputy General Manager
of the Energy & Infrastructure Business Promotion Department

Engaged for over 20 years in technology R&D in renewable energy power forecasting, evaluation, and system development. Certified weather forecaster.



Yuka Tachikawa

Energy & Infrastructure Business Promotion Department

Developed an interest in natural energy when she carried out research in photosynthesis as a student. After joining CTC, she has been engaged for 4 years in technology consulting operations for solar power generation. Currently involved in the NEDO Project.

Contributing to the Safety and Security of Society by Enabling the Visualization of Civil Engineering and Sharing Information

We will take civil engineering into the next generation through BIM/CIM technology for visualization of the construction site and by establishing a platform for the long-term management of various information related to structures.

—What is the Construction Business Promotion Department's main business?

Fujita: One of the undertakings that we are currently focused on is establishment of the technology for visualization of the civil engineering construction site. Called BIM/CIM (Building / Construction Information Modeling Management), a 3D model of the construction site is first created after which various information is consolidated into the model. Something similar had been attempted from the past in the field of construction. However, progress was very slow for reasons such as the fact that civil engineering sites are greatly affected by the natural environment of the site, making generalizations difficult.

However, we have been conducting BIM/CIM research and development for many years, and we have reached the point where we can currently provide BIM/CIM solutions at multiple sites. As a development from BIM/CIM, we are also developing an ILSIM (Information-Linked Simulation) platform for integrating and managing information for the whole lifecycle of a civil engineering project on a 3D model. It includes surveying and engineering information from before beginning construction as

well as maintenance and management information after starting construction.

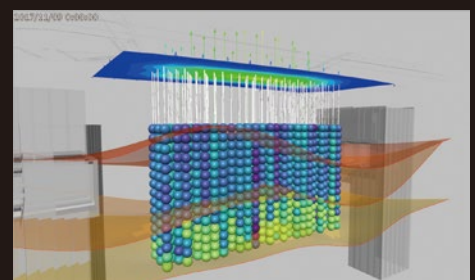
—Can you give us a specific example of BIM/CIM?

Fujita: There are various types of construction in civil engineering projects, from dams, bridges and tunnels to geotechnical engineering. There are three kinds of BIM/CIM-related solutions that CTC is offering ahead of others. They are for earthwork compaction, soil stabilization, and shield tunneling. They are all construction work beneath the surface in which the process cannot be seen. That is why there is a strong need for visualization. In earthwork compaction, a mountain is cut and developed, or land is leveled and flattened. By enabling the visualization of the process of how the original landscape changed through the use of heavy machinery, it becomes possible to understand the course of construction afterwards. Soil stabilization is work carried out to improve soil strength. One method, for example, is to dig a hole in the ground into which a cementitious material is injected. Enabling the visualization of information on how much and where the

CASE STUDY [Visualization of Soil Stabilization Work]

Obtaining an Understanding of the Strata Injected with Cementitious Material

CTC provides a solution that enables the visualization of the construction site for soil stabilization, which increases soil strength. The diagram on the right is a visualization of how the material, injected into the holes dug into the ground (the blue rectangular portion on the top), has gone into the holes. The color, etc., of the spheres indicates how much material has gone into each underground portion and at around what speed. On the other hand, the undulating orange surfaces indicate the borders of the strata. It shows that the state of the strata has changed there. By looking at these items together you can tell in a visual manner how such things as the state of the ground have changed (risen or sunk) or how the relationship with the state of the ground is.



cementitious material was injected, together with the information regarding the road surface and layer of earth at that location, makes it possible to obtain a visual understanding of what kind of change the construction work is bringing about to the soil and ground.

Meanwhile, in shield tunneling, a tunneling shield machine is used to excavate an underground tunnel. Through visualization, it becomes easy to adjust subtle misalignments of the machine in real time. Enabling visualization at the civil engineering site not only streamlines construction but also makes it easier to see the situation on site, thereby making it easier to spot problems, if any. Visualization supports construction from various aspects, in this and other ways.

—You said that ILSIM is a platform that integrates information, from engineering and construction to operation and maintenance. What are the benefits of integrating information in this way?

Fujita: Because civil engineering projects are public works, the management of each process, from engineering and construction to operation and maintenance, is typically handled by different companies – that is, by the company to which the process is contracted. What is more, civil engineering structures and social infrastructures have a long lifespan, and it tends to become difficult to transfer or accumulate information. That is why it is very beneficial to manage information centrally on a platform like the ILSIM and allow multiple business operators to access the information that they need. By enabling information to be accumulated over a long period, we believe that ILSIM will also be useful in the passing of skills from experienced workers to younger generations.

—As the awareness of environmental challenges grows, what is the future outlook in regard to the development of solutions in the field of civil engineering?

Fujita: The original objective of civil engineering is the resolution of issues related to the natural environment and disasters, so environmental challenges are something that is always close to it. Amid such circumstances, what is needed for various structures and social infrastructures to be passed on to the next generation safely and securely? Our job is to develop solutions with that in mind. The sharing of various information and passing it down to the next generation will no doubt become a large asset for society. We will promote development going forward based on that way of thought.

Mioko Fujita

Expert Engineer, Construction Business Promotion Department

Majored in civil engineering while in university. After joining CTC, engaged in the development of products for the construction field. In charge of the development of a service that uses 3D CAD to help resolve issues found at construction sites.

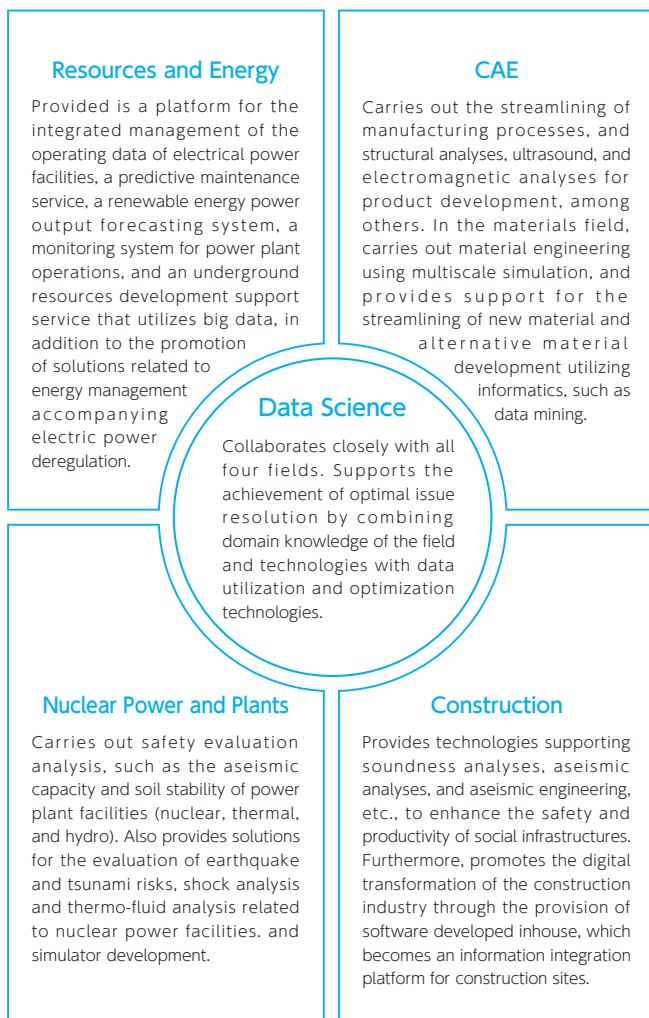


Contributing to a Safer and More Secure Society Through State-of-the-art Analysis and Simulation Technology

The Science & Engineering Systems Division provides IT solution services for the resolution of social challenges related to energy and the environment. Engineers with high expertise in the fields of resources, energy, CAE, construction, nuclear power, and plants, propose optimal solutions through numerical analyses, simulations, system construction, research and development, and consulting.

The Four Fields of the Science & Engineering Systems Division + Data Science

With state-of-the-art analysis and simulation technology at the core, we have rolled out a wide range of businesses in fields including renewable energy and social infrastructure, materials, resource development, airports, manufacturing, and distribution.



The Path Trodden by the Science & Engineering Systems Division, with Their Technology and Expertise Backed by a 60 Year History

After being founded in 1958, we have been developing together with the growth of Japanese industries and society.

1958	Founded; installed a Bendix G-15 computer and commenced the provision of a science and engineering-based computation service
1960	Commenced the provision of an analysis service using nuclear codes
1966	Commenced core management operations at Tokai Power Station
1969	Handled the structural analysis of Osaka Expo Pavilion and engineering computation for the Kanmon Bridge
1971	Installed a CDC 6600, the world's fastest supercomputer at the time
1975	Commended by the National Space Development Agency of Japan (NASDA) for cooperation in the launch of the N-series rocket
1980	Installed the Cray-1, becoming the first in Japan to adopt the use of a supercomputer
1980~	Participated in projects for the construction of ultra-long bridges such as the Honshu-Shikoku Bridge, Rainbow Bridge, and Tokyo Wan Aqua-Line
1991	Cooperated in Persian Gulf crude oil spill prevention and removal measures by way of crude oil spill simulation
1992	Obtained the Meteorological Agency's forecast permit No.34; commenced weather forecasting operations
1996	Opened the WEATHER-EYE meteorological information provision website
2004	The WinPAS system, which aids the selection of suitable sites for wind power generation, received the New Energy Award, Agency for Natural Resources and Energy Director-General's Prize
2011	Commenced the E-PLSM service, which utilizes wind and solar power forecasting and optimization simulation technologies, and encourages and supports the adoption of renewable energy
2012	Commenced the provision of tsunami simulation, which assesses possible tsunami damage
2014	Commenced the provision of analysis services that supports the development of nanomaterials
2015	Selected under the open call made by the New Energy and Industrial Technology Development Organization (NEDO) for the electrical power system R&D project / sophistication of measures to expand cooperation on renewable energy
2020	Established QuesTek Japan as a joint venture with QuesTek Innovations of the United States
2020	Commenced a service for quantitative evaluations related to the operation of airports
2020	The BIRD INITIATIVE, which accelerates the creation of new businesses through cooperative R&D, established by 6 companies in different business sectors
2021	Commenced simulation services for hydrogen energy infrastructures

Trans Simulation, a Next-generation Service for Making a Further Dramatic Leap

The Science & Engineering Systems Division is focusing on the creation of next-generation services under the concept of Trans Simulation.

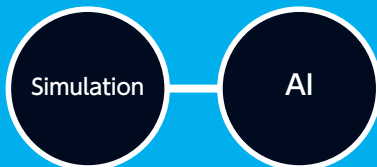
Using the Science & Engineering Systems Division's wide-ranging business areas and simulation technology as the foundation, necessary items are combined beyond the framework of new technologies and industry categories to

bring about a highly convenient service with which to respond to needs related to the resolution of social challenges. That is the Trans Simulation that CTC is aiming to achieve.

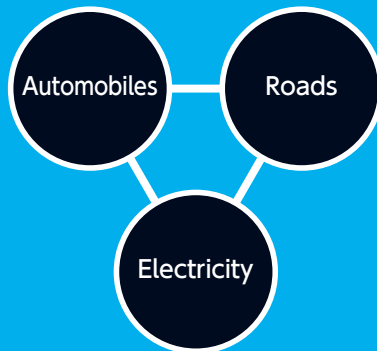
In particular, the whole Science & Engineering Systems Division will undertake Trans Simulation toward Green Transformation (GX).

Trans Simulation

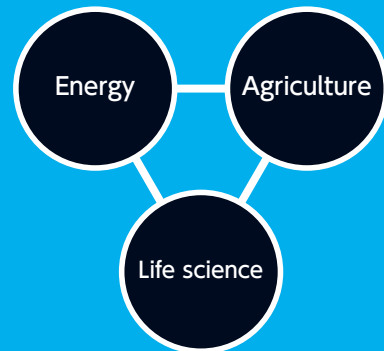
For example,
a Transsimulation that combines solution
technologies themselves



For example,
a Transsimulation that combines different areas
to achieve the evolution of automobiles



For example,
a Transsimulation that combines industries
to achieve the evolution of society



Mobility	Energy	Manufacturing	Supply Chain Management
Material	Infrastructure	Smart City	And More



This issue's theme is...

【 NFT Non-Fungible Token 】

NFT or “non-fungible token” is a term that suddenly started appearing in the media from around the spring of 2021.

It was through NFTs that digital art began to be traded at high prices.

Today, as we are nearing the end of 2021, the use of NFTs is showing even bigger surges. What exactly is an NFT? We will take a look at how they could change society going forward as well as this author's experience in how NFTs are bought and sold.

Text by Yuki Kondo

Proof that the Digital Data is Original

The first tweet ever made by Jack Dorsey, the founder of Twitter, was purchased for approximately 300 million yen, and digital data for a song sold by Elon Musk fetched a price of nearly 200 million yen. It was in March this year that such headlines appeared. The fact that a single tweet or song could be sold at such astonishing prices of several hundred million yen caused a stir. In the background are NFTs, or non-fungible tokens. This refers to digital data that come attached with a one-of-a-kind, irreplaceable token or certificate.

Because it is easy to reproduce digital data, it was difficult to give data itself a value as an asset. However, by creating NFT data, you can give the data a certificate that says it is unique and the

original, so a value can be attached to the original data, even if the data itself should be reproduced.

Blockchain technology made this possible. In this technology, “blocks” of data that is a ledger of transactions are made into a chain that is distributed across an entire network. This makes it difficult to falsify the data because falsifying the data in one block requires the data throughout the chain to also be falsified, which is impossible to do for all intents and purposes. This is the technology that enabled virtual currency (crypto asset*) transactions. One could say that NFT is an extension of that.

NFT Games, Also a Way to Make a Living

There are other important characteristics of NFT aside from serving

as proof that the attached data is unique and original. One of them is its programmability, which makes it possible to attach various functions to data. Let's say, for example, that an NFT art piece is sold by its creator, and the purchaser resells the piece to a third party. The NFT piece could be given a function that would pass a portion of the gains from the resale back to the creator. There could also be a function attached that would limit the number of transactions that can be carried out for an NFT piece. In other words, the copyright holder or creator of the NFT piece can control the rights to their own NFT piece.

Another characteristic is interoperability. Standards have been made for NFTs, which means that they are tradable anywhere regardless of the

platform on which the data was created. In other words, an NFT created within a certain structure can be traded outside of that structure.

Characteristics such as these expand the potential of NFTs. An example is the use of NFTs in digital games. NFT game characters procured or created in a game are already being traded outside of the game in question.

In fact, it was a digital game that first triggered the spread of NFTs. Released in 2017, CryptoKitties is a game in which players breed, sell or buy, and collect virtual cats. CryptoKitties players can earn virtual currencies outside of the game by selling the cats that they own as NFTs. As a result, cases in which the cats were sold for considerable sums began appearing.

There are currently a number of NFT game (aka "block chain game") titles like CryptoKitties. Among them, Axie Infinity, which was developed in Vietnam, became a hot topic because it generated revenues of approximately 38 billion yen in August this year. In this game, players collect, breed, and battle creatures called Axies. Not only can the creatures and items procured through the game be sold as NFTs, but players can also earn virtual currencies by playing the game. A YouTuber called Aruchan reported that he earned the equivalent of about 6,000 yen (at the exchange rate of that time) after playing the game for 5 or 6 hours. In fact, in the Philippines, there seem to be Axie Infinity players who are earning a living during the COVID-19 pandemic by playing this game.

The Surprisingly Easy Path to Selling and Buying NFTs

So, then, how does a person go about selling or buying NFTs? Actually, this

author never possessed a virtual currency, and NFTs are even more foreign to me. So, I gave them a try this time.

To sell or buy NFTs, a person uses an (electronic) marketplace dedicated to NFT trading. OpenSea is a typical example. I learned that to buy or sell NFTs on OpenSea, a user must obtain a virtual currency called Ethereum (ether or ETH) as well as set up an exclusive crypto wallet (online wallet) that can be used for trading on OpenSea.

It was already starting to feel a bit complex, but I started by obtaining (purchasing) Ethers. Ethereum is a widely used virtual currency and seems to be handled by any major virtual currency exchange (virtual currency shop). I decided to make my purchase at Coincheck, which is a leading virtual currency shop. I first opened an account at Coincheck, which can be easily done with a smartphone and a driver's license or other such ID. My account opened in less than half a day. As an experiment, I transferred 5,000 yen from my bank account to my Coincheck account using online banking. Of that amount in my new account, I converted 3,000 yen's worth to Ethereum (the handling charge was about 100 yen) and I successfully obtained 0.0076ETH (ETH being the Ethereum unit; ETH equaled about 380,000 yen at that time).

To purchase NFTs, I needed to transfer the Ethereum to a crypto wallet that could be used for trading on OpenSea. While there are many different such wallets, I decided to use MetaMask, which seemed to be a major crypto wallet and opened an account. To do so, I downloaded and installed the app on my smartphone. It took very little time to open my account, and no

personal authentication was necessary (a secret phrase consisting of 12 English words are used for security purposes) and the account open.

The final step to buying an NFT was to transfer the Ethereum that I had obtained earlier from my Coincheck account to my MetaMask crypto wallet. All I needed to do now was to choose an NFT from the OpenSea website and buy it (though I did not make the transfer from the Coincheck account to the MetaMask crypto wallet at the time because the transfer fee was pretty expensive (about 2,000 yen at the time).

NFTs Will Change the Concept of Services and Daily Life

While it is true that some preparation is necessary to buy or sell NFTs, it was much easier than I had imagined. It is conceivable that the mechanism will become even simpler in the future as the number of users increases.

Just as NFTs are starting to change playing digital games into a job (a way to earn a living), there is a possibility that going forward, NFTs will change the concept of various services and our daily lives. In fact, there is even talk recently of a metaverse concept as a virtual space where actual economic activities are possible. If metaverses become reality, NFTs will be playing a key role there as well.

Perhaps in a few years, ways to use NFTs that are unimaginable today will have become commonplace.

* What we knew of as a "virtual currency" is recently being called a cryptocurrency. For the purpose of this article, the word "virtual currency" is used as it is probably easier to understand.



Providing a Broad Range of Services in Indonesia, from the Sale of Products to State-of-the-Art Technology



Yasuhiro Saito
Vice President
PT. Nusantara Compnet Integrator

Possesses experience of more than 10 years in global business in the ASEAN region, including the launch of the Singapore Branch and M&A. Currently involved in new enterprise development domestically in Indonesia as well as with Japan.

The CTC Group has been strengthening its businesses in the ASEAN region with the objective of providing wide-ranging support for the rollout of client businesses in the region. In 2013, we acquired 100% ownership of a company in Singapore and another in Malaysia; In 2017, a company was acquired in Thailand, and 2 companies were acquired in Indonesia in 2019. As a result, we currently have a framework of 5 subsidiaries in 4 countries.

2 Mid-sized SI Group Companies in Indonesia

The Republic of Indonesia has a population of 270 million and is the world's largest archipelago. It has three time zones in its territory, with the distance between its westernmost and easternmost islands almost equal to the distance between the East and West Coasts of the United States. PT. Nusantara Compnet Integrator ("Compnet"), which was made a CTC subsidiary in September 2019, has 33 offices in this country with a territory that spreads out widely from east to west. It has the servicing and operational capability to cover the whole of Indonesia. Its strengths are infrastructure system integration and project management. The other company, PT. Pro Sistimatika Automasi ("Prosia"), specializes in application development. The two companies jointly develop total services that include infrastructure, cloud computing, and applications, and between them, have approximately 700 companies as clients, including private-sector and government-run companies in the public utility, manufacturing, financial, oil and gas, and mining industries. The size of their sales in the IT market makes them middle-ranking companies in Indonesia.



Has 33 service offices within Indonesia

CTC Group Companies

PT. Nusantara Compnet Integrator (Compnet)
Serves as a total ICT solutions partner [Established in 1996]

PT. Pro Sistimatika Automasi (Prosia)
Provides support for clients' enterprise strategies, with a focus on the software business [Established in 1996]

Total number of Compnet and Prosia employees:
596

Compnet and Prosia Group Companies

PT. Alfa Riset Informatika (Cognixy)
Suggests upstream proposals in the AI and analytics realms [Established in 2019]

PT. Inovasi Otomasi Teknologi (IoT)
Rolls out IoT-based solutions (various sensor information) according to industry [Established in 2018]

Differentiation Through Collaboration with Other Group Companies

The characteristic of Compnet and Prosia is that they are also engaged in state-of-the-art technologies, such as AI and IoT, in collaboration with Group companies in Indonesia. They handle face authentication and vehicle detection systems that use AI image authentication technology in areas that require high security, consulting services based on AI algorithms, as well as application development, such as for the adoption of digital banking by financial institutions. As a joint project with CTC, they began handling SAS, which enabled them to participate in the digital transformation project for the Special Capital Region of Jakarta's Smart City Initiative. Furthermore, with Japanese cooperation, going forward, they are scheduled to launch in Indonesia the RPAs and hybrid clouds rolled out in Japan by the CTC Group. Infrastructure construction accounts for the majority of Indonesian IT market sales. However, investment in AI, IoT, DX and other areas is expected to further increase in the future, and expectations are growing higher toward Compnet and Prosia, which have achieved sure performance in numerous projects in Indonesia to date.

A framework that will enable the provision of support to the ASEAN area has been developed in anticipation of economic recovery after COVID-19, and information sharing with various countries become even closer. The CTC Group will further strengthen its global business so that we can provide broad-ranging IT services to Japanese companies that have expanded their businesses to the ASEAN region as well as to local clients in the area.

News Pickup

Here is information on solutions and services featured in CTC news releases.

DX / Cloud

Provision of an API-linked Solution for Financial Institutions

We began the provision of an API-linked solution that achieves data linkage while maintaining a high security level. The solution is centered on Authlete, an API authorization enabler offered by Authlete, Inc. Authlete is a cloud-based service for financial institutions. It implements the functionality of authorizing access through APIs. When utilizing a bank's data through an API, it limits the hours during which the access can be made as well as functions. Going forward, CTC will expand the provision of API-linked solutions with an eye also on expanding functions that utilize AI based of purchase data that can be obtained from APIs.

DX / Innovation

Promotion of Research with the Tokyo University of Technology Regarding Decentralized Processing Using Smartphones

We embarked on research with the Tokyo University of Technology (TUT) on using numerous smartphones to conduct large-scale parallel distributed computing. In the method being developed, numerous devices connected to a network are linked together to enable grid computing, which achieves high calculation capacity, so that calculation-intensive processing is carried out by dispersing it among smartphones. TUT will utilize its knowledge related to high-performance computers to develop the method and assess its utility. Meanwhile, CTC will review commercialization based on its achievements in the construction and operation of large-scale systems.

Cloud / Information Communication and Broadcast

CTCSP Begins Sale of a Real-time Streaming Platform for Live Video Feeds

CTCSP, which handles the sale of IT-related equipment and software, commenced the sale of Phenix, which is U.S.-based Phenix Real Time Solutions' video streaming platform. It is a content delivery network (CDN) service that enables the real-time online streaming of sports, music, and other events. Video shot at live events can be viewed with minimum latency of less than 1 second. It can also be viewed simultaneously by several million people. CTCSP will also be providing support services including setting up the system related to real-time streaming.

Cloud / AI

Optimization of Core Systems in Accordance with Internal Operations

We commenced the provision of Figues, a solution that optimizes core systems in accordance with a company's internal operations without the need to touch the core system itself. It is a group of services that achieves coordination between core systems, centering on the ERP solution "SAP S/4HANA® Cloud," and other systems, as well as efficient operation and management. Linkage with other systems, such as personnel or operational workflow, is possible without the need to tamper with the core system. It enables the integration and changing of user interfaces, and also leads to lightening the operational load, so users will be able to make effective use of inhouse data.

DX / 5G / AI

Support of Corporate Digital Transformation (DX) Through a Human Resources Generation Program

Together with CTC Technology Corporation, which provides IT-related system maintenance support, operation management, and training services, CTC has commenced the provision of a DX Human Resources Generation Program, which develops personnel who promote corporate DX. It covers a wide variety of aspects, including agenda setting, planning, system design, application development, and service operation. The program can be flexibly customized according to client needs and the state of systems. We will provide total support for the DX efforts of our clients, including the transformation of operations to be engaged in after going through the program, as well as the creation of businesses.

SDGs / Engineering

Launch of a Total Simulation Service for Hydrogen Energy Infrastructure

With the aim of realizing a sustainable hydrogen society, CTC launched a simulation service related to the generation, transport, storage, and use of hydrogen. It will be rolled out for companies in the manufacturing, transport, and energy fields. We will contribute to progress in decarbonization through the spread of the use of hydrogen. Hydrodynamic and structural analysis technologies will be used to support the designing of tanks and pipelines used for the storage and transport of hydrogen. Consulting services will be provided through power demand forecasts for the timing of replacing fuel or on the location of hydrogen stations, and lead to the stable use of hydrogen.

Please visit the following for further details.

<https://www.ctc-g.co.jp/company/>



Golf Legend Bobby Jones' Dream Golf Course: Actualizing "The Men That Were Boys When I Was a Boy Shall Sit and Drink With Me"

At Augusta National Golf Club in April 2021, Hideki Matsuyama achieved his long-cherished dream of becoming the first Japanese national to win the Masters Tournament. Augusta National, highly strategic and beautiful, has been the setting for many a drama to date, and is a course where golfers around the world long to play.

After achieving his Grand Slam (winning all four major golf tournaments of his era: the open and amateur championships in both the U.S. and the U.K.) in a single calendar year in 1930, Bobby Jones retired from competitive golf at the young age of 28.

After retiring from golf, Jones began looking in his home state of Georgia for land to build his dream golf course. What he found was a fruit orchard in Augusta, located 240 kilometers from Atlanta, the state capital. It is said that the ideal golf course (club) for the golf legend was a place where he could actualize a passage from a poem by British poet Hilaire Belloc, which read "And the men that were boys when I was a boy Shall sit and drink with me."

Having strenuously devoted both body and spirit to competitive golf from around the tender age of 14, Jones was craving for a place where he could spend time in peace and quiet.

The fruit orchard struck a resonant chord with Jones and his co-designer, Alister

MacKenzie, as being the ideal property that had been waiting for someone to lay a golf course on it, and they began development. The relationship between Jones and MacKenzie had begun when Jones played a practice round at Cypress Point for the U.S. Amateur Championships at Pebble Beach in 1929. Cypress Point was a new course that had been designed by MacKenzie, and Jones was impressed by the design that made full use of the natural landscape. In designing the course, the motto of the two men was to create links like the Old Course at St. Andrews in an inland area.

Tournament Held To Boost Recognition of the Course Amid the Harsh Financial Circumstances Following the Great Depression

Construction began in November 1931 and was completed the following May, and Jones' private club, the Augusta National Golf Club, opened for play in 1932. After the opening, Augusta National received a harsh review from the New York Times,

which called it a "course for beginners." However, Jones's comeback was that it was, indeed, a course that could be enjoyed by any golfer, whether a professional or amateur. He said golf was no longer a pastime for the affluent few, and that the club should not be a place where a player would humiliate himself, even if an average golfer.

Financial circumstances were said to have been dire for the Augusta National Golf Club when it first opened due to the impact of the Great Depression on the United States. In charge of the club's finances was Jones' ally, banker Clifford Roberts. Securing members did not go smoothly, with many having been hit hard by the Great Depression. In fact, only a portion of MacKenzie's design fees could be paid. Destitute, he could not even take part in the Club's opening ceremony.

The tournament that we now call the Masters began in 1934. It started as a private competition of sorts to promote friendship. Jones invited expert players that



As you enter the front gate and go down Magnolia Lane, which extends from the gate, you see a bed of flowers shaped like the United States and the elegant, white clubhouse behind it.

he had met over the years through various tournaments. The original name of the tournament was the "Annual Augusta National Invitation Tournament." Jones objected to the use of the name Masters Tournament because he thought it was too presumptuous.

However, he approved its use from 1939 in response to the wishes of his fans and the mass media. The tournament began as part of a plan to increase the recognition of the golf club. It invited sports reporters, who spent their time covering major league baseball spring training in Florida until the end of March, to Augusta. That is the reason that the Masters is held in the first full week of April. What we would call today a marketing strategy was successful, and the Masters established a solid position for itself as the first Major golf tournament of the year.

The Course Requires the Use of 14 Golf Clubs, and Draws Out Magnificent Technique

I have visited this area several times, including during my first visit to Augusta in 1987, and the two times I was there as a tournament official. My first impression of the course was of how very hilly it was. In fact, you cannot tell just how much of a difference there is in the level by watching the Masters on TV. The current clubhouse is located at the highest point in the Augusta National premises. From there, golfers shoot downwards 31 meters on the 10th hole. The 10th green is located at the same height as the 11th tee, from where

golfers shoot downwards more than 20 meters. The 12th tee is the lowest point. That means that there is a height difference of about 60 meters.

Flat courses with holes separated by woods are considered good courses in Japan. However, this means that while it is possible to give the holes planar variety, it is not possible to give it multi-level variety, which is what offers the greatest memorability.

There are many holes at Augusta that require different types of shots to be made. For example, an approach to a horizontally long green that starts with a shot made from a lie angle that dips to the left from where a high shot must be made to the green. A long shot to a green with a steep upward gradient, a short iron shot to a breezy green, and so on.

Furthermore, it has always been said that draw shots that allow you to earn distance by using a slope is an advantage. However, in the final hole, the golfer suddenly not only needs to hit a fade ball but also hit up 27 meters. Each hole requires a different shot using all 14 golf clubs. You cannot hope for a good score unless you can do this. This kind of variety was made possible because of the hilly train.

What is more, the course has been renovated almost every year so that only the strongest player of that period and at the time will be victorious. This is the very nature of the Masters Tournament.



Taizo Kawata

Chairman, Japanese Society of Golf Course Architects
President, T&K Incorporated

Born in 1944 in Tokyo. After studying at The Ohio State University, graduated in 1967 from Rikkyo University's Department of Law. His career includes the design of 23 golf courses and the remodeling of 29 golf courses. Has also served as a referee at major golf tournaments, including the British Open and the U.S. Open.

Message from Hikari Fujita

a Female Professional Golfer
Supported by CTC

Working to Win a Spot to Play in the Regular Tour

We are now in the second half of this golf season. The new swing that I have been working on with my coach is starting to feel like my own, so I am hoping to tie it into achieving good scores as I play while "communicating" with the course.

Among that work, I am trying to be mindful of taking my swing with confidence. To do that, I have to make sure that when I take my swing, I do not go into addressing the ball with any doubts on my mind, including my choice of club. Even if you are a professional golfer, unexpected mistakes can occur if you do not take your swing with strong determination. I try to engage carefully, even in the basics.

I would very much like to finish toward the top in the qualifying tournament (QT) to win a spot to play in the regular tour. Until then, I will play in the remaining step-up tours and the Monday tournaments of the regular tours, and work to boost my play. I look forward to your continued support!



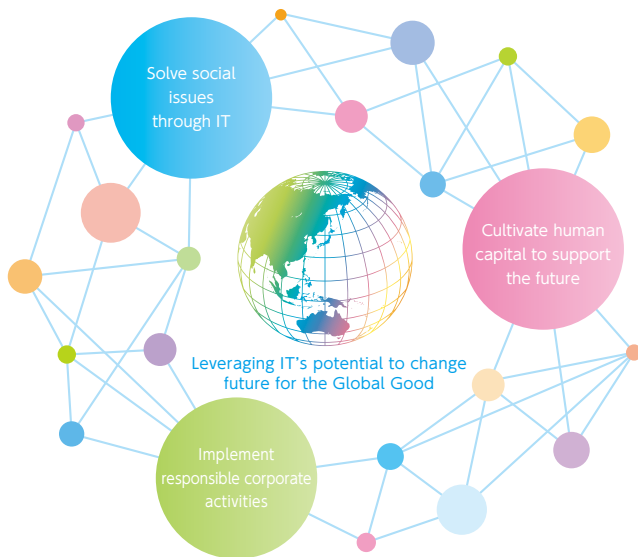
Hikari Fujita - born 1994. Started playing golf from age 3 with her father as her teacher. Passed the JLPGA pro test in 2013. First win as a pro was the JLPGA Kaga Electronics Rookies Cup. Achieved her long-sought win in a regular tournament in 2015.

CSR Forward

The CTC Group's Sustainability

We updated our materiality (material topics) in April 2021.

The mission of the CTC Group is “Leveraging IT’s potential to change future for the Global Good.” Under this mission, through our business activities we will aim for the achievement of a sustainable society and our own sustainable growth. The new materiality will serve as our medium- to long-term building principle for the realization of the sustainability of the CTC Group.



Solve social issues through IT

- Relentless pursuit of advanced technology
- Promote business co-creation with various partners
- Provide safe and secure IT services

Cultivate human capital to support the future

- Develop various professionals
- Foster a culture of mutual respect and growth
- Contribute to education of human capital that creates the future

Implement responsible corporate activities

- Strengthen effective governance
- Contribute to address climate change
- Practice responsible behavior by each individual

This diagram is our materiality itself and contains our desire to think and act together with a diverse set of values.

Background to Updating our Materiality

The CTC Group formulated its materiality in 2016 and has been working toward the achievement of a sustainable society. Meanwhile, issues such as the increase in CO₂ emissions arising from economic activities and the widening of the digital divide due to the development of IT technologies started to become marked. Therefore, we decided to go one step further than our past

materiality, which had placed its focus on achieving corporate social responsibility, and revise the materiality into one with an eye to the resolution of social challenges.

We will constantly conduct self-reflection and ask ourselves if the CTC Group is taking responsible action as companies, and aim to become a presence that drives a change of the IT industry.

information

The Relocation and Consolidation of the CTC Group Tokyo District Offices Were Completed

Activity-Based Working (ABW), which allows employees to choose the location and hours according to the content and objective of their work, and also encourages autonomous and creative work styles, was introduced at the new office. We will also try for new businesses through CTC-style ABW that will strengthen collaboration within the Group and promote diverse work styles.

New address: Kamiyacho Trust Tower, 4-1-1 Toranomon, Minato-ku, Tokyo



General Reception on the 10th floor

A large size multi vision screen (16 screens) was installed to the right of the reception desk.



A video tour of the Kamiyacho head office is available below.

www.ctc-g.co.jp/company/about/pr/corporate-video.html



Principal Group Companies

Japan

CTC Technology Corporation (CTCT)

Kamiyacho Trust Tower, 4-1-1 Toranomon, Minato-ku, Tokyo
<https://www.ctct.co.jp/en/>

CTC System Management Corporation (CTCS)

Kamiyacho Trust Tower, 4-1-1 Toranomon, Minato-ku, Tokyo
<https://www.ctcs.co.jp/>

CTCSP Corporation (CTCSP)

Kamiyacho Trust Tower, 4-1-1 Toranomon, Minato-ku, Tokyo
<https://www.ctcsp.co.jp/english/>

CTC Facilities Corporation (CTCF)

1-2, Ninomaru, Tsuzuki-ku, Yokohama
<https://www.ctcf.co.jp/>

CTC Business Service Corporation (CTCBS)

Kamiyacho Trust Tower, 4-1-1 Toranomon, Minato-ku, Tokyo
<https://ctcbs.ctc-g.co.jp/>

CTC Business Expert Corporation (CTCBE)

Kamiyacho Trust Tower, 4-1-1 Toranomon, Minato-ku, Tokyo
<https://ctcbe.ctc-g.co.jp/>

Asahi Business Solutions Corp.

Asahi Beer Azumabashi Building, 23-1, Azumabashi 1-chome, Sumida-ku, Tokyo
<https://www.n-ais.co.jp/>

CTC Hinari Corporation

Kamiyacho Trust Tower, 4-1-1 Toranomon, Minato-ku, Tokyo
<https://hinari.ctc-g.co.jp/>

CTC First Contact Corporation (CTCFC)

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PT. Pro Sistimatika Automasi

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<https://www.prosia.co.id/>

Best Engine

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