Best Engine

Vol. 11

Special Feature

The Ethical Perspective –
Of Especial Need in a Difficult Age

Satoshi Kodama
Associate Professor, Department of Ethics, Kyoto University Graduate School of Letters

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Cover illustration by
Miki Mohri

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Speaking of "DX"…

I got an intense craving for fresh strawberries the other day and went to a neighborhood supermarket. Strawberries seem to be in season right now, and when I went to the produce section, there were many different varieties on display. I noticed the letters "DX" by the name of some famous varieties. I wondered if the age of digitization had arrived even for strawberries, when I overheard an elderly woman ask a clerk, "DX stands for deluxe, right?" (DX has been a popular way to abbreviate "deluxe," in Japan, especially on product names.)

Come to think of it, yes, they certainly looked deluxe, so I bought a punnet of those strawberries. On my way home, I stopped at a nearby coffee shop. When I was ordering coffee to go, a man who seemed to be of a generation slightly above me was asking a clerk, "So, how do I use the Wi-Fi?" while fiddling with his flip phone.

The government recently announced its COVID-19 vaccination plan, and because of that, I learned that there are an astounding 36 million people in Japan aged 65 or above. I will not go far as to say that this applies to every single one of those people, but there is a digital divide between the younger generation that has been familiarized with things digital before they became working adults, and the current 65 and older population that is "digitally vulnerable." To be honest, I am certain that even I belong on the "digitally vulnerable" side of the divide when it comes to the operation of digital devices.

This autumn, the Japanese government will be launching a digital agency to be headed by the prime minister. The operative phrase is "Human-centered digital transformation with no one left behind." If, indeed, no one is left behind as this phrase proclaims, then the "human" in "human-centered" naturally refers to the digitally vulnerable.

Audrey Tang, who leads the charge of Taiwan's digitalization said, "The important thing is that it is not society that conforms to digital technology. Rather, we must find a form that digital technology can take to stay alongside people. No one should be excluded due to the advance of digitalization.

The time has come for companies like ours that are involved in IT to not only pursue state-of-the-art technologies and DX but also fulfill a role in achieving the human-centered digitalization advocated by the Japanese government.

Incidentally, the fresh strawberries that I purchased were very delicious and true to its DX name.
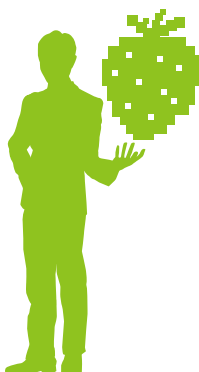
Satoshi Kikuchi

Chairman
ITOCHU Techno-Solutions Corporation

Special Feature

The Ethical Perspective –
Of Especial Need in a Difficult Age

The rapid advance of information technology, intensification of environmental issues, a widening division of society, and a growing pandemic—societal issues are becoming increasingly complex and difficult. The importance of ethics is becoming greater as a foothold for clarifying and resolving such challenges faced by modern society.

How should companies and individuals go about existing or living in this kind of age? We spoke with Professor Kodama of Kyoto University, who is a specialist on ethics.

Coverage and text by Yuki Kondo

Special Interview | **Satoshi Kodama**
Associate Professor, Department of Ethics, Kyoto University Graduate School of Letters

Ethics—A Means for Theoretically Deriving How One Ought to Behave

——The various problems that our society is facing in recent years are extremely complex and difficult. Individuals and companies alike are being questioned more than ever on how they should behave. Amid such circumstances, giving thought to ethics is believed to have become increasingly important. Can you tell us what ethics and ethical studies are about?

Satoshi Kodama: Generally, when people say "ethics" they often use it interchangeably with the word "morals." In other words, you could say that ethics is like social norms, which, separately from the rules established by law, dictate what you should or should not do in life. However, there is another way that the word is used and that is the way it will be used in this discussion. In other words, ethics here refers to various social norms as a whole, inclusive of laws and morals. For example, business etiquette as well as school rules would be included in this definition of ethics. Specific groups of professions, such as lawyers, physicians, and national government employees have codes that they should follow. These are known as "professional ethics." So, ethics includes the codes and rules of all groups as a whole. Laws, school regulations, and the professional ethics of a particular group – they all have an equal relationship therein. Similarly, each of the codes and rules also has some kind of sanction that is imposed if it is not followed. The systemic research and study of such overall ethics is "ethical studies."

——Can you describe the specific kind of research that is carried out in ethical studies?

S. Kodama: Ethical studies is generally divided into three fields. The first is normative ethics. This field investigates the rightness of various social norms, such as those I just mentioned, as well as how one ought to act, in a moral sense. Discussions are carried out utilizing ethical theories, some prominent examples of which are utilitarianism (i.e., an ethical theory that considers an action as being morally right if it maximizes the happiness of all those involved[*1]) and deontology (i.e., an ethical theory that holds that the moral rightness of an action is not based on its consequences but rather on whether it fulfills fixed obligations under any

circumstance[*2]). For example, if considering whether one should tell an ailing person that they only have a little time left to live, under utilitarianism, the decision should be made based on the consequence of telling the truth, while under deontology, one should tell the truth to the individual without thinking of the consequence because telling a lie is not good under any circumstance.

——I see. So, the definition of what is ethical changes depending on the ethical theory that one considers of importance.

S. Kodama: Yes. That would be the case. The second field is meta-ethics. It is a field that studies the larger framework of ethics. It considers what you could consider philosophical matters related to ethics, such as "What is ethics to begin with?" and "What is the relationship between laws and morals?" It became the mainstream field of ethics from the early 20th century in the UK and the USA. The third field is applied ethics. This takes normative ethics and applies it to a specific individual area such as medicine, environmental issues, sports, and business. It will take a social issue, such as climate change and euthanasia, for example, and carry out ethical analysis such as how the issue should be understood or what kind of action we should take. It is a field that tries to derive arguments and specific answers in such ways.

——So, ethical studies is a broad field of studies that covers philosophical discussions to its application to actual social issues.

S. Kodama: Ethical studies is a field that is related to all of our activities. Recently, we have seen the pros and cons of so-called "black (unreasonable) school rules" becoming issues. One of the roles played by ethical studies is to present guiding principles for matters like how school rules ought to be, or in the case of sports, considering, for example, the extent to which athletes should be allowed to target an opponent's injury for the sake of winning (applied ethics). On the other hand, ethical studies can start from a specific argument and go back to the ethical theory that is being applied and think about the theory itself (normative ethics). Or it can carry out a more philosophical discussion and address issues like "Can morals hold up without god or religion?" (meta-ethics). As you

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can see, based on the three aforementioned fields, ethical studies presents us with certain answers, directions, and the rationale at various levels regarding the way of thinking we should uphold and the action we ought to take.

The Course that Can Be Taken in Pursuit of Both Corporate Social Responsibility and Earnings

——I'd like to ask you about a specific matter. First of all, in relation to the area of business, awareness has spread regarding SDGs and ESG investing, and the trend in examining the social responsibility of a company is becoming increasingly stronger. Amid such circumstances, what kind of a mindset is important for a company to uphold—what are your thoughts from an ethical standpoint?

S. Kodama: The conflict between the stockholder approach and the stakeholder approach is a fundamental aspect of business ethics. In other words, the former approach is that a company should give utmost priority to the maximization of benefits to stockholders by pursuing earnings. On the other hand, the latter approach is that a company should think of stakeholders as a whole, including people who buy their products and the regional community. In the past, the predominant stance of companies was to take the former approach while being mindful of upholding compliance but that is no longer the case. Companies have more influence than ever, and they are expected to proactively do good deeds toward society. In other words, taking the stakeholder approach is becoming increasingly important. You could say that the SDGs are a reflection of that.

Furthermore, with such changes, the thinking of stockholders is also starting to change. As we see in ESG investing, making investments in companies that are fulfilling their corporate social responsibility has become a major trend. This means that making a social contribution could also provide long-term benefits to companies as well. On the other hand, however, it is unclear whether a company that makes an extremely high level of contribution to society can really prosper for a long time. Companies must think about how they should act amid such circumstances, and that becomes one of the ethical issues in business.

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*1 **Utilitarianism**
The thinking that the rightness of actions and doctrines is decided only by the goodness or badness of their results (consequences). What is more, the goodness or badness of the consequences is evaluated by how the actions and doctrines impact the happiness of those involved. In other words, actions and doctrines that maximize the happiness of all those involved are considered good. Prominent thinkers who take this position include Jeremy Bentham and John Stuart (J. S.) Mill (both British).

*2 **Deontology**
The thinking that obeying norms and rules is an obligation and that obligations should be abided by regardless of the consequences that may arise as a result. The largest characteristic of deontology is to uphold what is known as a non-consequentialist mindset that gives no consideration to consequences. Deontology, together with utilitarianism, is one of the major ethical theories in ethical studies. A prominent advocate is Immanuel Kant (German).

Table: Social Principles of Human-Centric Artificial Intelligence

The (seven) basic principles that should be noted by society to ensure that AI is accepted and appropriately utilized by society

Principle	Description
Human-centric	AI can expand human abilities and creativity not only by replacing part of human tasks but also by assisting humans as an advanced instrument. (etc.)
Education / Literacy	In order to get rid of disparity between people having good knowledge about AI technology and those being weak in it, opportunities for education such as AI literacy are widely provided in early childhood education and primary and secondary education. The opportunities of learning about AI should be provided for the elderly people as well as workforce generation. (etc.)
Privacy	AI that uses personal data and services and solutions that utilize that AI, including use by the government, should not infringe an individual person's freedom, dignity and equality in the utilization of personal data. (etc.)
Security	Society must promote broad and deep research and development in AI, such as the proper evaluation of risks in the utilization of AI and research to reduce risks. Society must also pay attention to risk management, including cybersecurity awareness. (etc.)
Fair Competition	There must not be unreasonable data collection or infringement of sovereignty under a dominant position of a particular country by concentrating AI resources. (etc.)
Fairness, Accountability, and Transparency (FAT)	Under the AI design concept, all people must be treated fairly without unjustified discrimination on the grounds of diverse backgrounds such as race, sex, nationality, age, political beliefs, religion, etc. (etc.)
Innovation	To realize Society 5.0 and continuous innovation in which people evolve along with AI, it is necessary to account for national, industry-academia, and public-private borders, race, sex, nationality, age, political and religious beliefs, etc. Beyond these boundaries and based on extensive knowledge, perspectives, ideas, etc., we must promote thoroughgoing diversification and cooperation between industry-academia-public-private sectors, through the development of human capabilities and technology. (etc.)

Social Principles of Human-Centric Artificial Intelligence that were summarized by the Council for Social Principles of Human-centric AI (Cabinet Office) in 2019 as principles that should be noted by society.

[Source] "Domestic and Overseas Discussions and Trends in International Discussions," Ministry of Internal Affairs and Communications (May 2019)

——In regard to such issues, what are the kinds of things that can be derived from ethical studies?

S. Kodama: One of the things that can be achieved by ethical studies is to summarize the points of contention on the basis of ethical theory and show what kind of options exist and what kind of actions can be taken. On the other hand, there are also researchers who emphasize going further and deriving and presenting a specific direction on what ought to be done. If anything, I take the latter position. Using a hospital as an example, interests differ depending on whether it is the interests of a hospital patient, staff member, or the management team. I believe that if asked to do so, we need to think in terms of ethics and make proposals even to the extent of what the code of a hospital should specifically be. Presenting not only the code but also the procedures that ought to be followed when making a code, such as the direction to be taken when going about forming a consensus, would also fall within the bounds of ethics. When making some kind of judgment or reaching a decision, clarifying the course of events that led to the conclusion as well as the grounds for the conclusion – that is to say, the rightness of the procedures – is important, and ethics plays a role when considering that point.

Ethics Will Become the Starting Point for Creating Rules for a New Field

——Next, a question regarding artificial intelligence (AI), which is rapidly evolving. It has been said that going forward, the utilization of AI will bring about an age in which we will be able to read the mind of the other person. There are also many who voice concern over that kind of development of AI. What are the ethical issues related to AI?

S. Kodama: Various issues are arising recently in relation to the ethics of AI. For example, The Japanese Society for Artificial Intelligence drafted ethical guidelines in 2017 because it saw a need to clarify what kind of a group it was in light of the fact that there was a general concern that progress in AI research might threaten humanity. A characteristic of artificial intelligence is that there is more than one technology that is not yet in practical use, and it is feared for the reason that no one knows what will actually become a reality. Thinking about what should be done to ensure that such fears will not become a reality is creating ethical norms.

——In other words, by thinking about what it is that we fear about AI, we can start to see the things like rules that society should have in relation to AI, right?

S. Kodama: Yes. In 2019, the Japanese Cabinet Office announced the Social Principles of Human-centric Artificial Intelligence. They are seven principles for the social implementation of AI. You could say that it indeed indicates our concerns related to AI. (See table.)

For example, it is conceivable that behind "human-centric," which is the first principle listed, is the fear that human agency and independence will be lost through AI. Independence is something that arrives at Kantian ethics. Similarly, there are other principles that have ethical philosophies in the background. In other words, ethics can also be said to fulfill a role as a point of origin for thinking about the active pointers and principles for such unknown areas.

AI needs to be first designed following these principles. On that basis, it is also important that discussions are carried out beforehand as much as possible and guidelines decided on what to do if any problems should arise when actually using AI. There are many situations in society where it is difficult to make ethical judgments. I think that even if it is something in relation to AI, it will be no different at the core in that the judgment of humans will be required after al.

The Importance of Discussion on Ethics Under Emergency Situations

——Today, under the COVID-19 pandemic, we have been forced to change our lifestyles and behavior. How should we process and understand such changes? What kind of discussions will be carried out from the standpoint of ethics?

S. Kodama: The various problems that the current infectious disease is causing are, in a broad sense, related to public hygiene. The basic aim of public hygiene is to improve and maintain the good health of all people. Various ethical issues arise during that process, and that is why the ethics of public hygiene has started being considered in recent years. However, Japan had long forgotten about the threat of infectious diseases, and there had been no related discussions taking place. We could say that is why various kinds of confusion are now arising. We need to learn a lesson on the

Suggested reading (in Japanese) to learn about ethics

Jissen Rinri-gaku
(Ethics in practice)
Publisher: Keiso Shobo
Author: Satoshi Kodama

How should we consider, make judgments, and behave regarding difficult ethical issues found in modern society, such as the issue of the capital punishment system or the pros and cons of smoking control? This is a guide for people who want to learn about how to think ethically.

Famine, Affluence, and Morality
Publisher: Keiso Shobo
Author: Peter Singer,
Japanese translation supervised by Satoshi Kodama

A book about issues that are still being discussed around the world, such as are we obliged to give aid to people suffering from poverty, or is distance not related? The book brought about the "effective altruism" movement.

Business Rinri-gaku Tokuhon
(The Business ethics reader)
Publisher: Koyo Shobo
Compiled by: Joji Nakaya

What is the relationship between business and ethics? A collection of papers on various issues related to business from the perspectives of utilitarianism, Kantian ethics, care ethics, etc., by prominent domestic and overseas researchers.

Robot Karano Rinri-gaku Nyumon
(Introduction to ethical studies from robots)
Publisher: The University of Nagoya Press
Authors: Minao Kukita, Nobutsugu Kanzaki, and Taku Sasaki

An introduction for ethical studies that considers various issues presented by robots and artificial intelligence. Discusses issues such as the responsibility of robots, the issue of privacy, and the military use of robots in a clear and simple manner.

Gendai Rinri-gaku Nyumon
(Introduction to modern ethical studies)
Publisher: Kodansha Gakujyutsu Bunko
Author: Hisatake Kato

A classic work on modern Japanese ethical studies. Provides readers will an opportunity to think about harm principle, obligation toward future generations, the issue of moral relativism, etc., through introductions of English and American philosophical arguments.

importance of thinking routinely during ordinary times about ethics under emergency situations.

So, then, what are the kinds of things that we need to think about? During emergency situations, there is the possibility that a necessity arises to restrict the freedom and rights of individuals, such as the government appeal to stay-at-home or self-quarantine that we are currently facing. For that reason, we need to engage in ethical discussions in advance regarding the extent to which and the situations in which such matters should be permitted. How much enforcement is permissible to protect the interests of the body, and what about in terms of protecting the interest of an individual? In other words, discussion based on two ethical principles – the harm principle and paternalism[*3] are needed. The results derived from such discussions become the grounds for laws such as the recent special measures law, the Infectious Disease Act, and the Quarantine Act, and that is why it is important that the discussions take place during ordinary times.

——In recent years, there was an outbreak and spread of infectious diseases, such as SARS and MERS, in other countries. I am acutely aware of how, at the time, I thought of them as being somebody else's problem and not something that concerned me.

S. Kodama: There is a separate, difficult ethical problem in relation to this. In other words, it is the issue of whether it is

ethical to think at all about the ethics of emergency situations. To put it simply, the ethics of emergency situations ends up being about deciding who is going to live and who is going to be sacrificed. This includes the debate on how the limited number of artificial respirators and vaccines will be allocated, or in what order will they be given out? There is a famous thought experiment called the Trolley problem. There is a runaway trolley, that is barreling down the tracks, and it is heading toward where five people are tied down on the tracks. If nothing is done, the five people will die. However, if you pull a lever, the trolley will head to a different set of tracks where there is one person tied to the tracks. Therefore, one person will die if you pull the lever. The problem is whether to pull the lever or not. There is a concept that debating this is in itself unethical.

——Does the trolley problem have a right answer?

S. Kodama: No sufficient consensus has been reached to any single answer. There are many possible ways of thinking about this problem. What ethical studies does is, it teaches us how to go about discussing such issues. I personally think that we should, without a doubt, think about the ethics of emergency situations. Using the across-the-board payment of 60,000 yen to eating establishments that are cooperating with the request to shorten operating hours under the declaration of emergency as an example, you could say, on the one hand, that eating
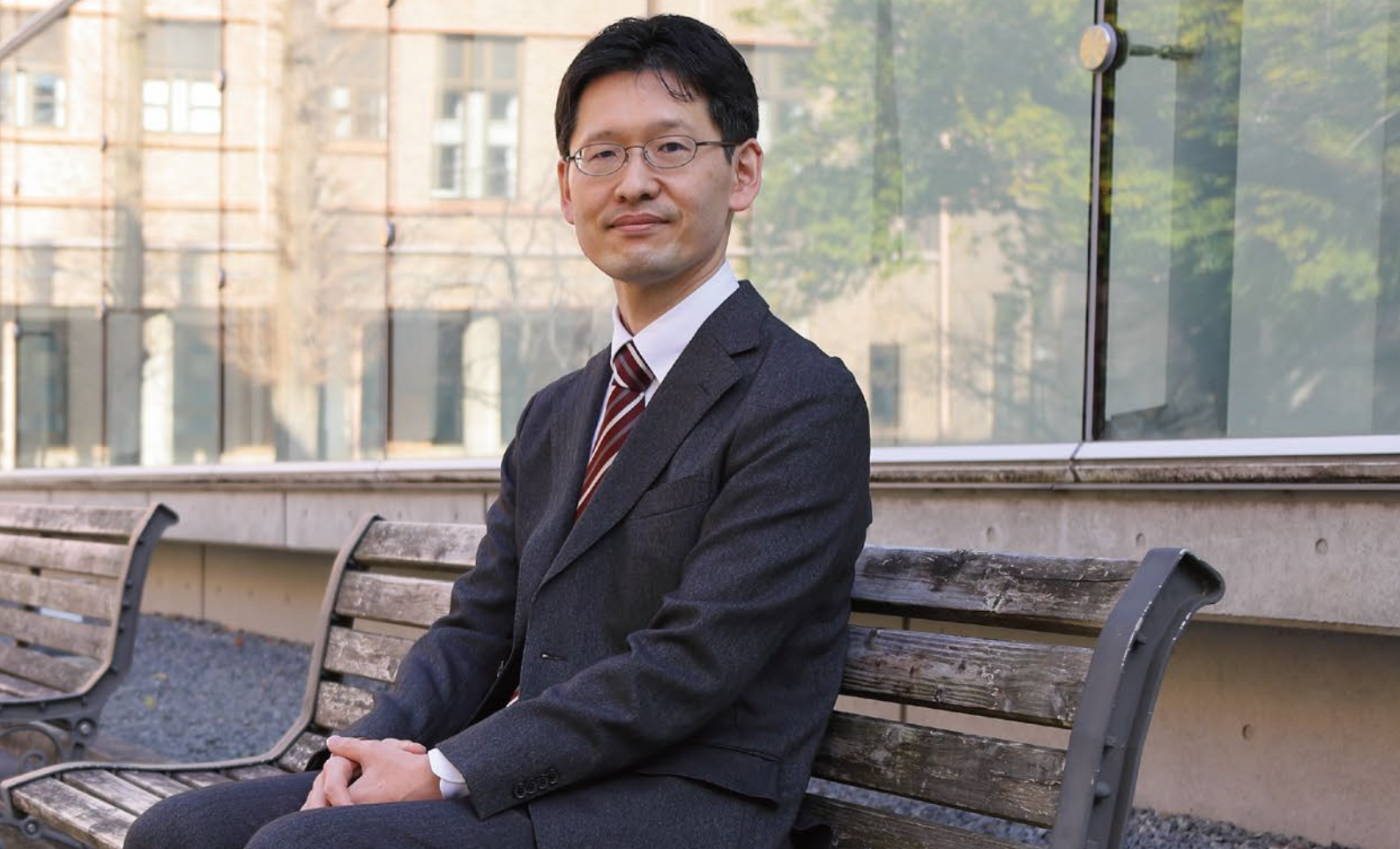
establishments are being treated equally. However, you cannot call it fair if you consider the different sizes of the establishments. So, then what is fair and equal? The move is creating various dissatisfaction because mutual understanding was not reached on points like those mentioned earlier. When executing some kind of political measure, there are many things that need to be shared in advance. If thought is not given to such matters beforehand, there is a possibility that greater confusion or sacrifices will be created. Even if thought must be given to the possibility that some people will become victims, I think it is important that discussion is made in advance during ordinary times on what should be done to minimize the number of victims, what the grounds are for thinking that way, and what kind of procedures will be required.

Life Could Become Easier by Learning Ethical Studies

——I think I am starting to understand the role played by ethical studies. Lastly can you please tell us anew the significance of ordinary consumers like us getting to know about ethics?

S. Kodama: As I have explained up to here, the significance of studying ethics exists on various levels. One of the important effects that ethics has on anyone is that when you study ethics, it becomes possible to take a step back and think critically and

reflectively about social norms and your own behavior. This helps make society better. At the same time, it has the possibility of making life easier to live for that individual. In other words, looking at social norms critically means that you start becoming aware that norms can be changed. For example, even if you should encounter an unreasonable rule at your company, it will probably help you feel better if you can take the attitude that the norm is not necessarily something that you must obey but rather something that you can change. Getting to know about ethics and ethical studies means that you will be able to decide your own guiding principles for life, and that will increase your options in life. As the world becomes complex, with everyone now facing difficult issues, I feel anew that importance. If this has piqued your interest, I hope that you will look deeper into ethics.

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*3 The harm principle and paternalism

To protect the safety of the individual as well as that of others, these two ethical principles become important when considering the extent to which governments and laws can intervene in a person's individual freedom and lifestyle. The harm principle holds that one can restrict the freedom of an individual only when they are behaving in a way that will cause harm to others. In paternalism, a third party intervenes for the sake of the interest of an individual even if that individual does not want that intervention. For example, if you think about "Is it all right to allow a restriction of the use of earphones and smartphones while riding a bicycle?" and, "Is it all right to make it mandatory to wear an automobile seatbelt?" I think you can concretely see the significance of the respective principles. Incidentally, the harm principle was advocated by J. S. Mill in his book, *On Liberty*. Mill also presented the points of contention regarding paternalism in the same book.

Developing a Data Usage Engine that Links Digital with Real to Add Value to the Customer Experience

The ANA Group

Company: ALL NIPPON AIRWAYS CO., LTD.
Head Office: Shiodome-City Center, 1-5-2, Higashi-Shimbashi, Minato-ku, Tokyo
Established: 1952
Website: https://www.ana.co.jp/

ANA **Inspiration of JAPAN**

The companies within the ANA Group are working together at leveraging digital transformation to improve customer satisfaction. As part of their efforts to establish a digital platform for delivering high quality customer service, they are building a customer information platform ("CX Platform") that virtually integrates and links data from systems related to passengers, flight operations, customer data, and more. The aim is to sustainably improve the value of their customer experience. The *Streaming Engine* was developed as an extension which uses data aggregated in this CX Platform to deliver services personalized to each customer at the proper timing. CTC worked together with ANA Systems Co., Ltd. ("ANA Systems"), the IT services company of the ANA Group, to jointly develop this new mechanism, and provides it to ANA as a managed service on a public cloud.

New Data Utilization Mechanism is Key to DX Strategy

ANA made digital transformation (DX) the main pillar of its business strategy starting in 2018. Since then, they have been pressing forward with digital transformation through a two-pronged approach of innovating while also overhauling IT systems.

In 2019 the ANA Group was selected for the second consecutive year by the Ministry of Economy, Trade and Industry and the Tokyo Stock Exchange as a Competitive IT Strategy Company, amongst which it was also the only company selected for the DX Grand Prix as a leading company in the digital era. One of the measures that helped ANA earn such lofty designation was the CX Platform launched in 2018, a large-scale virtual database that centralizes data such as customer information and flight details which had previously been managed separately.

Akinori Goshi, Manager of the Data Science & Design, Innovation of ANA's Digital Transformation, reflected on the process of building the CX Platform.
"In order to recognize customers who had previously been recognized separately amongst various systems as 'the same customer' through all systems, and then maintain that connection by providing services that deliver high satisfaction, we had to build a platform that aggregates and analyzes all types of data. Once data accumulates, you can gradually see more of the customers' online movements. You can then analyze this data to deploy communication methods tailored to each individual customer through digital contact points."

At the same time, the core of the ANA Group's business lies in the real-life services provided in the physical scenarios of domestic and international flights and use of related

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Manager
Data Science & Design, Innovation
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ALL NIPPON AIRWAYS CO., LTD.

Takayuki Kameoka
Customer Experience Management
Manager
ANA Systems Co., Ltd.

Kazuhiko Nishikawa
Customer Experience Management
ANA Systems Co., Ltd.

services at airport facilities. Building the CX Platform made it possible to aggregate and utilize customer and flight information, but the next activity apparently sought to connect this to concrete actions aimed at each individual customer.

Goshi explains, "We had separate mechanisms in digital and real life. For example, in digital we had mechanisms to analyze various data in order to encourage customers to make subsequent reservations. In real life, we had mechanisms to utilize data that customers had passed security check in our flight systems. However, the goal of the CX Platform was to leverage these for an improved customer experience. We had to create new mechanisms that could seamlessly link digital and real-life information about customer behavior and flight status to deliver the optimal information at the optimal timing."

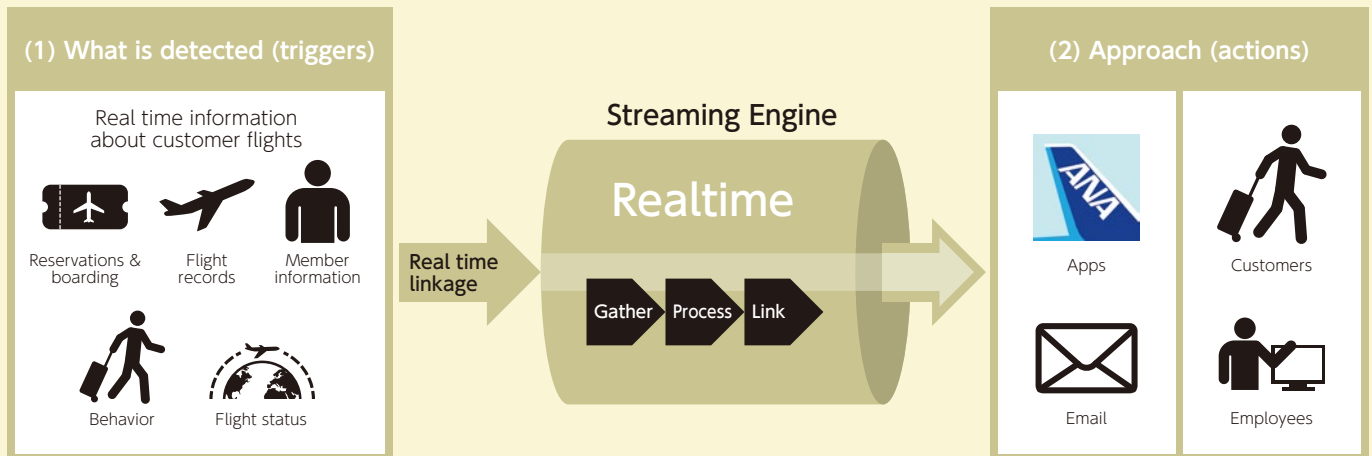## The Streaming Engine that Made Personalized Services for Each Customer Feasible

With this task at hand, a mechanism called the Streaming Engine which executes specific actions based on customer and flight information as well as other data was developed as an extension of the CX Platform. ANA and ANA Systems began full-scale reviews in April 2019, after which an ANA Systems and CTC collaborative team initiated roughly five months of development work in November of that same year, leading up to go-live in March 2020.

The Streaming Engine detects data from changes in customer behavior through digital reservations, payments, and cancellations, and from real-life check-ins, security gate passage, and boarding, as well as data from changes in flight status such as aircraft takeoffs, landings, and boarding gate changes. Utilizing this data makes it possible to deliver individual services and combinations of services through intuitive operations without compiling programs. As a result, personalized information can be provided to each individual customer in real time. The Streaming Engine has already produced tangible achievements.

Goshi continues, "We implemented a measure to get customers go through security check earlier. They would get a message the day before their flight with a coupon they could use for shopping at stores near their boarding gate on the condition that they pass through security check at least 45 minutes before boarding time. This service provides value from the customer's perspective, while our company also enjoys the operational benefits of better punctuality by having customers come to the boarding gates earlier." It successfully became the first service to seamlessly link digital information related to customer boarding with information about the real-life

■ Schematic of the Streaming Engine

(1) What is detected (triggers)

Real time information about customer flights

Reservations & boarding · Flight records · Member information

Behavior · Flight status

Real time linkage →

Streaming Engine

Realtime

Gather → Process → Link

(2) Approach (actions)

Apps · Customers

Email · Employees

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customer behavior of passing through security check.

Another measure has also been implemented which takes departure times and boarding gates into consideration to send timely advance warnings to customers whose boarding gates are located far away. Implementing services such as these with conventional systems would require new programs to be created for each individual measure, making them hard to execute in a quick and timely manner. However, the Streaming Engine has created mechanisms that can process data in real time and immediately execute specific actions.

Completing Development in Only Five Months with OSS & Agile, and Strong Teamwork

This project to develop the Streaming Engine was completed in only five short months thanks to the use of open-source software (OSS) and the agile development

methodology. It is a cloud-native system built in a managed containers environment using Amazon Elastic Kubernetes Service (EKS) on AWS, on top of which it was developed by combining multiple OSS including Spring Cloud Data Flow which processes streaming data, and Drupal to manage workflows.
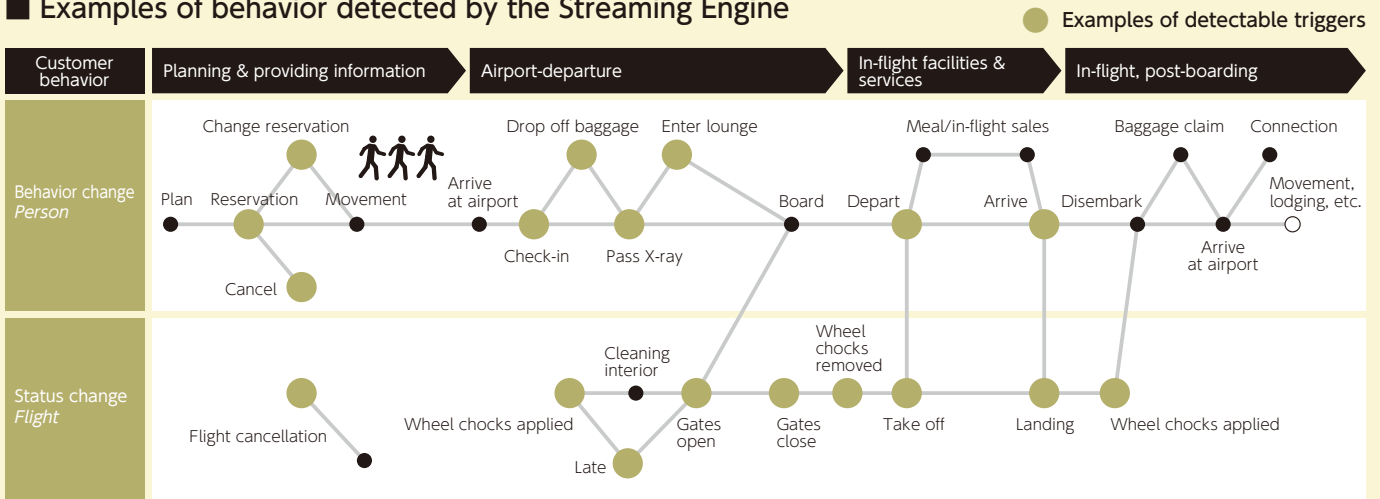
Takayuki Kameoka, Manager of the Customer Experience Management at ANA Systems, had the following assessment of joint development with CTC.

"Although we had hardly any experience at all in development with OSS, the technologies and expertise of CTC combined well with the operational know-how and development experience of ANA Systems, allowing us to complete development in a short time frame. Agile development sprints through smaller cycles of design, implementation, testing, and deployment, repeating the process of decisions and execution. I think one of the biggest factors to the success of the

project was that the decision maker ANA and the companies doing the actual development ANA Systems and CTC worked together as a three-member team with the same common goals."

One of the core developers for the project Kazuhiko Nishikawa, ANA Systems' Customer Experience Management, pointed out the strong teamwork in the project. "We held one meeting after another with members of CTC during the development period, and there were lots of discussions. The data handled by the Streaming Engine spans various departments within the company including those that are mission-critical, so it was difficult in some ways to reconcile and adjust specifications. However, the team members from CTC provided technical expertise in precisely these types of coordination scenarios, which allowed us to build mechanisms on a solid foundation."

■ Examples of behavior detected by the Streaming Engine

● Examples of detectable triggers

Customer behavior	Planning & providing information	Airport-departure	In-flight facilities & services	In-flight, post-boarding

Behavior change *Person*

Plan · Reservation · Change reservation · Cancel · Movement · Arrive at airport · Check-in · Drop off baggage · Pass X-ray · Enter lounge · Board · Depart · Meal/in-flight sales · Arrive · Disembark · Baggage claim · Connection · Arrive at airport · Movement, lodging, etc.

Status change *Flight*

Flight cancellation · Wheel chocks applied · Cleaning interior · Gates open · Late · Gates close · Wheel chocks removed · Take off · Landing · Wheel chocks applied

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Streaming Engine Accelerates Digital Transformation of the ANA Group

The Streaming Engine is currently in the full-scale operation phase, and CTC is supporting its stable operation by providing it as a managed service which includes maintenance. By entrusting the system monitoring, operations, and maintenance to CTC as a managed service, ANA and ANA Systems are able to dedicate their efforts to planning new services and measures.

For its efforts to establish digital platforms including the Streaming Engine, ANA was recognized in 2020 with the First Prize IT Award (Area of Client and Business Functionality) in the 2020 Information Technology Awards by the Japan Institute of Information Technology (JIIT). News of the award provided a wave of momentum to implement this new mechanism even more widely within the company, and various measures are now under consideration in on-site departments such as Marketing and Operations.

ANA's Goshi had the following to say about the prospects for use of the Streaming Engine going forward. "We will continue to expand the applicable scope of the Streaming Engine and produce more measures that are personalized for each individual customer. Throughout the company, we are headed in the common direction of improving customer satisfaction and doing so by pursuing initiatives that increase the value of the customer experience. Departments within the company each have their own ideas, and I believe this new mechanism will be a catalyst that drives creation of the next generation of services."

Kameoka of ANA Systems shared his thoughts about how the applicable scope of the Streaming Engine could be expanded. "We assume that the data currently handled by the Streaming Engine is mainly transactions in core systems such as reservation and boarding systems. However, in the future, data from sensors and other IoT devices will also enter the picture. For example, if we can gain proper approval from customers to detect things such as congested locations within airports and waiting times in lounges, we could come up with even more effective measures."

The digital transformation of the ANA Group will continue to accelerate. Stable operation and future functional upgrades to the Streaming Engine will be essential in formulating a variety of appealing services that can raise the value of customer experience to even greater heights. As a trusted partner, CTC will continue offering its knowledge and technological capabilities accumulated over the years to provide strong support for the ANA Group to achieve its ambitions.

This issue's theme is...

【 The Internet of Bodies (IoB) 】

While people seem to have become thoroughly familiar with the term "Internet of Things" or "IoT,"
there may be many of you who have never heard of "IoB" or the Internet of Bodies.
As you can see, the word "Things" has been replaced by "Bodies" in this term,
and it refers to connecting the human body to the Internet.
It might sound a bit ominous, but what exactly does it point to, and how will it change the world from now?

Text by Yuki Kondo

The Three Generations: Body External, Body Internal, and Body Embedded (Melded)

As far as I could tell from my online research, the term IoB (Internet of Bodies) seems to have been first used around 2017. While in IoT, various things are connected to the Internet to obtain data or to get things to work, the concept of IoB is to connect the human body, instead of things, to the Internet and to utilize this connection in various ways, such as to obtain biological data.

At an IoB lecture meeting held in 2017, an American legal scholar maintained that there were three generations of IoB and said that in the first generation, data, such as heart rates and the amount of exercise performed, is obtained by wearing a device externally on the body. In the second generation, a device is placed inside the body. The third generation of IoB is melded to the body and used, such as by embedding a device in a person's brain.[1] An article written at the end of 2019[2] by a tech-savvy, renowned author in the UK also mentioned three basically similar generations (body external, body internal, and body embedded), so I think it is safe to think of IoB in that way for now.

Will Embedding in the Brain Commence?

Let's think concretely about each generation of IoB. A typical example of first-generation IoB in which wearable devices worn externally on the body measure bodily information for use is the Apple Watch. They have already been widely accepted. If you consider how many people always carry their smartphones around with them, you might be able to include smartphones into this category in a broad sense. Meanwhile, a representative example of the next generation in which a device is placed into a person's body is a pacemaker, which is used to help control the person's heart. Pacemakers are not so uncommon these days. Then, what about the third generation in which devices are directly embedded in the brain, for example. None of our readers are probably using such devices at present. In fact, it may not even sound realistic to some. However, this is not the case. In the summer of 2020, Elon Musk's Neuralink announced that a device, which was to be implanted in the brain with the goal of use in the treatment of diseases by reading electric signals, had reached the testing phase. Furthermore, in 2021, Musk said that the implanting of a chip into the human brain could possibly begin before the end of 2021.[3] Actually, there is more. Implanting chips in the body for use in various communication is already a reality.

A Country in Which Chips Are Implanted in 1,000 People Every Year

Back in 2017, the U.S. technology company Three Square Market began offering its employees a chance to have microchips embedded under their skin if they so desired.[4] The microchips are about the size of a large grain of rice. By having it embedded in their hand, employees can use it to enter the company's offices, log into their computers, or purchase meals at the company cafeteria with the wave of that hand. When the embedding service began, around 50 employees got microchipped, while another 30 employees also got microchips embedded over the next year. In other words, by 2018, around 80 people, or one-third of the company's roughly 250 employees, were making use of the embedded microchip. Incidentally, although the microchips can be removed, as of the time that 80 people had been microchipped, only two people, who had quit the company, had their chips removed. It may be surprising to learn that there was already a company like that more than three years ago. However, even this was not the first such example. From 2015, there were already people in Sweden who used a microchip embedded in their hand to make payments or as keys to enter rooms. As a matter of fact, the president of Three Square Market is said to have decided to do the same thing at his company after learning about those circumstances in Sweden. What is more, since such microchipping commenced, about 1,000 people get chips embedded under their skin each year in Sweden, and as of 2020, roughly 6,000 people are presumed to have been microchipped. In the U.K., a company was confirmed in 2018 to be carrying out the microchipping of its employees.

As you can see, while not into the brain, the embedding of an IoB device had already become a reality several years ago in some developed countries. On the other hand, only a few (English-language) IoB-related articles could be found online in the past year or two. For now, it does not seem that the concept of IoB is spreading widely each year or that moves to embed chips or other devices in the body are greatly increasing at various locations around the world.

However, as medical technology progresses, the utilization of IoB will almost certainly expand going forward. The utilization of biological data obtained through first-generation IoB devices is already commonplace. The further development of medicine requires forward movement in the use of IoB devices to enable medical treatment that even better matches the state of a person's body, for example, by the constant, precise monitoring of cardiac motion or the state of a person's blood from within the person's body through second or third generation-type IoB devices. Perhaps, the advent of the age of a 100-year lifespan may become a reality with the spread of the use of body-embedded IoB devices.

Other, Non-medical Reasons for Embedding IoB Devices

However, it is easy to imagine why there are various concerns related to obtaining biological data by embedding IoB devices. A research team from the RAND Corporation, an American global policy think tank that carries out research of the benefits and risks of IoB, begins by citing privacy and security-related issues as being risks behind IoB.[5] Will there be no fraudulent use of data obtained through IoB devices? How can risks, such as cyberattacks, be eliminated? With the use of IoB devices progressing ahead of the development of a sufficient legal framework, a warning is being sounded for the need to discuss such aforementioned matters at haste. Further ethical concerns are also being raised by RAND, in other words, the issue that IoB might threaten personal autonomy. There are many problems that must be resolved, from matters such as who owns the obtained data to what happens to the rights of people who miss out on the advantages of IoB if a social system that presumes the use of IoB is created.

However, medicine may not be the only reason that encourages the embedding of devices into the body. Nerualink's Musk said something to the effect that as AI becomes increasingly stronger in the future, neural implants may become unavoidably necessary to enable humans to compete with AI.

We may already have entered a world that was only imaginable in the past in Sci-Fi stories.

[Reference]

*1 *IoT (Internet of Things) no tsugi, IoB (Internet of Bodies) heno keikoku [Warning on the Internet of bodies (IoB), coming after the Internet of Things (IoT)]*, Newsweek Japan, September 28, 2017)
https://www.newsweekjapan.jp/tsuchiya/2017/09/iotinternet-of-thingsiobinternet-of-bodies.php

*2 *What Is The Internet Of Bodies? And How Is It Changing Our World?* Forbes, December 6, 2019
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https://www.rand.org/blog/articles/2020/10/the-internet-of-bodies-will-change-everything-for-better-or-worse.html/

CTC Group Business in North America
Pioneering Silicon Valley's Cutting-edge Solutions, Plus Full-scale Deployment of System Integration in North America
ITOCHU Techno-Solutions America & SYSCOM GLOBAL SOLUTIONS

Hiroaki Oda
Director, Financial & Enterprise Solutions
ITOCHU Techno-Solutions America, Inc.

Stationed in New York since 2018,
handling CTC Group & SYSCOM partnership business

Since ITOCHU Techno-Solutions America, Inc. ("CTC America") was established as the North American business enterprise of the CTC Group in 1990, it has been pioneering cutting-edge technology created in Silicon Valley while introducing large numbers of advanced solutions to the Japanese market. CTC launched its system integration business in North America starting with an implementation project for a major telecom company in 2016, and now operates in a two-company collaborative organizational structure with SYSCOM Global Solutions Inc. ("SYSCOM") through a capital partnership concluded in 2018.

CTC America and SYSCOM: Collaborative Organization

The biggest challenge in the system integration business operated by CTC America in North America is improving the engineering staff on hand in order to offer even better services to customers. To that end, CTC America entered into a business partnership with SYSCOM in 2016, followed by a capital partnership in 2018 (acquired 33.7% stake). The CTC Group then established its North American system integration organization based on collaboration between the two companies.

SYSCOM was established in 1990 in New York, providing system integration mainly geared toward Japanese companies operating in the US. Having survived the dotcom bubble crash, the global financial crisis and various other hardships, SYSCOM has grown to a size of over 130 employees. Combining SYSCOM's staff of engineers who handle everything from system architecture to operation and maintenance, with the comprehensive capabilities of the CTC Group creates synergies that support the global businesses of customers operating in overseas markets including North America.

This two-company collaborative organization has been performing system implementations for large corporate clients in sectors including telecom, finance, manufacturing, and construction, in addition to call center services that leverage time differences between the US and Japan to provide round-the-clock, bilingual service, and more.

Future Business Developments in North America

The CTC Group has established a track record in North America in the following areas.

- Advanced technology research and product discovery in DX, hybrid work, next-gen infrastructure, etc.

- Development, operation, and maintenance of systems for financial institutions

- Building large-scale infrastructure for data centers of telecom operators

- Development and testing in the fields of AI and cloud native through collaborations with startups that possess cutting-edge technologies

Going forward, CTC, CTC America, and SYSCOM will continue partnering to support the businesses of Japanese companies operating in the US, while also exploring business expansion in North America through the development of products and services for corporate customers which leverage their development and implementation expertise accumulated over the years in the fields of applications, cloud native, and open source. The CTC Group also plans to further expand its global business by encouraging greater collaboration between the three regions of Japan, North America, and Southeast Asia.

News Pickup

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

DX / Agile Development

CTC Supports Product Development for DX

CTC has begun providing a "build service" to develop products while giving customers the knowledge they need for DX through skills transfer. Based on methods formulated by US company Slalom for developing applications in-house, this service gives tangible form to the values and concepts that customers offer, while also building mechanisms and systems for sharing information between project members. Comprised of teams for each role in which CTC engineers and customers work together, we support the in-house development of applications by our customers.

DX / IoT

CTC Now Providing Time Series Database InfluxDB

CTC has begun providing the InfluxDB open-source time series database by InfluxData in the US. It takes in time series data sent from sensors in real time, stores the data long-term and enables high-speed searches. InfluxDB enables efficient data management by saving storage capacity through data compression and reducing the amount of memory used during analysis. This solution is ideal for companies that use sensors to gather and analyze large volumes of data in the growing markets related to AI and IoT.

AI / IoT

CTC Launches IoT Camera Solution Using AI Video Analysis & Sensor Information

CTC has begun providing an IoT camera solution that combines video analysis to identify people and vehicles, with various sensors for parameters such as temperature and vibration. The video analysis uses IVAR software from Taiwan's largest video AI technology company Gorilla Technology, while Asteria's IoT integration platform Gravio is used to manage the sensors. In addition to providing this solution, CTC also offers comprehensive services from PoC and design to linkage with existing systems, and maintenance support.

Cloud / AI / Contact Centers

CTC Launches Telecommuting Solution for Contact Centers

CTC has begun providing a telecommuting solution for contact centers which links a communication solution from Avaya Japan with Citrix's virtual desktop cloud service. This solution enables smooth communication between customers and supervisors from the comfort of home, while also maintaining the same level of security. Combining the solution with an AI automated response system and AI chatbot eliminates customer waiting times and leads to higher operator satisfaction.

DX / Learning & Training

CTC Supports Demonstration Experiment for Keio University's Digital Identity Platform

CTC began demonstration experiments in October 2020 on a next-generation Digital Identity platform that issues official documents such as enrollment certificates and certificates of expected graduation to Keio University students through a smartphone app. The project is being conducted jointly with the Keio University Information Technology Center, the Blockchain Laboratory of Keio Research Institute at SFC, Japan Digital Design, JCB, Nippon Telegraph and Telephone West Corporation, and BlockBase, and also in collaboration with Microsoft Corporation.

DX / Life Science

CTC, Encise and SAS Form a Business Alliance in Life Sciences

CTC concluded a business alliance agreement with Encise and SAS for the purpose of developing new services that combine prescription drug sales data with data analysis solutions. The alliance combines Encise's prescription drug sales data with the data analysis products that are SAS's strength and the data service platforms of CTC to provide a cloud service for pharmaceutical companies to analyze their prescription drug sales data. The three companies will work together to provide pharmaceutical companies with the analysis and analytics services that they need, and contribute to the advancement of DX in the pharmaceutical industry.

Please visit the following for further details.

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

Memorable Beauty and Strategic Golfing

Kawana Hotel Golf Course, which overlooks the Pacific ocean, is now again being evaluated highly by the world.
With the Fuji Course and Oshima Course, which make the most of the natural landscape,
Kawana's varied 36 holes fulfill the two conditions of a prestigious golf course: having a signature hole and memorability.
Although 93 years have passed since Kawana first opened,
it continues to offer players an unchanging taste of the excitement that golf has to offer.

Golf Digest and Golf Magazine both announce their rankings of the top 100 golf courses of the world once every two years. The latest Japanese golf courses picked by the U.S. magazines were as follows.

The year before last, two Japanese courses were among Golf Magazine's World Top 100. They were Hirono Golf Club in 39th place (up 1 rank from the previous Top 100), and Kawana Hotel Golf Course – Fuji Course in 56th place, which is 12 ranks higher than the previous Top 100.

Meanwhile there were four Japanese golf courses among Golf Digest's World's 100 Greatest Golf Courses picks in 2019. Here again, the meteoric rise of Kawana's Fuji Course was eye catching: Hirono Golf Club (No. 50 → No. 13), Kawana – Fuji Course (No. 75 → No. 26), Tokyo Golf Club (Unranked → No. 63), and Naruo Golf Club (No. 84 → No. 71). Even if you did not take into account the fact that U.S. golf courses were excluded from these lists, I feel that they show that Japanese golf courses are being re-recognized.

Influenced by the Golf Resorts of the UK, Constructed Originally as a Villa of the Okura Zaibatsu

The Kawana Hotel was built by Kishichiro Okura of the Okura zaibatsu. During the Meiji period, Kishichiro studied in the UK, and while there, he stayed at the Gleneagles, a resort hotel catering to British aristocrats. It offered such pursuits on the grounds as golf, tennis and horseback riding. Kishichiro was impressed by the hotel and was inspired to build Kawana as a villa for the Okura zaibatsu upon his return to Japan. I personally think that it resembles the Turnberry golf resort more than Gleneagles.

Kawana opened in 1928. The first golf course that opened was the 18-hole Oshima Course, which was designed by Komyo Otani, one of the founders of the Japan Golf Association (JGA). The Fuji Course was designed by Rokuro Akaboshi. When about six or seven holes had been completed on the course, Kishichiro took note of the British landscape architect

Charles High Alison, who had been brought on board to design the Asaka Course at the Tokyo Golf Club as well as a course for the Hirono Golf Club that was being newly built, and Kishichiro changed the design of the Fuji Course. It is said that the deep bunkers seen in various places were created based on Alison's advice. The Fuji Course opened simultaneously with the Kawana Hotel in 1936.

Immediately after the outbreak of the Pacific War, US and British embassy officials and workers in Japan were temporarily interned at the Kawana Hotel while waiting to leave the country. Kawana later became a naval hospital. The hotel was requisitioned by the Allied Forces after the end of World War II before it was returned to the Okura zaibatsu. Today, it is under the management of the Seibu Group's Prince Hotel and Resorts chain. Kawana's history aside, here are my thoughts on why Kawana has been in the international limelight.

The Kawana Hotel is located to the south of Ito City on Izu Peninsula. It sits on higher ground with a sweeping view of Sagami Bay. Two differing golf courses, Fuji and Oshima, comprise 36 holes. It is a golf resort with a stately and classical hotel.

Entered the Spotlight after Obtaining High Recognition in the World Amateur Team Championship

It has its beginning with the hosting of the 3rd World Amateur Team Championship (WATC) for the Eisenhauer Trophy at Kawana in 1962. Japan won the Canada Cup (which later became the World Cup) held in 1957 at the Kasumigaseki Country Club, which brought about the first golf boom in Japan. To express appreciation for the success of the Canada Cup, Shunkichi Nomura, who was the vice president of the Japan Golf Association (JGA) at the time, visited the US Golf Association (USGA). At that time, he recommended the establishment of the WATC. The USGA was quick to make its decision, and the first WATC was held just one year later at the Old Course at St. Andrews in Scotland, where the modern game of golf originated. The second Championship was held in the US at the prestigious Merion Golf Club. It was only natural that the Championship was held in the UK and the USA, the two golf powerhouses. More than 20 countries were participating in the championships, and Australia and Canada were conceivable as the location of the next championship. However, not only was Japan chosen for the 3rd World Amateur Team Championship, but it was also to be held at Kawana, which was internationally unknown at the time. This boosted the reputation of the course in a burst, bringing it attention from golfers around the world.

In 1954, Marylin Monroe, who was at the height of her fame, visited Kawana when she came to Japan on her honeymoon with former major leaguer Joe DiMaggio.

The Beautiful Shape and Form of the 36 Holes Overlooking the Sea

All good, prestigious golf courses of the world have a signature hole. They represent the course and are noted for their aesthetic beauty as well as for being strategically challenging for players of all levels. Another condition of prestigious courses is its memorability factor. Kawana has both – a signature hole and memorability.

The first hole, with its sharp downhill tee, is known for the scenic beauty that unfolds below. The 11th hole nicknamed "SOS" is par 5 toward a light house, and there is a beautiful cliff bordering the 15th hole. Then, there are the 16th, 17th, and 18th holes. The course layout makes the most of the natural landscape and is truly a work of art. Today, landscapes can be changed at will using heavy machinery. Whenever I visit the course, made by people carrying dirt in rope baskets during an age when no heavy machinery existed, I find the view breathtakingly beautiful. I have no doubt that the elegant, classic hotel, built on a hill overlooking the majestic Pacific Ocean, and the highly interesting 36 holes of the Fuji and Oshima, which require strategic playing, will continue to be loved by golfers as a world-class Japanese golf course.

Taizo Kawata

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

Born in 1944 in Tokyo. After studying abroad 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

I Will Further Hone My Swing and Keep Up My Challenge!

Thank you as always for your wonderful support. There were many tournaments and matches that were cancelled last season due to COVID-19, so I spent much of my time in training and transforming my golf swing.

My golf style has always been characterized by my draw shots. Now, they have become even stronger, and the ball trajectory is one that allows for longer distances. Transforming my swing has not only led to improving distance but has also been effective in allowing me to keep the ball on the fairway. This season, I would like to further hone this swing, proactively utilize it even during matches, and gain confidence in my swing and play management.

Although I will have to start from qualifying rounds and recommendations in terms of the regular tour, I will set targets that will allow me to make the most of my limited opportunities and play matches among those in leading positions. Although my main battleground this year will be in the JLPGA Step Up Tour, I will aim for the top and keep on making challenges to for a return to being a regular member of the JLPGA tour.

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.

Sponsoring "Math Immersion Classroom" to Decipher the World of the Future

The CTC Group considers developing the next generation of IT human resources to be an important initiative to pursue. As part of this belief, the group sponsored a series of feature ads called *Suugaku Taikan Kyoshitu* (Math Immersion Classroom) which appeared in the Asahi Shimbun newspaper on October 30, 2020 and March 28, 2021. The project was directed by science writer Kaoru Takeuchi. With computers now an everyday item and the use of AI becoming expected, there is more interest in mathematics which is fundamental to these. Here are two excerpts from among the more well-known theorems and formulas that were published in the advertisements.
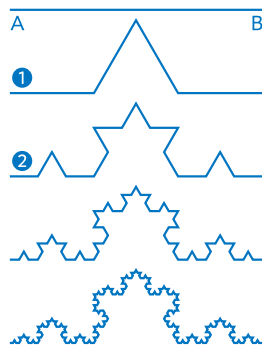
Appeared on October 30, 2020

Is one part the same shape as the whole?
[Fractals]

These are the figures we see if we try magnifying smaller parts of snow crystals, cumulonimbus clouds and ria coasts and they have the same shape as the whole, then a larger whole is formed by repeatedly reproducing those parts.

A   B
❶
❷

Math Immersion Challenge!

Draw a Koch curve (a fractal)!

First connect points A and B with a line, as shown at top right. Split that line into three lines of equal length and draw an equilateral triangle with the middle line as the base. After drawing it, erase the base and you will have a figure with four lines of equal length like (1). Then, repeat the same procedure as before with these four lines to get a figure like (2) with 16 equal parts. If you repeat the process again a number of times after that, the figure will become increasingly complex, and it will turn into a Koch curve.

It's the same shape!

Tip

Fractals are figures that look the same as the whole when one part is magnified. They were discovered by French mathematician Mandelbrot. When you magnify each individual broccoli floret, it also looks like the larger floret in its entirety.

Program now available online

Mathematicians were stumped for a long time
[Fermat's Last Theorem]

The meaning of this theorem is easy to understand, but it could not be proven for many years. When n is an integer 3 or greater, there are no combinations of (positive) integers for x, y, z that satisfy the equation $x^n + y^n = z^n$.

$$3^3 + 4^3 = 5^3$$
$$3^4 + 4^4 = 5^4$$
$$3^5 + 4^5 = 5^5$$

Math Immersion Challenge!

Try the problem that nobody could solve for over 300 years!

If n is 1, the equation involves addition of integers like $1^1 + 2^1 = 3^1$. If n is 2, the equation becomes $x^2 + y^2 = z^2$, then it can be demonstrated using the Pythagorean theorem and $3^2 + 4^2 = 5^2$ applies. So then, what happens if n is 3, 4, or 5? Try to apply a combination of integers that satisfy the Pythagorean theorem x=3, y=4, z=5, then calculate it out. Do you get $x^n + y^n = z^n$?

Try multiplying the same numbers three, four, and five times

5
4
3

Tip

About this theorem, Fermat apparently wrote "I have discovered a truly remarkable proof which this margin is too small to contain."

Answer now available online

https://www.asahi.com/ads/math/

The Asahi Shimbun Digital special website shows the answers to the quizzes in the newspapers, as well as examples of Python programming code related to the formulas, theorems, and definitions.

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https://www.ctcsp.co.jp/english/

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Best Engine

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