Best Engine

Vol. 14

Special Feature: Conversation | CTC approaches Generative AI

The Potential of Generative AI to Shape the Future of Business

ITOCHU Techno-Solutions Corporation

Best Engine

Vol. 14

Cover illustration by
Miki Mohri

CONTENTS

Version 5.0 of CTC

I would like to take this opportunity to go into more depth about "version 5.0 of CTC" which was mentioned in the previous issue. Version 5.0 of CTC refers to a new system of business management to address the evolution of technology and increasingly sophisticated and complex social issues while achieving continuous growth for CTC. With "CTC+++" (plus-plus-plus) as our keyword for transformation, we will shift from P&L-based (balance sheet-based) management which emphasizes short-term results, to what we call an intellectual capital business model that takes a medium- to long-term outlook.

Our efforts in version 5.0 of CTC will be centered on the following three focus areas.

The first of these is growing our intellectual capital. Seeing the four elements of human capital, organizational and structural capital, social capital, and information capital as the fundamental capital of our business, we will work to expand these not only quantitatively but also with a focus on the quality and composition appropriate for new business models and for the times.

Next is to maintain our innovative edge in terms of technology. To accomplish this, we will keep adding on to the technologies and expertise we have accumulated thus far in cloud, networks, maintenance, and services, and at the same time accelerate our research to incorporate key elements of future IT innovation such as AI and quantum computing into solutions as quickly as possible.

The third is to hone our unique skills in delivering practical, user-friendly solutions based on our in-depth understanding of technology. Leveraging our implementation capabilities forged in IT systems architecture along with our signature skills at combining, we will dedicate our energy to offering solutions that contribute to solving a broad range of issues—from our customers' business issues to social issues such as labor shortages and carbon neutrality.

Through these efforts, we will create sustainable growth cycles by achieving better financial results, and then re-investing them in growing our intellectual capital.

Recently, ITOCHU Corporation announced a tender offer for our shares, and we will become their wholly-owned subsidiary. However, the work we do and our relationships with our customers remain unchanged. If anything, I think teaming up with ITOCHU Corporation will actually enable us to take on a variety of new challenges that we could not have attempted on our own, and we should be able to turn many of the resulting achievements into solutions for our customers.

CTC will continue to evolve together with our customers as an IT partner going forward.

Ichiro Tsuge
President and CEO
ITOCHU-Techno Solutions Corporation

CTC approaches

Special Feature: Conversation

The Potential of Generative AI to Shape the Future of Business

Generative AI

With the emergence of ChatGPT, generative AI is now at everyone's fingertips. Here, CTC employees who have been using AI since its early days talk about the potential for AI business powered by technical knowledge, and about the timeline from the birth of generative AI to its path going forward.

Coverage and text by Yuki Kondo

Yutaka Terasawa
General Manager, AI Business Department, Digital Transformation Division
Business Innovation & Digital Transformation Group

Involved in AI-related business planning as a big data engineer and AI engineer, and also as a technology adviser to client companies. Planning the Asahiyaki Japanese pottery image generation project NeuCraft. Currently working on various service businesses primarily focused on generative AI and optimization.

Special Feature: Conversation 01

Great Opportunity as Generative AI Ushers In a New Era

Business in AI is on the verge of big changes with the emergence of generative AI.
As this plays out, what are CTC's aims and what moves is it making?
Yutaka Terasawa who plays a leading role in CTC's AI business and Hisatomo Tanaka
who conducts market and technological research on advanced technologies tackled this topic.

Two Turning Points in the Recent Evolution of AI

——First off, what duties do both of you currently handle?

Terasawa: I work in the AI Business Department, and as the name suggests, our main mission is to create business with AI. We are currently focusing on boosting recurring business to bring in earnings on an ongoing basis.

Tanaka: In the Advanced IT R&D Department, we are mainly active in three areas. One is our efforts in business development, including investigations and research on advanced technologies. Another is to manage in-house communities that drive new business creation by communicating about advanced technology trends and exchanging relevant information across organizational boundaries. We also work on incubation seeking to create new services and develop businesses capable of continuous growth. All three of these are important for us to make big things happen, and we are engaged in various initiatives to facilitate them.

——AI has changed significantly over the last decade or so. Which changes do each of you consider particularly significant?

Tanaka: I have been close to the epicenter of AI since being stationed in Silicon Valley around the year 2015. Various movements utilizing machine learning have taken shape during this time, but looking back on everything from then until now, I would say that the arrival of ChatGPT last year was a significant change. Movements in machine learning and deep learning until now have seemed to be occurring within a context of continuity. However, the series of disruptions accompanying the release of ChatGPT were a different type of shock.

Terasawa: I would say that "Google's cats" in 2012 was the first major turning point in the advancement of AI in recent years. The emergence of AI which was able to identify images of cats made people aware of the power of the deep learning method. The innovation in hardware that occurred with the evolution of GPUs around that same time also accelerated the

Hisatomo Tanaka
General Manager, Advanced IT R&D Department
CTO Office Advanced IT Strategy Division

Joined ITOCHU Techno-Solutions America, Inc. after previously working as an engineer handling telecom carriers. In addition to developing commercial products, oversaw business development primarily in the Open Compute Project and the Cloud Native field. Assumed current role after returning to Japan in 2023.

AI boom. The arrival of generative AI characterized by ChatGPT has indeed been a major change since then. Thus, business in AI seems to have changed greatly due to these two changes—deep learning and the emergence of generative AI.

Emergence of the "Real-Deal AI" that Anyone Can Use

——What was the shocking thing about ChatGPT from an expert's perspective?

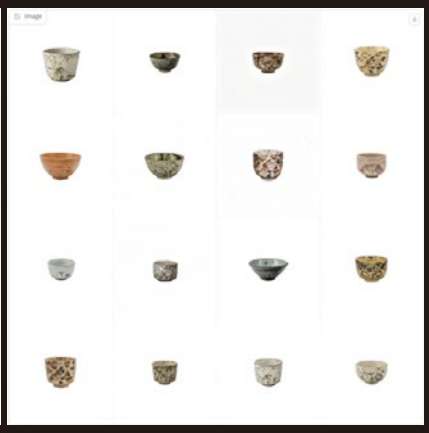
Terasawa: When processing language, conventional text analysis would comprehend the meaning of text through morphological analysis—in other words, classifying the parts of speech such as adjectives, nouns, and particles. On the other hand, ChatGPT composes sentences based solely on probability theory without noticing those parts of speech. For example, if it encounters certain words, it processes language simply by predicting what will come next. This has shown to be capable of smoothly generating text even for languages such as Japanese in which the subject nouns are frequently omitted. The fact that it was also able to execute that process with high accuracy was a surprise that greatly exceeded my expectations.

Tanaka: I think that another factor behind ChatGPT being able to generate this level of impact was that it came out in the form of an easy-to-use application. Even if you already knew to a certain extent about the large language model (LLM) mechanism powering ChatGPT, what was revolutionary was that it came in a familiar form capable of conversation, the way a typical person would imagine AI to be. Until not too long ago, when people would talk about AI, the prevailing attitude was a sort of real-world perception that it could not actually do much. Then, this read-deal AI appeared right in front of us. It was likely the first time that many people ever felt that AI could be helpful for them.

——There have been various debates about the advantages and disadvantages of generative AI. What particular aspects are people focusing on?

Terasawa: When people try to rely on ChatGPT for activities such as planning, it always generates the same type of thing. At this point in time, generative AI lacks creativity and novelty. It only creates things that resemble past information. Many companies tried for a while to use image-creating generative AI to design their product packages, and this is probably why hardly any of those efforts were successful. It should only be used in a support capacity. I think it would be a disadvantage if humans were to rely on it completely and stop using their brains. On the other hand, version upgrades to generative AI are still coming out one after another. For example, one that was released will flesh out a rough sketch that you draw if you feed it into the AI. With that type of generative AI, humans can use their brains for the initial stages and have the AI support them in the stages of fleshing things out into tangible forms. If you think about it as having a complementary relationship with humans, major advantages can be gained in terms of business, and I think we are getting closer to a situation where we can truly utilize that.

Tanaka: Generative AI offers a major advantage when you want to create content that is more versatile. For example, when you want to change a composition you've written to make it palatable to lots more people, entrust generative AI with refining it and you can harness tremendous capabilities. In a certain sense, this is because generative AI creates expressions that could be considered the greatest summation



NeuCraft

Based on our desire to use the latest technology to shine a spotlight on traditional craftwork to reintroduce its magnificence to the masses, CTC is engaged in a project called NeuCraft using AI in the field of traditional craftwork. As the first verification testing effort of this project, we are building an AI model to generate new Asahiyaki designs through a three-company joint effort with Qosmo, Inc. and with Asahigama, makers of Kyoto's traditional Asahiyaki Japanese pottery which has a history dating back roughly 400 years. Combining the aesthetic sense of artisans with AI technology, we are co-creating the future landscape of traditional craftwork.

https://neucraft.ai

of the humans alive during this era. The same goes for programs. Generative AI is probably very useful for making the source code that you wrote yourself more versatile and easy-maintenance.

To Continue Creating Our Own Unique Value

——We imagine that generative AI will have more than a small impact on CTC's business. Please share with us what you are each aware of on the business side.

Tanaka: As we see things from the customer's perspective, currently the primary focus of CTC is to support our customers in achieving their aims and provide useful solutions to meet the challenges they face. This type of work will of course remain important, but rather than just supporting customers, in the future I think it will be increasingly important to provide experience-based assets built through efforts to tackle the business challenges that we ourselves face. When we take the leading role ourselves to create something, we select relatively pinpointed options that focus on our own distinctive characteristics rather than limiting ourselves to highly universal one-size-fits-all options that seem applicable to other companies. That is where the value that integrates the "why, what, and how" lies. In this era of widespread generative AI, I think the degree to which we can accumulate that type of experience and convert it into business models will be key to continuously generating the value that we alone can offer.

Terasawa: The emergence of generative AI will undoubtedly compress the development processes for efforts such as creating programs. What engineers should be doing will also change accordingly. It will be important to take a more panoramic viewpoint. For example, we often hear discussions about whether or not ChatGPT should be used in educational settings. Assuming that it should, the question then becomes whether or not you can think of a beneficial way to use it. One example would be to work out how to use generative AI to teach the addition problem of 3 + 2 in elementary school. If you could create generative AI that only shows the thought process without giving away the answer, would that not be useful in an educational setting? And what sort of tuning should be applied to existing LLMs to create that? Then, if that type of generative AI were to be released, how would teachers' jobs change? Engineers who can make new proposals after imagining things out to that extent will be increasingly important going forward.

Tanaka: This really makes me realize that we need to show the extent to which we can confront our own challenges on a daily basis and repeat the trial-and-error process.

Extensive Research and Testing to Offer the Best Services

——You have helped us realize that business in AI is now truly in the midst of a major transition period. As that unfolds, what are some specific examples of the types of services and products that CTC is currently working to develop?

Tanaka: The CTC Group is working on numerous AI-related initiatives. Among these, one that we are working on in our department is business to develop products from CTC's own

unique perspective. In a project that we call PITWALL, we are creating cloud services that can help resolve issues at systems development and operations worksites. Various management tools are in use at the development and operations sites of each company, and while these individual tools are becoming more sophisticated, they are also manually switched over whenever critical incidents occur and are fraught with personnel dependency issues. These include issues with productivity and prolonged time taken to handle incidents as multiple departments need to communicate with each other, in addition to inconsistencies between the individuals who handle the incidents and the inability to handle them without a certain number of experts on hand. To address this, we are challenging ourselves in technology development to create situations where the necessary information can be accessed in one click under various circumstances. In our initiatives going forward, we plan to use deep learning in analyzing information and then employ generative AI in the areas where those analysis results connect to people.

Terasawa: In the AI Business Department, we are particularly focusing on the various generative AI-related services that we launched in 2023. The Generative AI Advisory Service which we launched in May is a service that meets customers' needs and supports them in various forms for everything from generative AI-related basic considerations to implementations. Then in August, we launched the AOAI Environment-Building Service. Using the Azure OpenAI Service, a generative AI service provided by Microsoft, this service builds generative AI environments that are consistent with each company's distinct objectives. Currently, we have an overwhelming number of requests for "ChatGPT-like generative AI that deeply understands the nuances of our company." For requests such as "We want to create an expert-like computer that can answer various questions from employees" and "We want generative AI that can accurately respond to all types of inquiries from general consumers," we tune aspects such as the search function of ChatGPT and train it with the content of internal documents to build company-specific generative AI environments. That is what this service is all about. We have conducted numerous verification tests to this point, and in addition to establishing a system that can meet wide-ranging needs, we are also taking every possible security precaution. Right now our daily efforts are mainly focused on handling these services. In doing so, our own knowledge of generative AI grows more extensive with each passing day.

——What sort of progression do you envision for this service going forward?

Terasawa: The way things are now, we would not be able to provide special offerings like the ChatGPT I mentioned before which does not give away the answers. In order to create that, we need to utilize resources such as open-source LLMs other than ChatGPT, tune them ourselves, and re-train them. We are also doing our utmost to get started on building services to meet needs that go a step further.

Tanaka: We need to thoroughly comprehend what the best choices currently are and make the best proposals to our customers. We and also Mr. Terasawa's team are engaged in various efforts to that end, such as creating our own sets of questions in Japanese and testing out the accuracy and natural quality of the responses, in order to understand the new characteristics of generative AI that keep appearing. ChatGPT has a massive presence at this point in time, but that might not necessarily be the case in the future. As we utilize what is best right now and properly link it to business, we will figure out how we should move forward by tackling our own issues and striving to evolve ourselves toward being able to make the best proposals in combination with experience-based assets.

Emergence of Generative AI as an Opportunity for Rapid Progress

——In closing, please remind us of CTC's mission and the role it should play in this age of the dawning of generative AI.

Tanaka: Normally, a new technology first goes into use in a particular industry, and then achieves wider usage by gradually spreading from there. However, in the case of generative AI, it entered all of the industries all at once. In other words, it is no longer enough to say "Here is a new technology, please give it a try" the way we used to. Instead, we must show that we ourselves are using generative AI and creating new value with it. CTC's strength is now being tested, and I think this also represents an opportunity to make rapid progress.

Terasawa: I agree with Mr. Tanaka. Generative AI truly was upon us all at once. At the same time, we were early movers, so I am confident that we can continue being a leader in this field. Please stay tuned to see what kind of services we create.

Masayuki Arima
Associate Principal
CTO Office Advanced IT Strategy Division

Specializes in the areas of databases, network programming, and controls. After being involved in development in the area of telecom carriers, he has been working on developing new businesses and services. Serving in current role since 2019.

Special Feature: Conversation 02

Delving into the Background and Technologies Behind the Emergences of Generative AI and ChatGPT

In what way did generative AI evolve leading up to the emergence of ChatGPT?
We spoke to Masayuki Arima who conducts trend surveys, research,
and also communicates on the subject of advanced technologies,
and Yoshitami Fujisawa who works in AI business development,
We asked them what AI technologies people should know about.

Involvement with AI from Different Areas of Specialization

——I understand that, respectively, the two of you are involved in AI from the perspective of proposing technology strategies and the perspective of planning and developing services. Please begin by describing each of your relationships with AI until now.

Arima: My original area of specialization was databases, but then I served as project manager and architect for developing services such as NTT Docomo's i-mode and i-Channel. After that, I worked on planning and development for CTC's services such as IoT Restroom, but in terms of AI, I had only gone so far as using existing models. Since ChatGPT was announced, I have been doing surveys and research primarily on generative AI.

Fujisawa: Originally, I specialized in dealing with Linux. Doing so, I had a chance to see a broad range of technologies associated with infrastructure, including middleware and databases. Then, when deep learning emerged, I got involved in AI from relatively early on. That includes being involved in AI development environments and launches of AI operations services. At first, I mainly thought about what types of frameworks and environments there should be to get AI to work better. After that, I became involved in planning and development for analytics services via AI.

Progression of Generative AI and the Advent of ChatGPT

——ChatGPT has had quite a significant impact on society, but people might not know what kind of background was behind its creation. What were the events leading up to the arrival of generative AI and ChatGPT?

Yoshitami Fujisawa
Manager, AI Business Department
Digital Transformation Division
Business Innovation & Digital Transformation Group

Now involved in AI business after previously working as an expert in functions such as analyzing middleware and databases including Linux/OSS. He had worked on planning and developing services to build development environments for AI and now does the same for generative AI-related services while also engaged in areas such as AI optimization and automation.

Arima: The concept of AI itself had already been around for decades, but I think the chain of evolutions leading up to now has taken place over the last 10 years or so. One particularly major turning point was "Google's cats" in 2012. It was 2015 when the "Go" board game software Alpha Go was able to beat the world's best Go player, leading to more narratives comparing AI to humans. Then in 2017, an LLM called Transformer which would end up being the foundation for ChatGPT was released. LLMs advanced very quickly after that, leading up to the November 2022 release of ChatGPT.

Fujisawa: LLMs are models created using deep learning technology in natural language processing (NLP), the field of processing human language via computer. NLP also has a long history, and if you consider how LLMs also came about as an extension of NLP, they can also be considered to have a long history.

——That may be true. However, ChatGPT brought about a shock that transcended the path of AI evolution until now.

Arima: It was also quite a shock to me. At the time, as Zoom had become widespread in the context of the pandemic, I had been thinking about services through AI avatars to facilitate smoother online communication. Then ChatGPT arrived, and I thought, "This is incredible." Up to then, although it was AI, it still had set scenarios in conversations. Fundamentally, if you said a particular type of thing, it was predetermined that you would get a particular type of response. Then, it was as if AI that is truly capable of natural conversation like HAL9000 in the movie *2001: A Space Odyssey* suddenly arrived in real life. That might have been the biggest shock I have ever experienced in the nearly 30 years that I've been involved with IT until now. Since then, I have shifted the majority of my work to being ChatGPT-related.

Fujisawa: ChatGPT was also a huge shock from my perspective, but I had already been working with generative AI since long before that. Generative AI refers to all AI in general that is able to create new content by learning data. It can generate many different types of content including images, videos, music, text, and program code, among which ChatGPT is one that specializes in text.

What set the stage for generative AI was a technology called Generative Adversarial Networks (GANs). GANs are one type of algorithm used in "unsupervised learning" that creates training data on its own. It can create virtual data that resembles but is only slightly different from the actual data, and it was used for purposes such as gaining data volume when there was insufficient data to train AI. That was where the word "generative" came from.

We are also using StyleGAN in the NeuCraft* project that we are working on. NeuCraft is a project to generate new pottery designs that potters would not have thought of but still retain the characteristics of the Asahiyaki style of pottery from Kyoto which the AI emulates, by photographing 1,000 past works of Asahiyaki pottery and training AI with the image data, then have the potters use the designs as inspiration for creating their next works. In the market as well, the potential to be able to use generative AI for business has grown at an accelerated rate over the past few years. The events leading up to ChatGPT after the arrival of Transformer are as Mr. Arima described. We know that ChatGPT is also a model based on statistics, but features such as the data volume to be able to do what it does, its tuning technology, and its technology to output language in natural form clearly

*Information about NueCraft is shown on page 8.

differentiate it from anything that came before. Previously, it was common knowledge that AI could not accomplish anything truly innovative or creative, but the shock happening now has fully shaken that image.

Interfaces and Higher Number of Parameters are Key

——Please share more details about the technology in ChatGPT. How are GPT-3 and GPT-4 related?

Fujisawa: OpenAI's GPT series began with GPT-1 in 2018 and is now up to GPT-4. Among those, ChatGPT is built on GPT-3.5, and its drastic increase in accuracy from the times of GPT-3 which came out in 2020 has been a topic of conversation. One reason for the jump was the evolution of the hardware—in other words, the evolution of GPUs. There is an element called "number of parameters" that determines the performance of generative AI, and it became possible to greatly increase this number. GPT-2 had 1.5 billion parameters, but GPT-3 has 175 billion. However, its successor GPT-3.5, which is ChatGPT, has 355 billion. (GPT-4 which requires a paid subscription has over 500 billion).

——What sort of indicator is number of parameters?

Arima: In 2020, a paper released by Open AI pointed out three elements that determine the performance of LLMs. There were data volume, computational intensiveness, and number of parameters. Computational intensiveness means the volume of work that a computer can process, while data volume refers to the amount of data that the computer was trained with. Then, number of parameters is a number that could be compared to the number of neurons (nerve cells) in the human brain. As humans grow from children to adults, their neurons increase in number. Along with that increase, the processing and transmission of information within their brains becomes more sophisticated, enabling them to think about more complex things. This is similar to how LLMs are able to handle more complex information if they have larger numbers of parameters. However, more resources are required for computations when the number of parameters increases, so the hardware must be high-performance. That is why evolution in hardware is also necessary for LLMs to evolve.

On the other hand, more than the increase in number of parameters, we can probably say that the reason why ChatGPT was able shock the world was that it was made so that anyone could use it thanks to the addition of a conversational interface. Up until GPT-3, it had been hard to use in services geared toward general users.

Fujisawa: While I cannot speak with certainty about in-house implementations, I think conversational AI has multiple functions that are different, and it executes the optimal flow with a focus on the conversation. I imagine it was ChatGPT that integrated these and built them into an interface.

Is the Emergence of AI Equal to Humans Not Far Off?

——What sort of progression do you foresee in generative AI going forward, or how far do you think it will evolve?

Arima: What I think will happen relatively soon is the emergence of multimodal AI, in other words, generative AI that deals not only with language but also images and sounds in combination. People will be able to have the interactions they currently have with ChatGPT through cameras and microphones. Once that happens, the possibilities of what can be done will greatly expand.

Fujisawa: AI that has the same sensibilities and thought patterns as humans and can perform intellectual work is called Artificial General Intelligence (AGI), but I think it will take some time for AGI fitting this definition to emerge. At the current stage, it can only generate new things based on past experiences and data. Its accuracy will certainly continue to improve, but some sort of breakthrough will still need to occur in order to achieve anything truly groundbreaking. Perhaps integration with quantum computers might be needed for the next big evolution to occur.

Arima: The words that we humans produce are generally based on the knowledge and experience that the individual producing them has acquired up to that point. In other words, we infer from our past history, from which we deduce the next conversation. That being the case, the mechanisms of human thought processes are probably not all that different from those of AI. Furthermore, AI reasons and produces output based on tens or even hundreds of millions of times more data than a human can acquire through conversation and learning over the course of a lifetime. Thinking about it that way, I get the feeling that if the number of parameters continues to increase the way it is going now, AI could eventually be able to talk, think, and create things just like humans at some

point—even if its current mechanisms stay the same.

Fujisawa: Indeed, if the accuracy keeps improving, we could reach a point of no longer being able to differentiate what humans create from what AI creates. However, even in that case, there will still be a difference between humans and AI in terms of having free will. I think that point is very significant.

Accept Change and Harness CTC's Uniqueness

——In closing, please summarize your thoughts on the current situation with the emergence of generative AI, and also your outlook on the future.

Arima: I see the current situation with generative AI as highly positive. As our brand slogan "Challenging Tomorrow's Changes" indicates, I think that our role is to continue challenging ourselves to create a better future after accepting the new changes as they occur. However, the work that we IT experts do will inevitably change. Until now, you could say that a large part of our role has been as interpreters connecting computers with humans, but ChatGPT can now do that part more efficiently. That being the case, it will be more important than ever for us to establish a closer presence with our customers—to understand their visions and what they want to accomplish. I feel like this new challenge definitely represents an excellent growth opportunity for us as professionals.

Fujisawa: Although generative AI can undoubtedly handle many types of work efficiently, on the other hand, I am worried that if we use it too heavily, all of the world's products and services could end up becoming uniform and dull. As an example, many students who want to join our company are now using AI on their resumes, and now the information on them is starting to all look similar. The person in charge of hiring now needs to have a good eye in order to identify those who we would really want to hire. The same applies to the field of IT. As generative AI becomes more widespread, how can we differentiate ourselves and better harness CTC's uniqueness? Not only will our technology be tested, but the very way we operate will itself be put to the test. While there are many things that should be done, I think times like these are particularly suited for us to be able to harness even more of CTC's strengths.

Basic terminology for understanding generative AI

Natural language processing (NLP)

Technology enabling a computer to process human language as it is spoken and written—referred to as natural language. Its history began with explorations into the potential of having computers translate languages in the 1940s and has progressed from the 1990s onward as the performance of computers has improved among other factors.

Morphological analysis

One of the fundamental technologies of natural language processing, morphological analysis distinguishes the parts of speech and the conjugations and inflections of words. "Morphemes" are the smallest meaningful units of a linguistic expression. This type of analysis is also used in situations such as breaking down words entered in search engines into the smallest possible units.

Large language models (LLMs)

In natural language processing technologies, mechanisms to assign larger probabilities to more natural word sequences and smaller probabilities to unnatural ones are called language models. Amongst these, those models with a number of parameters (see explanation below) larger than a set number are typically called large language models (LLMs).

Number of parameters

This is the number of adjustable variables (= parameters) needed to be able to produce an accurate result when training AI models with data. It has the two elements of weight and bias. This number is one important indicator for understanding the performance of AI.

Deep learning

This technology is one method for a computer to learn rules and other aspects underlying the data (=machine learning). It has been a driving force behind the advancements of AI in recent years. Deep learning is characterized by improving the accuracy of data recognition by analyzing data in a multi-layered structure.

Tuning

This refers to newly training AI with a dataset that matches an objective in order to adapt existing AI to a specified task. In addition to specifying what type of data to train with, it is also important to specify various types of variables (=hyperparameters) that determine how to perform the training.

Multimodal AI

This AI is capable of obtaining information from multiple types of data including image, text, audio, video, and sensor information, and processing it in combination. The current AI which only processes one type of data is called "single modal AI."

IT Terminology

This issue's theme is...

【 Web 4.0 】

Recently, we have started hearing the term "Web 4.0" pertaining to web technologies and how they are used. However, its meaning has not really been clearly defined yet. Regardless of that, its meaning will likely take shape since it has now come into regular conversational use. Through the term "Web 4.0" we will consider the internet's path to this point along with its future lying ahead.

Text by Yuki Kondo

Proof That Now Is a Time of Major Change?

The term "Web 3.0" has probably only become widely known over the past few years. Even this term has had a chaotic existence as will be described later, and its meaning is still not fully known. Despite that, we have already begun hearing the term "Web 4.0." That could mean that the world of the web really is in the middle of massive changes.

How exactly is the state of the web and internet about to change compared to when the terms Web 1.0, Web 2.0, and Web 3.0 emerged? And what does Web 4.0 specifically mean? Here we will explore that while looking back on the path the internet has taken to this point.

From the Dawn of the Internet to the Advent of Interactivity

The dawn of the internet is considered to be the period from the 1990s through the early 2000s. The term that referred to the mainstream way that the web functioned at that time was Web 1.0.

Fundamentally, internet users at the time were able to access the internet almost exclusively through character information on simple homepages. Nearly all users were only able to receive information from those who were communicating it. Since connection speeds and computer processing speeds at the time were slow, images and videos with large data volumes were difficult to use online.

However, that situation gradually began to change starting around the mid-2000s. Services such as social media platforms and blogs emerged, and all internet users gained the ability to put information online themselves. As a result, volumes of information on the internet grew explosively, while search engines also developed and the speeds of internet connections and computer processing also increased, making it possible to handle high volumes of data such as videos online. This was the beginning of the age in which anyone could receive all kinds of information and at the same time also send information out.

In other words, this was the age in which online interactivity was born. The impact that the internet had on society grew exponentially. That was the stage that Web 2.0 refers to.

The arrival of the Web 2.0 age expanded the internet's possibilities at an unprecedented level. However, everyone being able to put out information did not necessarily make the internet a democratic realm. That was because it was the age in which tech giants referred to collectively using terms

such as GAFAM[*1] began providing large numbers of services exclusively, causing an overconcentration of personal information from around the world to accumulate at these companies.

Using that information, the companies developed services and technologies that offered even greater convenience and built up increasingly larger concentrations of information and capital. Thus, as these companies gained an outsized influence, people began to have new concerns.

Web 3.0 Seeks Decentralization of Information

It was with this backdrop that Web 3.0 emerged. It is considered a concept that advocated decentralizing information that had been overconcentrated in order to change the nature of the internet which was trending toward extreme centralization. It was blockchain technology that made it possible to incorporate this concept into the actual internet.

Blockchain is a technology that enables the devices of multiple internet-connected users to distribute and control information. Known for making it extremely difficult to tamper with information since the histories of every type of transaction are recorded in the devices of multiple users, Blockchain is the technology that supports virtual currencies (cryptocurrencies) such as Bitcoin.

The age of Web 2.0 in which GAFAM wields outsized influence still continues today. In that context, the gradual spread of Web 3.0-type services is incrementally starting to change the way the internet exists. That might even be what we could call the current state of the internet.

However, there is still some confusion about the term "Web 3.0" itself. That is because Web 3.0 actually has another meaning as well. The meaning of Web 3.0 mentioned above is what was advocated in 2014 by Gavin Wood, a co-founder of a cryptocurrency called Ethereum[*2]. However, computer scientist Tim Berners-Lee who is also credited as the "inventor of the World Wide Web" had already separately proposed the term "Web 3.0" before that.

The latter meaning of Web 3.0 referred to the stage of the internet in which computers themselves could interpret meanings from data instead of simply treating it as blocks of alphanumeric characters[*3]. This Web 3.0 was originally to continue the progression from Web 1.0 and Web 2.0, but when people began using the term "Web 3.0" with the meaning that focuses on decentralization, it seems that the terms started getting confused for each other, thus making it increasingly harder to understand what Web 3.0 really meant. However, if we look at what has been in the media recently, it seems that usage of the term "Web 3.0" is often considered to be the concept focusing on decentralization.

Whichever it is, as the confusion about Web 3.0 continues, further evolution of the web and internet has now brought us the concept of Web 4.0.

Web 4.0 Is the Phase of Coexistence between Man and Machine

While the keyword "interactivity" characterized Web 2.0 and "decentralized" described Web 3.0, the word often used for Web 4.0 is "symbiotic," or in other words, coexistence. This refers to coexistence between man and machine. It may yet be unclear what exactly Web 4.0 is, but more people seem to have a shared image of what it might be. And it seems that AI will indeed be the technology playing the largest role in bringing it to life.

Coexistence between man and machine, plus AI. When many people hear that, ChatGPT is what most likely pops into their minds.

ChatGPT is an AI-powered chat service released by American company OpenAI in November 2022. More than a few of our readers have likely been astonished at its ability to accurately answer any type of question instantly in natural language. It seems certain that the emergence of this so-called "generative AI" will significantly change our future world.

ChatGPT is probably the first "machine" to give us a tangible image of what coexistence between man and machine might look like. When we see that natural give-and-take, it makes us ponder things such as what human thought really is, and whether the mechanisms of our thought processes as humans are really not so different from those of ChatGPT after all.

As we coexist with machines in the age of Web 4.0 that will soon be upon us, we may be confronted like never before with the question of what humans really are.

*1 An acronym for the five American tech giants Google, Amazon, Facebook (now Meta), Apple, and Microsoft. Some are also saying that MATANA (Microsoft, Amazon, Tesla, Alphabet, NVIDIA, Apple) will become dominant in the future.

*2 The concept advocated by Gavin Wood was originally described as "Web 3" (web three). Therefore, when Web 3 is written, it normally refers to this concept. On the other hand, when written as Web 3.0, it could likely be referring to either concept.

*3 Tim Berners-Lee called this type of framework in which computers themselves interpret the meaning of data and process it accordingly "semantic web" and it is the central element comprising his concept of Web 3.0.

Value Chain Evolution through Partnerships between CTC and the Digital Business Group

Business places have growing needs for digital transformation (DX) focused on transforming business models through the use of IT and digital technologies. In order to meet these needs, providers of IT services now need to offer sophisticated, high-added value services that provide consulting, marketing, business process outsourcing (BPO), and other services in combination. In addition to the Digital Group Strategy introduced in the previous issue of Best Engine, ITOCHU Corporation is extending its Digital Value Chain by partnering more closely with CTC and also joining forces with other companies that have functions that meet customers' increasingly sophisticated needs.

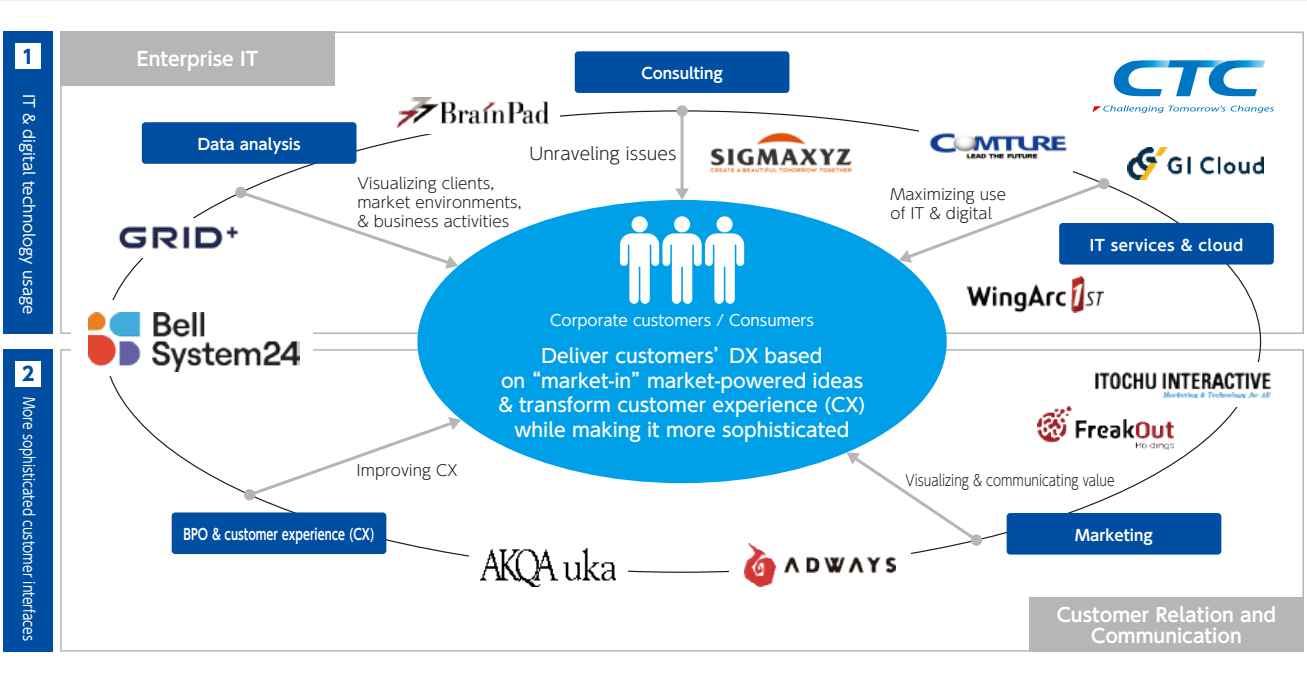
Market Environment and Structural Changes in the IT & Digital Industries

Continuous growth is expected in Japan's domestic IT services market. In addition to needs for conventional in-house IT systems implementations spearheaded by information systems departments, the market has increasing needs for DX that focuses on transforming business models through the use of IT and digital technology as a business strategy throughout all parts of a company—from business sites to corporate planning and marketing departments and more. Aside from the conventional method of developing systems according to customers' business requirements, in SaaS-type applications that standardize business operations, the method of developing systems to accommodate customers' business operations is starting to become more widespread. These types of DX needs are increasing, or it could be that the functions that customers require of vendors along with cloud usage are expanding beyond IT services such as system design, architecture, and implementation. They want integrated services that combine functions such as consulting, data analysis, business design, marketing, operations improvement, and BPO.

Building a Digital Value Chain and Delivering Higher Added Value

Jointly with CTC, ITOCHU Corporation is actively working on capital and business alliances with multiple companies that have functions such as consulting, data analysis, business design, marketing, operations improvement, and BPO (Digital Business Group). We will construct a Digital Value Chain capable of meeting customers' diverse DX needs and expand the range of features provided while working cooperatively with CTC and the Digital Business Group.

Combining CTC's strengths with the features owned in the Digital Business Group, the Digital Value Chain will seamlessly integrate everything from upstream processes from identifying, compiling, and analyzing customers' issues and offering solutions based on data analysis, to downstream processes such as marketing initiatives and IT systems maintenance, and



Kazushige Miyawaki

Deputy General Manager
Information Technology Business Department
ICT Division
ICT & Financial Business Company
ITOCHU Corporation

implementation of solutions that incorporate BPO. Doing so, we will deliver advanced, high-value-added services that have the customer's perspective in mind

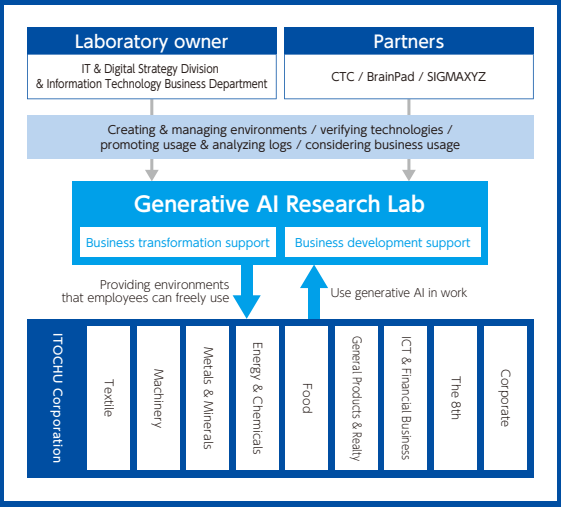
Providing New Added Value that Meets Customers' DX Needs

Until now, ITOCHU Corporation has worked on DX at the business sites of each group company while partnering with CTC and the Digital Business Group. We believe that we can help customers to perform their DX projects nimbly and flexibly by applying and incorporating the DX-related knowledge and expertise accumulated in the lifestyle and consumption-related segment which is ITOCHU Corporation's strength. Together with CTC and the Digital Business Group, we will support our customers even beyond the lifestyle and consumption-related segment, utilizing our broad, extensive business network in Japan and the world to address the DX needs of customers in various industries, as a partner that supports their business transformations through the usage of IT and digital solutions.

Case Study 1 Establishing a Generative AI Research Lab

In May of this year, CTC, ITOCHU Corporation, BrainPad Inc, and SIGMAXYZ Holdings Inc. jointly launched the four-company Generative AI Research Lab project to transform companies' business and support new business development using generative AI such as ChatGPT. An environment to enable the use of ChatGPT was rolled out in July to ITOCHU Corporation employees after securing the confidentiality of their information, and after around three weeks there are now over 1,000 users.

Going forward, we will consider linking this environment with business systems, expanding it to companies in the ITOCHU Group, and using it to offer the optimal products and services that match customers' attributes in the lifestyle and consumption-related segment and for other initiatives that make our business more competitive. We will continue accumulating more knowledge and expertise by stepping up our DX efforts through more such collaborations with CTC and companies in the Digital Business Group.



Case Study 2 Partnerships between CTC and the Digital Business Group in SAP Implementation

CTC has been working in partnership with SIGMAXYZ, one of the companies in the Digital Business Group, on SAP implementations through the Fit-to-Standard method which has been capturing attention in recent years. In conventional implementations via Fit-to-Gap, areas where the system and business operations cannot integrate are identified (= gap). Since the system is made to accommodate business operations in order to eliminate this gap, the cost and time required for implementations have been pointed out as problems with this approach, in addition to the extreme difficulty of version upgrades after implementation. On the other hand, in Fit-to-Standard which resolves these issues, the business processes and operations rules must be changed to eliminate this gap.

With SIGMAXYZ taking care of organizing and changing these business processes in addition to change management, and CTC's solution Figues handling the integration of the peripheral systems, implementations are proceeding for customers in the manufacturing and transport industries.

ITOCHU Corporation is also bolstering its organizational structure to support customers' cloud migration and data usage and analysis, entering into a capital and business alliance in June of this year with Comture Corporation which has strength in systems development in the area of cloud.

Generative AI Trends in the US

Koki Takahashi
Director, Business Development
ITOCHU Techno-Solutions America, Inc.

Researching the latest North American IT trends in Silicon Valley and sharing them with Japan since 2019. He handles development of commercial products and business development.

Interest in Generative AI is Quickly Ramping Up

Ever since OpenAI released ChatGPT in November 2022, the world's attention has been increasingly focused on generative AI. Although investment in startup companies declined in 2022, investment in AI-related companies showed exceptionally large growth, indicating just how high the level of interest is. Data reports show that around 30% of companies are already using generative AI in their business operations. Even companies that were not directly linked to AI are now converting business to generative AI, and cases of "generative AI" used as a keyword on the websites of Silicon Valley startups are quickly increasing.

New Form of Providing Software

One characteristic worth mentioning about AI is that it is released through open source software (OSS). For example, image generation AI "Stable Diffusion" developed by Stability AI is provided through OSS. Commercial open-source software (COSS) is garnering attention in the OSS field. SaaS is currently the mainstream form in which software is provided, but people say that it will be replaced by COSS in the future.

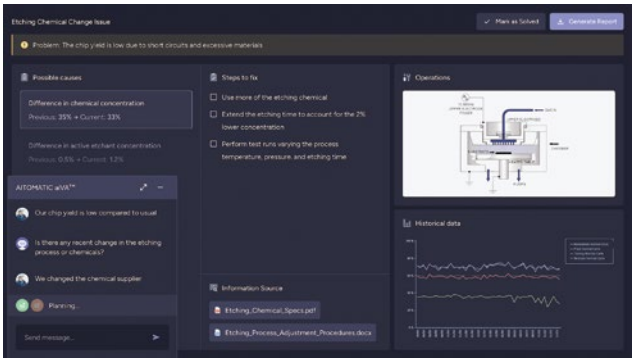
In March 2023, CTC invested in OSS Capital which is a company that specializes in COSS. Utilizing their in-depth COSS knowledge and professional network, we are exploring and digging deeper into COSS which shows great potential for the future, starting with generative AI. We have already begun working together with Stability AI, in addition to MindsDb which provides an MLOps operations platform for machine learning, and Aitomatic which deals with AI for expert knowledge use.

LLMs and SLMs

In generative AI, large language models (LLMs) such as OpenAI's GPT, Google's Bard, and Meta's LLaMA are prominent. Anthropic's Claude in particular which champions a method called "Constitutional AI" has captured attention as enterprise AI with a high level of safety. On the other hand, one issue with LLMs is that they are predicated on learning from vast amounts of data, and thus consume large volumes of machine resources and electric power. Since LLMs prioritize how natural the responses are to typical questions, they are also poorly suited for the specialized issues that are particular to enterprises.

Small language models (SLMs) were developed for the purpose of resolving these issues. Aitomatic is also a company in the SLM business. They offer their small specialist model (SSM) via OSS. Utilizing Aitomatic's technology, CTC aims to provide generative AI that can leverage industry-specific knowledge along with companies' in-house expertise.

Expectations have been high for the use of Generative AI in various business settings since its emergence as a new technology, but using it to make business operations more efficient and bolster performance is not actually easy. CTC is working to deliver more efficient and effective solutions to the challenges enterprises face by accumulating and providing knowledge and expertise gained through experience in systems architecture.



Screenshot of Aitomatic Industrial Virtual Advisor (aiVATM) provided by Aitomatic. Here it is investigating the cause of a problem occurring in a production process using the aiVATM chat feature.

News Pickup

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

Quantum Computers x Cloud

Launched CUVIC for Quantum Service to Support Quantum Computing Use

We launched CUVIC for Quantum ("CUVIC-Q"), a service to support the usage of quantum computing. To start with, we are providing Qiskit Runtime—a service for developing quantum programs that can be used on IBM Cloud. In the future, we will support our customers' business by clustering multiple quantum computers and also by working on developing platforms that can properly utilize quantum computing resources, as well as managed services, human resource development services, and other services, while establishing environments in which cloud-based quantum computers can be used.

DX x Cloud x BI / DWH

First Release in Japan of the Alation Data Catalog by Alation

We signed the first distributor agreement in Japan for American company Alation and domestically launched their data catalog product Alation Data Catalog. The catalog helps to make the processes involved in data retrieval more efficient by linking internal and external systems and cloud services to tabulate the data in a company. It automatically gathers data, including metadata such as the location and creator of the data, and displays it sorted into categories. It can also judge the reliability of search results through various forms of metadata, and makes data retrieval more efficient by displaying related data, creator names, and other information.

GX x Simulations x AI

Providing a Digital Twin Solution for Green Transformation (GX) in Manufacturing

We launched the Production Activities Optimization Service that recreates factory environments in computers, runs simulations, and finds ways to reduce greenhouse gas emissions, power consumption, and other environment-related parameters in production. This service can lead the way toward formulating designs and production schedules of optimal production lines that reduce environmental impact without sacrificing production efficiency. Through partnership with BrainPad Inc., we have also launched the Dispatch & Delivery Optimization Service for the transport industry, to optimize delivery routes and reduce greenhouse gas emissions in logistics.

DX x BI / DWH

Launched a Service to Tap into Latent Needs for Conversions to Digital

We launched the service Snowflake Prototyping with D-Native that taps into latent needs for conversions to digital. This service listens to customers express their internal and external challenges and the topics they aim to address, based on which it leverages data to convert their business operations to digital. Combining the cloud data platform of Snowflake with the D-Native assistance service provided by CTC that supports the entire life cycle of data usage, this service offers a full suite of processes from data collection to visualization.

DX x Human Resource Development

CTC Technology Launched Diagnostic Service for Basic DX Capabilities

CTC Technology, which handles IT systems operations and maintenance services and training business, has launched a basic DX capabilities diagnostic service for the development of companies' digital personnel. Through an online test with 50 questions overall, the service ascertains employees' IT knowledge and the basic skills they require for DX, and proposes training courses according to the diagnostic results. It offers both on-site and online courses, plus reviewable video services. In addition to ingraining knowledge, the service also supports the acquisition of skills for business transformation and new business creation at companies.

Science & Engineering x Simulations

Bolstering Joint Efforts with US Company QuesTek to Expand Business in Materials Informatics

Bolstering our partnership with business with QuesTek which owns advanced technologies in materials development, we launched a new materials design consulting service from QuesTek Japan K.K., a joint venture between CTC and QuesTek. Through this service that leverages QuesTek's cloud-based materials design platform ICMD® which includes proprietary prediction technology, we are supporting the development of new materials that satisfy performance requirements even with minimal data. With CTC's expertise in fields such as alloy design and material processing as a foundation, QuesTek Japan and CTC will help customers advance their materials development.

Please visit the link below for further details (Japanese only).

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

Golf Digest Editorial

The Style Taken by a Prestigious Golf Course that Enchants Golfers of the World

Pine Valley Golf Club | Commentary by Taizo Kawata

Why is “Pine Valley” Considered the World’s Best Golf Course?

The Pine Valley Golf Club has dominated the number one spot for many years ever since the world ranking of golf courses began. It is a course that is worthy of its prestigious name, and its traditions are alive and well.

When one talks about the virtues of the Pine Valley Golf Club (Pine Valley GC) course, it is always associated with the title of the “world’s best.” In the late 1970s, two major U.S. golf magazines (Golf Digest and Golf Magazine) began a ranking entitled “America’s 100 Greatest Golf Courses.” They assembled a panel of experts in the golf world and published this list alternately every two years. The panelists assigned and published scores based on factors such as layout, strategy, design balance, memorability of each hole, beauty of location, maintenance, and tradition.

The Pine Valley GC opened in 1913 in Pine Valley, New Jersey. In the first several publications, it was listed in the “most difficult courses”, but with a few exceptions, the course has continued to dominate the top position on this list.

I would like to share my analysis why it has continued to be so highly rated, but before I do so, allow me to explain my involvement with the GC.

Countless Number of Bunkers Rough Terrain and Typical Penal-Type Course

I first visited the GC in 1987, two days after Ayako Okamoto lost the championship in the U.S. Women’s Open in a playoff. J. Hunt, then USGA President, introduced me to a GC member J. Marshall (Rector of the United Nations University), and together we drove two hours from the hotel in New York City to New Jersey.

A white elegant clubhouse, not extravagant, but nestled in a deep forest.

There were no signs to guide us, and before we knew it, we had entered the grounds and arrived at the clubhouse from the back side. The driveway was not intimidating, nor was the clubhouse grandiose. The creaking stairway to the second-floor locker room did create an atmosphere of history and tradition, though.

The 18-hole course is laid out over a dense pine forest of about 13 million square meters, and you can think of the entire area as a sandy waste area except for the fairways and greens.

The 18th hole (428 yards, par 4) has a tee shot requiring 200 yards over a huge bunker, with a water hazard in front of the green.

The waste area does not require maintenance, and one can say it turned out to be what we now call SDGs (sustainability). The tee shot must be carried 200 yards to reach the fairway. This is the epitome of a penal design, where immature skills are penalized. There are a countless number of bunkers, so many that I stopped counting. It was hard to determine where the waste area ends.

Highly Strategic and Unique All 18 Holes Are Unforgettable

We played two rounds that day, and what surprised me was that at lunch, I could clearly remember each of the 18 holes. The holes consisted of par 3s, par 5s, uphill and downhill, doglegs to both sides, bunkers all differently placed, tee shots all aimed differently, and no two holes had the same pattern. It was not as if I was thinking, "I should memorize this great opportunity." But despite that, I remembered each of the 18 holes vividly in my mind. It was truly a mysterious feeling.

I thought that this is where the "world's number one" comes from. You can play a great course and be impressed, but when months and years go by, often you cannot remember the positions of the bunkers and hazards.

But with the Pine Vally GC, you still remember the course after decades. The strategic nature, the memorability, and the design balance of every hole are full of uniqueness. That is probably why it is an unforgettable course where one cannot help but rate it as one and only.

As a golf club, it was a men-only club, which didn't even have women's restrooms. Men were walking about naked in the locker room. But from one point, the club opened itself to women on Sunday afternoons only, so it is changing.

It was out of the blue that I became a member. In 2013, I participated in the U.S. Open at Merion GC as a referee for the USGA. The day after the tournament, P. Castleman, who was an executive committee member of the USGA, took me to the GC and the next day he told me, "You are now a member."

Countless Episodes Tell the Story of the History of the Club and Its People

I found an answer to "what constitutes a golf club" when I read the final chapter of its 75-year history at the club. There were various episodes of what happened at the club. A champion, after finishing the outward nine in 38 strokes, took 38 shots in the par 3 10th hole. A guest player got lost in the woods on the right side of the 13th hole, and came back from the neighboring village. A scratch player who, after shooting a birdie, an eagle, and a hole-in-one, and a birdie, got drunk and passed out in the bar after returning to the clubhouse. And the stories go on.

They say it is a tradition of the GC for young members to proudly talk about these historic episodes as if they had seen them with their own eyes. New members join as one golfer, and titles are unnecessary. There is a strong atmosphere among the members that they are eager to accept young people who will carry on such history and tradition.

In the final analysis, I believe the episodes written in the final chapter of the book indicate that the "history of the club is the history of the people."

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 US Open.

CTC Exhibit in a Pavilion at KidZania Fukuoka

Interactive exhibit using simulation technology to analyze changes caused by natural disasters as science engineers

On July 20, 2023, CTC opened the Simulation Technology Center pavilion in the advanced technology area of KidZania Fukuoka, a facility for children to interactively learn about jobs and society which is planned and operated by KCJ Group Inc.

Simulation Technology Center pavilion


Analyzing how a bridge planned to be built will be impacted by a natural disaster.


Holding the output from the interactive exhibit: simulation results videos (key cards for download).

The CTC Group considers developing the next generation of IT talent to be one of our important endeavors. One such initiative is our pavilion exhibit at KidZania Fukuoka. We will be offering a place for children who represent the future to learn about the possibilities of computer-based simulation technology as science engineers.

Simulation technology analyzes and predicts results, based on measurements and calculations performed by a computer. Since this scientific technology visualizes phenomena that are difficult to experience in real life, it also carries a high degree of social significance.

CTC has been using analytical and simulation technology in the fields of science and engineering for many years while taking on challenges to overcome various social issues. This Simulation Technology Center pavilion employs knowledge and expertise accumulated through those efforts. At the pavilion, children can analyze how much damage is received by infrastructure such as bridges when earthquakes, tidal waves, tornadoes, and other familiar natural disasters occur. In addition to letting children experience for themselves the importance of ensuring and supporting the safety of society by anticipating damage and drawing up measures to address it in advance, we also aim to nurture their interest in science and technology.

Key Points of Interactive Exhibit

- Learn the usage methods and convenience of computer-based simulations
- Learn about four types of damage: earthquakes, tidal waves, tornadoes, and flying objects in tornadoes
- See and analyze the results of a simulation on what types of structural changes and damage will occur when a bridge planned to be built is impacted by a natural disaster

Pavilion Overview

Name of pavilion: Simulation Technology Center

Name of job: Science engineer

Output: Videos of simulation results (key card for download)

KidZania Fukuoka Official Website
https://www.kidzania.jp/fukuoka/

Introduction page for Simulation Technology Center
https://www.kidzania.jp/fukuoka/activity/simulation-technology-center.html

information

ITOCHU Techno-Solutions TAIWAN Office

Challenging Tomorrow's Changes

Taiwan Office Now Open

In order to conduct research on advanced technology and partner collaborations in the Taiwan region, we opened the Taiwan Representative Office ("Taiwan Office") in Taipei, Taiwan on September 1, 2023. We are already working on partnerships with IT companies in Taiwan in fields such as networks and AI. Through this office, we will exchange information with companies and groups in Taiwan going forward, as we facilitate further cooperation between Taiwan and the CTC Group.


Taiwan Office

About the Taiwan Office

Official Names

Name in Japanese: 伊藤忠テクノソリューションズ株式会社 台湾代表者事務所
Name in Chinese: 日商伊藤忠科技決策股份有限公司 臺灣辦事處
Name in English: ITOCHU Techno-Solutions Corporation Taiwan Representative Office

Address

12F-3 No.128, Sec. 3, Minsheng E. Rd., Songshan Dist.,Taipei City 105602, Taiwan

Representative

Taro Inoue
General Manager, Taiwan Office

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)
Komazawa Nakamura Building, 16-7, Komazawa 1-chome, Setagaya-ku, Tokyo
http://www.firstcontact.co.jp/

Overseas

ITOCHU Techno-Solutions America, Inc.
2880 Lakeside Drive, Suite 116, Santa Clara, CA 95054, U.S.A
https://www.ctc-america.com/

CTC Global Sdn. Bhd.
Unit TA-10-1, Level 10 Tower A, Plaza33 No.1, Jalan Kemajuan, Seksyen 13, 46200 Petaling Jaya, Selangor Darul Ehsan, Malaysia
https://www.ctc-g.com.my/

CTC Global Pte. Ltd.
315 Alexandra Road, #02-01 Sime Darby Business Centre
Singapore 159944
https://www.ctc-g.com.sg/

CTC Global (Thailand) Ltd.
2525 FYI CENTER Tower 2, 5th Fl., Unit 2/502-2/504, Rama IV Rd.
Klongtoey, Klongtoey, Bangkok 10110, Thailand
https://www.ctc-g.co.th/

PT. Nusantara Compnet Integrator
AKR Tower Lantai 8, Jl. Panjang No.5, Keurahan Kbon Jeruk
West Jakarta, Republic of Indonesia
https://www.compnet.co.id/

PT. Pro Sistimatika Automasi
AKR Tower Lantai 12, Jl. Panjang No.5, Keurahan Kbon Jeruk
West Jakarta, Republic of Indonesia
https://www.prosia.co.id/

Best Engine

Vol. 14, Published October 2023

Publisher: Corporate Communications Dept., ITOCHU Techno-Solutions Corporation
Kamiyacho Trust Tower, 4-1-1 Toranomon, Minato-ku, Tokyo 105-6950 JAPAN

ITOCHU Techno-Solutions Corporation
www.ctc-g.co.jp/en/