NTT DATA Technology Foresight 2015

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Technology
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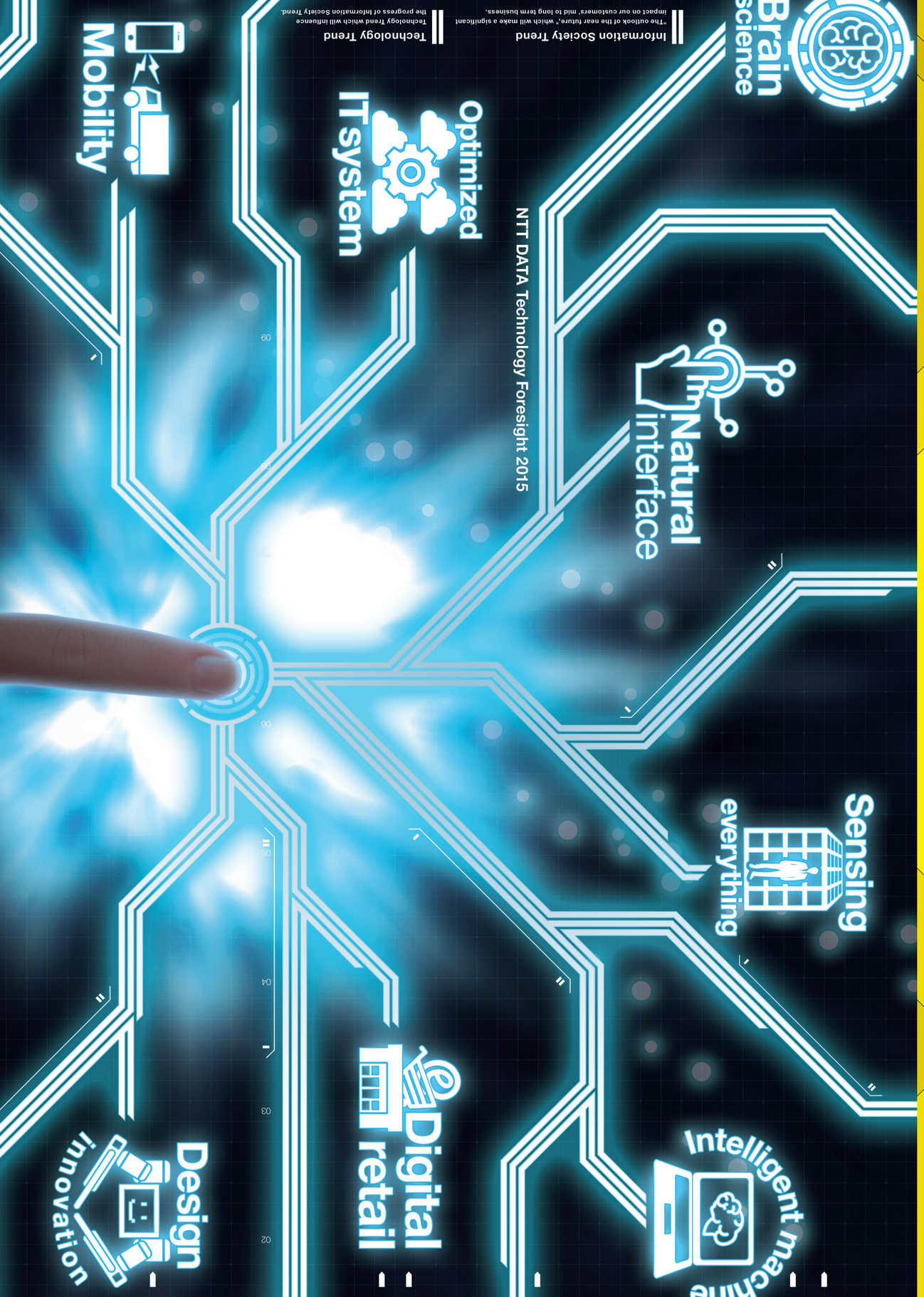

NTT DATA Technology Foresight

is the "outlook and technology trends of the near future" that is derived by NTT DATA once a year. It finds the challenges our future society will face at an early stage, and it serves as a compass to promote the creation of new value.

We aim for the betterment of society by depicting a future vision and achieving it together with various customers through foreseeing the impacts future technology will have on societies and businesses.

At NTT DATA, we incorporate NTT DATA Technology Foresight into our management strategy, and we are committed to technology development and service creation that anticipates changes in the business environment.

Looking ahead : Technology trends driving business innovation.

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Information Society Trend

We anticipate four key trends will have a significant impact on our clients' medium to long-term business.

IST01 Power of the Individual

IST02 Collaborative Value Creation

IST03 Knowledge Society

IST04 Smarter Society

IST01

Power of the Individual

The growing influence of individuals will transform existing societies and industries. Digitization will force providers to extend their existing business models to be more customer-centric, embracing the increasing power of the individual.

Changes in the consumer market are spreading to the entire society. While mobile and social media have already gone beyond the boundaries of communications between individuals to become a major tool for linking companies and organizations with individuals, these media are expected to be used increasingly as more of a communications business channel between companies. Bring Your Own Device (BYOD) is spreading beyond the workplace to encompass various aspects of life. For example, the use of smartphones is expanding to serve as: a key to the house, car, and hotel room; ID and a payment system, and a sensor. The shift of the customer contact point to BYOD is not just a change of communication channels. It means that control over the primary interface between companies/organizations and customers is shifting from the former to the latter, necessitating a breakdown of organizational silos and a transformation into a more customer-centric organization.

Personalization, which provides products, services, and information tailored to individual attributes, is a response to the increasing dissatisfaction of customers with mass marketing in industries such as manufacturing, retail, and advertising. Personalization is expected to take a step forward to reflect user locations, situations, and psychological conditions.

Other changes are also occurring to the relationship between a company or organization and its workers. For example, some major corporations are starting to use skill-based crowdsourcing. In the future, more workers may be able to select an organization to work for without belonging to it. Social interaction will increase, helping to make centralized and rigid organizations more flexible and dynamic. However, the increase of freelancers and self-employed workers might impact the social norms, rules, and systems of the workforce.

The relationship between the national or municipal government and its constituents is also starting to evolve. Traditionally, the only way individuals could choose their local government district was to move. There are now new indications that residents will be able to select their own local government district by voting without changing the location of their home. As a result, future boundaries of municipal governments may become more irregularly shaped, similar to those resulting from gerrymandering. That means municipal governments will be required to devise and implement innovative ideas in order to encourage selection by their constituents. The concept of constituent autonomy may expand as well.

Wearable devices will empower individuals by enabling access to information with higher speed and accuracy than smartphones by eliminating key entry. These devices raise high expectations as a means to enhance user convenience and capability. Wearable technology already seems to have gained momentum in the workplace, although consumers remain reluctant to take advantage them. However, further penetration of their use will require the alleviation of the "sense of imposition" on the part of the users and people involved. Additionally, more applications for wearable devices will need to be established, and the benefits must be explained to users in an easy-to-understand manner. Wearable technology will expand gradually from fields such as healthcare, which will help users to improve physical and mental health and performance through self tracking.

While the awareness of privacy has been somewhat diluted, the "right to be forgotten" has emerged as an important concept in privacy protection, empowering individuals to control their own information. However, erasure of information that is inconvenient to the individual may infringe upon the public's right to know and the freedom of the press. The future may present the challenge of balancing between the right of privacy and the public's right to know.

IST02

Collaborative Value Creation

Dynamic ecosystems will emerge in which constituents will interact collaboratively over decentralized network. This open exchange of information and resources will revolutionize both workplaces and societies.

Free flows of information on the internet have resulted in open co-creation and collaboration. Internet-style systems, which have no centralized governance mechanism but whose participants collaboratively balance one another with independent judgments, are coming into favor in various fields.

The social structure is also becoming increasingly closer to that of the Internet. Free flows of people have resulted from the increasing acceptance of telecommuting and web conferencing. An "Internet of people" is the future of work comprised of remote and crowdsourced workers. There still remain psychological hurdles, but connected workers will gradually spread throughout the workplace and across national borders.

The "Internet of goods and materials" has already started in the industrial world. In a project called Industry 4.0 or the Industrial Internet, manufacturing companies are starting to link sensors and radio frequency identification (RFID) tags embedded in manufacturing equipment or parts to each other through the Internet to enable automatic and dynamic control of production plans and manufacturing processes. Optimization of operations will contribute to a significant reduction in costs by adjusting inventories, improving operating rates, and reducing disposal loss as well as increasing the flexibility to deal with customer requests. Also expected is the use of information acquired from embedded sensors for product development and maintenance plans.

Linking multiple plants involving the distribution industry brings an innovation that aims for strategic use of distribution instead of considering it a cost. Flexible and agile inventory allocation on a distribution network allows reduction of shipping time and inventories. However, it is expected that the need will arise for Internet-style distribution, where the optimal shipping point and routing are determined in real time by dynamically changing the positioning and amounts of inventories based on demand forecasts and traffic flow of the potential distribution routes. The requirements for achieving a good balance between cost reduction and environmental load reduction are deliverable together with the transition to more flexible and open combinations of distribution assets such as warehouses and trucks.

An "Internet of money" has occurred in the form of a cryptocurrency, an Internet-based decentralized currency without an issuing entity such as a national government or a central bank. Its value is determined by the equilibrium between supply and demand. It can be circulated freely on a global basis without delay, and transaction costs are very low.What supports the circulation and value of a cryptocurrency is its users' trust in it. Payment systems using cryptocurrencies are being established, and leading distribution chains in some countries already accept them. However, cryptocurrencies are not without issues. For example, they do not have systems for guaranteeing value and protecting consumers, and taxation depends upon the country. In addition, some governments are trying to place new regulations on them. As a result, their potential as investment vehicles is unclear, but they are expected to penetrate into society as a convenient means of payment. Unlike a system where monetary balances or transaction values are simply transferred or settled as digital information, cryptocurrencies possess a potential to transform the financial infrastructure itself.

Open co-creation and collaboration enable individuals to overcome the resource limitations of organizations and promote innovation. Open co-creation and collaboration might also result in a transformation of the social structure. One of the reasons for the propagation of these services is that the existing system is inefficient. However, hurdles will have to be overcome before such innovative ideas are socially accepted. Some sharing services between individuals, which have been steadily growing, have faced resistance from existing businesses and have ended up being regulated. There are cases where municipal governments started sharing their idle assets, and major companies have utilized crowdfunding. This means the innovative system is not necessarily incompatible with the existing system. In the end, the innovative system is expected to take root in society over time.

IST03

Knowledge Society

The source of value will shift from tangible things and assets to the use of knowledge, design and functionality. Big data analytics will allow organizations to gain insight including alternate viewpoints which can fuel innovations.

As the notion of intellectual property rights such as patents and trademarks becomes widely accepted, the idea of evaluating products by the value created by using the products rather than that of physically possessing them is becoming accepted. The "servitization" of manufacturing that provides the advantages and benefits of the products by offering them as services is also increasing. Since the value created by using the products fluctuates by users and situations, it requires a paradigm shift from the notion that the value associated with products remains unchanged. It will take time until the notion of fluctuating product value will be widely accepted by society. Similarly in the services industry, it has recently become necessary to maximize customers' value by recognizing benefits as the source of value, rather than the service process itself. For example, the priorities of shoppers on atmosphere, service quality, efficiency, and price are different depending on whether they are looking for efficiency in shopping or a fun experience. Some retailers might be urged to redefine the value-to-offer from just selling product to face-to-face communication. For financial, medical, and elder services, it is also necessary to plan to maximize the target customers' value by re-defining the value of the services delivered.

The value of information is becoming more important. Smartphones and sensors deployed in all aspects of life allow people to create and record large quantities of data, whether or not they are aware of it. The amount of data created per year has been doubling every two years and is reported to reach 44 trillion gigabytes (or 10^{21} bytes) by 2020*1. The size of analyzable data is also expected to reach a level exceeding one third of the whole. Technological innovation of storing and analysis of data has generated increasing value from this big data. However, some data should be used for public benefit.

Tracing of the data recorded in real time and information transmitted is expected to uncover people's behaviors. The relationships between chronic illnesses such as diabetes, strokes, and heart disease and behavior will be elucidated. Individual-level understanding of the behavior patterns and environmental conditions, e.g., weather conditions, in which attacks may occur, will raise the possibility of preventing diseases from relapsing and becoming more severe. Aggregation of patients' data will illustrate the conditions most closely associated with a certain illness. In addition, behavior patterns and environmental conditions may have causal relationships with success, failure, accidents and criminal acts. The application of information regarding people's movement will also influence urban zoning, and will impact the development of transportation networks. For example, such information will affect the selection of locations to open new facilities and stores. Sensors embedded in products and information transmitted from consumers will enable an accurate understanding of how customers use or consume products in specific situations. Findings of usage and consumption that the provider did not expect may help develop new products and propose new potential value.

Artificial intelligence, which conforms to big data analytics, is entering our daily lives expanding to household appliance control, voice and image recognition, and automatic translation. Its application is also accelerating in business fields such as medical diagnosis, law and accounting operations, and fraud detection. Expected benefits include: improved productivity; enhanced customer satisfaction, and reduced damage. In the future, artificial intelligence may be used to lead the user to the optimal decision in light of the user's emotions and thoughts as well as vital data.

While digital natives, who are liberal about privacy, are voluntarily recording and disclosing information, people will probably try to determine which information is worth recording in the future. When that happens, the value of information as public property will also need to be considered There are issues about the data ownership and privacy between the source and the collector, which will require future discussion. Free flows and use of information will likely be negatively impacted unless the concerns and interests of both parties are secured, while the value of information as public property is protected. Privacy concerns will face further challenges, including social norms and emotional issues, and it may take several years before a conclusion can be reached. However, new regulations and rules are expected to be developed which will align with international society.

*1 IDC, "The Digital Universe of Opportunities: Rich Data and the Increasing Value of the Internet of Things," April 2014, Sponsored by EMC

IST04

Smarter Society

The physical-digital convergence will broaden in scope. The increased flexibility of responses to social and environmental issues will lead to a more sustainable society.

The physical and digital worlds are converging. Substantial decisions and activities in the physical world are influenced by digital devices or information gathered from them. Those who use smartphones while walking in the street or shopping are no longer aware of whether they are in the physical or digital world. Brick-and-mortar retail stores are already being forced to re-define the value they offer based on competition with e-commerce stores. Mass media and the publication industries are also exploring how to co-exist with electronic media. The social structure of the future will turn out to be one that incorporates both the physical and digital worlds.

Digital approaches with innovative ideas and designs are becoming increasingly important to confront problems of urbanization. Advanced countries, where the infrastructure crises is in progress while decreasing trends in demand for infrastructure are anticipated, are expected to turn toward digital solutions, which require less capital than physical solutions, to combat crises. On the other hand, developing countries will adopt digital solutions to complement physical infrastructures. For example, sensors and cameras will be installed all around communities; streets, transportation and parking spaces will be monitored for their usage, while structures such as bridges, buildings, and pipelines will be monitored for their usage and risk of collapse or damage. Smart grids and self-driving cars will be also used for monitoring and collecting information. Information and search keywords transmitted from residents' smartphones and their built-in sensors will also be consolidated to serve as effective information.

At workplaces, use of robots and wearable devices will continue to expand. Industrial robots are coming out of the cage to work collaboratively with people. Robots that are capable of learning tasks from human workers or which use human tools are emerging. Wearable devices are expected to support workers in the workplaces, including those professions which were not previously digitized. Mutual complementation between humans and robots will lead to the improvement of productivity and the creation of new value.

Omni-channel retailing will become more prevalent. People will be relieved from the stress arising from "waiting," as products ordered and paid for through a smartphones while in transit can be received without waiting in line at a brick-and-mortar store. This type of store will be required to make a customers' stay as short as possible – an idea contrary to traditional practice. This may also impact store design. For example, virtual stores in stations and airports are attempts to shorten perceived waiting time. In the meantime, e-commerce will enable the purchase of food and the receipt of merchandise at any location, expanding shopping opportunities. Consumers' buying process will be significantly faster and simplified by enabling direct access to e-commerce websites using Quick Response (QR) codes and digital watermarks embedded in TV screens, magazines, and other media.

Biological signals such as heart rates, breathing rates, and body temperatures are also being digitized and analyzed in a variety of ways. Continuous monitoring with wearable devices may become prevalent for medical and/or research purposes. This practice may not only provoke self-awareness of health issues and behavioral modification, but also lead to early detection and treatment, and pathological identification of disease in chronically ill patients or homebound seniors. In addition, studies are underway to harness biological data for business by estimating an individual's emotional status and stress level, in order to prevent work-related accidents and to benefit marketing-related purposes. Biometric authentication will widely be accepted as something that complements or substitutes personal identification and passwords. While there are some people who have microchips in their body in the form of a pill or implant for medical or business purposes, privacy-related issues will likely become a bottleneck to the popularization of this act, as it might be difficult for the person with the chip inside to control its functions by his or her own will.

With the boundaries of digital and physical blurring, it is anticipated this will cause situations that are beyond the scope of existing laws and regulations. The focus of responsibility when problems occur is a particular concern. Social rules should be updated in line with social changes so as not to discourage innovation.

Examples of NTT DATA Initiatives Related to Information Society Trends

Power of the Individual

An innovative bank designed through a customer-centric approach

Hello bank! is the first mobile bank, 100% digital, in Europe under BNP Paribas. NTT DATA Italy was involved in developing the design and building the application of Hello bank! Italy using observations and interviews of the target customers. NTT DATA defined the concept and the business model of the new bank to provide an optimum customer experience to digital clients by offering innovative products, services, and functionalities. Hello bank! Italy's main characteristics are the result of a true customer-centric approach and include a self-service model, multichannel interaction, and highly personalized support. The customer-centric approach used by Hello bank! Italy is expected to break down traditional silos and innovate businesses.

Knowledge Society

Social revolution: industrial application of neuroscience to understand, ask and satisfy the brain

It is believed that 95% of the decision-making and behavior of humans is done unconsciously, and neuroscience research to probe into the unconscious has been ongoing. The NTT DATA INSTITUTE OF MANAGEMENT CONSULTING has been involved with the industrial application of neuroscience, including the establishment and management of the "Consortium for Applied Neuroscience," in which more than 40 companies and research institutes participate. It utilizes the knowledge and research outcomes of neuroscience for corporate marketing and product development in addition to store design, human resource development and business management. It also provides support for clients to "understand, ask and satisfy the brain" of their customers and employees. Furthermore, by fusing and utilizing neuroscience and IT, including sensor networks and big data analysis, (e.g., lifelogging by measuring physiological information such as the amount of activity and pulse waves, and environmental information such as temperature, humidity and brightness for 24 consecutive hours) the organization supports management's desire to provide a greater sense of comfort and satisfaction to their customers and to increase the productivity and satisfaction of their employees.

Collaborative Value Creation

Energy management based using real-time big data analysis

It provides a mechanism that reduces peak electricity demand through bottom-up control by users instead of the conventional top-down control by power companies. In particular, it uses IoT (Internet of Things), such as a smart meter, to collect the data of power used in buildings and factories. Then, it uses big data analysis technology to forecast the power consumption of the current day, the next day and the upcoming week. Feeding back the forecast result promotes each user's voluntary energy-saving effort. This service automatically adjusts the parameters of the forecast model every day to increase accuracy. The forecast result of the day is updated real-time. With this mechanism, power companies can now stabilize power systems through voluntary reduction of peak electricity demand, and the owners of buildings can reduce cost systematically and operate off-grid power systems by leveraging the forecast result.

* This is a service jointly provided by U.S. AutoGrid and NTT DATA.

Smarter Society

Communication robots assist independent living for the elderly

Japan is the world's fastest aging country and the population ratio of those who are 65 years old or older already exceeds 25%. It is expected that one in every three residents will be elderly by 2035. NTT DATA is working to build a system for situation-based active care prevention services that capture the living conditions of the homebound elderly in real time in anticipation of the environmental changes. In particular, various types of sensors will be used to collect data, such as human sensing sensors installed in the rooms and pressure sensors installed under the bed, to visualize the living conditions of the elderly. We are investigating a mechanism to have a communication robot talk to the elderly depending upon the situation. Through conversation with a robot, supervised drug administration, safety checks and a fall prevention function will be performed. In the future, we would like to make it possible to provide cognitive function training and discover dementia at an early stage by analyzing conversation data. Assisting independent living of the elderly will help to resolve issues associated with an aging society.

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Technology Trend

The following 8 technology trends are expected to have the biggest influence on the world around us in the coming years.

- TT01 Invisible Computing
- TT02 Science of Life and Emotion
- TT03 Challenge of Artificial Intelligence
- TT04 Democratizing 3D Data
- TT05 Next-Gen Mobility and Transportation
- TT06 Digital Commerce
- TT07 Cloud Optimization
- TT08 Engineering Innovation

TT01

Invisible Computing

Computers will evolve to the point where users will no longer feel the existence of an interface. For example, there will be more opportunities and user benefits from ultra-realistic technology[*1] *and in medical care, implanting devices in people will become more common.*

Marshall McLuhan, who is known for his media research, says all technology and media are extensions of human bodies. His idea is that all artifacts including languages and clothes exist as an extension of human functions and senses. For example, bicycles and roads are an extension of feet and legs; phones are an extension of the mouth and cameras are an extension of memory. However, new challenges are arising in leveraging the latest extensions of the human body. Whereas the performance of devices is heightened by technology, people are having difficulties fully utilizing these advanced tools. The thought of "becoming able to use them" itself is wrong. The presence of all technology should be "invisible" to users in action.

In recent years, wearable technologies, which require a device to be worn, are gaining popularity. Wearable devices are not always unnoticeable but their presence is close to being transparent because they operate in accordance with the user's motion. There are a variety of wearable devices and various products that have been released such as ring-type, bracelet-type, watch-type, contact lens-type and clothing-type. The most famous wearable device is a head-mounted apparatus to be worn as glasses or a helmet. The head-mount variety has already been adopted to assist complicated work such as aircraft maintenance, and in highly specialized areas such as medical care. At this point, smartwatches seem to have become a type of wearable device that will be the most accepted by consumers.

Functions that can only be realized by smartwatches, such as identifying the user by heartbeat or collecting the information of body temperature and stress, are attracting notice. Various other possibilities are being considered for wearable technologies; however, it is likely that these will not be adapted by users as fast as hoped. It can be said for wearable devices in general that the potential far exceeds the current technology. There are still many technical challenges to be resolved such as batteries, sufficient communication bands and smooth and more realistic screen displays. Wearable devices are worn in concert with clothes; therefore, their design is equally important for their widespread adoption by end users.

What happens if wearable devices, such as smartwatches, evolve to have an invisible presence? One direction is implant computing that embeds devices in human bodies. Implant technology is already established to a certain extent because microchip implantation in animals has already been used commonly. The purpose of microchip implantation in animals is for identity verification; however, in humans its use would be mainly for medical treatment. Technology to fuse humans with devices is making great strides. A venture company called DEKA, which is led by Dean Kamen, the inventor of Segway, has developed a prosthetic arm that moves according to the way users think. This device reads electrical pulses generated by muscles and moves when a command from the brain is transmitted. There is other ongoing research such as using an implanted chip to measure blood sugar levels.

Another method to make the presence of devices invisible is ambient computing, which embeds devices into walls or desks instead of making them wearable. Ambient computing is a way to utilize devices with the least burden on people. In the future, we will enter an age in which the glass windows and walls of conference rooms will be turned into high-definition screens, and equipment will be operated by a gesture or smart devices. The video of those who are attending the conference remotely and the data to be shared will be projected on the screen and the information to be viewed personally will be confirmed using smart devices. It is thought that the use of similar devices according to the situation will grow.

Once this ultra-realistic technology is established, the virtual world and the real world will become almost indistinguishable and the presence of devices will become truly invisible.

What lies prior to the invisible interface? One area is extending human capabilities to fulfill desires that are not essential to existence such as recovering lost health. This is called technology enhancement. Examples of technology enhancement are having hearing that exceeds the human limit; vision that can see in the dark or seven fingers by adding mechanical fingers. Even if users can handle such powerful technology at will thanks to its invisible presence, users may not be able to do what they want because human beings are social animals. Even after a computer's presence becomes invisible, users will continue to face fundamental human challenges, such as "not being able to take action based on rules" or the search for "what true happiness is."

*1 Technology that brings sensations to the five senses of human beings as if they are at a different location than the present location.

TT02

Science of Life and Emotion

Research is accelerating in technologies that seek to understand human nature, e.g., genetics, brain-science and psychology. Depth psychology, including the effects of stress reduction methods and differences in the sense of happiness, will be scientifically elucidated, encouraging its use in business.

In October 2014, the Nobel Prize in Physiology was awarded to Mr. John O'Keefe and Mr. and Mrs. Moser for discovering a positioning capability in the brain like a GPS installed in car navigation systems or smartphones. In recent years, research on the brain has made great strides and the existing theories have been rewritten one after another. Generally, it was thought that the right hemisphere controls sensitivity and the left hemisphere controls logic. However, nowadays it is understood that there is no significant difference between the left and right hemispheres. Brain cells were believed to decrease after birth; however, much research has proven the continued creation of new cells. In recent years, the relationship between the brain and happiness has also been attracting attention. It was discovered that serotonin, a brain chemical, largely affects a sense of happiness and a variety of studies have been making progress in this area. Because a gene affects the secretion of serotonin, it is believed that the differences of genes among individuals affect the perception of happiness. Research on genes and happiness will continue to advance in the future and there will be new businesses that take advantage of the mechanisms of life and emotions.

It has come to light in recent research that a mother's love and great stress can affect the functions of genes. This research area is called epigenetics. It is proven that many genes become active and the resistance against stress improves in children who receive abundant love as they grow up. Studies have also shown that brain circuits can be rearranged at will to a certain extent depending on experience and training. A treatment approach that takes advantage of this is called mindfulness-based stress reduction. It uses a training method based on meditation and Zen that originated from Buddhism advocated by Buddha 2,600 years ago. It has been practiced successfully in medical facilities in the United States for the past 30 years. It has also become widely recognized by advanced companies that employee stress is costly. As a result, companies like Google, Intel and Goldman Sachs started to incorporate the concept of mindfulness into their training programs. It is well known that the late Steve Jobs devoted himself to meditation and Zen.

The advancement of genetics and neuroscience has also started to impact businesses. It is a known fact among experts that a person's true feeling is different from his answers during an interview. To address this issue, neuro-marketing that uses brain waves was devised. Conventional monitoring research could uncover the overall impression of a video commercial, but it could not identify the scene that was most strongly related to that impression. However, the monitoring of brain waves enables visualization of psychology using numbers; therefore, the most impressive and emotional scenes in the video commercial can be highlighted. Sometimes a computer can capture changes of emotions at a level that the user does not even realize.

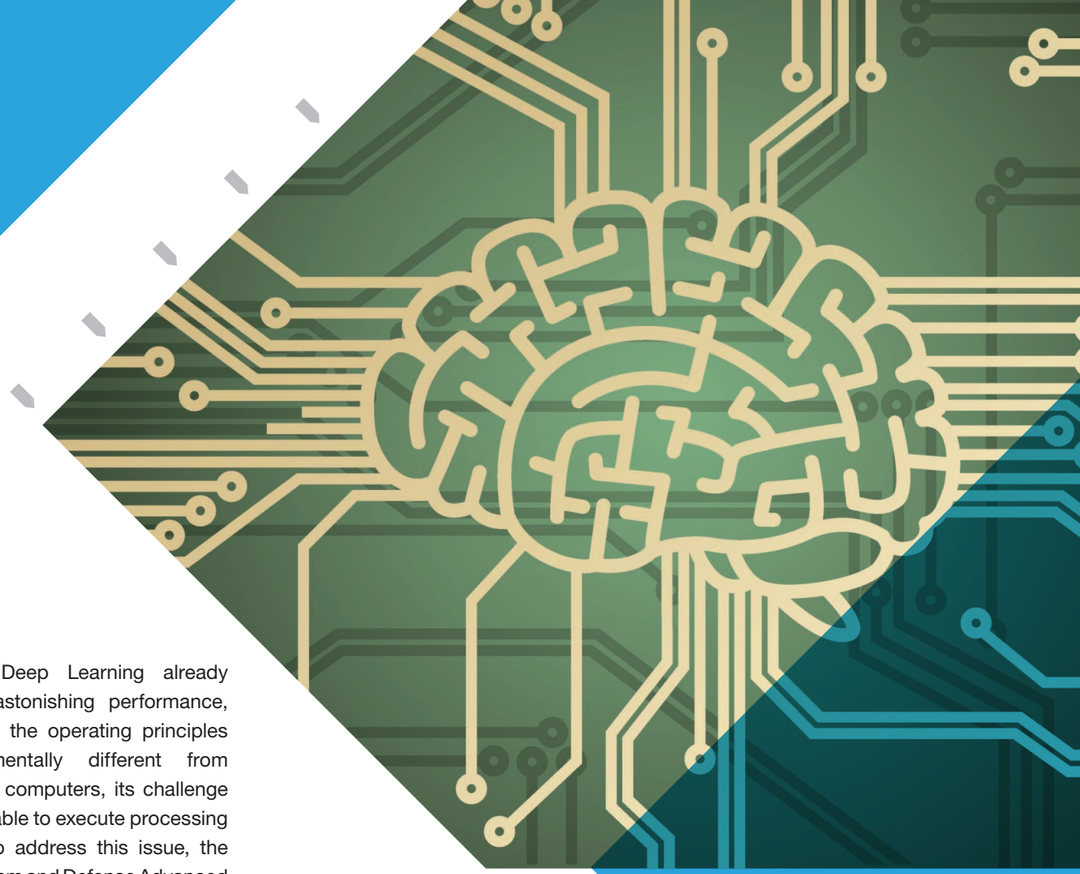
It is also possible to reveal depth psychology by seriously analyzing why emotional changes occurred after the fact. Businesses that take advantage of psychology instead of brain waves are also attracting notice. Some examples of the application of psychology to business are making adjustments to the color of food according to a customer's psychology, and improving the motivation of employees using a method called gamification.

A variety of advances are being made in genetics as well. Genetically modified human babies born in 1997 will graduate from high school next year in 2016. Uzbekistan is investigating a project to select future athletes using genetic information. In Shanghai, there is a venture company that runs genetic testing to find out the presence of talents. In addition, analysis of genes has started to shed light on the root causes of aging. In research, mice at an age equivalent of 60 years old in humans rejuvenated to a level of 20 years old and their diabetes showed improvement. In the near future, every disease caused by aging may become treatable by a rejuvenating medicine. A beauty product that contains a substance that has 200 times more rejuvenating effect than conventional products will be released in Japan in April 2015. The anti-aging business is expected to be a huge market in the coming 10 years.

Once life and emotions are understood further, there is a possibility of drastically changing the social structure. For example, a marathon in school may start recognizing the person who placed the most burdens on their body instead of who finished the race first. If life expectancy exceeds 100 years old, then there will be a necessity to fundamentally reform structures such as pension plans. To be ready for such drastic changes that shake the foundation of society, we need to initiate discussions with an eye on the future and start making preparations now.

TT03

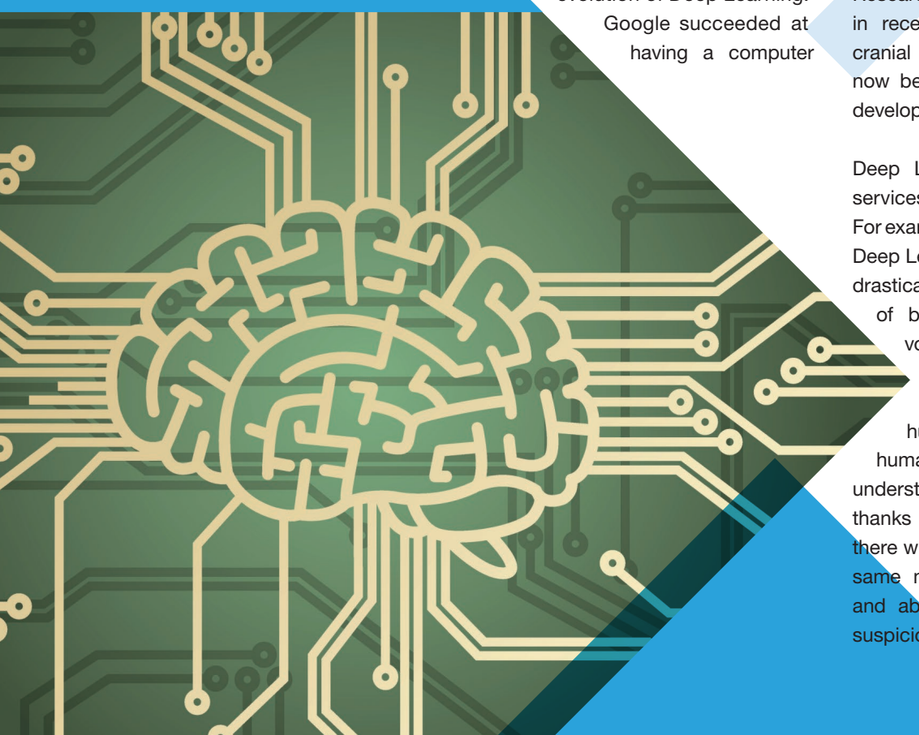
Challenge of Artificial Intelligence



Algorithms that mimic human brain circuits will become more sophisticated, allowing computers to understand meanings, concepts and context. The role of computers will shift to assist intellectual and creative work, enabling users together with computers to perform multiple and even more creative tasks in parallel.

Artificial Intelligence technology, called Deep Learning, which has copied the brain neurons of humans, is taking the world by storm. Deep Learning has advanced the neural network technology that has existed since the 1950s. A characteristic of this technology is that it has copied the brain neurons of humans. Since Deep Learning appeared, image recognition performance, by which computers state the correct name of physical objects on the screen, has improved dramatically. At an international contest called ILSVRC*1, where researchers around the world gather together, the accuracy rate of image recognition drastically improved from 71.8% in 2010 to 93.3% in 2014 thanks to Deep Learning.

By copying brain neurons, computers in the future will have thinking power close to humans. Humans naturally learn features such as “a cat has four legs” or “a cat is a living thing” from daily life. It is assumed that computers will able to do the same through the evolution of Deep Learning. Google succeeded at having a computer learn the features of a cat by itself by showing a video of many cats in an experiment in 2012. Another major advancement of artificial intelligence is the success of mimicking memory skills. This technology is called a Neural Turing Machine. For example, it can store the results of a calculation in process in the memory area and can execute a “sorting” process that is remembered by artificial intelligence. If this technology continues to evolve, it would be possible for artificial intelligence to have logical thought. Research on artificial intelligence in recent years tends to copy the cranial nerves of humans and it has now become a feasible challenge to develop an artificial brain.



Deep Learning is already used for services that handle voice and images. For example, Google and Apple applied Deep Learning to their businesses and drastically improved the performance of both their image search and voice input services. Facebook uses Deep Learning to allow computers to have the same human face recognition ability as humans. The computers’ ability to understand videos has also improved thanks to Deep Learning. Eventually, there will be security cameras with the same monitoring ability as humans, and able to make judgments about suspicious individuals based on rules of thumb. Deep Learning already boasts an astonishing performance, but because the operating principles are fundamentally different from conventional computers, its challenge is not being able to execute processing efficiently. To address this issue, the U.S. Qualcomm and Defense Advanced Research Projects Agency (DARPA) is leading the SyNAPSE*2 project. As part of this effort, they developed a chip that copied brain neurons to realize high-speed processing and low power consumption.

In business, the words “artificial intelligence” have become prominent buzzwords. The number of businesses utilizing artificial intelligence is increasing although it is not always via Deep Learning. A U.S. venture company, Grok, developed an original technology based on the mechanism of the cerebral cortex, and it has been providing abnormality detection service for communication networks on Amazon Web Services since January 2014. Artificial intelligence is now also being utilized to improve efficiency at call centers. The application of artificial intelligence will increase in the areas related to the creativity and sensibility of humans. An example of this is a service that automatically designs a website based on provided images and text, which will be launched in the spring 2015. Furthermore, there is artificial intelligence available that automatically designs logos or composes music. It will be natural for people to modify the contents created by computers to carry out multiple creative tasks in parallel in future business. Another point to note is that artificial intelligence can exercise originality such as thinking outside the box.

What happens to artificial intelligence in the future? Ray Kurzweil, a well-known futurist, predicted that computers will exceed human thinking power in early 2020 at the earliest or by 2045 at the latest. The historic turning point where artificial intelligence initiates technical innovation above human speed is called singularity and its expectations and threats have been seriously discussed. Unlike humans, artificial intelligence can easily replicate knowledge and it does not get tired. The company that develops artificial intelligence that exceeds humans for the first time in the world may be able to copy it to many computers running in parallel 24/7 to monopolize intellectual property rights.

Because an advanced artificial brain has the possibility of transforming the world, society needs to carefully watch the trends and establish a legal system and environment so that its characteristics can be utilized.

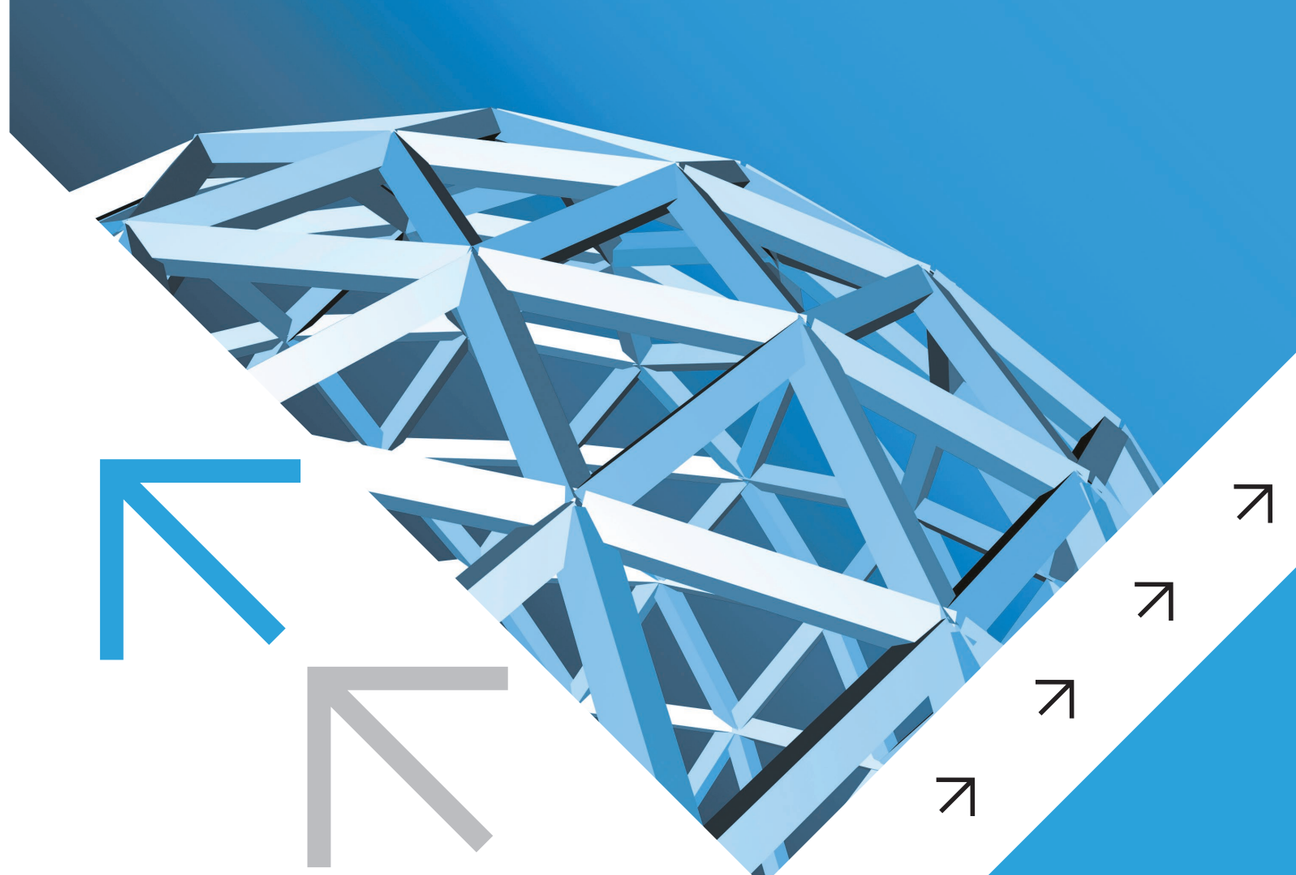
*1 The official name is “ImageNet Large Scale Visual Recognition Challenge.”

*2 The official name is “The Systems of Neuromorphic Adaptive Plastic Scalable Electronics.” It is also called a neuromorphic electronic engineering system.

TT04

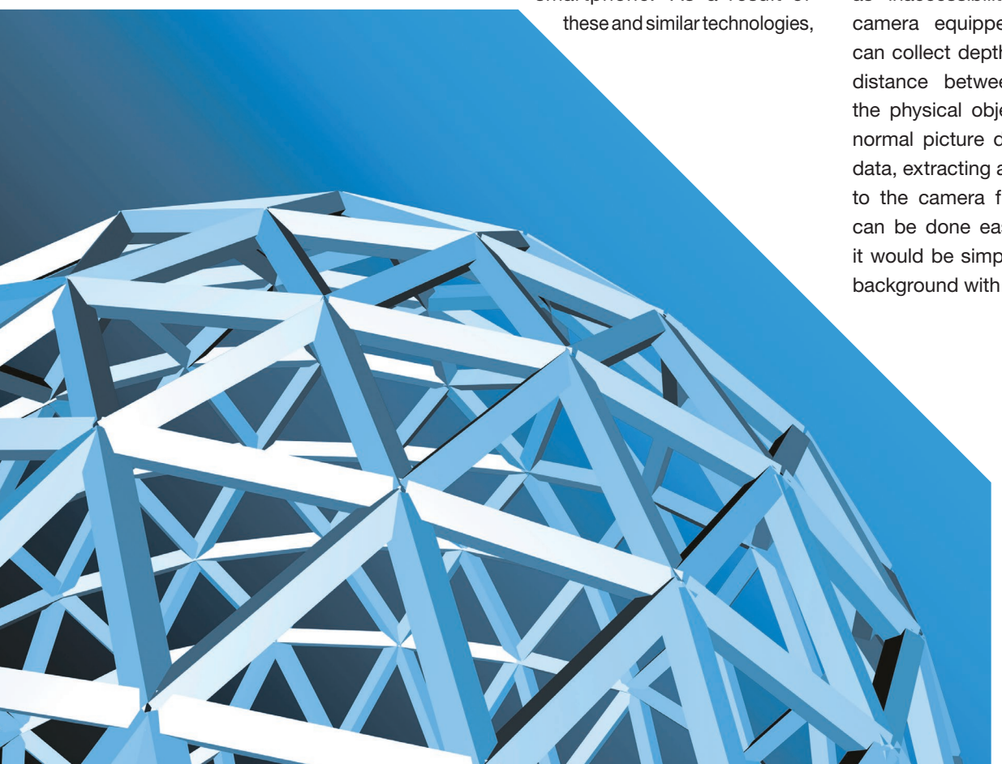
Democratizing 3D Data

3D technology is becoming accessible to everyone. 3D sensing will be available using mobile terminals, and 3D printing will become mainstream. While utilization of 3D technology will become common practice, it will nurture new and innovative uses of the technology impacting society.



Microsoft released a sensor device for its gaming console called Kinect in 2010, which made this 3D sensor available at an overwhelmingly low price. In addition to having a shockingly low price, Kinect has a development support tool that easily enables gesture control and Microsoft succeeded in selling 10 million units in only six months. A device that analyzes the motion of all fingers in millimeters called Leap Motion was also released at a low price in 2013. Then, Project Tango, which is led by Google, marketed a prototype of a smartphone with 3D space recognition capability in 2014. 3D printing, which can easily make something by machining plastic, has been adopted in many schools, and sales of 3D printers are increasing among consumers. Businesses are also starting to use a gaming technology called Unity that can smoothly run a 3D virtual space using a browser or a smartphone. As a result of these and similar technologies, it will become easy to handle 3D information, even if users do not have any special knowledge. A culture that actively utilizes 3D will take root throughout the world.

Space recognition methods that use 3D sensors utilize triangulation or a reflection of light called ToF (Time of Flight). It must be noted that if the space recognition method uses infrared rays, it has restrictions, such as inaccessibility under sunlight. A camera equipped with 3D sensors can collect depth data that shows the distance between the camera and the physical object in addition to the normal picture data. Using the depth data, extracting a person who is closer to the camera from the picture data can be done easily. Needless to say, it would be simple to replace only the background with a different image.



If pictures of a physical object are taken from various angles using a camera equipped with a 3D sensor, a 3D model of the object can be created effortlessly. In the future, users will be able to carry a 3D model of their body. Using such a model, users can not only try on clothes but also see the degree of fitting as a numeric value during online shopping. Users will eventually become able to sense the size of the clothing after several instances of online shopping. In recent years, it became possible to duplicate the wrinkles of clothing during fitting in a virtual space; therefore, a system to try on clothing that is out of stock at an actual store might become feasible as well. There are real estate companies that provide realistic 3D virtual spaces instead of simple images of the room layout of properties. Technically, it is possible to recreate substantially realistic spaces and the user can observe those rooms from any angle. If you create 3D data of furniture, users will be able to arrange it in the virtual rooms. In addition, it would be possible to provide a service for customers to experience actually walking inside of the property virtually by using a helmet-type display such as Oculus Rift. 3D sensors have a wide variety of uses and examples include the latest projection mapping method that projects a beautiful video of a proposed building with a complicated shape, and can then project both the drawing and the actual building after completion for comparative verification.

If anybody can easily use 3D sensors and 3D printing it will continue to spread, and manufacturing and sales by individuals will accelerate. In 2014, Amazon established a 3D printing store that sells products that have been manufactured by 3D printing. There is another service where the website operator takes care of manufacturing and delivery when a product is sold as long as its 3D data is registered. 3D printing cannot only make products using plastic but also metals and fabrics. 3D printing is making tremendous advancements. Hewlett-Packard announced that it will release a printer with a manufacturing speed 10 times faster than competitors in 2016. Manufacturing speed is one of the current challenges of 3D printing. If this issue is resolved, there is a possibility for 3D printing to proliferate even faster.

It will take time for 3D related technology to spread throughout the world. Users may not feel any drastic changes in the coming few years, but there will be major advances over the next 10 years, such as the establishment of an ecosystem*1. To spread 3D related technology, it is necessary to upgrade and expand software and train human resources to handle 3D technology. Although popularization of 3D sensors has the negative impact of making it easy to copy product shapes, it will spread steadily in society and 3D technology will eventually become an essential part of business.

*1 It is a specific mechanism established to increase the profits of the entire industry.

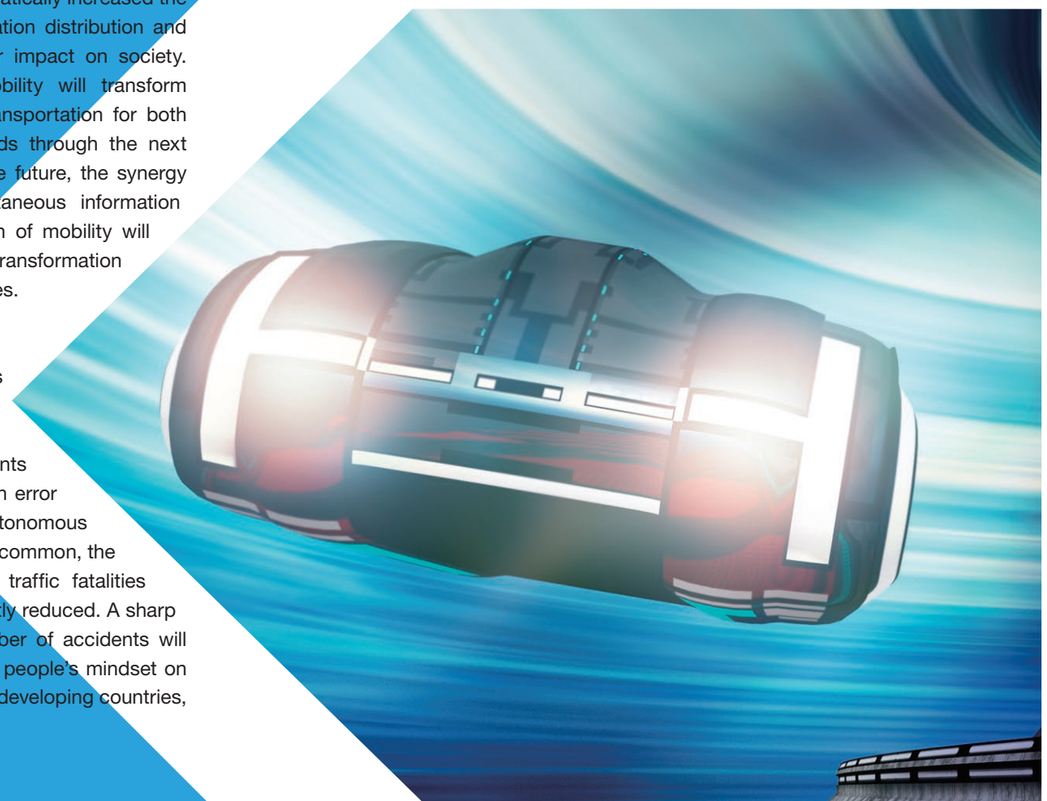
TT05

Next-Gen Mobility and Transportation

A new transportation system centering on autonomous cars will make a significant impact on urban convenience, insurance, logistics and energy policies. For individuals, the means of transportation will be diversified. And for business, drones will be used in certain regions to support logistics.

What comes to your mind when you think of future vehicles? Currently, autonomous cars are eliciting the most attention and it is thought that they will transform urban transportation systems. There are many ideas for mobility for the next generation, such as high-speed rail services to travel between cities in a short period of time, aircraft that fly twice the speed of the current ones or other new means of transportation for individuals. The Internet has dramatically increased the speed of information distribution and has had a major impact on society. Evolution of mobility will transform the means of transportation for both people and goods through the next generation. In the future, the synergy effect of instantaneous information and the evolution of mobility will accelerate the transformation of social structures.

How would autonomous cars affect society? It is said that 93% of traffic accidents are due to human error in judgment. If autonomous driving becomes common, the number of road traffic fatalities can be significantly reduced. A sharp drop in the number of accidents will probably change people's mindset on car insurance. In developing countries, traffic congestion is a serious social issue. There is also the possibility of reducing traffic to some extent if car sharing or car dispatching services that use personal cars as taxis, like UberX, become more widespread. For example, transportation demand in Singapore could be covered by 30% of the cars that exist in the country today by car sharing or dispatching according to an estimation calculated by the Massachusetts Institute of Technology. As long as autonomous taxi service is provided at a low charge, many people might not purchase a car. If that is the case, the number of cars could drop significantly. If the number of cars can be reduced by 30%, then the number of parking lots will decrease and it will affect city planning by the government. Another point to note regarding the next generation of automobiles is a competition between fuel cell cars and electric cars. There are different opinions regarding which type of car will take the lead; however, it is reasonable to believe that the situation will vary by country. Natural gas cars have already been utilized in Iran, Pakistan and Argentina, and there are 14 million units operating around the world. Fuel cell cars use hydrogen for power and continue to have many challenges in technology, cost, and systems. It is believed that these cars will most likely begin to become widespread around 2030. Electric cars, which are an extension of hybrid cars, have the potential to take the lead in the next generation of automobiles.



Innovations in mobility also significantly impact logistics. In recent years, logistics using radio-controlled helicopters called drones have been attracting attention. Delivery services using drones are already being planned in Dubai and Germany.

In the near future, automatic delivery by autonomous cars will be realized. Personal mobility is a one-person vehicle that may fill the gap between walking and autonomous cars. In the countryside, there are many senior citizens who cannot go shopping because public transportation systems no longer exist due to depopulation. In addition, in some urban areas, large grocery stores have shut down branches due to declining profit and there are people who have difficulty going shopping. Personal mobility vehicles powered by electricity are expected to resolve regional transportation issues for senior citizens, because they can be driven with peace of mind, at slower speeds than automobiles. There are a wide variety of shapes in personal mobility, from a bicycle type to a two-wheeler design ridden standing up. Wheelchairs can also be considered as personal mobility device. Nowadays, there are products with excellent designs that are not for conventional use. Means of transportation that are small and slow would cause less damage in case of an accident; therefore, they have the possibility of becoming autonomous before automobiles. Experiments in the U.K. and Singapore have been conducted to let the public ride electric autonomous cars that run on public roads at a low speed.

Advancement of mobility is a versatile concept and it can be seen as supersonic transport that flies between Japan and London in 4 hours, linear motor cars to become available in 2027 that can run approximately 400 km in 40 minutes, and private spaceships that can safely fly at an altitude of 100 km. Mobility for the next generation will not only make transportation more efficient, but will support expeditions to hard-to-reach places such as deep oceans or craters. Technology is a major challenge to the realization of mobility for the next generation, but this is not the only issue that needs to be overcome. One of the major challenges is social acceptance of the new transportation systems. There are psychological issues as well, such as the social acceptance of loss of life due to a malfunction of an autonomous car. Another problem is how to salvage people who cannot catch up with major social changes. In the future, in order for people to enjoy the many benefits of new transportation systems, it will be necessary to carefully develop a legal system, while giving consideration to building social consensus.

TT06

Digital Commerce

Consumer contact points for retail and online businesses will continue to be digitalized rapidly, and websites with customer service capability equivalent to that of humans, as well as bricks and mortar stores with the ability to diffuse Internet information, will emerge. Customer management will be expanded to potential customers who do not yet have contact points with the company.

The Internet has drastically changed people's purchasing behavior. The world's e-commerce market has become prevalent in people's lives and it has reached $1 trillion dollars as of 2013. The market is expected to grow up to $2.5 trillion dollars by 2018.

Major retailers that have many brick and mortar stores and pure e-commerce companies are both competing for share in an expanding market. Whichever company succeeds in improving quality and expanding customer contact points will win market dominance. Once companies succeed in reforming customer contact points, they will realize the "interactive commerce" that is closely tied to consumers and will lead the future market.

One advantage of e-commerce is that it is easier to acquire consumer data than within traditional retail stores. Advanced companies are already utilizing website navigation history to improve functions that are not user friendly and to enable early identification of criminal activities. Data analysis can also categorize the visitors of the website between those who are "just looking" and those simply "being indecisive." Some companies are increasing sales by having actual people serve the customers who are indecisive. Companies that only have a website and sales staff without having a brick and mortar office are also attracting notice. In addition, the number of companies that combine the customer service capability of people at traditional retail stores with the efficiency of websites is expected to increase in the future. On the other hand, traditional retail stores are rapidly incorporating the efficiency of e-commerce. For example, technology called a beacon or physical web displays a variety of information on smartphones when you get close to targeted merchandise. Analyzing customers' behavior using cameras and sensors placed within the store also enables the optimization of merchandise displays and assortment. Utilization of IT has also been reinforcing conventional retail stores, guiding customer behavior by disclosing the quantity of merchandise in stock or drawing customers to stores by introducing merchandise coordinated with the sales staff. The number of companies introducing tablets to improve productivity and customer service capability of sales staff is expected to increase. There is already significant competition around this foundation of store operations, and some companies have started distributing tablets with functions for accounting and totaling sales free of cost.

Because e-commerce encompasses the features of conventional stores and vice versa, the borderline between e-commerce and traditional retail stores is beginning to disappear. Omnichannel retailing will emerge and will make it possible for merchandise to be found, reviewed, received, returned and serviced from anywhere at any time. It will also enable companies to better understand consumers' behavior. Then companies will be able to do sales promotions and sell merchandise according to the needs of consumers.

One of the biggest challenges associated with the realization of omnichannel is the optimization of logistics. Logistics have been transformed in e-commerce and there are already services that deliver merchandise to a locker at convenience stores that are open 24 hours, or to the customer's home within an hour. A way for brick and mortar retail stores to compete against such a service would be via the promotion of omnichannel so that merchandise can be sold, returned and delivered at any store. Omnichannel can improve convenience to customers, but it makes logistics and handling of customers more complicated. As a result, the success of ominichannel requires big data analysis and the optimization of distribution and operations.

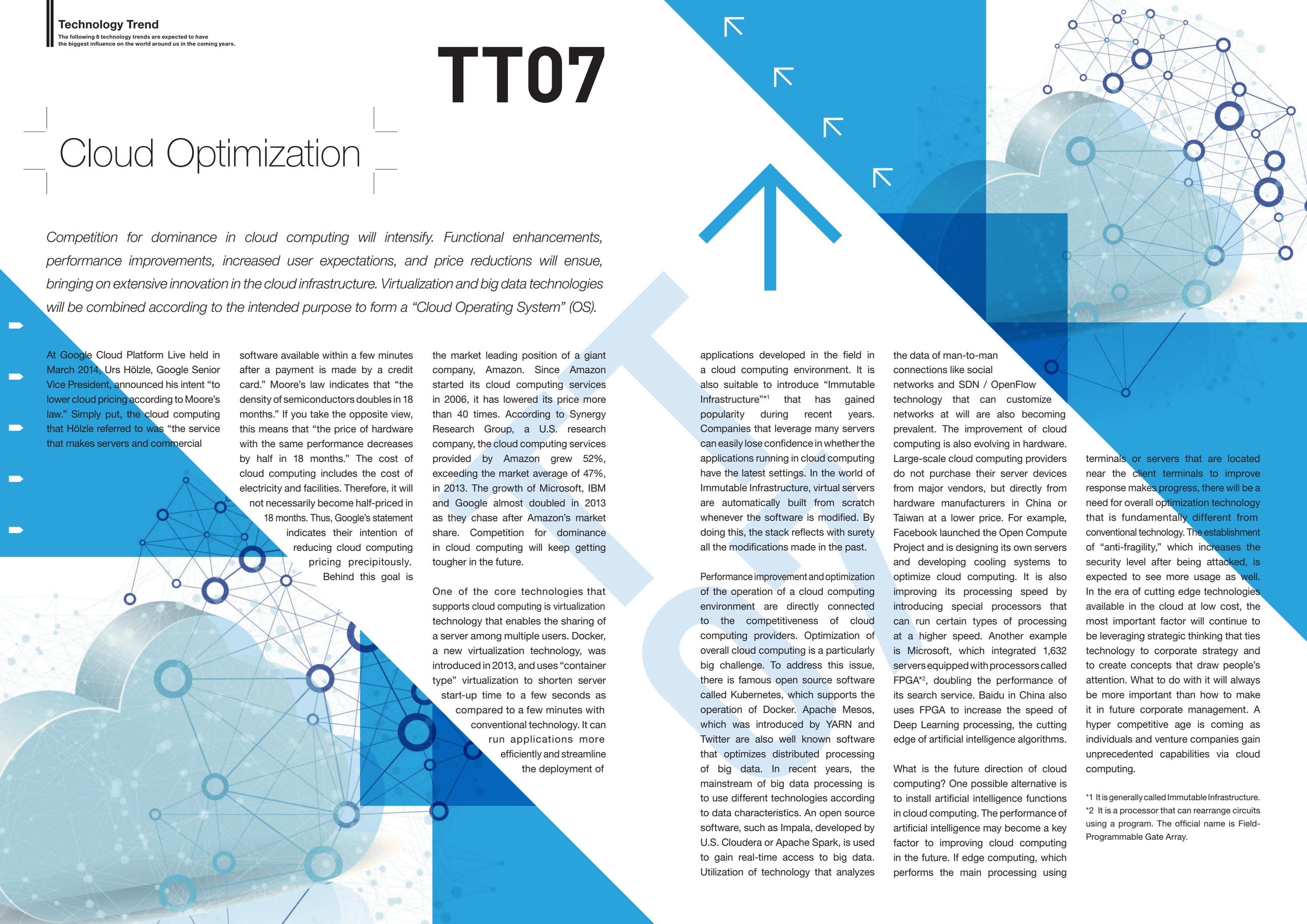
Digital marketing is attracting attention as a way to increase customer contact points. Major IT vendors have already started to purchase companies that sell marketing tools to expand and improve solutions. In recent years, marketing automation technology that automates the work processing required to kick off sales promotions and measure their effectiveness has emerged. In addition, private Data Management Platforms (DMPs) that implement effective marketing strategies by creating a database of customer and potential customer information are being utilized. There will be many cases of advanced marketing that fuse together these mechanisms and SNS data obtained from other companies in the future.

The status of retailing varies by country. For example, use of e-commerce is expanding faster in countries such as China. This difference is assumed to be due to a unique perception in China that famous e-commerce companies are more trustworthy than nearby retail stores. Global companies must understand the unique circumstances of each country to use both e-commerce and traditional retail stores strategically. Because omnichannel is just a tool, it is equally important to increase essential brand power and customer loyalty. Technology tends to be the center of attention in the realization of ominichannel, but it is also necessary to carefully consider the supporting organizational structure and its targeted customers.

TT07

Cloud Optimization

Competition for dominance in cloud computing will intensify. Functional enhancements, performance improvements, increased user expectations, and price reductions will ensue, bringing on extensive innovation in the cloud infrastructure. Virtualization and big data technologies will be combined according to the intended purpose to form a "Cloud Operating System" (OS).



At Google Cloud Platform Live held in March 2014, Urs Hölzle, Google Senior Vice President, announced his intent "to lower cloud pricing according to Moore's law." Simply put, the cloud computing that Hölzle referred to was "the service that makes servers and commercial software available within a few minutes after a payment is made by a credit card." Moore's law indicates that "the density of semiconductors doubles in 18 months." If you take the opposite view, this means that "the price of hardware with the same performance decreases by half in 18 months." The cost of cloud computing includes the cost of electricity and facilities. Therefore, it will not necessarily become half-priced in 18 months. Thus, Google's statement indicates their intention of reducing cloud computing pricing precipitously. Behind this goal is the market leading position of a giant company, Amazon. Since Amazon started its cloud computing services in 2006, it has lowered its price more than 40 times. According to Synergy Research Group, a U.S. research company, the cloud computing services provided by Amazon grew 52%, exceeding the market average of 47%, in 2013. The growth of Microsoft, IBM and Google almost doubled in 2013 as they chase after Amazon's market share. Competition for dominance in cloud computing will keep getting tougher in the future.

One of the core technologies that supports cloud computing is virtualization technology that enables the sharing of a server among multiple users. Docker, a new virtualization technology, was introduced in 2013, and uses "container type" virtualization to shorten server start-up time to a few seconds as compared to a few minutes with conventional technology. It can run applications more efficiently and streamline the deployment of applications developed in the field in a cloud computing environment. It is also suitable to introduce "Immutable Infrastructure"*1 that has gained popularity during recent years. Companies that leverage many servers can easily lose confidence in whether the applications running in cloud computing have the latest settings. In the world of Immutable Infrastructure, virtual servers are automatically built from scratch whenever the software is modified. By doing this, the stack reflects with surety all the modifications made in the past.

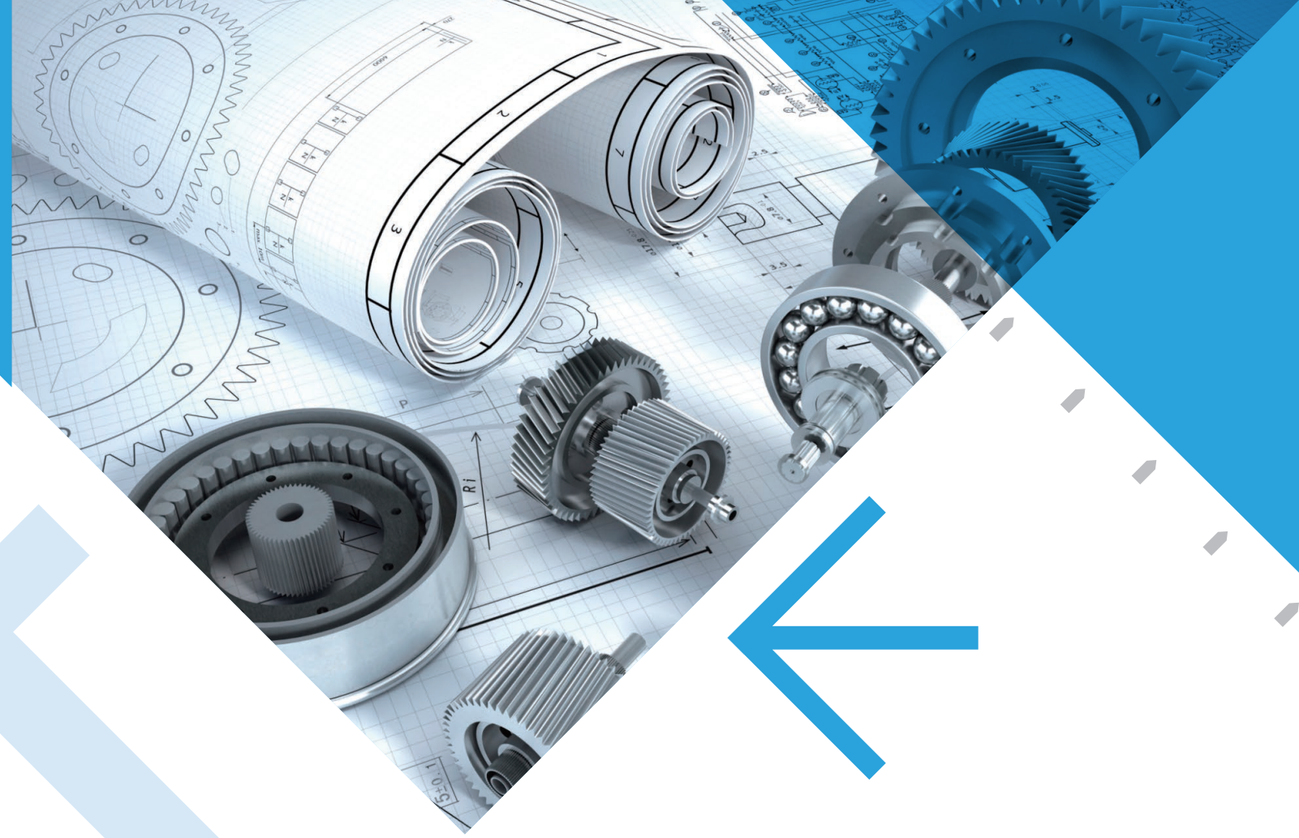
Performance improvement and optimization of the operation of a cloud computing environment are directly connected to the competitiveness of cloud computing providers. Optimization of overall cloud computing is a particularly big challenge. To address this issue, there is famous open source software called Kubernetes, which supports the operation of Docker. Apache Mesos, which was introduced by YARN and Twitter are also well known software that optimizes distributed processing of big data. In recent years, the mainstream of big data processing is to use different technologies according to data characteristics. An open source software, such as Impala, developed by U.S. Cloudera or Apache Spark, is used to gain real-time access to big data. Utilization of technology that analyzes the data of man-to-man connections like social networks and SDN / OpenFlow technology that can customize networks at will are also becoming prevalent. The improvement of cloud computing is also evolving in hardware. Large-scale cloud computing providers do not purchase their server devices from major vendors, but directly from hardware manufacturers in China or Taiwan at a lower price. For example, Facebook launched the Open Compute Project and is designing its own servers and developing cooling systems to optimize cloud computing. It is also improving its processing speed by introducing special processors that can run certain types of processing at a higher speed. Another example is Microsoft, which integrated 1,632 servers equipped with processors called FPGA*2, doubling the performance of its search service. Baidu in China also uses FPGA to increase the speed of Deep Learning processing, the cutting edge of artificial intelligence algorithms.

What is the future direction of cloud computing? One possible alternative is to install artificial intelligence functions in cloud computing. The performance of artificial intelligence may become a key factor to improving cloud computing in the future. If edge computing, which performs the main processing using terminals or servers that are located near the client terminals to improve response makes progress, there will be a need for overall optimization technology that is fundamentally different from conventional technology. The establishment of "anti-fragility," which increases the security level after being attacked, is expected to see more usage as well. In the era of cutting edge technologies available in the cloud at low cost, the most important factor will continue to be leveraging strategic thinking that ties technology to corporate strategy and to create concepts that draw people's attention. What to do with it will always be more important than how to make it in future corporate management. A hyper competitive age is coming as individuals and venture companies gain unprecedented capabilities via cloud computing.

*1 It is generally called Immutable Infrastructure.
*2 It is a processor that can rearrange circuits using a program. The official name is Field-Programmable Gate Array.

TT08

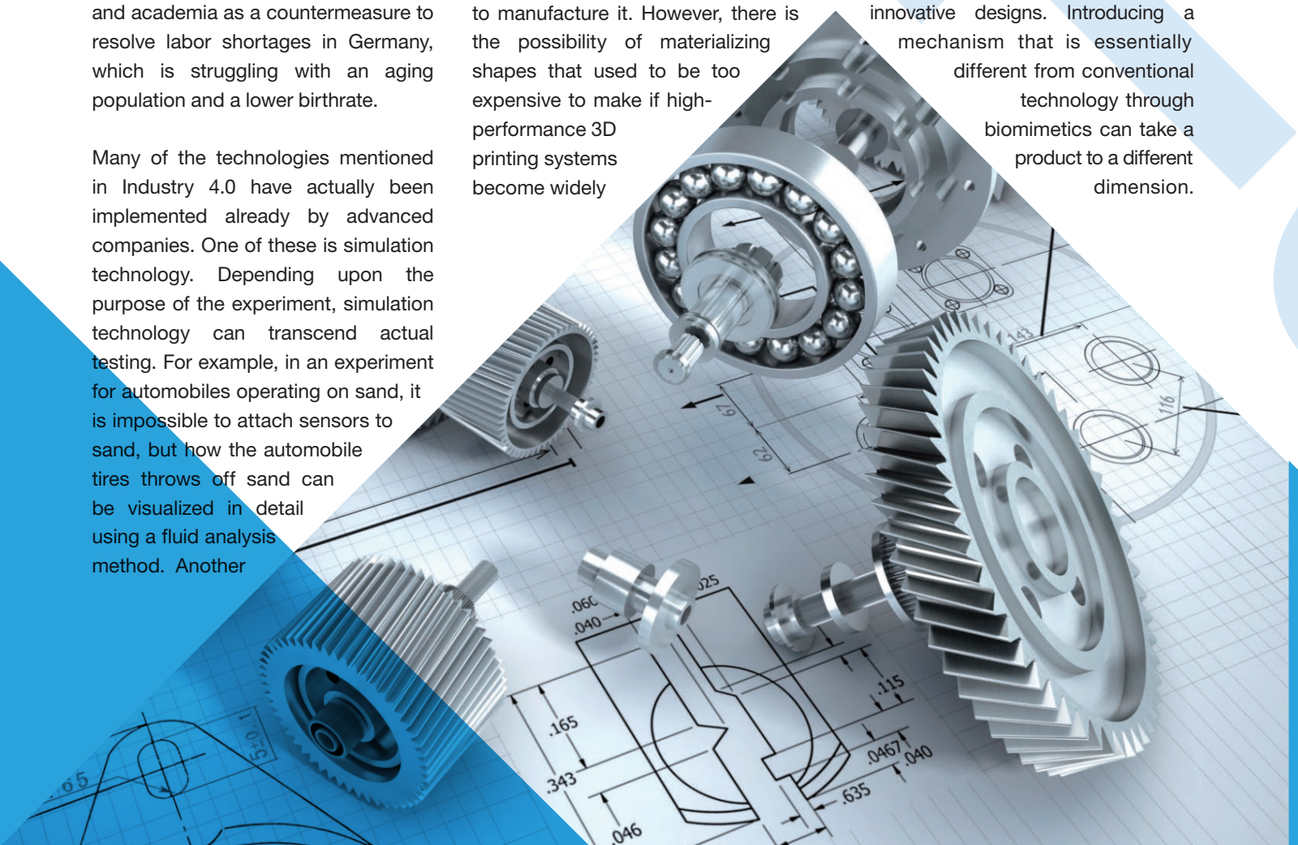
Engineering Innovation



Advanced simulation technology will be used increasingly in R&D and design phases to know what will work before making further investments. In product development, biomimetic technology and 3D printing will be utilized. Remote maintenance using big data will become popular, making the entire business operation more efficient.

At the Hannover Messe 2011, the world's largest industrial fair, Germany announced the concepts of "Industry 4.0" to lead the fourth industrial revolution. Industry 4.0 is a national project that links factories, goods and services through the Internet and creates new values and business models. It will be implemented through the joint effort of industry, government and academia as a countermeasure to resolve labor shortages in Germany, which is struggling with an aging population and a lower birthrate.

Many of the technologies mentioned in Industry 4.0 have actually been implemented already by advanced companies. One of these is simulation technology. Depending upon the purpose of the experiment, simulation technology can transcend actual testing. For example, in an experiment for automobiles operating on sand, it is impossible to attach sensors to sand, but how the automobile tires throws off sand can be visualized in detail using a fluid analysis method. Another simulation technology that is attracting attention is topology optimization. It uses computers to consider shapes that meet restrictions, such as strength or size, and it can find creative shapes that are outside the box. Behind this trend, is a sudden drop in 3D printing prices. Up until now, even though topology optimization could design an innovative shape, there were no means to manufacture it. However, there is the possibility of materializing shapes that used to be too expensive to make if high-performance 3D printing systems become widely available. In addition to 3D printing, if distribution center automation technology and cooperative robots that work together with people on production lines are implemented, then factories will be completely different from today. As a result, it would be possible to mass-produce custom-made products. In addition, biomimetics cannot be forgotten in the materialization of innovative designs. Introducing a mechanism that is essentially different from conventional technology through biomimetics can take a product to a different dimension.



The manufacturing process is not the only one that can gain a competitive edge from information technology. Technology is also revolutionizing maintenance. Once factories are connected to the Internet, they can enable remote maintenance in case of a breakdown. Currently, the maintenance staff goes to the site and starts looking for the root cause. However, there will be many cases where the root cause has already been clarified by the time the staff gets there. This also changes the concept of maintenance. The mainstream of maintenance is to perform inspections periodically such as once a year. However, it is expected to become popular to perform maintenance based on condition by identifying devices with a higher probability of failure through big data analysis and prioritizing the maintenance of deteriorated parts.

Today's fields require advanced specialization, and it is necessary for multiple teams to collaborate to develop products and services. Because this operation can easily cause confusion, it would be effective to digitize the design drawings, standardize call outs and automate the verification operation. The manufacturing industry is not the only one that digitizes the design process and manufacturing process. Construction and civil engineering processes are also being digitized using BIM / CIM*1. In addition, the information technology industry also digitizes designs and an ultra-rapid development method has been put to practical use for better productivity than the conventional method. Another point to note regarding the information technology field is a value accumulation type of development method called Agile or A / B testing. It promptly collects ratings from users and quickly feeds it back to the product. This cycle is repeated many times to improve the product over and over to maximize its value. This is a good process for software development because software can be changed more easily than hardware.

The United States has taken the initiative in the areas of individual data collection and artificial intelligence. Moreover, the United States and Europe are fiercely competing against each other in the area of biotechnology related to the brain and genes. Who is going to take the initiative in the new battlefield of innovation in the manufacturing industry? It might take almost 10 years for Industry 4.0 to be adopted universally because it requires careful standardization. However, it will steadily penetrate into companies. Then, advanced information technology will be applied to design, operation and maintenance. This will not only change dramatically the appearance of manufacturing aesthetically, but also the design in a broad sense, including process, strategy, and business model design. The realization of manufacturing lines that have adopted advanced information technology will increase products and services customized for individuals. At the end of the day, the key to success will be whether the products and services elicit a heartfelt response.

*1 The official name is Building Information Model/ Construction Information Modeling.

Examples of NTT DATA Initiatives Related to Technology Trends

Invisible Computing

A functional material that measures biological information automatically just by wearing something called “hitoe”

Conventionally, taking an electrocardiogram or heart rate requires special devices, and it has normally been troublesome to attach these devices to the body or to carry the device. However, wearing an item of clothing made of the functional material called “hitoe” enables easy and comfortable measurement of biological information in a variety of everyday scenarios. “hitoe” is a durable material and has a high sensitivity for detecting biological signals, and it is made by impregnating nanofiber fabric with conductive resin. It can continue to measure under any living environment such as a workplace, school, and while playing a sport or driving. Its strength is that it can stably acquire biological signals, especially during physical activities. NTT DATA analyzes and utilizes various data acquired from sensing devices like “hitoe” to strive towards social infrastructure that supports a comfortable life.

* “hitoe” is a registered trademark of a conductive functional material jointly developed by Toray Industries, Inc. and NTT.

Challenge of Artificial Intelligence

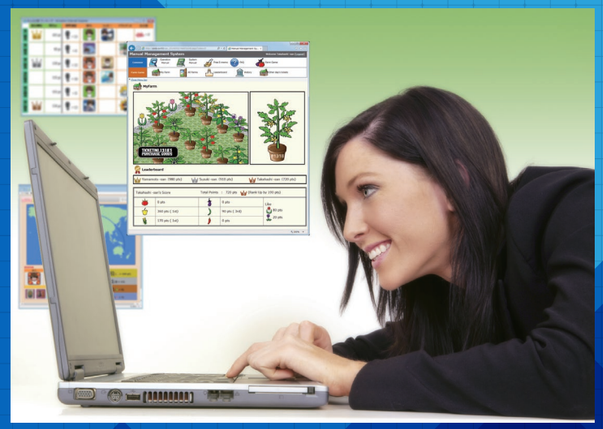
Casual conversation technology that realizes natural conversations between humans and computers

“Artificial intelligence” includes a variety of technical areas. Machine translation, voice recognition, image recognition, conversation, recommendation, natural language processing and big data analysis are examples of such areas. NTT has been working on the research and development of these segments of artificial intelligence. For example, NTT DATA developed a “Global Conference Assistance System” that translates the conversation, prepares text and outputs conference minutes in different languages through a fusion of machine translation and voice recognition. In addition, NTT DOCOMO provides a “casual conversation technology.” With casual conversation technology, the computer can analyze what the user said and talk back naturally by taking the context into account. Not only can it carry a flexible conversation according to the circumstances based on the vast knowledge that it has learned beforehand, but also it can change the ending of words to express personality. If it continues to incorporate conversation data and improve, it will in the future be able to carry a conversation at the same level as a human.

* The casual conversation technology was developed by NTT DOCOMO with NTT’s basic technology.

Science of Life and Emotion

Gamification: increasing motivation in business with the psychology of competition and a sense of accomplishment



Applying the “elements of gaming,” e.g., leveling up, team play or rankings, can provide a sense of accomplishment or self-satisfaction while having fun, increasing motivation and engagement. NTT DATA has a motivating gamification method incorporated into a variety of systems. For example, the System Maintenance Department has a control screen illustrating a town. The service operation rate is expressed by weather and the number for business improvement is displayed as the number of houses so that the status can be understood while having fun. The Administrative Department applies a farming game interface and every time a task is completed, a vegetable grows and you can earn points. The Sales Department applies a puzzle game style. When sales information is registered into the system, you can obtain pieces of a puzzle depending on the frequency, volume and quality. We plan to continue our use utilization of human psychology and emotions for businesses using a scientific approach.

Next-Gen Mobility and Transportation

Alleviation of traffic congestion through traffic forecasts and signal control using big data

NTT DATA developed a system that derives and controls optimum signal changing timing to alleviate traffic congestion. It understands the current traffic conditions and simulates the future traffic conditions based on the information obtained from vehicles, such as location information and speed. A field study of this system was conducted in Jilin City, China. GPS information from approximately 200 buses in the city and statistical information from road and traffic volume research were combined to achieve the optimum signal changing timing using the system. The system actually changed the signal settings of 60 signals at intersections throughout the city. The result is that it alleviated traffic congestion and the operation time of buses improved up to 27%. The local police noticed and felt the improvement and the effect was acknowledged. As a result, the city decided on the continued use of the signal settings. We are going to kick off smart city-related projects in various countries in the near future.

The Physical-Digital Convergence in Retail

Securing authentication using the input from a virtual keyboard in a smart-glass environment

Although the utilization of wearable devices in business is expected, there is a challenge with smart glasses in that they cannot be used to enter letters because there is no keyboard or touch panel. However, it is essential to enter an ID or a password for authentication in order for them to be used with a variety of existing enterprise systems. To address this, NTT DATA developed a technology that shows a virtual input keyboard on the smart-glass display so that letters can be selected by gesture to enter an ID or a password. Because it uses a keyboard in augmented reality (AR) and actual fingers to control the keyboard in the air, it can prevent peeking or secret filming and ensure high security without leaving any trail. In addition to these security countermeasures, the NTT DATA Group will accelerate the development of enterprise systems utilizing wearable devices and various applications to be used in business.

Design and Production Innovation

Realizing mass production of a titanium alloy earphone casing using 3D printing

Based on its track record in technical development and establishment of knowhow in 3D printing for nearly 20 years, NTT DATA Engineering Systems continues to expand the application of 3D printing using its extensive experience in optimization methods and layout design. The result is our ability to form a shape previously thought impossible, as well as a laser irradiation parameter design that improves surface treatment quality. One example of this is the first mass production earphones with a completely integrated casing made of titanium alloy using 3D printing*. Because 3D printing remains behind conventional manufacturing methods in terms of cost and accuracy, it has not yet been used often to mass-produce goods. This success is only the first example and there is the potential to expand the industrial application of 3D printing at a variety of manufacturing sites in the future. The manufacture of “Functional shapes” unique to 3D printing will be pursued to increase value.

* NTT DATA Engineering Systems cooperated with a final audio design to develop “final audio design LAB 01,” that is “titanium earphones manufactured by 3D printing for the first time in the world.”

Looking ahead : Technology trends driving business innovation.

More than ever, the importance of applying innovative technologies

for sustainable growth is accelerating.

NTT DATA Technology Foresight presents

information society and technology trends.

By analyzing major issues within politics, the economy,

society and technology,

we hope to deliver business innovation for our clients and society.

Tsuyoshi Kitani

Senior Vice President

Head of Research and Development Headquarters

NTT DATA Technology Foresight

NTT DATA is a leading IT services provider and global innovation partner headquartered in Tokyo, with business operations in over 40 countries. Our emphasis is on long-term commitment, combining global reach with local intimacy to provide premier professional services varying from consulting and systems development to outsourcing. For more information, visit www.nttdata.com.

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