NTT DATA
Global IT Innovator

NTT DATA Technology Foresight

2014

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 vision of the impact that

future technology will have on the world around us

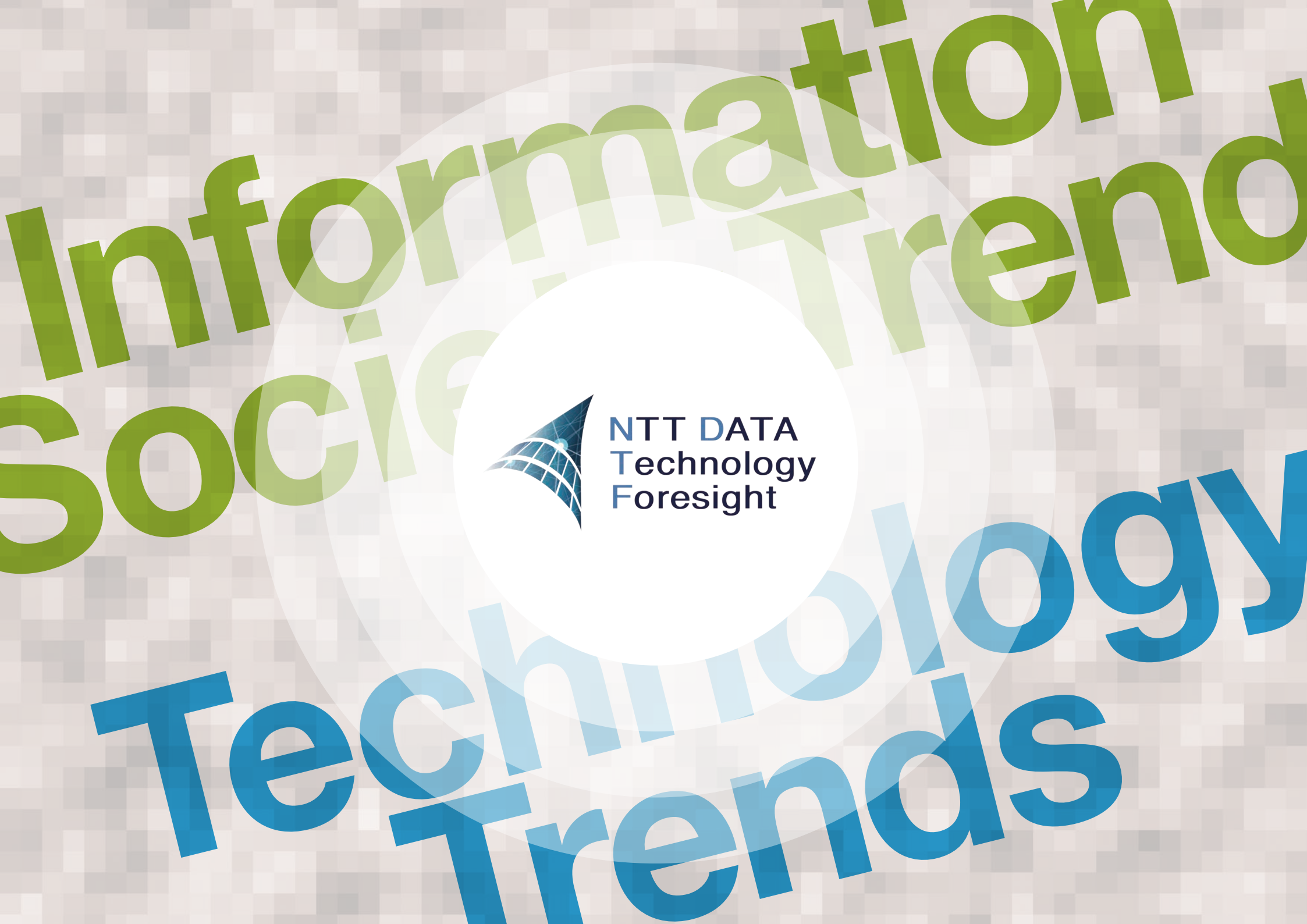
and then working to deliver it.

At NTT DATA, we incorporate Technology Foresight

into our management strategy.

We are committed to developing technologies and services

that anticipate change in the business environment.


Information
Social Trend
NTT DATA
Technology
Foresight
Technology
Trends

NTT DATA Technology Foresight aims to map out the impact that technology will have on society and business in the coming years and outline expected business innovation.

Information Society Trends

NTT DATA Technology Foresight


IST01
Power of the individual
IST02
Collaborative value creation
IST03
Knowledge society
IST04
Smarter society

01 Power of the individual

The growing influence of individuals will transform existing societies and industries. It will be necessary for businesses to recognize the increasing power of the individual and re-focus existing processes into a more customer-centric model.

Individuals have obtained the power to instantaneously transmit their messages on a global basis through social media. It is no longer possible to ignore the influence that individuals have on shaping opinions and even prompting political reform. For example, the spread of online shopping has altered the purchase decision-making processes of consumers, resulting in the increase of showrooming[1] and direct shipping. The natural convergence between online and offline that has evolved among individuals has encouraged businesses to offer seamless customer understanding and services across multiple channels. Based on a re-definition of matters, such as the value provided to customers and the role of each channel, providers must shift from product-focused silos to a customer-centric approach that drives customer value. For instance, recommendations to consumers have evolved, from the basis of past records of other buyers with similar purchasing histories, to a method that incorporates the taste and buying record of each individual consumer. There are also cases where related providers, such as the aviation and hotel businesses, collaborate for better customer understanding.

In the past, innovation emerged in the resource-intensive and highly specific fields of Business- to-Business. However, in recent years, more innovation has emerged in the consumer market. We are now witnessing consumerization, whereby technologies and services that were initiated in the consumer market, - such as smart devices and the use of social media, - have now transferred into the world of business. Consumerization can also be understood as a partial transfer of the initiative to decide the business platform from companies to employees. In accordance with the broadening applications of smart devices such as displays, remote controls, keys and payment methods, the scope of influence of the individual has also been expanding. The introduction of payments via smart devices and virtual fitting rooms, in sync with social media, has resulted in the possibility of a review of bricks and mortar store design.

In medicine and healthcare, there has been an increasing recognition that the choice of treatment methods that take into account factors such as a patient's medical condition; pre-existing condition; genetic information; living conditions and mental state will enhance

the quality and effectiveness of treatment. In particular, patients with chronic diseases have a higher possibility to continue treatment for a long time by setting achievable lifestyle improvement goals. Today, genetic testing and nutritional guidance tailored to the individual are key to the prevention of disease. In the future, the personalization of medical care is expected to advance even further.

E-learning, which initially existed to complement school education, has been recognized for its effectiveness in teaching materials suited to each individual's level of understanding, and it has changed school education. The flipped classroom, in which students learn at home and individual feedback and group work are done at school, is spreading throughout the world. Now, e-Learning has expanded from primary education to higher education, and there is hope that it can provide students with the ability to play an active part in the world even if they are economically disadvantaged.

The use of 3D printing has expanded from the production of prototypes to the manufacturing of products, and it has facilitated the personalization of products. The appearance of 3D printing models for household use has transferred a part of the manufacturing process from the provider to the user. The publication of 3D data leads to the commercialization of individual design. With additive manufacturing being incorporated into the manufacturing process, start-ups now have the opportunity to compete on an equal footing with large companies. Low-volume production of parts with special shapes has become easier, and a change in the manufacturing process to perform on-demand production close to the usage site is also taking place.

Today, it is the generation referred to as "digital immigrants" - or those that have adapted to the introduction in their lifetime of smart devices and the internet - that dominates society. As "digital natives", - those who have been familiar since birth with the internet and personal computers and take for granted that services can be obtained anywhere, at any time,- increasingly form the core of society, society will change . Having been surrounded since birth by smart devices and social media, the next generation will differ even more in their way of thinking. Innovation typically emerges from the consumer sector and going forward, is expected to spread to the fields of business-to-business and government-to-business. How to protect personal data will continue to be an important challenge. But it is believed that, by the time digital natives form the core of society, the way that personal data is viewed, will also change.

1 People increasingly view goods in shops, but buy them online (predominantly to secure the best price).

02 Collaborative value creation

In an advanced information society, the consolidation of a large number of opinions and the ability to secure professional human resources will become easier. This will result in more innovation. Cooperation between companies and users will also continue to progress and there will be increasing use of a participatory model, in which users assume partial responsibility for product development and related services.

The Internet has greatly contributed to the formation of collective intelligence, and it has obscured the boundary between provider and user. New business opportunities that leverage collective intelligence are also arising. On the Internet and in social media, much of the content is posted by users. The authors of the most widely used encyclopedia on the Internet, Wikipedia, are also anonymous Internet users. When compared to encyclopedias edited by experts, it is on the whole, as accurate as traditional references and, indeed, some believe that it provides even more information than printed encyclopedias.

The use of user information is now spreading to highly specialized areas such as medical care. For example, there is one global community of over 200,000 patients with intractable diseases, in which the sharing of experiences and feelings between patients is said to lead to improved quality of life. The raw information obtained from patients within this community is provided to physicians, researchers, pharmaceutical companies, regulatory authorities and similar interested parties, and it is used as a reference for matters such as therapy development and policy decisions. Another project that has been introduced is one that asks individuals to anonymously disclose their gene data to physicians and researchers so that it can help promote gene therapy research.

The effect we can expect from the spread of smart devices is similar to that of installing cameras and sensors throughout a city. The smart devices of citizens will automatically provide a variety of information in real-time, such as traffic congestion, potholes, air pollution and earthquakes. In such participatory sensing, in which citizens and businesses cooperate in monitoring and detecting abnormalities, the low accuracy of individual data can be mitigated by the large number of collected observation data. Because of this and its lower cost compared to the installation of dedicated sensors, participatory sensing is becoming more popular. There have also been cases of using surveillance cameras in neighborhoods to deter crimes and arrest suspects.

Crowdsourcing as a means of developing products has been effective in reducing costs and shortening the time spent on R&D. It has also helped start-ups roll out new technologies and services. One benefit of crowdsourcing is the increased collaboration between start-ups and established companies. That, in turn, will foster increased innovation in the marketplace. The historic one-way relationship between provider and customer is expected to give way to a two-way relationship, where customer participation is used to help develop and promote products. Crowdfunding, - which uses crowdsourcing as a funding mechanism,- and peer-to-peer (P2P) lending, - which links the lenders and borrowers of funds, - have facilitated fund-raising for start-ups. At the same time, crowdfunding and P2P lending have lowered the barriers for start-ups to get support not only from organizations, but also from individuals.

In addition to collecting ideas through contests, there are also instances where customers cooperate with the provider without being aware, such as through their reactions on social media, as well as via sensor information from smart devices and vending machines. Customer behavior and the effects of advertising are all useful data points for manufacturers or service providers, in terms of reviewing existing sales, as well as considering new services. Among free services that exist on the Internet, there are also many multi-sided business models where the user cooperates with the funder as the information provider.

The distribution of virtual currency and digital currency, which do not have a guarantee of value by the state, is increasing. In addition to money transfer between individuals, there are also digital currencies that are used for payment in actual stores, exchanged with cash, payment of salaries and used for tax payments. The users support its value. The user population has increased in line with its expanding scope of use, and new ways of usage are being introduced. The market for these new currencies is unstable, because they have no proof of value, but they hold the promise of emerging out of being just an auxiliary means of payment, and leading to a review of the roles of monetary systems and banks.

The information distribution infrastructure that has been established by the Internet has facilitated collaboration that goes beyond the framework of existing organizations. Breaking down organizational silos and blurring boundaries of involved parties enhance the optimal procurement and effective use of resources, so creating the environmental changes to accelerate innovation. In the future, it will be necessary to review regulations and social mechanisms so that they do not interfere with innovation.

03 Knowledge society

The amount and variety of accumulated information will continue to grow rapidly and the analysis and application of information will become more sophisticated. The source of value will shift from tangible things and assets to the utilization of knowledge, design and functionality.

Today, we are in a period of transition, moving towards a knowledge society. The spread of smart devices and social media has greatly advanced the digitization and accumulation of customer behaviors and attitudes. By 2020, the data created and copied annually is expected to reach 40,000 exabytes, or 40 trillion gigabytes. Data used to help management decision-making, - such as prospecting data and results on new product development, - is still around 0.5%[1]. However, there have been examples in which hitherto unexpected consumer behavior has been explained by social media analytics, as well as examples in which citizen behavior patterns have been used as part of urban planning. The decisive factor, in terms of value, is the success or failure of analytical algorithms. Another finding reports the productivity of companies adopting data-driven management to be 5 to 6% higher[2].

The development of globalization and the expansion of digitization are accelerating the commoditization of products. Generating sufficient new demand through price competition or increased functionality is no longer sufficient and we are beginning to see companies change strategy to embrace the new knowledge society. The appeal of new values such as good health, reduction of environmental impact and assistance to developing countries has similarities with the concept of shared value[3]. The conversion of pricing strategy, from competitive pricing to premium pricing, reflects a shift in the basis of pricing from cost to value. Since even the same product or service provides different degrees of value according to factors such as the customer or situation, a transformation is occurring from one price for identical products to multiple prices for identical products. For example, the rates of airfares and hotels vary greatly depending on the season and demand. In the same vein, attempts have already been made in grocery stores to offer different prices for products such as daily necessities based on the customer's purchasing history and personal profile. Price modeling that takes into account the value to the customer is also starting to expand. Examples include real-time pricing of toll and parking fees depending on the congestion situation; dynamic pricing of sport events according to the team's rank and players, as well as auctions and reverse auctions.

In the manufacturing industry, movements to provide products as parts of complete solutions, rather than individual items, have amplified. The "servitization", or the increased focus on services, leads to the long-term continuation of relationships between providers and customers and a shared sense of purpose. Value is not something that is used or consumed, but depends on the benefits realized, and it is co-created by the customer and provider. For customers, this has the advantage of shifting from CAPEX to OPEX, in addition to facilitating the response to changes in the market environment. The conversion from ownership to usage is also connected with the increased focus on sustainability and the increased criticism of materialism.

It is said that private cars are only used for an average of about 1 hour per day. Particularly in Europe and the U.S., peer-to-peer (P2P) sharing of cars, rooms, garages, various tools and pets is expanding. These initiatives can now be established as businesses, thanks to transaction costs having been reduced significantly as a result of the use of social platforms and the spread of smart devices. There are discussions regarding regulations, insurance and taxation, but products such as cars that can easily be converted to P2P sharing are readily available. These businesses are still small in size, compared to existing businesses, but they have grown to become a presence that cannot be ignored, and have become subject to new regulations. It is also possible that these businesses will lead to a change in society's perception about ownership and consumption.

Flexible service designs have made possible services that were once difficult to realize by traditional business models. In microfinance, which provides financial services to the poor, there are loans that have maintained a high repayment rate despite being unsecured. Understanding the motivations of people seeking loans, has resulted in a positive effect on poverty reduction and increased independence. In some countries, regions that are not profitable for publicly-owned telecommunications companies are now covered by the wireless networks of nonprofit organizations (NPOs).

The shift from an industrial society to a knowledge-based society will involve the transformation of fundamental ways of thinking about social life in relation to production, consumption, labor and value. The values of an industrial society will not be denied in a knowledge society, but they will have a different orientation. There is a possibility that the two value systems will be opposed to each other in the transition period, but it is expected that corporate strategy will also be divided into different camps, -one where value is dependent on things and assets, and one where value is dependent on knowledge, design and functionality. The analysis of information and the sophistication of activities are expected to lead to the creation of new values, competitions and markets.

1 IDC Digital Universe Study, sponsored by EMC, December 2012.

2 Erik Brynjolfsson, Lorin M. Hitt, and Heekyung Hellen Kim, "Strength in Numbers: How Does Data-Driven Decisionmaking Affect Firm Performance?" April 22, 2011.

3 Shared value. Concept of evaluating corporate activities based on the realization of both economic value and social value. It has been proposed by individuals such as Professor Michael Porter of Harvard University, and some companies are already putting it into practice.

04 Smarter society

A flexible response to changes will make possible the reduction and steady solution of social issues. Prevention and damage mitigation by prediction and forecasting will lead to the realization of a sustainable society.

The world population will continue to increase mainly in developing regions, and its estimate for 2050 exceeds 9.5 billion people[1]. Urbanization and aging are accelerating, and the improvement of basic services such as water, food, electricity, gas, education and medical care is in urgent need in regions where the population is growing rapidly. In contrast, in developed countries, it will be necessary to review urban planning based on growth assumptions, given the stagnation of population and maturity of the economy. Physical and technical countermeasures, such as securing resources and doctors, power plants, construction of schools, expansion or extension of roads as well as the increased frequency and acceleration of transportation facilities, require a large initial investment, as well as time and expenses. Flexible and quick measures, backed up by a new way of thinking, are desired for tomorrow's smarter society.

In schemes like the smart city, overall optimization will be promoted through the control of both supply and demand. Shortages of power and transport will be addressed by creating self-imposed restraint through measures such as hiking prices in real-time. Telework will be a transfer of demand from transportation to communication, and stores and Wi-Fi hotspots in stations make people feel the waiting times are acceptable. Autonomous cars will increase the driving density on the road and expand supply capacity in addition to improving the safety of traveling. There are estimates that report traffic congestion to correspond to an economic loss of about 2-5% of the GDP[2,3]. So the impact of relieving traffic congestion will be great. We will see the spread of car navigation systems that determine in real-time the necessity to go by a roundabout route, when an accident occurs, by taking into account the time it will take to travel to the site and predicting the handling time and movement of other vehicles based on past data.

In developed countries, dilapidated infrastructures such as roads, bridges and port facilities now need to be repaired, but there is a trend to restrain replacement investment due to the impacts of the financial crisis. Even if they do not lead to accidents, there are concerns about adverse effects on logistics and transportation by regulations such as weight restrictions. To deal with this infrastructure crisis, it is effective to conduct preventive

maintenance in which the usage and deterioration status is constantly monitored and repair is carried out at an early stage. Continuous monitoring will also be effective in mitigating damage from natural disasters, as well as the early detection and restoration of damage situations. In production sites, efforts are being made towards the remote monitoring of equipment and facilities as well as the optimization of inventories, and it is expected that the target of these efforts will expand to the effects on the environment and human body, resource conservation and waste disposal. The optimization of supply chains and whole communities will lead to a more sustainable and resilient society.

In terms of diseases, a shift from treatment to prevention is being advocated. There is an increasing number of people who quantify and record their daily health status, behavior, diet, sleep and mental state by using wearable and smart devices. Because this enables the recognition of early symptoms and quick response, it will be especially effective for the health management of patients with chronic diseases. The analysis of behavior patterns and environmental conditions, as well as other factors will lead to the avoidance of worsening symptoms. For healthy people, it will inspire an interest in their own health status, and have the effect of guiding them to performance enhancement and lifestyle improvements. Its use will expand even to watching over infants and elders, improving the effectiveness of training and preventing accidents during exercise and it is expected to lead to changes in the way we will think about medical care and health as well as inhibit health care costs.

In financial services, products that vary in interest rates and insurance costs depending on personal risk have appeared. In addition to factors such as assets, income and age, speech and behavior on social media, as well as purchasing and payment history in online shopping will also be subject to assessment. In addition, reflecting the monitoring results of exercise habits and driving methods into the premium will encourage behavioral change.

Continuous monitoring is also being utilized for environmental purposes and in ensuring the safety of food. There have been instances in which information about people's travel activities has helped to clarify the infection routes of contagious diseases. Currently, less than 1% of all devices are connected to the Internet, but connections will be developed, and it is expected that the Internet of Things will advance rapidly. By connecting people and things via the internet, our understanding of situations will improve. This, in turn, will help the accuracy of prediction and forecasting. In the meantime, it is possible that societies that depend too much on the Internet might be made dysfunctional by cyber crime, and the expansion of continuous monitoring comes with a risk of leading to a constant surveillance society. There will be a need to achieve a social consensus on the balance of risks and benefits.

1 United Nations, “World Population Prospects: The 2012 Revision,” June 2013.

2 OECD, “Managing Urban Traffic Congestion,” May 2007.

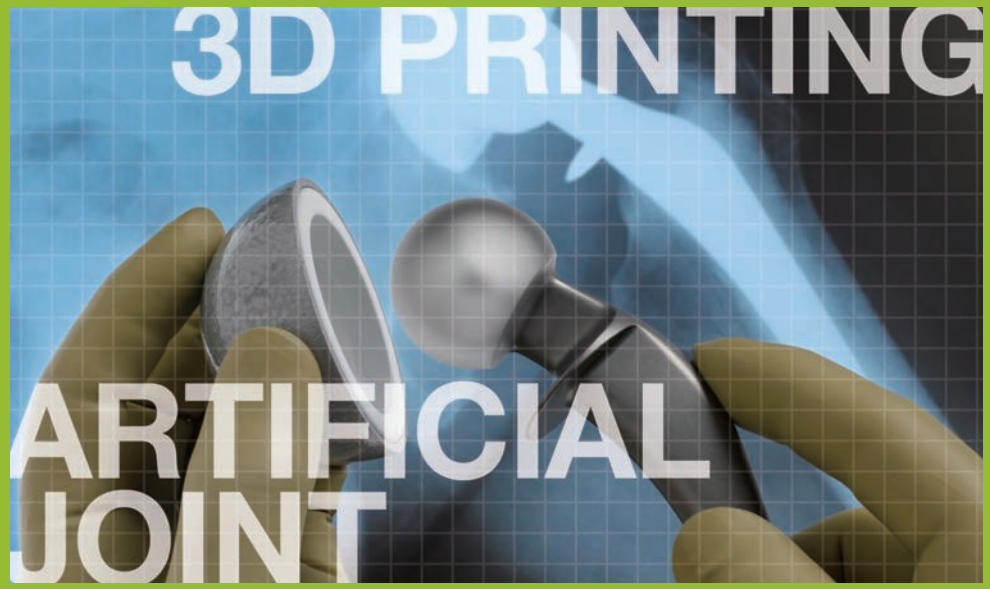
3 Asian Development Bank, “Managing Asian Cities,” June 2008.

Examples of NTT DATA Initiatives Related

Power of the individual

Manufacturing artificial joints and surgical instruments tailored to the individual by 3D printing

NTT DATA Engineering Systems is helping to create surgical instruments to cut bones with 3D printing in order to accurately join artificial joints. In conventional surgeries, a variation of over 250 types and shapes of surgical instruments are prepared to accurately cut bones that differ from one person to another. Historically, doctors and nurses have been required to have the skills to select the right one out of these variations and precisely cut the bone. By using a 3D printer, it will become possible to manufacture custom-made surgical instruments for cutting bones in the ideal shape tailored to the patient, presenting the possibility of surgery that does not solely depend on the surgeon's skills. Amidst a situation where surgeries for artificial joints are expected to increase with the aging population, manufacturing technologies that can personalize products quickly and at low cost will probably become part of the social infrastructure that delivers individualized medical care services.



Collaborative value creation

An infrastructure management system that measures road surface conditions using an iPhone

Road diagnostic techniques that are efficient and low-cost are in high demand, because the maintenance and control of road pavement requires huge costs and we need to respond to the infrastructure crisis that has become apparent in recent years. In response to this, JIP Techno Science Corporation, in collaboration with the University of Tokyo, has developed a system that evaluates the pavement surface conditions of roads through simple means by using an iPhone. By using the iPhone's angular velocity sensor, acceleration sensor, images and audio, they have realized a significant reduction of implementation costs compared to the past evaluation methods that used specialized equipment. By driving a car in which an iPhone is installed with an application for measurement placed on the car's dashboard, the evaluated result can be projected on maps such as on Google Earth, and road surface conditions can be visually checked. The spread of such software will also make possible open road monitoring through iPhones in many cars.

Notes : This system is continuing to be developed by the "Vehicle Intelligent Monitoring System Consortium" whose participants include the University of Tokyo, Kyoto University, Nagasaki University, Nagaoka University of Technology and others, and it has been expanded globally.

to Information Society Trends

Knowledge society

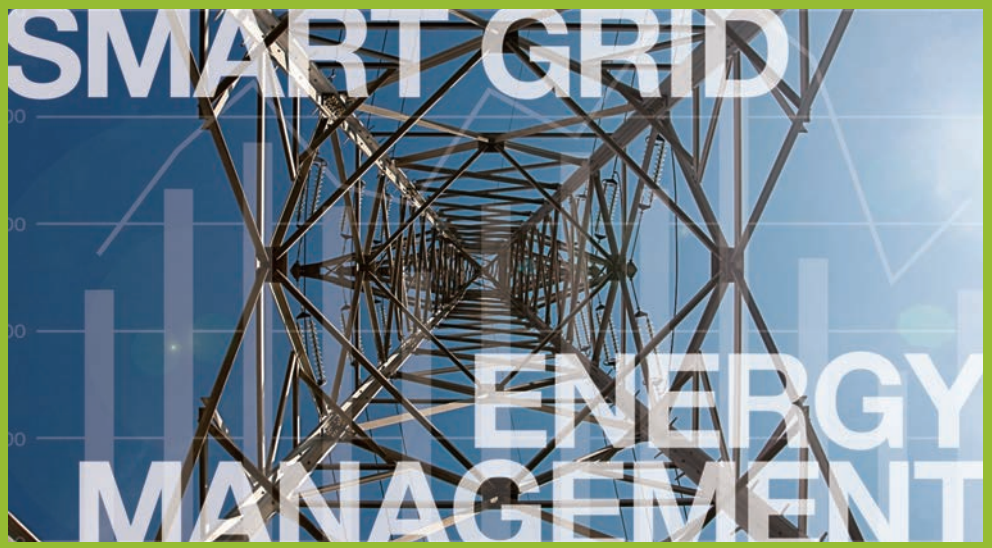
Jubatus: Processing Framework for Real-time Analysis of Big Data

In order to secure new knowledge from Big Data analysis and apply it in business, both detailed analysis and speed are required. Jubatus is an analysis processing framework in which knowhow for large-scale distributed processing of NTT and machine-learning technology of Preferred Infrastructure Inc., are integrated. The framework achieves high speed through real-time processing and delivers deep analysis through machine learning. For instance, Jubatus can receive huge amounts of tweet data from Twitter, and judge or categorize profiles such as the sex of the tweeter; his/her relation to a specific company and other parameters in real-time. Jubatus is open-source, so anyone can use its clustering, impropriety detection and social analysis functions. NTT DATA has a good record in the application of this on Big Data analysis. We believe that such information analysis will create new value in a knowledge society.

Smarter society

Energy management that predicts and controls the amount of power supply and demand

Smart grid initiatives have spread around the world in recent years, and demonstration experiments are actively being carried out, for example, to maximize renewable energy use, reduce peak power usage and level out power consumption. At NTT DATA, we have conducted research, using Big Data in the electricity market to provide energy management solutions. Using this research, we can review real-time electricity use in offices and factories and then use dynamic pricing technology to optimize the balance between power supply and demand. For example, by enabling controls such as setting higher prices for energy during times of high demand or lower prices during times of low demand, we can suppress fluctuations in energy consumption and balance its supply and demand. By introducing data analysis techniques with fast analysis cycles, and by making predictions based on the collection and analysis of real-time electric quantity data, the realization of rapid response to changes in balance will become possible.



Technology trends that will influence how information society trends may evolve.

Technology Trends

NTT DATA Technology Foresight

TT01
Natural extensions of human abilities

TT02
Modeling of human beings

TT03
Mobile-centric

TT04
Intelligent processing by artificial intelligence

TT05
Real-world sensing and analysis

TT06
Smart infrastructures

TT07
Next-generation web architecture

TT08
Environmentally adaptive IT systems

TT09
Defense in depth

TT10
Rapid design technologies

01

Natural extensions of human abilities

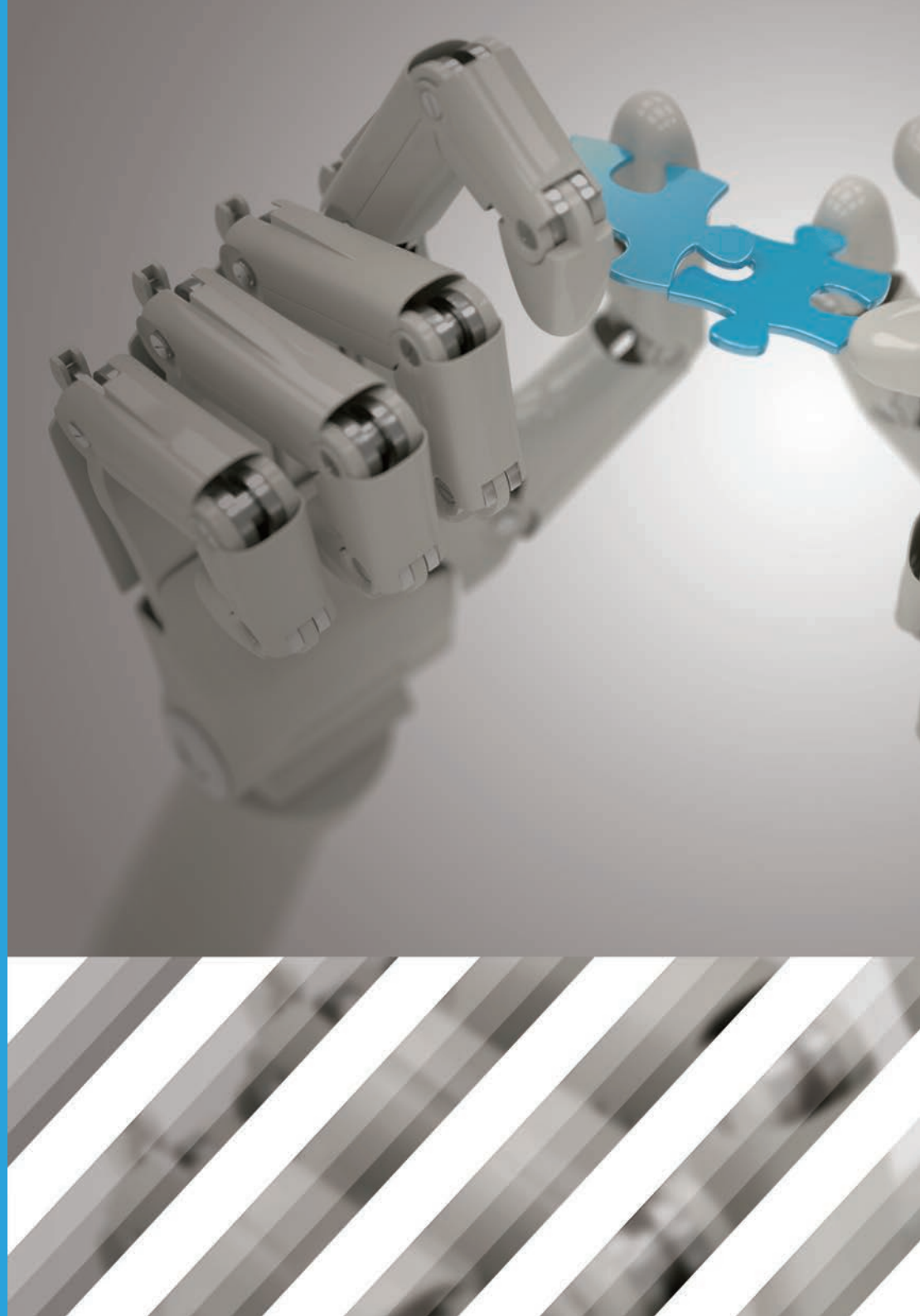
Human intellectual and physical abilities will naturally be enhanced.

The spread of intuitive interfaces will enable digital devices to operate automatically according to human behaviors and situations. Human beings will enjoy the support of equipment without any burden and human abilities in terms of the body, knowledge, situation awareness and others will naturally be enhanced.

Robots are spreading rapidly in the fields of medical and nursing care. The surgical assistance robot called the da Vinci Surgical System (hereinafter called “da Vinci”) is a system in which the robot’s surgical arms are operated in sync with the motions of the physician. The system has been introduced in 32 countries around the world, and its total clinical use has exceeded 780,000 cases. Currently, there are 1,500 units in the US and 380 units in Europe that are in operation. Robot suits that are used by cladding the robot are also being put to practical use. These robot suits enhance the physical functions of its wearers by moving in accord with the movements of the wearer. HAL is one type of the robot suit. It reads the faint biopotential signals that occur when the muscles are moved by sensors that are attached to the suit wearer’s skin surface. Its mechanism enables the robot suit to move in sync with the movement of the muscles.

Tele-presence technology, which realistically transmits one’s presence to a remote location, can also be said to be a type of extension of human ability. Tele-presence robots, which are a combination of tele-presence technology and robots, are often self-running, and will enable remote conferences as well as site visits and dangerous tasks from a remote location. In the US, there are 5 million people per year who are undergoing intensive care. However, there are only 6,000 physicians available to respond to this need. By implementing tele-presence robots, hospitals will be able to request physicians on the other side of the planet to do the nighttime rounds, thereby realizing more efficient hospital management.

According to ABI Research, a US research company, the number of shipped wearable devices as represented by glasses-type devices is expected to reach 485 million units per year in 2018. As existing mobile devices were unable to cover new demand requirements, wearable products that could, emerged onto the market. The most typical wearable terminal is the head-mounted display (HMD), in which the user wears glasses or a



helmet with lenses that provide a transparent display. The applications of HMD are manifold. While traveling abroad, the user's non-native language can be automatically translated, and the meaning of unfamiliar signs will be shown on the HMD display. The field of view of survival games will expand to 360 degrees, and when running, users will be able to compete with a virtual runner who runs at the speed of their personal best. Business applications are also being considered. In business, functions to automatically recognize a person's face and to display their name and affiliation, as well as functions to display a script when making a speech, have been devised. In the future, complex work procedures will be shown on the HMD display worn by site workers in accordance with their actual tasks. It is expected that, when there is something that is unclear to the worker, a system to transfer the view seen by the worker to supporters in a remote location will be generally available. In addition to the HMD type, there are a variety of wearable terminals such as ring-type, bracelet-type, watch-type, contact lens-type and clothes-type, and various products have been released to leverage these devices.

Brain Machine Interface (BMI) is also attracting attention as an even more natural method of device operation. By using BMI, it will be possible to operate robots and computers using brain waves. BMI is not a technology of the distant future. Inexpensive BMI-operated devices are already being sold for $80. In terms of an ultimate form of wearable technology, there is implant computing, which restores human functions by embedding devices inside the human body. In the US, there is already a product being sold that restores the sight of vision impaired individuals to the degree of being able to see 576 points of light by embedding an artificial vision device into the body. It is believed that not just wearable device equipment, but also ambient computing that uses equipment embedded in walls or desks, will spread. In the future, we will enter an age in which the walls and glass windows of conference rooms will be turned into screens, and equipment will be operated by gesture and smart devices.

Human enhancement technologies will enrich the lives of human beings by removing the restraints of time, space and skill, but may also lead to negative effects such as more sophisticated terrorism. Wearable technologies enable users to access real-time information, but will generate new human challenges such as "not being able to take practical actions based on the useful information obtained."

02 Modeling of human beings

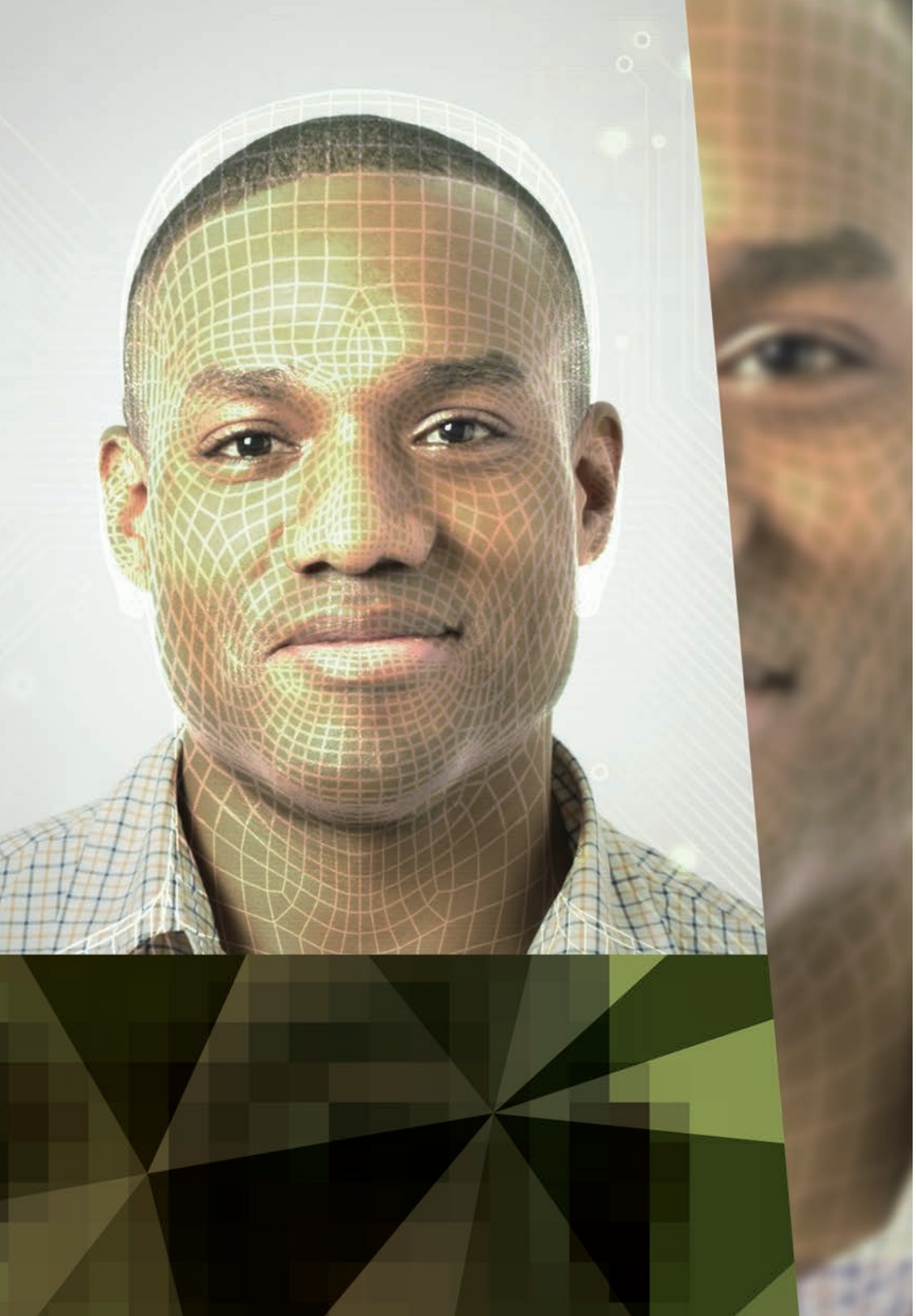
Human beings will be understood well enough to create superior ergonomic and behavioral models.

The biology, behavior, senses and psychology of human beings will be understood ergonomically and these lessons will be applied to various services. Personalization, enthusiasm and continuous improvement will be realized, and new services that utilize the five senses will appear.

The Human Genome Project, which was started in the US with international support in 1990, reached completion in 2003 when 99% of the human genome sequence was read with an accuracy of 99.99%. Many ambitious efforts have been started since then, promoting a number of international projects such as ENCODE, HapMap and the 1000 Genomes Project. Behind the rapid gene database expansion are the lowering costs of DNA sequencers and increased reading speed. As human genes are 99.9% identical, the sequencers only have to read the remaining 0.1%. The “$1,000 genome” is already near, and further price reduction is expected.

Genes are the ultimate biological blueprints of human beings. Once the structure of genes is understood, it will be possible to simulate human growth and the presence or absence of medical effects. Genes are also used in police investigations. In the US, a technology for reproducing a criminal’s face through DNA information extracted from saliva contained in leftovers is being used in actual criminal cases. The use of genes also enables the determination of blood relationships by comparing the gene of the principal person with the gene of a relative. Furthermore, it is expected that innovations in DNA technology will realize the extension of the human life span, regenerative medicine (e.g., iPS cells), designer children that reflect the ideal child, and similar advances.

The generation of 3D data of the human body (i.e., modeling data) can also be considered one type of modeling. In recent years, the low price of 3D scanners has created an environment in which it is relatively easy to collect 3D data of the human body. As a result, the provision of products and services tailored to the individual is expanding. Technologies that convert the five human senses into digital data have also appeared. The conversion of the five senses into digital data will enable the conveyance of senses like smell and taste to remote locations. Research on transmitting temperature, pressure and vibration felt by a robot to the operator of the robot in a remote



location has already reached the level of being capable of transmitting the texture of fabric.

In the area of behavioral understanding, targeting technology is well-known, whereby advertising that matches user attributes is delivered by analyzing the user's web browsing history and exposure history with specific advertising. Recently, the real-time selection of advertisers by a method called real time bidding (RTB), in which bidding begins at the moment a user visits a site and the highest bidder's advertisement is displayed, is becoming mainstream.

The sophistication of advertisements has mainly been carried out in the cyber world. Going forward, advertisements in the real world will become far more targeted. Geo-fencing is one method that is currently in the spotlight that displays advertisements customized based on the user's position information. An even more refined method, in which advertisers are charged each time their advertisements placed in a store or other location are seen by a customer, has a patent pending. Other methods that have been devised include charging a varied fee based on the degree of emotional impact, captured by sensing changes in the size of the viewer's pupil. Future digital signage systems will understand human behaviors and provide an interactive experience that suits the advertisement's presentation. Advertisements are expected to evolve from the simple provision of information to new forms that utilize the senses such as olfactory stimulation by smell, pseudo-tactile sensation by ultrasound and visual effects by 3D hologram. Ultimately, "ambient advertising" will be sought as a form of advertisement that naturally blends into everyday life.

There is also a technology approach that links the understanding of human psychology to business. This is a method called "gamification" that aims to enhance motivation through the visualization of achievements and implementation of the principle of competition. It is being used in streamlining simple operations such as data entry jobs and in improving customer loyalty.

Free services are generally provided in exchange for personal information, and companies gain profit by using this personal information to display advertisements to users. Currently, free services are being offered in exchange for personal information but, in the future, there is a possibility that users will be compensated in real value such as through points. In addition, users will need to be attentive to the trends of laws outside of their own country, because these laws are applied depending on the location where the server is installed.

03 Mobile-centric

Smart devices will become the hub for connecting services, devices and people.

Smart devices will become the hub for connecting services, devices and people. The multi-functionality of smart devices will progress, and become part of the social infrastructure. User interfaces appropriate for mobile use will be devised and operability will improve.

According to research by International Data Corporation (IDC), the number of mobile devices shipped in the second quarter of 2013 was 432.1 million units. One of the reasons for the steady sales of smart devices is their decreasing prices. The recent release of devices offered for $60 and $100 is increasing demand in emerging countries. In emerging countries where infrastructure is vulnerable, unique services are also being created with mobile devices at the core. In Africa, services to access Facebook via short message service (SMS), as well as services to access e-mail on a cloud system via SMS on mobile phone, are being offered. Mobile payment, in which payment is made by mobile terminal, is also spreading. According to research by Gartner, Inc. the market size for global mobile payments reached $163.1 billion in 2012 and increased 44% year-over-year to $235.4 billion in 2013. For a long time, the solution to mobile payment was thought to be near field communication (NFC) technology that realizes touch-type payment, but in order to implement NFC in business, cooperation amongst retail stores, credit card companies and smart device vendors is a prerequisite. NFC has not spread as rapidly as expected, due to the issue of not being able to offer services just by NFC-enabled mobile devices.

Instead, mobile payment utilizing mobile applications has been attracting attention. Usually, in order for affiliated stores to allow payment by credit card they would need to purchase or rent an expensive payment terminal; but, in recent years, a method of turning smart devices into payment terminals by attaching a credit card reader to the earphone jack has appeared. Mobile health (mHealth) is another representative social service with mobile technology at the core. General mobile devices cannot be used as medical equipment because they have not acquired a medical device certification. Thus, mHealth focuses on providing general preventive care, or can be used to provide basic medical care in developing and emerging countries. The functions that can be realized by smart devices are increasing year by year. Recently, smart devices that can measure heart rate, blood pressure, ECG, alcohol intake, radiation and similar measurements by itself or attaching a special device are being sold.

In terms of the technical aspect of smart devices, Wi-Fi Direct and Bluetooth 4.1 are likely to increase in use. Wi-Fi Direct is a standard that allows communication between wireless LAN-enabled devices without access points. Compared to Wi-Fi Direct, Bluetooth 4.1 is superior in terms of power consumption, but it is inferior to Wi-Fi Direct in terms of communication speed. In the future, various home appliances will most likely be able to access the Internet via smart devices.

A module that can simply turn a TV into a smart TV by attaching a compact and low-cost dedicated device has been released. If mobile devices are individual displays, it can be said that smart TVs serve as shared displays. TVs are not the only things that can be controlled by smart devices. By using smart devices, it will be possible to remotely lock and unlock your home and car. Remote control of home appliances will be realized in the future, but the rate at which it spreads will be determined by the presence of killer apps. There is also a concept of operating in-vehicle equipment with smart devices, and 12 car manufacturers are planning to adopt it. As various operations become increasingly possible through smart devices, ease of operability is expected to become the challenge. In order to improve the operability of smart devices, methods such as gesture, eye tracking (operation by line-of-sight), handwriting input and novel soft keyboards have been proposed.

One of the issues of smart devices is poor battery life, but there is a possibility that this issue will be resolved by wireless charging technology. The Qi standard, which allows non-contact power charging, will enable smart devices to be charged in a very natural way. In the future, power charging will be done seamlessly in daily life.

Going forward, the keywords of interest in mobile technology are thought to be "connected" and "mobility." Connected means that a variety of things will be connected to the Internet via smart devices, and mobility signifies "optimally utilizing the value of mobile." Ultimately, the concept of "mobile" will become commonplace through the spread of mobile devices around the world, and mobile devices will become recognized as standard computers.

04 Intelligent processing by artificial intelligence

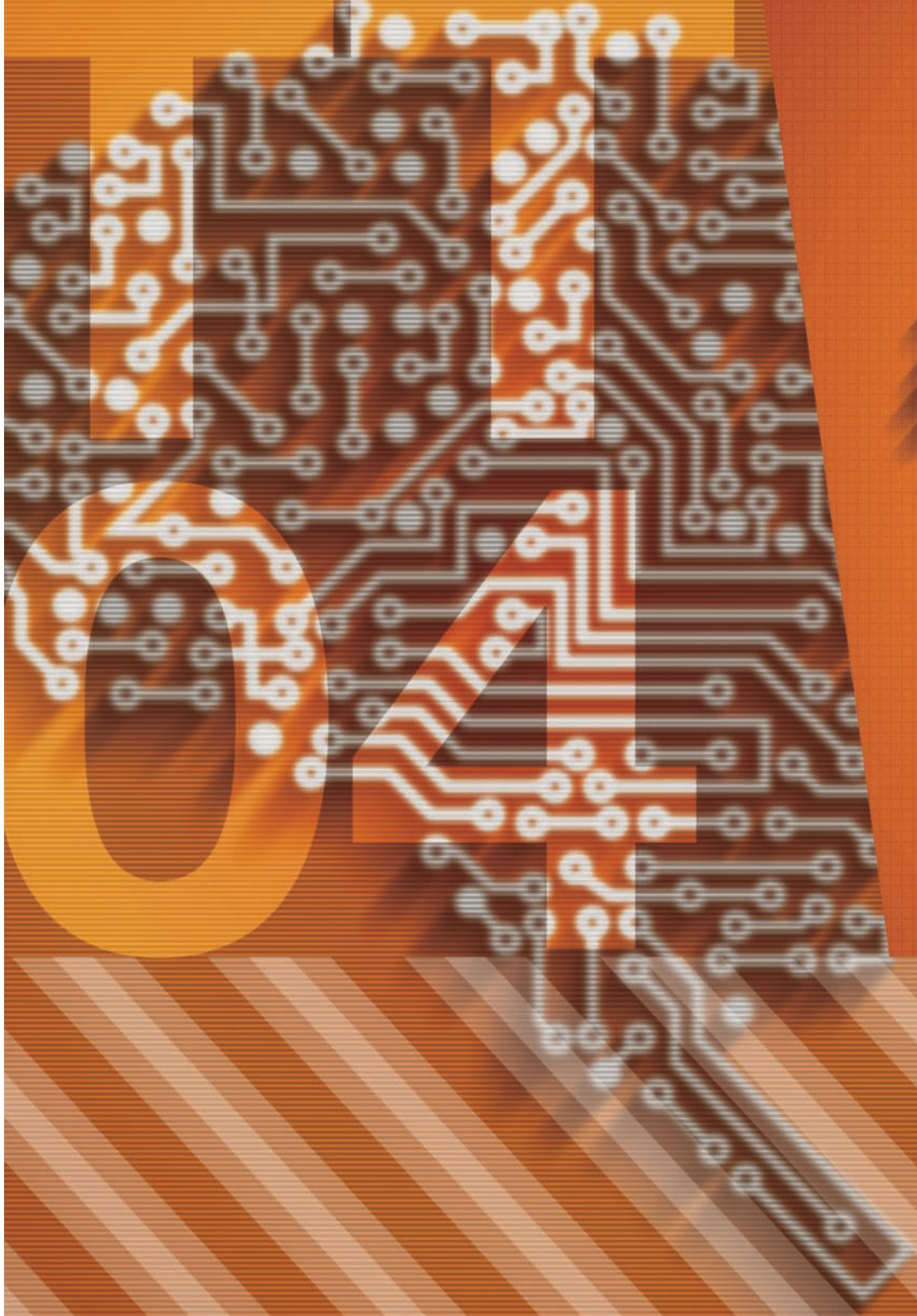
Computers will reach the level of intellectual activities of human beings.

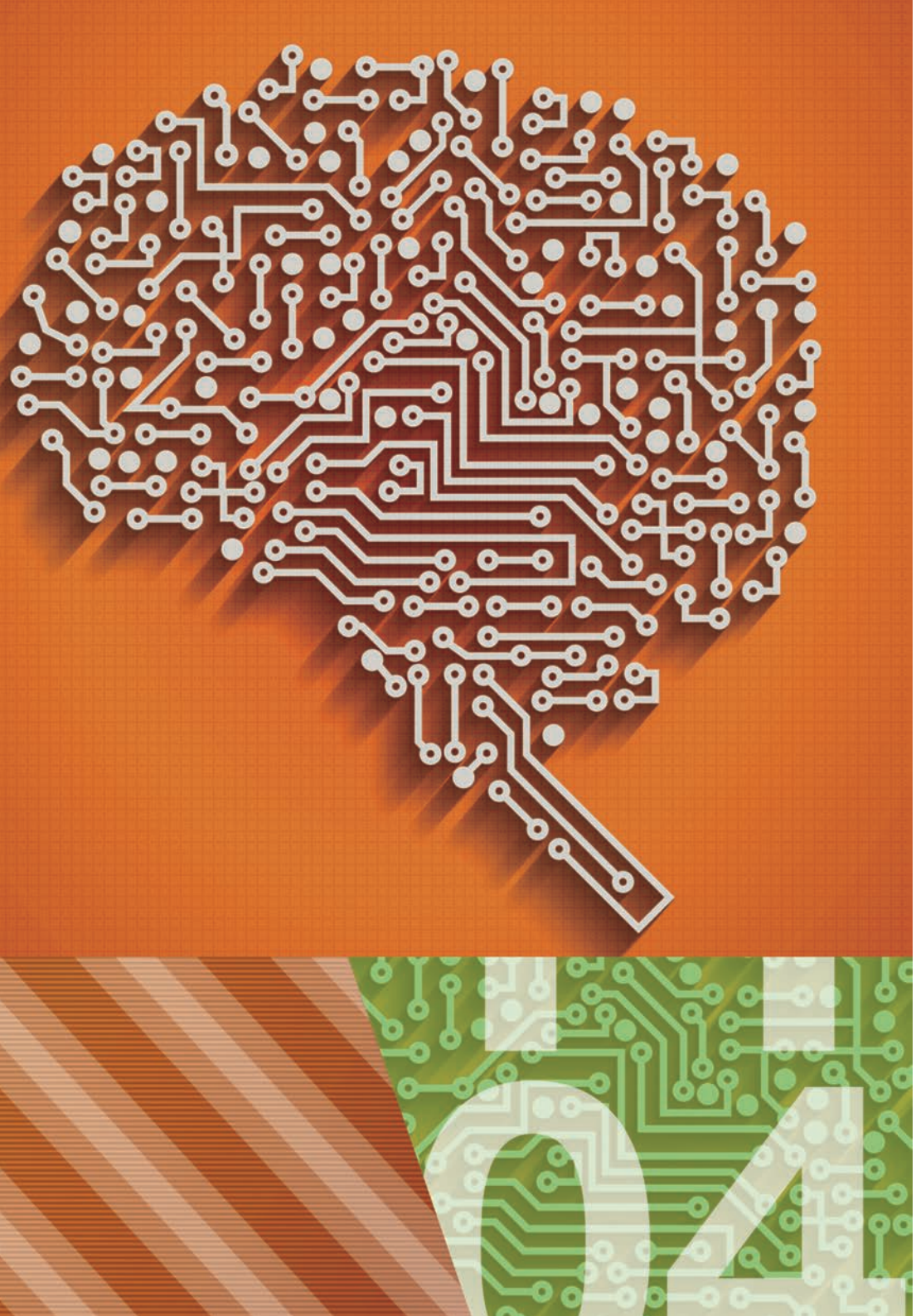
Computers will substitute a part of the intellectual activities of human beings. The appearance of computers with a high degree of expertise will result in a society where anyone can utilize specialized knowledge, and human beings will spend a lot of time in activities that place importance on creativity and human nature.

Renowned futurist Ray Kurzweil predicts that if supercomputers continue to enhance performance at their current pace, one supercomputer alone will simulate the brains of all humankind combined by 2045, and it will reach a computing performance capable of processing more than the brains of all humankind combined. The turning point at which there will be a shift to a world where computers discover new science and technology before human beings, and technological innovations go beyond biological limits, is referred to as the singularity. Serious discussions are being carried out regarding its expectations and threats.

There are two types of artificial intelligence: “strong AI,” which possesses human creativity and emotions, and “weak AI,” which surpasses human beings in a particular task. One of the methods of realizing a strong AI is the “artificial brain,” which simulates the human brain on the synaptic level by computer. In 2025, the processing performance of supercomputers is predicted to reach the level capable of simulating the human brain, and realizing artificial intelligence in its true sense will require innovation in software in addition to hardware.

Simulation experiments of the brain have entered an intense, globally competitive age. The European Commission announced in January 2013 that it will invest 1.2 billion euros over a period of 10 years in the Human Brain Project, which aims to understand the brain through IT. In April 2013, the US announced a similar project called the BRAIN Initiative. Brain simulation technology has the future potential of realizing a strong AI that possesses thinking capabilities similar to human beings. In the field of algorithms, a pattern recognition technology called Deep Learning that has a structure close to the human brain is attracting attention. Deep Learning is a modification of neural network technology and it has performed very convincingly in competitions of algorithmic performance held around the world.





As brain simulation requires an enormous amount of operations to be performed, research is underway on a new type of CPU, called a neural processing unit (NPU), which aims to reproduce the human brain structure on a chip. Since its architecture completely differs from the commercially available Neumann CPU, studies of new programming paradigms are being carried out. Research of the next-generation CPU consists not only of NPU but also subjects such as quantum computers.

Innovation is also happening in the world of weak AI. Deep Blue, a computer developed by IBM specifically to play chess, astounded the world by defeating the chess champion, Garry Kasparov. In Japan, a computer specifically designed for playing shogi is ahead of a professional with three wins, one loss and one draw. Computers are about to surpass human beings even in the world of shogi, which is significantly more complex than chess.

In the field of medical care, medical diagnosis using artificial intelligence is being studied. In 10 to 15 years, it is likely that we will enter an age in which computer physicians make a diagnosis based on medical knowledge from around the world and past medical examination results from the patient. Computer physicians will perform examinations equally well on each patient, without human error and without feeling tired. They are expected to present human doctors with a proposed diagnosis of intractable diseases and the rationale for that. In the future, diagnosis using past knowledge will be done by computers, and the role of human physicians will shift to creating new medical technologies and focusing on psychological care.

In education, online teaching, tailored to the student, is increasingly normal and there is more emphasis on raising student motivation by using gamification. Computer teachers are expected to provide appropriate education through continuous improvement based on student feedback. Human teachers will be able to spend more time on the human aspects of education such as enhancing student sociality.

The utilization of weak AI is also making headway in business. Tasks that are simple for human beings, but difficult for computers to process right now, will become targets of automation in the future. Automation of a variety of intellectual tasks is already being carried out, such as the automated authoring of news articles, summarizing of news, detection of errors in text and optimal arrangement of complex work shifts.

It is possible that companies that are the first to leverage advanced artificial intelligence on a large scale, through parallel execution of multiple artificial intelligence 24 hours a day, 7 days a week backed by huge capital strength, will monopolize intellectual property in all fields. Advanced artificial intelligence has the potential to transfigure the world, and we will be forced to take appropriate actions including the establishment of a legal framework by watching its trends carefully.

05

Real-world sensing and analysis

Sensing technologies will enable better understanding and prediction of real-world conditions.

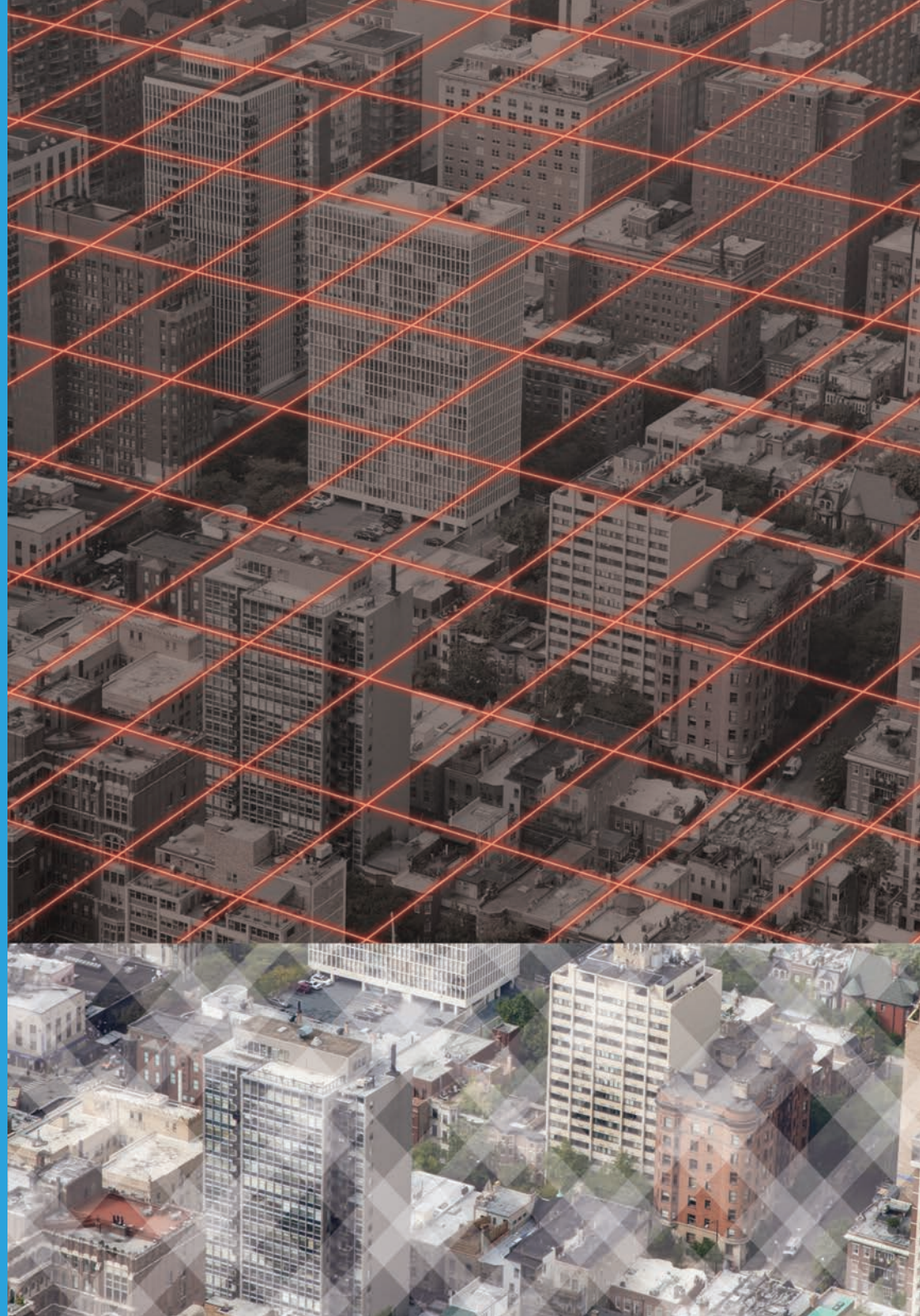
The spread of advanced sensing technologies will help accelerate man's understanding of the world and improve our ability to predict. Data of people, things, society and the environment will be collected in real-time and in large amounts, and it will be applied to the strengthening of industrial competitiveness, the design of cities and social systems, as well as abnormality detection in disaster prevention.

By the end of the 2010s, the age of the "Internet of Things," in which a variety of things are connected to networks will come of age. It is thought that the number of devices connected to networks will exceed 10 billion units. In accordance with the increase in the number of devices connected to a network, the amount of generated data will increase exponentially. International Data Corporation (IDC) predicts that the total amount of data generated globally in 2020 will reach 40 zettabytes (1 billion terabytes)[1].

Big Data is said to be a term created by Professor Francis Diebold of the University of Pennsylvania in 2000. Data collected for the purpose of analysis covers a broad range of categories including people, things, society and the environment. The fusion of sensing and Big Data technologies will bring about the visualization of waste, detection of abnormality, redesign of cities and systems and improvement of quality of life (QoL).

One of the applications of Big Data is an effort to measure the traveling population by collecting a large amount of GPS data from users who consented to it. Up to now, traffic measurement was conducted by human hand, but going forward the use of GPS data will enable a greater understanding of traffic volumes of all roads within each time frame. There is also a method of automatically generating a map from traveling population data, and it is expected to be applied to emerging countries where maps are underdeveloped. A new service using vehicle sensors, called telematics, is also gaining notice. By analyzing information collected by a sensor mounted on a vehicle, it realizes the prediction of congestion as well as the detection of road closures.

As seen in the example of GPS data analysis,



the scope of IT applications is expanding from the cyber world into the real world. In the near future, retail stores will be able to optimize their entire store by leveraging customer behavior information, in addition to purchasing trend analysis using the conventional point-of-sale (POS) data. The installation of sensors that analyze customer behavior will facilitate processes such as understanding consumer traffic in real stores, understanding traffic volume in front of stores, measuring time instore, managing expiration dates and comparing power consumption of each store.

Improvements are also being made in the field of medical care through sensing technology. Capsule endoscopes in the form of a pill; technologies to monitor vital data effortlessly, such as ECGs that have sensors attached to clothes, as well as services that use sensors to watch over children and the elderly have been devised. In the future, there is also a possibility that cancer screening will be performed on a daily basis just by using toilets and wash stands equipped with special sensors.

In terms of social sensing, analysis of social networking service (SNS) data is attracting attention. The use of SNS data has helped the forecasting of economic trends, election results as well as audience ratings. There are also efforts to leverage SNS data in criminal investigations and the optimal placement of police officers. Analysis that combines SNS data with open data, provided by the government and municipalities, is also expected to spread.

In Japan, there is a strong demand for the reduction of medical care costs, which have reached 38 trillion yen (approximately $380 billion). The containment of medical care costs is a global challenge, and “medical Big Data” projects to perform analysis, by collecting large amounts of patient charts and medical fees, is gaining recognition. The problem of “infrastructure crises,” which causes serious situations like the disintegration or collapse of aging infrastructures, is also becoming acute. For example, in the US there are 600,000 bridges of which 27% are deteriorating. Thus, the maintenance and management of infrastructure is a pressing issue. Sensing technology will play a significant role in solving this problem, and experiments of technologies that detect infrastructure distortion at low cost by using light sources have been carried out in recent years. Sensors will be applied, not only to the operation and maintenance of infrastructure, but also for a wide array of purposes, including autonomous inspections.

1 IDC, "THE DIGITAL UNIVERSE IN 2020: Big Data, Bigger Digital Shadows, and Biggest Growth in the Far East." Sponsored by EMC, 11 Dec 2012

The scope of sensor data applications will expand from houses, buildings, and infrastructure to cities. In parallel, the world will shift from individual optimization to total optimization. Companies that deal with vast amounts of data will be required to pay attention to the development of data visualization technologies in addition to data analysis technologies. The future age will be one in which the superiority and inferiority of each company’s ability to create ideas will be determined by technologies that can convert and visualize large amounts of data in a format that is easily understood by human beings.

06 Smart infrastructures

Infrastructures will be optimally controlled by using software.

Infrastructures controlled by software will spread and overall optimization will be realized. Supply chains will be highly automated, and the consumption of resources such as power will be minimized.

Autonomous cars are thought to have been first introduced at the DARPA Grand Challenge sponsored by the U.S. Defense Advanced Research Project Agency (DARPA). The Grand Challenge is a car race for autonomous cars aiming to identify and solve the challenges of autonomous driving. Competitions were held in 2004 and 2005 and, in 2007, six teams completed a race to finish a course of some 60 miles, within six hours, that replicated an urban district. According to a report by the Institute of Electrical and Electronics Engineers (IEEE), in 2040, a maximum of 75% of cars running on general roads are predicted to be autonomous cars. The spread of autonomous cars will bring about the benefits of a reduction of accident rates, easing of congestion, improvement and observance of speed limits, abolition of the licensing system and travel support for the visually impaired. It is believed that environmentally-friendly acceleration by autonomous cars will improve fuel efficiency by 20% or more.

Practical applications of nursing robots are also expected. The total world population in 2010 was 6.9 billion people, and it is estimated to reach 9.6 billion people in 2060. The global aging rate (the ratio of people 65 years and older in the total population) rose from 5.2% in 1950 to 7.6% in 2010, and it is projected to increase to 18.3% by 2060. R&D of nursing robots is actively being carried out to respond to the rapid aging of the population, and a number of products will soon be released.

Robot use in supply chains will also advance. In 2011, the number of industrial robots sold in major countries exceeded 1.6 million units, and the number in operation is approaching 12 million units. The trend of robot development is shifting from “acceleration of operation speed” to “collaboration with human beings,” and robots that are operated in the same production line as human beings are increasing. Most of the collaborative robots are double-arm models, and they are capable of tasks such as inspecting and sorting products. Since employees can teach the robot how to carry out new jobs just by moving the robot’s arms and letting it learn the procedures, newly purchased robots can be incorporated into the production line in about one hour after installment. The price for such robots is around $20,000 and

they can be operated 24 hours a day. They also maintain high safety by constantly monitoring the movements of people nearby with various sensors.

The automation of distribution centers is also making progress. There is one example of nearly halving the cost of a distribution center through the automated pick-up of products by robots. The robots automatically perform optimization of warehouse space by placing products with a lot of orders near the packing machine and products with fewer orders farther away. Utility costs can also be cut, because robots do not require air conditioning or lighting.

The concept of delivery is also expected to change significantly. In the near future, it is thought that automatic delivery will be realized through unmanned helicopters. Although some countries have already conducted test operations of product delivery by unmanned helicopters, the realization of unmanned delivery in the true sense will require a solution to a broad range of problems, including legal regulations, safety, theft and hacking. Autonomous cars will realize automatic delivery between factories and stores. It is thought that progressive companies will attract attention by achieving a next-generation supply chain that carries out the entirety of ordering, manufacturing and delivery through unmanned operations. Technological developments are being made not only in product delivery, but also in the automation of farm work. In five to ten years, the use of autonomous tractors will go mainstream in large farms, and it will enable the optimization of harvest efficiency by reducing waste such as in seeds, fertilizers and water as much as possible. It is believed that high costs foods will increasingly be cultivated in plant factories, if high cost is acceptable.

Smart grid is an electricity network that realizes the automation of the streamlining and restoration of power transmission. By using smart grids, real-time data can be collected from the smart meters installed in homes and companies, and it will be possible to accurately predict power consumption. Thus, it is believed that the optimization of efficiency in energy utilization will be achieved.

In the real world, with autonomously operating smart infrastructures such as cars and robots, the focus of responsibility in the event of an accident can be a problem. As a result, there is a need to clarify whether the user, smart infrastructure manufacturer or the company providing smart infrastructure services is legally responsible. In order for human beings to enjoy the many benefits of smart infrastructures, it will be necessary to develop an updated legal system in the future, while also providing consideration to the building of a social consensus.

07

Next-generation web architectures

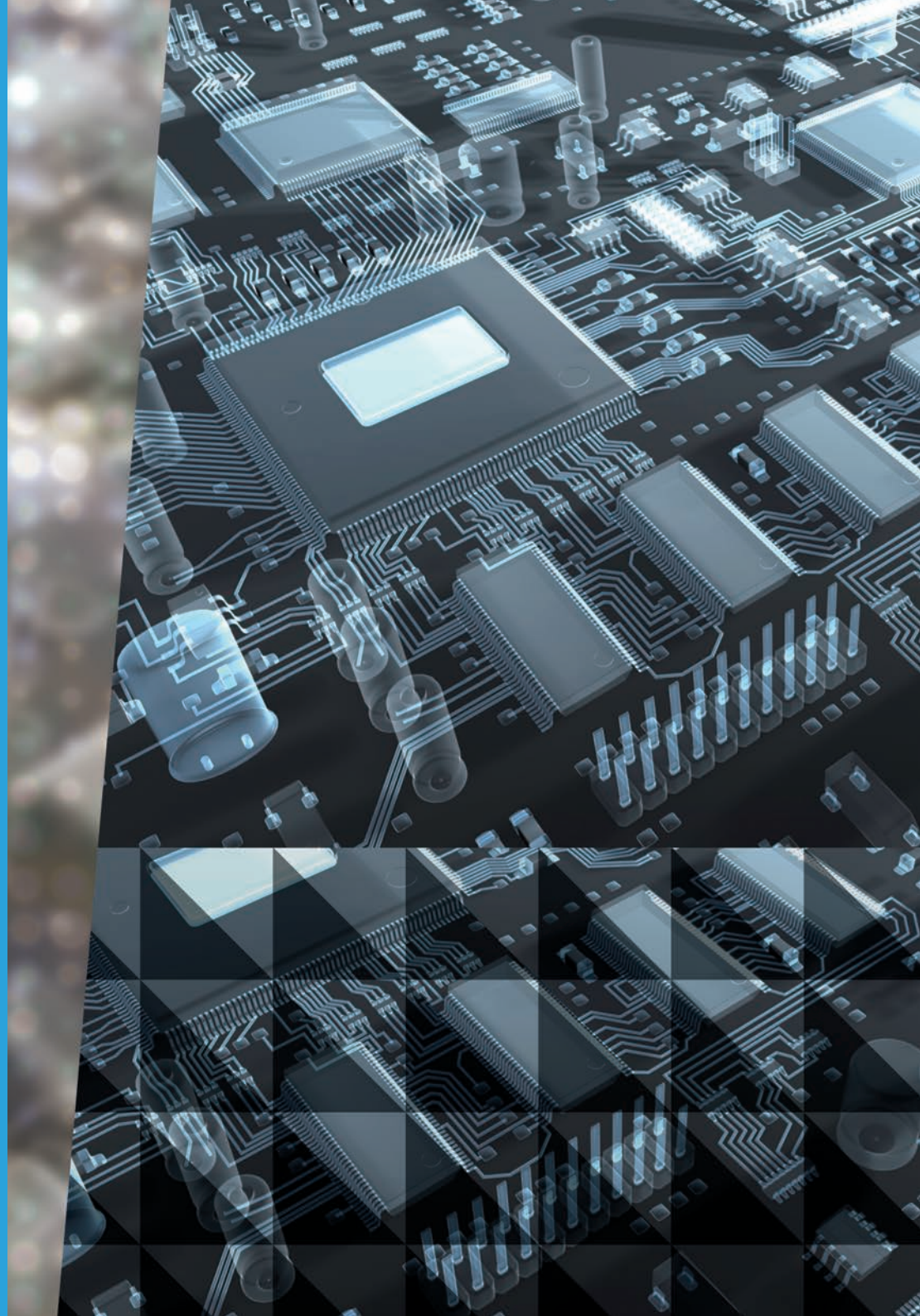
Acceleration and enrichment of web applications will advance.

Change will occur in the architectures of web systems, and cloud-side processing loads will be transferred to the client-side. The acceleration of applications will progress and the introduction of green technologies will also advance.

In the current web system, "mobile first", in which mobile services are provided first and then services are expanded to other terminals like desktops later, is becoming mainstream. Many types of mobile terminals have been released. Up to now, in most cases centralized architectures that implement many functions on the cloud-side have been adopted in order to reduce development time in the face of the explosion of terminals. However, going forward, it will not be necessary to develop applications that take into consideration differences between mobile OS due to the introduction of HTML5.0. It is believed that there will be a shift to distributed architectures that implement many functions on the client-side.

In the near future, browsers could disappear from mobile terminals. For example, there is no browser built into Firefox OS, which is called the 3rd mobile OS, and it will be optimized for the execution of web applications (hereafter referred to as “web apps”). There are two forms of web apps: packaged apps, which are used by installing them in advance, and hosted apps, which are used by accessing websites when necessary. The web apps are provided in a ZIP file, and the file is comprised of contents such as HTML5.0, CSS, JavaScript and Manifest (configuration file). It will be necessary in the future to consider whether to adopt native apps or web apps prior to development.

The technologies used in developing web apps are significantly evolving. In relation to JavaScript, developments such as the following have been made: asm.js that operates at a speed not much slower than native code; Dart and TypeScript that are alternative languages of JavaScript and that realize improved development efficiency; responsible web design that freely changes the user interface in accord with the screen size on the terminal-side; and frameworks that synchronize multiple terminal screens in real-time. In the future, language, framework, and sensor technologies such as gesture and line-of-sight recognition will be launched to enrich web apps and bring fresh experiences to the user.



Improvements to web systems are also being made in areas other than applications. HTTP/2.0, which was developed based on SPDY developed by Google, solves many of the problems in HTTP/1.0. HTTP has been recently improved. In addition, new challenges have become apparent in TCP/IP. Going forward, it is believed that protocols that improve TCP/IP such as QUIC will gain recognition.

The evolution of hardware is also continuing. Compared to the method of using hard disk drives, the method of directly connecting flash memories to the internal bus of servers, called server-side flash, has accelerated the processing speed of database servers to about 10 times faster. A method of connecting non-volatile flash memory in the memory has also appeared.

Recently, the electricity cost has increased to about 1/3 of the operating cost of data centers run by large-scale cloud operators. Improving the efficiency of energy use is a major challenge faced by large-scale data center operators. Apple has accelerated its investment in green data centers, and is switching all power supplies at data centers to renewable energy. In recent years, there have been an increasing number of data centers employing a DC power supply that further improves power efficiency.

There are also examples of improving the efficiency of energy use by self-designing hardware. In 2011, Facebook reduced the cost of data center construction by 25% and power consumption by 24% by establishing the Open Compute Project and carrying out data center design on their own, with an aim towards building high-efficiency data centers (their PUE, power usage effectiveness, is 1.07). In addition, servers with several hundred CPUs (Central Processing Units) that have low performance, but low power consumption are being developed.

The number and types of terminals that are capable of accessing the web will probably continue to increase in the future. Since there is a possibility that websites will be accessed from a variety of terminals, such as cars and home appliances, it will be necessary to be conscious of "Future Friendly," in which websites are built based on predictions of the future. Although the method of efficiently building websites is important, it will be necessary to pay attention to Content First and User Experience first when building websites, because outgoing content and user experience remain the most important factors.

08 Environmentally adaptive IT systems

IT systems will be able to quickly adapt to change.

IT systems will adapt quickly to changes and are expected to autonomously respond to rapid load alterations, as well as increases or decreases in the amount of data. Operations and testing will be made more efficient and cooperation between data centers will improve.

Cutting-edge Big Data processing technologies are being led by Google. The de facto standard of Big Data processing, Hadoop, was created from a research paper that Google presented in 2004. Compared to conventional means, Hadoop, which was developed as open software, has realized data processing that is 10 times faster at one-tenth of the cost and has utterly transformed the face of business.

As most Big Data processing technologies originate from research papers presented by Google, the technologies that will appear in the future are also predicted from the same source. According to a research paper announced by Google in 2010, the next technology that will be realized is a “high-speed real-time inquiry” that can access data in a format similar to a database. In 2010, Google announced Pregel, which supports large-scale graph processing (i.e., processing that is used in social network analysis, etc.) and, in 2012, it published an article about a technology called Spanner that spreads data across multiple data centers. Other than Big Data processing technologies led by Google, there is a stream data analysis technology called complex event processing (CEP). CEP continuously processes data generated in real-time, notifying the user if there is a change such as when there is an abnormality. It is mainly used in the analysis of sensor data.

One of the important research themes in Big Data is the location where generated data is saved. Edge-Heavy data is a type of data distribution architecture, and its feature is that data is not sent to the cloud-side but rather saved in the edge-side (i.e., the side where the sensor is and where data is generated). Another type of data placement architecture is the centralized model. The balance of “advanced real-time analysis” and “iterative analysis” will be realized in the centralized model. In the future, it is expected that R&D will be carried out in random architectures that can save all collected data in storage, apply advanced analysis in real-time and perform re-analysis in accordance with the improvement of analysis algorithms.

The word “cloud” is said to have been

first used at the Search Engine Strategies Conference in 2006 by then Google CEO Eric Schmidt. The cloud has reduced the procurement period of hardware from several weeks to just one click, and a pay-as-you-go system has facilitated the construction of seasonal systems such as campaign sites. Using the cloud has also enabled responses to rapid increases and decreases in processing. The auto scaling function, which increases or decreases the number of servers according to system loads, is already widely used. Going forward, R&D is expected to be carried out in cloud bursting, which executes normal processing on-premise and links the on-premise with the cloud only when there is a surge in load that needs to be processed. It is expected that a variety of functions will continue to be implemented in the cloud and that IT systems will be able to respond to changes even more flexibly than before.

Recently, the concept referred to as “software-defined” has gained wide acceptance. One representative technology that realizes the concept of software-defined is OpenFlow. By using OpenFlow, the functions of networks can be freely expanded through programs. Up until now, vendors aggregated user opinions and implemented functionalities, which were the greatest common denominators, to network equipment. However, the future age will be one in which users implement required functions on their own.

Domain Specific Language (DSL) is one of the powerful methods to implement required functions by users. DSL is a dedicated programming language specializing in particular processes, and it can change the behavior of systems at low cost. In the future, it is believed that there will be an age in which each user will customize office systems for their own use. An example of this would be the administrative division making changes to DSL on the browser and customizing the flow of decisions.

It is believed that automation of operations and maintenance will also advance. The use of tools that automate operational management, such as Chef and Puppet, is expanding. By using these tools, vendors can guarantee that the development and commercial environments are configured in the exact same way. These tools also enable the streamlining of processes by applying build scripts published on the web by other vendors and absorbing differences in OS.

In order to develop technologies that support large-scale processes, it will be necessary for enterprises to have their own large-scale processing environment. This is the reason why over-the-top companies like Google and Facebook maintain a competitive edge in large-scale processing. It is expected that advanced technologies will continue to be introduced by these companies. Companies that use advanced technologies should also note that, in addition to the acquisition and maintenance of the latest technologies, they must align strategic thinking to technology to be effective.

09

Defense in depth

Multi-layered security measures that assume intrusion will increase in importance.

As cyber attacks become more sophisticated, defensive measures to minimize actual damage at the time of intrusion by attackers will become increasingly important. In addition to preventing intrusion, the adoption of multi-layered measures that combine high-accuracy detection, damage diffusion prevention, as well as decentralization and encryption of sensitive information will advance.

In previous times, the purpose of individual hackers in cyber attacks was mainly to show their skills, but hacking is continuing to evolve into attacks that are highly skilled and organized, such as seen in hacktivists that aim to make social and political statements, criminal organizations that aim to gain economic profit and state organizations that aim to secure national defense. According to Kaspersky, secret maneuvering of cyber mercenaries who perform cyber attacks at the request of external parties has been confirmed, and cyber attacks are becoming more sophisticated and diversified at an even greater pace.

Attacking techniques, such as watering hole attacks aimed at specific targets and ransomware that demands ransom for the restoration of systems, wreaked havoc in 2013. In addition, the number of mobile malware surged in response to the rapid spread of smartphones, and according to statistics provided by Trend Micro, the total number of malware targeting Android has reached 1 million.

Today, attackers hold an overwhelmingly dominant position and it is impossible to completely protect corporate networks from intrusion. To minimize actual damage and avoid a catastrophic impact on business, companies will be required to take multi-layered countermeasures such as the following:

1st layer: Prevent intrusion
In order to prevent malware intrusion, implement security checks by firewall, intrusion detection systems (IDS), intrusion prevention systems (IPS), and gateway and client anti-virus products at the intrusion entry points like the web and e-mail, and block improper communication.

2nd layer: High-accuracy detection
In the event that attackers have broken through the checks and intruded the system, detect the intrusion as soon as possible by periodic full scans of malware, log analysis products, and security information and event management (SIEM).

3rd layer: Prevent diffusion
Prevent the diffusion of malware by network

segmentation and stopping remote services. Also, prevent information from being taken out and new malware from being downloaded by URL filtering, proxy authentication, and data loss prevention (DLP) products.

4th layer: Isolate, encrypt and distribute confidential information
Ensure that confidential information that is particularly important, such as information related to national defense and customer information, cannot be used even if it is taken out by isolating it from the network, encrypting the database, and using secret sharing technologies.

5th layer: Understand the full picture of the attack
Based on information obtained by forensic analysis as well as event information collected by a SIEM product, identify the route by which the attack took place and specify information that was leaked or altered.

Furthermore, we must pay attention to the increasingly ambiguous boundary separating the inside and outside of a company due to the use of the cloud, business process outsourcing (BPO), Bring Your Own Device (BYOD) as well as open co-creation & collaboration with external companies and individuals. Security countermeasures must be implemented with an awareness of the total business environment, including one's external partners. This awareness can be said to be the zero-layer of security countermeasures.

One notable change that occurred in 2013 was the leak by Edward Snowden, which exposed the fact that national organizations are tapping information on the Internet. In such a situation, it is difficult for the efforts of companies alone to ensure security. In the future, it will be necessary to build a mechanism of countering threats to society as a whole, with multi-layered countermeasures that are widely extended even outside of companies.

For example, the following countermeasures can be considered:
1st layer: Industry and community level
Because there are many commonalities in facilities and information that are attacked as well as attacking techniques, implement joint countermeasure plans and share risk related information.

2nd layer: Communication carrier and Internet service provider level
Notify access to dangerous sites and malware infection by quarantining communication. Cut off or restrict communication by BOT (malicious use of internet robot) and C&C (Command and Control) server.

3rd layer: National level
Cut off or restrict improper communication across the nation. Reveal attackers based in the country. Develop an attack response system that is integrated with operators of important infrastructures such as electricity and communication.

The outflow of intellectual property due to cyber attacks will lead to a loss of corporate competitiveness and future decline. According to a survey by Symantec, in the U.S., the average cost per compromised record is $188, and the total cost per data breach is $5.4 million. Direct losses due to cyber attacks are growing. In order to avoid catastrophic losses to one's business by cyber attacks and ensure growth, it will be necessary to build mechanisms with effective multi-layered countermeasures and continue making sustained efforts for improvement.

10

Rapid design technologies

Rapid development and iterative improvement will maximize the value of products and services.

Rapid and iterative development will increasingly enhance companies' responsiveness to rapidly-changing markets and optimize the value of their products and services. Advanced rapid-development technologies such as 3D modeling, system development automation and simulation will spread.

Unlike dedicated equipment installed in general factories, 3D printers are capable of manufacturing things in a variety of shapes just by changing the 3D design data (input data). In recent years, model accuracy has particularly increased and rapid manufacturing, which produces not only parts, but also completed products by 3D printing, is expanding. By leveraging the characteristic of 3D printers to produce things in a variety of shapes, the realization of "producing multiple types in appropriate volumes," which was thought to be difficult up to now due to cost constraints, will be facilitated. In the future, it is expected that businesses that manufacture products tailored to the individual will expand. It is also possible that 3D printers will innovate the nature of distribution. For products with simple structures, "self production, self use" will be performed by 3D printer production at home by buying product data on E-commerce websites, and there will no longer be a need to wait a few days until products are delivered. There is also a possibility that, for relatively large products, home-delivery services will appear in which production is carried out by convenience stores and distribution depots on behalf of users. If products that were previously manufactured at factories start to be produced at convenience stores and delivery centers, there will no longer be the need to reassemble production lines to respond to rapid changes in order quantity on the provider-side, and the need to keep an inventory will also be eliminated. The barriers to entering the manufacturing industry will also be lowered through the provision of production capabilities by convenience stores, and numerous individual businesses will be launched in which individual operators will design products on their PCs and sell their 3D design data on online shops.

There are also technologies to reproduce things in the virtual world. Virtual modeling techniques do not require time or material costs for recreation. The method of virtual modeling includes using virtual reality technologies with a head-mounted display as well as generating a stereoscopic image by 3D hologram. Simulation is also a method of carrying out R&D in the virtual world. In drug discovery utilizing supercomputers, the development time of drugs has been significantly reduced by using the method of simulating 10 billion combinations of binding experiments between proteins and compounds in cyber space, and by only experimenting with those combinations that have potential in the real world.

In terms of technologies that accelerate the development of IT systems, design document restoration technology that automatically generates external design documents from source code has been gaining recognition. Design document restoration technology analyzes older-generation legacy source codes as represented in COBOL and PL/I on the computer and automatically generates the design information that is the specification of the source code. In addition, a new paradigm referred to as non-programming development has also been introduced. Development speed will be significantly improved because it will be possible to develop web applications just by carrying out simple design work on the browser screen using a non-programming development tool, without needing to create a program.

In connection with the progress of informatization, development styles are also changing. Program development environments such as Eclipse are starting to be implemented in the cloud, and development that does not depend on a workspace is becoming possible. Development utilizing social networking service (SNS) is also expanding. By using a service called GitHub, that manages source codes under development, developers can easily identify the developer of modules and readily ask questions via SNS. In the future, ubiquitous development environments will become commonplace.

In order to maximize the value of products and services, “feedback loops,” in which immediate feedback from users is repeatedly performed, will become more important. Concepts and methodologies to realize feedback loops include agile development, lean startup and scrum. It is fundamental in the world of lean startups to make improvements to the system in as short a period as possible (there are examples in which systems are updated every day). In order to carry out frequent updates to the system, it is necessary that the software is always capable of being released to the production environment, and to develop an environment of continuous delivery with highly automated builds and releases. A well-known example of a method of effective feedback from user opinions of the system is A/B testing, which prepares two types of screens to a website and adopts the one that receives better user reaction. Also gaining attention is the concept, or development technique, called DevOps that improves the relationship between development personnel and operation personnel in order to perform frequent service improvements. Moreover, the utilization of Design Thinking, which is a methodology of eliminating trade-offs in industrial product design and social design, is also expanding.

As a result of competitiveness shifting from “problem solving skills” to the “ability to create opportunities,” it will be increasingly important in the future to develop skills in designing business models and social systems. Such skills will be required to think of new technological, legal or security models as well as to generate profits. In parallel with human resource training, innovation management is also thought to become important. Going forward, management of the process from creating an idea to realizing it will become a major challenge for companies.

Examples of NTT DATA Initiatives Related

Modeling of human beings

Streamlining and increasing motivation in BPO operations through gamification

By applying “gaming elements,” such as level up, team play and ranking, to routine tasks, workers can increase their motivation by enjoying work through competition while continuing to have a sense of accomplishment. At NTT DATA, we are actively using gamification to enhance employee motivation. In one example, using the analogy of working on a farm, we link the completion of tasks to growing fruit and vegetables. This example applies fun gaming elements, such as competition by ranking of vegetable points acquired based on job completion and awards honors and badges by thank you points acquired based on helping other members. In this way, we are ergonomically understanding elements of human psychology and motivation, and applying them to increase performance as well as visualize and streamline operations.

Mobile-centric

Next-generation mobile utilization infrastructure that enables secure working with smart devices

NTT DATA’s next-generation mobile utilization infrastructure can provide the management and security functions needed for using smart devices at work. There are various cases for business use: the company provides the device to employee; an employee uses his/her own device, also called BYOD (Bring your Own Device); one device is shared by multiple employees and others. Secure working is a given for all of these cases, with NTT DATA’s next generation platform. Specifically, by generating a safe business area or “secure container” inside the mobile device and setting the control policy for smart devices depending on the usage situation, a mobile style is realized in which users can carry out tasks wherever, whenever and from whichever device desired. Additionally, this technology was awarded the ITmedia Enterprise Award, which was presented at the ITpro EXPO AWARD 2013.

to Technology Trends

Intelligent processing by artificial intelligence

Global conference assistance by real-time translation and auto-creation of minutes

The progress of globalization has increased opportunities to hold conferences in English through voice calls between countries using different languages. At NTT DATA, we are developing a Global Conference Assistance System that assists understanding in these kinds of conference situations. This system performs voice recognition and machine translation when English is spoken, and it displays the English text and the translated Japanese text. In addition, after the conference, the system extracts decisions and assignments by utilizing natural language processing techniques, and it enhances work efficiency by automatically creating conference minutes. The more audio recognition, machine translation and minutes creation are used, the higher the accuracy and quality is realized by machine learning. That in turn leads to the increased sophistication of the computer's intelligent processing.

Smart infrastructures

Alleviating congestion by traffic control

At NTT DATA, we are assessing current traffic situations through the use of GPS probe data, such as geo-location and speed, and using that to forecast and simulate the future movement of vehicles. The results can then be used to change and control how frequently traffic lights change, and so help alleviate congestion. The simulation technology can be introduced at low cost, because it uses GPS data, collected from terminals, such as in-vehicle devices and mobile phones. In addition, by leveraging the world's fastest graph data analysis processing technology developed by NTT, this system aims to level processing in parallel computation and realize real-time simulation. By applying Big Data to infrastructure control, we are helping society as a whole improve its resource optimization.

CASE STUDY

Environmentally adaptive IT systems

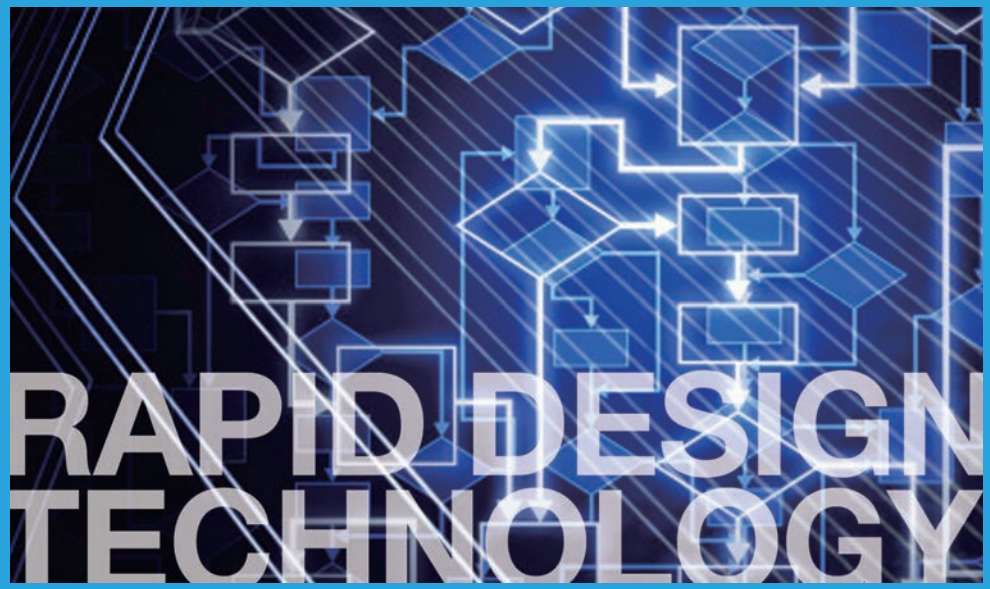
Disaster prevention information distribution by broadcast wave and Wi-Fi

At the time of a disaster, network congestion sometimes causes information transmission failure and delay. To combat this problem, NTT DATA has developed an information distribution system that sends reliable emergency information, and the administrative information required to save lives, with broadcast wave and Wi-Fi multicast. The system uses IP data cast technology that delivers data at the same time with a designed protocol and transmission scheme. Even if the network is unstable, the technology enables the system to reliably transmit and deliver data by the function such as error correction. In the future, we expect the system to flex up to handle rapid load changes during periods of disaster.

Rapid design technologies

Acceleration of system development through production technology innovation

Today, many organizations have a desire to reduce dependence on specific engineers or vendors who have previously involved during system development. Moreover, reduction of system development time has become essential for keeping up with the rapidly changing business environment. NTT DATA's initiative in response to these challenges is "production technology innovation." In production technology innovation, we balance productivity enhancement and high quality in system development by combining various technologies and tools. In terms of requirement definition, we can analyze the source code of existing systems and mine the exact specifications by using re-engineering technologies. In the design phase, we can implement efficient reviews by identifying human errors in design documents and inconsistencies between documents by using consistency check tools. In the development and testing phase, we can generate source codes and test codes from the design information and eliminate coding errors and variations in quality by using automation tools. Going forward, we plan on further enhancing system development, by providing high quality automatic "health checks" and re-use of past modules that will speed up development.



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.

NTT DATA
Technology
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The Value of NTT DATA Technology Foresight

Anticipates the impact of technological innovations and guides the sustainable growth of businesses.

Discovers latent needs and future challenges by envisioning the future world we will live in.

Contributes to the creation of new businesses and the development of society as a whole.

Information Society Trend

IST01 Power of the individual

IST02 Collaborative value creation

IST03 Knowledge society

IST04 Smarter society

TT01 Natural extensions of human abilities

TT02 Modeling of human beings

TT03 Mobile-centric

TT04 Intelligent processing by artificial intelligence

TT05 Real-world sensing and analysis

TT06 Smart infrastructures

TT07 Next-generation web architecture

TT08 Environmentally adaptive IT systems

TT09 Defense in depth

TT10 Rapid design technologies

Technology Trend

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, contact rdhkouhou@kits.nttdata.co.jp .

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