

Orchestrating a brighter world

NEC



NEC Vision for Social Value Creation 2015-2016

Orchestrating a brighter world

“NEC Group Vision 2017” was formulated as a declaration of NEC’s desire to become “a leading global company leveraging the power of innovation to realize an information society friendly to humans and the earth.” We are also focusing on the “Solutions for Society” business that enhances social infrastructure through the use of Information and Communication Technology (ICT) and have made it our goal to contribute to global society by resolving various social issues.

With the expanding world population and concentration into urban areas, the demand for energy, water, and other resources is increasing. There is also a growing need to ensure the safety and security of cities with intertwined risks facing the global environment and societies. Eventually, the current social infrastructure becomes unable to support people’s day-to-day lives.

The new social infrastructure will be required resolving those social issues in the IoT (Internet of Things) era. NEC aims to contribute to the realization of a brighter society where safe and secure services can be provided efficiently and equally, by organically combining individuals, physical things, and systems through the use of ICT.

NEC has been leading the industry and providing our customers the infrastructure to underpin their business by driving the

development of state-of-the-art technologies in the three areas of computing, network, and software creating solutions. We are also pursuing various research and development initiatives for the future in the advanced areas such as sensing technology, data science, artificial intelligence (AI) and IoT. By accumulating technological capabilities and know-how, we contribute to the enhancement of new social infrastructure with an eye to the future.

In 2014, NEC announced our new corporate brand statement, “Orchestrating a brighter world,” under which NEC Group will further unite to promote the solutions for society business. This message represents our firm determination that NEC will continue exercising the leadership role as a social value innovator, while integrating our superior technologies, wealth of expertise, and ideas to orchestrate a brighter and more hopeful way of life and society for the future together with people of the world.

In addition, starting with the new corporate brand statement “Orchestrating a brighter world,” NEC formulated the following seven themes to represent this approach of social value creation: (1) “Sustainable Earth,” aiming to live in harmony with the Earth; (2) “Safer Cities & Public Services,” to make safer and more

secure cities and administrative platforms; (3) realizing a safe and highly efficient "Lifeline Infrastructure"; (4) "Communication," to support an enriched society; (5) "Industry Eco-System," to promote value chain innovation with ICT; (6) "Work Style," to offer diversified ways of working beyond borders; and (7) "Quality of Life," realized in a prosperous, equal, and active society.

NEC will continue to collaborate closely with our business partners and customers around the world to address the seven themes of social value creation. We strive to provide value of safety, security, efficiency, and equality to the global society while taking full advantage of ICT.

We sincerely hope that you will take the time to read this booklet describing NEC Vision to realize "a brighter world."

April 2016



President and CEO, NEC Corporation

Takashi Niino





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NEC Vision for Social Value Creation

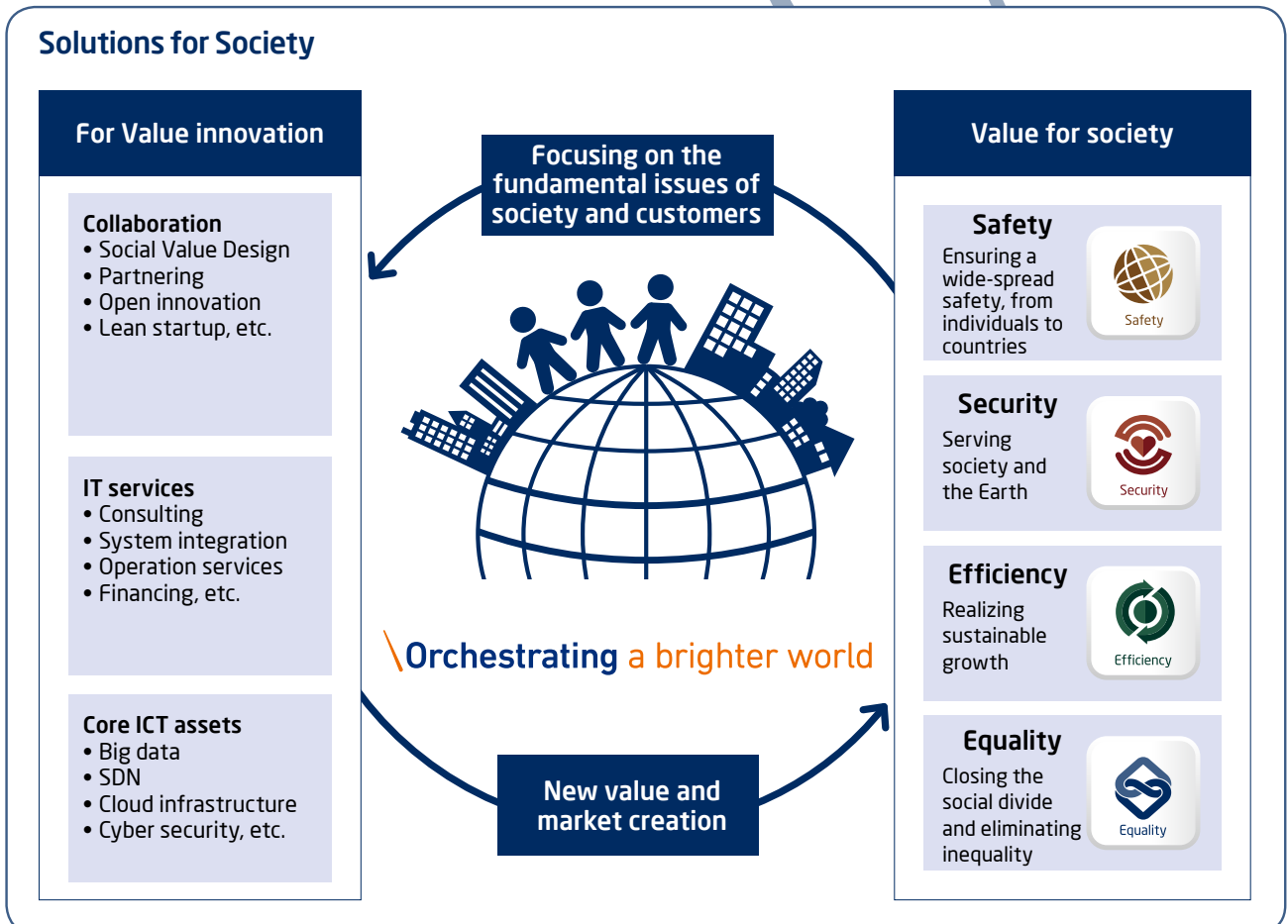
NEC Group is focusing its efforts on providing “Solutions for Society” by upgrading the social infrastructure with ICT. The goal is to form a society that provides safety, security, efficiency, and equality, where people can live prosperous lives. This booklet describes the vision that NEC has for creating social value through our business activities. ICT will continue to evolve and play an increasing role through future contributions to society and business, as well as everyday life. Although the challenge of solving society’s various issues will be great, we anticipate this great opportunity to create new social infrastructure together with our customers.

In this booklet, there are two key messages.

First, as the world’s population increases and concentrate in urban areas, the demands for energy and food will rise at an unsustainable rate. In order to build a fair and sustainable society that utilizes the world’s limited resources without waste, we must develop new social infrastructures driven by ICT.

Second, there are four steps in the process of creating social value: (1) identifying the fundamental issues, (2) collaborating to create value, (3) devising business models and applying ICT, and (4) providing valuable goods and services to customers and co-creating social value. These four steps are indispensable to NEC group. As a promise to our customers and greater society, NEC announced its new corporate brand statement, “Orchestrating a brighter world,” along with the seven themes to represent this approach of social value creation. Collaborating closely with our customers and our partners, we strive to add value to society and to create a bright and prosperous future.

We have also issued a separate booklet titled “NEC Vision: Case Studies and Highlights 2015-2016,” which features examples of our “Solutions for Society” business. We sincerely hope it will prove to be useful to you.



Chapter 1

Realizing a Brighter and More Hopeful Future

1

Global Megatrends

The world is going through an enormous transformation. New social infrastructure powered by ICT is called for in order to create a fair and sustainable society by using our limited resources on earth.

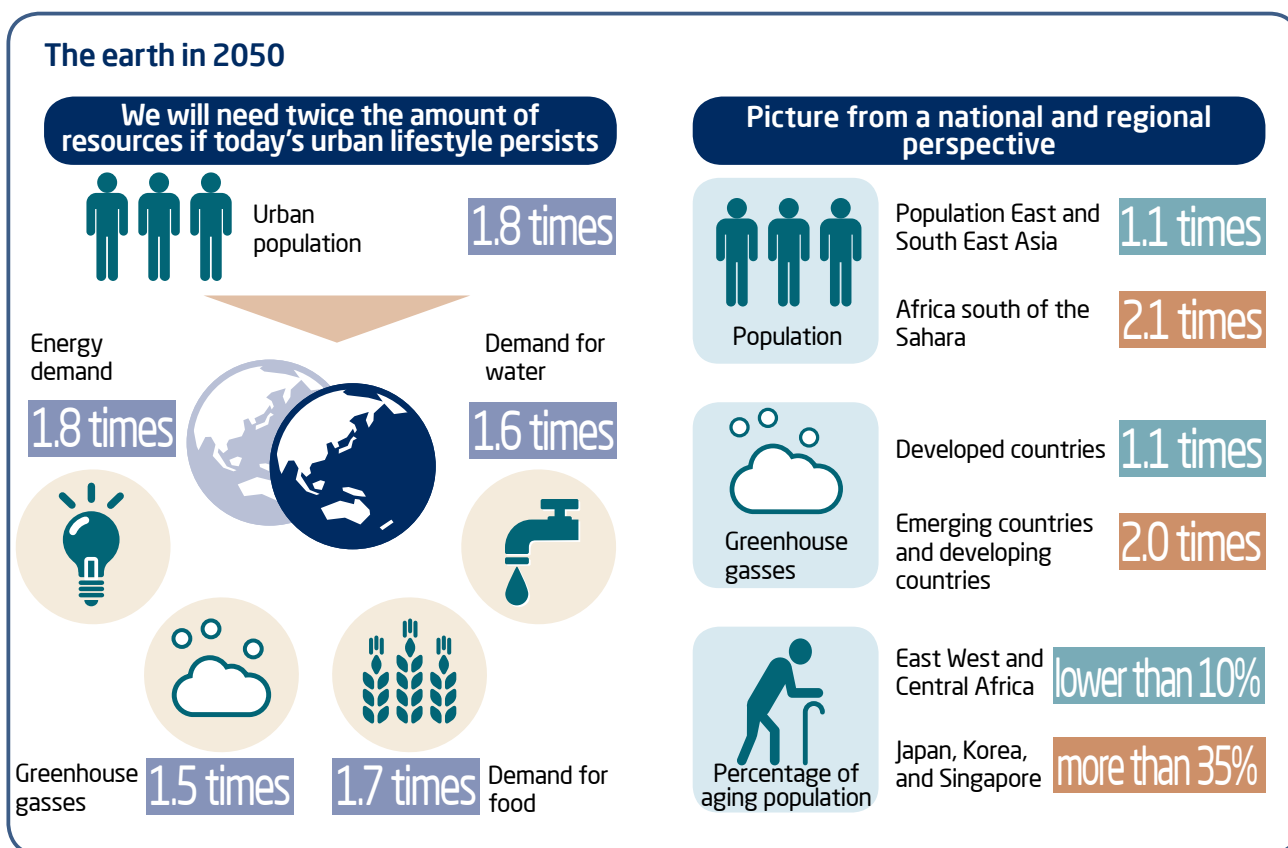
Future Earth and global trends

At this rate, two times the Earth's resources will be required

According to the United Nations, the world's human population will increase to 9.6 billion by 2050. As the people congregate in urban areas, it is estimated that the world's urban population will increase to 6.3 billion, 1.8 times the current figure. As a result, 1.8 times the energy, 1.6 times the water, and 1.7 times the food is deemed necessary. If today's urban lifestyle persists, calculations state that by 2050 society will require double the earth's available resources. In order to build a sustainable society under these conditions, we have no choice but to improve resource productivity, as well as alter the structure and lifestyle of society, so that the

earth's resources are used efficiently.

Although, the situation may appear different from a regional perspective. For example, it is estimated that by 2050 greenhouse gas emissions will increase 1.5 times on a global scale. Emerging countries and developing countries can expect to double their output, while developed countries will see only a 10% increase. Low birth rates and aging populations will affect some countries, regardless their economic status. Countries like Japan, Korea, and Singapore are facing real problems with their dwindling populations, but in France, England, Sweden, and other countries where plans to counteract low birthrates have proved successful, the problem is not so great. So, even when it comes to pressing, global issues, the sense of urgency may differ by region, which makes resolution difficult.



(Source: Data from OECD, FAO, PwC and the United Nations)

Decentralized power and the Digital New Age

Economic development in emerging countries with growing populations will cause a shift in the power balance between nations. Studies estimate that by 2050, the GDP ratio for E7^{*1} to G7^{**2} will be around 64%, while only 36% remains with G7. Although G7 is currently at the forefront of political economics, numerous emergent countries will peak and cause the decentralization of both political and economic power in the world.

New technologies and services, as well as natural disasters, disease outbreaks, and other events or incidents that arise in a specific country to region, will have quick ramifications across the entire globe, in the form of everyday living, stock prices, humanitarian efforts, etc.

The worldwide spread of the Internet is encouraging this trend. In 2014, the number of Internet users exceeded three billion people, and by 2050, that number is expected to reach eight billion, more than 80% of the earth's human population. Advancements in technologies, such as big data analysis, artificial intelligence, and robotics, are being accompanied by a paradigm shift. Thanks to developments in international ICT services, like social networking services, video posting sites, and crowdfunding, the influential power of the

individual will grow further. And with networks tying into the global economy, interdependency between countries will also increase. Emerging countries, with their growing economies, will launch new innovations, and trigger reverse innovations as they spread to developed countries.

With the spread of the Internet, it is under pressure for national governments to enforce Internet regulations and "right to be forgotten" (the right to erase personal information off the Internet for the purpose of protecting privacy), uphold privacy rights, in order to counteract new threats, including confidential information leaks and cyber-attacks. A fusion between the real world and the cyber world has already begun, and this global trend is gaining speed.

Need for new social infrastructure

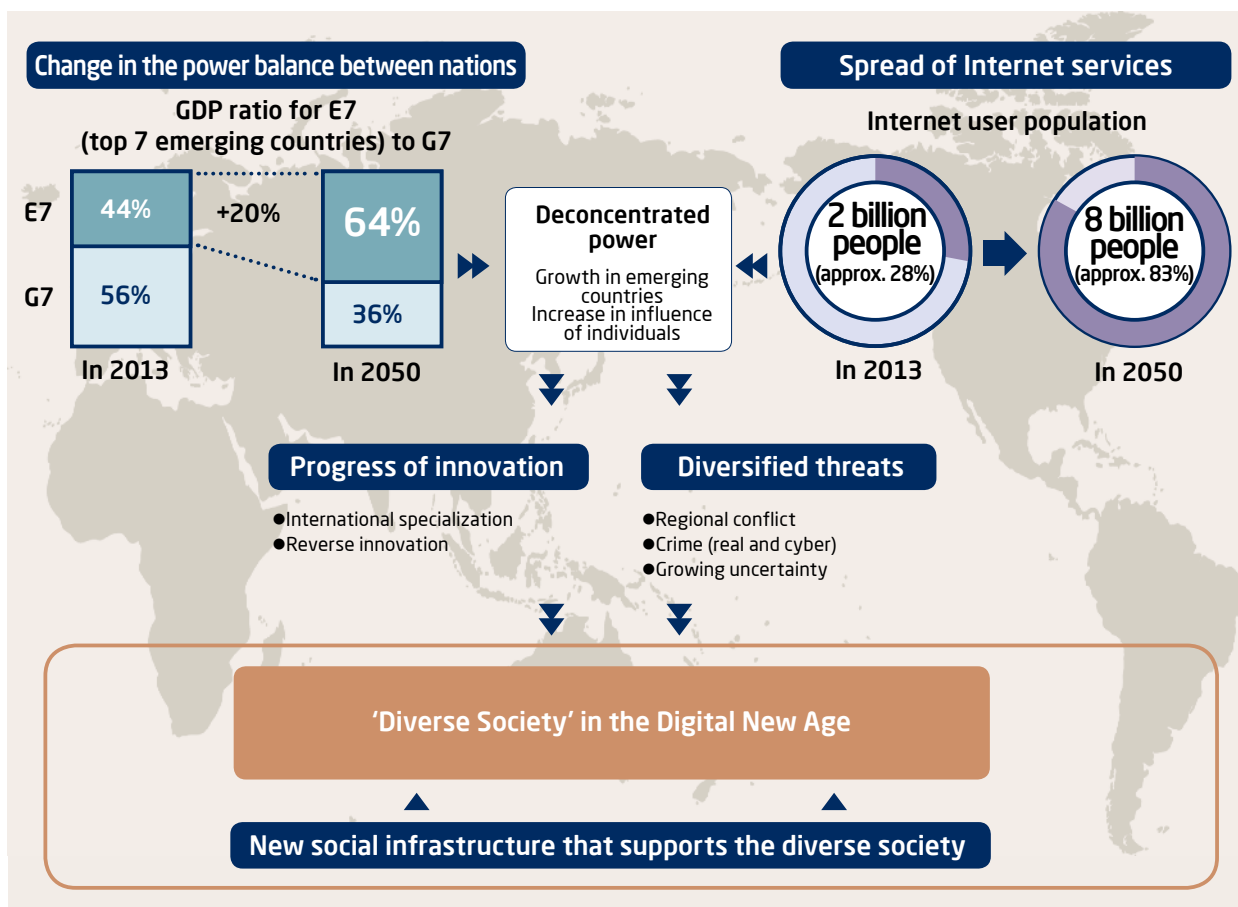
At the UN Summit held in September 2015, a set of Sustainable Development Goals (SDGs)^{**3} for 2030 was officially adopted. Among these goals, "inclusive" is one of the key word. This concept aims to build a society that inclusively accepts everyone, without exception, including people suffering from poverty, disparities, and disabilities. And from now on, making efforts to be inclusive in the cyber world will be just as important as in the real world. For example,

*1 E7: China, India, Brazil, Russia, Indonesia, Mexico, and Turkey

**2 G7: America, France, United Kingdom, Germany, Japan, Italy, and Canada

**3 Sustainable Development Goals (SDGs) consist of 17 goals and 169 targets.

Power deconcentration and the dawn of the Digital New Age



(Source: Data from PwC and International Development Engineering Society)

when it comes to regions and individuals who have not been able to receive sufficient medical training or treatment, there is a push for remote medicine and video education, dispersing knowledge and resources from both the real world and the cyber world.

As of now, we are still feeling out what sort of design and structure accompanies a diverse society in the digital new age. For a world where eight billion people are connected to the Internet, the future holds extreme potential and unimagined changes in perspective. Once every corner of the earth has Internet access, the interdependence between users will rise, as will people's reliance on ICT for daily life. The services that will be offered from the cyber world will have influence over the real world. In order to actualize a diverse society in the digital new age, we must plan and implement new social infrastructure that can effectively utilize the earth's limited resources and cope with diversified threats and social issues that vary by country or region.

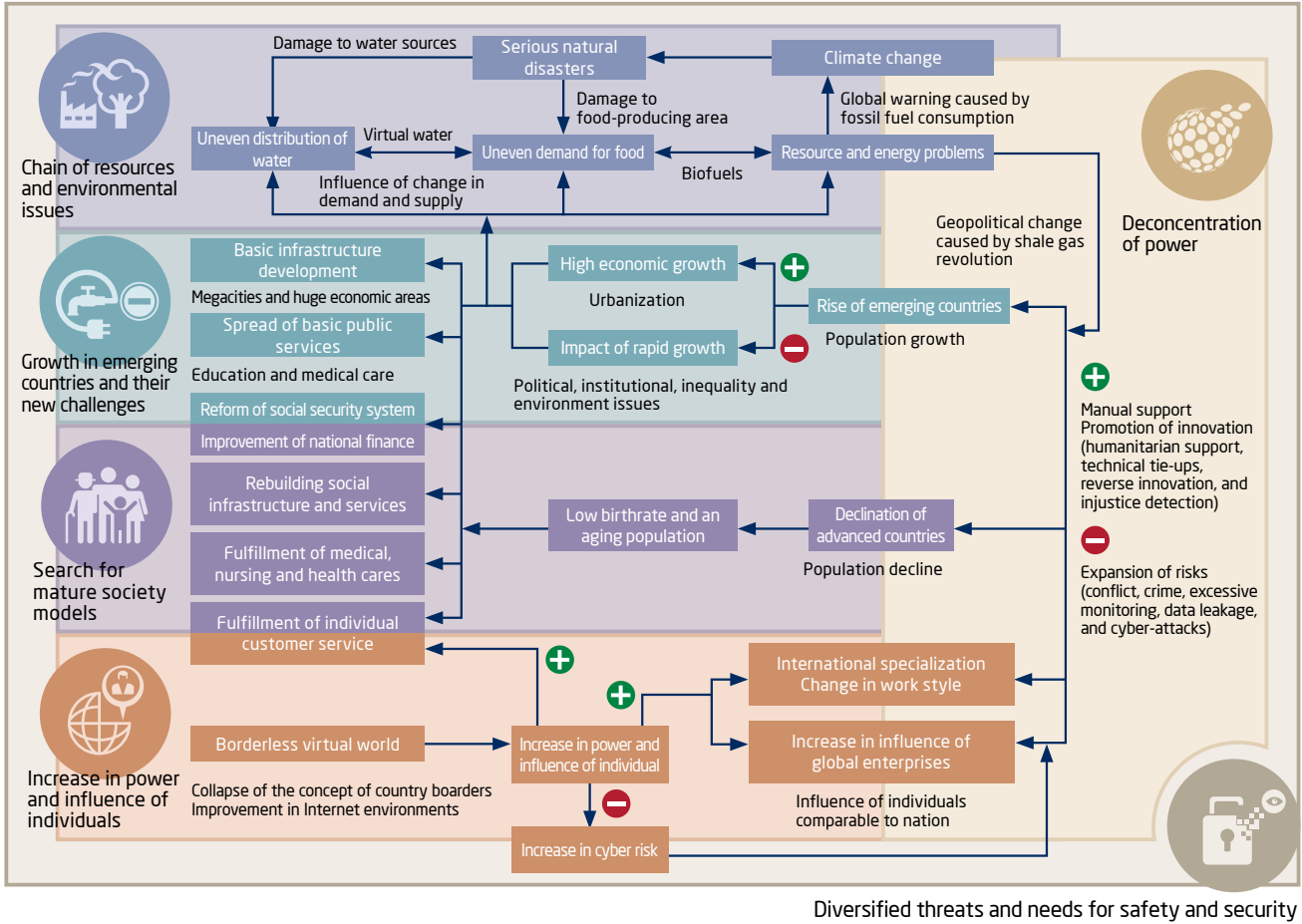
Six megatrends and their interconnectedness

When we structurally envision the trends in global economics, society, and technology that will occur over the next one to three decades, some megatrends become apparent.

NEC has classified into six megatrends: (1) chain of resources and environmental issues, (2) growth in emerging countries and their new challenges, (3) search for mature society models, (4) increase in power and influence of individuals, (5) deconcentration of power, (6) diversified threats and needs for safety and security. All of these trends are complexly interconnected and affect one another.

For example, global population growth and the urban and economic development taking place in emerging countries will have a profound impact on our resources and energy problems. Increasing demands for staple grains could lead to water

Correlation of 6 megatrends



shortages and then desertification, in turn. The impact on our natural environment would be enormous. Also, now that progress has been made in our ability to extract oil and natural gas (shale gas) from shale formations, there is a chance that the world’s energy situation will change. In addition to altering the economies of current oil-producing countries, the whole power balance between countries could shift.

Although there is a limit to how accurately we can predict the future amidst these the complexly interconnected megatrends, NEC considers global megatrends to be an important guiding tool to discovering new opportunities in our imagined future. And as members of an international society, it is our responsibility to strive for a diverse society in the digital new age. In the next section, we will introduce NEC’s vision for social value creation.

6 megatrends

- 

Chain of resources and environmental issues
The consumption of water and food due to population growth and urbanization will impact the other resources and the environment.
- 

Growth in emerging countries and their new challenges
Rapid economic growth in emerging countries will cause new issues, such as environmental concerns and resource shortages, even as their power grows.
- 

Search for mature society models
In advanced countries, low birthrates, aging of populations, and the deterioration of facilities will encourage reform of the current legal and social systems.
- 

Increase in power and influence of individuals
Advancement of the Internet will raise concerns over cyber-attacks, etc., while increasing the influence of individuals on the global stage.
- 

Deconcentration of power
As emerging countries and individuals have more influence, the world will decentralize and form a new power balance.
- 

Diversified threats and needs for safety and security
Big changes in the world will generate various threats to both the real world and cyberspace, and increase demand for safety and security.



2

NEC Aspires to Create Social Value

A number of social issues, as well as remarkable ICT innovations, are occurring on a global scale. Keeping these two megatrends in mind, NEC aims for a brighter, enriched society for all people.

Working with customers and partners for a brighter world

The Seven Themes for Social Value Creation

As we mentioned in the previous section, the world will be seeing a dramatic increase in population and urbanization. We must prepare countermeasures for a number of social issues, including increased resource consumption, global warming,

environmental destruction, aging populations in advanced countries, diversified crime, and more.

On the other hand, we better notice that technological advancements will also continue to evolve, and will play a major role in resolving these future social issues.

NEC has established the Seven Themes for Social Value Creation, based off of the six megatrends introduced earlier. These themes all embody NEC's mission to work on the "Solutions for Society" business by addressing social issues on earth through the ultimate application of ICT.

The seven themes are as follows: (1) "Sustainable Earth," aiming to live in harmony with the Earth; (2) "Safer Cities & Public Services," to make safer and

The Seven Themes for Social Value Creation



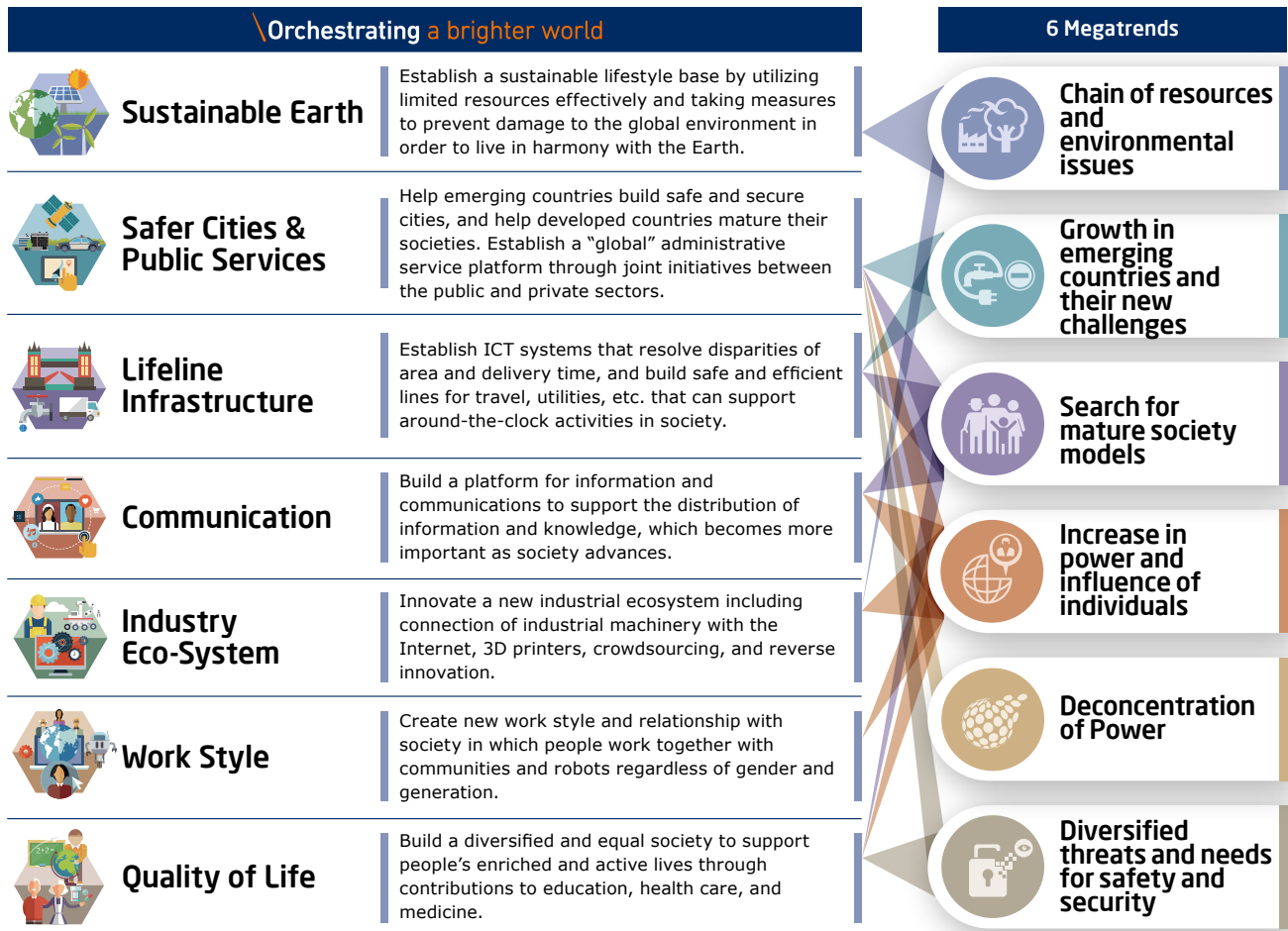
more secure cities and administrative platforms; (3) realizing a safe and highly efficient “Lifeline Infrastructure”; (4) “Communication,” to support an enriched society; (5) “Industry Eco-System,” to promote value chain innovation with ICT; (6) “Work Style,” to offer diversified ways of working beyond borders; and (7) “Quality of Life,” realized in a prosperous, equal, and active society.

“Orchestrating a brighter world”

On a mission to provide solutions for society, NEC has adopted “Orchestrating a brighter world” as our corporate brand statement. This brand statement embodies NEC’s resolve to “co-create” brighter, more hopeful lives and societies for the future in “cooperation” with people from all countries and regions of the world, by following the seven themes for creating social value.

NEC demonstrates leadership as an unprecedented integrator of computing, network, and software solutions. And with our superior technology and extensive range of expertise and ideas, we will continue “Orchestrating a brighter world.”

Seven Themes for Social Value Creation and Six Megatrends



Solutions for social issues based on the megatrends

Recognizing the fundamental issues

NEC believes that it is important to identify the essence of value for society and for our clients before taking further steps to create social value. When hit with a string of unexpected circumstances, it is not uncommon for previously-held values to become uprooted. In such cases, it is difficult to gain a proper understanding of the fundamental issues. One way of identifying the issues is design thinking. NEC has been working on "Social Value Design," which combines the perspectives of both the end-users and society when drawing up solutions to issues that were identified through field work (on-site observations and surveys). NEC aims to work together with our customers and the community to identify and then solve

the core issues, based on the needs of each region.

The prediction that humanity will require two times the Earth's actual resources by the year 2050 only applies if we perpetuate our current lifestyle. But if we look closely at today's social and industrial structures, there is a lot of unnecessary waste. The Japanese word "MOTTAINAI" indicates the senseless waste of an important resource. When we think about the world's resources in our present world, imagine what could be considered "MOTTAINAI."

For example, only 0.01% of the water on earth is drinkable, and yet 10% to 40% of the water in big cities around the world is wasted through leaks. Also, about one third of the food produced world-wide is disposed of each year. Current technology can provide only 50% thermal efficiency in the internal combustion engines used in gas-driven automobiles. And even traffic jams could be considered as another kind of "MOTTAINAI," wasting of both energy and time.

A movement to re-design existing systems is starting, for example, shifting the time of

Reducing “MOTTAINAI”

Let us consider water as an example of how ICT can be used to reduce “MOTTAINAI,” which means needless waste.

When the amount of water available to a region falls below 1,700 m³ per person per year, the strain experienced in everyday life is considered “water stress.” It is estimated that two-thirds of the world’s population will be suffering from water stress by 2025. And yet, the water leakage rates in major cities are as high as 10% to 40%.

Currently, the primary countermeasure against leaks is specialized maintenance workers, who use tools to listen for the sound of water leaking from underground conduits. However, quickly detecting changes in a vast network of water pipes is difficult when using this labor oriented method. And because the water pipes are aging and maintenance workers are becoming fewer, the situation is getting worse.

NEC’s solution to water leaks is to install sensors that measure vibrations in waterways and to

connect them to the cloud for analysis, enabling quick and accurate leak detection. This will do more than just optimize maintenance costs for our customers. Detecting and stopping these leaks in their early stages will protect the surrounding gas pipes, roadways depression, etc. from second-hand damage.

In addition, we are conducting joint research on smart water management with the Imperial College London. For the sake of remote electronic control over water systems, this brand new initiative constructs mathematical models of water facilities and water flow from massive data and combines it with water usage forecasts provided by NEC’s own heterogeneous mixture learning technology (artificial intelligence).

NEC is making efforts alongside our customers to stabilize our limited supply of water, thus facilitating the creation of safe and secure cities, where any person can access water at any time.

Customer and society issues

- Shortage and exhaustion of water resources
- Fair distribution of drinking water
- Higher leakage rate due to aging pipes

Create customer value

- Expansion of the coverage of drinking water supply through the purification of water sources
- Efficient operation of water infrastructure and improvements at the service level
- Streamlined advanced system maintenance using sophisticated water leakage analysis (Type 2 RO water treatment systems, water leakage monitoring services fault detection, monitoring control techniques, water use analysis and forecasting)

Create social value with customer

- Society where everyone has access to water anytime
- Sustainable use and stable supply with limited water resources

Estimated water-stressed population

Two-thirds of the world’s population (2025)

(Based on data from United Nations Environment Programme (UNEP))

Water leakage rates in major cities

Cities	Water leakage rate(%)
New York (United States in 2008)	1.8
Tokyo (Japan in 2010)	2.7
Sydney (Australia in 2009)	8.2
Madrid (Spain in 2006)	12.3
Beijing (China in 2006)	15.9
Istanbul (Turkey in 2008)	25
London (England in 2006)	33.3
New Delhi (India in 2007)	40

(Based on data provided by the Tokyo Metropolitan Government)

availability to match the circumstances of the people, or promoting shared use instead of individual ownership. NEC believes that by applying these ideas and efforts to society and the industrial world, we can see a drastic reduce of “MOTTAINAI.”

Cooperation and co-creation

The most important tools to improving and resolving society’s issues through new techniques and strategies are the industry knowledge and practical know-how of our clients. It is necessary to collaborate with NGO/NPO and

local governments, who understand the core of the issues faced by local communities, and to engage in cross-industrial partnering. NEC tackles issues through open innovation, lean startups (a new business development plan), and other proactive developments.

By combining an accumulation of our advanced ICT assets with system construction and service expertise that has been cultivated over many years, NEC wants to create a brighter world by joining with our clients and partners to design and achieve new value. This resolve is at the root of our management when constructing social and industrial systems that incorporate ICT.

NEC Initiatives for Creating ICT Value

Over a hundred years of history

Since its foundation on July 17, 1899, NEC has forged a long history of innovation in the information and communication fields under the slogan "Better Products, Better Services." These ICT developments are supported by computing, network, and the software that creates solutions. Over the past 20 years, the computer performance—specifically the processing power of CPUs—has increased by approximately 500 times. In addition, the transmission capacity of submarine optical cables increased by approximately 2,000 times from 1994 to 2014. It is now estimated that by the year 2020, the wireless transmission capacity of mobile network will be one million times greater than it was in 1992.

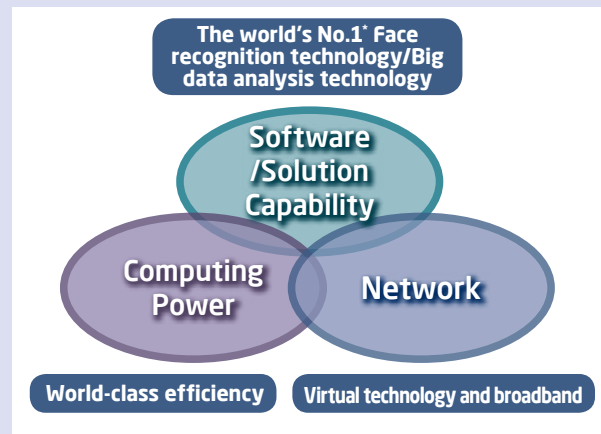
Taking advantage of three areas of ICT, computing, network, and software, NEC is committed to providing solutions and value to our customers through world-class technologies and services.

Real-time, dynamic, and remote

NEC believes that advancement in the areas of computing, network, and software can evolve the three value of ICT: real-time, dynamic, and remote attributes.

The first attribute, "real-time," refers to the ability to overcome time constraints. For example, in the wake of a disaster, when complicated circumstances are at play, the situation can change moment-by-moment, but getting fast and accurate information about the status on the scene can help to minimize the damage. It is important to predict the ways in

Three areas of ICT development

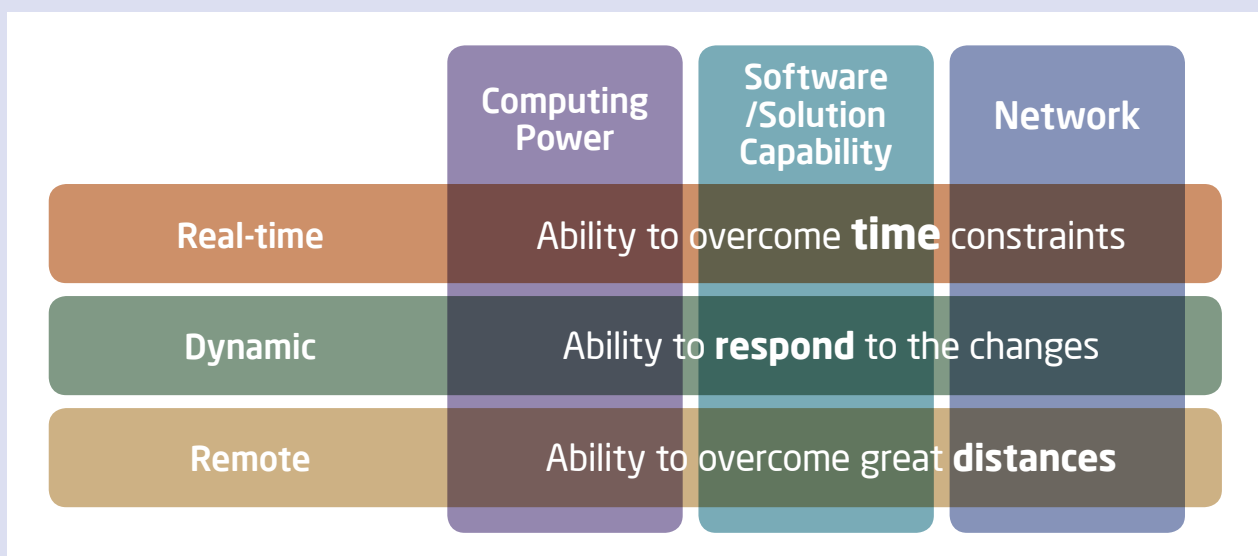


which the disaster may spread and to provide real-time evacuation instructions.

The evolution of ICT will make it possible to analyze terabytes and even petabytes of data from a wide range of sources in just a small matter of seconds or milliseconds.

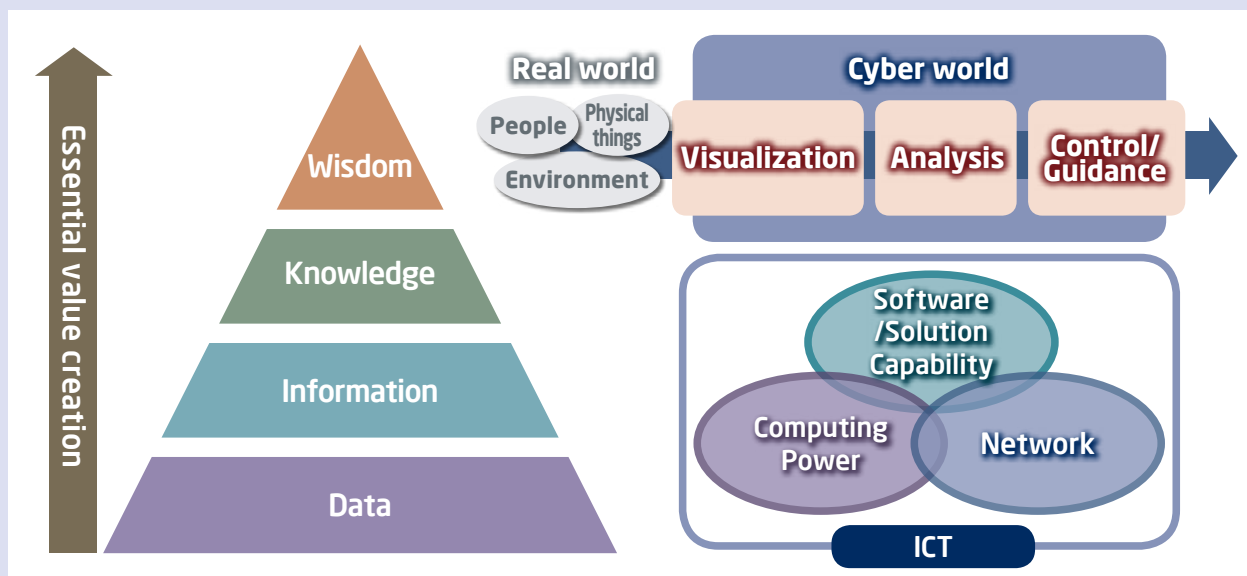
The second attribute, "dynamic" refers to the ability to respond to any changes. By applying Big data analysis technology to a surveillance system that detects signs of failure in plant manufacturing, the operation center can acknowledge any "unusual" signs as soon as possible, and take preventative action.

The third attribute, "remote," refers to the ability to overcome great distances. In the field of remote medical care using ICT, doctors can examine patients, even from a distant place. This ensures quality medical service, regardless of location.



* Ranked 1st in United States' NIST (National Institute of Standards and Technology) benchmark testing.

Creating value with ICT



Value created by linking “physical things” and context

The IoT (Internet of Things) is quickly gaining popularity. For example, consider what constitutes “Things” when you take a picture with your camera and save it to the cloud. In this situation, “Things” refers to more than just the “physical things” captured by your camera. Aspects of the context, such as the behavior of the photographer, the weather that day, location information, the condition of “physical things” in the image, can also be considered “Things.” In this way, the person using the camera, “physical things” captured by the camera, and the situational and behavioral context gracing the image are all connected on the Internet. The day is coming where reality and cyberspace will merge, and without any conscious effort all of the people, “physical things,” and contexts will be constantly linked.

NEC believes that value will be created through a three-step process: (1) Visualization, (2) Analysis, and (3) Control/Guidance.

“Visualization” is the act of converting various types of data from real people, “physical things,” and context into meaningful digital information via sensing technology. “Analysis” is the analysis of this digital information using artificial intelligence software, computers, and network processing powered by sophisticated algorithms. Finally, by using “Control/Guidance,” innovative services based on unconventional wisdom can be implemented.

Transforming data into information, then knowledge and wisdom

When given a purpose, the accumulation of simple data can result in meaningful information. For example, general data on the traffic in a city

becomes useful information when divided according to time and human context. Accumulating this information in a variety of places and times creates knowledge of group behaviors and the utilization of public services across the entire city.

Through the development of ICT, people’s gender, age, walking speed, and other information can be instantly analyzed from camera images, providing wisdom. From there, once it’s possible to predict people’s actions based on their clothes or facial expressions, this wisdom can be used to secure smooth traffic lines develop a safer city.

NEC initiatives

NEC is making a continued effort to create value in each of the three areas of ICT.

For computing, NEC is using original technology to build streamlined data centers that reduce installation space and power consumption by 70 to 80%. They’re also using supercomputers outfitted with vector processors, suitable for image processing, to predict flood damage caused by tsunamis. In network areas, NEC’s submarine optical cables and PASOLINK (compact microwave radio system) are being widely adopted across the world.

For network virtualization and control, NEC led the research and technological development of SDN (software-defined networking), promoted standardization in the industry, and produced the first corresponding goods on the market.

And in software, NEC possesses facial recognition software, crowd behavior analytics, and media processors with world-class precision, which can run facial comparisons at a rate of three million people per second. NEC also has a rich set of solutions with actual applications using artificial intelligence technologies, including invariant analysis and heterogeneous mixture learning.

3

Our Technology Vision with an Eye on Society in the Next 10 Years



In the world of ICT, technological concepts quickly become reality and integrate into our society, to the point of becoming indispensable. NEC pursues problem-solving technologies, while keeping in mind the state of the world in ten years.

The Role of ICT in Creating Social Value and the Direction of Technology Development

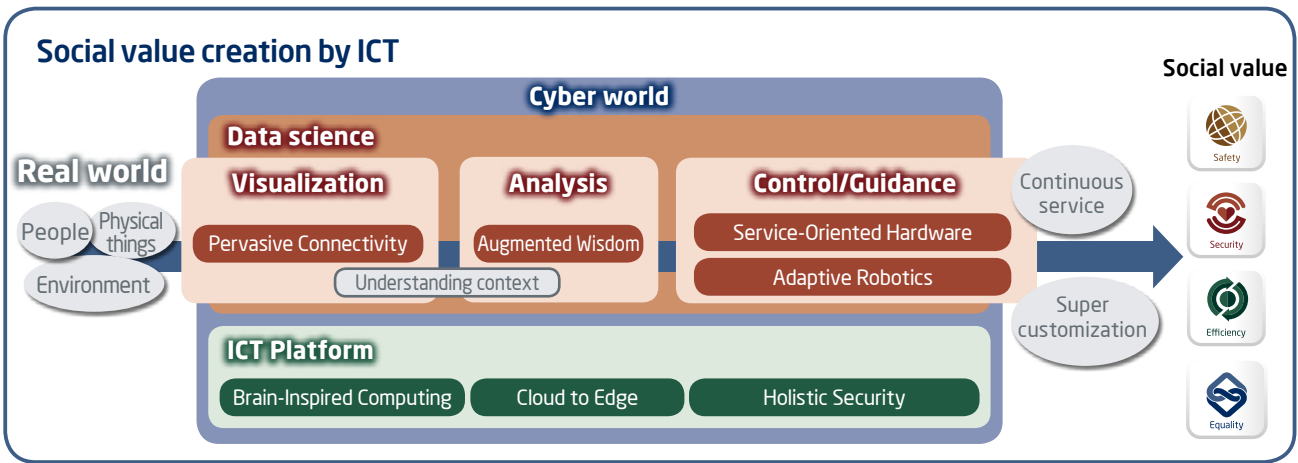
Understanding context gives rise to new business opportunities

By infusing all areas of the world with ICT, NEC will increase its efforts to resolve social issues, thereby creating social value. In these efforts, technologies can connect the real world with the cyber world and perform advanced analyses will serve an important role.

As numerous “physical things” in the world of IoT become interwoven and more data is accumulated, we are able to visualize “physical things” and the environment. Furthermore, by allowing an artificial intelligence to analyze how “physical things” are linked, the context of what is taking place can also be understood.

As a result, new services that promote safety, security, and enriched life can be created. For example, if a business that offers goods and services can truly understand the context in which their product is being used, then they can understand and predict the needs of the end-user.

And, they will be able to respond to these needs with continuous improvements to their services. These continuous improvements will push the boundaries of services, software, and hardware. Even the hitherto rigid constraints of inflexible hardware have been overcome by software-driven functions, allowing hardware to cope with dynamic change. “Softwarized hardware” connected to a network continues to offer new features, as it undergoes daily upgrades. These sorts of technological developments anticipate the demands and preferences of the users and allow “super customization” of the goods and services, based on the time, place, and other situational factors, to meet a user’s exact preferences. Also, by understanding context, people from various fields will cooperate to create new types businesses.



Evolution of seven technologies	to present	in 2020	on and after 2025
Pervasive Connectivity	Things are connected	Context are connected	
Augmented Wisdom	Analysis/recognition	Understanding context	Reasoning/Decisions
Service-Oriented Hardware	Utilization of software	Utilization of services	
Adaptive Robotics	Partially operated		Autonomous cooperation
Brain-Inspired Computing	Left brain work		Right brain work
Cloud to Edge	Concentrated on data center	Data center/Edge linkage	Deconcentration of function
Holistic Security	Cyber security	IoT security	Total security

NEC's Technology Direction

As ICT makes significant changes to society, NEC focuses on using data science to foster a deeper understanding of context and to provide valuable services. We are also devoted to creating the necessary ICT platforms that are both efficient and secure.

From now on, pursuing a level of ICT that can cope with the size and complexity of social issues will require a well-grounded understanding of context, especially when dealing with issues that do not have clear solutions, or making judgments that satisfy changing situations, etc.

Let's draw a comparison to automobile control. Optimal car control requires more than a simple understanding of the traffic situation; conclusions are made in real-time based on many factors, including the weather and the mental state of the driver. And even then, the results can be dealt with in a number of ways. To execute this level of advanced processing requires network connectivity, to maintain a constant grasp on the status of the person and the equipment, as well as an artificial intelligence that can think and reason as well as, if not better than, a human. Finally, the technology capable of automatically controlling

the equipment based on these judgements is also required.

It is essential that we create new ICT platforms to support these new systems and technologies. For example, in order to realize advanced artificial intelligence, modern-day computers must overcome the obstacle of power consumption. Therefore, there is high demand for the development of things like brain-inspired computing with excellent power efficiency. Also, in the field of automated driving, optimizing regional transportation and alleviating heavy traffic will require handling over not only the automobile, but also on the cloud. For this cause, the technology and its individual functions must be fully distributed. At the same time, security technology in regards to driving must be developed.

In these ways, NEC works from multiple perspectives in order to develop new technologies that impact all areas of social infrastructure. The following pages describe the details of these efforts.

A Technology View of the World which will transform Society

As technological fields which will transform the whole of society, NEC is focusing on the following seven areas.

Pervasive Connectivity :

As developments in information communications accumulate, Internet becomes available regardless of whether a person is indoors or outdoors, and a variety of objects and networks become linked via the IoT. People and objects will be casually tied to the Internet, and through computer analysis of everything from the status of these people and objects to the contextual environments of active businesses and running machinery, a broader visualization of society will be formed.

At present, this level of connectedness is limited to specific organizations and corporate domains, but in the future, it will spread to the whole of society. By overcoming these boundaries and sharing resources across various organizations, the knowledge of different fields can be consolidated, giving rise to new innovation. We may even see a shift in values and structures.

Augmented Wisdom :

To live in a rapidly-evolving information society brings comfort to daily life and facilitates newfound experiences. But on the other hand, it also requires one to cope with an increasing amount of information. We can narrow down information with searching technologies, but it still takes a considerable amount of time for a person to examine the details and comprehend the results.

It is in this area that artificial intelligence is garnering high expectations in this field. Thanks to developments in artificial intelligence, computers that are still only able to organize past information and extract the patterns and trends will soon be able to suggest new

perspectives and reasoning for uncertain situations and to aggregate this data through verification. By relying on artificial intelligence for fixed form procedures, and a portion of intellectual labor, people will be able to concentrate on strategizing and performing other work that requires a great deal of decision making or emotional sensitivity. The hope is that refined artificial intelligence will enhance our wisdom and become a partner to mankind.

Brain-Inspired Computing :

Advanced intellectual processing, such as artificial intelligence, requires huge amounts of processing, and if we were to enlarge current computers, which use von Neumann architecture, the power consumption would increase proportionately.

Meanwhile, we know that processes performed by the human brain are highly advanced but consume very little power (averaging 20 watts). Therefore, research is progressing on a new computer architecture which imitates the human brain.

In the future, the von Neumann computing that exists today will be relegated to generic processing and strict calculations, while brain-



inspired computing will handle more specific processes that require human-like reasoning and ambiguous calculations. Computer technology that blends these two architectures is growing in importance.

Service-Oriented Hardware :

By developing ICT through virtualization and abstraction, it has become possible to define a large number of hardware functions through software. This software development trend is not limited IT equipment, but is spreading to airplanes and automobiles.

The advantage of “softwarized hardware” that is malleable through software is that functions can be added and upgraded, even

while in operation. In designing such “softwarized hardware,” the manufacturers must anticipate the addition of new services. The current definition of after sales service does not cover these changes to the physical system, so future services will expand to create lasting links between the product providers and their customers.

Adaptive Robotics :

Robotics is becoming commonplace for its direct contribution to increasing productivity. And now the idea of “cloud robotics,” in other words connecting robots to online networks, is gaining advocacy for its ability to decentralize intelligence, sense, and actuation. Due to this, robotics is becoming an integral component of ICT systems as that which serves the role of controlling things in the real world.

Furthermore, robots respond to specific objectives and are being developed for different purposes, be they industrial, human interactive, for transportation, etc. Productivity is certain to increase with the



level of autonomy that robots can achieve, as they also become partners to humans and fill an important role in society.

Cloud to Edge :

As the IoT develops beyond this point, components that operate at the edge of a network, including sensors, actuators, and network equipment, will be equipped with processing features. Future IoT systems will incorporate both the cloud and edge computing, and will allocate calculation processes depending on the volume of data and real-time sensitivity. Flexible coping and dynamic control will be possible. By allowing real-world information to be processed closer to the source, even violent changes can be dealt with quickly.

Holistic Security :

With the spread of the IoT, the target range of security will expand to include physical systems. We must consider the risk that cyber-attacks against IoT systems linked to the real world may be coupled with human infiltration or destruction of facilities, etc. Those risks may not be exclusive, but mutually coordinated. Together with the strengthening of cyber security, comprehensive security measures that are linked to the real world, such as image surveillance for identifying intruders, must be strengthened.

Chapter 2

Creating the future with our Customers

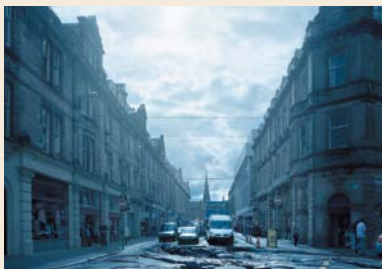
While looking at the world from a wide perspective ranging from the global environment to society, industries, and lifestyles, NEC delivers essential solutions to problems instead of shortsighted fixes and aims to realize a bright future while establishing a balance between the value of customers and the value of society.

Customer and Society issues



Shortage and uneven distribution of resources such as energy, food, and water / Enlargement of natural disasters and impacts on ecosystems due to global warming

Development of urban infrastructures / Improvement of a safe and secure society with such as security / Lifestyle support / Measures in regard to the aging population, etc.



Create customer value

For Value innovation

Collaboration

- Social Value Design
- Partnering
- Open innovation
- Lean startup and etc.

Core ICT assets

- Big data
- SDN
- Cloud infrastructure
- Cyber security and etc.

Cooperation

Towards the Realization of "a brighter world"

This chapter explains the seven themes of social value creation with which NEC is making efforts in to realize "a brighter world."

As a starting point for social value creation, NEC places an importance on "pursuing essential value of society and customers." By grasping the essential "problems of society and customers," we will continue to pursue not only the development of customers but the realization of a sustainable society.

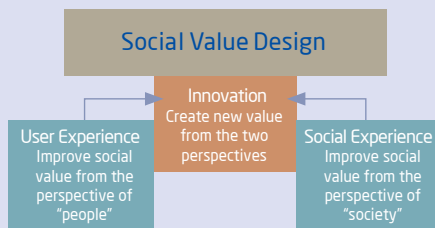
In order to accomplish this, NEC has been making efforts to "co-creation of social value while collaboration" with not only customers and partner companies but also various stakeholders.

In addition to advanced "ICT assets" and our knowledge of system construction accumulated over many years of experience, we are combining our efforts towards "partnering towards the resolution of problems" and the introduction of "new business models" to create value that will realize "a brighter world."

For Value innovation

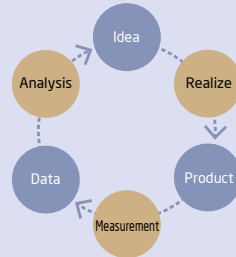
Social Value Design

Efforts to provide solutions from the two perspectives of "user" and "society" in relation to problems extracted through field work (on-site observations and investigations).



Lean startup

Efforts aiming to essentially resolve problems with minimal costs and time by repeating, in relation to complicated social problems, hypotheses construction and verifications in short cycles.



Create social value with customer

IT services

- Consulting
- System integration
- Operation services
- Financing and etc.

Co-creation



Efficient utilization of limited resources / Flexible correspondence to environmental changes / Improvement of the safety and security of the lives of citizens

Disaster prevention and reduction / Infrastructure maintenance / providing of a secure network / Safe provision of food and materials / Medical care and education free of disparities, etc.





Orchestrating a brighter world

Sustainable Earth

Coexistence with the Earth

In the next 30 years, the increase of the world's population and urbanization will bring threats with such as large burdens on the global environment and an increase of natural disasters. NEC recognizes that the state of the world will continually change, and we are committed to contribute to the realization of a society coexisting with the earth through efficient and fair distribution of limited resources and the solving of environmental problems.

A Sustainable International Society

The rapid increase of the population and urbanization throughout the world is becoming a large burden on the global environment and posing various threats on humanity. In order for societies to persist, from a global perspective which surpasses the boundaries of countries and regions, it is necessary to reduce the burdens on the global environment as a whole, prepare for the occurrence of natural disasters to enable safe and secure living, and efficiently and fairly distribute resources to enable sustainable utilization.

NEC's businesses cover a wide area ranging from outer space to underseas. Collecting and deciphering various data in regard to the global environment will lead to predicting the occurrence of disasters such as earthquakes, typhoons, and tsunamis and predictions of the demand for energy. NEC aims to realize a safe, secure, efficient, and equal society by making efforts so that many can protect themselves from disasters and reducing the waste of limited resources.

Future ICT that solve Environmental Problems

Technologies for capturing sensor data from satellites have been rapidly evolving. Satellites sensors which are able to identify details on the ground in units of several centimeters make it possible to grasp in real time and in detail the vegetation status of forests and the growth status of plants throughout the world. Further by capturing and analyzing various sensor data such as ground surface temperatures, CO2 concentrations, ocean surface temperatures, and water circulation, for example it is possible to clarify and predict the effect that changes of the environment due to global warming have on plants and ecosystems. With the evolution of IoT and sensors becoming connected, the environmental information which we can gather from our surroundings will expand. In other words, by using sensors to monitor the entire earth from outer space to ocean floors, similar to with a health check for humans, the status of the global environment can be diagnosed in real time to be put to use in devising appropriate countermeasures. In order for us to continue to receive blessings from the earth in the future, it is necessary that we maintain the global environment in a healthy state. NEC will make use of ICT technologies to correctly grasp the worsening situations

Forest Protection Monitoring predicting the Spread of Fires

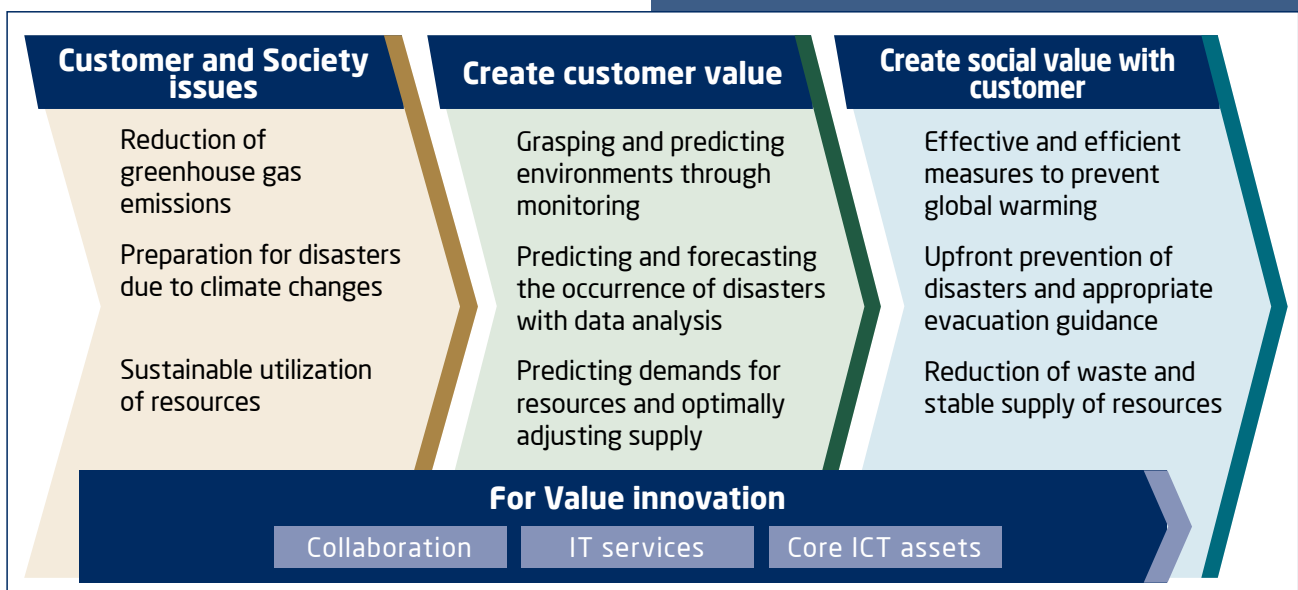


of the global environment to think of and support the efficient implementation of the most effective countermeasures.

The change in climate due to global warming has already been having an impact on society. In order to realize safe and secure living, we can prepare for such impact by utilizing ICT.

For example, in regions with increasing dryness due to global warming, it is predicted that forest fires will occur more frequently and on a larger scale. Monitoring from satellites can grasp in real time the climate changes and statuses of forests all across the world and not only increase the accuracy of forest fire predictions but also be put to use in identifying areas in which fires have occurred and the extent that such is likely to expand to, guiding evacuation, and drafting plans for firefighting activities. Towards the realization of a sustainable society, various countries, regions, companies, and individuals must cooperate in making efforts to resolve environmental problems on a global scale. NEC aims to globally contribute to the resolution of such problems by making use of ICT in all sorts of locations from outer space to ocean floors.

Social value creation



NEC initiatives

NEC has realized in various countries throughout the world ICT which supports a sustainable earth.

For example, the "Synthetic Aperture Rader" mounted on artificial satellites are able to observe a wide area of forests regardless of the climate condition 24 hours a day, contributes to crackdown on illegal logging.

Further, technology has been developed which, by combining three-dimensional analysis of aerial photos and spectral analysis, enables identification of the heights and tree types of forests over a wide area at a low cost and this is being put to use with forest protection. In addition, the data sent from cable-type ocean floor earthquake monitoring systems installed in ocean floors are distributed to related institutions in real time to contribute to reducing damages due to earthquakes and disasters as well as disaster prevention measures such as evacuation while also being put to use in investigations and research of elucidating the configurations of oceanic plates and crustal activities.

The "earth simulator" which NEC contributed to the development of is being put to use for elucidation and future predictions of the causes of phenomenon appearing along with environmental changes on a global scale based on various observation data of the earth starting with information from satellites and ocean floors and is also serving an important role in discussions regarding countermeasures for climate changes.

In such a manner, NEC contributes through business to the realization of a society coexisting with the earth by visualizing the state of the continually changing earth from various angles and supporting research of causes of environmental problems and countermeasures for such.



Orchestrating a brighter world

Safer Cities & Public Services

Safe and Secure Urban and Administrative Foundations

In cities where populations are becoming concentrated and globalization is taking place, the risk of safety being threatened with a cyber-attack is also increasing. Through the detection of crime and disasters before they occur, NEC will contribute to the realization of a global administrative foundation in which the appeal of regions can be exhibited by making use of the power of its people in addition to the fields of industry, government, and academia.

Borderless Urban Coordination supported by ICT

As urbanization and globalization proceeds throughout the world, it is likely that the activities of people and commerce will become borderless. Coordination across the boundaries of nations, local governments, and companies will deepen not only in the real world but also in the cyber world. Economies will be stimulated and the lives of residents will become enriched. The barriers of languages and cultures will also be eliminated as universal designs and machine translation technologies fuse into cities due to ICT. The appeal of large events, business, and sightseeing hosted in each city will increase and lead to the increase movement of people and things.

On the other hand, ensuring and maintaining safety and security will be an issue in such cities. Biometric recognition technologies will serve an important role in providing services that are both secure and highly convenient. While realizing a solid security environment with identification technologies by flexibly combining biometric information such as one's fingerprint, face, veins, and iris patterns, we

will provide a high level of convenience where users can receive services seamlessly without hassle of legacy physical identification methods.

Protecting Cities from Both Cyber and Physical Perspectives

The safety of cities in the future cannot avoid increasingly sophisticated and intense cyber-attacks. There is a concern that cyber-attacks will become intricate and continuous, and with the utilization of machine learning, nations and companies can protect themselves from attacks by increasing the level of automated protection by teaching the know-how of expert security analysts to artificial intelligence. In the event of an emergency, security countermeasure systems making use of such as SDN (Software-Defined Networking) will execute endpoint security with automatic shutdown, to minimize the damage.

Correspondence to threats making use of ICT will also realize sophistication of disaster countermeasures physically. Preparations for impending will be performed by making use of information from satellites and drones. Layering satellite images and weather data in addition to environmental data such as air, water, and soil of cities constantly going through change due to

Gateless immigration controls using biometric authentication



activities of its residents, will lead to upfront predictions of disasters and provide for quick and precise guidance of evacuation. Furthermore, residents will be accurately provided with the risks that they are prone to in a visualized manner that is easy to understand.

A common Foundation Realizing Urban Coordination

Safe and secure administrative services are longed for in many countries and regions throughout the world. In the future, flexible coordination that is not restricted to particular nations or local governments will evolve in order to provide people with optimal services through secure and efficient operation of cities. The existence of a common foundation based on ICT is essential for such coordination. NEC will realize a society in which convenient services are provided to any city in the world through coordination between government ministries, local governments, and private enterprise on a common foundation based on ICT.

Social value creation

NEC initiatives

Urban development towards a safe, secure, and comfortable city through the use of ICT is taking place in various locations throughout the world. By providing biometrics technologies of such as facial and fingerprint recognition technologies boasting the world's best*1 accuracy, NEC has participated in numerous projects and developing rich experience.

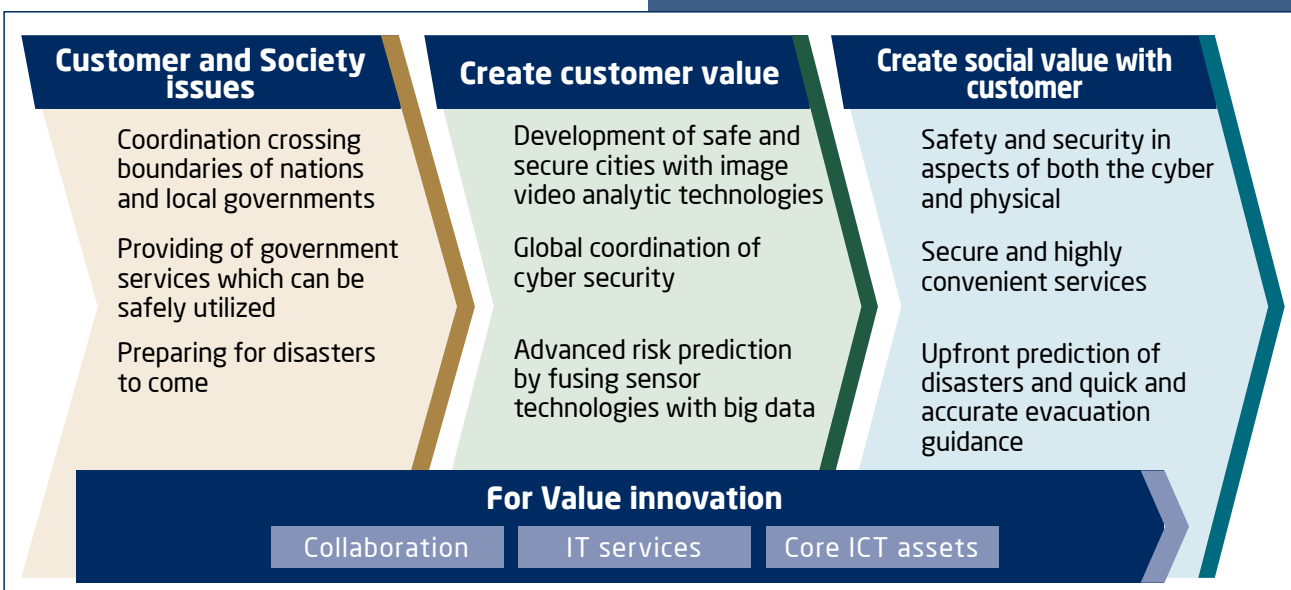
NEC is promoting research and development aiming to provide increased safety and security. An example of this is our "crowd behavior analysis technology" in which images captured by cameras installed in public locations are used to detect the status of congestion and abnormalities in crowds and public spaces without identifying individuals. Practical application of this technology is being promoted in various cities to help predicts and respond to incidents and accidents before they occur.

NEC has also been applying IoT to the field of disaster prevention. As a risk prediction service realized by fusing sensor technologies and big data, we have succeeded with the practical application of a landside disaster detection and prediction solution. This solution is capable of detecting in real time and with high precision the likelihood of a landslide occurring using only water content sensors installed in the soil.

In the field of cyber security, by making use of our rich knowledge and technologies cultivated over a course of 20 years together with know-how obtained through operation of the cyber security factory*2, we have been making efforts in researching new security applications to which advanced technologies such as SDN and artificial intelligence can be applied.

*1 Rated No. 1 based on benchmarks by the National Institute of Standards and Technology (NIST).

*2 SOC (Security Operation Center) operated by NEC





Orchestrating a brighter world
Lifeline Infrastructure

Safe and High-Efficiency Lifelines

Production and infrastructure are becoming increasingly diverse and complex with the global progress of urbanization. NEC continues to ensure safe and efficient supply of valuable resources by providing infrastructure that operates 24/7, alleviating the regional and time disparities with flexible and sophisticated ICT systems.

Achieving a flexible social infrastructure

Electricity, gas, water and sewerage systems, telecommunications, transportation, and logistic networks required to provide the daily necessities for life are the lifelines of people and economic activities. In the near future, a time will come when the supplies for the social infrastructure that sustain our lives cannot match the demand due to the accelerated pace of population concentration in larger cities. Social infrastructure from now on must flexibly respond to demographic and technical changes, and the growing risks of major disasters.

The ICT used in future social infrastructures will not only manage individual social infrastructure elements, but will also progress in a way so that integrated management is possible by linking different elements. The union of social infrastructure with ICT will drive a paradigm shift that takes us away from the current simple physical infrastructures to one that is dynamic, and software-driven “flexible social infrastructure.”

Active people in future cities supported by ICT will be constantly connected to the network via smartphones, wearable devices, and sensors. A dynamic and holistic optimization of social infrastructure can be achieved by flexibly

connecting diverse sources of information to the integrated social infrastructure management system. Information such as changes in lifestyle, demand on resources, and the status of various social infrastructure elements, weather, and accident and disaster conditions will be integrated.

Innovative Social Infrastructure will be everywhere close at hand. It will maintain and improve the quality of life and urban resilience by forecasting changes to infrastructure by means such as failure predictions and demand forecasts.

The whole picture of the future social infrastructure can be understood multidimensionally through the integrated ICT-managed lifelines that support people’s daily lives, linked together like the nervous system of a living being. The encompassing correlation analyses by artificial intelligence will also contribute to the discovery of refined knowledge that supports innovative urban management.

For example, issues in emerging economies associated with rapid urbanization can be dealt with through demand forecasting, consensus building, flexible pricing, and other management measures. In case of disasters and other emergency situations, the provision of lifelines can be maintained by dynamically switching to alternative supply systems based on real-time information. Cyber-attacks can be combated by

Safe and High Efficiency ICT based lifeline



control system security catching even the smallest signs of threat, which is conducive to the realization of a resilient society that can respond flexibly to changes in people and physical infrastructure.

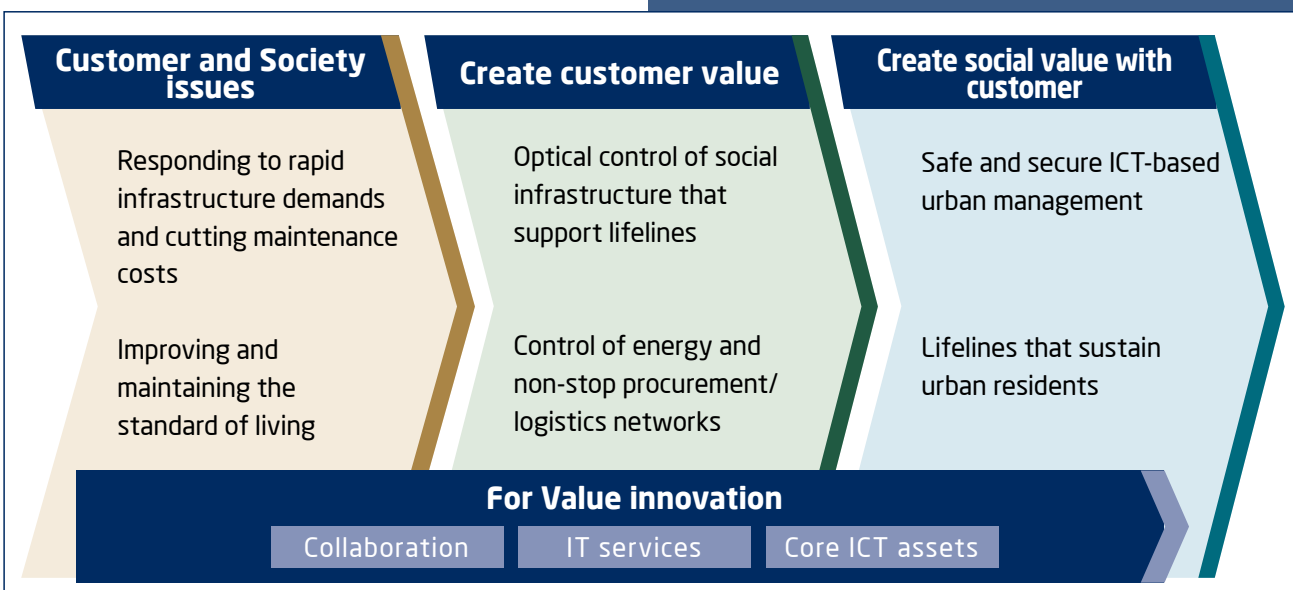
ICT that supports a safe and enriched life

The future lifelines that support urban residents will not work without advanced ICT. As such, the individual foundations must continue to develop.

Greater solid control of unstable new energy sources, such as wind and solar power, and real-time detection, data analyses and management for low-cost recovery of aged water systems and other physical infrastructure can offer great benefits to people's lives.

Enriching lives through the use of ICT that supports reliable year-round continuous operation of procurement and logistic networks utilizing transportation infrastructure for food and other essentials of life-such is the future that NEC continues to work toward.

Social value creation



NEC initiatives

Optimal control of infrastructure that supports lifelines needs the ability to collect a huge amount of information from sensors, analyze them and make a prediction on a real-time basis. In response to such needs, NEC is promoting the development of "invariant analysis technology," "Heterogeneous mixture learning technology," and other initiatives for real-time analyses of diverse real-world events. Simultaneously, NEC is engaged in solution building through its security consulting service aimed at combating cyber-attacks on lifelines.

Also, to realize a high efficiency lifeline, NEC is carrying out research and development activities and empirical studies in various applications. In the area of electrical power, NEC developed the "Virtual Integrated Control Software," which delivers real-time supply and demand balancing comparable to existing power systems. This is realized by controlling over one million distributed storage cells and electric vehicles from the cloud. For waterworks, in partnership with overseas governmental, private, and academic organizations, NEC researches and conducts empirical studies on smart water management aimed at the effective use of water resources. For distribution and logistics, we have started to provide major distributors with a solution to predict product demand and make purchase orders automatically based on the Heterogeneous mixture learning technology, and are now getting back results from our pilot programs in the retail industry that show a reduction in disposal losses by 40%.

Based on advanced technology, NEC is making efforts to create new value in the field of fault prediction and demand forecast and optimize the control and management of various lifelines.



Orchestrating a brighter world

Communication

Enriching Society through Information Communications

With the ongoing enhancements in society and the evolution of digital networks that connect people, things, and context, the importance of sharing information and knowledge is ever-increasing. NEC is building a foundation for information communications from technological assets which span from the ocean's depths to outer space. This foundation will allow people and companies throughout the world to utilize information safely, securely, and impartially.



4.7 billion people and 1 trillion IoT devices

By 2025, the number of people using network connections is expected to increase by 50% to 4.7 billion people. At the same time, as various types of sensors and other devices gain network connections, the total number of IoT devices is estimated to reach 1 trillion.

In such a world, having a foundation for information communications will play an important role in supporting the IoT devices that effectively connect human senses with digital information. An infinite number of sensors and other devices will be used to develop a rich society that is safe and secure, and information communications will likely be applied in a large number of ways to meet the growing needs. Such a link between people and information will contribute greatly to the resolution of social issues, such as food and water shortages, disasters, energy problems, and medical care.

Next-generation communication environment

With the spread of networks, which are not bound by location and time, it will be as if all people and

things are constantly connected. In a world that connects all people, things, and their extended contexts (conditions, circumstances, relations, etc.), social services, such as remote medical care, remote education, and assisted driving, are likely to be introduced. We can also expect advancements in disaster relief measures, thanks to this interconnectedness. Even when the victims are in an isolated area, that reassuring sense of connectedness can be provided by maintaining communication through calls and emails and by providing a communication environment that meets the needs of the situation.

However, a constant state of connectedness does present risks to safety, security, and social equality for individuals. For example, if a future system that serves a more significant role than any of today's systems succumbs to a cyber-attack, individuals and companies could suffer immeasurable damage. The most important challenge for the future foundation for information communications is not just to minimize this type of damage, but to prevent it from occurring.

The key is to develop technology that implements secure information communication. Encrypting data will not be enough. By using a

Remote medical care to support your daily life

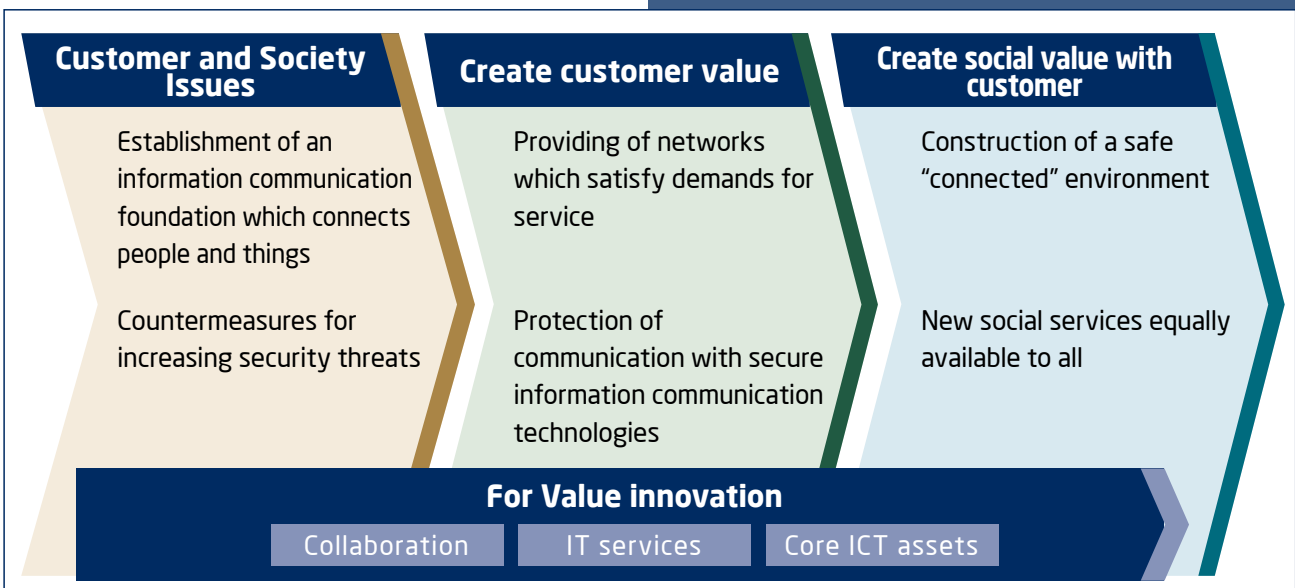


person’s voice, face, DNA, and other biological data to attribute identification signals to all the things and contexts connected to networks, communications will be protected from the threats of falsification and fraud. Furthermore, by analyzing the fluctuations and patterns in the data traffic through networks, virtual network technologies will be able to quickly detect and avoid threats like cyber-attacks from the outside.

A world of new communications

In a future society where the IoT has become commonplace, a new form of communication that allows cooperation across spatial divides and secure transmissions will facilitate a lifestyle that is safer and more secure than ever before. For example, when it comes to virtual diagnosis through remote medicine, it will become possible for patients to convey sensations and feelings to their doctors. For doctors with advanced skills to be able to give diagnoses and perform surgeries remotely to anyone anywhere, this will generate safety and security in life.

Social value creation



NEC initiatives

Advanced networks will be required to be secure and stable with almost no delay, not to mention higher speeds. Also, it is expected that they will be required to be flexible enough to change communication paths and channel capacities as needed, while maintaining high-rate-return cost efficiency.

Through analysis which combines the traffic volumes and network delay information of communication service providers with data such as weather and transportation, NEC is focusing on realizing solutions which predict in real time network failures, satisfaction of users, and congestion to enable flexible and dynamic control of such as assignment of resources and changes of communication paths.

Furthermore, with solutions that centrally manage the operation of networks and business, NEC supports the efficiency of the overall business operation of communication service providers. Additionally, towards the popularization of IoT, NEC has led the world in developing technologies which cut control signals in accordance with the properties and situations of IoT devices such as sensors and reduce the network load. By proposing these new technologies to international standardization organizations as the standard specifications for 5G, NEC has contributed global technological innovation.

Through its efforts in expansion and upgrade of submarine cables, satellites communications, wireless base stations, etc., is committed to making significant contributions in realizing the advanced information and communications systems, in which people and things in the world can communicate with each other anytime and anywhere.



Orchestrating a brighter world Industry Eco-System

A World Recreated with New Bonds of Industries and ICT

Industry structures are continuing to evolve with the appearance of new businesses emerging from the organic linkage of people, physical things, and process with IoT. Rapidly growing digitization of production and sales, diversification of consumption experiences, and their corresponding needs are becoming more complex. Through a new digital platform, NEC will realize the next-generation industry eco-system.



Deepening relations between users and industries

Due to people, physical things, and context becoming constantly connected, large transformations will take place amongst not only companies but also users. From the consumption of physical things to contexts, from owning to sharing, and co-creation together with manufacturers, the relationship between users and industries are continuing to change.

For example, users are shifting towards the expectation of a richer consumption experience. A future will soon be realized where consumers will be able to virtually experience products with the use of augmented reality while communicating with an advisor in a remote location. Also, customized products based on past histories and predictive information will be immediately produced from a 3D printer.

Furthermore, various user experiences will be stored on a cloud as data where through analysis of usage patterns with artificial intelligence, it will become possible to continuously provide experiences that are more prosperous and engaging to consumers.

In the field of the manufacturing industry, the usage conditions of products will be constantly grasped by retrieving various data from embedded sensors in

real time to communicate proper methods of use, predict failures, proactively purchase consumables for maintenance, and identify new ways of using the products. Instead of simply being a product provider, becoming a partner that further supports consumers will increase the opportunities for business more than ever.

ICT that transforms industry foundations

The digitization of industry platforms to correspond to the sophisticated needs of consumption will also rapidly evolve with the progression of ICT.

In the field of manufacturing comprising of production, logistics, and sales, the situations of people, physical things, and processes will be visualized in real time with sensors and other devices for more effective coordination of the supply chain.

Furthermore, autonomous control executed with artificial intelligence will realize a value chain with increased productivity and efficiency through overall optimization. Decision making for store operations will utilize, large volumes of data from purchase histories, as well as interactions and events occurring within the store, and consumers purchasing behavior gathered with the use of IoT. Products will be checked instantaneously with image analysis using artificial intelligence and operations such as customer service and check outs will be performed by robots. A balance between the providing of further advanced user

Industries evolving with the Understanding of Users

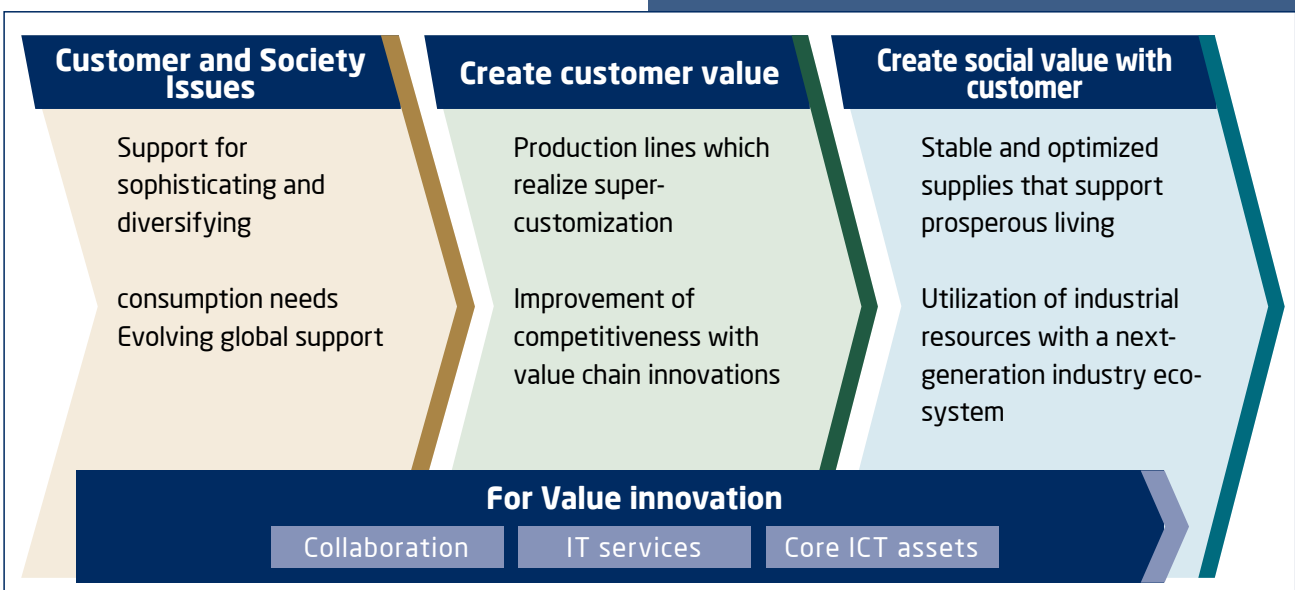


experiences and productivity will be realized through the co-creation of ICT with humans and robots.

Even with forecasts of supply and demand, the scope will expand to consumption on the individual level. Individual identification utilizing images will realize an improvement of traceability with visualization. Once a supply chain is constructed in which visualization, analysis, and control are incorporated, it will be possible to meet the increasingly complex needs of consumption on a global scale. It will be also possible to procure materials without waste, produce without excess or shortages, standardize facility operation rates, and optimize inventory.

In the next 10 years, through the development of ICT centered on IoT, data of various situations involving physical things and the contexts in how they interact will become available. Many new value will be discovered with the use of artificial intelligence. These value will be shared between many companies as new knowledge and wisdom to form a new industry eco-system that exceeds the boundaries of countries, regions, industries, and categories.

Social value creation



NEC initiatives

Along with the globalization of the economy, value chains consisting of R&D, planning, design, development, procurement, logistics, and sales will evolve in a further dynamic manner. NEC will respond to industrial structure transformations in the future and trends of new value creation and realize value chain innovations through ICT to support the businesses of our customers.

In further detail, with an eye on the future of the development of IoT which will continue to expand from conventional areas of manufacturing, transporting, and selling to areas of consumption experiences, we aim to construct a platform which supports next-generation SCM by responding dynamically in real time to changes of the value chain based on analysis and predictions.

NEC will be focusing on multi-purpose deployment of image recognition technologies. Starting with the world's first "identification technology" capable of identifying individual pieces of industrial products or components, we are moving forward with research and development in aiming for an advanced understanding of various people, physical things, and contexts through such as immediate identification of large volumes of products and analysis of lines of motion of people in stores and factories. Furthermore, as a next-generation manufacturing solution which makes use of IoT, efforts are being made with "NEC Industrial IoT." Also with the "manufacturing co-creation program" which NEC took the initiative to establish, efforts are being made to promote research between customers. Through such cooperation, NEC will proceed with the development of new technologies and the creation of solutions and services which support new industrial structures.



Orchestrating a brighter world Work Style

Diverse Ways of Working beyond Boundaries

An era has come where co-creation with people having diverse backgrounds leads to the competitive strength of countries, regions, and organizations. Eventually time will come where people will surpass the boundaries of generation, gender, nation, and organization and even cooperate with robots. Through ICT, NEC will design diverse ways of working to create high-quality work and employment.

Ways of working supported by ICT where people cooperate with each other globally

In some advanced nations, the labor force has been continually decreasing along with an aging population. Meanwhile, in emerging countries the labor force will continue to increase due to population growth. As economic development of emerging countries will continue to improve the level of education, and the mobility and liquidity of the international labor force will increase.

Amidst significant changes of the world due to globalization, development of networks, evolution of technology, and ICT environments which support knowledge workers will face great changes as well.

It will become possible to actively partake in problems of various places across the globe, not only in the country or region one is born. Co-creation by people rich in talent and having diverse backgrounds will take place not only in the real world but also in cyber world.

In addition, as the fields in which ICT is utilized will greatly expand into the real world along with the development of IoT and artificial intelligence, the fields in which human labor can be replaced will expand.

Professor Osborne, a researcher of machine learning at Oxford University, lists work which makes use of social wisdom, creative wisdom, perception, and operation as work that is difficult to be replaced with computers. As such, a world will come where people and artificial wisdom/robots will supplement each other. Each will be allocated with work that they are better suited for while cooperating to work efficiently. Robots performing dangerous jobs in place of humans and artificial intelligence providing the knowledge and wisdom which humans cannot perceive instantaneously will be put to practical use. Work allocation and cooperation between humans and "the new work force" will become commonplace in daily life at workplaces in the future. ICT will support ways of working that are more diverse which are not confined to restrictions of time and location.

Arrival of a society in which diverse work styles can be selected

In the future, especially in advanced countries, the consciousness of respecting work-life balance will permeate through society. Teleworking from one's home in a remote location, choosing time shifts over a 24 hour periods, and shorter working hours to suit conveniences of individuals will become possible with the utilization of ICT, the times and location in which each individual desires to work will diversify.

Amidst such diversification of needs, it is likely that a platform will be developed for making use of artificial intelligence to comprehensively determine and match the needs of diverse human resources and projects of both public and private enterprise.

There will also be an increase of people who will reduce their working hours and instead spend their free time with their family or participating in social activities such as sports, people who will work multiple jobs concurrently, and people who will be involved in social contribution activities while maintaining a full time job.

Structures for new personnel systems, personnel evaluation, and project management which support such work styles will also be provided on a global ICT platform. Such structures will also have the need for new information security solutions inclusive of biometric authentication.

Through ICT, NEC will design new and diverse work styles. We will aim for a society in which people with limitations on times and locations due to child care or nursing care, actions due to old age or disabilities, and various restrictions such as boundaries of languages and culture beyond countries are able to efficiently and fairly make use of their resources such as time and their potential abilities.

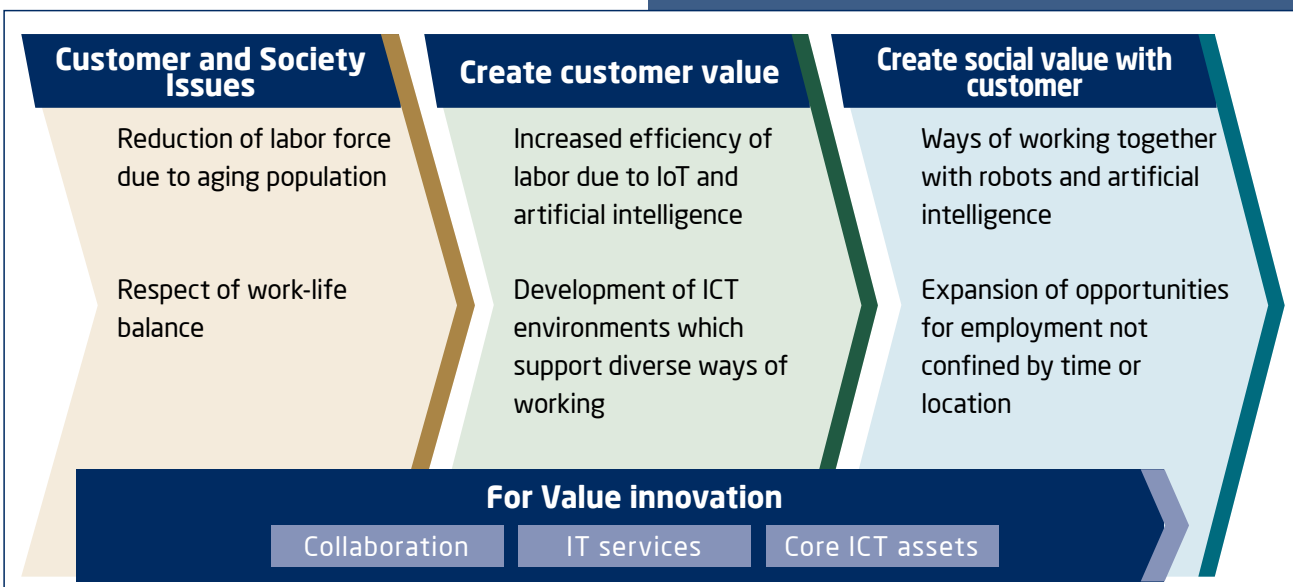
Social value creation

NEC initiatives

As IoT broadly infiltrates society, the way people work and collaborate will greatly change as well. Business environments with increased freedom and higher productivity will spread and new opportunities will arise for both the working force and companies. When this is realized, companies will be able to readily access the required human resources having the advanced expertise and highly regional know-how as well as skills that enable insight based on deep intelligence. As a result, human resources which were not made use of full-time will be given opportunities to become active.

At NEC, we are also developing various solutions that make use of artificial intelligence. For example, with "RAPID machine learning" in which precision improves in proportion to the amount of data captured, we can provide a human resources matching solution with which it is possible to find a person that is best suited for the human resource requirements that is needed by a company or project.

On "Software Factory," our independently operated cloud-based software development environment which is of the largest scale in the country, more than ten thousand engineers from India and China are already moving forward with its joint development. Numerous technologies that NEC is specialized in will be put to use in such future environments of co-creation. NEC will continue to provide safe, secure, and location-free ICT environments which support diverse ways of working.





Orchestrating a brighter world Quality of Life

A Prosperous and Equal Society where Individuals actively participate

When looking at the world, infrastructures for receiving high-quality education and medical care are still insufficient. Through ICT, NEC will promote health and preventive medical care, construct educational environments that are not restricted by location or language, and realize a diverse, prosperous, and equal society in which individuals actively participate.



ICT to completely change healthcare in the next 10 years

Together with the steep rise of social security burdens due to increasing lifestyle-related diseases and the increasing need to reduce medical care expenses, the world of healthcare will be shifting "from treatment to prevention." The utilization of IoT in healthcare over the next 10 years will involve one's health status being observed without them being conscious of such.

For example, knowledge accumulated through the application of artificial intelligence will be automatically referenced based on one's facial expressions, tone of their voice, and data from their body and activities collected using wearable devices. When a disorder is detected, appropriate advice will be provided based on predictions of diseases. With such support of ICT allowing measures to be taken before diseases become serious, it will become possible for everybody to proactively maintain their own health. From healthcare to medical care and nursing care, the evolution of ICT will greatly change the conventional roles of specialized services provided by healthcare professionals.

Realization of an equal and comprehensive learning environment

While a "society where there is more than one answer" is emerging along with the increasing

complexity and diversity of problems in the world, education in the future is required to develop human resources that promote the creation of unique solutions through learning.

Along with lecture-based education, comprehensive learning environments that incorporate interactive group work and practical training will be necessary. However, there is the need for the utilization of ICT to significantly enhance the ability to deliver such environments.

With "EdTech,"** fair and comprehensive learning environments are starting to spread to people all over the world. For example, by analyzing the degree of comprehension and progress from data of learning histories, it will become possible to provide learning programs that are optimized for each individual learner. Grasping the degrees of comprehension and areas of difficulty amongst a large number of learners will also promote improvement of the educational content.

Providing high-quality, low-priced, and easy to understand classes on the cloud which are available at any time provides all learners with a place for learning which exceeds the limits of location and time.

Support environment based on an understanding of consumers

In the future, IoT will be incorporated into various aspects of daily life. Information of experiences and statuses of users and the related environments in which they interact in will be constantly digitized,

* EdTech: Education x Technology. A coined word combining "education" with "technology." A field of business which fuses education and ICT to create new innovations.

Oral health care digitalized with IoT



collected and aggregated on platforms such as those on the cloud.

With comprehensive analysis of such information using artificial intelligence, various services may be prepared in advance based on behavioral predictions of individuals or families.

For example, when a guardian has to run an errand on a short notice artificial intelligence services can extend the hours for their child’s daycare service, present recipes based on ingredients available at home, and make arrangements for missing ingredients. Providing such support will create a prosperous life where one can place importance on “time spent with their families or for themselves.”

In a digitized world supported by IoT, the understanding of consumers will rapidly deepen. Creating an environment where such information can be handled in a secure manner is likely to give rise to service experiences which improve the “Quality of Life” in various aspects of medical care, education, and daily life.

Through the providing of ICT, NEC will continue to aim for the realization of a diverse, prosperous, and equal society in which individuals actively participate.

NEC initiatives

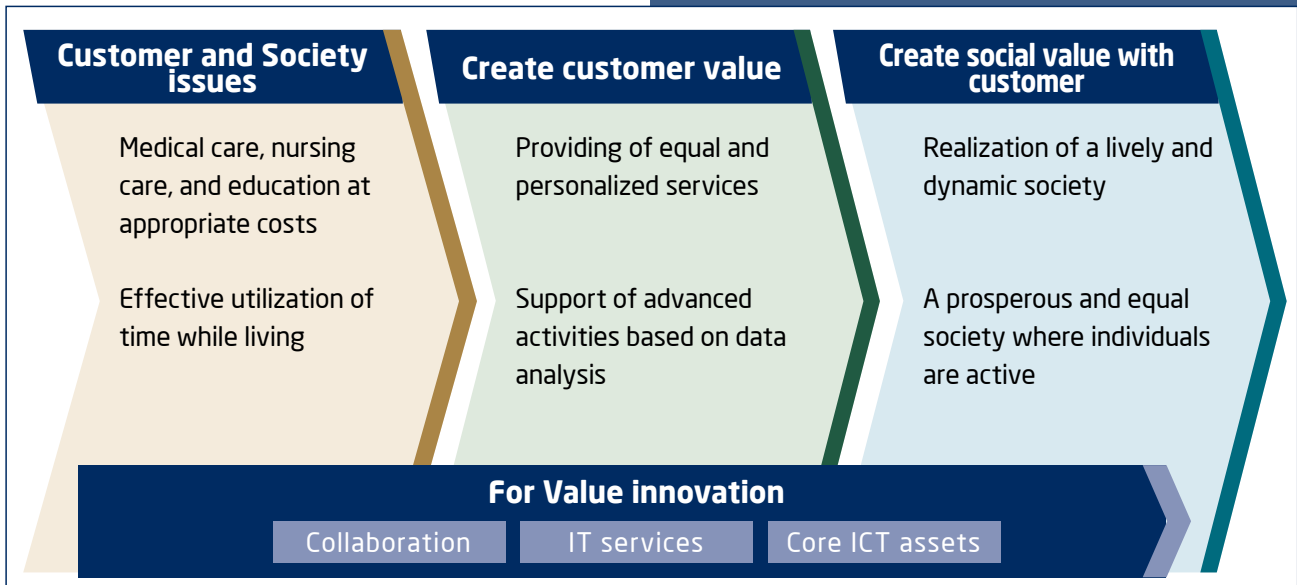
So far, NEC has been making efforts over a great number of years to utilize ICT in services of medical care. For example, our electronic medical record system, “MegaOak,” boasting a rich track record of installations, has greatly contributed to developing information that has increased the efficiency of operations in medical institutions across the country. As part of our efforts in view of further sophistication of medical services, we are also moving forward with the development of “advanced medical consultation” where the medical records of a patient is comprehensively reviewed and results communicated to doctors.

Furthermore, starting with analysis technologies for predicting those prone to a higher risk of diseases becoming severe based on pharmaceutical and medical examination data, we have been focusing on creating systems for advanced support of medical and healthcare services with ICT. Such systems include a pathological image analysis system which reduces the load of diagnosis placed on doctors working on a busy schedule.

Further, with the concept of a next-generation healthcare vision making use of IoT, we have been involved with the research of an algorithm for measuring low-load blood pressure, as well as the development of solutions for supporting adherence to medication based on medical guidance and the management of remaining drugs from dosing records.

In the aspect of education, NEC has provided the Ministry of Education of Buenos Aires in Argentina with a “remote teaching system.” In seven states in the Republic of Colombia, we have established 648 rooms with ICT environments that can be utilized in schools and public halls. In the future, while cooperating with overseas government and educational institutions, NEC will continue to provide global and accessible ICT platforms that deliver remote education free of disparity between regions and restrictions of nationality, location, or time.

Social value creation



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