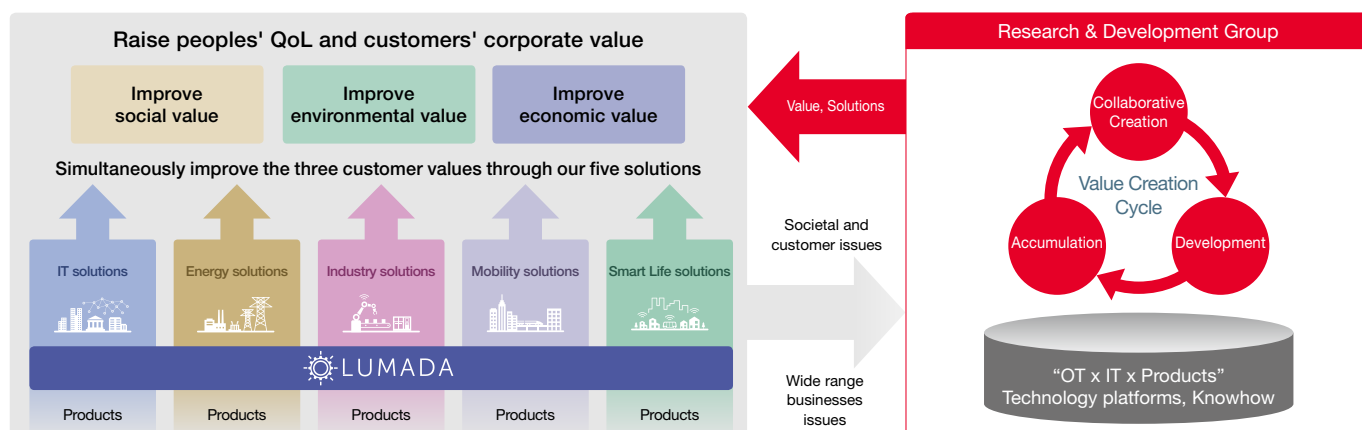# Accelerate Innovation

An R&D Strategy to Accelerate the Global Creation of Value

For more than 100 years since the Company's foundation, Hitachi's R&D has been putting the Hitachi Mission – "Contribute to society though the development of superior, original technology and products" into practice, developing the most cutting-edge technologies and fostering innovations that ushered in the future. As part of our 2021 Mid-term Management Plan, Hitachi aims to become a global innovation leader advancing the realization of the United Nations' Sustainable Development Goals (SDGs) and Society 5.0. Moreover, to contribute to enhancing social, environmental, and economic value for our customers, the Hitachi Group will invest ¥1.2 trillion in R&D to establish an ecosystem for driving innovation and enhance our core technologies to expand Lumada business during the three years covered by the Plan.

The strength of Hitachi's R&D lies in its centralized ownership of the technology platforms and knowhow integral to the Hitachi Group's operational technology (OT), IT, and products, as well as the five Hitachi sectors, allowing the Company to establish a value creation cycle that extends from collaborative creation to development, and further accumulation. Moreover, as Hitachi creates solutions that provide value to our customers, R&D efficiency continues to improve through the value creation cycle.

To become a global innovation leader advancing the realization of SDGs and Society 5.0

1. The Evolution of Collaborative Creation to Accelerate Innovation

■ The Evolution of Collaborative Creation Accelerating Innovation

Building an Innovation Ecosystem

In the 2021 Mid-term Management Plan, we will accelerate open innovation where we will grow together with partners by using Hitachi's technology platforms and knowhow, and bringing in external knowledge, as we work to create the three values of social, environmental, and economic value by raise peoples' quality of life and customers' corporate value.

To accomplish this, we are developing NEXPERIENCE, Hitachi's original customer collaborative creation methodology to promote delivery of Lumada solutions. We expect to realize this through *Kyōsō-no-Mori*, the new research initiative launched from the Central Research Laboratory, and through stronger collaboration with industry-academia-government initiative and startups.

In April 2019, we established a new Corporate Venturing Office to promote collaboration with external startups, and in June established a corporate venture capital fund. By promoting investment in and collaborative creation with startups, especially in Europe and the US, we are bringing in disruptive technologies and business models.

Evolving Collaborative Creation through Open Innovation with Stakeholders

Kyōsō-no-Mori
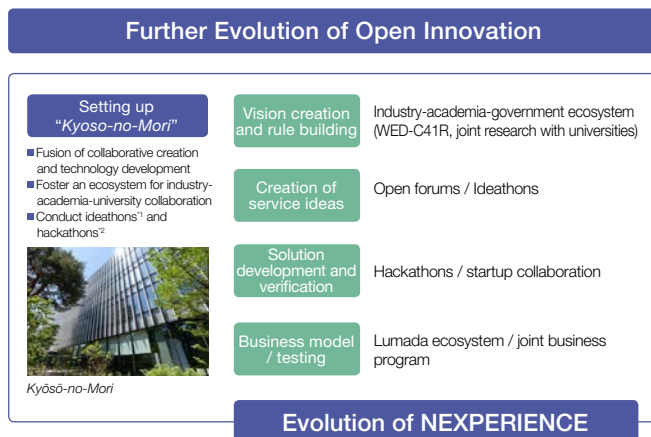
*1 Ideathon: A competitive event to generate ideas
*2 Hackathon: A competitive event to develop commodities such as services, systems, and applications

◼ Creating Visions through Industry–Academia- Government Collaboration

Joint laboratories were established with the University of Tokyo, Kyoto University, and Hokkaido University in 2016 for the purpose of creating value to resolve future societal issues.

The Hitachi The University of Tokyo Laboratory holds open forums under the themes covering societal issues such as "urban planning" and "energy" to publish books and policy proposals to share visions, as well as conducting verification trials in Matsuyama City, Ehime Prefecture, to resolve regional challenges. The Hitachi-Kyoto University Laboratory developed a "policy-proposing AI" focusing on issues in society in the year 2050m and is verification trials in Nagano Prefecture. The Hitachi-Hokkaido University Laboratory is also working on themes such as "regional issues" and "food and health." Further, in 2018, we also signed a collaboration agreement with Tsinghua University to resolve future societal challenges in China.

Through such efforts, we hope to gain insight into future societal issues, and by innovation, we will communicate to the world new visions to achieve both the resolution of those challenges and while realizing economic development.

◼ Launching *Kyōsō-no-Mori* to Accelerate Collaborative Creation with Partners and Customers

To foster an innovation ecosystem, Hitachi launched a new research and development initiative, *Kyōsō-no-Mori*, from the Central Research Laboratory in Kokubunji, Tokyo. The Company consolidated the customer collaboration functions of the Akasaka facility in Kokubunji, to facilitate agile development of value by deepening the fusion with cutting-edge research.

At the *Kyōsō-no-Mori* Opening Ceremony, a panel discussion was held on "smart city initiatives" with the ambassadors from Thailand and Australia participating in dialog on the value and significance of smart city initiatives. Further, to generate ideas and accelerate innovation, ideathons[1] and hackathons[2] are being held both in and outside of Japan in areas such as FinTech and blockchain applications. In parallel, Hitachi is cooperating with Kokubunji City to evaluate local digital currencies, while in North America, the Company has started developing technology such as remote control for 5G solutions, and will continue to expand open innovation globally from *Kyōsō-no-Mori.*

2. Enhancing Core Technologies to Expand the Lumada Business

◼ Strengthening Core Technologies Supporting Lumada

In addition to promoting innovation through collaborative creation, we are focusing investment on the "5 sectors x Lumada," Lumada core technologies and strengthening products, to expand Lumada business.

Lumada is being deployed in each sector. For the IT sector, we are focusing on data utilization solutions for financial, social, and public systems. In the financial area, we are working with state-owned banks in India for next-generation digital payment platforms and developing solutions based on next generation blockchain technology in North America. In the energy sector, we are aiming for a low-carbon or decarbonized society through system stabilization solutions suitable for introducing renewable energy. Meanwhile, in the industry sector, to realize the "smartification" of priority areas such as manufacturing, maintenance and logistics, we are working to maximize customer KPIs through the seamless connection of on-site operations with management. Notably, we have achieved practical predictive maintenance technologies to improve the operating efficiency of industrial and medical equipment, which represents successes that we are achieving through OT X IT X Products. In the mobility sector, "Dynamic Headway" which is currently undergoing field tests will be further advanced so that it can be provided to not only trains but also as an facility planning optimization solution for building facilities such as elevators. In the smart life sector, we are focusing on smart therapies, smart cities, and connected cars, including autonomous driving and software updates via Over the Air (OTA).

Accelerate Innovation

Sector	IT	Energy	Industry	Mobility	Smart Life
Solution examples	• Financial solutions • Predictive maintenance simulations	• System stabilization • Automated power distribution • Energy management • P2P Electric power trading	• Next-generation manufacturing • Next-generation maintenance • Next-generation logistics	• Building/facility solutions • Smart ticketing	• Connected cars • Smart therapies • Smart cities
Lumada (core technologies)	AI, Video analysis Sensing Electrification	Data → Cyber Space ☀LUMADA OT for Real ← Physical Space			5G Robotics Security
Products	• Storage	• High voltage transmission systems • HVDC • Circuit breakers, transformers • Large centralized power sources	• Air compressors • Marking • 3D printing	• Global railway vehicles • Railway vehicle inverters • High-speed elevators • Service robots	• EV components • Diagnostic and treatment systems • Home electronics and air-conditioning equipment

HVDC: High Voltage Direct Current

To strengthen Lumada core technologies, our efforts are directed towards realizing Lumada CPS (Cyber Physical System) which connects cyberspace with the real world, focusing on AI and audiovisual analytics, sensing, electrification, 5G, robotics and security.

The strength of Hitachi's AI is that its development is based on equipment control technology, product design, and maintenance technology that the Hitachi Group has built-up over the years. For example, in predictive maintenance technology for industrial equipment, the AI visualizes the difference between a normal state or an abnormal state which could lead to material degradation or failure, from real-world operational data. This helps to determine whether there is a high probability of industrial equipment failure. This technology already has a good track record in Hitachi's medical equipment and is being used in regions such as North America.

In the area of audiovisual analytics, video images from stations and buildings are analyzed in real time, allowing specific people to be searched or tracked, as well as human flow analysis. In sensing, we have realized an extremely sensitive vibration sensor that can detect and measure very small signals even in large spaces exceeding 100 meters by applying MEMS[1] technology based on semiconductor device technology fostered at the Central Research Laboratory. We are currently proceeding with water leakage detection field tests using this device. Such technologies will be key in realizing safety and security in smart cities.

With regard to products, we are aiming to deliver world No. 1 technology. For example, with inverter technology which is central to electrification, we have created and commercialized the world's most efficient full SiC inverters for use in railway cars. For diagnostic and treatment systems, Hitachi has developed the world's smallest particle accelerator for the treatment of cancer, and it is currently in operation at a heavy ion therapy center in Japan. Furthermore, we have realized wear- and corrosion-resistant material which was unachievable with existing alloys, and have started applying it in the 3D printing of industrial machinery parts.

By accelerating such efforts, we hope to contribute to the global expansion of Lumada business based on OT x IT x Products.

*1 MEMS : Micro Electro Mechanical Systems

Sensing

Ultrasensitive vibration sensor that can measure very small status changes in large spaces exceeding 100 meters.

Digital city monitoring/Ultrasensitive sensors

Commercial facilities
Water and sewage systems
Roads
Underground areas

Detecting circuit
Control circuit
MEMS

• Damage to underground piping (leak detection)
• Construction status
• Crowd movement Understanding conditions during a disaster

• World's highest sensitivity* (15ng/√Hz)
• Wide detection range (>100m)

* MEMS sensor

Data analysis, AI technology ✕ Semiconductor device technology

Creating Disruptive Technologies

Solving societal issues also requires the creation of disruptive technologies. In collaboration with the University of Cambridge in the UK and CEA-LETI in France, Hitachi has successfully demonstrated the world's first silicon quantum bit[2] system which promising advantages for system integration for quantum computers. In the near future, we believe this will contribute to resolving complex societal issues. In 2017, the Hitachi established the Hitachi Kobe Laboratory in the Kobe Biomedical Innovation Cluster to achieve practical applications in regenerative medicine. The Laboratory has already created technologies contributing to a healthy society, including the world's first successful automated culture of retinal cells derived from human iPS cells.

Globally, we are promoting joint research with many universities based on their respective strengths to create disruptive technology and enhance technology platforms. For example, in the area Fintech, we are working with Stanford University and in the smart manufacturing area, with a research institute in Germany.

We are also actively participating in the open communities, contributing to open projects and consortiums in areas such as blockchain and edge computing. Also, through participation in organizations such as WEF-C4IR,[*3] we are also actively involved in forming rules.

*2 Quantum bit: the smallest unit of encoded quantum information, including in the direction of the electron spin
*3 WEF C4IR: World Economic Forum, Center for the Fourth Industrial Revolution Network

■ Initiatives in Intellectual Property

Amid an ongoing international pro-patent shift, Hitachi is strengthening its intellectual property activities in products and solutions. To demonstrate our OT x IT x Products strengths, we have drafted an intellectual property masterplan that defines areas of focus and bolsters our patent creation activities. This has resulted in Hitachi being awarded the National Invention Award three years in a row, including for railway cars and particle beam cancer treatment equipment. Under the 2021 Mid-term Management Plan, we will be accelerating the creation of solutions to further drive the global

deployment of Lumada solutions. We aim to move ahead of other companies to acquire intellectual property rights for core technologies supporting Lumada, centering on Lumada CPS. We will also promote an open policy for intellectual property related to public matters to contribute to the design of future societies, and the maintenance and progress of societal norms. Further, we will aim to establish an intellectual property strategy for a new era, "IP for Society," by working with international organizations.

3. R&D Investment, Portfolio and R&D structure

With the goal of enhancing competitiveness in the five core Social Innovation Business sectors, the Hitachi Group's R&D investment amounts to about 4% of total revenue. Approximately ¥1 trillion was invested in R&D during the period covered by the 2018 Medium-term Management Plan and the aim is to increase this to ¥1.2 trillion during the 2021 Mid-term Management Plan. This includes corporate-led R&D investment focused on collaborative creation with our customers, global No. 1 technology, and exploratory research, as well as investment to accelerate the global development of Lumada business which is our engine for growth. To realize this, we are establishing a common digital platform for efficient global development, as well as enhancing our research resources worldwide.

The R&D structure to achieve these goals includes the Global Center for Social Innovation (CSI) that will lead through ideation and solution development, the Center for Technology Innovation (CTI), responsible for building world No. 1 technology platforms, and the Center for Exploratory Research (CER), addressing the challenge of resolving challenges faced by future societies, together with the research bases in North America, Europe, China, and Asia. In FY2019, a North American employee was appointed to be head of CSI to further accelerate the global deployment of Social Innovation Business. Through such measures, Hitachi will aim to simultaneously realize improvements in social, environmental, and economic value.

Trends in R&D Spending

	FY2014	FY2015	FY2016	FY2017	FY2018	FY2019 (forecasts)
R&D expenditures (¥ billion)	334.8	333.7	323.9	332.9	323.1	335.0
Share of revenues (%)	3.4%	3.3%	3.5%	3.6%	3.4%	3.7%

R&D spending has remained generally flat due to portfolio restructuring, including the sell-off of listed subsidiaries, and the fact that investment has been carefully focused in targeted areas.
Moving forward, we will continue to focus investment in the field of digital solutions, including Lumada.

[Recognition for Outstanding Technology and Design]
Hitachi was bestowed the Imperial Invention Prize in the National Commendations for Inventions for its global railway vehicles, which was highly evaluated for design and technologies focused on analyzing comfort and safety. In addition, Hitachi has been granted prestigious awards for semiconductor measuring equipment, X-ray fluoroscopy equipment, open MRI equipment, and storage equipment, with Kazuo Hiramoto receiving the Medal with Purple Ribbon award for his development of an innovative particle therapy system.

Accelerate Innovation

## Human Resource Strategies Supporting Innovation Creation

With the goal of creating innovation and new value in the global and digital era, Hitachi is focused on securing and fostering a diverse workforce and the organizations capable of driving sustainable growth. We have established a firm relationship between employees and the Company by providing places of employment that offer a favorable work-life balance, focusing on worker safety and health, and respecting the basic rights of employees and ensuring equal opportunities. Hitachi is also proactively engaged with all its employees regarding compensation and career advancement.

■ Transforming Human Resources Management

The development of the Social Innovation Business requires us to actively investigate social and customer issues, and then cooperate with customers to create all new solutions.

Hitachi is working to transform human resources management with the aim of placing the right person in the right position anywhere in the world. Clarifying through a global standard the role, responsibilities, and reporting lines of each position, and embracing a common understanding serves to accelerate the creation of a solid global structure for Hitachi. In addition, it fosters an organizational culture that recognizes and makes best use of its diverse and self-motivated individual workers.

The Transformation in Human Resources Management
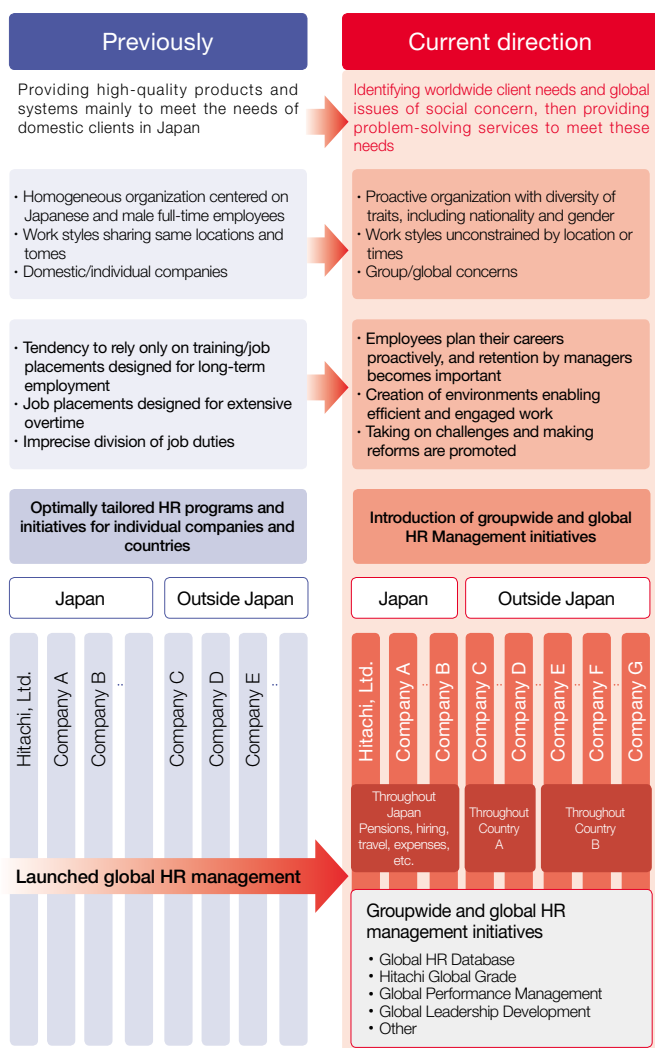
■ Global Human Resources Management

To create a global common platform for HR management, Hitachi has introduced a Global HR Database, as well as Hitachi Global Grade and Global Performance Management since 2012.

Hitachi launched in full human capital management integrated platform in January 2018, centralizing processes and measures enacted to date. The three main benefits of this platform are as follows.

(1) Improving Talent visibility

Until very recently, it was quite difficult to quickly get a handle on the skills and abilities of employees in a given country, region, or company. Improved visibility in this respect allows us to make appropriate placements and provide training suited to a particular individual, to find and develop future leaders, and facilitate better communication between managers and employees.

(2) Strengthening the "I will" culture

The platform allows employees to enter their own experiences and skills, with all employees having access to that information at all times. This expands the likelihood of employees taking on challenges in work areas of interest, resulting in the creation of a workforce of proactive employees able to think and act for themselves.

(3) Improving Speed and Efficiency

The use of global common data allows us to quickly and smoothly launch a new project by rapidly and efficiently placing the human resources necessary to that project.

Human Resources Management Initiatives

Fiscal 2012
Global Human Resources Database
Goal: Create a database of human resources information
Global Leadership Development
Goal: Create a pool of leading global talent and foster their development

Fiscal 2013
Hitachi Global Grade
Goal: Use of a uniform Group standard to assess position weightings for managers and those in higher job positions
Hitachi Insights (Employee survey)
Goal: Improve employee engagement

Fiscal 2014
Global Performance Management
Goal: Promote growth and sustained improvement in both the business and the individual by linking the goals of the two

Fiscal 2015–2018
Hitachi University (educational platform for Hitachi Group employees all over the world)
Goal: Use HR development to contribute to sustainable global growth
Global Hiring Support System
Goal: Ensure hiring of the best individuals as business expands, improve efficiency in hiring, lower costs
Human capital management integrated platform
Goal: Improve HR visibility, strengthen the "I will" culture, improve speed and efficiency

2021 Human Resources Strategy

The mission of the human resources division is "contributing to the business through talent and the organization." The division formulated its 2021 HR Strategy based on the goals of the 2021 Mid-term Management Plan announced in May 2019. The HR Strategy focuses on achieving growth throughout the world through a diverse workforce that is happy and proud to work at Hitachi and creating for all employees a safe and vibrant workplace that respects a wide range of diverse values.

Hitachi is committed to building a company where employees with different cultural backgrounds, as well as experiences and ways of thinking can work together. We aim to instill in all our employees around the world a shared sense of values, including the "Harmony, Sincerity, and Pioneering Spirit" values central to the Hitachi Group identity, with the "One Hitachi" idea crossing national, regional, and departmental borders and contributing to the betterment of society. We are also promoting measures aimed at the optimal placement of personnel through the visualization of HR data, the use of analytics based on accumulated data and HR technologies,[1] and improved efficiency. Finally, we are focused on advancing initiatives for fiscal 2021 based on the four key concepts of Talent, Culture, Organization, and HR Transformation.

[1] HR technology refers to technologies using new forms of IT, including big data and AI in human resources to create new value.

Ensuring Fair Evaluations and Compensation

Amid the ongoing globalization of business, there is an increased need to establish a global human resources system that ensures fair evaluations and compensation. In order to attract a diverse and highly engaged workforce, Hitachi is focused on building a consistent management system and accordingly follows a common "Global Compensation Philosophy" based on "maintaining market competitiveness," "pay for performance," and "ensuring transparency."

We are developing a compensation system that is fair and competitive in the context of each country or region's labor market, with an individual's compensation determined after an evaluation of their performance. Individual assessments are conducted annually to set each employees compensation, and feedback on their performance results is provided to inspire them to develop and grow even further.

We ensure compliance with the laws and regulations of each country in which we operate when determining compensation. Starting pay for new graduates in Japan—representing about half of all new graduates recruited each year across the Group's global operations—was roughly 20% higher than the weighted average of Japan's regional minimum wages.

Fostering the Next Generation of Leaders

In addition to Hitachi University, the Group's global learning management system, we have developed a variety of educational programs tailored to different jobs and positions. We are also focusing resources on selective training courses aimed at developing future managerial candidates at an early stage. In these courses, participants discuss what is necessary for the growth of Hitachi. The opportunity to generate ideas to present to senior management helps to cultivate the next generation of leaders—people with a unique perspective and determination.

In addition, we have identified a group of about 50 employees from around the Hitachi Group with next-generation development potential. People in this "Future 50" group are selected on merit, regardless of age, gender, or nationality.

They are given challenges to help expand their horizons and build their perspective, including tough assignments, different types of work, and internal and external training opportunities. The Future 50 group members receive one-on-one mentoring opportunities with independent directors to benefit directly from their extensive business experience and global perspective. Our aim is to change mind-sets so that we can develop people for important positions in the future.

Accelerate Innovation

■ Strengthening Front-Line HR and Establishing a Digital HR Training Policy

Hitachi in April 2016 shifted to a business structure with strengthened front-line functions to accelerate collaborative creation with our customers as part of the drive to advance the Social Innovation Business. Hitachi's technologies and know-how must be developed so that they can be provided as a service by front-line personnel, who are closest to our customers. With this in mind, we have strengthened the front-line talents we expect to drive the Social Innovation Business moving forward.

While there are a number of companies focused on achieving a digital transformation through digital technologies such as AI, IoT, and big data, one key challenge throughout the world is the shortage of data scientists specializing in data analysis. In addition to its digital solutions focusing on the fusion of OT (operational technology) and IT, Hitachi has launched measures to foster a digital workforce that can be expected to drive digital transformations.

With a target of increasing the number of data scientists to 3,000 by fiscal 2021, Hitachi's strengthening of its data scientist workforce at group companies in Japan and overseas will allow us to further support our customers and drive the expansion in digital solutions.

■ Strengthening Front-Line HR and the Digital HR Training System

Before the 2016 start of the new front-line structure, discussions on bolstering front-line talents were initiated by a preparatory committee, which includes officers and business unit managers and was created in 2015. The committee defined front-line functions, roles, and personnel qualifications necessary to bolster the front-line workforce. Based on these discussions, the Company also identified the need to develop human resources, from leaders to practitioners, to promote the Social Innovation Business, and in 2016 created the Social Innovation Business Front Talent Development Program, consisting of four phases, as well as action learning, group training, and e-learnings programs. Phase 1 and Phase 2 focused on action learning using real-world projects for leaders expected to drive the collaborative creation business, with Phase 3 and Phase 4 focusing on employees in the Hitachi Group as a whole based on the results of the first two phases.

Integrating its training institutions to further strengthen and foster its digital workforce, including front-line workers, Hitachi newly launched Hitachi Academy in April 2019, which will now be charged with training the human resources expected to drive digital transformations. The new entity will combine measures designed to foster digital human resources with on-the-job-training as it seeks to build a new digital transformation training system and accelerate the Social Innovation Business.

■ Diversity & Inclusion

Diversity is the wellspring of innovation at Hitachi and our growth engine. Hitachi regards personal differences—gender, nationality, race, religion, background, age, and sexual orientation—as facets of people's individuality. By respecting our employees' individualities and positioning them as an advantage, Hitachi frames its diversity and inclusion as conducive to both the individual's and the Company's sustainable growth. We will adapt to the diverse needs of our customers by using our diverse capabilities, our outstanding teamwork, and our extensive experience in the global market.

We are promoting diversity management as a key management strategy under the initiative slogan "Diversity for the Next 100." We believe it important to share opinions and recognize diverse values if we are to provide optimal solutions based on an accurate understanding of the complex issues confronting society and our customers. With the goal of having members with different values on the same team sharing the same goals, we are working not only to secure and train a diverse workforce, but also to create an environment where each of these individuals can work to the best of their abilities.

Hitachi, Ltd., and 15 major group companies jointly operate the Advisory Committee and the Diversity Development Council, which focus on accelerating the promotion of diversity across the Hitachi Group as a whole, including in regard to supporting diverse human resources and providing work-life management. The Advisory Committee implements to the fullest the Company's diversity management policies, while the Diversity Development Council shares best practices and discusses specific diversity-related activities. Each committee meets every six months. Group companies and business groups/sites have also set up their own diversity-promotion organizations and projects, such as those to help develop women's careers, to enhance initiatives geared to the challenges faced by individual workplaces. Hitachi from fiscal 2018 has broadened the sharing of diversity promotion policies across the entire group, with Group companies around the world working together to accelerate implementation.

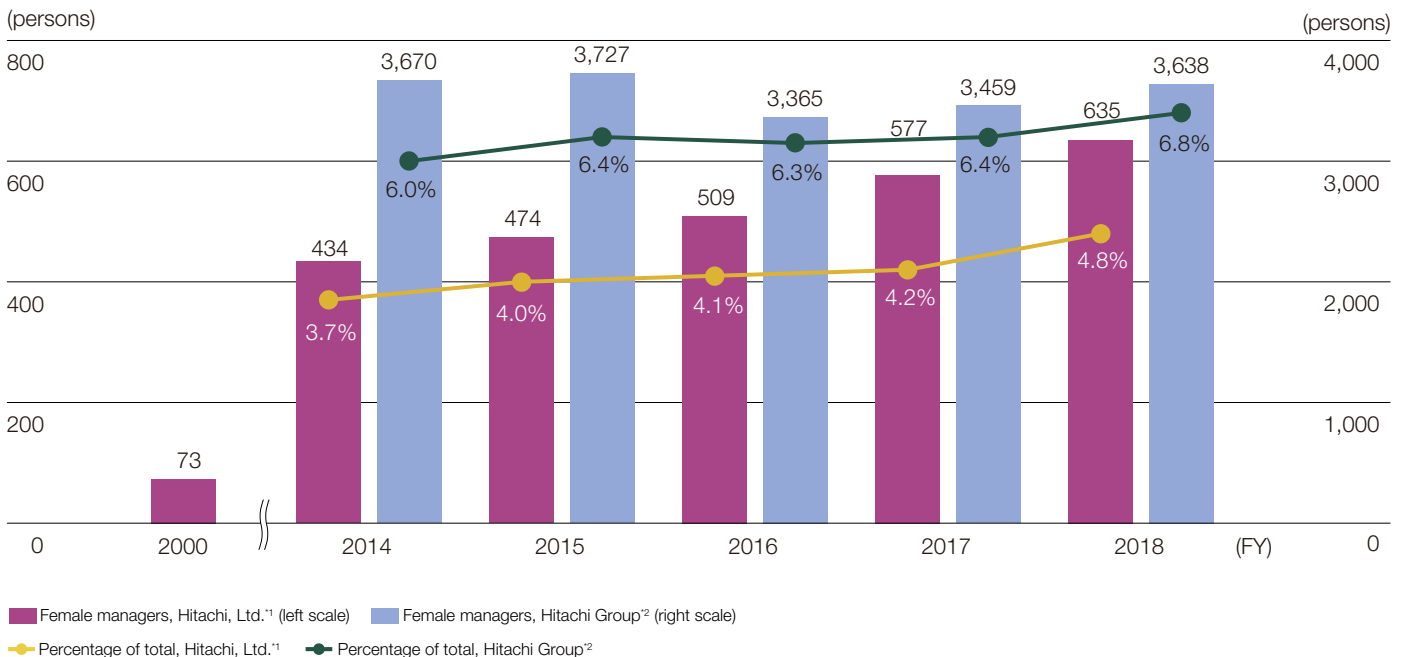## Diversity Activities and Developing Women's Careers

With the goal of promoting participation in management decision-making by people with differing backgrounds and enabling as many female employees as possible to take up leadership positions, Hitachi, Ltd., has created two key performance indicators (KPIs) for the appointment of women in executive and managerial positions.

In fiscal 2013, Hitachi set a goal of promoting women to executive positions by fiscal 2015. In April 2015, the Company appointed its first female corporate officer, a position equivalent to the executive level. We will continue to promote this goal to ensure that diverse views and values will be reflected in our management. In November 2017, we publicly announced our commitment to increasing the rate of female executive and corporate officers to 10% by fiscal 2020. We are also working to promote more female employees to managerial positions, aiming to double the number of female managers to 800 by the end of

fiscal 2020 compared with fiscal 2012. These efforts demonstrate our commitment both internally and to the world to improve our diversity management.

As part of our efforts in this area, we have been hosting since 2016 the Global Women's Summit, inviting 100 or more female employees from Hitachi Group companies around the world. The event is held in different areas of the world and is focused on improving awareness in leadership and career planning, and to enhance motivation through the formation of a global support network. The day the summit is held features a message from President and CEO Toshiaki Higashihara, the participation of executives, and the exchange of opinions among the many female employees attending.

Number and Ratio of Female Managers

Female managers, Hitachi, Ltd.[*1] (left scale)   Female managers, Hitachi Group[*2] (right scale)
Percentage of total, Hitachi, Ltd.[*1]   Percentage of total, Hitachi Group[*2]

Note: Figures include section chiefs and above.
*1 "Female managers" in fiscal 2017 include managerial employees dispatched from Hitachi, Ltd. to non-Group companies and those accepted from non-Group companies by Hitachi, Ltd. Figures prior for fiscal 2016 and earlier include regular managerial employees dispatched to non-Group companies but exclude those accepted from non-Group companies.
*2 All full-time, regular female managers excluding those dispatched to non-Group companies.

Ratios for Female and Non-Japanese Executives and Corporate Officers (Hitachi, Ltd.)

	June 2017	June 2018	June 2019
Number of female executive and corporate officers (persons)	2	2	4
Ratio of female executive and corporate officers	2.4%	2.6%	5.0%
Number of non-Japanese executive and corporate officers (persons)	3	5	7
Ratio of non-Japanese executive and corporate officers	3.7%	6.4%	8.8%