

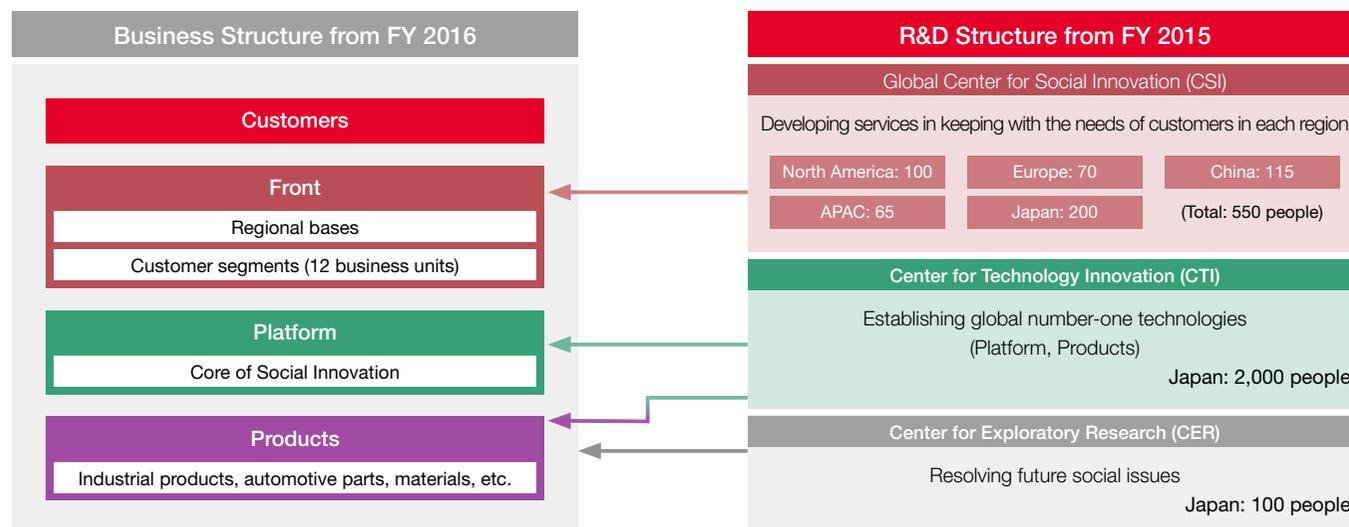
Innovation Management

A Century of Research and Development at Hitachi

The Research & Development Group, which finds its origins as the Research Team of the Hitachi Mine of the Kuhara Mining Company celebrates its centennial anniversary in 2018. The Group has delivered innovation for the future while pursuing cutting-edge research and development activities in each era to execute the Corporate Credo “to contribute to society through the development of superior, original technology and products.”

In this centennial anniversary year, the Research & Development Group reaffirms its commitment to the corporate Mission, and with the Hitachi Values of “Harmony,” “Sincerity,” and “Pioneering Spirit” deeply ingrained in our hearts, is supporting the company goal to become the “Innovation partner for the IoT era” through research and development, and lead future growth through collaborative creation with customers.

Research & Development Group Structure



Customer-Driven R&D and Hitachi's Business Structure

To accelerate collaborative creation with customers, the Research & Development Group was realigned into a more customer-driven research structure in April 2015. Three research laboratories in Japan—the Central Research Laboratory, Hitachi Research Laboratory, and Yokohama Research Laboratory—were consolidated along with the Design Division and overseas research centers and regrouped into the Global Center for Social Innovation (CSI), the Center for Technology Innovation (CTI), and the Center for Exploratory Research (CER). This R&D structure supports the new market-driven business structure created in April 2016 along the lines of the “Front” (the customer interface), “Platform,” and “Products,” to drive our Social Innovation business.

Under this structure, CSI is developing services to meet the needs of regional customers and the 12 Front business units (BUs). To carry out collaborative creation with customers

globally, CSI has locations in five key regions—Japan, Asia-Pacific (APAC), North America, China, and Europe—with about 350 of approximately 550 CSI personnel assigned outside Japan. In April 2017, a new office was opened in London to facilitate collaborative creation in Europe. Furthermore, a global research team, the Insights Laboratory, was established the same month to accelerate the delivery of digital solutions. In December 2017, two new facilities were established in China: a collaborative creation center in Beijing, and the Open Automation Laboratory in Guangzhou, a facility for collaborative creation in the field of industry. CSI will leverage these co-creation spaces to accelerate co-creation globally with customers.

CTI is delivering new value to customers in various sectors by working with the Platform BUs that provide the backbone of Social Innovation, as well as the Product BUs responsible for the highly competitive key components that support services, to generate digital solutions combining OT (operational technology) and IT.

The CER is conducting cutting-edge research to realize a human-centric society that pursues the fundamental human goals of “outcomes and well-being,” working in collaboration with various research institutions to resolve future social challenges.

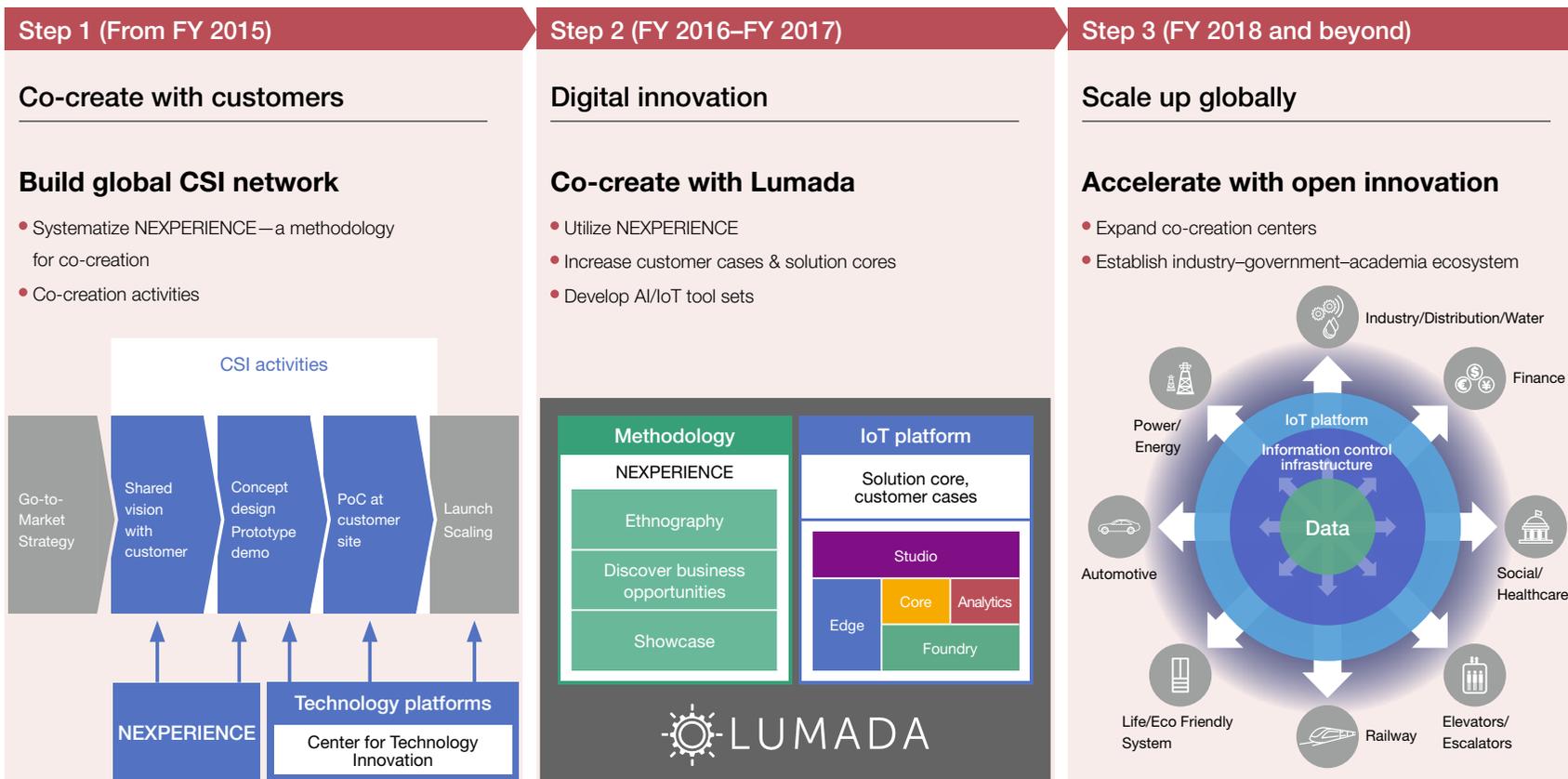
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R&D Initiatives Toward Creating New Value Through Hitachi's Social Innovation Business

In collaborative creation with customers, new value is created by sharing challenges and visions to design a business model, and by actualizing that model through verification and simulation. This requires an open and secure platform that connects the systems of many stakeholders. To realize this, Hitachi launched the Lumada IoT platform and began offering services

in fiscal 2016. In co-creation using Lumada, the Research & Development Group is using NEXPERIENCE, a systemized methodology for collaborative creation, to enhance Lumada customer cases and solution cores. By resolving our customers' issues, we aim to not only deliver satisfaction to our customers but also strengthen our core technology. Further, a positive cycle of gaining insights into potential new business areas has also begun, building on customer cases.

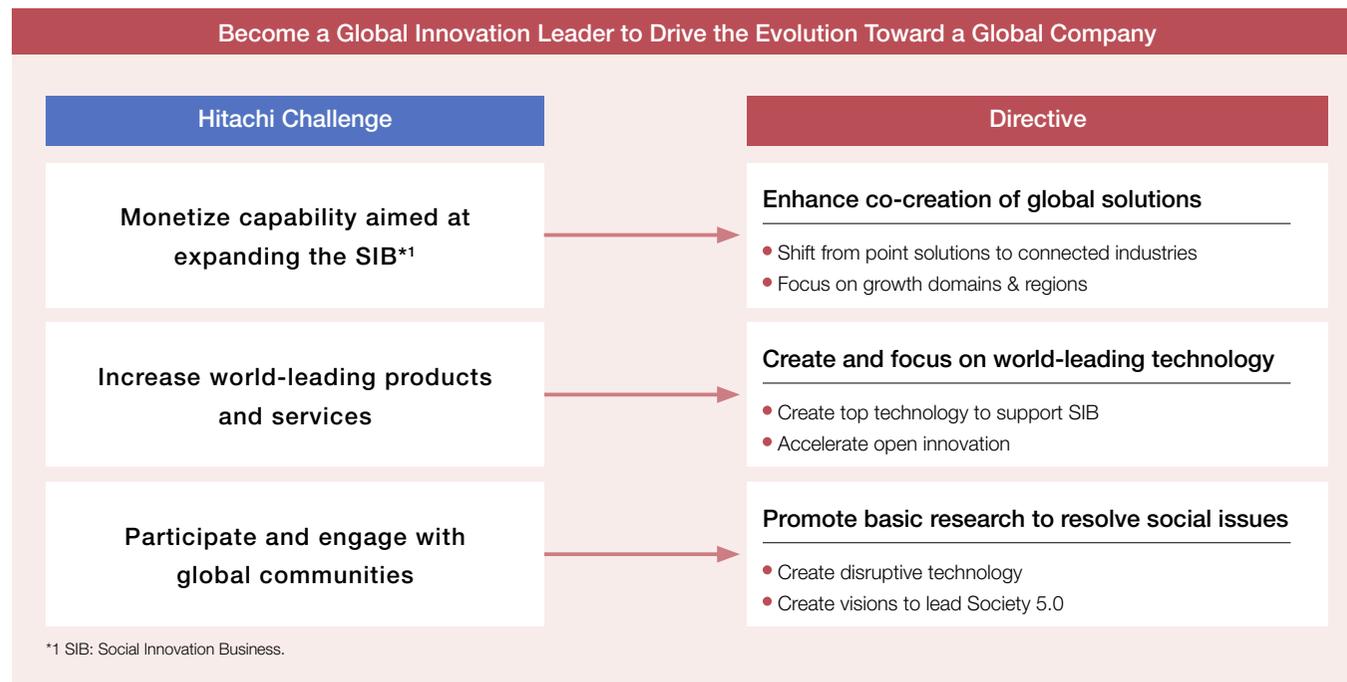
To extend these initiatives globally, the Research & Development Group will be promoting Open Innovation through activities such as building innovation ecosystems through industry–government–academia collaboration.



R&D Directives for Fiscal 2018

The Research & Development Group has a variety of ongoing initiatives as part of its mission to become a global innovation leader and drive Hitachi's evolution toward a global company. The three specific challenges the group has set for itself are "Monetize capability aimed at expanding the Social Innovation Business," "Increase world-leading products and services," and "Participate and engage with global communities." Three directives have been established to ensure that these challenges are overcome.

R&D Directives for Fiscal 2018



▶ **Enhancing Co-Creation of Global Solutions**

Shifting from Point Solutions to Connected Industries

To further enhance collaborative creation with customers, the Research & Development Group intends to shift its focus from developing point solutions for individual customers to providing "Connected Industries" solutions. These will connect the various solutions provided to customers in different industry sectors to deliver even greater value. One concrete example is connecting SME customers in the manufacturing field with financial institutions, to manage and share global supply chain

information. Digitizing customer orders to suppliers using a blockchain platform will not only improve efficiency in procurement and inventory management but will also enable financial institutions to swiftly make real-time decisions on matters such as settlement and financing. Further, the Research & Development Group will be strengthening initiatives addressing growth areas and social challenges in each global region, to contribute to the expansion of Hitachi's global solutions business.

Focusing on Growth Areas and Regions

The Research & Development Group is focusing on Hitachi's four focus business domains of "power and energy," "industry, distribution, and water," "urban," and "finance, social, and healthcare" according to the individual needs of each global region in terms of growth areas and challenges in that society.

CSI-APAC is focusing on the industry, finance, and social areas, working to create a digital infrastructure business in collaboration with governments. In Thailand, it is moving forward with the creation of a digital business centered on manufacturing.

CSI-North America is focusing on the industry and finance areas, with plans to expand from maintenance to mobility services, as well as blockchain verification and business development.

CSI-China is focusing on the healthcare and urban areas, developing its digital businesses in response to the "Healthy China 2030" policy, and aims to expand in elevator and escalator installation and maintenance and digital solutions.

CSI-Europe is focusing on the urban area as the railway business expands from rolling stock and signaling to a services business, promoting its Dynamic Headway solution for optimizing operational planning based on people flow analysis.

▶ Creating and Focusing on World-Leading Technology Creating World-Leading Technology to Support the Social Innovation Business

The Research & Development Group is also actively working on creating world-leading technology to support Hitachi's Social Innovation Business. For example, it is developing technology for high-speed railway and traffic management systems, pursuing increased safety, comfort, and convenience, to contribute to business expansion in Europe. In the field of elevator design, flow analysis developed for railways was combined with experience to redesign the elevator carriage and realize the world's fastest elevator. In the industry area, the world's first amorphous motor integrated oil-free scroll compressor that is both compact and highly energy-efficient was developed and launched as a product. We will continue to foster the development of world-leading technology in the areas of autonomous driving, smart manufacturing, AI, and robotics.

In order to create world-leading technology, it is essential to use digital technology and increase the value of Hitachi's OT, IT, and products. To realize this, human resources are extremely important. The Hitachi Group is aiming to increase the number of data scientists it employs to 3,000 by fiscal 2021, and is currently enhancing its training program as well as setting up a "professional community" of top-class researchers and experienced professionals in each area. In this community, the Research & Development Group will play a leading role in further developing core technology and value creation.

Accelerating Open Innovation

To realize innovative technology development that cannot be achieved by one company alone, the Research & Development Group is collaborating with research institutes, universities, the

open source community, customers, and start-ups both within and outside of Japan to build an open research environment to further enhance technology platforms.

In Japan, joint research laboratories were established within the University of Tokyo, Kyoto University, and Hokkaido University in June 2016 to work toward the realization of the "Super Smart Society" (Society 5.0)*¹ proposed by the Japanese government. In April 2017, the Hitachi Kobe Laboratory was opened within the Kobe Biomedical Innovation Cluster as a development facility to achieve practical applications for regenerative medicine. These centers will seek insights into future social challenges and propose visions and innovations that can both resolve those challenges and contribute to economic development. Globally, as well as its links with the University of Michigan around autonomous driving technology, Hitachi has established joint laboratories with three Chinese universities where it is currently working on joint research projects leveraging the strengths of each institution: Tsinghua University for IT, Shanghai Jiao Tong University for materials, and South China University of Technology for manufacturing.

As part of our open source community activity, we are also actively promoting participation in open projects and consortiums in areas such as blockchain and edge computing. In 2016, Hitachi became a premier member of the Hyperledger Project for blockchain technology, an area of rising interest in FinTech and other fields. Additionally, we are one of 46 groups from North America, Europe, and Asia participating in the OpenFog Consortium and play a key role in the Japan regional committee. Aiming to go beyond the traditional boundaries of business and industry to create new value in the edge computing domain, in February 2018, Hitachi joined the board of the Edgecross Consortium, which was established with the goal of contributing to IoT for manufacturing. Additionally, in April

2018, Hitachi established a joint company with Fanuc Corporation and Preferred Networks, Inc. (PFN) to lead the world in developing intelligent edge systems for the fields of industry and social infrastructure. Moving forward, Hitachi will promote open innovation with start-ups through its investment in Geodesic Capital Fund I-S.

*1 Super Smart Society (Society 5.0): A proposal from the Japanese government to create a new type of society. The proposal envisages using AI, IoT, robotics, and other innovations in science and technology and making use of a range of data within society to achieve both economic development and the resolution of social issues, creating a society where all people can live rewarding, comfortable lives.

▶ Promoting Basic Research to Resolve Social Issues Accelerating the Creation of Disruptive Technology

At Hitachi, we believe that disruptive technology is an essential part of driving technological development toward resolving social issues. Successful examples from fiscal 2017 include Ultrasound CT and the CMOS annealing machine based on quantum computing technology.

The CMOS annealing machine, which can process the enormous volume of calculations required to solve combinatorial optimization problems in a realistic time frame to find practical solutions to social challenges constantly increasing in scale and complexity, achieved a world-leading 100,000-bit processing level in June 2018. As a result, to give just one example of its applications, it was able to conduct the calculations needed to determine the optimal routing to ease traffic congestion for 2,000 cars on 160 vertical and horizontal roads.

Creating Visions to Lead Society 5.0

Sharing and reaching consensus on future visions and the creation of disruptive technology will be indispensable for resolving social issues. Through its joint research centers at the University of Tokyo, Kyoto University, and Hokkaido University,

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Hitachi is creating visions for Society 5.0. The Hitachi The University of Tokyo Laboratory is addressing urban development and energy systems, the Hitachi Kyoto University Laboratory is addressing anticipated social challenges in 2050, and the Hitachi Hokkaido University Laboratory is addressing regional issues and food and health. All have begun sharing their visions globally. For urban planning in particular, the company is exploring visions of future cities, models for resolving social challenges, and business models that could help achieve the goals of a decarbonized, 100-year life society and regional revitalization. In June 2018, an open forum was held to deepen discussion with stakeholders.

Hitachi believes that these initiatives will also contribute to Goal 17 of the SDGs, “Partnerships for the goals,” and will identify concrete research challenges the results of which can be promoted as sources for sustainable development.

R&D Planning and Budget

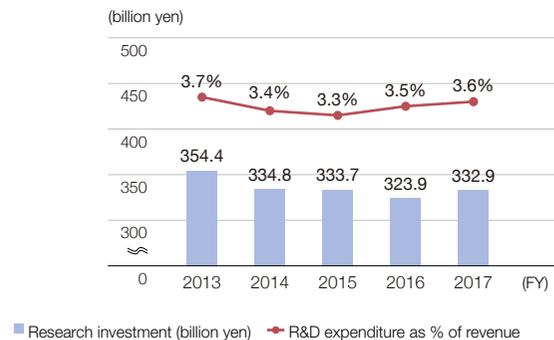
R&D investment by the Hitachi Group is equivalent to about 4% of revenue, and is used to strengthen the four focus business domains and open innovation, focusing on our Social Innovation Business. Approximately one-fifth of this amount represents the expenditure of the Research & Development Group, which can be further divided into Sponsored and Advanced Sponsored Research from the business units and Hitachi Group companies based on the Business Roadmap, and Frontier and Platform Research based on the mid-long term Technology Roadmap. The aim of Sponsored and Advanced Sponsored Research is to expand and grow core businesses with a target date for practical applications within three to five years. Frontier and Platform Research aims to strengthen collaborative creation with customers and technical platforms, and to create new businesses.

In fiscal 2017, investment in Frontier and Platform Research was concentrated on the four focus business domains identified in the 2018 Mid-term Management Plan—power and energy; industry, distribution, and water; urban; and finance, social, and healthcare—as well as digital solutions (Social Innovation Business using digital technology) that contributed to the evolution of the Lumada IoT platform.

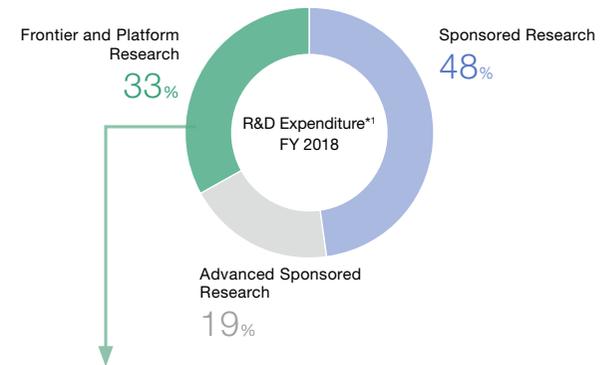
In fiscal 2018, we will strengthen our investment in Frontier and Platform Research, particularly in digital solutions. Further, in the same fiscal year, the Research & Development Group will invest toward accelerating open innovation 1.6 times the amount invested in fiscal 2015.

Key Indicators

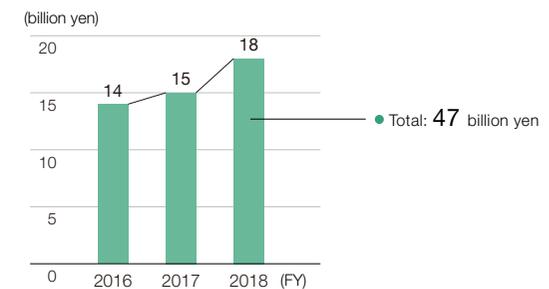
• R&D Expenditure (Hitachi Group)



• Allocation of Research & Development Group Funds



Digital Solutions



*1 Roughly 20% of total Hitachi Group R&D expenditure.

R&D Ethics Reviews

In September 2000, Hitachi established an ethical review committee to oversee the handling of information from human genome analysis. It was the first such committee to be formed by a company manufacturing medical devices in Japan. The majority of the committee members are external experts, and the committee meets two or more times a year. Currently, the committee’s activity is governed by ethical guidelines based on government directives outlined in documents such as the “Ethical Guidelines for Clinical Research” and the “Ethical Guidelines for Human Genome/Gene Analysis Research.”*1

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All Hitachi business divisions and Group companies whose activities require review are expected to demonstrate a high level of corporate social responsibility, and high ethical standards are expected of researchers and staff as well.

*1 Addressing medical research-related tasks performed at Hitachi, the ethical review committee confirms and audits research goals, legitimacy, rationality of methods, protection of the human rights of subjects, and sincere and appropriate performance of tasks.

Intellectual Property

▶ **Supporting Our Social Innovation Business with IP Activities**

Intellectual property (IP) is a key element of Hitachi’s business strategy. In our Social Innovation Business, we plan and implement IP strategies appropriate to each area of our product and digital solution businesses.

In our product business, where IP strategies are crucial for competitiveness, we are actively working toward obtaining and using patent and other intellectual property rights (IPRs), and enhancing our competitive edge by planning and implementing an “IP master plan” customized to the nature of our business. In recognition of these efforts, in 2017 Clarivate Analytics included Hitachi in its Top 100 Global Innovators for the seventh consecutive year, and the Japan Institute of Invention and Innovation presented Hitachi with its second consecutive National Commendation for Invention.

In our digital solution business, on the other hand, IP

strategies are indispensable for collaborative creation. As collaboration with our customers and partners increases, we believe it is important to use IP to promote partnerships and to build ecosystems. We take a broad view of “intellectual property,” which goes beyond patents, copyrights, and trade secrets to include other data and information assets as well. In recent years, attention has been drawn to liabilities and ethical issues arising from the application of artificial intelligence, robots, and autonomous-driving technologies. There is also a growing trend toward data localization, as seen in the European General Data Protection Regulation (GDPR). We will accelerate our IP activities by accumulating findings and knowledge

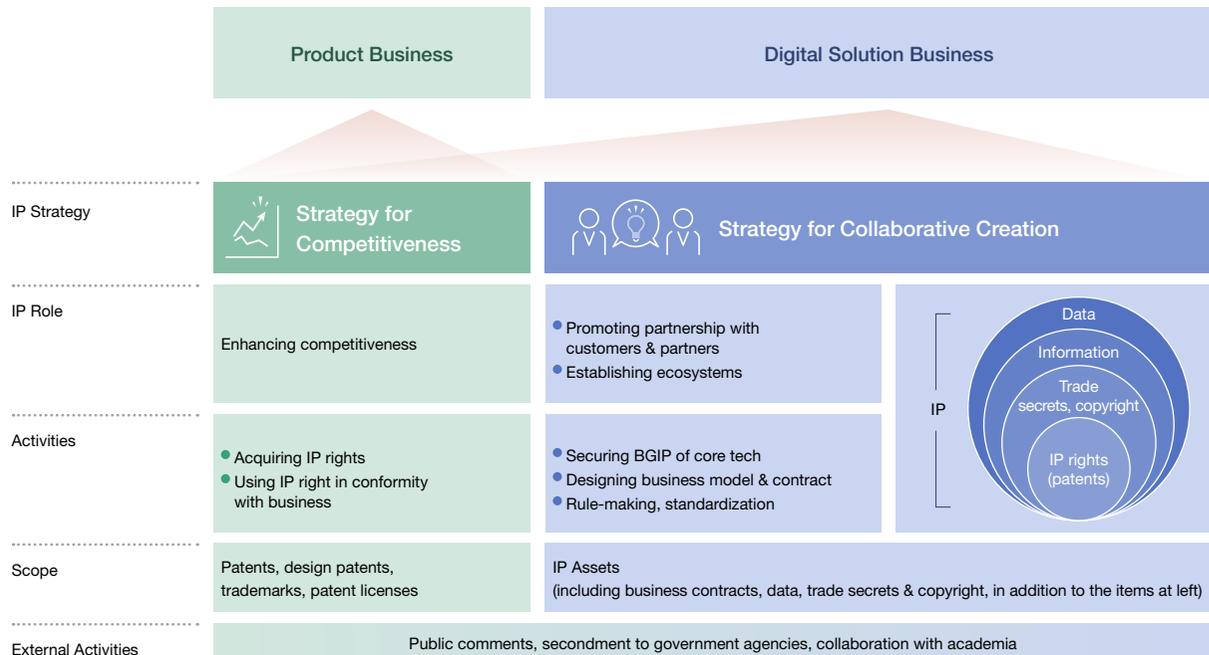
about these new technologies, along with national/regional rules and regulations.

The scope of our IP activities continues to expand as the digital transformation proceeds. We will promote new IP activities, leveraging our strengths built over long years of experience in areas requiring integrated knowledge of management, law, and technology. Through our IP activities toward promoting data use, we will contribute to our Social Innovation Business as well as to the achievement of the SDGs as we aim to realize Society 5.0.



Hitachi Group Codes of Conduct: 6. Protection of Intellectual Property and Brand

Two Types of IP Activities for Social Innovation Business



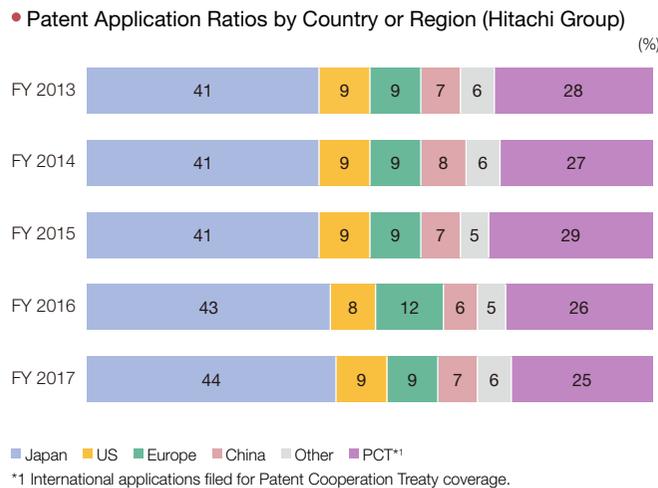
▶ Supporting our Global Business with IP Activities

One of the IP activities supporting our global operations is the development of a global patent portfolio to ensure worldwide protection for innovations emerging from our R&D and prevent competitors from imitating the technological advantages that set us apart. The portfolio also enables us to demonstrate the advantages of those technologies to customers and provide patent licenses to other companies, spurring further collaborative creation. We increased our patent application ratio outside Japan from 47% in fiscal 2009 to 56% in fiscal 2017, and we will continue to efficiently build and maintain our global patent portfolio.

In tandem with efforts to globalize our R&D centers, we are also globalizing our IP hubs. We currently have IP offices in New York and Santa Clara, California, in the United States, Beijing and Shanghai in China, and London in the United Kingdom to protect the innovations generated through R&D activities outside Japan.

Another key issue is developing globally minded IP human resources. Since fiscal 1964, Hitachi's Intellectual Property Division has operated an international job training system, sending trainees to IP law firms and Group companies in Europe and the United States and to study abroad. In fiscal 2017, three trainees went to the United States and one to Singapore, while one employee was sent to the United States and one to China's Special Administrative Region of Hong Kong to study.

Key Indicators



▶ Protecting Our Designs and Brand

Protecting Hitachi's designs and brand is crucial for promoting our Social Innovation Business and supporting our global operations. We operate a rigorous regime against such infringements as making and selling counterfeit goods copying our designs or carrying the Hitachi brand and illegally applying for or registering trademarks similar to the Hitachi brand.

Until recently, the bulk of counterfeit goods were manufactured in China, but over the past several years manufacturing methods and sales routes have become more sophisticated and diverse, which has spurred us to take further action.

To stamp out counterfeit goods, it is also important to teach general consumers not to buy them. Hitachi conducts ongoing consumer awareness activities to eliminate counterfeit goods.

▶ Reward System for Employee Inventions

We motivate employees in the R&D field with an ample reward system for new inventions. To make this reward system as fair and transparent as possible, we set standards to evaluate inventions and disclose these standards to employees. We also have a mechanism for receiving inquiries about the rewards, as well as opinions on the reward system.

We have established a special division within the Intellectual Property Division to plan and operate this system, while an internal Invention Management Committee made up of R&D, legal affairs, personnel management, and IP experts ensures that the system operates effectively across the whole Group. The system includes an invention information channel to promote communication between inventors and the business divisions implementing the resulting patents. Inventors can ask the business divisions for information about patent implementation and check the evaluation standards used to calculate the rewards for their inventions. To ensure transparency and inventor satisfaction, we also set up an Arbitration Committee for Invention Rewards, composed similarly to the Invention Management Committee. Inventors can appeal to this committee if they disagree with the amount they have been awarded.

From fiscal 2005, we have given President's Awards to the top 100 inventors. Since fiscal 2006, we have also given awards to the top 50 young inventors (under 35 years old) based on patent application rewards received within five years of their joining Hitachi.