Overview

Hitachi Group's R&D Strategy

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R&D LEADING THE EXPANSION OF THE SOCIAL INNOVATION BUSINESS

HITACHI is working to expand its Social Innovation Business throughout the world. This business involves developing a common understanding of problems with customers and then mobilizing its technologies, products, services, personnel, and other business resources to work with them to achieve innovation and deliver solutions to those problems. The research and development (R&D) at Hitachi that leads this process seeks not only to create technology and other knowledge, but also to enhance the organization's capacity for innovation by utilizing these to create new value that will provide business opportunities.

Hitachi, Ltd. was established in 1910 and since then has been working to expand and transform its business areas based on its Corporate Credo of contributing to society through the development of superior, original technology and products. This has included focusing on technology development from the beginning and maintaining its own independent research organization from its early years (1918). That organization, now called the Research & Development Group, is still working on a wide variety of R&D across the entire Hitachi Group.

The business divisions, meanwhile, are also working on short- to medium-term development, drawing on the research results of the Research & Development Group, in order to meet the requirements of the relevant markets and their customers. Hitachi's annual investment in R&D totals about 350 billion yen, of which the development being worked on by business divisions is becoming a larger proportion.

The Research & Development Group plays the following three main roles.

Development of Technologies that Individual Business Divisions Find Difficult to Resolve on Their Own

The Research & Development Group has built up both tangible and intangible business resources suitable for R&D. Having spent many years working with a wide range of technologies that cross the boundaries between different business divisions, the group has acquired a collection of methodologies that represent research best practices and common platform technologies with broad applications. The group is also able to be selective and focused, assigning research resources flexibly based on the urgency and importance of the challenge concerned. It is able to utilize these resources to resolve high-level problems by responding promptly to changes in market and customer needs.

Technology Development that Spans Multiple Market Areas

It is not uncommon for a technology developed for one market segment to be applicable to other market areas, either as is, or with only a few modifications. There are many cases where technologies can be enhanced through the centralized development and accumulation of technologies from a wide variety of different market segments. Along with serving as an important asset for future R&D, this also provides the driving force for opening up new markets.

Technology Development for Expanding into New Markets or Creating Future Markets

Hitachi is working on R&D that is based on the following three policies aimed at the sustainable development of society and customers. Open innovation holds an important key for each of these.
(1) Become familiar with market information obtained by having an involvement in a wide range of business areas
(2) Become familiar with information on advanced technologies obtained through R&D for a wide range of business areas
(3) Conduct research into methodologies that include human sciences and system sciences for identifying signs of social change from the aforementioned marketing and technology information

The following sections describe Hitachi's R&D organization for implementing its 2018 Mid-term Management Plan, its basic policies, global R&D

initiatives, and the development of an Internet of Things (IoT) platform that accelerates social innovation.

HITACHI'S R&D ORGANIZATION FOR IMPLEMENTING ITS 2018 MID-TERM MANAGEMENT PLAN

Hitachi's 2018 Mid-term Management Plan aims to expand its Social Innovation Business by accelerating collaborative creation with customers in its role as "An Innovation Partner for the IoT Era."

To accelerate collaborative creation with customers, Hitachi adopted an organizational structure based on customer-focused business units (BUs) in FY2016 (see Fig. 1).

The front (customer-driven) businesses that develop and supply services closely with customers through collaborative creation are made up of 12 BUs organized by customer segment, and various regional bases. These businesses use platforms for the timely and efficient supply of services. To this end, the Services & Platforms BU develops and supplies platforms for a variety of services. The Industrial Products BU and group companies supply globally competitive parts, materials, and other products to customers and to front BUs.

The Research & Development Group represents the further strengthening of the customer-driven R&D organization that was established in 2015 in advance of the change to the BU structure in order to work with this new structure (see Fig. 1).

The Global Center for Social Innovation (CSI) is a front organization that works with customers to develop solutions. In addition to its four bases in Tokyo, North America, China, and Europe, it has also established an Asia-Pacific (APAC) base that works closely with local regions on investigating ways of overcoming challenges. It also utilizes the technology platforms and other innovative products of the Center for Technology Innovation (CTI) (described below) to provide leadership that extends from developing prototype solutions to conducting on-site testing.

The CTI has nine research centers that deal with energy, electronics, mechanical engineering, materials, systems engineering, information and telecommunications, controls, production engineering, and healthcare, respectively. Its role is to support the development of new solutions through the optimal
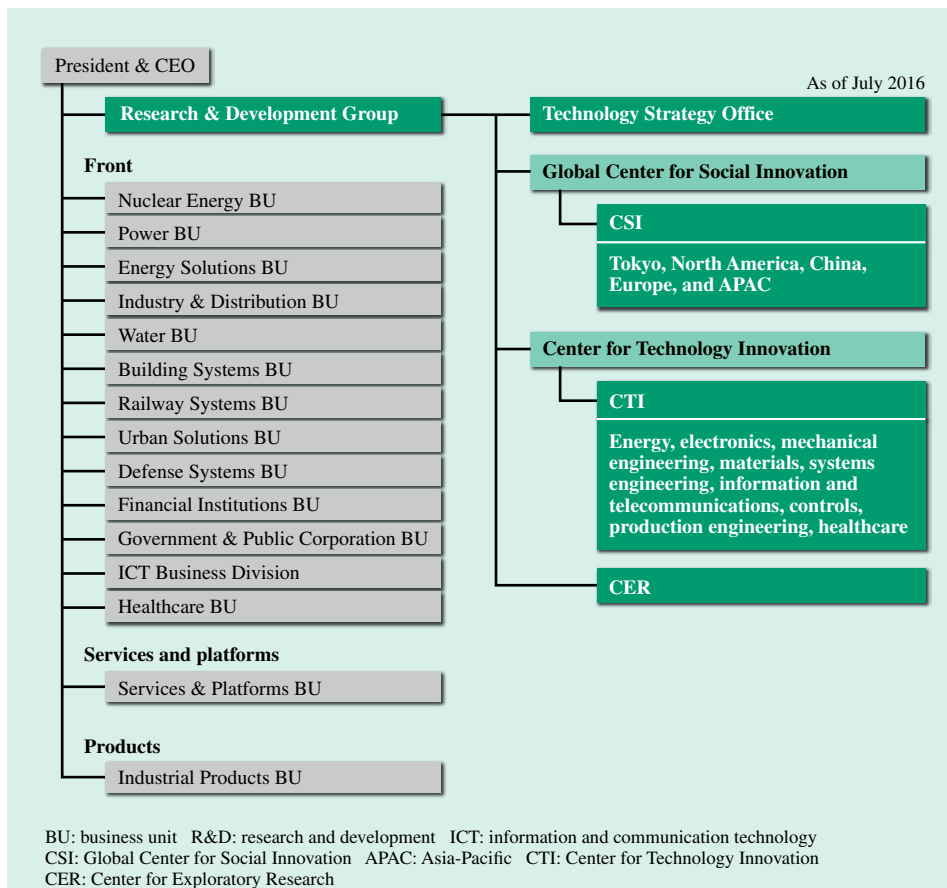
Fig. 1—Hitachi's Business Unit Structure and R&D Structure.
The Research & Development Group works on customer-focused R&D throughout the world, with initiatives that include working on methodologies for developing new markets and the development of common platform technologies in ways that cross the boundaries between BUs.

BU: business unit   R&D: research and development   ICT: information and communication technology
CSI: Global Center for Social Innovation   APAC: Asia-Pacific   CTI: Center for Technology Innovation
CER: Center for Exploratory Research

combination of a wide range of technical fields while also strengthening the technology platforms for these nine fields through the development of innovative services, products, and platforms.

The Center for Exploratory Research (CER) conducts leading-edge R&D from a long-term perspective on ways to resolve the challenges that society will face in the future, and also operates as a global open laboratory to open up new opportunities for Hitachi's Social Innovation Business through collaborations with a variety of other research institutions.

BASIC POLICIES OF RESEARCH & DEVELOPMENT GROUP FOR IMPLEMENTING ITS 2018 MID-TERM MANAGEMENT PLAN

The Research & Development Group has set three basic policies in its role as a research laboratory that will lead Hitachi to become "An Innovation Partner for the IoT Era."

(1) Creating service business by accelerating collaborative creation

(2) Building up technology platforms for Service and Product business growth

(3) Challenging future societal issues through open innovation

Creating Service Business by Accelerating Collaborative Creation

The challenges facing customers and other parts of society are becoming more complex, encompassing problems such as energy and the environment, food and water, and transportation systems and security. The Research & Development Group has been working on initiatives aimed at collaborative creation with customers to achieve a common understanding of these challenges alongside customers and joint development of solutions in accordance with the 2015 Mid-term Management Plan. These initiatives will be stepped up under the 2018 Mid-term Management Plan, whereby the group will contribute to service business development by working rapidly through the following cycle, engaging with front BUs to accelerate collaborative creation with customers (see Fig. 2).

(1) Identify challenges

Identify challenges by rigorously focusing on the "pain points" of end users. Consult with front BUs to identify business opportunities and to come up with solution ideas in ways that take account of customer circumstances.

(2) Resolve challenges

Work with front BUs to initiate collaborative creation with customers and demonstrate the value for these customers.

(3) Leverage outcomes

Incorporate the know-how and systems developed into an IoT platform to enable ongoing service delivery by BUs.

The past practice for collaborative creation with customers[1] has been to help improve efficiency by using ethnographic surveys of a specific customer activity (warehouse logistics, for example) to identify problems, formulate solutions, and verify benefits. In
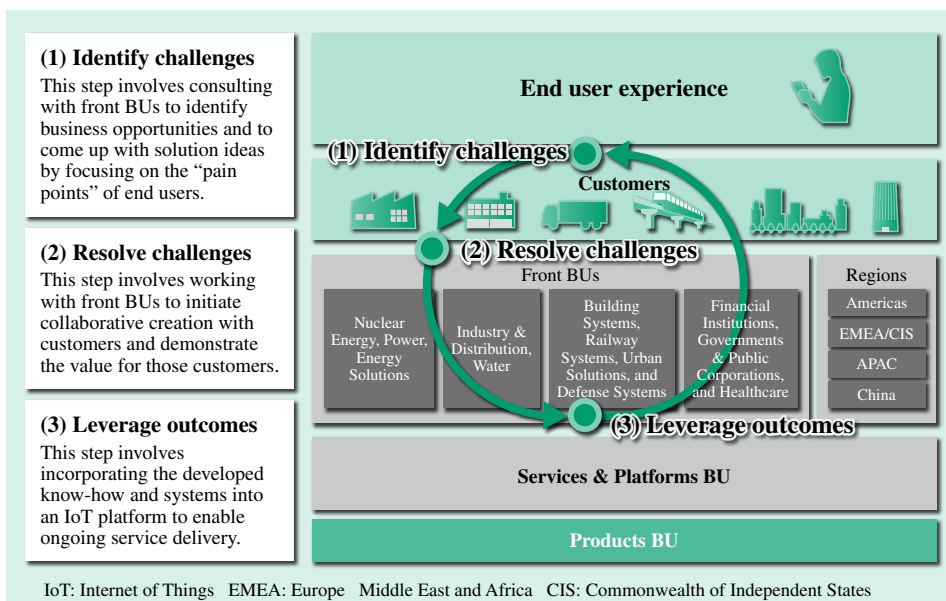

(1) Identify challenges
This step involves consulting with front BUs to identify business opportunities and to come up with solution ideas by focusing on the "pain points" of end users.

(2) Resolve challenges
This step involves working with front BUs to initiate collaborative creation with customers and demonstrate the value for those customers.

(3) Leverage outcomes
This step involves incorporating the developed know-how and systems into an IoT platform to enable ongoing service delivery.

IoT: Internet of Things   EMEA: Europe   Middle East and Africa   CIS: Commonwealth of Independent States

Fig. 2—Creating Service Business by Accelerating Collaborative Creation.
The Research & Development Group contributes to service business development by working rapidly through the cycle shown in the figure, which involves engaging with front BUs to accelerate collaborative creation with customers.
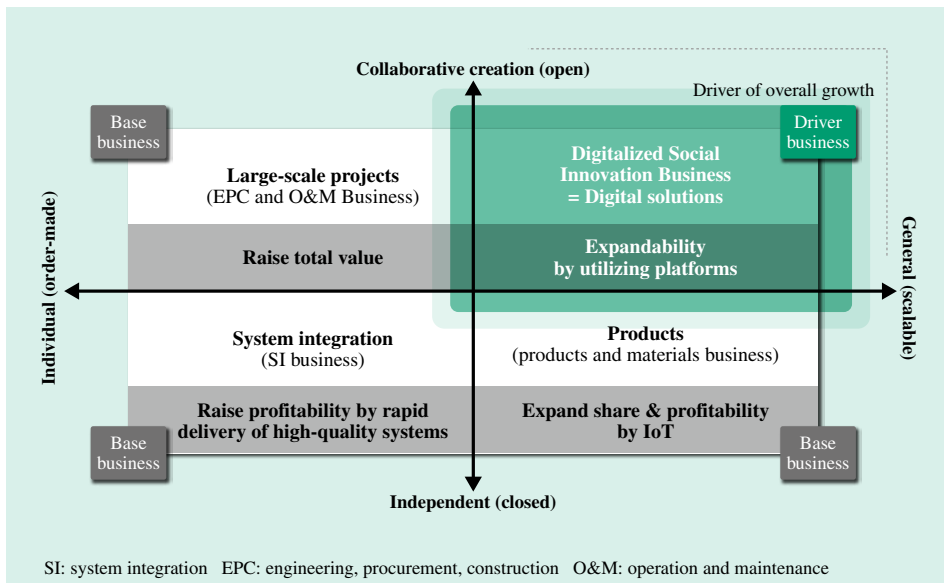
Fig. 3—Building Up Technology Platforms for Service and Product Business Growth. Building-up technology platforms will improve the profitability of existing businesses and help expand the Social Innovation Business.

the future, Hitachi aims to deliver even greater value to customers by using 25 Future Signs for 2025[2] (insights into the future of society as a whole from the perspective of the general public) as a prompt to anticipate changes in customers and by identifying business opportunities through the application of ethnography across the entire customer value chain (such as integration with inward and outward goods and delivery).

Building Up Technology Platforms for Service and Product Business Growth

Fig. 3 shows the direction of future business expansion at Hitachi and the policies for building the associated technology platforms. The figure classifies Hitachi's business sectors based on four quadrants. The horizontal axis represents whether products and services are custom-developed for individual customers (order-made), or supplied for use by a large number of general customers (scalable). The vertical axis represents whether businesses are independent to Hitachi (closed), or involve collaborative creation with partners (open).

The Research & Development Group is working on the following technology development to build a technology platform for each quadrant.

The bottom-left quadrant corresponds to system integration (SI) businesses such as financial and public sector systems. In this quadrant, Hitachi is working on technology development that will boost both its own profitability and that of its customers through the rapid delivery of high-quality systems.

The top-left quadrant corresponds to engineering, procurement, construction (EPC), and operation and maintenance (O&M) businesses with large-scale projects in fields such as railways, nuclear power, and particle beam therapy (PBT). In this quadrant, Hitachi is working on technology development that will help improve value along the total customer value chain.

The bottom-right quadrant corresponds to products and materials businesses such as industrial and IT equipment, escalators and elevators, and auto parts. In this quadrant, Hitachi is working on developing technologies that are intended to enhance customer value and boost market share, such as quality improvement and adoption of the IoT.

The top-right quadrant corresponds to digital solutions, meaning Social Innovation Businesses that use digital technology. Examples include service businesses for energy management, electronic commerce, and industry and distribution. The market in this sector is expected to grow rapidly in the era of the IoT, where digital technology is used in various different things that are linked together. Hitachi's strength when it comes to creating digital solutions is that it has technologies and practical experience in both operational technology, which involves equipment operation and the collection of workplace data, and IT, which involves status visualization, analysis, and prediction. Hitachi is putting this strength to work in technology development that expands by utilizing platforms.

One example[3] is its work aimed at increasing extraction from oil fields and boosting productivity in the oil and gas industry. In a solution for converting geological data to digital form and applying analytics to the resulting big data, the analysis platform has been

made scalable by separating the top-level application and platform.

The Category Overview of technical innovations describes initiatives involving innovative technologies that drive strategic growth in the four business sectors above and presents development examples in detail.

Challenging Future Societal Issues through Open Innovation

Open forums that cross the boundaries between organizations, disciplines, nations, and regions are essential in a time of major changes in the nature of the economy and society and the structure of industry if people are to formulate a vision for the future of society and work together to achieve it.

To achieve Society 5.0[a], the concept of a human-centric smart society that combines economic growth with the resolution of societal problems, as laid out in The 5th Science and Technology Basic Plan[4] of Japan, the Research & Development Group is working on exploratory research and incubation based on an original vision in four categories, namely the information sciences, physical sciences, life sciences, and frontier (see Fig. 4).

(a) Society 5.0

An initiative aimed at creating a Super Smart Society that satisfies its diverse needs in an efficient and personalized manner through a sophisticated combination of cyber and physical spaces. It incorporates the idea of a transformation guided by scientific and technical innovation to create a new type of society that will be a successor to the hunter-gatherer, agricultural, industrial, and information societies.

Developing diverse relationships will be essential to achieve this vision. The group intends to actively pursue open innovation, not only with customers, but also with technology partners from outside Hitachi, and other countries, and regions. Joint research facilities were established during FY2016 with the following Japanese universities.

(1) Hitachi Hokkaido University Laboratory[5]
The laboratory draws on regional characteristics that represent a microcosm of Japan to work on pre-emptively identifying issues and conducting trials.

(2) Hitachi Kyoto University Laboratory[6]
The laboratory draws on regional characteristics with a long history and culture to identify challenges for as far out in the future as 2050.

(3) Hitachi The University of Tokyo Laboratory[7]
The laboratory is engaged in joint studies into the future role of Japan with reference to global social trends to develop a national vision.

Details of work on this objective of challenging future societal issues through open innovation are presented in the Category Overview of exploratory research.

Research & Development Group Global R&D Initiatives

The Research & Development Group is working on global R&D in accordance with trends in different regions (see Fig. 5).

In North America, it is working on development that is playing a leading role in the IoT platform business

Fig. 4—Challenging Future Societal Issues.
To realize the goals of Society 5.0, Hitachi intends to engage in exploratory research and incubation based on an original vision in four categories, namely the information sciences, physical sciences, life sciences, and frontier.
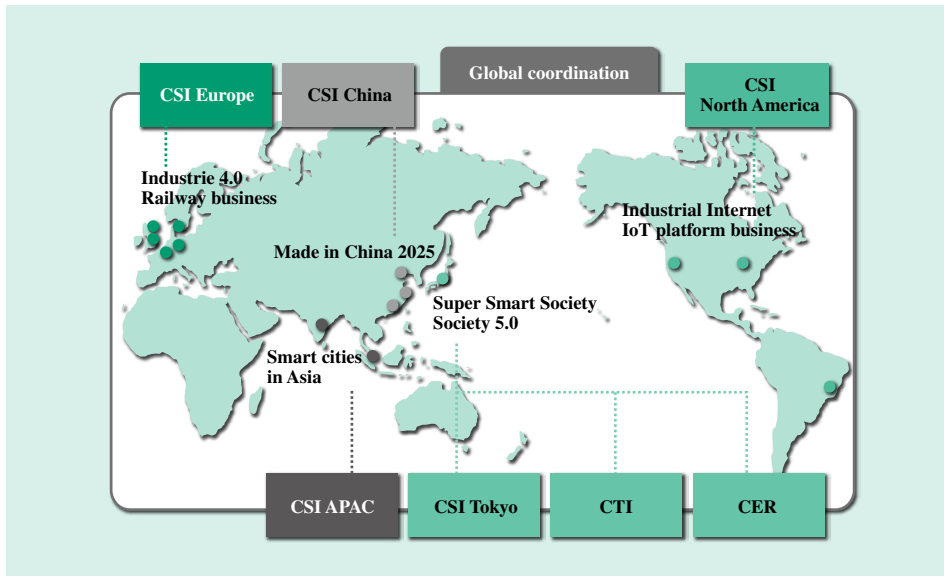
Fig. 5—Global R&D.
The CSI has facilities around the world and coordinates with the CTI and CER to build the Social Innovation Business in ways that take account of regional developments and customer needs.

with reference to what is happening with the Industrial Internet[b]. It is also developing service businesses in digital solution hot spots such as FinTech[c]. In China it is picking up the pace of collaborative creation with customers in the industrial sector with reference to what is happening with Made in China 2025[d]. In Asia, it is working on collaborative creation with customers that incorporates the growth in Asia, such as smart cities. In Europe, it is strengthening collaborative creation with customers on total solutions for railways and industrial solutions with reference to Industrie 4.0[e].

The Category Overview of collaborative creation with customers gives details of these new global R&D initiatives.

(b) Industrial Internet
   An IoT initiative led by the Industrial Internet Consortium established primarily by General Electric Company, a US company. Aimed at sectors like manufacturing, energy, healthcare, the public sector, and transportation, it seeks to improve productivity and cut costs by connecting industrial equipment to the Internet and collecting and analyzing data.
(c) FinTech
   A term coined by combining "finance" and "technology," FinTech refers to innovative financial services and the activities involved in creating them.
(d) Made in China 2025
   A roadmap for the development of manufacturing industry through to 2025 that was published by the Chinese government in May 2015. It focuses on next-generation IT, machine tools and robots, and aerospace systems, including measures for improving the nation's ability to innovate and for the high-level fusion of IT and industrial technology with the aim of becoming a major manufacturing nation.
(e) Industrie 4.0
   An advanced technology strategy of the German government that is characterized as being a fourth industrial revolution. It seeks to achieve smarter practices and greater standardization across all aspects of manufacturing, including logistics, through the use of IT for things like machine-to-machine (M2M) communications, big data analytics, and the integration of manufacturing and commercial systems.

EXAMPLES OF INNOVATIVE R&D

This issue of *Hitachi Review* includes 13 articles that present examples of innovative R&D in three categories: collaborative creation with customers, technical innovation, and exploratory research.

The first three articles deal with global collaborative creation with customers and describe work being done on the creation of solutions for energy, care cycle optimization, and predictive maintenance.

The next seven articles deal with technical innovation and describe work being done on technology development relating to products for the railway, industrial, and automotive sectors, IoT platforms, and reliability analytics for manufacturing.

The final three articles deal with exploratory research and describe work being done on research into innovative functional materials, area energy design, and regenerative medicine.

CREATING IOT PLATFORMS THAT ACCELERATE SOCIAL INNOVATION

The development of an IoT platform for supplying Hitachi's innovations to customers in the form of services is important to the further growth of its Social Innovation Business. Hitachi will supply new services by using a platform based on the IoT to analyze customer challenges, verify value, develop solutions, operate, and connect to the OT or IT systems of customers and other partners.

Hitachi is marketing this as the Lumada IoT platform. The Research & Development Group is

contributing to the development of the IoT platform by developing core technologies that include analytics for the collection, collation, analysis, and presentation of data; artificial intelligence for the automation of optimization and decision-making; and security for providing safety and reassurance in both cyber and physical spaces. Details of this work are described in an article on the IoT platform in the technical innovation category.

Hitachi is directing the expansion and growth of its Social Innovation Business by working on R&D of these technology platforms and by working with customers to develop platforms.

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