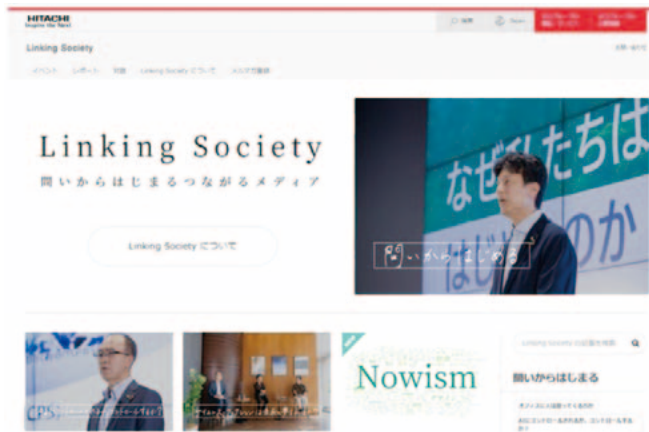


Evolution of Global Co-creation



Access to Linking Society website

<https://linkingsociety.hitachi.co.jp/>

To view articles, scan the QR codes* below using a smart device or the camera on your PC.



News site (top page) in Japanese



Facebook page in Japanese

* See "Trademarks" on page 150.

1 Linking Society: News service operated by Hitachi's Research & Development Group

1 Linking Society: Innovation Inspired by Asking Questions – Transformation to a New Digital Approach to Co-creation

Companies have come to recognize the value of collaborative creation (co-creation) over recent years as a means of driving innovation. Hitachi developed its NEXPERIENCE methodology for co-creation with customers and has been putting it to use, including the establishment in 2019 of its *Kyōsō-no-mori* facility in Kokubunji, Tokyo. While *Kyōsō-no-mori* has served as a venue for open collaboration with a wide variety of stakeholders, the COVID-19 pandemic has forced Hitachi to update how it goes about engaging with its co-creation partners, and how it generates ideas and shares challenges.

In practice, Hitachi's co-creation partners include business people, academics, government officials, and local residents, each of whom has a visceral appreciation of the societal challenges in their localities. With working from home having become an increasingly longstanding practice, there have been numerous instances in which these partners have taken actions to resolve their particular challenges by drawing on net-based communities.

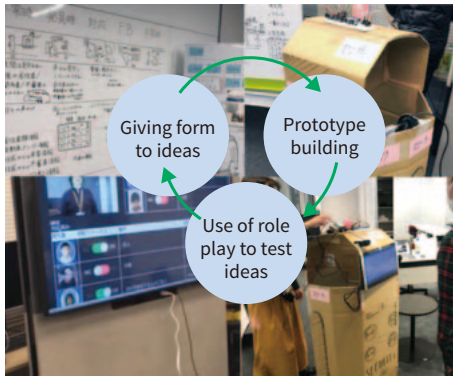
Accordingly, "Linking Society: a collaborative media outlet inspired by asking questions" was launched in October 2021 as a news service that can host discussion on the reappraisal of societal challenges and create a shared vision for an inspiring future. By using this forum

to highlight the unmet needs in the public, Hitachi is laying the groundwork for co-creation and accelerating societal innovation in a spirit of consensus.

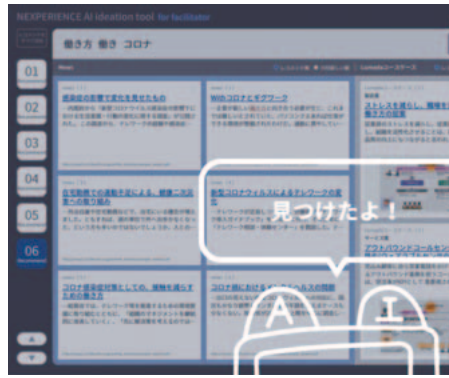
2 Digitalization of NEXPERIENCE and Its Use for Co-creation

Hitachi has formalized its practices for smoothing the process of co-creation in the form of its NEXPERIENCE methodology and put it to use in support of social innovation across more than 1,000 projects. It has now followed this up with the development of digital tools that support co-creation, and during 2021 has put these to work at the Lumada Innovation Hub Tokyo, its flagship facility for such activities. Specifically, these are a co-creation prototyping tool that allows people to try out ideas on the spot, an artificial intelligence (AI) ideation support tool that uses AI to recommend other relevant examples of co-creation, and a future envisioning tool that envisions future changes by drawing on the information acquired through co-creation work spanning numerous different industries.

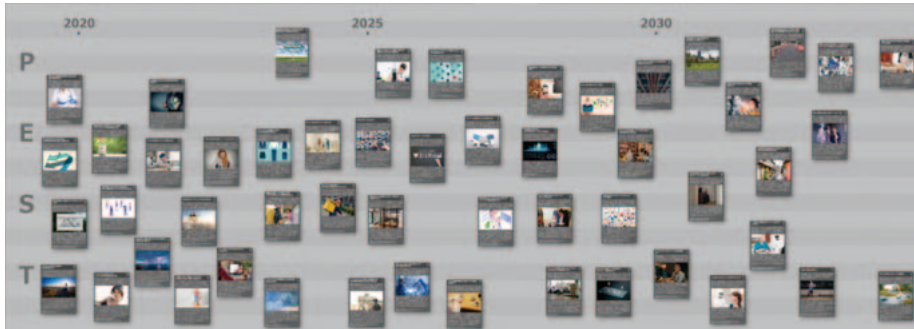
Customer feedback from the use of these tools in a number of projects included comments about how they made it possible to give form to ideas on the spot and easier to envisage the future, demonstrating how the tools facilitate the practical realization of future scenarios and



Co-creation prototyping tool



AI ideation support tool



Future envisioning tool

2 Digitalization of NEXPERIENCE and its use for co-creation

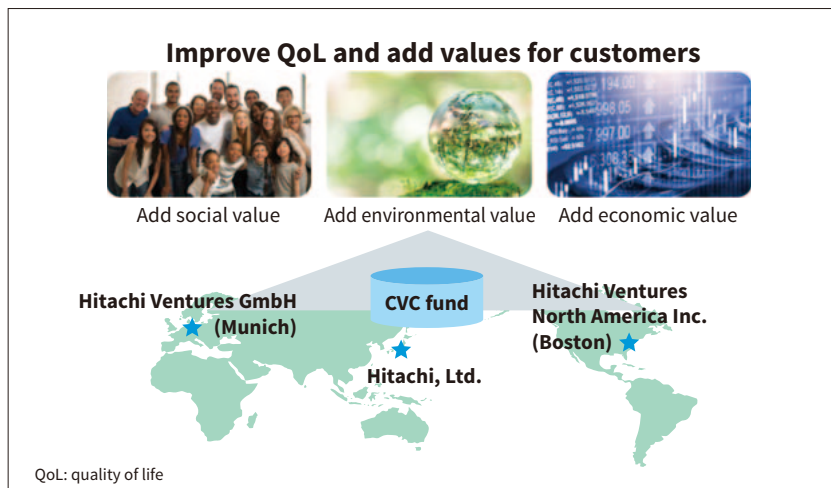
ways of achieving them. In the future, Hitachi intends to continue with the digitalization of techniques for achieving social innovation to accumulate and deploy co-creation knowledge and expand the range of projects where these tools can be used.

play its part in innovation ecosystems through investments in startups around the world. It has since invested in 11 such startups across a range of industries, including industrial AI and the Internet of Things (IoT), data management and computing, and digital healthcare. Chief Executive Officer (CEO) Stefan Gabriel was selected as among the top 25 in the Global Corporate Venturing (GCV) Powerlist 2021, which identifies outstanding CVC entrepreneurs.

A second fund was established in October 2021 to boost investment in startups that create environmental value by addressing climate change and promoting

3 Open Innovation through Collaboration with Startups

Hitachi Ventures GmbH was established in FY2019 as a vehicle for corporate venture capital (CVC) that could



3 Open innovation through collaboration with startups

resource efficiency, as well as social value through health-care, including medicine and pharmaceuticals.

In the future, Hitachi will continue discovering and supporting startups that take on the challenge of advanced technologies and advanced business models as it achieves growth through innovation by developing advanced technologies through research and development (R&D), and by collaborating and partnering with startups.

4 Design of Connected Home Appliances for Enhanced Value



4 Connected home appliances from Hitachi

Hitachi sees design as a means of enhancing people's QoL.

This includes the design of connected home appliances with upgradable functions and user interfaces that can change to suit the different ways in which the appliances are used in order to adapt to the continually changing and

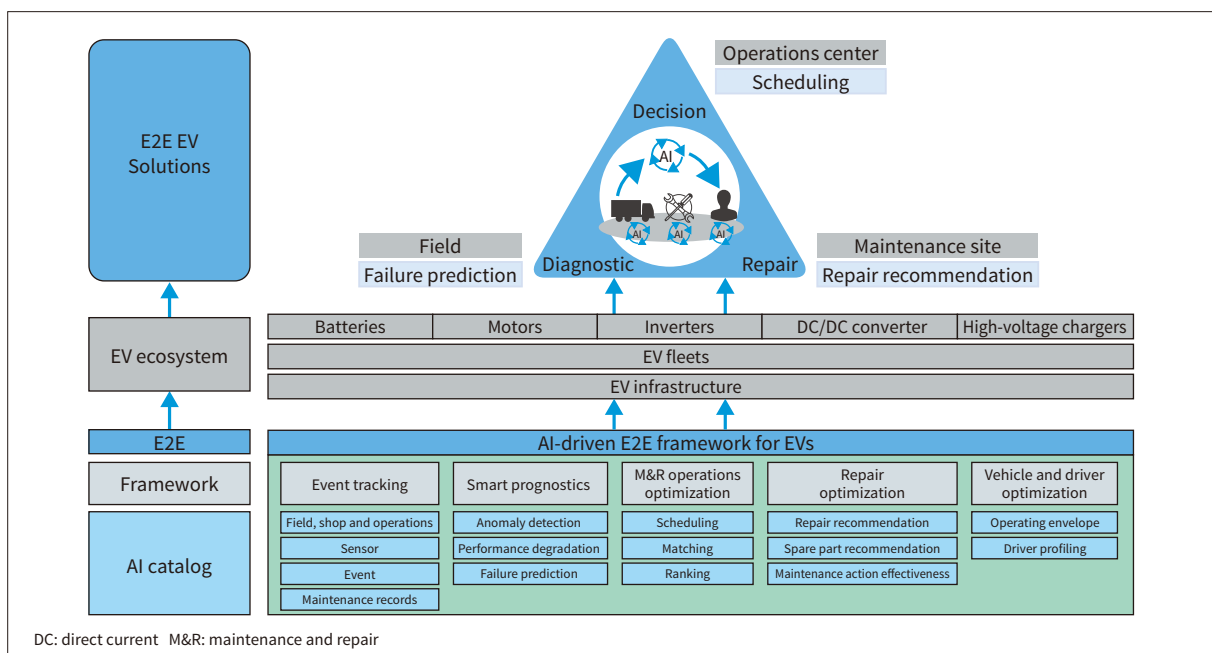
ever more diverse needs of consumers. The smart-stocker function for Hitachi single-door refrigerators can assess the remaining quantity of refrigerated items and replenish them as needed by purchasing from a prearranged site. A similar function for washing machines with automatic detergent dispensing can operate the washing machine appropriately for the detergent brand being used and automatically re-order when stocks get low. It can also advise the user about which settings to use based on the day's weather forecast and adjust how it completes the wash cycle by learning the user's preferred washing methods. Likewise, the health-conscious microwave ovens makes daily recipe suggestions based on the user's preferences. Users can also expand their repertoire by updating the app with new recipes.

By staying in close contact and paying attention to how people go about their lives, Hitachi intends to continue enhancing the value it delivers to customers through designs that are very easy to use.

5 AI-Driven E2E Framework for Electric Vehicle Fleet Operations and Maintenance

With the unprecedented growth of the electric vehicle (EV) market, EV manufacturers seek opportunities to improve EV efficiency and effectiveness. They also want to offer fleet operators value-added services that allow them to optimize EV operations and maintenance.

EV operations and maintenance differ from internal combustion engines as they require a deeper



DC: direct current M&R: maintenance and repair

5 Maximizing EV operations and maintenance using an AI-driven E2E framework

understanding of components (e.g., battery, motor) dynamics and their impact on range optimization, charging network and schedules, and performance levels while still requiring attention to known issues, like breakdowns, repair planning, and vehicle uptime.

Hitachi is offering an AI-driven end-to-end (E2E) solution for EV operations and maintenance that addresses unique EV challenges, common ones and can leverage Hitachi Energy Ltd.'s infrastructure. This solution empowers EV fleets with AI technology by streamlining event tracking, predicting failures and breakdown events, optimizing operations and repair, recommending repair actions, and optimizing vehicle usage and driver behavior. Its E2E approach defines a framework where multiple AIs are combined to work together in a plug-and-play fashion to achieve higher optimization levels than point AI solutions. (Hitachi America, Ltd.)

6 Reducing Shape Defects in Hot Rolling Mills with AI and ML

For steel producers, defects in the produced strip and coil shape can incur significant financial losses. Often steel strips and coils with a defective shape coming out of a hot rolling process need to be reworked or discarded.

Hitachi is offering AI-based digital solutions to empower steel makers to reduce losses caused by defective strips and coils and to increase productivity by: (1) understanding the root cause for the shape defects and taking preventive measures before starting production; (2) predicting shape defects and taking counter measures during production. Hitachi's root cause analysis

(RCA) solution identifies the root causes of shape defects effectively and efficiently over a large variety of product materials and requirement. The predictive quality analytics solution can accurately predict the downstream strip shape metrics using hot rolling mill shape measurement and sensor data.

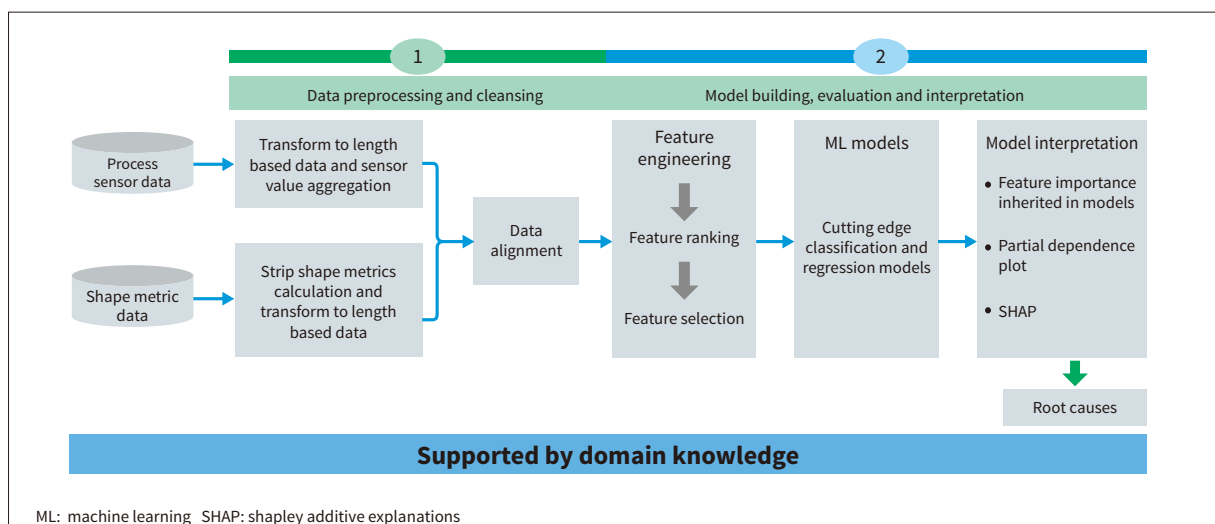
Based on its customer experience with some of the largest steel producers in the world, Hitachi strongly believes that its solutions can help steel makers improve quality and productivity. (Hitachi America, Ltd.)

7 AI Model Development Technique for More Efficient Extraction of Information from Dark Data

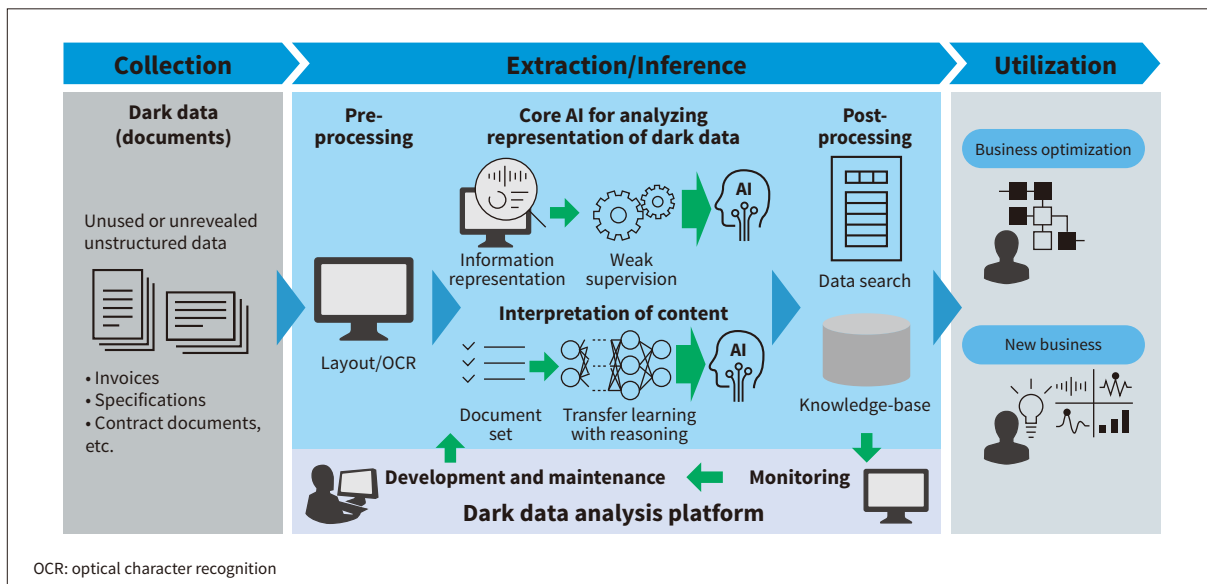
How to use AI to extract value from data is the subject of ongoing work. At Hitachi, this includes the development of a dark data solution for extracting value from unstructured data that lies unused.

A key feature of this solution is its ability to efficiently extract information from documents in a variety of different formats, which is done using a technique for analyzing the structure of information representation that looks at the visual features of documents, combining this with weak supervision, a learning technique that can generate AI models from small amounts of training data. However, it is also restricted by the fact that it uses a new form of learning that requires specialist expertise in model development, and because it only looks at visual features and so is unable to consider the document content.

To overcome this, Hitachi has developed a technique for identifying the features of information representation



6 Reducing shape defects in hot rolling mills with AI and ML



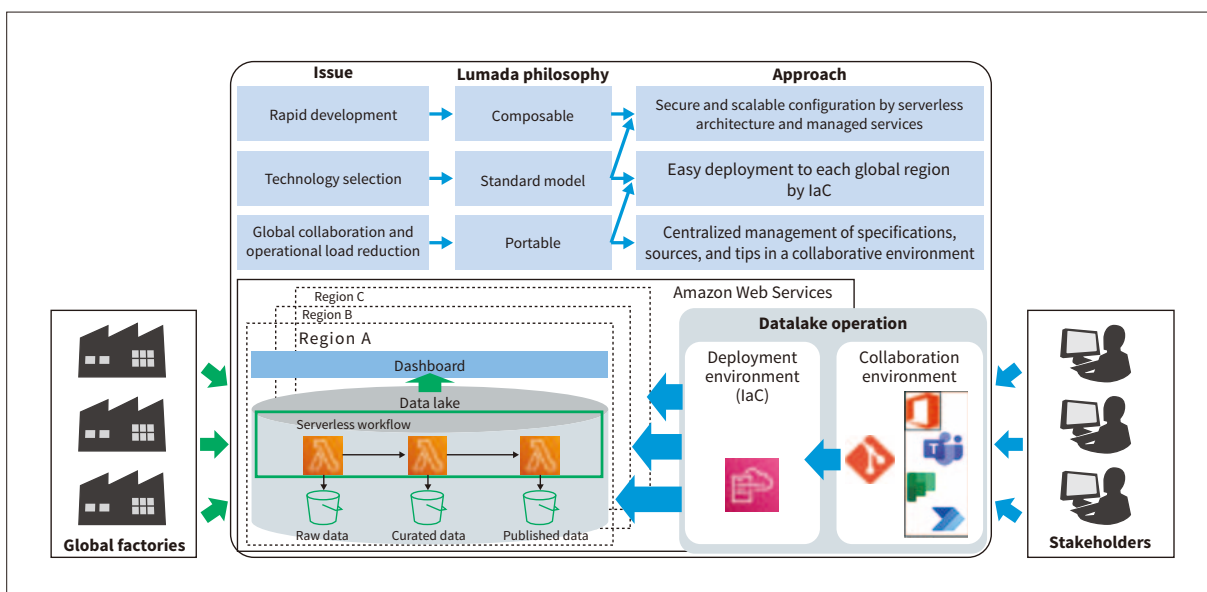
7 Dark data analysis solution

that automatically extracts the visual features of documents. By simplifying model development, this makes it easier for customers to adopt the solution. A technique has also been developed to enable natural language analysis. This can obtain an inferred structure and works by augmenting the AI used to determine the document structure with learning of cause-and-effect relationships. It expands potential use cases to include documents in which an understanding of the content is assumed, such as contract documents. In the future, Hitachi intends to use this AI model development technique as the core of a dark data analysis platform that covers everything from the collection of data to its use.

(Hitachi America Ltd.)

8 DX Project for Bringing Standardized IoT Services to Worldwide Plants

Hitachi Astemo, Ltd. is working on building a global IoT system utilizing the public cloud to share data from its more than 140 factories. The Research & Development (R&D) Group has been participating in this activity and has made several contributions including IoT readiness assessment of Hitachi Astemo factories, digital transformation (DX) architecture design, rapid development, technology selection, global data sharing, and reduction of operational load, building new and scaling existing applications. On the public cloud, the R&D Group followed Lumada's philosophy such as using a design that combines existing composable technologies, following



8 IoT system architecture for Hitachi Astemo

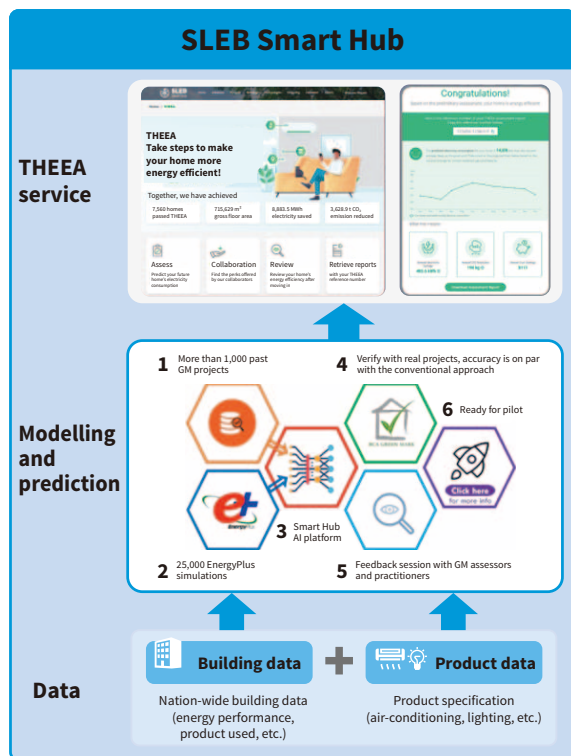
the data management standard model, and deploying a portable system by DevOps-style operation. And the Group realized a secure and scalable configuration using serverless architecture and managed services, enabled easy deployment in multiple global regions using infrastructure as code (IaC), and centralized management of specifications, sources, and tips in a collaborative environment.

Thus, as scheduled, the system commenced rollout to each factory sequentially from October 2021. The R&D Group will continue to collaborate to expand automated content and design a global data sharing method that can support future business expansion.

(Hitachi America, Ltd.)

9 Tropical Home Energy Efficiency Assessment Service

With hot and humid tropical climate in South-East Asia, buildings account for more than 50% of total electricity consumption. To contribute to a carbon-free society, Hitachi Asia Ltd. has been commissioned by Building and Construction Authority (BCA), Singapore to develop the Super Low Energy Building (SLEB) Smart Hub, Singapore's first digital knowledge centre for green buildings in the region.



GM: green mark
<https://www.sleb.sg/theea>

9 THEEA service provides energy performance assessment report for green loan application

Utilizing cutting-edge big data analytics and AI, SLEB Smart Hub provides several services to facilitate the adoption of green building technologies. Tropical Home Energy Efficiency Assessment (THEEA) is one such service. THEEA helps to predict a home's electricity consumption by assessing the use of energy-efficient home appliances and smart home features. If a home is assessed as energy-efficient by THEEA, the applicant can use the assessment report to apply for green loans provided by financial institutions with promotional rates. Hitachi Asia will extend this service to commercial properties soon. Together, the company can play a crucial part in keeping the city sustainable and energy efficient, while enjoying both carbon and financial savings.

(Hitachi Asia Ltd.)

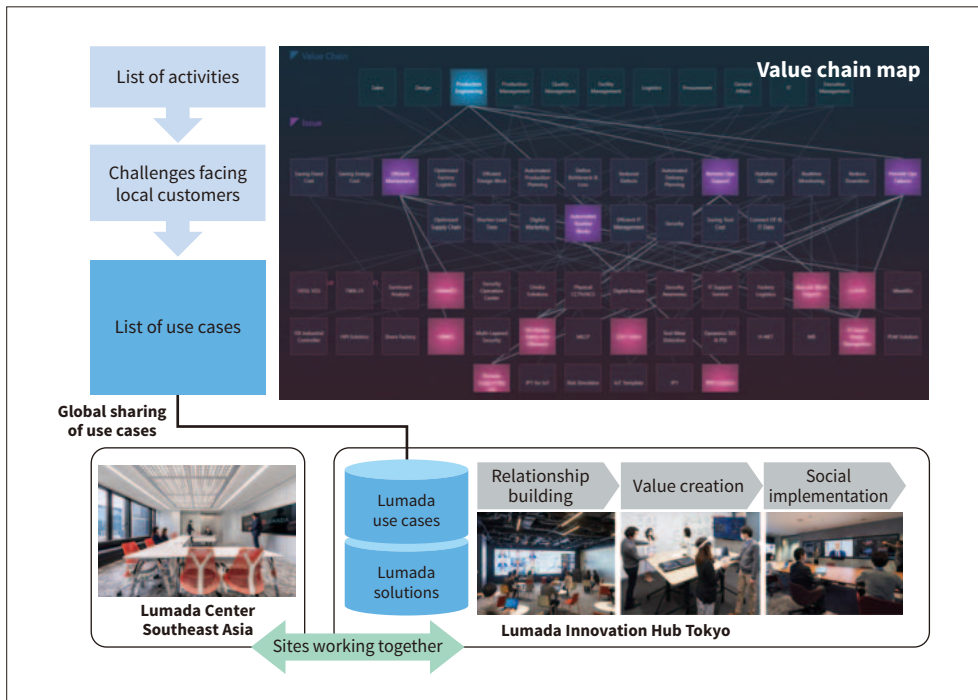
10 Use of Lumada Center for Co-creation with Customers

Hitachi established its Lumada Center to facilitate its Lumada business in the Asia-Pacific (APAC) region. Having expanded the scope of co-creation during 2020 to encompass manufacturing, energy, finance, and smart cities, Hitachi's R&D Group has established a local presence in the region that is based around its NEXPERIENCE methodology for co-creation.

Along with indigenous technological innovation, business in Thailand also has strong demand for solutions that maximize value on the basis of advanced technologies from elsewhere. Among the key challenges are the identification of customer issues that have a direct bearing on business activities and how to obtain a rapid understanding of the diverse solutions available from Hitachi. To achieve this, Hitachi has developed a value chain map in which it has collated a list of important customer challenges and a mix of local and overseas use cases, narrowing these down to 40 use cases that are of particular relevance to Thai customers. The map serves as a digital tool that simplifies the identification of key challenges. Through its use in sales activities in the manufacturing industry, the value chain map is already helping to uncover customer challenges and expand the Lumada business in Thailand.

To extend the Lumada business globally, Hitachi intends to work in collaboration with Lumada Innovation Hub Tokyo to standardize tools like this while also expanding co-creation in the environmental and smart city sectors.

(Hitachi Asia Ltd.)



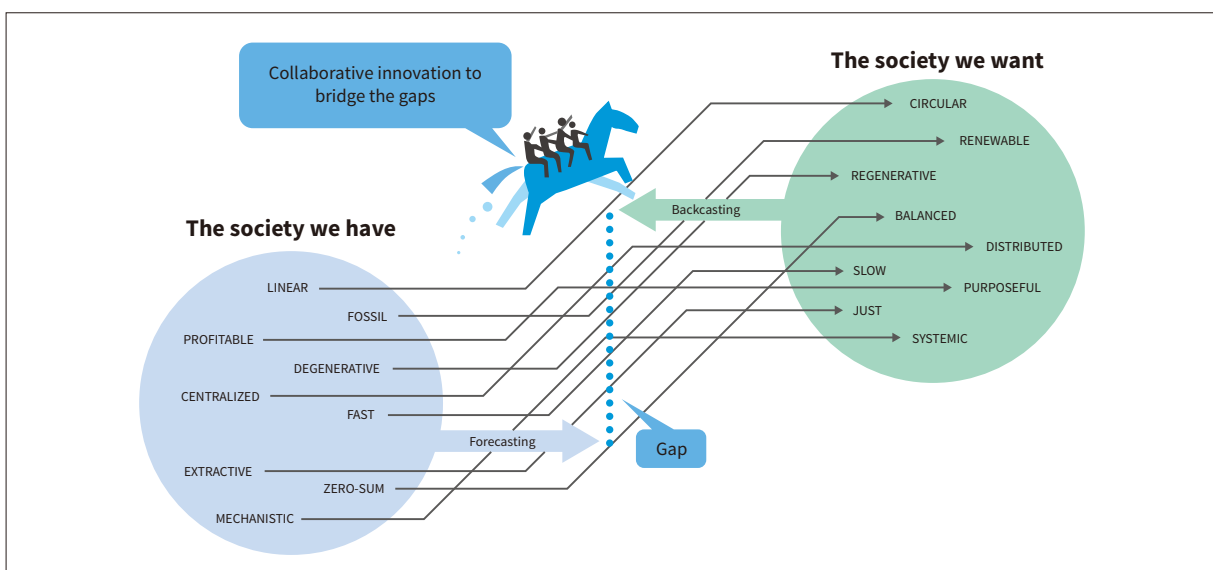
10 Lumada Center and value chain map

11 Transitions to Sustainable Futures

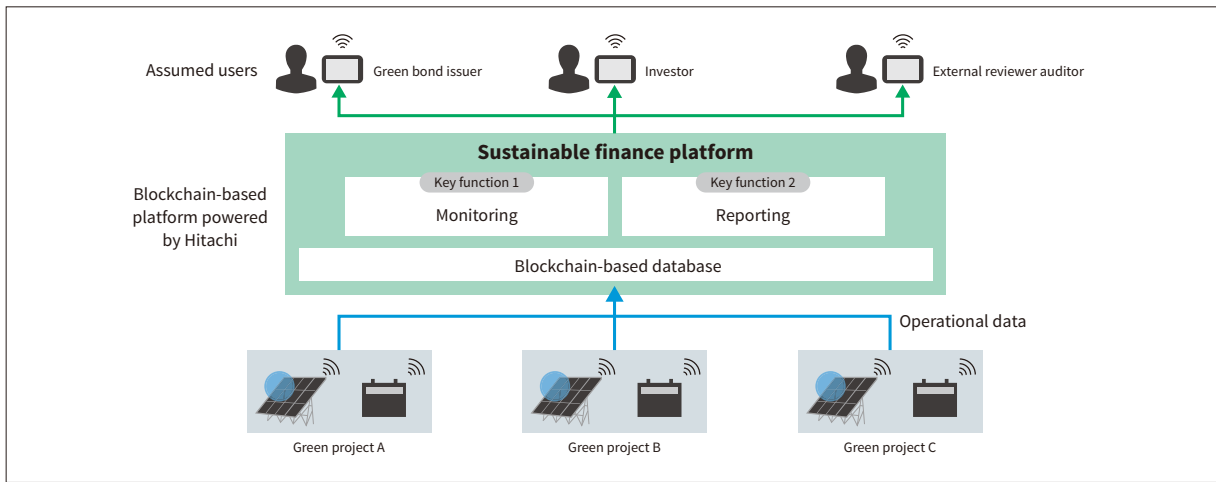
The transition to a sustainable carbon-neutral society will be difficult to achieve through individual efforts alone. Rather, as well as developing businesses in collaboration with customers and partners, changes in areas such as public behavior will also be required. In response, Hitachi has developed an innovation technique for filling in the gaps between what is and what should be. Using dialogue with experts and co-creation with customers and other partners, the technique works by creating pictures of present-day society and the sort of society people want

in 2050 and then using backcasting from the future and forecasting from the present to identify where the discontinuities lie. The company is also working to create specific businesses.

A set of nine transition models were published on a website in March 2021. With titles such as “Transitioning from fossil fuels to renewable energy” and “Moving from centralized to decentralized decision-making,” the transition models were developed in consultation with world-renowned experts in sustainability. The transitions to sustainable futures that combine carbon neutrality with a good QoL is also being mapped out in a process of ongoing consultation with stakeholders at the open and



11 What is needed to transition to sustainable futures



12 Sustainable finance platform

global venues provided by the United Nations Climate Change Conference (COP26) held in November 2021 and a forum hosted by the Hitachi-UTokyo Laboratory in December 2021.

12 Sustainable Finance Platform for Transparency

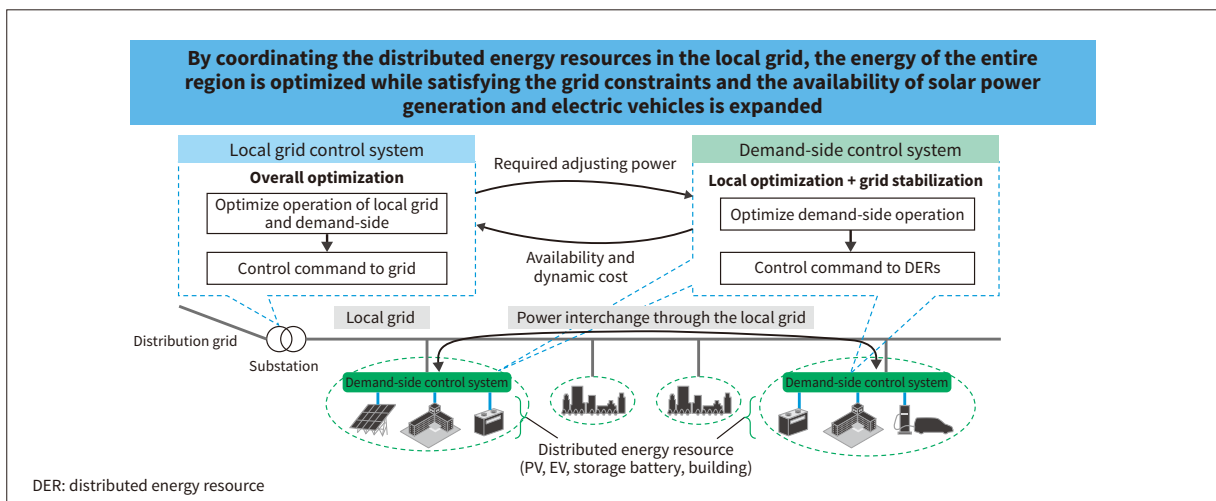
To reach decarbonization targets and limit global warming to a 1.5°C increase, investment into sustainable activities and projects is required. Financial instruments such as green bonds, green loans, and key performance indicator (KPI)-linked loans enable this investment, but evidence of greenness is needed. Through the sustainable finance platform (SFP), Hitachi aims to facilitate the transparency of these green claims using IoT and blockchain technology to provide trusted reporting of data and KPIs to investors, auditors, and other key stakeholders. The next stage in SFP’s development is a commercial demonstration as part of the “regulatory sandbox” of the

UK’s Financial Conduct Authority.

Hitachi also contributes to thought leadership in sustainable finance. The Hitachi European R&D Centre participated in the World Wildlife Fund and World Bank Group’s whitepaper on “Spatial Finance: Challenges and Opportunities in a Changing World.” With VTT Technical Research Centre of Finland, Hitachi published a whitepaper entitled “Sustainability transition in cities,” which, covered case studies, the drivers of change, the identification of projects, the process to set KPIs, and the financing mechanisms. (Hitachi Europe, Ltd.)

13 Efforts for a Carbon-neutral Society in China

China has declared to achieve carbon peak out by 2030 and carbon neutrality by 2060. At the same time, electric power deregulation will progress. The energy system will change greatly, as renewable energy will become the main



13 Collaborative development of DERMS-DGS

power source and it will be shifted from the load-following type to the prosumer type. On the energy consumption side, distributed photovoltaics (PV) and EV have already been introduced on the largest scale in the world, and it is expected that the introduction will increase to four times and 16 times, respectively in the 10 years until 2030. However, the mass introduction of them will have a large impact on the local grid, and the opportunity loss of PV power generation and EV charging will become an issue due to its operational restrictions.

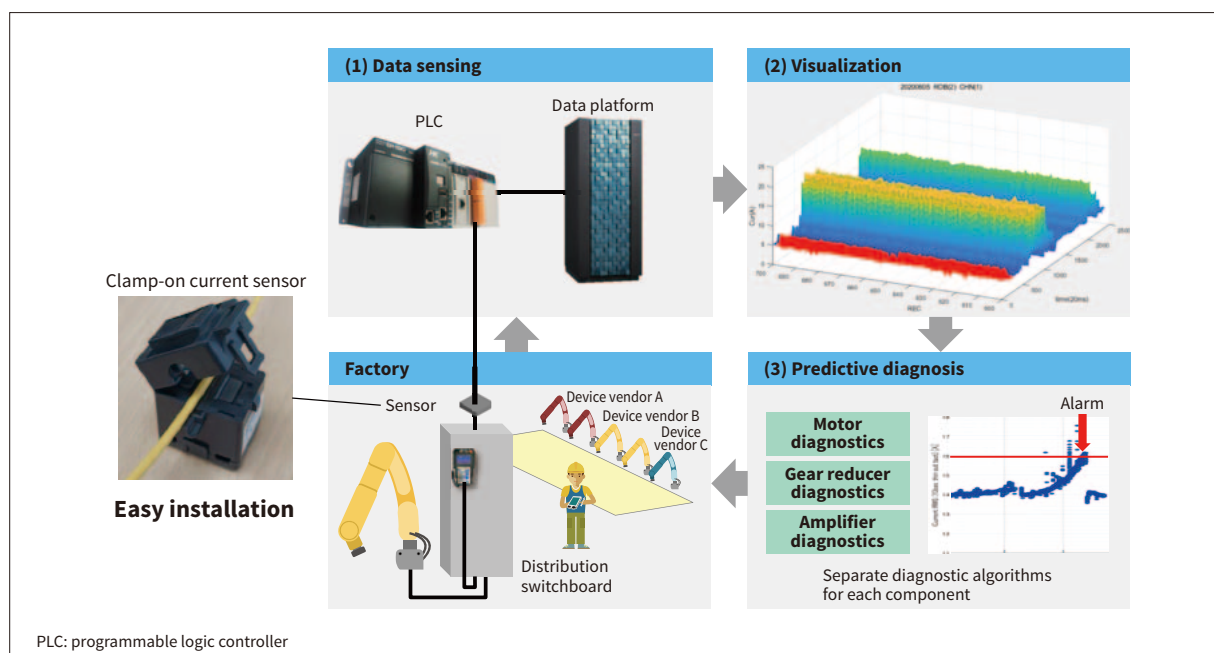
Therefore, in collaboration with Tsinghua University, Hitachi developed the distributed energy resource management system with distribution grid stabilization (DERMS-DGS) which satisfied the system operation restrictions and optimized the energy of the entire region by coordinating the distributed energy resources such as PV, EV, storage batteries, and building equipment with the local grid. As the result of simulation with the typical region model of China in 2030, it was confirmed that the DERMS-DGS gave the effect of improving economic efficiency by 47% and reducing carbon dioxide emissions by 1.44 times compared to the conventional system. [Hitachi (China) Ltd.]

predictive diagnosis solutions supplied by equipment vendors is that they collect data in ways that are tailored to their own products, and this raises problems of compatibility when the aim is to support equipment from a range of different vendors. In response, Hitachi is developing a plug and play solution for the predictive diagnosis of equipment faults that uses attachable current sensors that are easy to install and not affected by the different specifications used by different vendors.

Recognizing that, despite their being supplied by different vendors, different items of equipment that perform similar functions use similar components, such as electric motors, gear reducers, and power amplifiers, Hitachi has developed separate diagnostic algorithms for each of these different components that derive from analyzing the correlation between electric current and their different fault mechanisms. In proof-of-concept (PoC) testing at the Chinese manufacturing operations of a number of customers, the solution succeeded in identifying signs of potential faults in certain components. Along with commercializing the solution and deploying it more widely, future plans also include improving diagnostic accuracy and expanding the range of components with which it can be used. [Hitachi (China) Ltd.]

14 Plug and Play Solution for Predictive Diagnosis of Equipment Faults

While production line downtime caused by equipment failure is one of the issues faced by factories that install automation, a common problem with the existing



14 Solution for predictive diagnosis of equipment faults