Collaborative Creation with Customers

1 Creation and Presenting Innovation from *Kyōsō-no-Mori*

1 Workshop held using digital communication tool

The *Kyōsō-no-Mori* [collaborative creation (co-creation) facility] established at Hitachi's Central Research Laboratory in April 2019 was visited by senior officials from 119 government and private business organizations in FY2019, engaging in activities such as forums and ideathons, which in two instances led to ideas being commercialized. Furthermore, the new research building *Kyōsō-tō* won the Creative Office Award at the 32nd Nikkei New Office Award.

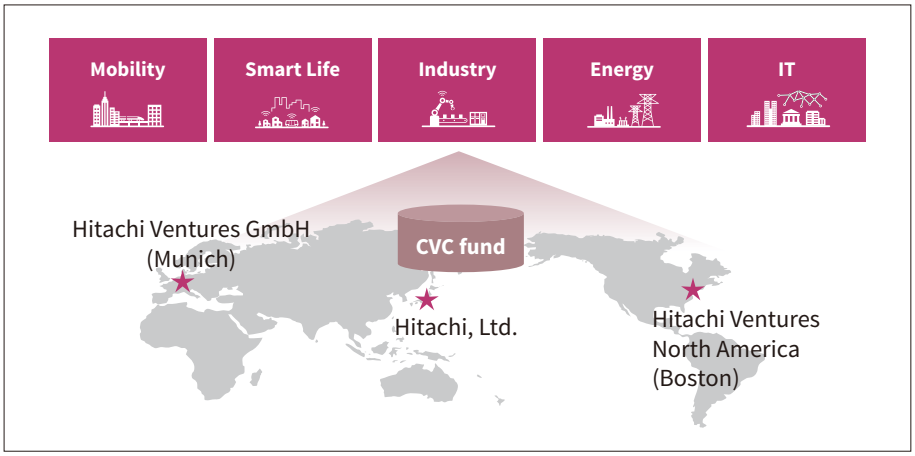
Adjusting to the current requirement for finding new ways of working, Hitachi has been utilizing digital technologies to further expand its activities. This has involved utilizing digital communication tools to hold workshops or other online events as a way to engage with customers and work with them to identify issues and develop a vision, and also the sharing of solutions and demos using the Lumada Solution Hub and other sites around the world such as the Lumada Center Southeast Asia in Thailand.

In the future, Hitachi intends to continue contributing to the creation of a sustainable society that is human-centric with a high quality of life (QoL) by using open co-creation to come up with innovations that can solve societal challenges while also searching out new forms of co-creation combining both interactive and remote activities that make appropriate allowances for preventing the spread of infection.

2 Open Innovation through Partnership with Startup Companies

Hitachi Ventures GmbH was established in FY2019 as a corporate venture capital unit that contributes to innovation ecosystems through investment in startup businesses around the world. Along with seeking out and supporting technologies and business models that can benefit customers or wider society, the objectives of the new unit go beyond investing in startups to also include the creation of new services and businesses through co-creation in an effort to deliver innovations that will facilitate future societal and industrial reform.

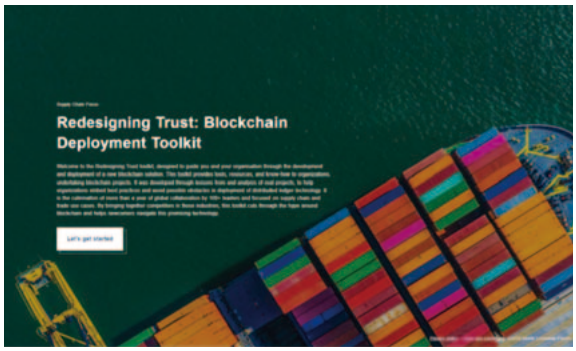
Hitachi has established corporate venture capital operations in Germany, the USA, and Japan and is working



2 Corporate venture capital operations

with partners in the corporate venture capital (CVC), venture capital (VC), and consulting sectors to contribute to enhancing social, environmental, and economic value by accelerating open innovation with startup businesses around the world.

3 Technology Governance Initiative in Collaboration with WEF C4IR



Source: World Economic Forum

3 Toolkit for blockchain solution development

The objective of the Fourth Industrial Revolution and Society 5.0 is to create inclusive and prosperous societies with digital technologies. Unfortunately, these initiatives including technology adoption and utilization, face a number of obstacles, not least being concerns over privacy. In response, Hitachi has been working with the Centre for the Fourth Industrial Revolution (C4IR)* of the World Economic Forum (WEF) on establishing technology governance practices that can make the most of digital technology while also ensuring that this use is safe and secure.

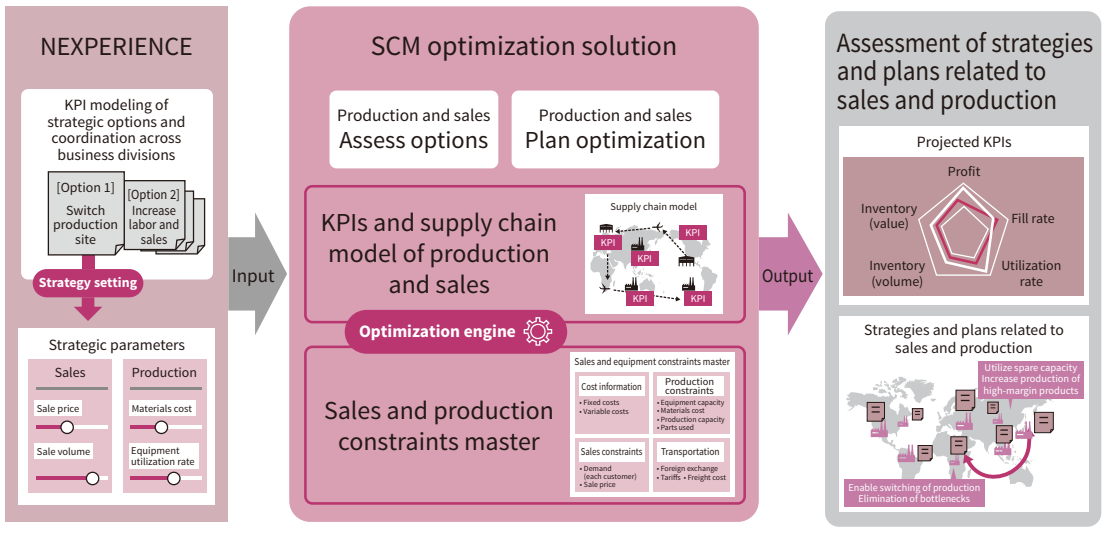
In one such initiative, Hitachi is participating in a project looking at blockchain (BC) applications in the supply chain. This involves identifying ways of using technology that have not been considered in the past, such as identity (ID) management that allows for things like interoperability and autonomy, collating this in the form of a framework for technology governance. Material published by the WEF includes seven white papers as well as a toolkit developed to serve as a guide for blockchain solution development.

Hitachi is also contributing to the establishment of technology governance practices through participation in other projects dealing with smart cities and data governance.

* See "Trademarks" on page 158.

4 Production and Sales Planning Solution for Optimization of KPIs amid Fluctuating Demand

Manufacturing industries such as chemicals produce many varieties while responding to highly variable demand. This makes it important to coordinate all operations across the company from production to sales and to consider a variety of strategies based on actual circumstances to formulate realistic daily production and sales plans with the strategies as inputs. The requirement here is to formulate strategies and plans for production



4 Overview of production and sales planning and execution solution

and sales that will maximize key performance indicators (KPIs), taking account of a wide variety of parameters relating to manufacturing and sales operations around the world on a per-product and per-customer basis, including price, sales and production volume, equipment utilization rate, production capacity, and tariffs. Unfortunately, this is difficult to achieve manually and consumes a lot of time.

In response, Hitachi has utilized its NEXPERIENCE*1 methodology for co-creation to model different combinations of operational requirements for evaluating strategies and plans across multiple business divisions acquired from its co-creation work with customers, combining this with a supply chain management (SCM) simulation*2 from Hitachi Solutions, Ltd. This led to the development of a solution for the rapid generation of strategies and plans related to sales and production that can optimize KPIs in response to fluctuating demand. A trial of the new solution demonstrated that the time taken for decision making could be reduced by 95% compared to past practice, with the ability to generate approximately 60 times more options for strategies and plans daily. By deploying this solution, Hitachi intends to contribute to further process reform in manufacturing across entire supply chains.

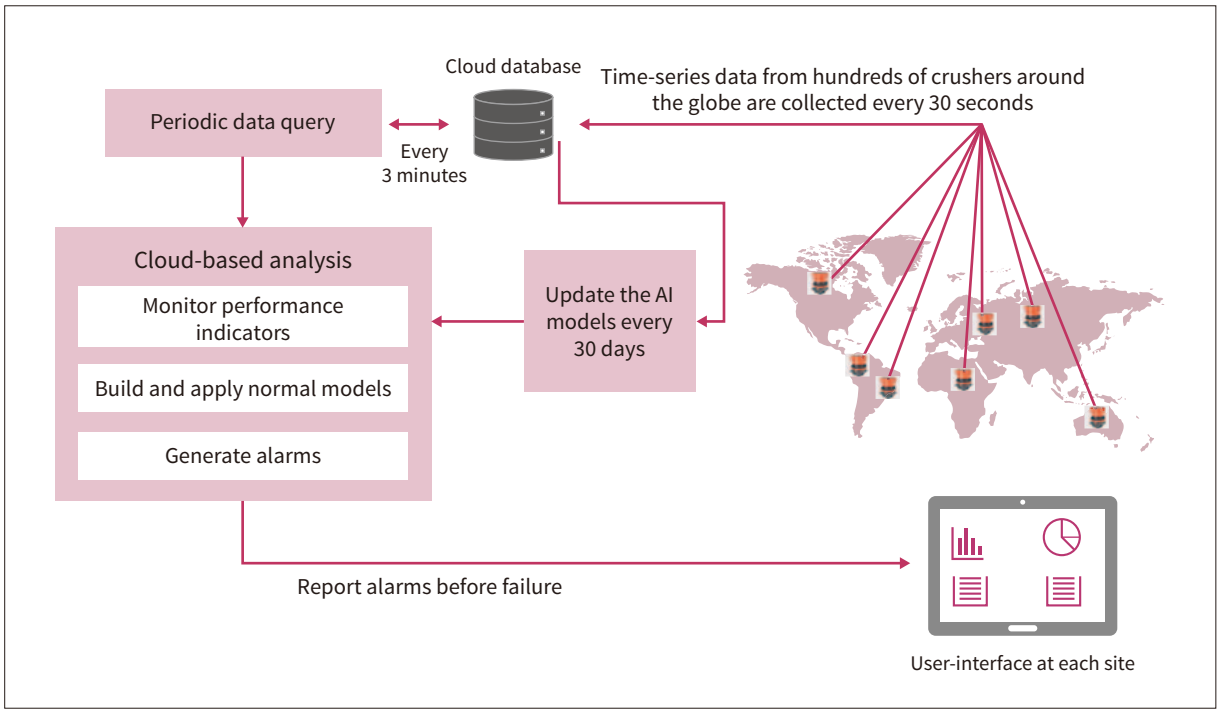
*1 Hitachi's approach to co-creation that uses design thinking to devise new services. It is made up of a methodology, digital tools, venues, people, and activities that utilize these resources.

*2 A technique for simulating the optimal combination of variables such as production site, production volume, sales volume, and total cost that utilizes mathematical optimization methods developed by Hitachi Solutions, Ltd. It is being made available as a service for global SCM simulation.

5 Hitachi SaaS-based Predictive Maintenance Services for Mining Equipment

Crushers are one of the most important equipment in the mining industry, and eccentric bushing burnouts can lead to unplanned downtime which costs millions of dollars. Hitachi has developed a predictive maintenance solution that can detect faults in cone crushers before they lead to eccentric bushing burnouts. Using machine learning, the solution can detect fault patterns several minutes before failure. The solution monitors performance indicators and normalizes them using machine learning to remove the effect of load and seasonality. A normal model is then learned for each performance indicator from historical data. The real-time indicators are compared to the corresponding normal models and alerts are generated if the performance deviates from the normal behavior.

The solution has been co-created with a mining conglomerate with hundreds of crushers operating around the world. Hitachi provides a predictive maintenance solution using the software-as-a-service (SaaS) framework to monitor hundreds of pieces of equipment around the world and send end users timely alarms that prevent catastrophic failures. When monitoring many crushers, to maximize the reliability of the alarms, the solution generates artificial intelligence (AI) models tailored for each individual crusher using its own historical data. Another feature of the solution is that the models are updated automatically and periodically to capture the most recent



5 Hitachi SaaS-based predictive maintenance services for mining equipment

changes in the crushers, such as component degradations and environmental changes.

The machine learning modeling and the solution architecture approach can easily be scaled to other equipment and verticals. This is an ideal solution for equipment that can benefit from early detection of faults.
(Hitachi America, Ltd.)

6 Real-time Intelligent Operation Management Solution

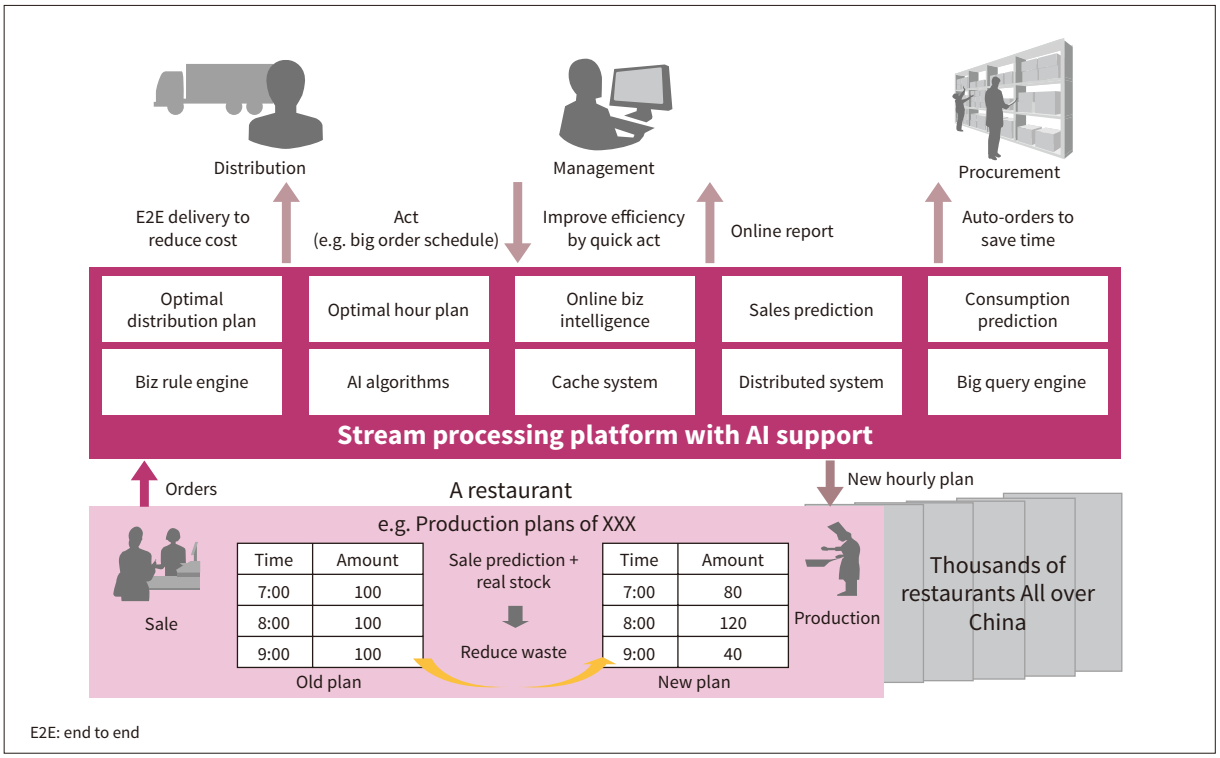
In the COVID-19 epidemic, online orders are rapidly increasing yet dramatically varying. The solution is proposed to improve online order operation management and to enhance values for customers even if operating over 10,000 stores. It utilizes Hitachi's two kinds of generic technologies including the large-scale real-time streaming technology that is used to process orders and to calculate management KPIs on-line for improving management efficiency, as well as online machine learning technology to predict orders in the near future and to eliminate overproduction based on optimized production plans for reducing cost.

It has been deployed in customers and performs well in scalability and quality, where it supports processing of 30 million orders a day and improves the accuracy by about 10% comparing to traditional order prediction methods. The deployments have successfully helped reduce the time cost for overall operational report from week level to minute level and reduce the waste in food production.
[Hitachi (China) Research & Development Corporation]

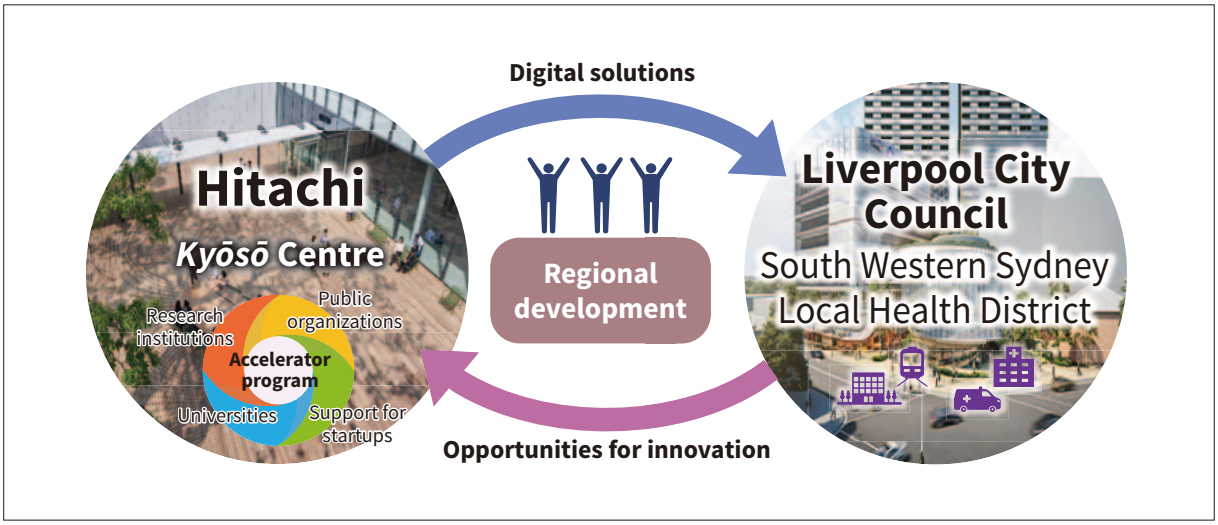
7 Western Sydney *Kyōsō* Centre for Social Innovation in Australia

As a rapidly growing region, Western Sydney in Australia offers a wide variety of business opportunities. The Australian federal and the New South Wales (NSW) state governments are working on the development of employment, social infrastructure, and transportation networks for the Western Sydney area (Western Parkland City) that is expected to reach a population of more than 1.5 million people over the next 20 years.

Hitachi and the NSW state government agreed in October 2019 to establish the *Kyōsō* Centre (open co-creation center) as a means to support the growth of startups and small- and medium-sized enterprise (SME) businesses and to contribute to regional development and employment creation. The co-creation center will attract startups, universities, research institutions, and other organizations and will run an accelerator program that aims to improve citizens' QoL through the rapid and sustainable creation of innovative digital solutions. The center is scheduled to open in 2023.



6 Real-time E2E smart operation management solution

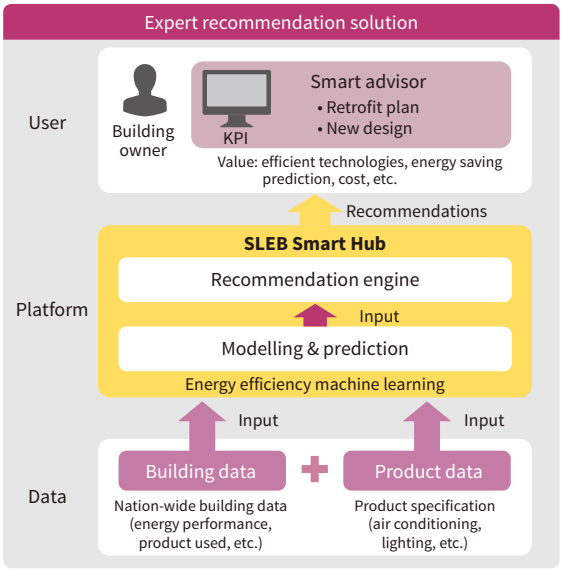


7 Co-creation model initiated by Hitachi *Kyōsō* Centre, Liverpool City Council, and South Western Sydney Local Health District

Meanwhile, co-creation activities commenced in 2020 in advance of the center opening. A hackathon was held in Sydney city during February and this was followed in May by the announcement of a memorandum of understanding on promoting innovation that was signed with Liverpool City Council (one of the councils in Western Sydney) and the South Western Sydney Local Health District (SWSLHD). Through these activities, Hitachi intends to accelerate social innovation in Australia by building an ecosystem in partnership with diverse stakeholders.

8 Super Low Energy Building Smart Hub to Empower Sustainable City Development

With hot and humid tropical climate in South-East Asia, buildings account for more than 50% of total electricity consumption. Reducing building energy consumption while maintaining occupant comfort is a challenge for most building owners.



8 Super Low Energy Building (SLEB) Smart Hub

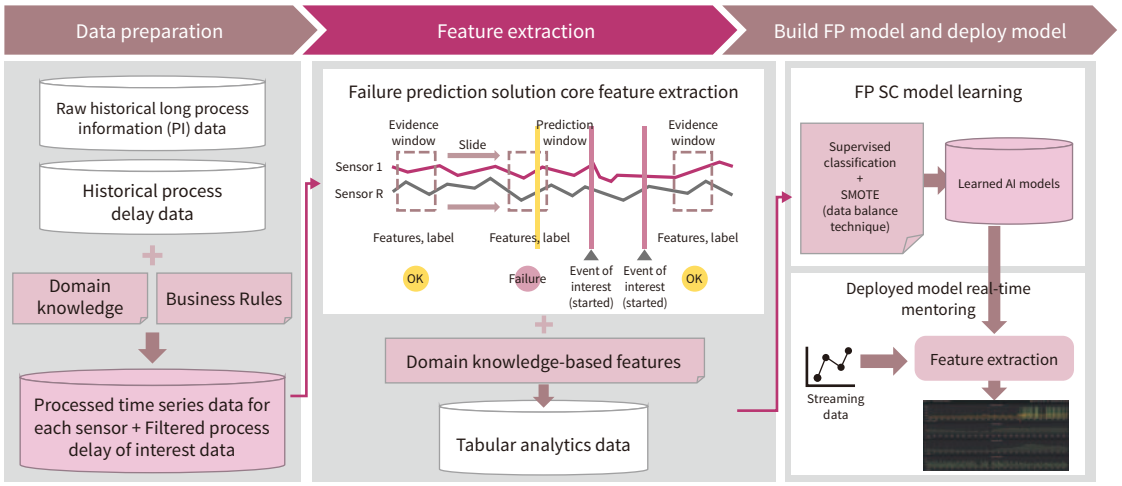
To contribute to a carbon-free society, Hitachi Asia Ltd. has been commissioned by Building and Construction Authority (BCA), Singapore to develop a platform called Super Low Energy Building (SLEB) Smart Hub Singapore's first digital knowledge centre for green buildings in the region. It is a national database that collates and analyses green building technologies.

Beyond being a data repository, its smart advisor recommends suitable green technologies and predicts the associated costs and energy savings, using cutting-edge big data analytics and AI techniques based on a building's current data set and user's requirements. It allows building owners to evaluate and source green technologies to transform buildings to attain high energy performance.

Since launched in September 2019, it has benefited more than 90 companies. This will ease the adoption of green technologies and support the national target to green 80% of buildings in Singapore by 2030.
(Hitachi Asia Ltd.)

9 Improving Customer's Operational Efficiency across Its Production Processes with AI and ML

Nowadays, more and more manufacturers are seeking smart digital solutions to transform their operations. To reduce the time to build solutions, and ensure solution quality, Hitachi has been building repeatable and scalable solution cores (i.e., abstracted AI analytics pipelines) in different horizontal areas of industrial operations such as maintenance, quality, operations, and safety.



FP: failure prediction SC: solution core SMOTE: synthetic minority over-sampling technique

9 Process failure prediction solution tailored to customer needs

The recent proof of value (PoV) engagement with a leading mining company has demonstrated the effectiveness of the industrial AI solution core approach. The customer has a large-scale serial process consisting of a significant number of assets with no standby for some of the major equipment. Any point of failure in the process either due to equipment failure or process failure will halt a module and even the whole production line. When the production stops, it's time-consuming for operators to troubleshoot and restore the production within a large-scale plant. Hence, it is critical to leverage AI to predict process failure before they occur.

Hitachi has repurposed the equipment failure prediction solution core for process failure prediction and delivered a solution tailored to the specific customer needs, enabling proactive actions to reduce potential delays. Some of the customizations are: (1) a comprehensive exploratory analysis on delay records along with domain knowledge to identify a target for prediction that is viable for application of solution core as well as being businesswise meaningful; (2) cascade event analysis and customized event merging to ensure practicality; (3) domain knowledge-guided relevant sensor selection and feature engineering. Besides, to handle the lack of failure data, the company use data balancing techniques.

It is estimated that Hitachi solution helped the customer increase its revenue by 5% in the first month of deployment.

(Hitachi America, Ltd.)

10 iF Design Award

Hitachi's Global Center for Social Innovation – Tokyo has been making major advances in design quality in order to gain a high level of market competitiveness and to deliver new forms of value that are in step with societal

10 Air purifier for Chinese market, refrigerator for Asian market, three-door refrigerator for Japanese market, and commercial air conditioner

trends. Along with the conventional work of design development, putting information out into public media also forms a large part of these activities.

Four Hitachi products were recognized at the internationally prestigious iF Design Awards 2020 in Germany: an air purifier for the Chinese market, a refrigerator for the Asian market, a three-door refrigerator for the Japanese market, and a commercial air conditioner. Of particular note, Hitachi received its first ever Gold Award for the EP-PF120C series air purifier developed in collaboration with Naoto Fukasawa, a well-known Japanese designer. In the future, Hitachi intends to continue enlightening and enriching people's lives through high-quality design.

11 NEXPERIENCE Methodology for Resolving Societal Challenges

Hitachi has developed the NEXPERIENCE methodology to support the steps from discovery of new business opportunities to the analysis of issues, idea generation, and evaluation, and applied it to co-creation with customers to create new services and businesses.

The new normal has brought rising expectations for the creation of new businesses that recognize changes in the public's perception of value. Achieving this requires the creation of new societal trends arising out of values-driven business concepts that resolve societal challenges along with action on putting these into practice. To this end, Hitachi has made enhancements to its NEXPERIENCE methodology based on the following three considerations.

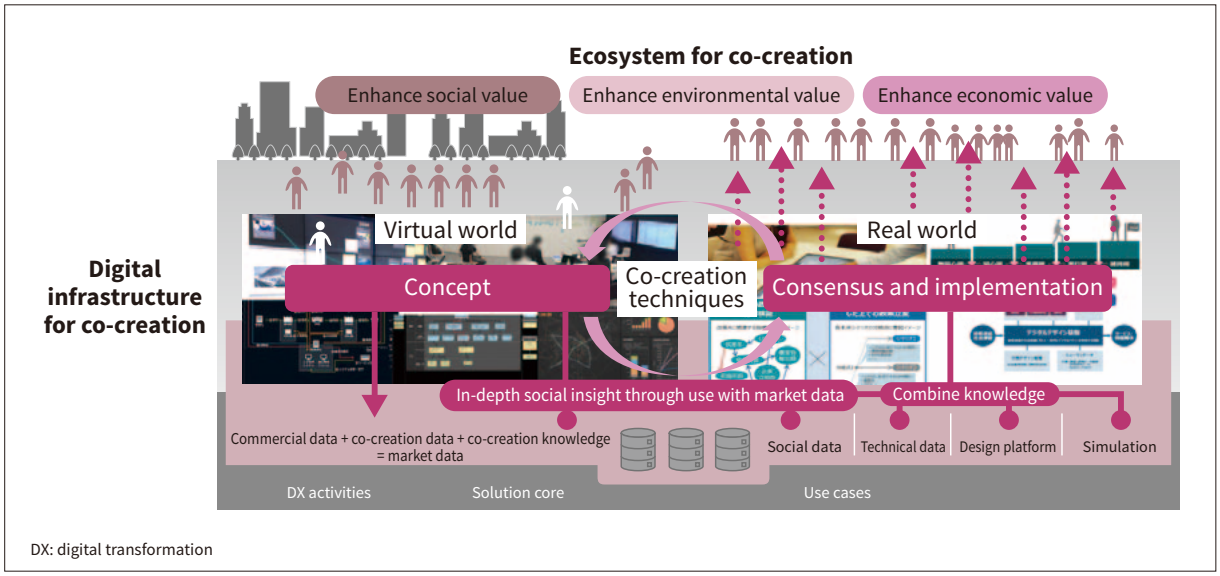
(1) Digital infrastructure for co-creation that enables partners to work together regardless of time or place.
(2) Co-creation techniques that utilize data from sources such as past examples and knowledge, and that work through an iterative cycle of concept, consensus (buy-in), and implementation to deliver value to society.
(3) Establishment of an ecosystem for co-creation that enables sustainable growth by society, customers, co-creation partners, and Hitachi.

On top of this, Hitachi is also working to realize its Social Innovation Business through the activities of people with the skills to put design thinking into practice.

12 Co-creation of Digital Control Centre for Smart Hospital Transformation in UK

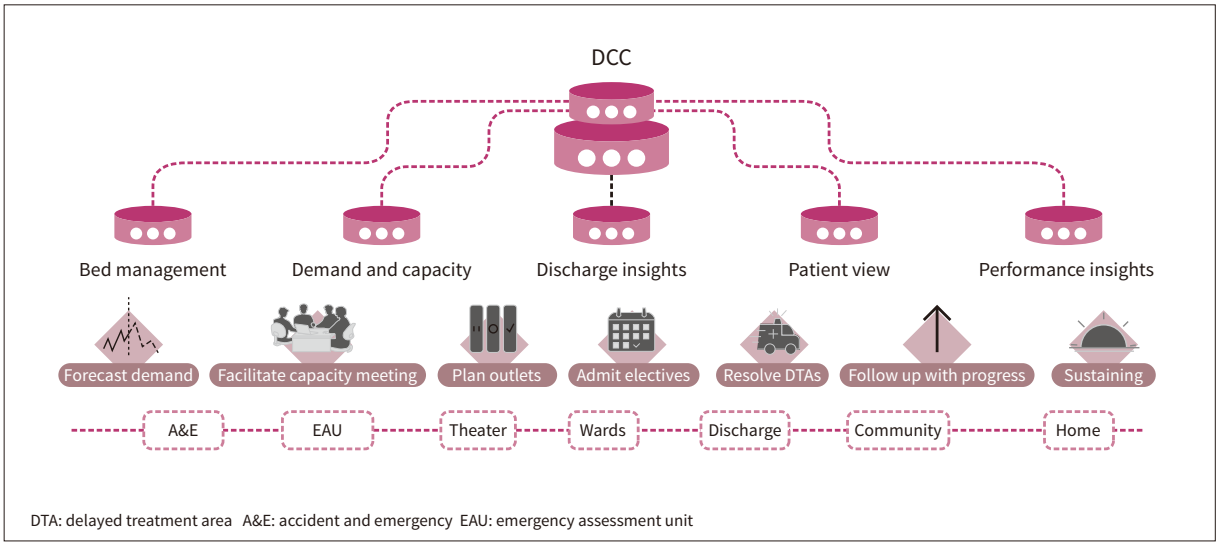
National Health Service (NHS) and hospitals in England are facing a significant challenge of slowed budget growth despite increased costs and ageing populations. This has led to overcrowded emergency wards, extended lengths of stay and reduced flexibility to deal with peak variations in demand. In addition, management of patient flows through hospitals is often on handwritten boards and paper documents with a limited overall plan of what beds are available or of which services are needed and when.

Hitachi has been working alongside Salford Royal NHS Foundation Trust in the UK to launch a digital control centre (DCC) as part of a first of a kind 10-year smart hospital transformation programme. The DCC will allow the hospital to get a digital view of what beds are currently free and match this to forecasted demand from patients coming through the front door. Advanced



DX: digital transformation

11 Ecosystem for co-creation



12 The DCC solution

analytics and IoT data will give actionable insights by predicting likely admissions, how long a patient will stay in the hospital and resources and equipment needed to support better capacity planning and smart scheduling.

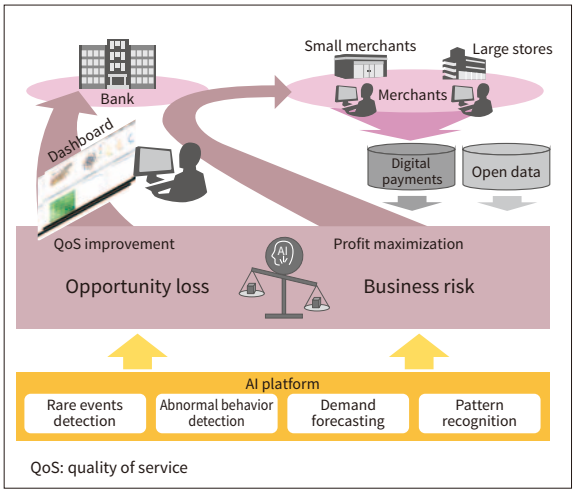
The digital solution is being developed using Hitachi's human-centered co-creation approach called NEXPERIENCE and is exploring new models of care requiring operational change throughout the patient journey while reducing costs and improving staff experience, flexibility in dealing with peak variations in demand, and providing optimal care to patients.
(Hitachi Europe Ltd.)

13 AI-driven Digital Payment Service

Digital payments are seeing a fast adoption in India due to various factors such as Government push for less cash economy, 24×7 instant access to funds, and greater smartphone penetration. With merchants adopting digital platform, the digital payment transactions have exponentially increased.

In 2019, Hitachi established a joint venture on digital payments with State Bank of India (SBI). Hitachi is developing AI-driven value-added solutions to optimize the overall lifecycle of payment services to merchants. The solution will offer data-driven recommendations and insights to reduce business opportunity loss, transaction risk and promote a strong network of valuable customers. For this, Indian research and development (R&D) center is developing AI platform for analyzing data at scale that are coming from multiple diversified sources, along with analytical functions to detect rare events and filter patterns at an early stage. A concept solution showcase of the analytical services using the prototypes has been developed for the acceleration of customer co-creation activity.

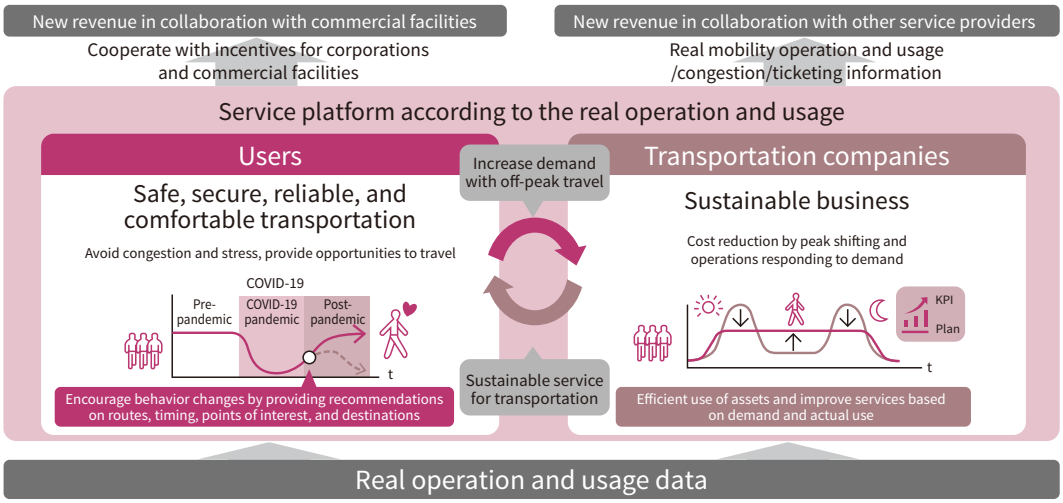
Leveraging this platform, Hitachi will collaboratively work with SBI to create advanced digital services and accelerate the adoption of digital payments.
(Hitachi India Pvt. Ltd.)



13 Hitachi AI-driven digital payment service

14 Hitachi's Activities for Providing Mobility Services in the New Normal

Solutions that realize both sustainable movement for residents and sustainable business for transportation companies under the new normal have been developed by co-creation with transportation companies and workshops with them and other participants, such as universities, startup businesses, residents, etc. This article



14 Overview of mobility service solution

introduces one solution created by this activity. This solution provides the following two values while also having them interoperate for enhanced effectiveness.

(1) For users: guide users to safe, secure, reliable, and comfortable transportation by offering recommendations on how to get to destinations, how to spend, bundling together information on departure timing, available transportation and routes, places to stop along the way, points of interest, and destinations with some incentives to promote movement.

(2) For transportation companies: provide control over the movement of people together with use of KPI simulation and operational coordination across multiple services to reduce asset management costs with peak shift and operations responding to demand.

With this solution, transportation companies can sustain their business. This solution also has the potential to deliver new revenue in collaboration with commercial facilities, services for mobility as a service (MaaS), logistics, etc.