From Components to Systems—

Supporting Customer's Global Operations with Solutions for Factories and Industrial Plants

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CURRENT BUSINESS ENVIRONMENT

EMERGING economies, although also showing signs of slowing growth amid the continuing global economic slowdown, are still expected to maintain their economic development driven by ongoing population growth and investment in social infrastructure. These regions are experiencing vigorous activity in the field of plant construction. These plants are needed to provide the energy, water, transportation and other social infrastructure required for large-scale urban development, and the additional production equipment associated with economic development. Companies see this situation as an opportunity, and are competing fiercely to expand their businesses or enter new markets. To develop their businesses, and with the aims of developing and expanding their markets and reducing costs, these companies are pursuing global operations that include siting production facilities locally and working in partnership with local companies.

Meanwhile, in seeking to establish overseas production facilities, companies face a wide variety of challenges and risks, including regulatory and environmental factors that differ from nation to nation. Examples include the consents required by environmental and other regulations; the optimization of production processes to suit the availability of electric power, transportation, and other local infrastructure; construction planning, which includes the supervision and management of construction contractors; and productivity once the plant is up and running. Dealing with these demands both decision-making based on accurate local knowledge and the ability to act locally.

SOLUTIONS FOR NEEDS OF CORPORATE CUSTOMERS

Hitachi supplies solutions globally based on the following philosophies (see Fig. 1).

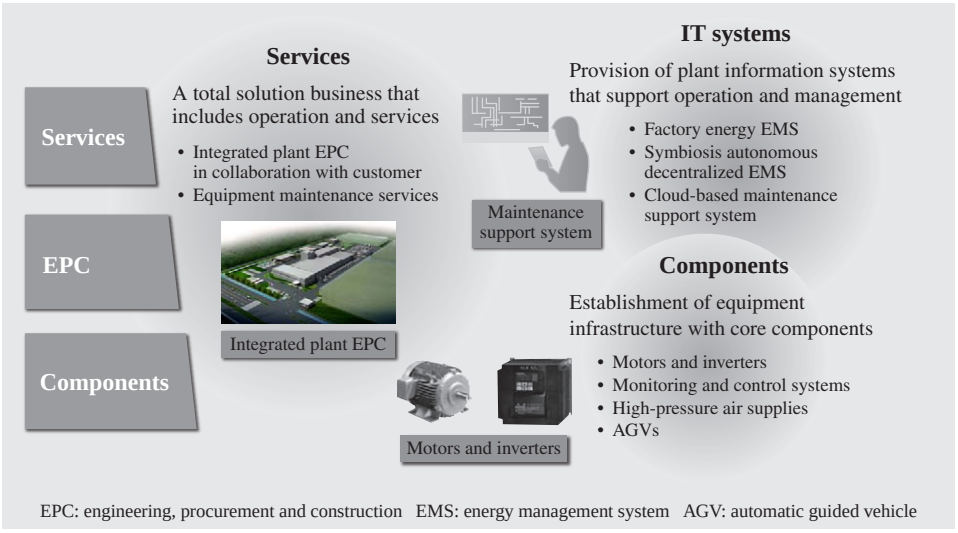


Fig. 1—Solutions Supplied Globally by Hitachi.
As a one-stop supplier of total solutions that extend across components, EPC, and services, Hitachi delivers accurately targeted responses to corporate customer needs.

(1) An all-encompassing role in the coordination of plant construction, with a capacity for undertaking engineering, procurement, and construction (EPC) projects that involve the execution and management of both planning and construction
(2) A capacity to integrate motors, inverters, compressors, and other components required for efficient and reliable production equipment with information technology (IT) systems that support management and operation
(3) A capacity for service delivery that can respond quickly and appropriately to the various issues that arise after a plant commences operation

For corporate customers establishing overseas operations and constructing production facilities, Hitachi has the infrastructure to provide full support and deliver solutions that meet their diverse needs, which include ensuring that construction work is conducted in line with the customer's quality requirements, ensuring that plant commissioning proceeds smoothly, and providing maintenance after the plant commences operation. Hitachi achieves this by utilizing its own overseas operations; by establishing an optimal grouping of construction partners, contractors, and other vendors from the destination country; and by undertaking global design, procurement, and work management (see Fig. 2).

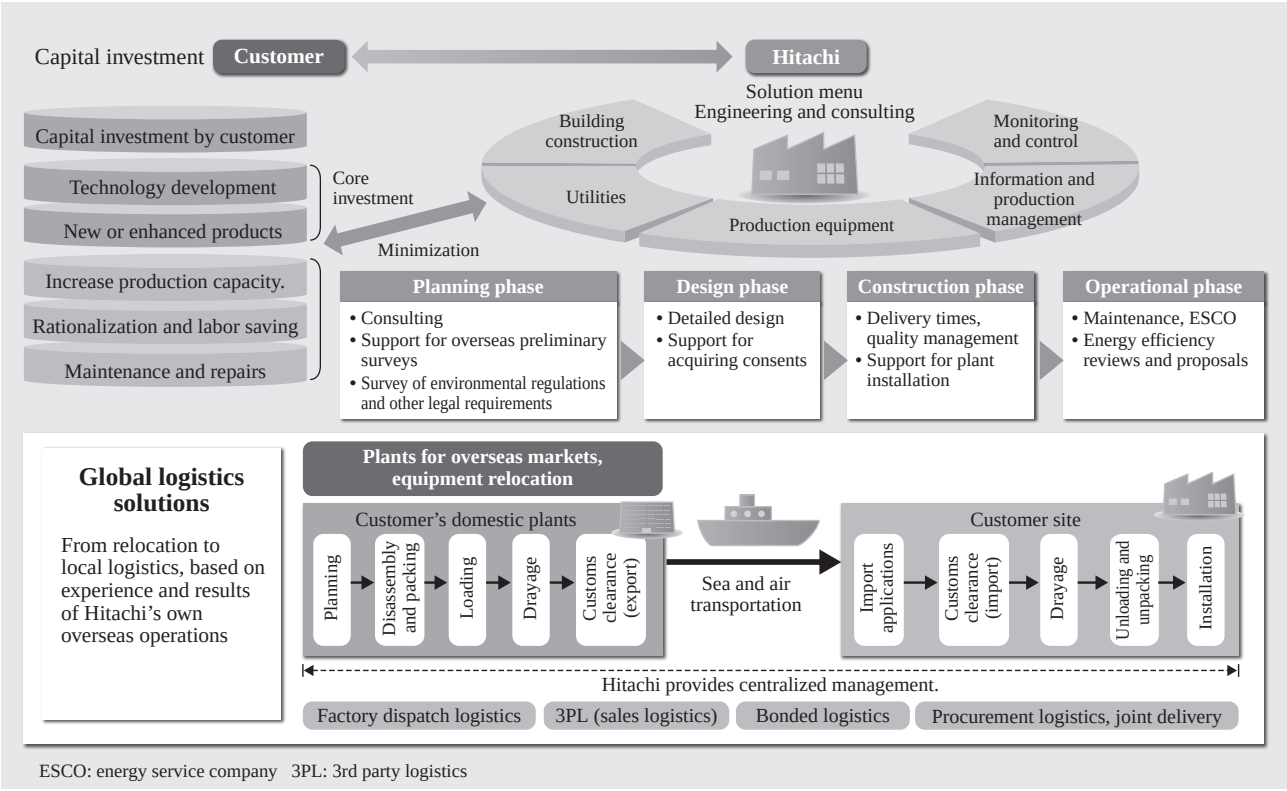
The following sections describe this approach in more detail using examples.

HITACHI'S INVOLVEMENT IN PLANT CONSTRUCTION AND OPERATION

Plants achieve their purpose through the organic interoperation of multiple components. Hitachi works to maximize value for corporate customers by enhancing this interoperation through the planning, construction, and operational phases.

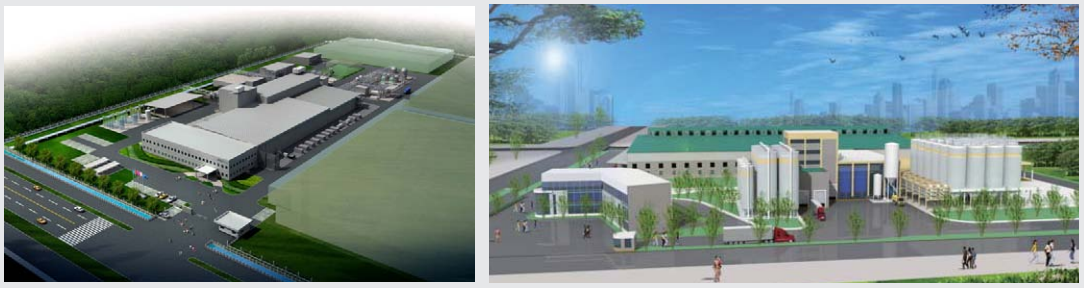
Plant Construction in Collaboration with Customers

To reduce the risks of overseas plant construction for its corporate customers, Hitachi has established the capabilities to take an all-encompassing approach to projects and to ensure short construction time and high quality. This helps maintain clear communications with customers and an unambiguous division of responsibilities, leaving corporate customers to focus on the planning and operation of their core business,



ESCO: energy service company 3PL: 3rd party logistics

Fig. 2—Comprehensive Approach to Plant Construction.
Hitachi builds optimum plants by fitting the right components together in the right way across the various phases from planning to design, construction, and operation.



(a) (b)

Fig. 3—Overseas Plant Construction in Collaboration with Customer.
Rapid project completion is achieved through collaboration with the corporate customer and Hitachi's comprehensive involvement in construction. Shown here are Shin-Etsu (Jiangsu) Optical Wand Co., Ltd., the Chinese joint venture of Shin-Etsu Chemical Co., Ltd. (a), and a model of the brewery in Long An of Sapporo Vietnam Ltd., a Vietnamese joint venture of Sapporo Holdings Ltd. (b).

which is the industrial process itself. Two examples of the benefits of this approach are an optical fiber preform (precursor material) plant for Shin-Etsu (Jiangsu) Optical Wand Co., Ltd., (a Chinese joint venture of Shin-Etsu Chemical Co., Ltd.), and a brewery for Sapporo Vietnam Ltd. (a Vietnamese joint venture of Sapporo Holdings Ltd.) (see Fig. 3).

The Chinese plant has a floor area of 13,126 m^2, and Hitachi won an EPC contract to supply the plant that included civil engineering, construction, air conditioning, electrical systems, and sanitation. The project complied with Chinese commercial practices, and the plant was completed in late 2012 after a 14-month construction schedule. For the brewery, Hitachi had overall responsibility for the design and installation of utilities, including connection to the electric power grid, primary electric power distribution, steam, heating and cooling, compressed air, water treatment, waste water treatment, hot water, and the supply and collection of carbon dioxide (CO_2). The project lasted 12 months, with the brewery commencing production after completion in April 2011.

Factory Energy Management Systems

Amid calls to move to a low-carbon society, reducing industrial CO_2 emissions is an important part of corporate social responsibility (CSR). Furthermore, energy efficiency improvements also deliver major cost savings. One technology involved in achieving these objectives is the factory energy management system (FEMS). As a first step toward realizing this idea, Hitachi has commenced a trial that center on Omika Works of Hitachi, Ltd. This involves the integrated management of information and energy, including photovoltaic power generation (940 kW) and batteries (4.2 MWh) (see Fig. 4). The first stage includes the use of photovoltaic power generation and batteries in a control system for cutting peak demand, while the plan for the future is for this to develop into a symbiosis autonomous decentralized energy management system (EMS) capable of more sophisticated control in which a number of EMSs work together. Hitachi is also looking to deploy the system at overseas production facilities by customizing it to suit specific local requirements.

CORE HITACHI TECHNOLOGIES USED IN INDUSTRIAL PLANTS

Hitachi has numerous core technologies suitable for use in factories and plants. By combining and applying these distinctive technologies correctly, Hitachi is able to offer solutions capable of further boosting plant productivity. The following sections give some examples of these solutions.

Energy-efficient Air Conditioning System for Data Centers

New data centers are being constructed to keep pace with progress in the information society, including in emerging economies. The increase in heat generation associated with the greater capacity of server hardware means that reducing air conditioning power consumption poses a challenge for the operation of these data centers.

Hitachi has developed the spot cooling system that directly cools the hot air discharged from around server hardware and returns it to the servers as cooling air (see Fig. 5). The benefits of the system include an approximate 60% decrease in the power required for air conditioning. This is achieved through measures such as reducing the heat conveyance power for cool

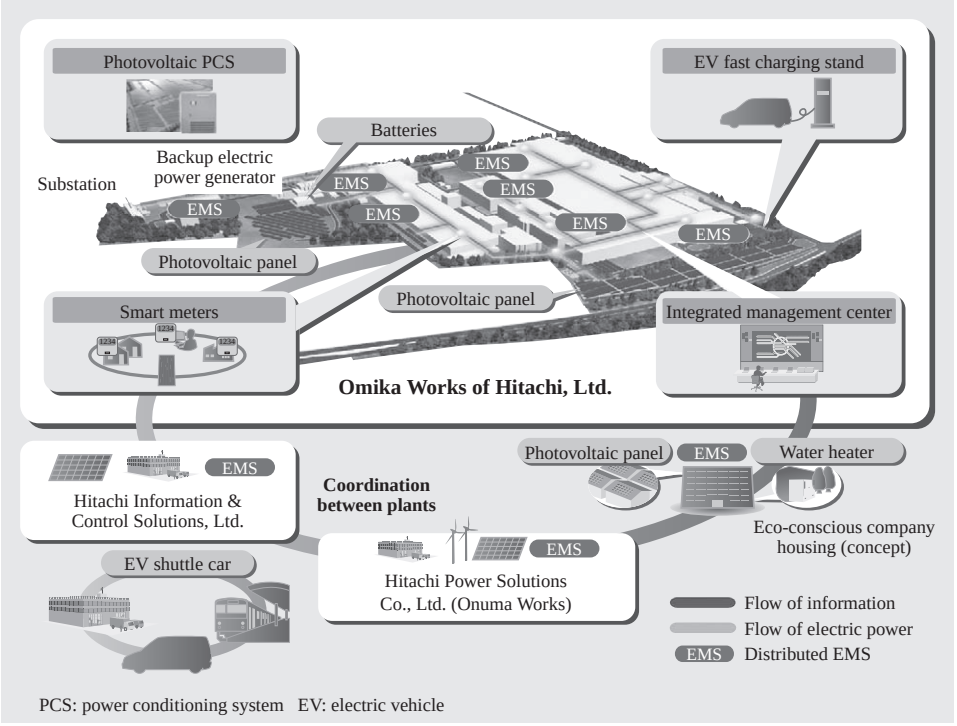


Fig. 4—Factory Energy Management System Trial.
Hitachi, Ltd. has built a factory energy management system based at its Omika Works. It integrates individual energy management systems and manages the flow of information and electric power.

air produced by spot cooling air conditioners, use of natural circulation of refrigerant(a) to reduce the power required for refrigerant conveyance, and use of natural heat sources. It has already been supplied to a number of users, including a server room for cloud systems at SoftBank Telecom Corp.

(a) Natural circulation of refrigerant
A cooling method that uses the difference between the specific gravities of the refrigerant in gas and liquid forms to drive natural circulation without the need for heat conveyance power. The cooled and liquefied refrigerant flows downward under its own weight. It then absorbs waste heat causing it to increase in temperature and vaporize, and this in turn causes it to rise. Cooling results from the refrigerant flowing around this cycle. In spot cooling system, multiple spot cooling units individually control parameters such as the refrigerant flow rate and temperature based on the conditions in the servers.

Bioplastics Production Plants

Increasing environmental awareness is driving growth in demand for bioplastics. “Bioplastic” is a general term covering plastics produced from plant material that can easily decompose in the natural environment. Hitachi has about 60 years of experience with chemical plants, and supplies a range of solutions for bioplastics.

Core technologies that support these solutions include high-viscous material processing technology that promotes polycondensation reactions (see Fig. 6), simulation techniques for finding optimum reaction processes, and process verification technology that utilizes a pilot plant owned by Hitachi.

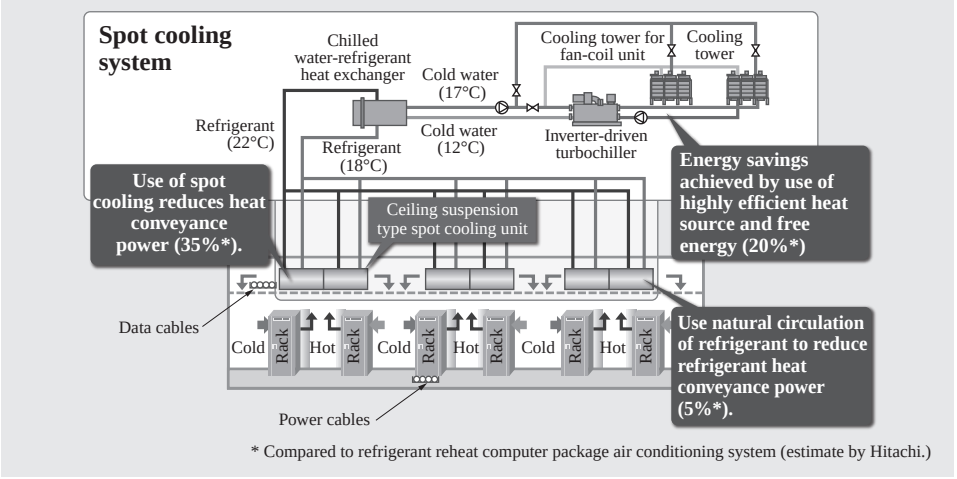


Fig. 5—Spot Cooling System for Data Centers.
Spot cooling system improves the energy efficiency of data center air conditioning by using spot cooling units that directly cool and return the hot air discharged from server racks.

Fig. 6—High-viscous Material Processing Technology. The polycondensation reaction in the bioplastics production process requires agitation to be performed to remove byproduct gas from the highly viscous molten polymer. Hitachi has extensive know-how in the design of the reaction tank and agitators required to achieve this.

Pharmaceutical Production Plants

Biopharmaceuticals such as monoclonal antibody drugs[(b)] and the vaccines essential for preventing infectious diseases are produced using mammalian cell cultures. Because they are more easily affected by the production process than are low-molecular-weight pharmaceuticals produced by chemical synthesis, they demand a higher level of technology to manufacture reliably and efficiently. Production at a biopharmaceutical plant consists of a culture process, during which mammalian cell growth occurs, and a recovery and purification process, in which the product is extracted from the culture fluid. To obtain the desired biopharmaceutical compound, both processes need to be set up with the optimum conditions. Hitachi uses computational fluid dynamics to assess bioreactor performance, and incorporates biological, chemical, and physical models into this work to optimize the culture conditions.

Industrial Waste Water Treatment System

Companies have a duty to protect the environment by treating the waste water discharged by production activity at their plants so that it meets environmental standards. It is necessary to perform the appropriate waste water treatment with consideration for the different environmental standards for water quality that apply in different jurisdictions. Hitachi has an extensive range of water treatment systems. One example is a system that uses anaerobic ammonium oxidation (ANAMMOX) bacteria[(c)] for the treatment of water that contains a high concentration of nitrogen. This system can treat water efficiently by using ANAMMOX bacteria capable of removing nitrogen directly from ammonium nitrogen. The bacteria are embedded in "inclusive immobilization supports" (nitrifying pellets made of polymer gel) (see Fig. 7).

New Lightning Prevention System

The surge currents[(d)] that result from lightning strikes can disrupt devices such as the control systems in production equipment. This new lightning prevention system helps maintain equipment reliability by reducing the risk of lightning strikes themselves.

COMPONENTS THAT UNDERPIN SYSTEMS

The equipment that forms the infrastructure of industrial plants is built from a wide range of components. Examples include the electric motors that provide motive force, the air compressors that supply high-pressure air, and the monitoring and communication equipment that optimizes the interoperation of different equipment. The choice of materials and designs for these components not only gives them their characteristic energy efficiency; it also enables optimum plant operation by allowing changes to operating conditions, the monitoring of plant operation, and networked functions.

There is also growing demand for automating the conveyance of parts within factories to reduce costs. Hitachi's autonomous automatic guided vehicle (AGV) uses a laser rangefinder for positioning and

(b) Monoclonal antibody drugs
Pharmaceuticals that utilize the antibodies that play a core role in our immune system as a mechanism to identify pathogens, foreign matter, or other antigens.
These drugs are recognized for their potential to provide effective treatments with few side effects. This is because they use a mechanism in which antibodies act selectively on specific antigens that are found on the surface of cancer and other unwanted cells to indicate that they are intruders.

(c) ANAMMOX bacteria
First reported in 1995 by a research group at the Delft University of Technology in the Kingdom of the Netherlands, these bacteria mediate an anaerobic ammonium oxidation (ANAMMOX) reaction that removes nitrogen from nitrous acid and ammonia in an anaerobic environment. The advantages of using these bacteria in a nitrogen removal system include reducing by more than half the quantity of oxygen required for nitrification, and also eliminating the need to add chemicals for nitrogen removal.

(d) Surge current
A large, short-duration flow of current in an electrical circuit or similar that exceeds normal operating conditions. The surge currents generated by lightning strikes are particularly large and are a common cause of faults in electrical equipment.

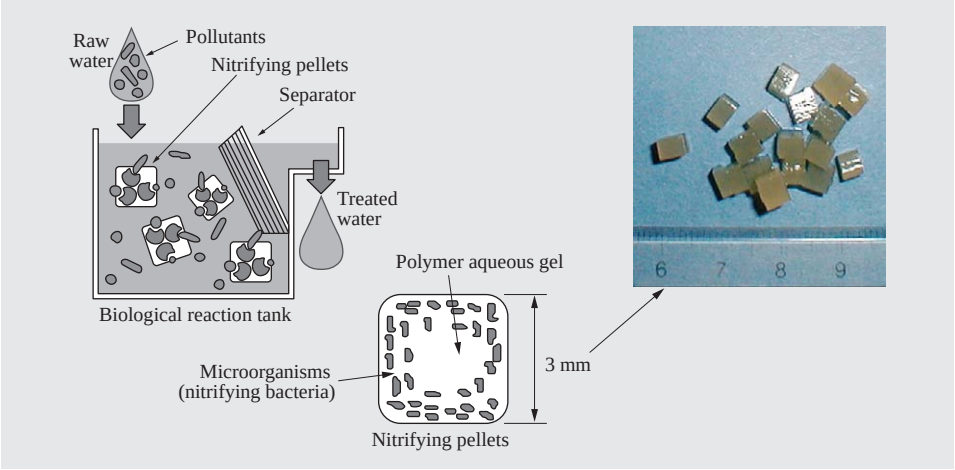


Fig. 7—Comprehensive Immobilizing Nitrogen Removal System.
The system can treat water efficiently by using microorganisms capable of breaking down ammonium nitrogen that are embedded in nitrifying pellets (inclusive immobilization supports made of polymer gel).

localization algorithm. Because it does not require the installation of guide lines, and because of the ease with which it can adapt to changes in plant layout, the autonomous AGV is highly regarded for its wide range of potential applications.

EQUIPMENT MAINTENANCE SERVICES

Equipment maintenance has an essential role in ensuring that production at industrial plants proceeds smoothly. While maintenance frequently requires specialist knowledge and experience, obtaining appropriate maintenance personnel is often difficult due to a shortage of such people or because they lack these attributes. The scope of services provided by Hitachi extends beyond just the construction of plants and the supply of equipment; it also encompasses solutions for maintenance after the equipment commences operation.

In emerging economies, factors such as traffic congestion make it difficult to provide effective inspection services in the form of on-site "patrol" inspections in which maintenance personnel make regular visits to each production site to conduct inspections and perform repairs or adjustments as needed. Hitachi has developed and started to deploy technology for supporting cloud-based maintenance services in order to improve further the level of equipment maintenance supplied to corporate customers.

In addition to monitoring the operation of machinery and other equipment so that the resulting information can be stored and processed at the data

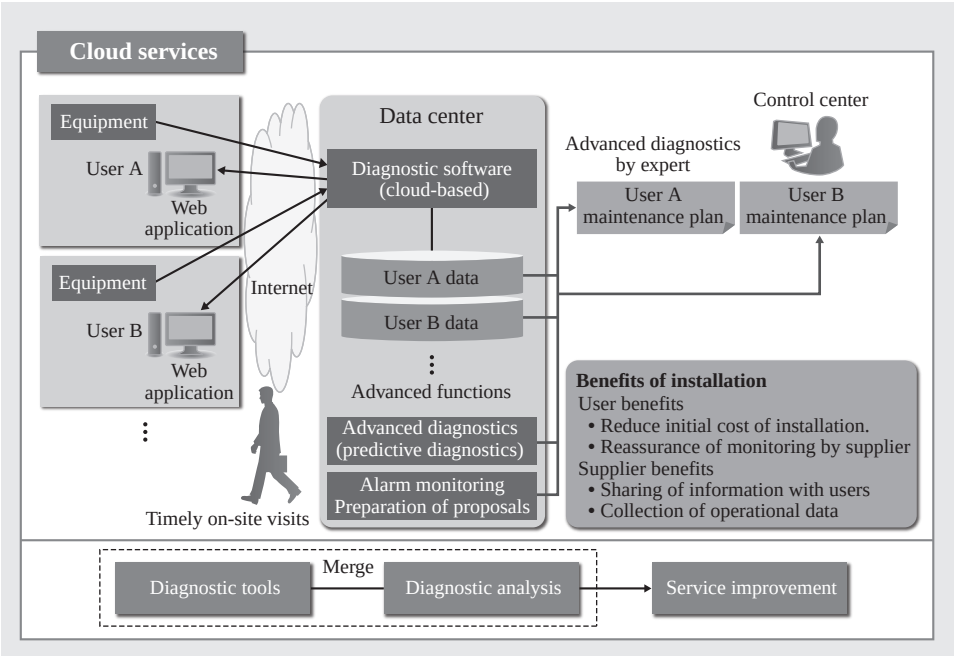


Fig. 8—Cloud-based Maintenance Services.
By monitoring the operation of machinery and other equipment and then storing and processing the resulting information at a data center, the system enables not only emergency response, but also activities such as the formulation of precise maintenance plans that allow optimum operation. The anticipated benefits include reducing the total cost of maintenance, improving utilization, and ensuring safe operation.

center, this technology also facilitates tasks such as the automated generation of maintenance plans, spare parts administration, and emergency response (see Fig. 8). The anticipated benefits include reducing the total cost of maintenance and cutting downtime.

FUTURE ACTIVITIES

As described in this article, Hitachi has been supporting its corporate customers by utilizing its engineering capabilities, which are underpinned by extensive experience, to bring together distinctive systems and components and supply comprehensive construction solutions designed to suit local conditions. In the future, Hitachi intends to utilize its strengths in core technologies and components to supply plant information systems that support operation and management, while also drawing on its engineering capabilities to support global business operations with solutions that package together elements ranging from components and systems to operations and services. Hitachi also intends to extend its range of component products that deliver greater reliability, faster speeds, and increased capacity in the systems that support these activities, and also to continue enhancing its "top runner" products that enable energy and resource efficiency.

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