

## Featured Articles

# Service Mall with Support for Collaboration with Third Parties

Masatoshi Furuya  
 Kaname Ikoma  
 Takafumi Ebara  
 Mitsuhiro Tatsunokuchi  
 Yasuhisa Ichifuji

*OVERVIEW: A feature of service malls is that they perform unified management on the cloud of equipment and energy data from multiple sites and make the data available for online use, not only by site managers but also by equipment manufacturers, maintenance companies, consultants, and others. Even at sites where it is difficult to station skilled engineers despite having a wide variety of different equipment, this makes it possible to maintain appropriate and timely collaborations with external experts over long periods of time while also making good use of data collected on the mall. This helps resolve issues on a variety of fronts, including equipment upgrade plans, rationalization and optimization of equipment operation, identification of wasteful operating practices, emergency response, and report preparation. The mall is also useful for equipment manufacturers who find it difficult to establish and maintain their own remote support infrastructure.*

## INTRODUCTION

THE operation and management of things like equipment and energy use involves more than just tracking the operational status of equipment or monitoring for faults, it should also include control operation with consideration for operational and energy efficiency, enabling continuity of operation in the event of a disaster, and ongoing improvements. Achieving this requires drawing on the diverse knowledge, experience, and know-how of the operations and equipment described below to establish the organization and infrastructure needed for ongoing improvement.

- (1) Selecting various types of leading-edge equipment, installation and upgrade planning, and financing
- (2) Tuning equipment to improve its capabilities, rationalization and optimization of equipment control
- (3) Analyzing correlations between equipment operation and energy, and identifying waste and inefficiency
- (4) Providing operation manuals for routine and emergency operations, training and drills

In practice, however, customers find it difficult both to recruit people with expertise in a wide variety of fields and to establish a labor-intensive

organization divided into narrow specializations. Japan has been experiencing an aging population and falling birth rate in recent years. Appropriate operation and management is limited to a particular scope, with most areas being ignored. Maintaining a stable workforce is one of the critical issues facing companies that sell equipment, systems, or added-value services to customers.

Two effective ways of dealing with the problem of skills shortages are the centralized management of equipment spread over multiple sites and routine collaboration with experts on those elements that are highly specialized<sup>(1), (2)</sup>. Service malls play a part in this improved convenience.

This article describes Hitachi's view of the features and benefits of service malls that enable participation by multiple stakeholders and are suitable for corporate customers in a wide variety of fields, not just industry. A key aspect of a service mall is that access rights to the data entered into it and its applications are assigned according to the needs of each stakeholder.

The article also looks at how the use of time shifting offers a potential way of dealing with bottlenecks in actual equipment operation and maintenance workloads, regardless of whether a service mall is used.

TABLE 1. Categorization of Stakeholders in Equipment Operation and Management  
 This article categorizes stakeholders as follows.

Category	Description	Main stakeholders	Main sources of data
Customers	Organization that operates and manages equipment installed at a plant, and is directly involved in using the equipment	Factories and other plants, offices, shopping complexes, warehouses, railway stations, schools, hospitals, etc.	Equipment operation, equipment faults, equipment records, energy, measurement data
Equipment vendors	Organization that manufactures and sells equipment to customers	Equipment manufacturers, system manufacturers, etc.	Equipment specifications
Energy suppliers	Organization that supplies customers with the electric power, gas, or other energy needed to operate equipment	Power company, gas company, etc.	Energy supply price, energy saving requests
External data providers	Organization that supplies customers with the external data needed to operate the equipment	Weather information provider, traffic information provider, map company, etc.	Weather information, traffic information, maps
Support service provider	External organization that supports or facilitates installation and operation of equipment by customers	Trading companies, construction companies, system integrators, operation & management providers, maintenance companies, design offices, consultancies, equipment diagnosis organizations, financial institutions, etc.	
Organizations with which customers have to file reports	Organizations with which customers have to file reports relating to things like equipment, energy, or environmental impact to meet legal obligations or similar	National or local governments, fire departments, auditors, etc.	Report or submission formats, conversion constants

## SERVICE MALLS

### Definitions

Table 1 lists the different types of stakeholders considered in this article. Here, a service mall is defined as follows.

A service mall is a cloud service that collects and manages equipment and energy data from the customer's site and makes it available as required (subject to access rights) to not only the customer (factory or other workplace), but also equipment vendors (including manufacturers), energy suppliers (such as power companies), support service providers (such as consultancies), and organizations with which the customer has to file reports (such as local governments).

Two important concepts with service malls are the ability of numerous stakeholders to get online access via data networks to customer data stored in the cloud, and that the rights to view data granted to stakeholders are assigned at the discretion of the customer who owns the data. Limiting usage to the same internal stakeholders as in the case of an in-house network service significantly undermines the benefits of using a cloud service. A service mall also increases the added value for each stakeholder by keeping up to date with the latest data from such sources as equipment vendors, energy suppliers, and external data providers, and by providing applications for the further processing of this data in conjunction with customer data.

### Comparison of Cloud Service Models

Fig. 1 shows the relationships between stakeholders in various cloud service models. This example omits the

model in which the customer only outsources server management to a data center.

#### (1) Client-server model

This involves collecting and managing operational data from the customer and performing contracted services such as remote monitoring. The service is run by the equipment vendor. The client-server relationship in this model simply involves migrating server functions (such as applications and data management) to a cloud platform managed by the equipment vendor. The customer and equipment vendors have a 1:N (or M:1) relationship.

Because there is a different cloud service for each vendor, this limits the ability of customers with equipment from a number of different vendors to perform management and operation across all equipment. In this model, third parties (other than the customer and service provider) do not have online access to the data.

#### (2) Portal model

This involves collecting and managing operational data from the customer and performing contracted services such as remote monitoring. The service is run by a third party that acts as an intermediary between the customer and equipment vendor. The intermediary plays a hub-and-spoke role and links customers and equipment vendors with an M:N relationship. In terms of the relationship model, this is equivalent to web sites for things like web search, reservation services, and e-commerce sites that act as intermediaries.

Because everything is consolidated into a single cloud service, this enables customers with equipment from a number of different vendors to perform

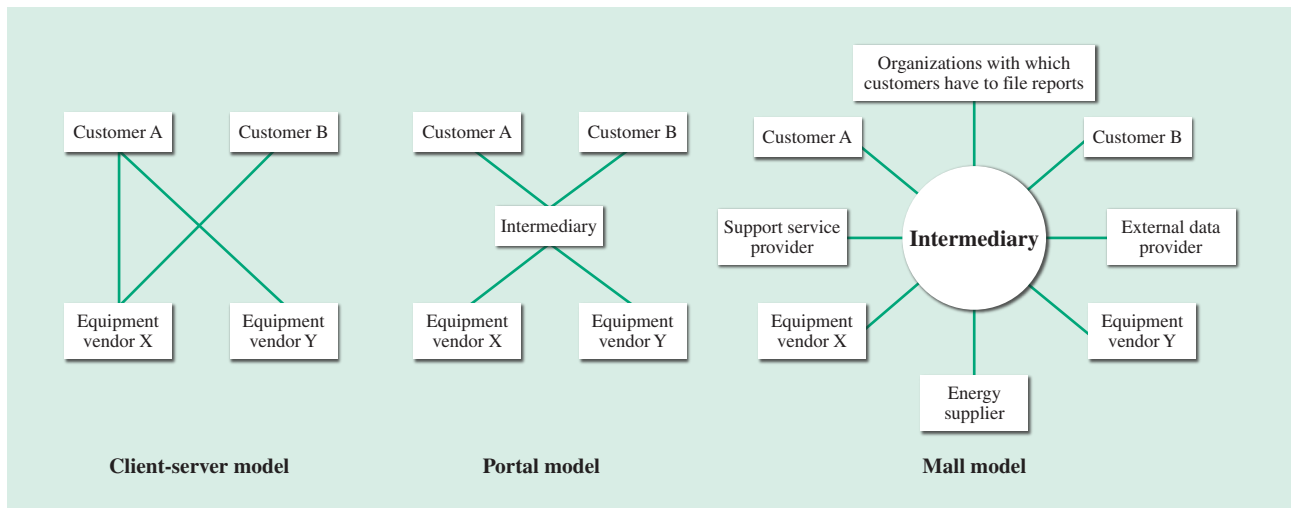


Fig. 1—Comparison of Cloud Services.

A feature of the mall model is that it can be used by a wide variety of stakeholders, not just customers.

management and operation across all equipment. In this model, third parties (other than the customer and service provider) do not have online access to the data.

### (3) Mall model

This involves collecting and managing operational data from the customer and performing contracted services such as remote monitoring. The service is run by a third party that acts as an intermediary between the customer and equipment vendor. While this links customers and equipment vendors with an M:N relationship, the same as the portal model, it differs in enabling third parties such as support service providers and organizations with which the customer has to file reports to participate in the community, granting online access to the customers' data. It is equivalent to the relationships in a social media site around which a community group is formed that shares information.

Because everything is consolidated into a single cloud service, this enables customers with equipment from a number of different vendors to perform management and operation across all equipment while also facilitating collaboration involving numerous support service providers that extends beyond the cloud. This has benefits for customers concerned about maintaining their workforce, equipment vendors, and support service providers alike<sup>(3)</sup>. While current practice with reporting typically involves the customer submitting documents to the organization concerned, Hitachi envisages that the workload associated with preparing and submitting reports can be significantly reduced in the future by putting in place the ability for the recipient of the report to view the data itself.

### Ideal Service Mall

Maintaining a stable workforce and eliminating waste and inefficiency are frequently quoted as issues in corporate management. Maintaining qualified personnel for equipment operation and management is a challenge even for large companies. The value of a service mall is that it can assist with rational and effective operation and maintenance through the use of personnel and services from both inside and outside the company.

The advantages to each stakeholder of using cloud services based on a service mall model are as follows.

#### (1) Customers

(a) Avoids the need to have people with highly specialized knowledge, experience, and know-how in a wide variety of fields stationed permanently at the workplace.

(b) Can unify diverse services from different equipment vendors.

(c) Provides centralized management of multiple dispersed sites. Simplify comparison of data from different sites.

(d) Provides the ability to share some equipment with neighboring organizations.

(e) Can receive remote notification from equipment vendors identifying equipment with minor faults, equipment operating less efficiently than normal, or idle equipment, and advice on what to do about it.

(f) Can call on locally based suppliers to provide on-site support when a major fault occurs.

(g) Can make use of the latest weather, maps, and other data.

(h) Enables automatic response to requests from the power company to reduce power consumption.

(i) Eliminates the need to visit the site, download data for analysis from equipment and other systems, and supply it to external support service providers.

(j) Reduces security concerns by giving external support service providers direct access to plant equipment and other systems.

(k) Enables planned equipment upgrades.

(l) Facilitates selection of best option from among those provided by the energy supplier, and switching between options.

(m) Reduces the workload associated with preparing and submitting reports to national and local governments or certification agencies.

#### (2) Equipment vendors

(a) Avoids the need for the company to establish, maintain, and manage its own cloud service.

(b) Minor faults or other performance degradation can be dealt with without visiting the site.

(c) Analysis and consulting can be delegated to the appropriate support service provider in the case of customers who also use equipment from other vendors.

#### (3) Support service providers

(a) Identify equipment that has deteriorated significantly over time and formulate upgrade plans for the customer at an appropriate time.

(b) Can handle system setup for customers remotely.

(c) Enables analysis and consulting based on statistical data from the workplace (big data).

(d) Provides access to equipment vendor expertise to obtain advanced knowledge and know-how about equipment.

#### (4) Service mall operator

(a) Can utilize large quantities of data from a large number of stakeholders (big data) to extract statistical knowledge, and use this as the basis for future innovation.

(b) Presence of a large number of stakeholders encourages third parties to join and to provide superior applications. Increases value to stakeholders.

### Service Mall Requirements

#### (1) Stakeholder-specific access rights

The following describes typical situations encountered when considering the requirements for access rights.

Consider the case when company A (a customer) has company F install air conditioning manufactured by company D. Company B (another customer), meanwhile, has company F install air conditioning manufactured by company E, and contracts company G (a consultancy) to provide consulting and analysis. Companies A and B (the customers) both need to file regular reports with the local government (Z).

Table 2 shows an example of access right settings for each stakeholder. Note that “stakeholders” here means individuals, not the companies or other organizations to which they belong.

In this example, companies D and E are given view and modify rights to look at data on the air conditioners they have manufactured. Company F is given rights to view air conditioner data from the customers (A and B) and to perform system setup. Company G is given rights to view data and reports from customer B only. The local government (Z) is given the right to view reports. The customers (A and B) are not able to access each other’s data.

#### (2) Management of multiple sites at different locations

A company like Hitachi, for example, needs to manage and operate equipment appropriately, not only at its factories but also at a wide variety of other facilities, such as offices, research centers, hospitals, and warehouses. A service mall should provide ways

TABLE 2. Example Service Mall Access Rights Settings  
Stakeholders do not necessarily have access to the full range of data and services.

Site	Data	Use	Customer A	Customer B	Vendor D	Vendor E	Company F	Consultancy G	Local government (Z)
Customer A	Vendor D air conditioner	View	○		○		○		
		Operate	○						
		Modify	○		○				
	Report	View	○						○
	System	Set	○				○		
Customer B	Vendor E air conditioner	View		○		○	○	○	
		Operate		○					
		Modify		○		○			
	Report	View		○				○	○
	System	Set		○			○		

to share experience and know-how and perform comparisons between sites through the centralized management of a variety of different types of sites.

(3) Simplicity of screen operation

Service malls are intended to be used not only by customers but also by service providers and others. Accordingly, screens need to be easy to understand and intuitive to operate.

(4) Anonymity of service data

Service malls collect data from a large number of customers and convert it into anonymized statistical data to make it available for analysis and consulting.

(5) Third-party provision and registration of applications

In addition to managing equipment operation and energy, equipment management and operation also includes things like community management, document management, equipment records management, environmental management, billing management, and security management. A large number of excellent third-party application services are available on the market, and service malls actively seek to incorporate these, while also maintaining neutrality, in order to provide greater benefits to stakeholders.

**USING TIME SHIFTING TO AVOID CONCENTRATED WORKLOADS**

Off-peak commuting is one way to reduce the congestion that occurs during city rush hours. Rolling shutdowns to

deal with peak electric power demand in summer can be thought of as another example of time shifting. There are also cases in which the concept of time shifting can be utilized in equipment operation and management. The following describe a number of examples.

(1) Using time shifting in production planning

It is common practice at factories to operate each production line on the basis of detailed production schedules to ensure that products are produced efficiently and delivery is on time. In this case, it is possible to adjust production schedules to avoid bottlenecks and thereby shift peaks in electric power use (see Fig. 2).

(2) Using time shifting in power-sharing arrangements

Time shifting is also a useful technique for mutual power-sharing arrangements that are managed centrally by bringing together at the district level customers with different types of businesses, such as factories, shopping centers, hospitals, offices, condominiums, or event venues. For example, facilities such as factories, hospitals, and offices have high daytime power demand on weekdays, whereas demand from condominiums is high from evening through to night. Shopping centers and event venues, on the other hand, attract large numbers of people on non-working days. In other words, district-wide demand peaks can be smoothed by organizing mutual power-sharing arrangements designed to use time shifting together with batteries and other technology.

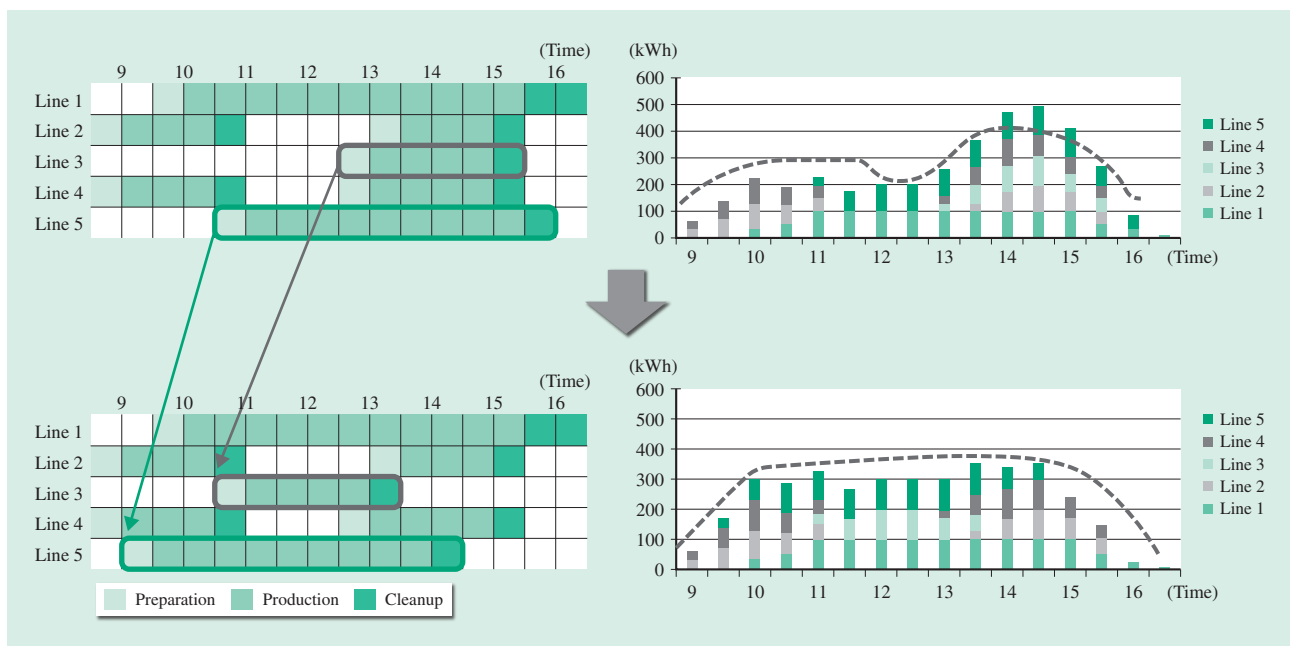


Fig. 2—Use of Time Shifting in Production Plans. Power use can be smoothed by shifting production processes that overlap in time.

(3) Using time shifting with equipment start times

Many types of equipment such as air conditioning, etc. draw a large amount of power when starting up. Accordingly, rather than starting air conditioners all at once at the start of each working day or after the lunch break, automatic scheduling can use time shifting to smooth peak demand. Also, more reliable operation can be achieved when using emergency generators, such as during an outage in the commercial power supply, by offsetting equipment (load) restart times.

(4) Using time shifting in anticipation of equipment upgrades

Operating equipment in such a way that the timing of upgrades can be offset is a useful way to avoid having to fund upgrade costs all at once. In a case where multiple heat sources or batteries have similar performance and design life specifications, for example, this would mean deliberately controlling the number of units that are operating at any one time so that some are used more than others, rather than using all of the heat sources or batteries to the same extent.

As a result, the operating hours and the number of times each unit is operated are different. This helps with investment planning because unit upgrades due to failure or performance degradation no longer occur all at once.

**INTEGRATED ENERGY AND EQUIPMENT MANAGEMENT SERVICE DESIGNED BASED ON SERVICE MALL CONCEPT**

**System Configuration**

Hitachi markets its integrated energy and equipment management service based on the service mall concept. The integrated energy and equipment management service is broadly divided into on-premise and center systems that are connected together via a controller (or server) that acts as a gateway (see Fig. 3). The service mall is on the center system and manages data and applications that include equipment operation data, energy use, and fault records from the site. Customers access the service mall via the Internet for equipment

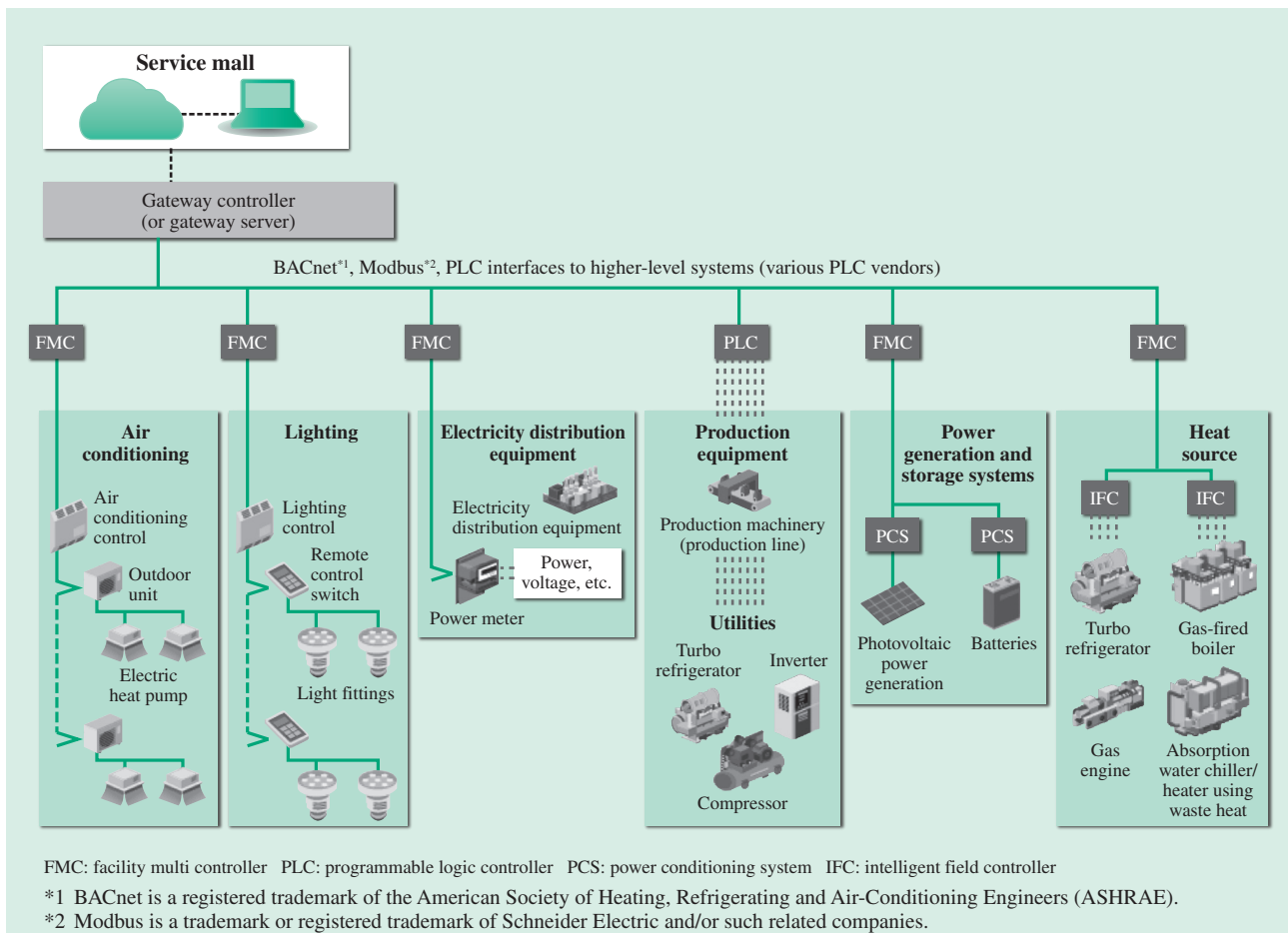


Fig. 3—System Configuration of Integrated Energy and Equipment Management Service. The site systems are linked to the cloud-based service mall via gateways.

management and operation, while equipment vendors, support service providers, and others are able to use the system within the scope defined by their assigned access rights.

The on-premise system is connected using the BACnet, Modbus, and communication protocols used by common programmable logic controllers (PLCs) for communicating with higher-level systems, which are widely used in various markets and industries. The integrated energy and equipment management service can also be used in a closed configuration consisting of the on-premise system only, without a connection to the service mall. This configuration can be subsequently upgraded by adding a connection to the service mall.

### Applications

The integrated energy and equipment management service is an application for commercial users. It provides functions for equipment and energy management. The available management screens are designed based on the business operation cycle of “view,” “know,” “restrain,” and “continue.” The screens are designed in such a way that, as far as possible, even people who do not use the system in their daily work can intuitively find the functions they need. Also, compared to sites such as office buildings in which air conditioning and lighting make up a large proportion of daily power use, production equipment accounts for a large proportion of power use at factories<sup>(4)</sup>. Accordingly, the energy management functions for factories include a peak shift guidance function that uses production plan simulations. The on-premise system sends production schedule data from the production management system to the gateway server, which runs a simulation of power use to provide guidance on peak shifting. The service mall does not collect this production schedule data.

### CONCLUSIONS

This article has described the features and benefits of cloud service malls, which enable participation by multiple stakeholders and operating practices that use time shifting to avoid bottlenecks, and the cloud service, which incorporates some of these concepts. Key points include the use of access rights to enable collaboration and the neutrality that enables participation by multiple stakeholders.

In the future, Hitachi anticipates that cloud services based on the service mall model will become a

standard practice for social infrastructure, and that most equipment installed in plants will include a communication interface to higher-level systems as a standard feature.

### REFERENCES

- (1) “Dokodemo Data.Net” Distributed Data Collection and Analysis System: A New Remote Equipment Management System for the IT Era, in Japanese, <http://www.tfmhy.com/dokodemodata.net/dokohpdata/remotapp.pdf>
- (2) “The Mountain Moved”: The University of Tokyo’s Initiative for Power System Visualization, in Japanese, [http://www.gutp.jp/activities/pdf/20110831\\_05-report.pdf](http://www.gutp.jp/activities/pdf/20110831_05-report.pdf)
- (3) J. Sato et al., “O&M Cloud Service for Expediting Business Innovation,” *Hitachi Review* **64**, pp.24–28 (Feb. 2015).
- (4) Summer Power Saving Options, Ministry of Economy, Trade and Industry (Jul. 2012) in Japanese, [http://www.meti.go.jp/setsuden/pdf/supply\\_120606\\_01g.pdf](http://www.meti.go.jp/setsuden/pdf/supply_120606_01g.pdf)

**ABOUT THE AUTHORS**

---

**Masatoshi Furuya**

*Urban Solutions Engineering Department, Security & Energy Solutions Division, Infrastructure Systems Company, Hitachi, Ltd. He is currently engaged in business planning for equipment and energy management.*

**Kaname Ikoma**

*Solution Planning Center, Energy System Division, Energy Engineering Business Management Division, Energy Solutions Business Management Division, Hitachi, Ltd. He is currently engaged in business development for district energy management services.*

**Takafumi Ebara**

*Strategic Business & Standardization Promotion Department, Corporate Technology Division, Infrastructure Systems Company, Hitachi, Ltd. He is currently engaged in marketing energy management services to new areas.*

**Mitsuhiro Tatsunokuchi**

*Urban Solutions Engineering Department, Security & Energy Solutions Division, Infrastructure Systems Company, Hitachi, Ltd. He is currently engaged in engineering work on energy solutions.*

**Yasuhisa Ichifuji**

*Facility Solutions Development Department, Facility Solutions Office, Facility Solution Division, Social Infrastructure Business Group, Hitachi Systems, Ltd. He is currently engaged in planning and product development for energy management solutions.*