Facilities Management System That Reduces Environmental Burden of Buildings

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In recent years, the problem of global warming has become serious, and it has become an important challenge for architects to reduce the environmental burden of buildings. In response, Fujitsu has developed facilities management systems called Futuric that make buildings safer and more comfortable by collecting information about equipment in buildings and then making it available for management and control purposes. Lately, however, more importance has been attached to reducing environmental burden by providing energy-conservation functions for entire buildings.
The Futuric facilities management systems have various energy conservation functions in their building energy and environment management systems (BEMSs) to support environmental burden reduction.
This paper introduces the Futuric systems and describes how they help reduce a building's environmental burden using an example introduction in an office building.

1. Introduction

Facilities management systems are generally called building automation systems (BASs) because they are systems for achieving safety, livability, energy conservation, and laborsaving in facilities by collectively managing and controlling information about, for example, electricity supply, air-conditioning, lighting, hygiene, and disaster and crime prevention. Fujitsu introduced its first BAS system in 1975 and since then has introduced them to about 1100 facilities.

The main function of facilities management systems was originally focused on the conservation of energy and laborsaving through the automation of equipment management. However, the revision of the Energy Conservation Law in April 2002 obliged building owners to periodically report their energy management to the Government and formulate mid-term to long-term plans for reducing their energy consumption and CO_2 emissions. The Futuric systems, therefore, have become important tools for achieving environment and energy conservation.

Against this background, Fujitsu has developed three Futuric systems: Futuric/B, Futuric/BILCYBER, and Futuric/SX.[note 1)] These systems support standardization of communication protocol, materials, operating system (OS), and data and have a flexible configuration and many BEMS functions.

2. Outline of latest Futuric system: Futuric/SX

The latest Futuric system, Futuric/SX, is divided into three fields: the local field, operation/integration field, and client field. Moreover, it is composed of four main elements: human interface modules (HIMs), intelligent controllers (Iconts), remote stations (RSs), and a building energy and environment management system (BEMS). **Figure 1** shows the concept of the system, and

note 1) Fujitsu total control and supervise system for Facilities and UTilities of URban InfrastruCture

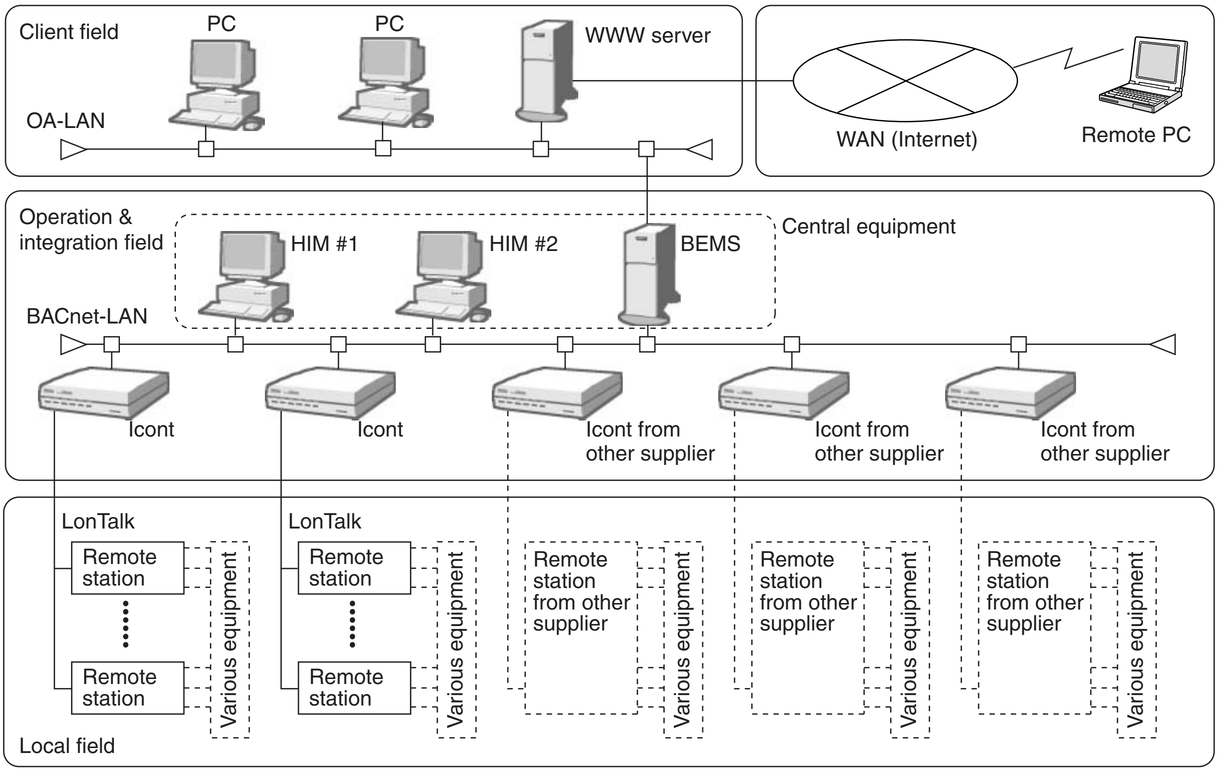

Figure 1
System concept of Futuric/SX.

Figure 2 shows a photograph of the central equipment.[1)]

The Iconts collect dry-relay data from the RSs, convert it into BACnet protocol,[note 2)] and then transmit the converted data to the HIMs. The HIMs processes the received data and report the results to the manager by displaying them on the HIM monitors and using audio signals and other means. The manager uses the HIMs to send on/off control and setting instructions in BACnet protocol to the Iconts and also receive control/setting signals from the RSs. The BEMS cooperates with the HIMs and Iconts to collect and store energy data about equipment to support the management of equipment maintenance and management of energy and the environment.

note 2) A Data Communication Protocol for Building Automation Control Network: BACnet is a registered trademark of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).

3. Features of Futuric/SX

Futuric/SX has two main features. Firstly, it supports globalization for easy construction of a multi-vender system. Secondly, it has various functions for conserving energy and protecting the environment.

3.1 Standardization support

Futuric/SX supports standardization of the communication protocol, materials, operating system (OS), and data.

1) Standardization of communication protocol

The BACnet protocol described in ISO standard 16484-5 is adopted as the communication

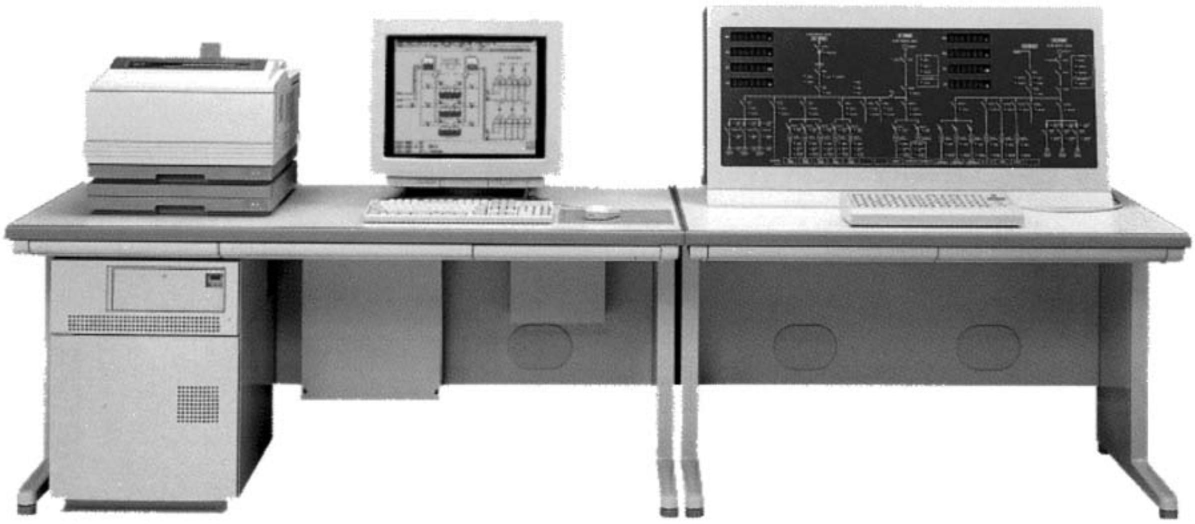

Figure 2
Central equipment of Futuric/SX.

protocol in the operation/integration field. Also, the de-facto LonWorks note 3) standard is adopted as the communication protocol in the local field. The adoption of these two protocols enables seamless connections of various equipment without the need for gateway equipment, making it easier to collect large amounts of data.

2) Open building information

The BEMS collects data about equipment and makes the data available to personal computers (PCs) in the client field. In addition, it is used in conjunction with a Web browser and PCs to monitor equipment, change temperature settings, and change the operating schedule of air-conditioners. Furthermore, the BEMS is used to tally up accumulated energy data in order to publicize reductions in CO_2 and other emissions on the Web and allows the data to be downloaded to PCs.

note 3) Local Operating NetWorks: LonWorks is a registered trademark of Echelon Corporation.

3.2 Environment and energy consumption function support

Because of the growing importance of environmental protection, the need to conserve energy during a facility's operation has become much stronger. As a result, there have been high expectations that the BEMS will be an effective energy conservation measure for office buildings to help prevent global warming. Therefore, Futuric/SX incorporates various energy saving functions, the main ones of which are summarized in **Table 1**.

Compared to conventional systems, Futuric/SX is physically much smaller and consumes much less power. Calculations made according to the Environmental Assessment Method used by Fujitsu note 4) show that compared to other systems, this system achieves a 46.7% — or more than 17 kg — reduction in CO_2 per year (**Figure 3**).

Recently, a subsidy system to support the

note 4) This is a Fujitsu Laboratories method provided to customers when they introduce Futuric. It makes trial calculations of a facility's environmental impact in terms of CO_2 emissions before and after Futuric is introduced.

Table 1
Main energy conservation support function list of Futuric/SX.

Class	Function	Summary
General control	Schedule control	Enables equipment to run automatically based on the operation pattern to which equipment is set beforehand. Also, automatically adjusts operation times of season-dependent equipment at season changes.
	Event control	Performs ON/OFF control and setting control of equipment set beforehand in case of status changes, alarms, and analog measurement abnormalities.
Electric power control	Electric power demand monitoring	Monitors cyclic electric power consumption. When the system forecasts an electric power consumption exceeding the contracted amount of electric power, it reports the situation to the operator.
	Electric power demand control	When an electric power demand alarm is generated, this function performs cut-off control of the equipment that caused the power demand excess. After recovery from the alarm, this function turns on equipment as power becomes available.
	Power factor improvement control	Performs ON/OFF control of phase advance capacitor to bring power factor close to 100%.
Air-conditioning control	Target temperature setting control	Automatically adjusts settings of air-conditioning facilities based on previous year's settings.
	Season mode switch control	Performs automatic switch control of equipment that changes its operation mode at season changes.
	Intermittent operation control	Performs intermittent operation in cycles and in time zones set beforehand to conserve energy for power equipment, etc.
	Air intake control	Compares outdoor air enthalpy with indoor air enthalpy and performs open/close control of air dumper for energy conservation by effective use of heat and coldness sources (e.g., hot air and cold water).
BEMS	Data storage	Accumulates energy data collected with Futuric over a long period for easy output to external media in a versatile format and easy analysis/processing by general-purpose software.
	Energy data analysis	Detects wasteful energy consumption by calculating/processing energy data collected by Futuric and graphically displaying it to support energy conservation judgments.
	Environmental performance data recording & management	Automatically sends consumption amounts of electricity, water, gas, and other commodities collected by Futuric to environmental performance data recording management system (SLIMOFFICE*1) so the amounts of exhausted CO_2, Nox, Sox, etc., can be calculated to support environmental management.

*1 System developed by Fujitsu FIP Ltd. This system quantitatively manages the amount of environmental burden generated as well as the amount of consumption every month due to production activities of all types of business (e.g., manufacturing, circulation industries, and municipalities) to monitor the converted CO_2 and money values.

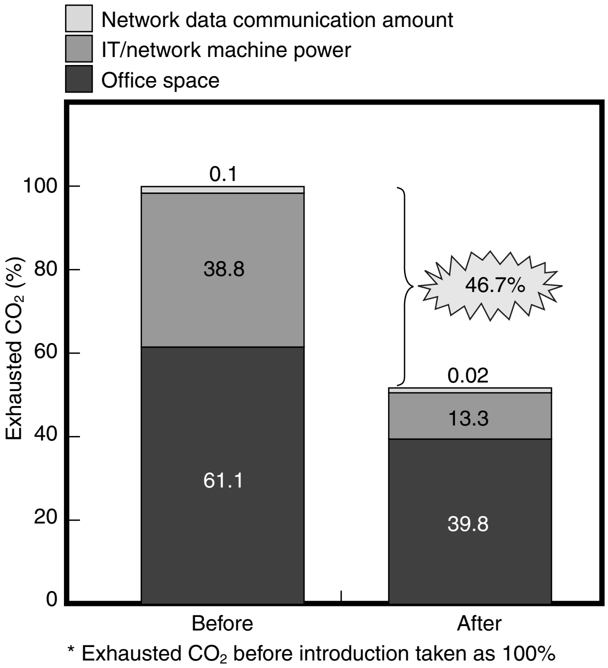

Figure 3
Exhausted CO_2 before and after Futuric/SX introduction.

introduction of BEMSs has been established by the Ministry of Economy, Trade and Industry as a measure for environment and energy conservation. Also, when facilities management systems are replaced or upgraded, BEMS data will be analyzed to help protect the environment together with the customer.

The next section looks at an example in which Futuric/SX was introduced to conserve energy in an office.

4. Environmental burden reduction after introducing Futuric/SX[2)]

In this section, we described how Futuric/SX reduced the environmental burden in the offices of a company in the gas industry in 2002. The system configuration of the office is shown in **Figure 4**.

In the office, a conventional data-collection management system was developed so the staff could participate in energy conservation and the control of indoor temperature over the Web by accumulating data and using the most suitable equipment based on that data. **Table 2** shows the main functions that were introduced for the office.

After Futuric/SX was introduced, the system began to regularly collect data and analyze it. When the system detected a potential loss of energy, it analyzed the potential causes. The necessary maintenance was done, and the office staff established a detailed energy conservation plan through energy conservation management.

By introducing the most suitable operation control functions, Futuric/SX made a remarkable reduction in the environmental burden of this office without decreasing the comfort of the staff. Moreover, a further reduction in environmental burden was achieved by encouraging the staff to become more aware of environmental problems and participate in energy conservation activities.

The energy conservation effect graph for the introduction of Futuric/SX is shown in **Figure 5**. Over the course of one year, compared to ordinary offices, this office achieved a 9% (measured) higher energy conservation in the west building and at least a 30% (calculated) higher conservation in the east building.

5. Conclusion

This paper introduced Fujitsu's Futuric facilities management system and described how it helps reduce a building's environmental burden using an example introduction in an office building.

Since its release in 1975, Futuric has offered various energy conservation functions. However, in order to promote even better energy conservation in the future, it will be necessary to quickly support equipment upgrades and offer more effective energy conservation functions. To achieve this goal, more detailed data must be collected. Moreover, because energy conservation and human comfort sometimes conflict with each other, when introducing energy conservation functions, the people who live or work in the building need

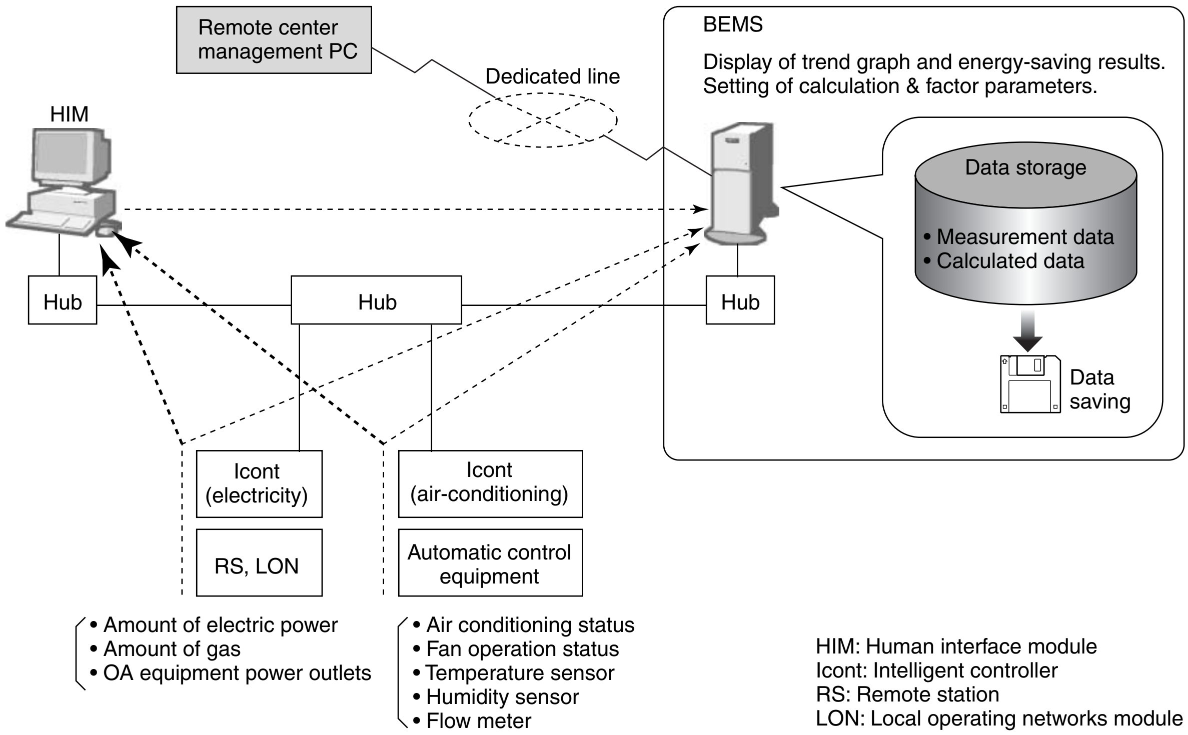

Figure 4
Futuric/SX system of office example.

Table 2
Energy conservation functions used for example office.

Function	Summary
Best operation mode control	Selects whether to use natural ventilation, ceiling fans, floor blow air-conditioning or a combination thereof to select the best mode for energy conservation.
Best CGS*1 control	The operation mode of CGS is determined by simulating the energy cost and amount of CO_2 emission.
Night purge control	Exchanges air of offices using cool air of night to reduce air-conditioning consumption during the next day.
Energy conservation results indication	Improves staff's awareness of energy conservation by measuring and totaling the amount of energy used on each floor and in each zone and then emails results to the staff.
Electronic questionnaire (air-conditioning comfort)	Conducts questionnaires about staff's comfort and calculates amount of clothes being worn and staff's metabolism based on data from BEMS. Then, sends results to PMV*2 value calculation for air-conditioning control.

*1: CGS: The Cogeneration System generates electric power using, for example, diesel generators, and recycles exhausted heat from generators.
*2: Abbreviation of Predicted Mean Vote (expected average temperature comfort report), which is an index showing temperature comfort based on six parameters (temperature, humidity, air flow, radiation, amount of clothes worn, and amount of physical activity).

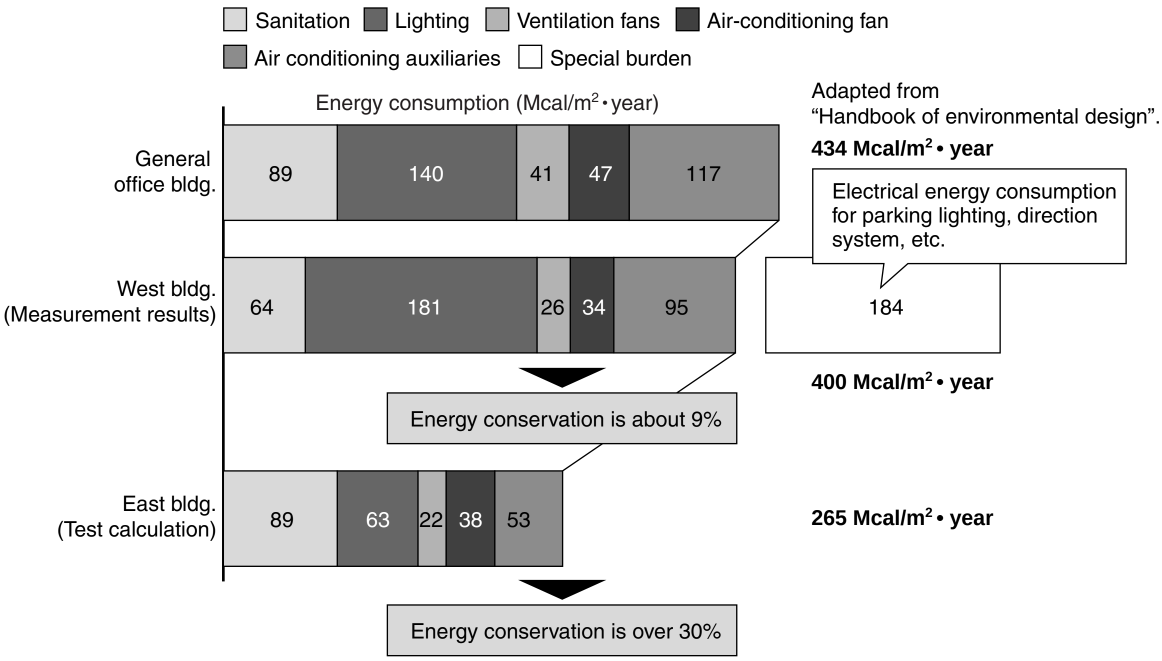

Figure 5
Reduction of primary energy consumption.

to participate in the process. It is also necessary to forecast how the new functions will affect their comfort.

In a typical facility, the energy required to condition air and control the air-conditioning equipment accounts for almost 30% of the overall energy consumption; therefore, a reduction of air-conditioning energy consumption can greatly reduce a facility's overall consumption. Moreover, although heat exhaustion through natural ventilation of air to the outside and the use of cogeneration systems (CGSs) are very effective, they are heavily influenced by the outside temperature and other weather conditions. Therefore, there will be big demands for energy conservation functions that optimally control air conditioners and other equipment in cooperation with weather data, weather forecasts, and other information. Because Futuric is still in the verification stage, our main tasks now are to collect and analyze data after Futuric introductions, analyze the potential causes of potential energy losses, and feed back our results to develop concrete methods for better energy conservation.

References

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