Offering of High Value-Added Services by Facility Information Management System

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Abstract

Our facility information management system called "e-FaIn" is used to support improvement of quality and efficiency for a series of our maintenance services by sharing the facility information among our major servicing business premises. This system systematically and centrally manages various facility-related information and documents. For proper preventive maintenance, this system aims to contribute to effectiveness and adds high value to our overall maintenance services such as minimizing risk and cost, taking measures for facility life extension, and supplying useful information for decision making regarding facility renewal investments.

Going forward, as the facility diagnostic technologies for the facility maintenance are ever-improving, facility information (inspection, repair, inspection results, etc.) plays a key role in diagnostic work.

1 Preface

We installed many facilities including substations for our customers. Many of these facilities are going through the aging process and we were able to anticipate various occurrences of failure such as a breakdown due to deterioration from aging and underperformance. In order to avoid such challenges in advance, it is very important to maintain an adequate system of maintenance and repair. By applying diagnostic services to facilities, adequate countermeasures can be taken before the failure occurrence. Given the aforementioned, in order to achieve effective maintenance and improvement of quality, one of the most effective measures is to carry out systematic management and build a database of customer information about each system configuration and facility maintenance. We aim to use such collected data for proposals to our customers such as facility diagnosis and system renewal.

This paper introduces the facility information management system, "e-FaIn," which we newly created as one of our maintenance supporting tools.

2 Outline of the Facility Information Management System

2.1 Purpose

Information about the maintenance of subject facilities and equipment is systematically consolidated in the database of a server. Based on the maintenance-related information about these facilities and equipment, improvement of reliability is made by data analysis at each opportunity for proposing to our customers our ideas about a maintenance plan, extension of facility life, and timing for system upgrade. Whenever we receive any queries from customers, we can easily refer to the history of maintenance for their facilities and equipment and we can provide responses quickly. This system is intended to support overall maintenance activities. **Fig. 1** shows a diagram of maintenance service support based on facility-related information.

2.2 Background

Our maintenance service business unit has many business locations around Japan and each site has managed the individual information of each customer's facilities. Along with the recent growth of IT, network-related engineering has become popular in order to realize electronic information sharing and common use of the same information. Con-
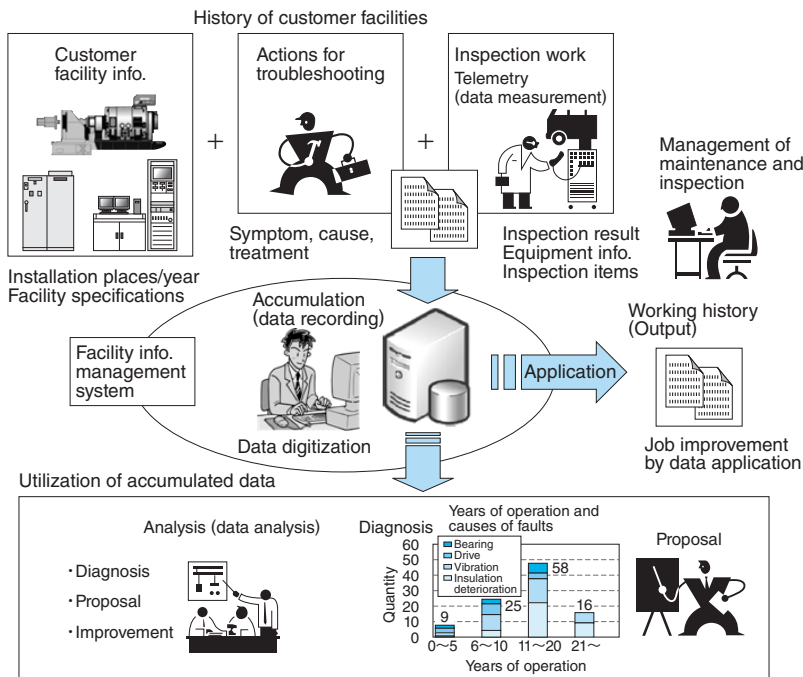
History of customer facilities

Customer facility info.
+
Actions for troubleshooting
+
Inspection work
Telemetry (data measurement)

Installation places/year
Facility specifications

Symptom, cause, treatment

Inspection result
Equipment info.
Inspection items

Management of maintenance and inspection

Facility info. management system

Accumulation (data recording)

Application

Working history (Output)

Data digitization

Job improvement by data application

Utilization of accumulated data

Analysis (data analysis)
· Diagnosis
· Proposal
· Improvement

Diagnosis

Years of operation and causes of faults

Proposal

Fig. 1 Support of Maintenance Services with Facility Information

Facility information is being used for system analysis, diagnosis, and proposal.

Facility info. management system

DB server

Management of customer info.

Intranet

Document info. DB
Facility info.
Drawings

Proposal

New facilities

Facility maintenance

Facility info. DB
Facility info., constitutive equipment
Facility info., inspection info.
Inspection records & details
Trouble shooting records
Establishment of inspection history & reports

Inspection

Inspected facilities

Repair services

Facilities of trouble-shooting

Facility diagnosis
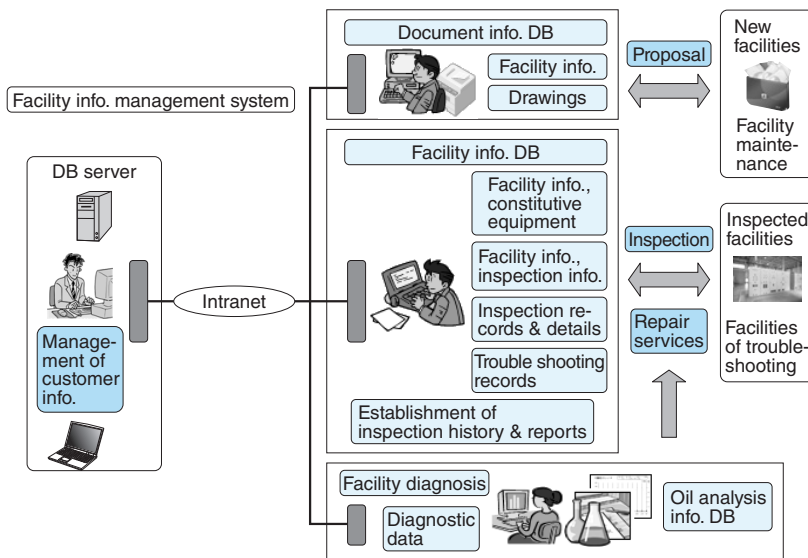Diagnostic data

Oil analysis info. DB

Fig. 2 System Configuration

This shows an overall system configuration showing the relationship among system manager, user, and the contents of information.

solidated management of such information on the database is also possible. As a result, information on maintenance and diagnostic services relating to facilities and equipment is kept on a database at each of our business sites so that more fine-tuned facility maintenance service can be offered to the customers.

2.3 System Configuration

Fig. 2 shows an overall system configuration and **Fig. 3** shows the data configuration. This system consists of facility information (about customers, inspection records, and troubleshooting data), document-based information, and facility diagnostic information. Data access and registration for reference are carried out via the Web so that the accumulated data can be made available for active analysis. The database is utilized through a client terminal that is connected to the network.

2.4 Major Functions

The Web browser at each client terminal makes it possible to perform easy retrieval, browsing, and editing of various data. Since the updated information is kept in a common server, data can be used actively for maintenance services. Main function is listed below.

### 2.4.1 Information Retrieval of Customers, Facility/Equipment, and Maintenance

（1） Information about facility/equipment

Information about facilities and their configuration can be browsed and edited. Keyword retrieval and refined retrieval by specifying a property item can be performed. Items for maintenance are adequately arranged at the respective servicing bases in order to support promotion of renovation projects. At the time of large-scale modification, horizontal development of such related information can be easily performed. **Fig. 4** shows a screen of facility/equipment information operation.

[Contents of information]

Customer information: Name, address, and location name

Facility information: Facility type, installation place, facility name, equipment configuration, and data

Equipment information: Equipment name, manufacturer name, type, serial number, equipment specification, year-month-day of installation, drawings, etc.

（2） Facility history control

Data-logging is managed, regarding inspec-
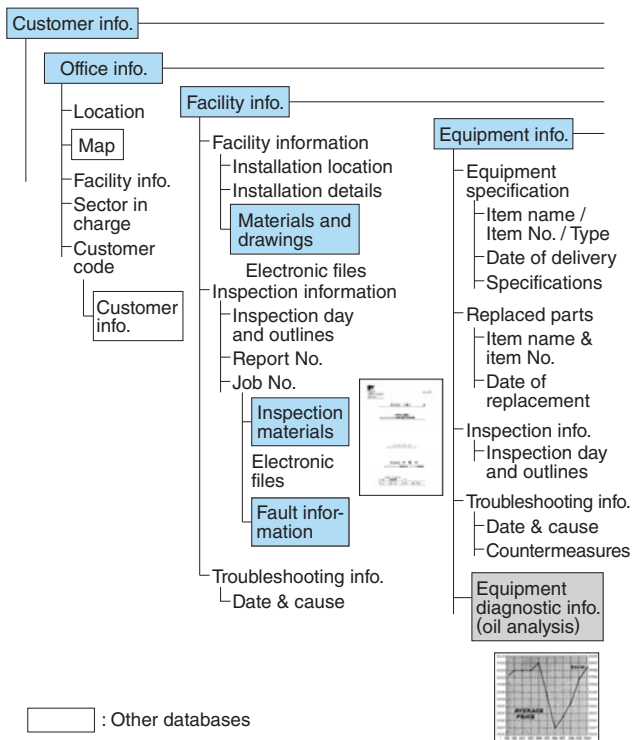
Fig. 3 Data Configuration

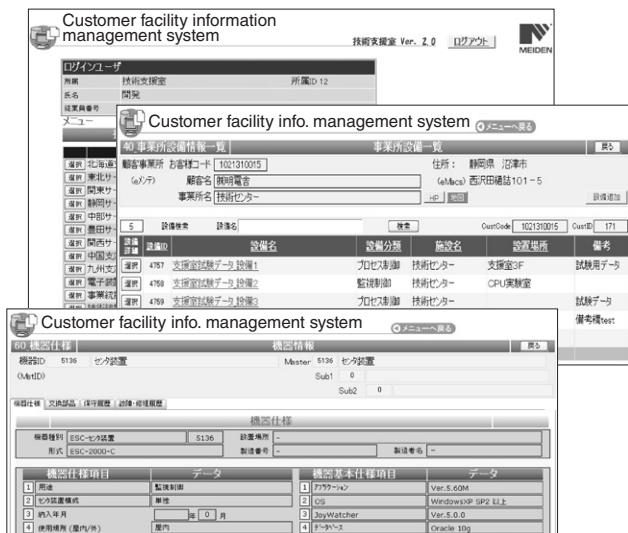This shows information data structure relating to facilities and equipment.

Fig. 4 Facility/Equipment Information Operation Screen

Regarding facilities and equipment, an information operation screen is shown.

tion, failures, queries, fixing, extension, modification, etc. Maintenance support is carried out by linking the historical data to facility/equipment information. Facility history information can be retrieved by selecting the period, keyword, and facility. **Fig. 5** shows a screen of error codes and trouble-shooting service inputs.
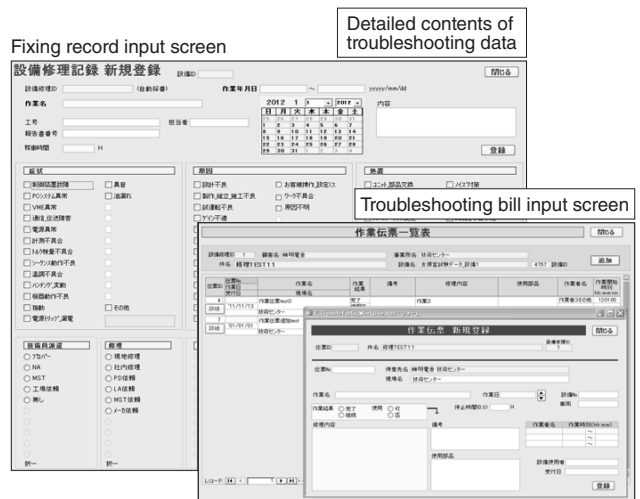
Fig. 5 Troubleshooting Service Input Screen

A troubleshooting service input screen is shown for facilities and equipment.
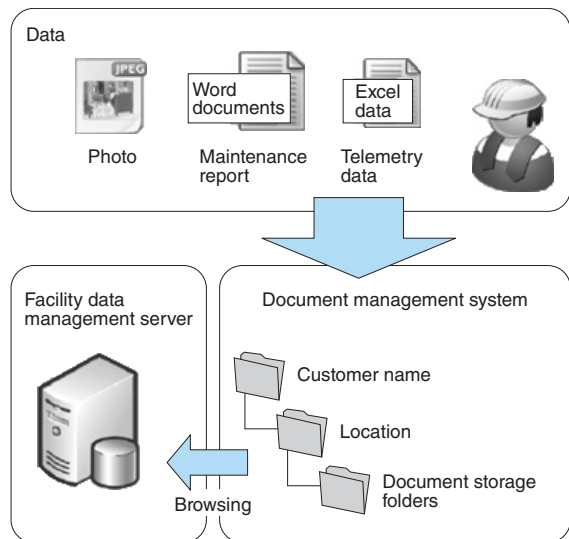

Fig. 6 Document Management

Various electronic documents are managed on the database.

（3） Related data control

Various data (drawings, reports, fixing/inspection data, etc.) about facilities can be checked. **Fig. 6** shows a diagram about document management.

3 Current Challenges

In order to build and actively use the database, it is indispensable to have the correct initial database structuring and perform subsequent data updating continuously. For regular business at our units using this system, we design for minimum data maintenance.

Since there are a variety of subject facilities and equipment under our contract care, it is important to correctly select diagnostic data and inspection data to be accumulated and monitored while we establish useful diagnostic techniques including analytical techniques by a statistical approach. There are some identifiers which are hard to identify such as serial numbers. In such a case, it is necessary to devise the method of data registration management.

In order to overcome such challenges, we have to design this system to be a more useful tool.

4　Significance of Facility Data Collection in Facility Diagnosis

For facility diagnosis, the status parameters of facilities in the past and present are quantitatively understood. This enables us to investigate possible causes of errors or failures and predict their future effects and determine necessary countermeasures. Diagnostic approach for facilities is similar to the diagnosis of an illness. As a diagnosis of an illness requires doctors, medicines, and follow-up, the correct diagnosis of facilities calls for records of maintenance works in the past (inspections, failures, repair services) and skilled technicians and engineers. For this purpose, the collection and accumulation of inspection and repair service data relating to the facilities, as well as a feedback action to the site, are an essential for a proper diagnosis.

The stored and accumulated information in the facility information management system is an important data source for diagnosis. Using various data regarding facilities, the most effective maintenance services can be accomplished by asking questions relating to issues at the facility, the degree of problem, if any, the value comparison difference between standard values and initial values, the difference from another similar specification machine, how to recognize the problem in terms of: type of problem, location, possible cause, and grade, and then predict the possible time (lead time) leading into the failure. Through such a course of thinking, adequate countermeasures

can be discovered. Referring to diagnostic services based on facility data, effective maintenance services can be offered. **Fig. 7** shows the added values of facility information management.

5　System Extension

Fig. 8 shows the system expandability. As the functions for system extensions, accumulated information about facilities, maintenance data, repair service data, etc. are being used. The cell phones or tablet PCs can be used so that data retrieval, reference, and data input can be carried out on site. This function is useful to improve working efficiency for maintenance when taking measures for services. System extension is promoted by intensifying
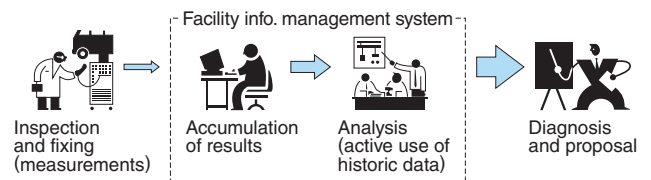
Fig. 7　**Added Values of Facility Information Management**

Added values can be raised through active use of information. (This is being used as information for making a decision for diagnosis and proposal)
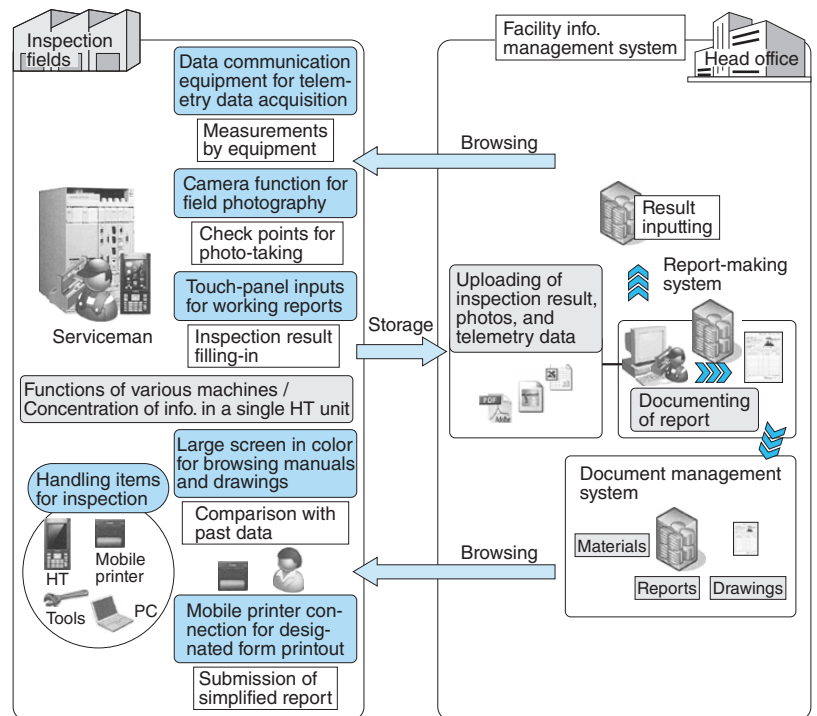
Fig. 8　**System Extension**

System expandability is shown for more effective use of data from the facility information management system.

the functions itemized below.
（1） Facility information browsing
（2） Maintenance history browsing
（3） Troubleshooting data browsing
（4） Related data browsing
（5） Working record inputting
（6） Simplified report outputting

6　Postscript

　　Maintenance services for facilities are classified into many business brackets for trial run, inspection, repair, adjustment, modification, extension, partial updating, etc. Therefore, systematic and consolidated management of various data and information is an essential factor for the efficient utilization of this system.

　　This system is intended to support the rational and efficient utilization for a series of maintenance services by actively feeding facility-related data. This system is also designed to provide useful information in deciding if we should provide for facility life extension or perform partial renovation while minimizing risk and cost. It aims to provide support for effectiveness and adds further values for maintenance service works in general.

　　Going forward, we will continue to increase the capability of this system to be a more useful tool that offers the most effective maintenance services.

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