Application of ICT to Lifecycle Support for Construction Machinery

Yoshihiko Takishita
Katsuhiko Murakami
Kunio Seki
Kazuaki Morishita

OVERVIEW: In its 2020 Vision, Hitachi Construction Machinery Co., Ltd. has expressed its aim of being a "Close and Reliable Partner anywhere on the Earth with Best Solutions through Kenkijin Spirit," and all parts of the company are working to ensure that they can satisfy increasingly diverse customer needs in a timely manner. ICT is a particularly effective tool for achieving this objective, and a wide range of technologies have been adopted in the construction machinery industry to provide the infrastructure for easy access to large quantities of data. Global e-Service is a support service that offers a diverse range of options for providing information on machine operation, while also making this information available for use in the lifecycle support of these machines.

INTRODUCTION

OUTSIDE the developing economies, the market for construction machinery is a mature one in which it has become difficult to differentiate products on the basis of performance alone. This makes aftermarket service particularly important.

What customers are looking for in aftermarket service is an improvement in machine utilization and a reduction in maintenance costs. Each construction machinery manufacturer has responded to this by using information and communication technology (ICT) to introduce techniques for managing machinery remotely.

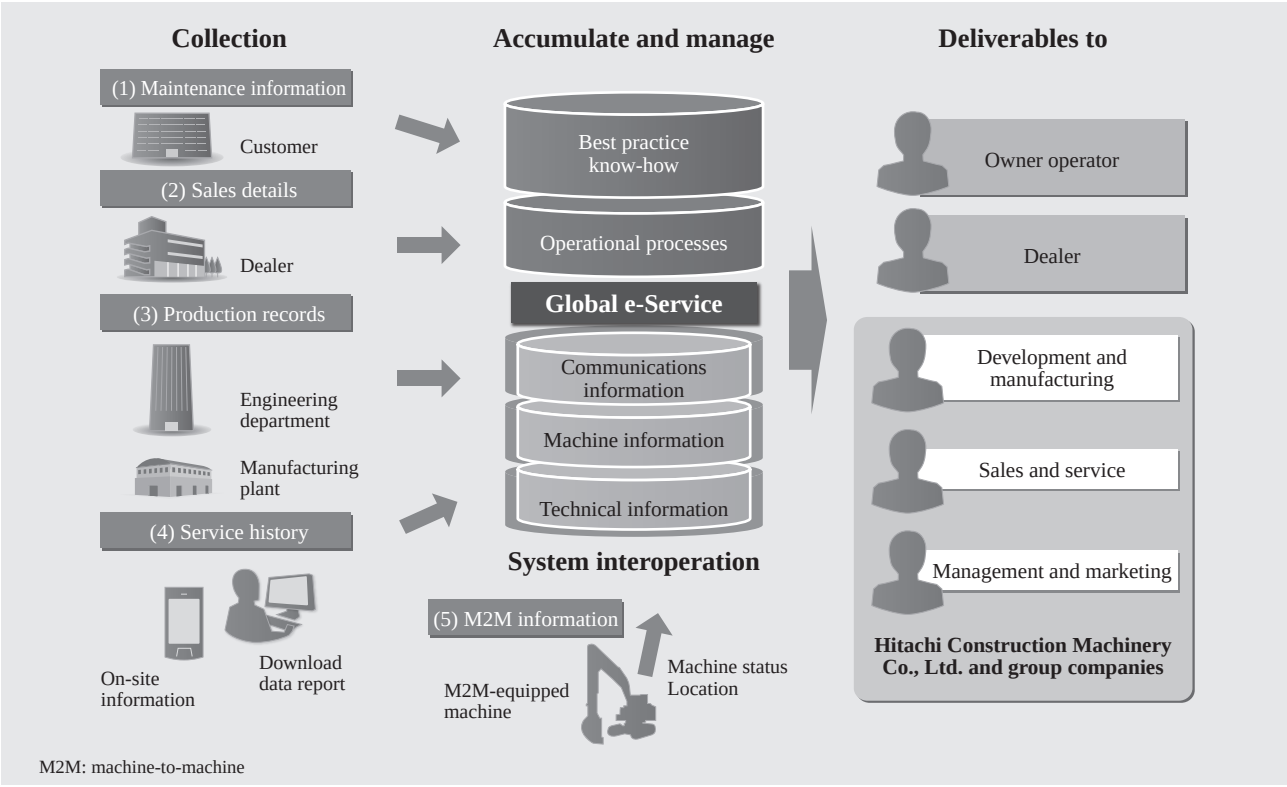


Fig. 1—Overview of Global e-Service Support Service for Construction Machinery.
The service performs integrated management of information that includes production records, service history, technical information, and sales details as well as operational data, supplying this data in ways that suit different users.

Hitachi Construction Machinery Co., Ltd. led the market in June 2000 by offering a satellite communications device as an option in its ZAXIS* Series 1 hydraulic excavators, releasing it on the market as an "information excavator" capable of remotely collecting operational information[(1)]. The function was subsequently made a standard feature on the ZAXIS-3 Series released in April 2006.

Hitachi Construction Machinery has also been operating its Global e-Service since October 2005. This system performs integrated management of operational information together with associated machine and technical information. It seeks to improve work efficiency by supplying everyone involved in supporting the machinery with the information they require, including the customer.

This article gives an overview of how Global e-Service uses ICT to support the lifecycle of construction machinery, and describes examples of aftermarket use of operational information for lifecycle support.

OVERVIEW OF GLOBAL E-SERVICE

Global e-Service can be broadly divided into the following three functions.

(1) Collect production, quality, operational, technical, sales, and service history information from the time of manufacture to the end of the machine's life (see Fig. 1).

(2) Store the collected information and perform integrated management.

(3) Provide a range of options for making the accumulated information available to the parties involved with the machine.

Including those used by administrators, the system offers approximately 80 functions. Different combinations of functions are made available to suit different users, such as dealers or customers.

Global e-Service currently manages document information for all Hitachi Construction Machinery Group products, and supplies useful information to approximately 24,000 registered companies and 60,000 users. As indicated by its name, the system supports 20 languages and operates globally with users in 82 countries or regions.

Global e-Service monitors operational information from machines via mobile phone or satellite communication networks, which is called machine-to-machine (M2M) services. It currently collects and stores large amounts of information from approximately 110,000 machines internationally and supplies this information for use in a variety of applications, including overlaying on maps, for example.

Fig. 2—Example Daily Report Screen.
This report presents the daily operational status of each machine in the form of graphs and data for use in machine management.

Based on data acquired from these M2M systems, the service can display information about the operation of each machine in the form of a daily report. The information in this report can be used to view details such as engine operating conditions, daily operating hours, the amount of fuel in the tank, and cumulative operating hours (see Fig. 2).

The system also includes a link function that allows various information from the machine to be accessed from this screen. Access to details such as the machine's maintenance history or technical data allows a quick response when responding to a customer inquiry, for example.

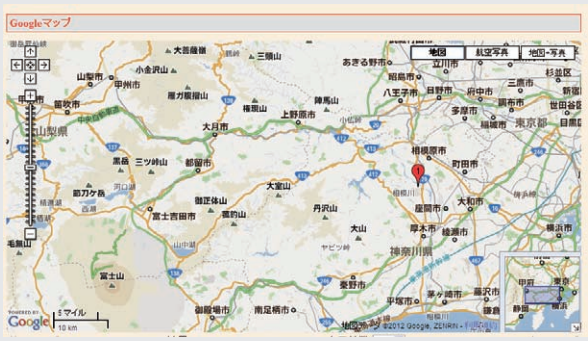
The communications device includes a global positioning system (GPS) function, and position information is sent together with operational data. Displaying the latest machine position on a map helps service personnel to work more efficiently (see Fig. 3).

EXAMPLE APPLICATIONS

Use for Service and Parts Sales

The departments responsible for service and parts sales are working on the development and utilization of a system for generating service reports for customers that uses the daily operational data sent from general-purpose hydraulic excavators and other mining equipment fitted with communications

* ZAXIS is a trademark of Hitachi Construction Machinery Co., Ltd.



*1 Zenrin is a product name, trademark or registered trademark of Zenrin Co., Ltd.
*2 Google and the Google Logo are registered trademarks of Google Inc.

Fig. 3—Managing Machines on Map.
Displaying the latest positions from all of the machines belonging to a customer on a map improved the efficiency of field servicing.

Fig. 4—Example Repair Proposal Screen.
Convincing proposals can be produced by combining operational data with the results of a visual inspection.

devices to collect information such as advice on when to perform maintenance or repairs, suggestions for preventive maintenance, and guidance on operating practices. To provide timely services and sales of spare parts, they also conduct field servicing and other work at appropriate times based on data such as the cumulative engine running time (“hour meter”) and position information. The following sections describe the functions of the report system based on machine operating data and provide examples of how it is used and of proposals presented to customers.

(1) Service report support system

In the past, most reporting has been done by hand using printed forms or on a personal computer using software such as Microsoft Excel* or Microsoft Word*. Accordingly, in certain ways, the quality of the reports and the time taken to produce them depended on the abilities of the people doing the work. The service report support system establishes the procedures (“flow”) for consistent reporting processes and methods, improving report quality, reducing the work required to produce them, and enhancing the ability to present proposals to customers.

In Japan, Hitachi Construction Machinery provides a free inspection service (special field servicing) as part of its marketing of services, using the results of the inspections as feedback to gain orders for repair work or to produce proposals for services such as preventive maintenance. Along with machine inspection results, the service report support system collects operational information recorded by the machine, such as temperatures and loads, and also provides an easy way to present it in a graphical format. This makes it possible to explicitly determine the required timing for repairs or other maintenance by presenting not only external damage or deterioration, but also the load on the engine and hydraulics, and to compile convincing repair proposals (see Fig. 4).

Customer concerns about cost continue to grow in the global market for construction machinery, and the service departments are currently transferring to overseas dealers the know-how in acquiring orders for services that they have built up through their own experience with services in Japan.

In overseas markets, meanwhile, the favorable conditions enjoyed by mining businesses in recent times are making support for mining machinery even more important. In countries such as Australia or the Republic of Indonesia that have a large number of mines, customers are increasingly using operational data themselves to ensure that machine maintenance is efficient and economical, and are expressing strong interest in the reports from dealers. Significant numbers of mining machines have full maintenance service contracts (FMCs) and dealers provide periodic reports on these machines. Utilizing this information, Hitachi Construction Machinery is working to deepen communication with customers and to improve machine utilization (see Fig. 5).

A reporting system is also under development to generate operating data reports for hybrid models

* Microsoft Excel and Microsoft Word are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries.

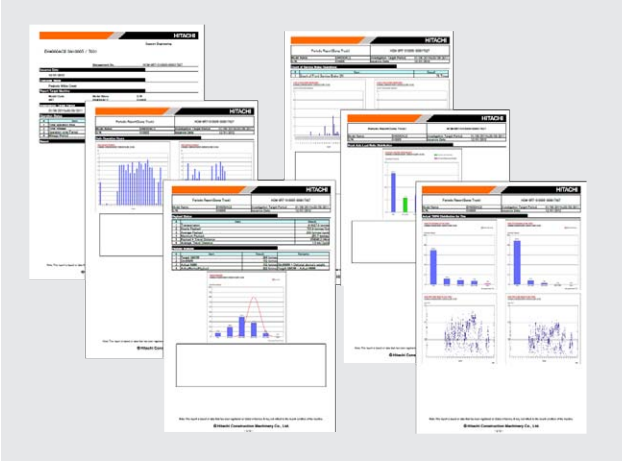


Fig. 5—Example FMC Report Screen.
Regular detailed operational data reports are sent to customers who have mining machinery covered by a full maintenance contract (FMC).

released in 2011 and to show the superiority of hybrid models by comparing these with conventional models, particularly in terms of operational and fuel consumption data. Recent price increases have further raised customer concern about fuel consumption. Because whether or not hybrid models deliver adequate fuel savings and environmental benefits depends on how they are driven by the operator and on other operational conditions, Hitachi Construction Machinery sees these reports as becoming an effective tool for contact with customers in the future. Reports are already being distributed on a trial basis and the ultimate plan is to integrate this reporting into the service report support system.

(2) Use of event monitoring system

Steps are being taken around the world to reduce emissions of greenhouse gases, and industry is obliged to comply with exhaust gas laws that also apply to construction machinery fitted with large engines. Under the schedule for implementation of these laws, key models are currently covered by Stage III B (in Europe) and Interim Tier 4 (in the USA). The technology used to achieve compliance involves fitting muffler filters (DPF, catalyst-based diesel particulate filter).

Muffler filters work by extracting and burning particulate matter (PM), and maintaining this PM scavenging ability is a mandatory requirement for reaching the levels stipulated in the regulations. To achieve this, Hitachi Construction Machinery developed an event monitoring system that uses the communication function for efficient status monitoring. The system collects relevant events that indicate the engine status and passes this information to Global e-Service. Service departments remotely monitor the machines in their territories and respond to each event depending on its status. Guidelines have been compiled specifying how to respond to each event, providing instructions on what to do when events occur and improving the speed of response (see Fig. 6).

(3) Example proposal to customer on how to improve work practices

This example describes how analysis of operational information helped improve machine fuel consumption.

When the basic performance of the machine in question was first studied, it was found to have no problems itself and to be delivering its rated performance. Next, operational information was collected from other machinery from the same industry to provide a comparison (see Fig. 7).

When the pump load of the machine in question was compared against the average pump load from the other machines, it was found to be frequently operating in the maximum load range. The customer was questioned about the nature of the work being performed by the machine and suggestions for improving operating practices were made to reduce actual fuel consumption.

Marketing Example

In contrast to servicing work that deals with individual machines, sales departments take a macro

Fig. 6—Example Screens for Event Monitoring System.
The screens present engine status information together with guidance on what to do next based on events from the machine.

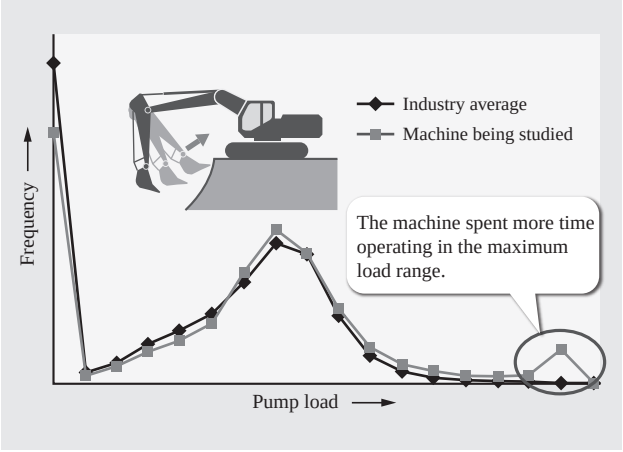


Fig. 7—Analysis of Pump Load.
Based on a comparison with average loads in the same industry that indicated the machine was frequently operating in the maximum range, improvements were made to operating practices to reduce fuel consumption.

approach to analyzing operational data. A system has been implemented that provides an overview of operational data from machines around the world and displays the trend in operating times in each region (see Fig. 8).

This system can be used to compare changes in relevant time-series information (such as total operating time, mean operating time, and number of machines) over any time period between one day and three years. The system also allows different comparison variables to be selected for display, including customer-related information such as industry type, demand information, or economic indicators.

Currently, the system is mainly used for reference when formulating sales strategy and to issue reports to senior management and the respective country managers, accompanied by comments from local managers.

CONCLUSIONS

This article has given an overview of how Global e-Service uses ICT to support the lifecycle of construction machinery, and described examples of aftermarket use of operational information for lifecycle support.

Other ways in which Hitachi Construction Machinery is using this technology include in new machine development and to help make further quality improvements. For example, centralized management of operational data from around the world provides an understanding of how machines are used in each country or region, allowing the development of machines that suit actual conditions.

Putting operational information to good use throughout the product lifecycle, including development, allows Hitachi Construction Machinery Co., Ltd. to deliver machines and services that customers can use with confidence, and to seek to be a "Close and Reliable Partner anywhere on the Earth with Best Solutions through Kenkijin Spirit."

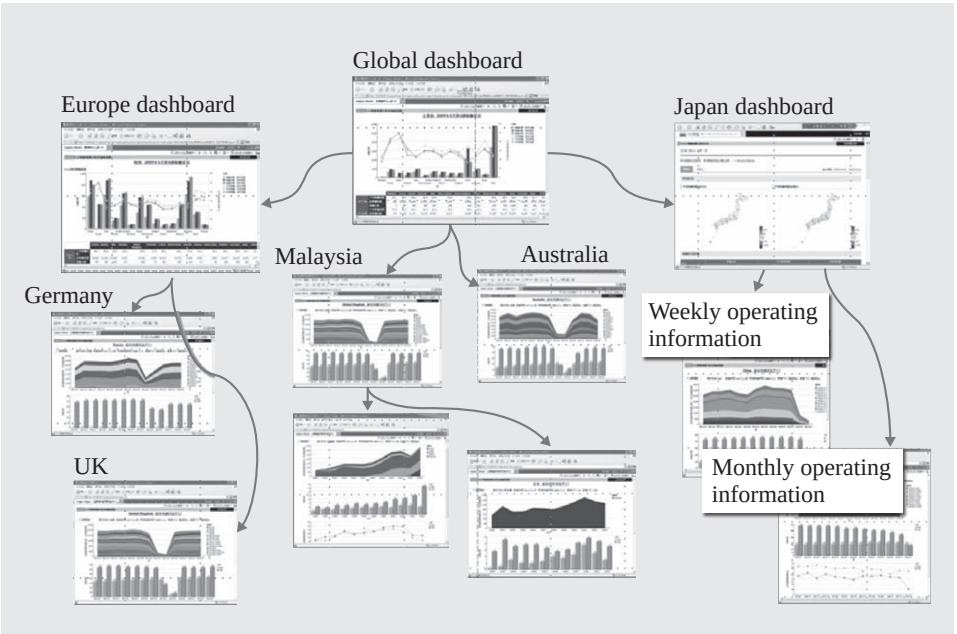


Fig. 8—Screens from Operation Visualization System.
The system can be used to view operational information from around the world by shifting the focus from the global dashboard to specific regions or models.

REFERENCE

(1) G. Sugiyama, "Construction Machinery and Construction in the 21st Century: Use of IT in Construction Machinery," Kensetsu no Kikaika, No. 611, pp. 46–49 (Jan. 2001) in Japanese.

ABOUT THE AUTHORS

Yoshihiko Takishita

Joined Hitachi Construction Machinery Co., Ltd. in 1981, and now works at the Information Strategy Department, Development Support Center. He is currently engaged in planning and analysis of machine operation data.

Katsuhiko Murakami

Joined Hitachi Construction Machinery Co., Ltd. in 1979, and now works at the Service Department, Customer Support Division. He is currently engaged in service planning, administration, and dealer support.

Kunio Seki

Joined Hitachi Construction Machinery Co., Ltd. in 1989, and now works at the Life Cycle Support Promotion Office, Life Cycle Support Operations Group. He is currently engaged in planning and administration for the Life Cycle Support Operations Group.

Kazuaki Morishita

Joined Hitachi Construction Machinery Co., Ltd. in 1987, and now works at the CRM Promotion Department, Sales & Marketing Division, Marketing Group. He is currently engaged in customer relationship management, businesses intelligence, sales force automation, global web management, and digital marketing.