

Topics

Operation and Maintenance Solution for Social Infrastructure such as Roads

As many bridges and other social infrastructure throughout Japan were constructed during the era of rapid economic growth, a large number of them are now deteriorating. Prompted by events such as the Sasago tunnel accident, the Ministry of Land, Infrastructure, Transport and Tourism is working on allocating responsibility for the inspection and diagnosis of social infrastructure, and on establishing maintenance cycle practices. Hitachi Systems, Ltd. supplies a one-stop solution for the operation and maintenance of social infrastructure targeted at highways and local government agencies. The solution includes: (1) centralized management of ledgers, (2) use of deterioration prediction for maintenance planning, and (3) support for field work. Hitachi Systems also provides associated services that include support for creating initial ledgers, business process outsourcing (BPO) of inspection work, and positioning (using radio-frequency identification tags or color coding). Hitachi Systems intends to expand progressively into new areas of activity by combining Hitachi Group's products and services to provide comprehensive support for the operation and maintenance of social infrastructure.

INTRODUCTION

APPROXIMATELY 70% of the 700,000 or so bridges in Japan are on municipal roads and so are managed by local government agencies. Like other social infrastructure, many of these bridges were built since the period of rapid economic growth in the 1960s, meaning that an increasing number will be nearing 50 years of age.

It has been reported that local government agencies find it difficult to take adequate steps to deal with the deterioration of social infrastructure due to a lack of budget, human resources, and technology⁽¹⁾. Approximately 90% of Japan's municipalities have expressed concerns about safety due to a lack of funds for dealing with deteriorating infrastructure. Furthermore, approximately 50% of towns and 70% of villages lack any civil engineering staff to work on bridge maintenance. Approximately 80% of local government agencies are reported as having issues with the quality of inspection work, with their bridge inspection requirements specifying remote observation only rather than a close visual inspection⁽¹⁾.

Prompted by the 2012 ceiling panel collapse in the Sasago tunnel, the Ministry of Land, Infrastructure, Transport and Tourism is taking steps to deal with deteriorating social infrastructure, including investigating whether to have road managers conduct routine inspections, soundness calculations, and repair planning based on standardized criteria, and whether to provide subsidies or offer other funding schemes to local government agencies that take appropriate steps.

This article describes a solution supplied by Hitachi Systems, Ltd. for the operation and maintenance of social infrastructure in relation to measures for dealing with deteriorating social infrastructure.

SOLUTION FOR OPERATION AND MAINTENANCE OF SOCIAL INFRASTRUCTURE

Hitachi Systems supplies a one-stop solution for the operation and maintenance of social infrastructure, with features that include (1) centralized management of infrastructure ledger data (infrastructure details, inspections, repairs), (2) calculation of long-term repair costs and repair planning based on predicting the deterioration of infrastructure, and (3) functions for supporting inspections and other field work (see Fig. 1).

The ledger database provides centralized management of collected data that includes details of the infrastructure (name, location, coordinates, jurisdiction, date of entering service, structure, and so on), inspection records (date, materials, status, presence of abnormalities, type of problems, assessment, and so on), and repair information (date, location, method used, and so on).

This data is used as the basis for deterioration prediction and lifecycle cost (LCC) calculation to produce a long-term management plan that includes a list of the repairs to perform in each fiscal year.

It is also intended to improve efficiency by providing functions that use a tablet computer for

things like outputting of work instructions, displaying of relevant data, and uploading of inspection data. Hitachi Systems also offers a data entry outsourcing service for things like infrastructure details and inspection records.

Formulation of a Long-term Management Plan

This section describes a function for utilizing data to formulate a long-term management plan based on information such as infrastructure details and inspection records⁽²⁾.

A deterioration model is used to predict the future value of the soundness index for each item of infrastructure based on its soundness index as determined by inspection.

Scenarios are defined in advance of the LCC calculation indicating the value of soundness index at which repair work is triggered for each item of infrastructure. This can be used to obtain the repair costs that need to be funded in each fiscal year by estimating the future value of the soundness index, including the improvements that result from repairs.

A long-term management plan is then formulated by totaling up the repair costs in each fiscal year for all of the infrastructure administered by the local government agency and then making adjustments such

as deferring maintenance to later years in order to fit within the available budget.

This maintenance planning process is designed, at the system level, to provide a common platform that is not specific to any one type of social infrastructure or local government agency, and to be customizable.

Furthermore, because it is possible to specify for each item of infrastructure which model to use, Condition Based Maintenance or Time Based Maintenance, a hybrid approach can be adopted for infrastructure that includes equipment of different types, such as civil engineering structures, machinery, and electrical equipment.

Screen Output Example

Fig. 2 shows an example of screen output for bridges that shows a repair plan that satisfies budget constraints. The left side of the screen shows a graph of the total bridge repair costs for each fiscal year and another of the distribution of soundness index values for the bridges. The center part of the screen displays a list of all of the bridges. The right side of the screen shows the LCC trend graph for the bridge selected in the list together with a list of the repairs required in each fiscal year.

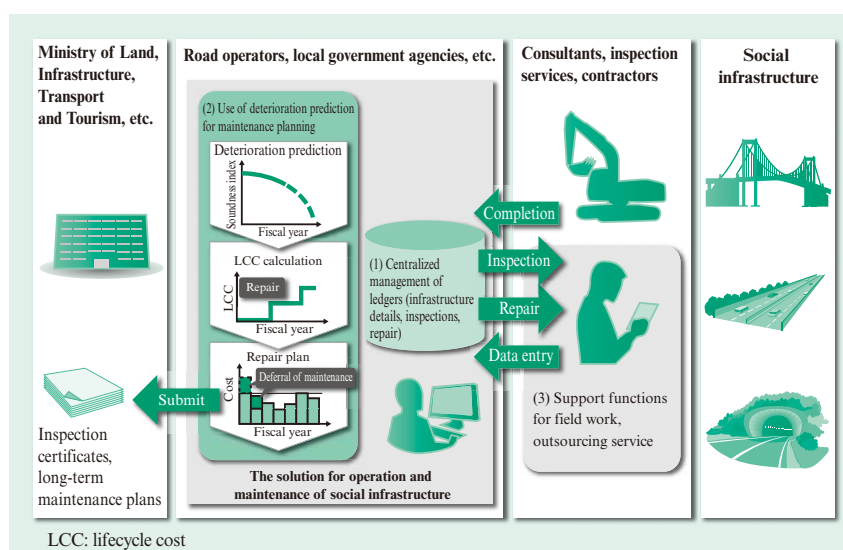


Fig. 1—The Solution for Operation and Maintenance of Social Infrastructure. It supports road operators, local government agencies, inspection services, and other organizations by providing a one-stop solution for the maintenance of social infrastructure.

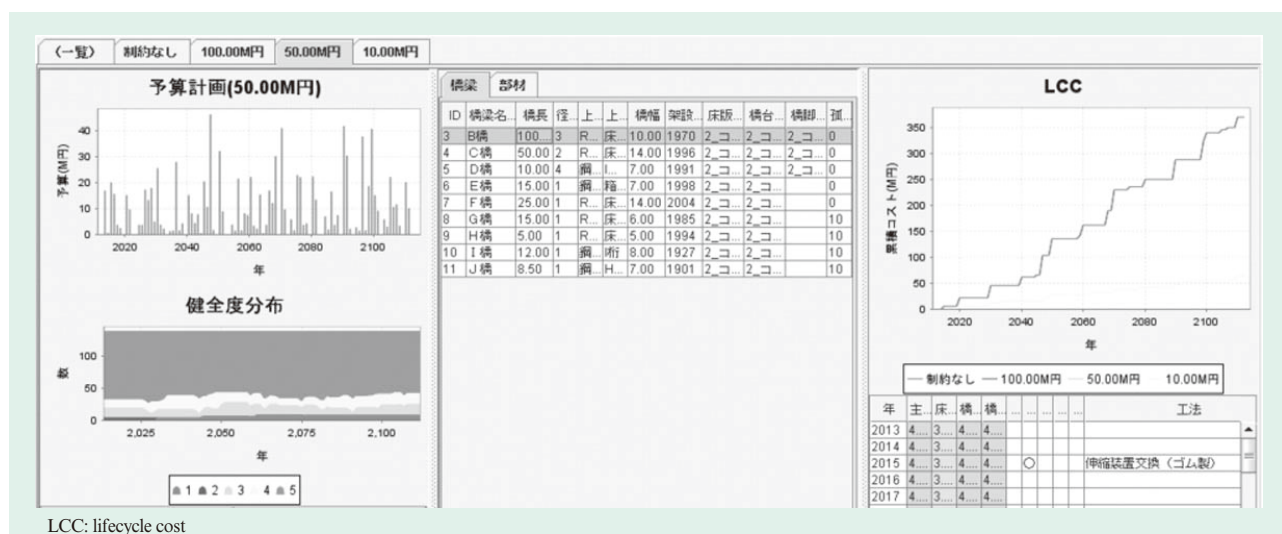


Fig. 2—Screen Output Example for Bridges.

The screen shows a graph of the total bridge repair costs for each fiscal year and the distribution of soundness index values (left), a list of all bridges (center), and an LCC trend graph for the specified bridge and a list of the repairs for each fiscal year (right).

FUTURE OUTLOOKS

While the ledger function and the functions for using data are currently provided as an on-premises system, Hitachi Systems is also planning to make a cloud service available.

Meanwhile, by sharing information as much as possible with neighboring local government agencies, there is also scope for achieving highly accurate deterioration prediction and consistency in repair planning over a wide area.

CONCLUSIONS

This article has described the one-stop solution for operation and maintenance of social infrastructure that provides functions for managing maintenance in ways that deal with the deterioration of social infrastructure, including: (1) centralized management of ledgers, (2) use of deterioration prediction for maintenance planning, and (3) support for field work.

In the future, Hitachi Systems intends to combine the products and services of Hitachi, Ltd., Hitachi Industry & Control Solutions, Ltd., Hitachi Solutions, Ltd., and other companies with the aim of delivering multifaceted services that include peripheral services. Hitachi Systems also intends to contribute to the ongoing progress of society

by expanding its work for highways and local government agencies.

REFERENCES

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ABOUT THE AUTHORS



Hideo Abiru
Social Information Service Division,
Hitachi Systems, Ltd. He is currently engaged in
development of the Public Infrastructure Asset
Management System.



Toyohisa Morita
Research & Development Division,
Hitachi Systems, Ltd. He is currently engaged in the
research and development of data analysis. Mr. Morita
is a member of The Institute of Electronics, Information
and Communication Engineers (IEICE), The Japan
Society of Mechanical Engineers (JSME), and The
Institute of Electrical Engineers of Japan (IEEJ).