Contribution to the achievement of SDGs by Furukawa Electric Group


# Digital Transformation of Infrastructure Maintenance Provided by FURUKAWA ELECTRIC

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**ABSTRACT** The Social Design and New Business Development is an organization whose mission is to create new businesses that solve social issues in order to realize the "Furukawa Electric Group Vision 2030". Specifically, the organization is working to create new businesses in segments such as social infrastructure maintenance and management DX, life science, and space by 2030. This paper introduces the Maintenance/Inspection Support Solution for Small-scale Infrastructures, which realizes the digital transformation (DX) of maintenance and management of small-scale infrastructures, a major initiative in the current DX segment of the social infrastructure maintenance management, and also introduces future developments in the social infrastructure maintenance management segment.

## 1. INTRODUCTION

The Social Design and New Business Development (SDNBD) was established in 2021 with the goal of creating new businesses that contribute to solving social issues and creating new businesses in fusion fields in order to achieve the "Furukawa Electric Group Vision 2030". The SDNBD is characterized by its ability to create new businesses by quickly changing direction in the right direction based on the Voice of Customer (VOC), using design thinking and lean startup methods, rather than being overly concerned with its own technologies. Currently, the SDNBD is focusing on the social infrastructure maintenance DX, life science, space, and other business segments.

In the social infrastructure maintenance and management DX segment introduced in this paper, we aim to develop new DX businesses through technological innovations for the maintenance and the management of social infrastructures, which are facing many issues, and to grow them into businesses. At present, we are mainly working on DX for the maintenance and the management of small-scale infrastructures and facilities along railroad lines, and DX for the disaster prevention and its mitigation. In this paper, we introduce the Maintenance/Inspection Support Solution for Small-scale Infrastructures as a case study, keep in mind that the main customers are municipalities that manage small-scale infrastructures and construction consultants who are contracted by municipalities to perform inspections, which are completely new to Furukawa Electric. In addition, the technology required was not our own, and it was a challenging work, but we have received more than 50 orders to date, and it can be said that we have taken a steady first step toward our goal of creating new businesses.

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## 2. WHAT IS THE MAINTENANCE/INSPECTION SUPPORT SOLUTION FOR SMALL-SCALE INFRASTRUCTURES?

Before moving on to the introduction of the Maintenance/Inspection Support Solution for Small-scale Infrastructures, we will first explain the environment and issues surrounding small-scale infrastructures. Small-scale infrastructures are mainly consisting of roadside structures such as road signs and road lighting, and are administrated by municipalities and prefectural public safety commissions. Infrastructure maintenance and its management may give a strong illustration of the maintenance required for the road structures such as bridges and tunnels, but small-scale infrastructures are also required to make efforts to conduct an interim inspection once every five years and a detailed inspection once every 10 years, and periodical inspections are conducted by construction consultants commissioned by the administrators. However, the number of such lists is large, and it is known that there are many cases in which the lists themselves do not exist, or even if they do exist, they deviate from the actual situation. Furthermore, in inspecting all of them, the inspection method, timing, and diagnosis often differ depending on

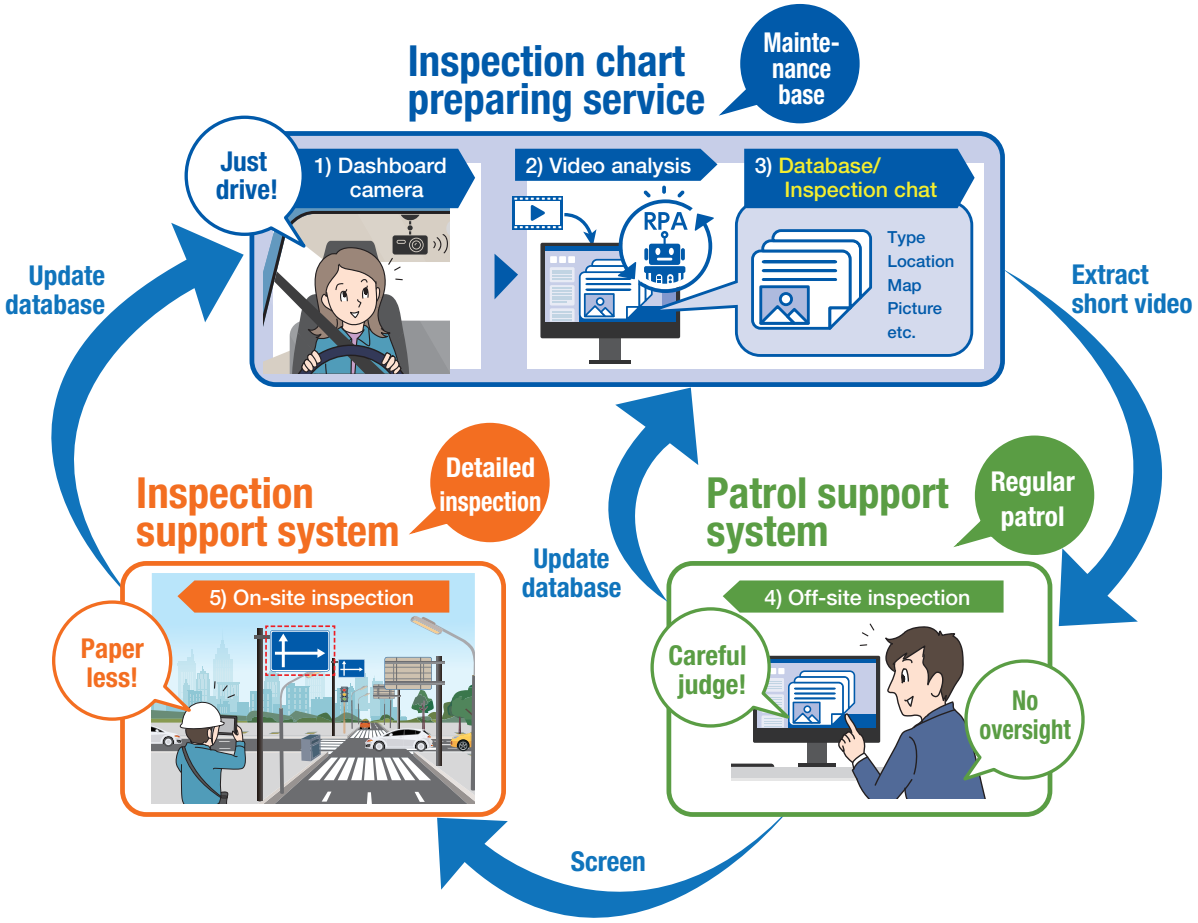


**Figure 1** New maintenance cycle realized by the Maintenance/Inspection Support Solution for Small-scale Infrastructures.

the characteristics of the route, the influence of automobile traffic, and the installation environment, making it difficult to conduct inspections using a standard method. In other words, many municipalities are caught in dilemmas such as “It is difficult to make plans without knowing all buildings and locations.”, “In addition, budgets cannot be secured because of the large costs involved.” and “Due to a number of issues such as the inability to standardize inspection methods, the issues end up to be left alone.”

In response to the above situation, believing that the method of screening only small-scale infrastructures that should be inspected in details and implementing a management inspection plan in a rational manner should be adopted, instead of the two options of conducting a detailed inspection of the entire numbers or not at all, we have developed a new method to realize a new maintenance cycle for a vast number of small-scale infrastructures by utilizing our original Robotic Process Automation (RPA) technology (Figure 1).

## 3. THE MAINTENANCE/INSPECTION SUPPORT SOLUTION FOR SMALL-SCALE INFRASTRUCTURES SERVICES

In order to realize the maintenance cycle shown in Figure 1, the Maintenance/Inspection Support Solution for Small-scale Infrastructures provides the services required for each maintenance phase.

### 3.1 Creation of Databases and Inspection Sheets Using the Inspection Chart Preparing Service

At first, it is necessary to identify small-scale infrastructures to be managed and inspected, and to create a database. In contrast to the conventional human tactic method, we have developed a method to acquire digital data of panoramic views and location information of small-scale infrastructures using our original RPA technology from data acquired by a dashboard camera equipped on a patrol vehicle or other means traveling on the target road (Figure 2). This allows the administrator to complete the database simply by driving on the road with a vehicle

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | no | time | category | lon | lat | imagefilename |
| 2 | L00000010 | 2021-08-0 | カーブミラー | 139.4575256 | 35.3324355 | 20210809-051000925-L00000010.jpeg |
| 3 | L00000020 | 2021-08-0 | カーブミラー | 139.4576007 | 35.33247489 | 20210809-051008925-L00000020.jpeg |
| 4 | C00000030 | 2021-08-0 | 道路照明施設 | 139.4580621 | 35.33223856 | 20210809-051016814-C00000030.jpeg |
| 5 | L00000040 | 2021-08-0 | カーブミラー | 139.4583195 | 35.33215541 | 20210809-051022037-L00000040.jpeg |
| 6 | L00000050 | 2021-08-0 | カーブミラー | 139.4583625 | 35.33212915 | 20210809-051023074-L00000050.jpeg |
| 7 | L00000060 | 2021-08-0 | カーブミラー | 139.4587487 | 35.33191909 | 20210809-051029111-L00000060.jpeg |
| 8 | L00000070 | 2021-08-0 | カーブミラー | 139.4589418 | 35.33182281 | 20210809-051032518-L00000070.jpeg |
| 9 | C00000080 | 2021-08-0 | 道路照明 | | | |
| 10 | C00000090 | 2021-08-0 | 道路照明 | | | |
| 11 | C00000100 | 2021-08-0 | 道路照明 | | | |
| 12 | L00000110 | 2021-08-0 | カーブミ | | | |
| 13 | A00000120 | 2021-08-0 | 道路標識 | | | |
| 14 | C00000130 | 2021-08-0 | 道路照明 | | | |
| 15 | L00000140 | 2021-08-0 | カーブミ | | | |
| 16 | L00000150 | 2021-08-0 | カーブミ | | | |
| 17 | C00000160 | 2021-08-0 | 道路照明 | | | |
| 18 | C00000170 | 2021-08-0 | 道路照明 | | | |
| 19 | A00000180 | 2021-08-0 | 道路標識 | | | |
| 20 | C00000190 | 2021-08-0 | 道路照明 | | | |

**Figure 2** List file and a panoramic photo of the small-scale infrastructures created by RPA.

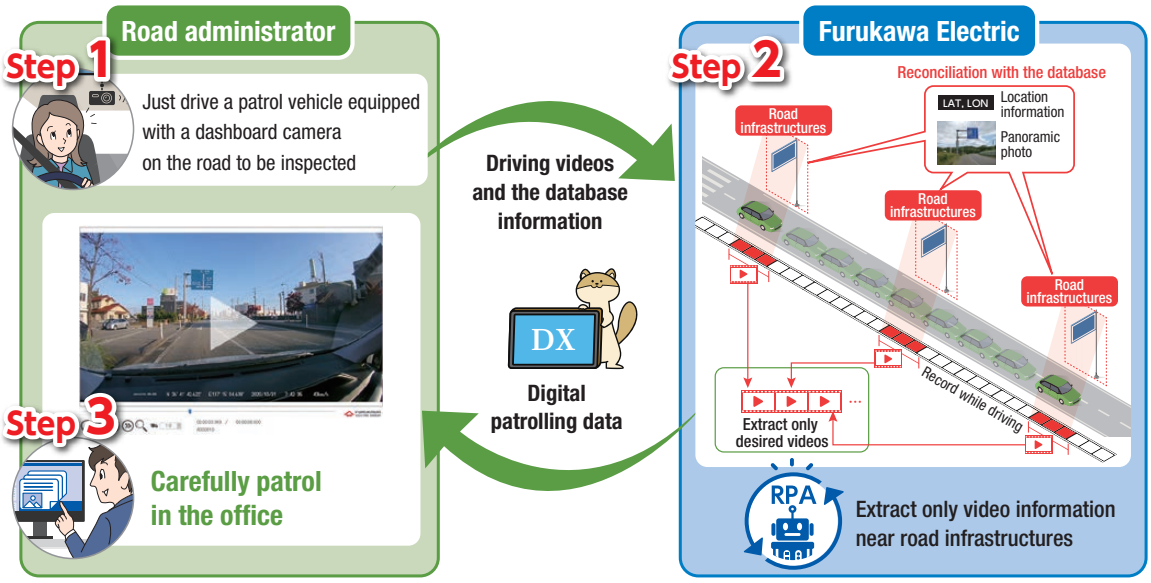


**Figure 3 Flow of the Patrol Support System.**

equipped with a dashboard camera, which significantly reduces costs and man-hours.

In addition, the system automatically creates an inspection list for each small-scale infrastructure in accordance with the inspection guidelines of the Ministry of Land, Infrastructure, Transport and Tourism, and creates and provides a digital management database that includes the above location and photographical information. This is what we identify as the Inspection Chart Preparing Service.

### 3.2 Patrol Inspection and Screening Using the Patrol Support System

With a correct situation of the small-scale infrastructures that need to be managed, it is necessary to periodically check for damages, in other words, conduct inspections and repairs. Here, too, we are providing a patrol support service that utilizes data from a dashboard camera. Based on the location information of small-scale infrastructures extracted using the Inspection Chart Preparing Service, short video data showing small-scale infrastructures are extracted from the video taken by the dashboard camera (Figure 3).

By linking the extracted videos to the database created by the Inspection Chart Preparing Service and reading them with dedicated software (Figure 4), it is possible to conduct patrol inspections without visiting the site.

**Figure 4 Example of the dedicated software display.**

In the patrol inspection with a car, since driving is necessary in areas where there are no small-scale infrastructures, it is not efficient and sometimes oversights may occur. However, using the Patrol Support System, it is possible to see videos of only the areas around small-scale infrastructures, and it is more efficient and also prevents oversights. Furthermore, by comparing videos extracted from the data obtained from the dashboard camera at different dates and times, it is possible to easily capture the deterioration over time.

What is important here is that the Patrol Support System allows a rough assessment of damages in a short period of time and without having to visit the site. If the inspection interval becomes long, the damage may progress to the point where rebuilding is necessary, and the cost of repairs will be high, but if the damage can be identified at a less severe stage, the cost of repair can be kept low. In addition, by identifying the level of damage in the preliminary stage of a comprehensive on-site inspection, it is possible to select small-scale infrastructures that should be inspected on a priority basis and to develop an efficient inspection plan. This is made possible with only the Patrol Support System, which can collect data simply by driving with a dashboard camera and efficiently extracting the necessary data using RPA, and can be considered the key element of the new maintenance cycle we are proposing.

### 3.3 Detailed On-site Inspection Support Using the Inspection Support System

The small-scale infrastructures that are judged as “detailed inspection required” using the Patrol Support System should be inspected in details at the site. In the detailed inspection, such as loose bolts, cracks, ... etc, are checked, and the results are recorded in an inspection sheet. However, the editing process is very complicated. It requires to enter the information written on paper at the site on a PC, or transferring photos taken with a

digital camera to a PC and posting them on the inspection sheet when coming back to the office. In order to reduce the burden of such works, we have developed an application called the Inspection Support System. The user brings a tablet with this application installed to the inspection site. The digital inspection sheet created by the Inspection Chart Preparing Service can be read and the inspection results can be directly input (Figure 5).


**Figure 5** **State of inputting inspection results in the Inspection Support System.**

In addition, since the system is equipped with a function that automatically assigns the photos taken to each part of the equipment, the need for conventional photo organization is eliminated (Figure 6).

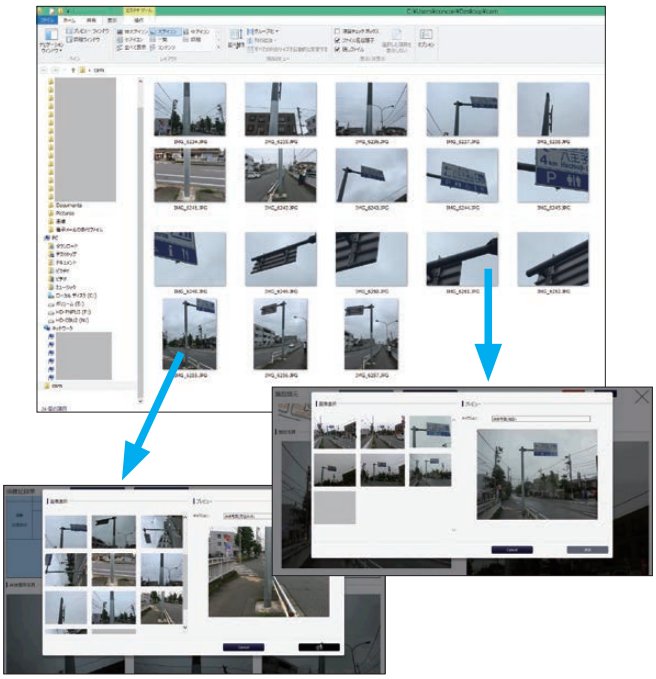

**Figure 6** **Function of automatically organizing photos in the Inspection Support System.**

This application is mainly used by construction consultants who are contracted by administrators to perform inspections, and it contributes greatly to the efficiency of the inspection work.

## 4. HISTORICAL RESULTS OF THE MAINTENANCE/INSPECTION SUPPORT SOLUTION FOR SMALL-SCALE INFRASTRUCTURES

Since its release about three years ago, more than 50 municipalities and construction consultants have used the Maintenance/Inspection Support Solution for Small-scale Infrastructures.

Municipalities such as Utsunomiya City and others are using the Inspection Chart Preparing Service to create databases, and have confirmed that it has significantly reduced work time by a factor of 10 compared to the conventional method. In addition, an increasing number of construction consultants are using the Inspection Chart Preparing Service to perform field inspections (e.g., preparation of field notebooks, confirmation of small-scale infrastructures, etc.) prior to detailed on-site inspections, as a result expanding the scope of use beyond database preparation.

Furthermore, in collaboration with a construction consultant, we have started an initiative to realize a new maintenance cycle (preventive maintenance), which is the goal of the Maintenance/Inspection Support Solution for Small-scale Infrastructures. The Inspection Chart Preparing Service is used to maintain a database of small-scale infrastructures managed by the target municipality, and then the Patrol Support System is used to perform patrol and screening. Based on the results, on-site inspections and individual facility plans will be developed. Starting from this plan, we will aim to operate preventive maintenance using the Patrol Support System.

## 5. FUTURE DEVELOPMENT OF SOCIAL INFRASTRUCTURE MAINTENANCE DX

We have mainly introduced the Maintenance/Inspection Support Solution for Small-scale Infrastructures up to this point, but now we will introduce other cases of social infrastructure maintenance and management DX services that are being developed, such as the Maintenance/Inspection Support Solution for Lineside Facilities, which is an extension of the Maintenance/Inspection Support Solution for Small-scale Infrastructures to the maintenance and management solution for facilities along railroad lines, bridge inspection support services, etc.

The Maintenance/Inspection Support Solution for Lineside Facilities utilizes the technology developed for the Maintenance/Inspection Support Solution for Small-scale Infrastructures and is being developed into a service that supports the maintenance of facilities along railroad lines, such as railroad poles and signals (Figure 7). The main services will include the creation and updating of a database of facilities along the railroad line and the support for patrols and inspections, and are scheduled to be launched as early as the fiscal year 2023. In addition, we are considering the development of a function to mea-

sure building limits and separation distances between facilities, as well as a function to automatically extract changes in condition, as needed unique to railroads.

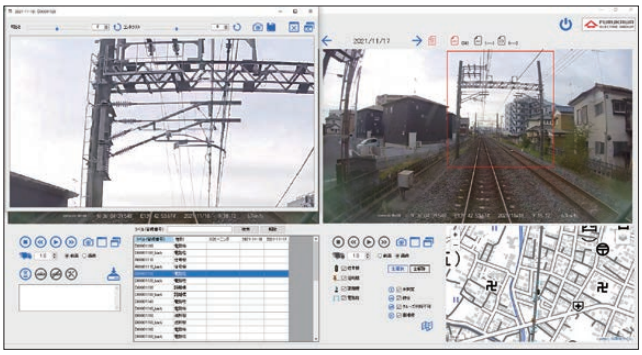

**Figure 7 State of facility patrol inspection along the lineside using the Maintenance/Inspection Support Solution for Lineside Facilities.**

In addition, DX for the maintenance and management of bridges, which are road structures, is also a large market, and in light of the recent circumstances, we believe that there is ample room for market development through unique solutions utilizing the Maintenance/Inspection Support Solution for Small-scale Infrastructures technology. We will capture the jobs of construction consultants involved in bridge inspections through design thinking and aim to provide truly needed services as soon as possible.

## 6. CONCLUSION

In this paper, we introduced the activities of the SDNBD to create new businesses in the social infrastructure maintenance and management DX segment. In the future, we will further increase the number of municipalities that introduce new maintenance cycles using the Maintenance/Inspection Support Solution for Small-scale Infrastructures, solve social issues related to small-scale infrastructures, and expand the market. We will also continue to develop the market for the Maintenance/Inspection Support Solution for Lineside Facilities, the bridge inspection support, etc., and contribute to the realization of the “Furukawa Electric Group Vision 2030”.