INSPECTION OF DISTRIBUTION FACILITIES USING TABLET COMPUTERS

Seiro NISHIKI
Kansai Electric Power Co. – Japan
nishiki.seiro@a5.kepco.co.jp

Ryota HOSOKAWA
Kansai Electric Power Co. – Japan
hosokawa.ryota@b2.kepco.co.jp

Juichiro TAKATA
Kansai Electric Power Co. – Japan
takata.juichiro@a2.kepco.co.jp

ABSTRACT

In Japan, we have constructed a huge amount of distribution facilities from 60's to 80's, the period of high economic growth. After this period, the economic growth became going down, so it is with the increment pace of our facilities. This means that we had been losing the opportunities to replace our facilities, and we will face a huge amount of aged facilities in near future. For this issue, we need to predict the remaining lifetime of our facilities, and in order to achieve it, more quantitative, more extensive, and more detailed data will be required. For this purpose, we have developed the system which can be called the system supporting "maintenance-oriented" operation, by utilizing tablet computers.

1. INTRODUCTION

In a period of high economic growth in the past, we constructed so many distribution facilities because the demand for electricity were everywhere, and our operation structure at that period focused on the effective construction work. However, after the period, due to the slowing down demand for electricity, we had been losing the opportunities of construction, which meant our facilities lost the opportunities to be replaced. Then, vast amount of our facilities are getting aged and deteriorated, and outliving their usefulness (refer Figure 1).
Under this situation, it is quite important to predict remaining lifetime of our facilities and set up the effective replace plan. For this, it is necessary to record, manage, and analyze the various kinds of data such as the environments of the deteriorating facilities. To achieve this, we have changed the structure of our operation to manage and maintain our facilities appropriately, from the construction-oriented operation.

2. ISSUES ON DISTRIBUTION FACILITIES MANAGEMENT

Our system has been mainly supporting the construction-oriented operation to construct a huge amount of facilities, while it did not support the maintenance operation sufficiently. In order to deal with the aged deterioration of our facilities, we need to change our operation from construction-oriented one to maintenance-oriented one, and we need to work on the following 4 issues;

2-(1) Collection of needed data to analyse the aged deterioration of our facilities

Our distribution facilities used to be often replaced through construction before the end of each lifetime, so we have not taken care of the aged deterioration and accumulated enough knowledge about it. Therefore, it has been quite difficult for us to predict remaining lifetime of our facilities. In future, through inspection or construction, we have to collect the quantitative, extensive, and detailed data effectively and accurately, which would be enough for us to be able to predict remaining lifetime of our aged facilities.

2-(2) Accumulation of the data

In the past, only the latest result of the inspection had been recorded, and there was not any historical record of past inspection results.
Not only the latest result but also the consecutive result from the past till now are required in order to evaluate the state of deterioration of our facilities and predict their remaining lifetime. We consider that even when we remove our facilities, the level of the deterioration of

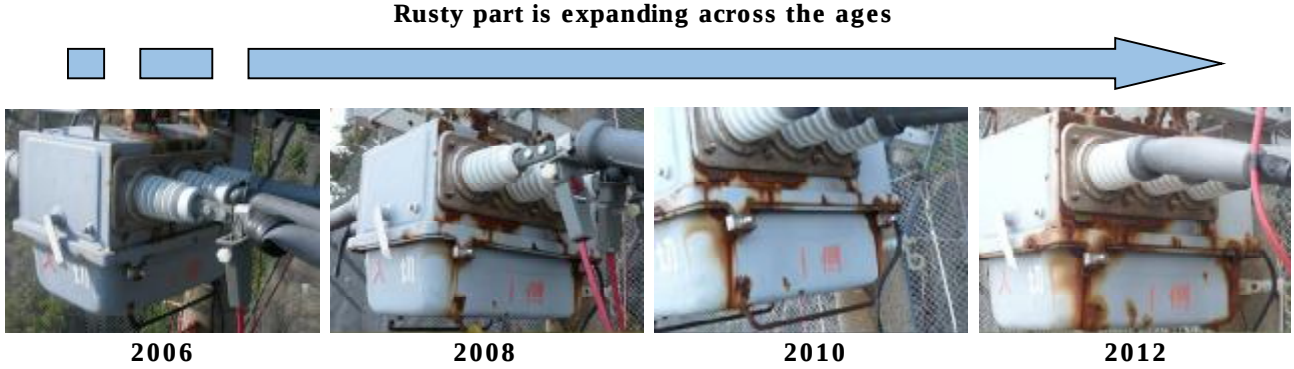

Figure 1: An example of the deterioration of a facility across the ages

such removed facilities should be analyzed and recorded for this purpose.

2-(3) Consistent management of data originating on facilities

Our current operation system is comprised of several operation units such as planning, construction, maintenance, and so on, and various kinds of data regarding each facility are stored dispersedly (refer Figure 2). So it is complicated and difficult to extract the whole data about the individual facility. It is necessary to change the system to manage the data originating on facilities consistently, so that we can extract the data needed for analysis, effectively and accurately.

2-(4) Reconstruction of the system which is bloated and complicated

Because we had modified our operation system several times, it has been complicated and expanded, which became a kind of patchwork-like system. Thus, it is required to be integrated and sophisticated system from both data extraction and utilization point of view and system maintenance point of view, in addition to addressing the issues 2-(1), (2), and (3).

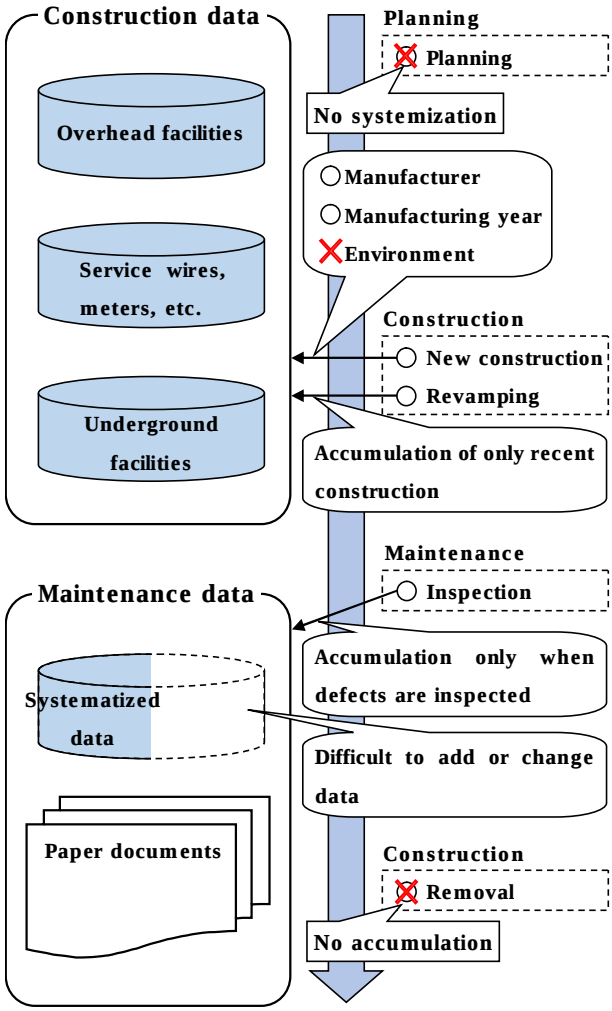

Figure 2: Problems about data accumulation on present operation system.

3. MAINTENANCE MANAGEMENT SYSTEM OF THE DISTRIBUTION FACILITIES IN THE FUTURE

3-(1) Improvement of our inspection operation

In order to address the issue 2-(1), we considered what would be the factors for aged deterioration which could be checked through our inspection work, and what kinds of data we should collect. Then, we decided to collect the environmental data where the facility is set because the environment has a huge effect on progression of its deterioration. As the result, it required us to collect much more extensive and detailed data than before. Besides, when field engineers sometimes encounter the deteriorated facility of which level is difficult to judge, we need to help them judge appropriately.

Our inspection work had been recorded by hand on many kinds of papers. It is obvious that work record done by hand on papers requires troublesome effort to be registered to the system and may contain some errors such as miswritten record. For these problems, we developed the system with using tablet computer, which enables field engineers to bring out the facility data to the field, enter and register the inspection result in the field.

3-(2) New system for data management

For the issues 2-(2), (3), and (4), we are reconstructing the operation system and newly constructing an integrated database of facilities, which stores all kinds of data of each individual facility, such as year of manufacture, name of manufacturer company, year of constructed, environmental data, inspection result in the past, etc. It will make it possible to refer and extract all kind of required data such as the history of inspection and maintenance and the level of deterioration, and to analyze and evaluate them.

Furthermore, we believe that it would be valuable for evaluating remaining lifetime of facilities to collect environmental data of removed facility as well, which make us to be able to set up the efficient and cost effective replacement plan. To achieve this, we newly constructed a database of removed facilities (refer Figure 3).

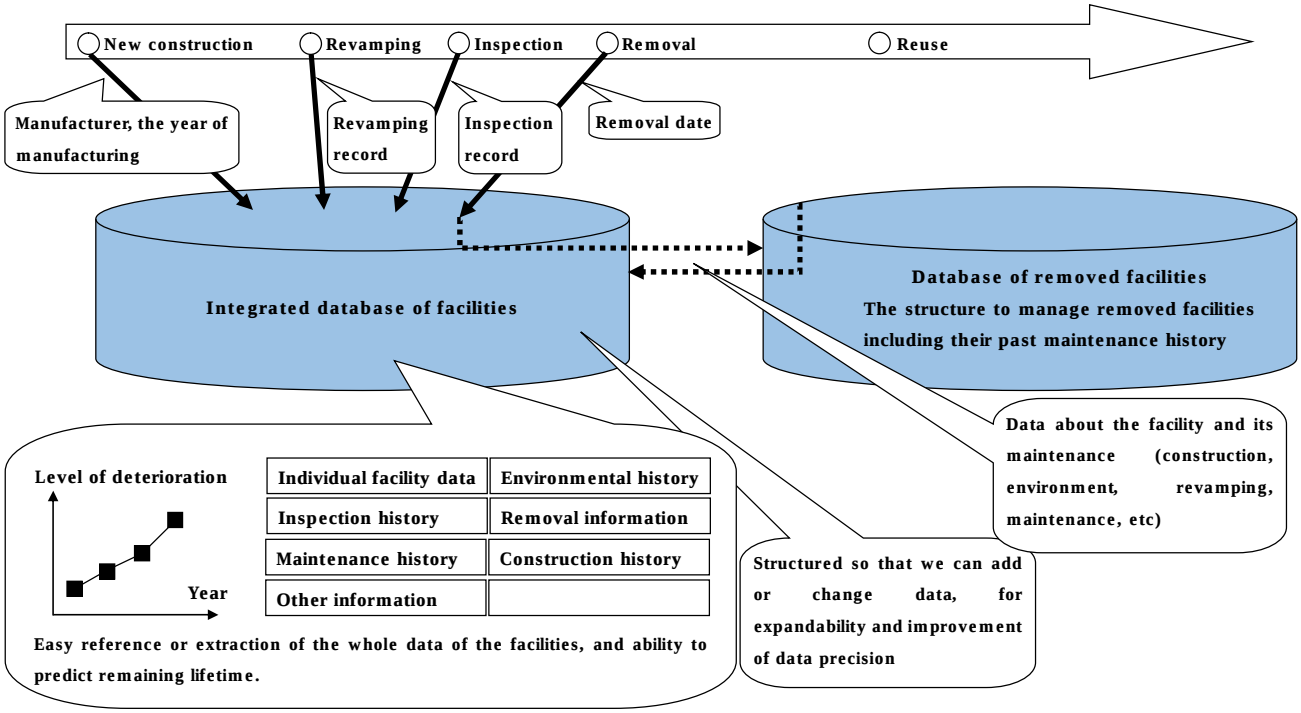

Figure 3: The image of the accumulation and management of the data in the future

4. MAINTENANCE OPERATION OF THE DISTRIBUTION FACILITIES USING TABLET COMPUTERS

We have developed the tablet computer system supporting our maintenance operation above and started to apply it in April 2014.

4-(1) Overview of the tablet computer system for inspection and points of its development

The tablet computer has a 7-inch screen that has a good visibility and easy to use by only one hand. It weighs 545 grams and its durability and waterproof function are enough for our field engineers handling in the field.

Figure 4: A field engineer inspecting facilities using the tablet

Our field engineers can take high-quality pictures of deteriorated spots by 13-mega-pixel digital camera on the tablet, and the picture files are resized appropriately to avoid an excessive consumption of the available memory.

We have eliminated the functions depending on OS itself and machine specification as much as we could, which helps us to decrease the modification of the program when we change the machine model in the future. Furthermore, items to be inspected for each facility are sorted out in a table so that we can easily deal with changing or adding them. For security matter, its authentication function prevents non-authorized people from logging in.

4-(2) How to inspect facilities using tablet computer

Before field engineers start daily inspection, they download the data about the facilities that exist in the targeted area of inspection on that day from our operation system to the tablet in the office. In addition the tablet computer has the documents containing information about facility maintenance work like manuals. In the field, the field engineers tap the symbol of the electric pole on the map shown on the tablet, and then items for every facility to be inspected come out. Following the indication on screen display, field engineers register the level of deterioration, the environmental data where the facility is set and the necessity level for replacement (refer Figure 4 & 5).

Figure 5: The operational image on the tablet

When field engineers found any deteriorated facilities that should be replaced, they issue the slip sheet for requesting replacement, and take and save pictures of such facilities in the tablet. These pictures are associated with the pole ID.
Furthermore, when it is difficult for field engineers to judge the level of the deterioration of the facility, the tablet can show our manuals and example pictures to help to determine the level of deterioration, so that the inspection level would be standardized.

4-(3) The effectiveness of the use of the tablet

Since April 2014, taking advantage of the tablets, we have been operating the "high-precision inspection", recording more extensive and detailed level of deterioration and the environmental data than ever. Compared to the conventional inspection, our field engineers spend more time in the field because our high-precision inspection needs more items to be inspected. However, the tablet computer system somewhat streamlined the inspecting operation because it doesn't need many paper documents taken to the field (refer Figure 6). Besides, the inspection result entered to the tablet in the field can be easily uploaded to the operation

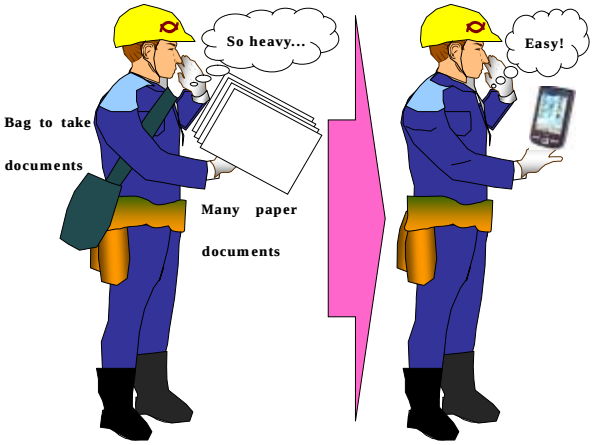

Figure 6: The comparison of a field engineer inspecting using paper documents and tablet computer

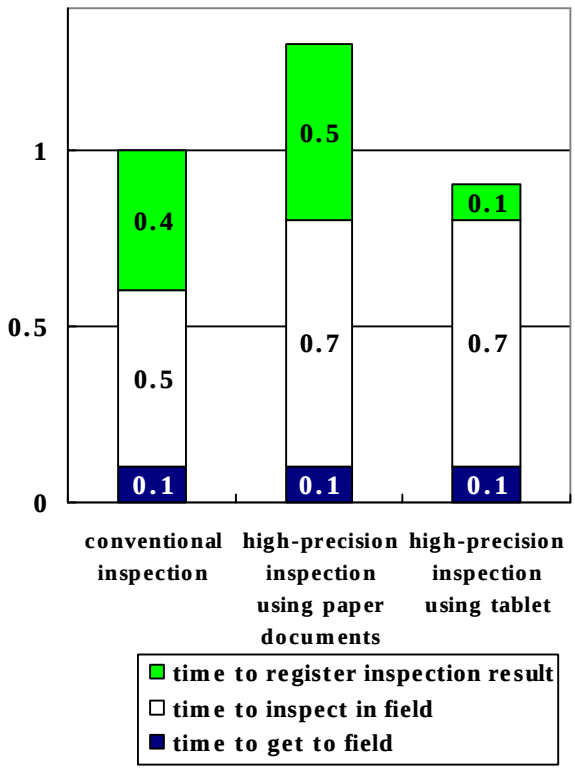

Figure 7: The comparison of effort on inspection of facilities

system in the office, so the effort to register the result and publish the documents is significantly reduced (if we operate this using paper documents, we need a lot of effort to coordinate the result and register them to the system, and face a risk of transcription errors). The whole effort on our high-precision inspection using tablet is almost same as that of our conventional inspection (refer Figure 7). Except the promotion of streamlining noted above, transcription errors are being less, so we expect that the tablet will contribute to the improvement of our data accuracy.

5. CONCLUSION

In the coming years, broadening the range of application of tablets to other maintenance operation, we are achieving further streamlining on the operation and improvement of the data precision. Furthermore, we plan to replace our facilities effectively, applying the accumulated data about maintenance record like inspection consequences to remaining lifetime prediction of our facilities. In the future, when an accidental outage occurs, we expect that our accumulated data about the maintenance record will help us find the fault point much more quickly.