Initiatives for improving equipment reliability for Smart Factory activities

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Abstract

In order to further improve competitiveness in terms of cost and quality achieved through electrification, JATCO is carrying out Smart Factory activities aimed at realizing factories capable of maintaining maximum efficiency by fiscal 203X.

This paper reports on how the prevention of maintenance equipment data entry omissions and failure analysis capability improvements were achieved by adopting tablets and developing an app for the maintenance equipment management system, and how this contributed to our Smart Factory activities.

1. JATCO Smart Factory activities

The Facility&Maintenance Engineering Section of the Production Administration Department (Maintenance) is currently tackling Smart Factory activities with the following three steps.

Step 1 Maintenance equipment data collection

Step 2 Maintenance equipment data analysis

Step 3 Predictive maintenance, corrective maintenance, MP (reflected in new equipment construction)

At present, there is a failure loss of 5% between Steps 1 and 2, but JATCO is working to reduce failure loss and improve equipment reliability with the aim of reducing failure loss to 0% at Step 3 (Fig. 1).

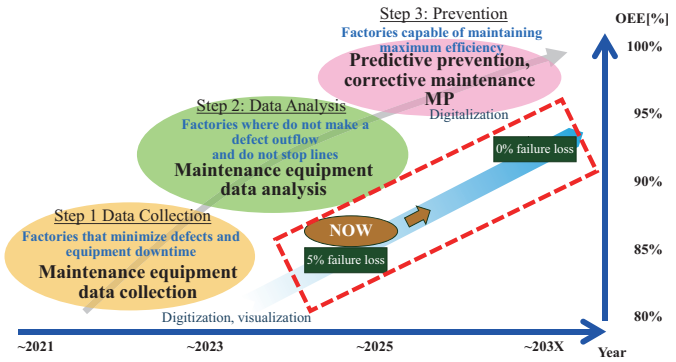

Fig. 1 Smart Factory activities

2. Understanding the current situation

2.1 Necessity of maintenance equipment data

Maintenance is currently planning measures for equipment failures which involve entering the corresponding investigation, failure analysis, and corrective action data in a management system when failures occur, and preventing failure recurrence based on this data.

At JATCO, this management system is known as SEMES, and is an acronym of Supports Efficient Maintenance of Equipment System.

Hereinafter, this system shall be referred to as SEMES (Fig. 2).

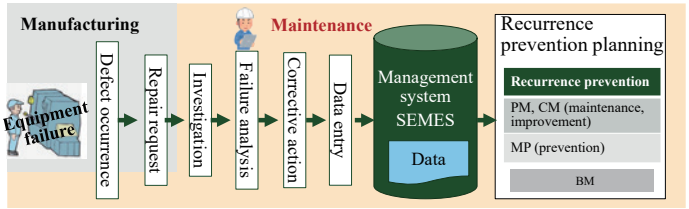

Fig. 2 Equipment failure handling process flow

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2.2 Understanding the current SEMES data situation and establishing issues

Analyzing the current SEMES data situation revealed the following two problems.

(1)Failure analysis, corrective action data entry omissions

Data on failure analysis and corrective action had been omitted, and this corresponded to a failure loss of 1%.

(2)Failure to analyze true cause of failure

There was a case in which the failure analysis process remained stuck at the failure location identification stage, and the true cause was not determined. This corresponded to a failure loss of 4% (Table 1).

The above two points were established as issues.

Table 1 Understanding the current SEMES data situation

	SEMES data	Failure loss
(1)	Failure analysis, corrective action data entry omissions	1.0%
(2)	Failure to analyze true cause of failure	4.0%
	Total	5.0%

2.3 SEMES data issues and causes

(1)Cause of failure analysis, corrective action data entry omissions

When dealing with failures, maintenance staff take notes at the site, and later enter data in SEMES from memory and notes at the office. Staff tend to forget details the more time passes, and are unable to understand their own notes, leading to data entry omissions (Fig. 3).

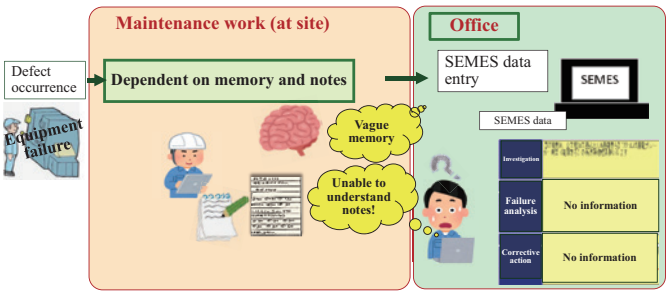

Fig. 3 Cause of failure analysis, corrective action data entry omissions

(2)Cause of failure to analyze true cause of failure

The analysis of failures by maintenance staff is dependent on individual knowledge, experience, and skill, and there is a tendency for the items that are checked to differ between staff. This variability between staff resulted in a case whether no one was able to determine the true cause of the failure, and the only measure taken was simply to restore the equipment (Fig. 4).

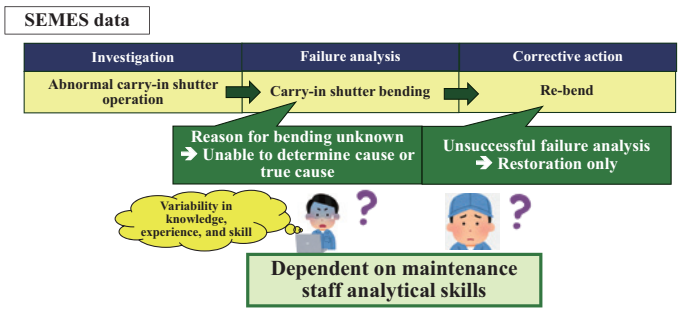

Fig. 4 Cause of failure to analyze true cause of failure

In summary, there were two issues with SEMES data.

Issue 1: "Entering data by relying on memory and notes"

Issue 2: "Failure analysis dependent on individual knowledge, experience, and skill"

3. Studying and deciding upon measures proposal

3.1 Concept

In coming up with suitable measures to address the two issues, a concept was decided.

(1)Having maintenance staff enter data at on site

(2)Being able to identify the true cause of failures without relying on skill

From these two goals, the concept of "considering the true cause on site" was decided, and measures were planned based on this (Fig. 5).

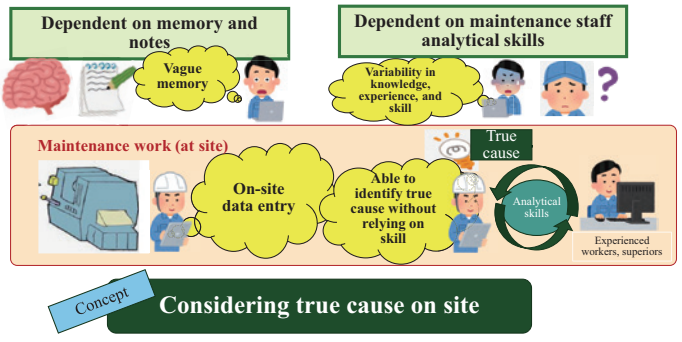

Fig. 5 Measures concept

3.2 Studying and deciding upon measures proposal

In accordance with our concept, the following three directions for measures were decided (Fig. 6).

(1)Mobile terminals should be used.

(2)Failure analysis should be navigated.

(3)Support with failure analysis should be provided.

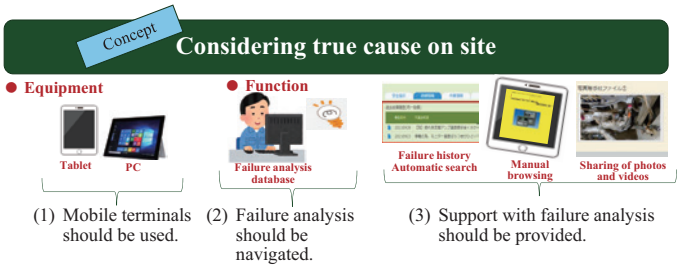

Fig. 6 Measures proposal study

In terms of direction, we proposed measures, conducted an evaluation, and then came to a decision.

(1)For our mobile terminals, we compared laptop PCs with tablets, and decided to adopt tablets due to their outstanding cost performance.

(2)For navigating failure analysis and (3) supporting failure analysis, we began developing an in-house app that allows new functions to be added, and modifications to be made quickly and efficiently (Fig. 7).

Concept Considering true cause on site	Measures (proposal)	Tool	Benefit	Cost	Management	Adoption
On-site entry	(1) Use of mobile terminals	Tablet	○	○	○	Yes
		Laptop	○	△	○	No
Able to identify true cause without relying on skill	(2) Failure analysis navigation (3) Failure analysis support * Automatic failure history search Manual browsing Sharing of photos and videos	SEMES modification	○	△	△	No
		App	○	○	○	Yes

Fig. 7 Deciding measure

4. Implementing measures

4.1 On-site data entry using tablets

In order to link SEMES and tablet data, we opted to use QR Codes (Fig. 8).

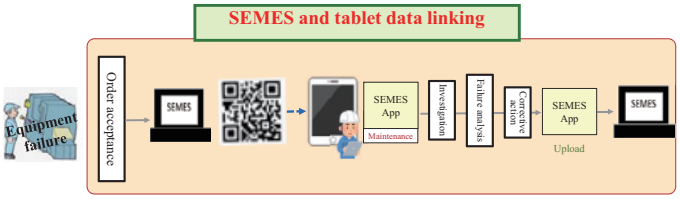

Fig. 8 On-site data entry using tablets

4.2 Failure analysis navigation app

(1)Creation of failure analysis database

We created a database based on FTA to address failure locations by using past data accumulated by multiple experienced maintenance staff.

(2)Failure analysis navigation app development

- Navigation function

  This function allows users to navigate failure analysis data by calling lists of investigation items for failure locations from the database, and entering indicated items. The function has also been equipped with an interlock that prevents users exiting the app if they fail to enter data in the investigation item list.

- Additional navigation function

  We also added a function that allows maintenance staff to add new function locations and investigation items to the database using the app.

By doing so, we were able to consolidate the knowledge, experience, and skills of maintenance staff.

JATCO developed a proprietary failure analysis database and navigation app in house (Fig. 9).

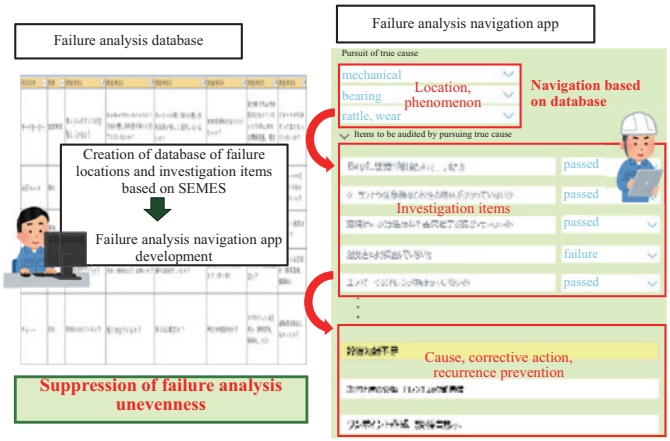

Fig. 9 Failure analysis navigation app

4.3 Failure analysis support app

The fault analysis support app consists of automatic failure history search, instruction manual browsing, and photo and video viewing functions.

(1)Automatic failure history search

By entering the equipment number or name of the equipment manufacturer at the tablet, failure history is automatically collected and displayed.

(2)Instruction manual browsing

By entering the model number of an NC unit or robot, etc. at the tablet, an instruction manual is displayed, allowing it to be browsed on site.

(3)Viewing photos and videos

By searching failure history, photo and video data can be viewed on site (Fig. 10).

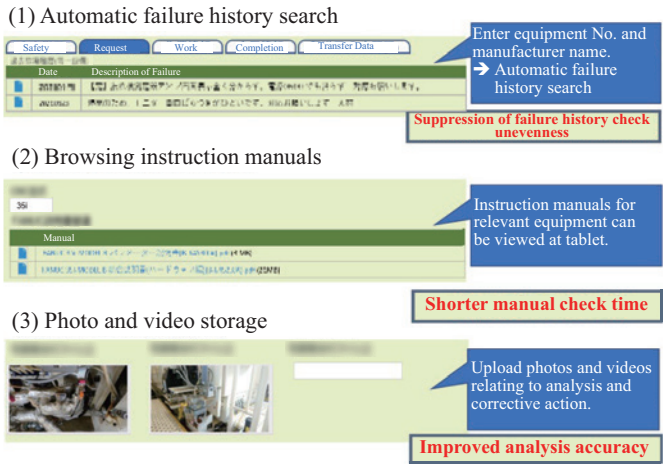

Fig. 10 Failure analysis support app

5. Verifying the benefits

By implementing the above measures, we achieved the following benefits.

(1)Failure analysis, corrective action data entry omissions

Failure to enter failure analysis and corrective action data became a thing of the past, and failure loss improved by 1%.

(2)Failure to analyze true cause of failure

Maintenance staff were able to identify the true cause of all failures, and failure loss improved by 1% (Table 2).

Table 2 SEMES data situation

	SEMES data	Failure loss	
(1)	Failure analysis, corrective action data entry omissions	0.0%	1% → 0% 1% improvement
(2)	Failure to analyze true cause of failure	3.0%	4% → 3% 1% improvement
	Total	3.0%	

6. Future Issues

The ability of maintenance staff to analysis failures has improved, but we still have a failure loss of 3%. We intend to address this by seeking to further improve failure analysis accuracy.

7. References

(1)Makoto HIROSAKI: Construction of a platform for supporting promotion of manufacturing workplace data digitization and improvement of overall equipment effectiveness, JATCO Technical Review No.22, pp.111 - 115.

(2)Taisuke Yamaguchi (plant engineer), Initiatives for Realizing Equipment Reliability Improvement Cycle, Vol.55, No.9, pp.34 - 44, Japan Institute of Plant Maintenance, 2023.

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