Business development for newly-born JIPM

Issues and aims (visions) for JIPM: No. 3

Study activities No. 2: Studies on “progress on the current TPM” and “response to year 2007 problem”

Japan Institute of Plant Maintenance
Yoshitaka Murase, Director

1. Studies on “progress on the current TPM”

1-1 Studies on equipment life prediction and replacement of equipment

(1) Research objectives

There are two types of aging of equipment life.

① Aging of equipment itself: the product life of the equipment itself comes to an end (i.e., aging of parts, fatigue in spindles and foundation, paint deterioration of buildings, towers and vessels, and increase in discontinued products, etc.)

② Aging of functions independent from aging of the equipment: the product life of the equipment itself has not ended (incapacity to meet required quality, higher requirement on quality, obsolescence with products in the market, etc.).

Associated with these types of equipment lives, companies replace or newly build equipment. Therefore, it is not too much to say that the accuracy in equipment life prediction can change a corporate culture, and can even make or break its business activities.

In terms of theory, the equipment life is organized and easy to follow, but in reality, it is very difficult to judge. This study focuses on this equipment life prediction to explore how to increase the accuracy in equipment life prediction. The focal point in this paper is “aging of the equipment itself” as described in ① above.

(2) Details of the studies

Repair costs greatly depend on aging of equipment, because the cost of repair and updating accrues according to the equipment life. The determinants of the updating are equipment life prediction, and time and scope for updating. The study on prediction will also cover the methodology for determining the probability of troubles or the size of the risks.

① Studies on technology for equipment life prediction

The state-of-the-art technologies for equipment life prediction have greatly advanced. Above all, those related to vibration are organized and employed in many rotating machines. Also, things like oil

control and data on current and power are used to estimate the equipment life.

However, if the equipment has been in use for 5, 10 or 30 years, it is quite difficult to predict the degree of deterioration of the equipment month by month. Due to this, some companies have given up equipment diagnostic technology in spite of their initial interest.

Also, a lot of record data on equipment have been consolidated beyond corporate boundaries. However, estimation with this data is only valid for the average equipment lives, but not the equipment life of their own company with 100% validity, because it is difficult to make adjustments to reflect the company's background history of corrections, such as repair records, presence or absence of failures and operating conditions. The problem with this is that it is not possible to accumulate data good enough to apply directly to their own equipment.

From these facts, we aim to conduct studies focused on methodology to judge equipment life and on the equipment diagnostic technology and the data analysis system, so that they will be easy-to-use, convenient and highly reliable.

② Consideration of risks and studies on equipment life prediction

Even with predicted equipment life, a trouble can occur unless it is treated properly. This means that another viewpoint to determine a timing for replacement is how to think about the size of risk and countermeasures in case of trouble. In other words, equipment that causes little impact when in failure can be repaired after the failure, but those that may trigger serious disasters should be repaired before they break down.

In so doing, what kind of risks should be considered is an important issue. In this study, issues such as how to think about these risks, which types of risks needs to be predicted, and how to relate the prediction with actual management practices will be the themes for discussion.

(3) System and period of the research

Regarding ① above, the study group on state-of-the-art maintenance technology has been set up. In this study group, the scope of research will not stay within the state-of-the-art equipment diagnostic technology, but will expand to the surrounding systems to support the diagnosis, such as EAM, PAM, RCM and RBM, to perform activities to pursue proactive maintenance. It is an important research task to understand the current situation correctly and consider how to reflect that information on maintenance. In our perspective, this will be applied not only to the process industry, but also to a wide range of industries such as assembly processing, automobiles, semiconductors, and food.

Regarding ②, we would like to take it as an issue for fiscal 2006 onward. In this fiscal year, the relationship between risk & loss, maintenance and management within the framework of MOSMS will be under study,

which will then be put to further discussion in fiscal 2006 onward.

2. Studies on year 2007 problem

2-1 "Streamlining a whole plant"

(1) Research objectives

We aim to streamline "the flow of goods" from raw materials to finished products, and to visualize this flow by ensuring the consistency between "information" and "goods" by use of visual management and information technology. Also, a production system will be developed to enable progress management in real-time and continual improvement and reform from a comprehensive viewpoint.

(2) Details of activities

- Analysis on the current flow of goods and the approach for streamlining
- Experiments to introduce an information system for RFID tags to visualize the flow of goods
- Establishment of a methodology to streamline human resources, equipment, jigs, molds and other production resources for the flow of goods (streamlining the flow of production resources from the stage of preparation, through operation, winding up, and maintenance)
- Development of a solution algorithm to achieve real-time progress management and continuous improvement from a comprehensive perspective

(3) Members of the study group

Based on the ongoing research activities and findings by Ubiquitous Production System Research Group, constituted by Keio University, NTT DATA Corporation, TOYO SEIKI Co., Ltd and the Japan Institute of Plant Maintenance, the members of this study group will be also appointed from companies hoping to conduct field experiments and joint research and development.

(4) Research period

Initial period of research: from April 2006 to March 2007

2-2 Study group on sensing technology

(1) Research objectives

In order to respond to highly automated and unmanned equipment and to contribute to advancement of production management, it bears very significant meaning that sophisticated sensing/control technologies are used in field management.

At this stage, the research task is to sort out the current issues and to study future advancement of sensing/control technologies and consider how to use them.

(2) Details of the research

① Studies on sensing/control technologies responding to advancement of production control

In the manufacturing fields, control technology, represented by automation with

the use of sensors, has been in active advancement. The problem is, however, that sensing/control technologies are being developed discretely by many parties such as sensor manufacturers, engineering companies, equipment makers, vender companies, users and production lines, and the commercialization is done without fully understanding the new needs on the user side. The following are examples of requirements in manufacturing fields.

- There is a need for a consistent foundation, which would cover everything from planning through design, production and operation of the control technology, addressing issues such as which sensing/control technologies should be engineered for what sort of on-site needs.
- People want to know whether there is an effective maintenance management method for employed numerous sensors.

Also, it is important to show guidelines for the issues such as:

- How failures in sensors, transmission systems or instruction systems can be detected and how to prevent them
- How to acquire consistent technologies covering everything from design through production and response to manufacturing sites, and so on.

In other words, we would like to convene a study group to try to standardize sensing/control technology.

② Studies on value-creating sensing/control technologies

On the other hand, there are expectations for development of value-creating sensing technology by using the state-of-the-art sensing technology such as RFID tags. Along with the advancement of production control that incorporates information and goods, quick response from a managerial perspective will be realized by carrying equipment management information on tags. Unconventional production control technology such as “management of a whole plant” may be developed. In addition to the issues on maintenance, value-creating sensing/control technologies will be studied.

In Expo 2005 Aichi Japan, many robots were exhibited. In a way, their performance was also “a great experiment to get machines to do more human-like functions.” Sensing/control technologies are very important here again, and many technologies have been incorporated and advanced, such as advanced sensors, speedy data transmission/processing, and suitability of feedback including responses. These technologies are highly likely to be introduced into “management of a whole plant.” Together with advancement of computer technology, more automated and elaborate management will be materialized.

For example, in terms of equipment management, it will be possible to take over or further develop the activities currently done by human beings, such as to monitor the internal environment and the yield

simultaneously, to get equipment to detect an occurrence of failure or defect by itself and transmit that information with a report of the cause, or even to obtain a close estimate on remaining equipment life expectancy. This is expected to be a countermeasure to the future decrease in workforce anticipated in Japan.

In this field, the research theme on a variety of sensing/control technologies after development is "which sensing technology to adopt and apply, and how and where."

(3) System and period of the research

In order to conduct the aforementioned studies, a research system will be organized as follows.

① Study group on advanced sensing/control technologies

We hope to conduct this study in collaboration with Nippon Electric Control Equipment Industries Association. During the progress of the research, issues on maintenance will be also studied while exchanging opinions with engineering companies, manufacturers, and companies on the user side.

Standardization of sensing/control maintenance technologies consistent from design to operation with "failure prevention" is an expected finding. In this fiscal year, we aim to establish the study group and mainly sort out problems in manufacturing fields and study and report solutions in the next fiscal year onward.

② Study group on "production management of a whole plant"

We hope to conduct this study in collaboration with the aforementioned study to use RFID tags. Mainly focusing on plant management in actual practice, studies will be conducted on management of a whole plant with the use of RFID tags.