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Strategic Data Collection

Key points to consider...

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Aim

The aim of this paper is to develop an understanding of, and some tips about setting up and managing strategic data collection systems.

Preamble

Some Definitions

The following acronyms are used throughout the paper.

- CMMS Computerised Maintenance Management System
- OEE Overall Equipment Effectiveness – A performance measure used mainly in manufacturing that is the product of availability, rate of production and quality all expressed as percentages.
- RA Reliability Assurance is process that determines the inherent reliability and performance of an asset in its operational context and serves first to increase the level of performance to the inherent level by the application of preventive and predictive maintenance, and then, by data collection and problem solving, increase the inherent performance level through the introduction of modifications to the machine design and the operating conditions or methods.
- RCA Root Cause Analysis
- RIMS Reliability Incident Management System based on RIMSys ®
- RCM Reliability Centered Maintenance according to SAE standard JA 1011
- PM Preventive Maintenance which includes fixed time component replacement programs and condition based replacement programs
- PMO Planned Maintenance Optimisation - In this presentation when we refer to PMO we refer to our own version which is PMO2000™. This version is not the same as PMO programs developed and used in the US Nuclear power industry. The difference being that PMO2000™ produces the same results as RCM whereas the latter may not.

Notes to Readers

The content of this paper assumes a basic knowledge of the concepts of the RCM task selection criteria according to the SAE standard SAE JA1011 titled Evaluation Criteria for Reliability Centered Maintenance processes.

Strategic Data Collection

Data Types

Data collection in the maintenance environment can take many forms. It is important to collect data about plant condition and what maintenance work has been done. However, that data is not the data most needed for Reliability Assurance. The data required for Reliability Assurance is data relating to equipment failure and the circumstances surrounding that failure. There needs to be a clear distinction between these different types of data when setting up a strategic data collection system.

This paper is concerned with plant failure data not work history data or plant condition data.

Data Elements

Introduction

Even though the data required for Reliability Assurance varies between sites, the following generalisations apply to the vast majority of cases.

Machines exist 24 hours of every day they are on the company register. During this time, they may be in a number of states. Some of these states are listed below:

- Having upgrades or modification,
- Not required for production,
- In transit or being changed to different products,
- In production,
- In planned maintenance, and / or
- In breakdown maintenance after having suffered a failure and being repaired or running at a reduced rate.

Many companies track these states and establish a figure that compares production time to total time. This figure is often called Asset Utilisation or Total Effective Equipment Productivity. In some cases, companies discount the availability figures taking into account rate loss and quality loss.

This paper is primarily concerned with machine reliability and is therefore mostly concerned with the latter two points on the above list. It should be noted that this paper is restricted to analysis of evident failures¹ as hidden failures by definition do not of themselves cause operational loss.

Maintenance Loss Categories

Planned and Breakdown losses can be expanded as follows:

- Planned Maintenance
 - Preventive Maintenance, or
 - Corrective Maintenance
- Breakdown Maintenance
 - Expected Failure - Equipment breakdowns that have been assessed as “No Scheduled Maintenance”, or
 - Unexpected Failure - Equipment breakdowns that should have been predicted or prevented.

¹ Evident failures are failures that can be detected by site personnel under normal circumstances. Hidden failures can not be detected by site personnel under normal circumstances.

Inherent in these elements are some concepts that need to be understood clearly in order that the Reliability Assurance approach makes sense. These concepts are explained with the assistance of the models shown in Figure 1 and Figure 2.

Inherent Capability Loss

The reliability and performance of any machine is determined by two factors. These are as follows:

- The way the machine was designed, and
- The way it is operated.

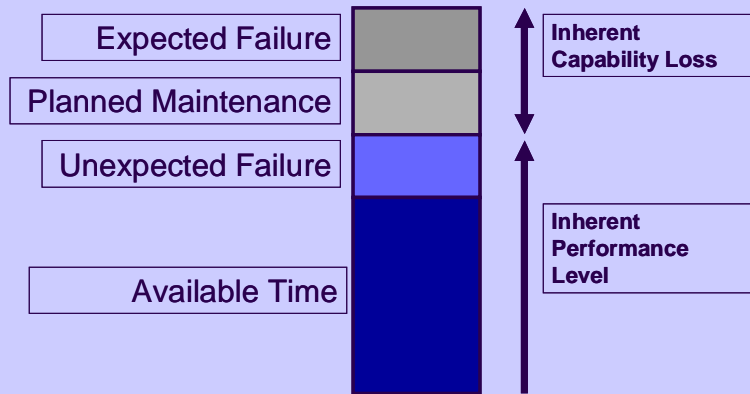


Figure 1 Model showing the definition of Inherent Capability Loss (ICL).

Expected Failures

Failure characteristics and economics are such that for some failures, the defined maintenance strategy is “No Scheduled Maintenance” (NSM). This may be because of the two scenarios described below:

- the failure is random, and the PF interval is too short to be of any use, or
- because the cost of prevention is more than the costs of the failure.

This reality means that there will be a certain level of unavailability inherent in the design and operating conditions. Failure modes which have NSM strategies will inevitably become breakdowns and result in capability loss. We call such failure modes Expected Failures. This is because over the life of the asset, it is expected that such failures will occur and result in loss of production².

Planned Maintenance

While some failures or breakdowns will be accepted as being inevitable, others will be prevented either through condition monitoring or fixed time replacement. Where these preventive actions require that the plant is taken off line, then the preventive maintenance is another loss that is inherent.

In addition, condition monitoring may detect the onset of failure. The rectification action taken in such cases may require the plant to be taken off line.

All of these losses combine to form the Inherent Capability Loss shown in Figure 1. The Inherent Performance Level is therefore the total time less the Inherent Capability Loss.

² It is worth noting that if the failure consequences are hazardous, a NSM strategy can not be made. In such cases, a modification is required to reduce the risk of failure to a tolerable level.

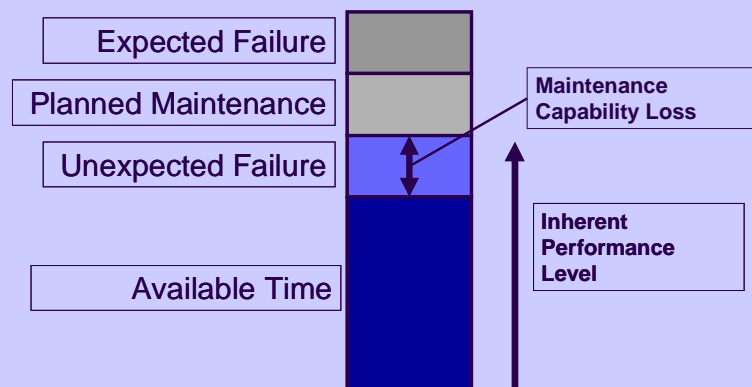


Figure 2 Model showing the definition of Maintenance Capability Loss (MCL).

Maintenance Capability Loss

If the PMO/RCM maintenance analysis was done correctly, and the machine is maintained and operated according to the approved process, then it should suffer no unexpected failures. This is not to say that the plant will not fail, what it means is that all the failures the plant experiences will be expected. The reality in most organisations is that some failure modes that receive PM will fail unexpectedly which means that some failure modes that have preventive maintenance activity, occur during production.

These losses are shown in Figure 2.

Data Collection Systems

The steps suggested are discussed in the following paragraphs.

Step 1 – Setting up a Generic Data Collection System

Setting up a generic data collection system is not difficult in theory. In practice, data collection usually involves people in the collection of the data, input into computers, and its use. The following is a list of important factors that should be considered early in the development of the data collection system.

- Data collection systems often have a large number of interested parties or stakeholders. For this reason, data collection strategies should not be created by a single person with only one agenda in mind.
- Data is often collected by people who operate machines. The degree of literacy and numeracy should be assessed and considered. Avoiding written notes by using codes is a good idea.
- Consider what types of codes are applicable as the reporting loss codes determine the reports that can be generated.
- In most cases, someone has to enter the data into a database. It is important to minimise the effort involved in keying in information.
- In some cases it is important to collect data about rate variance and quality loss. If these are important, then there should be plans put in place to account for these losses. Sometimes this data can be difficult to obtain accurately however, it is often worth making some assumptions and implementing something rather than waiting for the perfect solution to be found.
- The system should be reconcilable. This means that the actual output plus the losses should amount to the standard rate multiplied by the time in production.

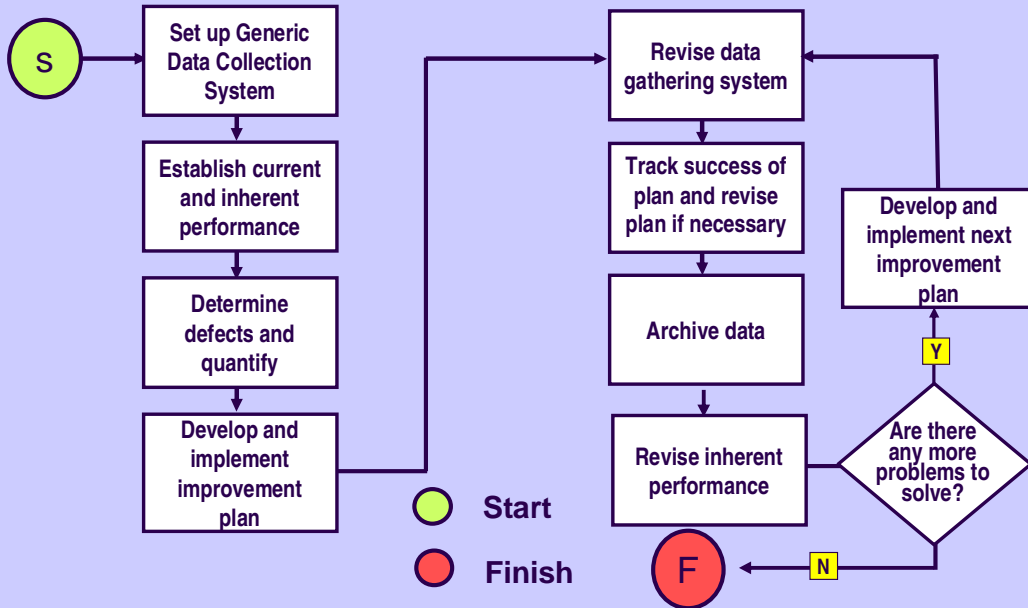


Figure 3 - Flow Chart for setting up strategic data collection

- Information about plant failure is best input after the fault has been corrected. The system should be such that codes are not entered at the time the fault occurs. They should be entered after the rectification is complete.

Step 2 – Establish Current and Inherent Performance

Establishing the current performance of an asset can be done when the data collection system is implemented. It may take some time to generate sufficient data to understand the average performance levels as there could be quite a bit of variation over time.

The establishment of the inherent performance level assumes that RCM or PMO2000™ has been undertaken. The process commonly used to determine inherent performance level is to collect all the loss data from a recent period long enough to be valid and consider what failure modes are treated with PM and which ones will be left to repair when they fail. By making the assumption that the failure modes that now have the PM done at the correct interval will have been planned maintenance activities rather than breakdowns, then it is possible to predict what the performance would have been under the new maintenance strategy.

Step 3 – Determine Defects and Quantify Them

From the data gathered, or from discussions with people close to the plant, determine what the main causes of downtime are and attempt to quantify them

Step 4 – Develop and Implement an Improvement Plan

Conduct workshops to establish causal relationships and create an improvement plan. It is highly recommended that the workshops involve the people who operate the plant and collect the data as this will build a sense of ownership in the improvement plan.

In this step, formal RCA workshops can be used.

Step 5 – Revise Data Gathering System

Once the improvement plan is created, the categories for improvement need to be reviewed to ensure that it can be determined whether the improvement plan is working.

Step 6 – Track the Success of the Plan and Revise if Necessary

The data collected should indicate if the improvement strategy is working. If the strategy is not working then a new one needs to be created or the problem needs to be listed as inherent in the system.

Step 7 – Archive Data

When the problem is solved, revise archive the data and return to Step 3.

Common problems with Plant Performance Data Collection

The most common problems organisations have with plant performance data collection systems are as follows:

- The foundation of PMO work has not been done.
- Getting information is time consuming.
- Too many incidents are being investigated at once.
- Data collection strategy is too generic and lacks definition.
 - There is little knowledge of what problems are being looked at and for what reasons.
- The systems are too cumbersome to get data into and get data out.
- Too much data is being collected.
- There is more than one system collecting the same data. This
 - Frustrates the people who collect the data, and
 - Leads to arguments about the data rather than a focus on solutions.
- No-one tracks whether the improvements worked or not... they are not integrated with the OEE system
- The people that collect the data are not involved in using it to solve problems.
 - This results in poor data quality.
- The data is collected at the wrong level and can not be interrogated according to the necessary parameters. For example in a manufacturing plant, data may be collected against the line and so investigations comparing performance of different products can not be easily done.

Use of software

OMCS International has developed a suite of software that can be deployed across an enterprise covering data collection, maintenance optimization and reliability investigation management.