



The Objectives of Maintenance Management

Computer based maintenance management can increase plant availability and reduce overall maintenance costs. John Hookham describes some of the essential elements that are needed in such systems for maximum effectiveness.

Maintenance management can be considered as the direction and organisation of resources to control the availability of equipment. The tasks associated with maintenance can be divided into three main areas; work management, plant condition control and cost control.

Work Management

Work management is concerned with the logistics of organising maintenance and has the following objectives:

- To identify, control and co-ordinate the resources (labour, spare parts, materials and tools) that are required to complete the maintenance tasks;
- To ensure that job priorities are correctly allocated;
- To locate plant failures or potential failures and provide an appropriate response.

Plant Condition Control

Close monitoring and control of the overall plant condition is necessary to achieve a high level of plant availability. Its long-term objectives are:

- To highlight maintenance engineering problems by monitoring plant performance, diagnosing causes and providing effective solutions;
- To adapt maintenance policy as production requirements change. This should not be restricted to changes in preventive maintenance but should encompass re-design and the application of condition monitoring techniques where appropriate.

Cost Control

The third activity, cost control, is normally operated as part of a company's budgetary and expenditure control system, primarily for job costing. To achieve the improvements in maintenance effectiveness and efficiency, the maintenance manager must make use of all of the available management tools.

Computerised Maintenance Management System

A computerised maintenance management system will contain a number of integrated programs or modules to improve the efficiency and effectiveness of the maintenance engineering function. In this sense the system is like a set of tools, albeit highly complex and difficult to produce. But with the correct design the system should be easy to use and provide the engineer with all of the information that is required to make better decisions.

The basic modules or component part of the maintenance systems are as follows:

- Preventive maintenance
- Asset register
- Maintenance stores system
- Purchasing



- Work order planning and control
- Plant history and analysis

Preventive Maintenance

By preventive maintenance we mean all actions carried out to prevent or pre-empt a failure. These actions can take two forms.

Firstly, there are inspection based or non-intrusive techniques. These will encompass the relatively complex inspection such as vibration monitoring but should also include the basic techniques: look, listen, touch and smell. Often these basic techniques are ignored but should and can form the basis for detecting and preventing failures. The preventive maintenance system should provide the inspector with details on where the work should be done, what the initial values and points to be aware of are and also when the work should be done. To enable the inspector's time to be used effectively the work list should be output in, for example a route order.

Secondly, preventive maintenance should prompt for services and overhauls on a calendar basis, on hours run or amount of product manufactured. Using preventive maintenance it is possible to have a much better idea of the condition of the equipment and consequently it is possible to increase the percentage of work that can be planned. Early detection of faults will decrease both the number and duration of breakdowns.

Asset Register

This is an inventory of all of the plant, equipment and services for which a manager has responsibility. Repair work that is generated by the preventive maintenance system will in most cases need to be planned and prepared. Consequently it is necessary for the planner to have rapid access to details of the equipment. This includes technical details, serial numbers, location, manufacturer etc. and most important a list of the spare parts used on the machine together with the current stock balance. The purpose of the asset register is to centralise this data for use in planning maintenance work.

In addition to providing rapid access to information, the manager can be sure that the relevant data is always available and has not been misplaced.

Maintenance Stores System

It is essential that this maintenance stores control system is not a modified production stores control system. The requirements of maintenance differ significantly from those of the production department. For example, the usage profile for maintenance spares differs from that of production materials. If a spare part is used only during a major shutdown it is important that the part is available when required and also that spares are not stocked unnecessarily, tying up valuable working capital. Since it is not possible to completely avoid some breakdowns, it is necessary to organise the repair work as quickly and efficiently as possible.

For example, during a breakdown, often the last thing a fitter knows about a spare part is the company's internal stores control number. He is more likely to know one of the following:

- The machine that the part is used on;
- The supplier's item number
- A basic description



It is essential therefore that the fitter can enquire on any part of the three items listed above in addition to the company assigned stores control number.

Purchasing

The purchasing system is closely related to the stores control system and has three main inputs. Firstly, there should be a facility to automatically prompt for the re-ordering of items that have reached a pre-determined re-order point. Secondly, the system should enable the engineer to purchase items that are in constant use and spares that are used only during a major plant shutdown. Thirdly, the maintenance department will need to purchase contractor and building services, together with non-stock items. Purchasing for maintenance can take many forms and requires many functions to deal with, for example, telephone ordering, order chasing, invoice checking and monitoring.

The chosen system should enable all of these functions to be carried out by the purchaser. If only a limited number of these functions are available, with the others being carried out by, for example, a corporate system, mistakes will occur and this will have an adverse effect on the operation of the entire maintenance department.

Work Order Planning and Control

Efficient and effective maintenance requires detailed planning of repairs, plant services, overhauls and projects. For each asset in the system a maintenance plan is required. This work must be co-ordinated with the requirements of production to have the minimum effect on the overall production plan. The work that is to be done should be recorded directly into the system. The additional information such as the required manning level, required date, estimated time etc. can be added by the planner. To do this effectively the planner will need access to standard job descriptions, the production schedule, resource availability, details of outstanding work etc. consequently the planner should be able to list for example: the work planned for the next stop, outstanding work from the last stop, up-to-date details of committed resources etc. pre-planning of work enables the optimal use of the maintenance department's most critical resources: time and labour. The maintenance plan should be easily modified to allow for major emergency work, changes in production methods and improvements in design.

Maintenance control indices can provide a method of assessing maintenance activities. Control indices should function as part of the overall maintenance information system and use dynamic data such as labour costs, spares usage, and delay costs. Analysis of the data provides feedback that the manager can use to assess actual performance against a target, and so monitor the effect of changes in maintenance policy.

Plant History Analysis

A plant history system is essential to follow-up maintenance activity for both technical and financial aspects. With a manual card based system this is extremely difficult and time consuming. Computer based systems come into their own when large a volume of data needs to be sorted and presented in a meaningful way. In the longer term, analysis of plant history can provide the most effective method for improving plant availability. The system should require a minimum of data input from the preventive maintenance and work order modules. For the analysis to be accurate, it is essential that all the base data is transferred from the work order module together with the additional information which is fed back as a result of the work that has been done, i.e. a fault code, downtime, a description of any extra work done. The plant history module should have standard reports to show for example:



- The relationship between preventive maintenance and corrective maintenance;
- The equipment causing the most downtime;
- The equipment with the highest number of faults.

To obtain the full benefits of recording plant history, the company will need to have a smoothly operating stores inventory system to provide details of spares usage, and an accurate work order control system to provide labour hours and costing.

Reliability and defect / failure analysis is an essential tool for the maintenance manager. Defect analysis can be used to examine the performance of a single plant item or group of items. Defects should be recorded using a coding system and then analysed to find the mode of failure (early life, random or wear out), mean time between failure and so on.

The application of such techniques was used to good effect in a company where couplings on a mill failed frequently, resulting in high maintenance costs. The preventive maintenance policy was changed a number of times in an effort to increase the reliability, without any success.

Statistical analysis of the time between failure occurrences across all of the couplings showed clearly that failures occurred in early life. This suggested that the cause of the failures was due to poor installation. Further investigation proved this to be the case.

Without computer-based analysis it is difficult to analyse plant history because of:

- The large volume of data;
- The vague way in which the data is recorded
- The difficulty in processing the data that was relevant to the investigation.

Implementation and Benefits

For the implementation of a computer based maintenance management system to be successful a number of points need to be considered:

- Agree a detailed realistic schedule for implementation;
- The end user of the system should have rapid and direct access to the information;
- The programs should be easy to use by inexperienced computer users;
- In larger plants, there should be terminals situated in all of the relevant areas if the plant;
- The end users need to be trained to ensure they are familiar with the information that is available.

The end user should be involved in all stages of the implementation to ensure the system is seen as the maintenance department's system and not the system that has been imposed by management or the data processing department.

Typical Results Achieved

In general, using a computer based maintenance management system will increase availability and reduce maintenance costs. Increases in availability range from 2% to 6% and reductions in maintenance costs range from 5% to 25%. Many users have reported reductions in spare parts inventory ranging from 5% to 15% after re-organisation, and computerisation of the maintenance stores.