

## 8. COMPUTERISED MAINTENANCE SYSTEM

### INTRODUCTION:

Maintenance is often seen simply as a necessary evil. Though a number of initiatives have been taken to raise the awareness and concern for maintenance, still the importance of maintenance function remains underestimated. It becomes essential to apply a combination of management, financial, engineering and other practices applied to physical assets in pursuit of economic life cycle costs. Maintenance and /or servicing must be seen as a combination of all technical and associated administrative actions intended to achieve the planned plant availability at the optimum maintenance expenditure.

As a result of increasing capital intensity and equipment complexity, increasing the interaction between production and maintenance, a gradual decentralisation can be considered. This leads to a closer interaction between maintenance, production and other related functions. At the lower level of the responsibility triangle, the craftsmen would build up specific expertise about machine behaviour. Also there is a growing need to concentrate on some periodic maintenance activities such as annual shut-downs. Complete overhauls are only effective under specific conditions and periodic maintenance often leads to over-maintenance. Analysis of failures and of overhaul and reduction of inspection content and frequencies. Condition-monitoring, using simple and more sophisticated means of measurement will indicate the necessity for any corrective work. Identification and analysis of problem area require facilities for data recording and easy data retrieval, which are being provided by the various modern systems these days.

The need to strengthen the information system in the maintenance function requires no special emphasis. This is because the increased demands on plant equipment increased operating cost awareness affect everyone concerned. By assessing the existing potential for profitability and greater reliability, it is felt that the improvement would not be effected through fundamental change in approach to equipment performance and maintenance work load. Further various studies have pointed out that old methodologies could not be enhanced to generate significant improvements.

The existing high incidence of failures and problems causes plants to adopt a posture of panic-decisions being made on the basic of feeling or fear. This leads to high maintenance cost and low equipment availability. Therefore, it becomes unavoidable to change our work execution procedure so that the most economic methods are adopted and the jobs are scheduled for the most appropriate time frame. It is also necessary to make changes in decision-making process so that it was based not only on plant history, derival prediction of equipment behaviour and performance but also on knowledge of the work required, the desired completion date and the degree of business risk resulting from the deployment of the most economic alternative.

The primary objective of maintenance management is to achieve the optimum balance between plant availability and maintenance resource utilisation. The effective matching of labour and material resources for maintenance planning and control is certainly a dynamic activity. The latest approach has concentrated on supplying management with reliable

information on both equipment performance and cost that would allow them to make informed decisions. Thus it becomes essential to adopt techniques that would provide accurate and timely information for making the maintenance function more meaningful and reduce the unforeseen plant outages.

The implementation of a computerised maintenance system is one of the successful ways for achieving the above mentioned features.

### **COMPUTERISED MAINTENANCE SYSTEM:**

The computerised maintenance system (COMS) has been seen as the optimum tool to support the management in achieving the following objectives:-

- a) Single source of information
- b) Improved decision-making
- c) Better resource utilisation
- d) Reduction of unwanted paper-work

The reduction in clerical effort and the availability of reliable and timely information would allow increased opportunity for improved analysis, decision-making and resource utilisation. Periodic (calendar-based) preventive maintenance is easy to schedule for the long-term; condition-based maintenance requires more flexible, short-term resources and equipment downtime scheduling, manual scheduling of which would be very laborious due to the need for frequent updations. If introduction of a computerised maintenance system is considered, there requirements need to be stated in global functional specifications, reflecting the organisational and procedural improvements which are required and which would be achieved as a result of the application of a interactive computerised maintenance system.

### **REQUIREMENTS FOR A COMPUTERISED MAINTENANCE SYSTEM:**

A computerised maintenance system could be made effective only if it is complete in all respects. In other words, the computer's assistance should be extended to support all the functions related to maintenance. A computerised system should not only be complete, but should be of an integrated character. It should be able in any particular function to call up requested information from other functions. Thus it becomes essential to consider all the relevant factors in order to see that the introduction of a computer to aid the maintenance function is a total and not peace-meal approach.

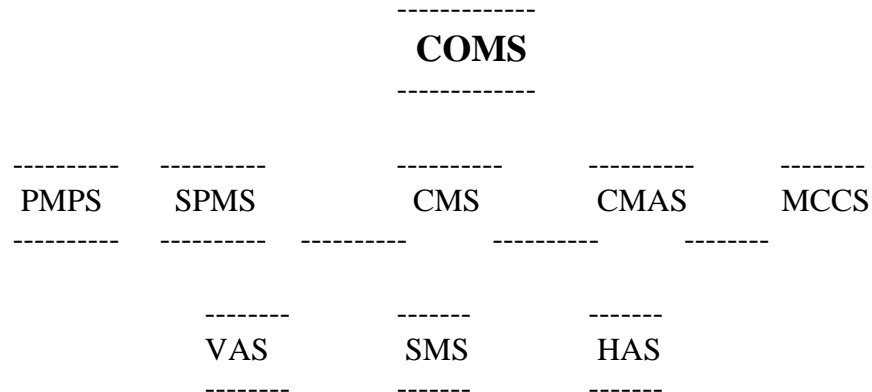
### **AREAS FOR COMPUTER APPLICATION:**

Computers are useful for carrying out repetitive tasks and for managing information. They can also be used for more complex calculations, if an appropriate algorithm can be defined. The usual areas could be broken down into the following functions:-

1. Preventive Maintenance Planning System (PMPS)
2. Spare Parts Management System (SPMS)
3. Condition-Monitoring System (CMS)

- \* Vibration Analysis System (VAS)
- \* Shock-pulse Monitoring System (SMS)
- \* Hot-spot Analysis System (HAS)

4. Corrective Maintenance Analysis System (CMAS)
5. Maintenance Cost Control System (MCCS)



The areas indicated above are the functional areas common to maintenance function in any industry. The details of these sub-systems of COMS are explained in the subsequent chapters.

Computers can help, but paradoxically the success of their implementation depends to some extent on whether the manual systems are adequately covered or developed. Computers installed for the purpose of strengthening the management of a weak manual system are on a shaky ground. Clearly, it is inadequate to justify computerisation of the scheduling of jobs by saying that the computer will improve work performance where the acquisition of spare-parts is the problem.

**PREVENTIVE MAINTENANCE PLANNING SYSTEM (PMPS):**

The days of allowing machines to run without any maintenance until they break down are gone. To improve the working of plant and machinery two types of maintenance activities are carried out.

These are:

1. Activities which directly contribute to prolonging the life of machines, such as lubrication, machine cleaning, etc.
2. Activities which are carried out to assess performance of various components/sub-assemblies at any particular point of time. These activities themselves do not prolong the machine life. Examples are inspection jobs, condition monitoring jobs, etc.

Activities pertaining to both the categories are taken up for planning, scheduling and

monitoring in this subsystem called PMPS. The sub-system also provides for post-mortem analyses with a view to effective rectifications in future.

### **OUTPUTS FROM PMPS:**

- \* Weekly confirmed PM jobs (list of activities to be taken up in the current week).
- \* Tentative PM job plan (one week in advance)
- \* Work order recording and control
- \* PM jobs completion report
- \* Pending PM jobs report
- \* Unexecuted PM jobs report
- \* Various exception reports

This module produces all the reports mentioned above on a regular basis for effective planning and control of all PM works. The outputs are discussed below:-

### **WEEKLY CONFIRMED PM JOBS:**

A report is prepared in the beginning of a week listing all the PM activities to be taken up. The report is organised on a department-section basis for user's convenience. This report helped the maintenance-in-charge of the concerned department/section to plan the works keeping in mind the manpower and other resources available with him. Machine shut-down time, if required, can also be planned in advance. The report, besides showing the usual planning parameters, will also indicate the requirements and availability of any specific spare part or tools and tackles that may be needed for each one of the activities. The maintenance chief can decide the priority of the jobs scheduled because the report indicates the delays that might have already taken place in executing the various jobs.

### **TENTATIVE PM JOB PLAN:**

This report lists down the jobs which fall due in the coming week. Although these jobs fall due, it may so happen that some of the jobs may not be taken up because of production pressure, non-availability of spares, etc. This look-ahead report allows the concerned people to indicate the suitability or otherwise of these jobs for execution and for jobs which are not to be taken up, the reasons also require to be given. The report complete with the remarks from the concerned departments (such as production, stores etc.) forms the basis for chalking out a definite work-plan for the next week. This also helps in analysing at a latter date the reasons for delay in execution of certain jobs and provides a pointer towards the deficiencies in the existing system.

### **WORK ORDER RECORDING AND CONTROL:**

For all the jobs listed in the first report work orders are prepared. These work orders produced machine-wise and discipline-wise (mechanical/electrical) are sent to the maintenance-in-charge along with the first report. These work-orders are handed over to the maintenance crew, authorising them to carry out the jobs. At the end of the week the work-orders are returned for all the completed jobs with indications of time taken, etc. This then forms the basis for updating the master schedule before next weeks schedule is drawn out. The delayed jobs, when completed, will have indications on the work order regarding the reasons for delay.

### **PM JOBS COMPLETION REPORT:**

This report shows the actual figures such as labour time and down time against the corresponding plan parameters for all the activities completed in the course of the week. If some spares have been consumed that is also reported. The report is organised on a department-discipline basis providing a performance indicator for that department/discipline for the week under reference.

### **PENDING PM JOBS REPORT:**

The dynamically changing situations on the shop floor may force some jobs taken up for execution to remain incomplete at the end of the week. This report will list those jobs which are on going at the week end. The report will be useful in controlling recurrence of such deviations from the plan in future.

### **UNEXECUTED PM JOBS REPORT:**

The report points out those PM jobs which had been scheduled for the week, but could not be taken up at all. The fluctuations in the real life may force some jobs to be deferred, but such incidents should be under control. That is what this report aims at doing.

### **EXCEPTION REPORTS:**

Apart from the regular, periodic reports as indicated above, exception reports are produced to focus management's attention on large scale deviations from norms. The type and the contexts of such reports will vary from plant depending upon the existing system and the environment.

The regular reports as indicated above deals with the planning and control of routine activities. Besides that, management may need, to know from time to time the status of various maintenance activities. Such adhoc needs may arise from emergency situations developing in the plant. These needs can be met by Query system, where the system answers specific queries of the user. Some of the typical responses could be as given below:-

- i) For a specified machine/equipment, system will list all the PM jobs,
- ii) For a specified activity on a specific machine the status (when due again, when done last etc.) is displayed. For delayed jobs, the reason for delay is also indicated. The various planning parameters such as

frequency, crew size, labour time, etc. may also be indicated for specific activities on specific machines.

### **INPUT REQUIREMENTS:**

For effective functioning of this PMPS module it is necessary to provide the input forms at the specified intervals. The inputs are:

1. Completed work-orders
2. Completed confirmed PM jobs List
3. Completed tentative PM jobs list

These inputs are to be supplied to the system at the end of every week after making the necessary entries depending upon the execution, pending or non-execution.

### **FILES HANDED:**

#### **1. Preventive Maintenance Master - File**

PM - details like number of activities for each machine, its frequency of execution, required skill, labour time, down time planned, spares required, if any, tools and tackles required etc.

#### **2. Spares Master - File**

Details covered: Spares details like the quantity available at the stores, lead-time for its procurement and the other planning parameters like ROL, Maximum, Minimum stocks, ordering quantity etc.

### **PRE-REQUISITES FOR PMPS MODULE:**

- ◆ Codification of Machines, PM activities spareparts different sections or departments.
- ◆ Standardisation of gang-size for each PM activity, their required labour and down-time.
- ◆ Identification and codification of various reasons for delay of non-execution and also for non-completion of pending PM jobs.

### **CORRECTIVE MAINTENANCE ANALYSIS SYSTEM (CMAS):**

In this module any repair or correction undertaken, in order to correct the faults will be accounted and monitored. Using the condition based maintenance philosophy, the repairs are taken on a planned basis to the extent possible. In spite of regular condition monitoring and planned stoppages, due to reasons of fatigue failure breakdowns are expected for all the machines. The maintenance systems efficiency depends very much on how the system helps in reducing these unexpected failures. The details of this module are as below:-

## **Reports Generated:**

### **Periodic Reports:**

1. Failure Analysis Report
2. Downtime Analysis Report

### **Query Reports:**

1. Maintenance History Query
2. Fault Query
3. Parts Failure Query
4. Downtime Query

The details of these are discussed as under:

#### **1. Failure Analysis Report :**

The various faults along with the details like frequencies of occurrence in each quarter and the corresponding downtime involved will be reported under this heading. Even each partwise such a report can be prepared.

#### **2. Downtime Analysis Report:**

Another quarterly report is the report produced by listing the downtimes involved in various categories of maintenance like PM, CM and others (or Installation, Commissioning etc.)

#### **3. Maintenance History Query:**

Given the machine number and the reference date, the corrective maintenance history from the date onwards will be indicated in this Query.

#### **4. Fault Query:**

Given the fault code, the details about the fault will be displayed for a particular machine or for the entire plant irrespective of the machine.

#### **5. Part Failure Query:**

When the part number is specified, the details about the failure pattern will be generated under this query.

#### **6. Downtime Query:**

Given the machine number, all the relevant downtime details for that machine will be outputted here.

## **INPUT REQUIREMENTS:**

1. Corrective Maintenance work order

## **PRE-REQUISITIES:**

1. Codification of machines
2. Codification of faults and spare-parts

## **MAINTENANCE COST CONTROL SYSTEM (MCCS):**

In many industries maintenance is viewed as an unwanted expenditure. The usual complaint from the maintenance department is that the maintenance does not get its required importance from the top management and other functional departments. Economy drives often begin by slashing the maintenance budget. These problems are created because of the deficiencies of the reporting system of the maintenance group. One of the problems occurring internally in this department is its failure to project its requirements in terms of cost figures. The maintenance people are generally technically sound, but often they are not so good managers. Whenever they are planning their resources or monitoring their own performances, they do so purely based on technical points. The example could be their evaluation of maintenance function which is based only on down time analysis. It would be appropriate if the analysis is carried out using the cost figures after converting the time figures into monetary values. For this existing condition, maintenance function alone should not be blamed. The reasons are:

- ◆ The cost figures are often incorporated and maintained by the finance departments only.
- ◆ The interaction between the maintenance and other related departments is very limited.
- ◆ The whole maintenance system is designed in such a way that the entire reporting and evaluating system works without the cost figures.

Therefore, it is essential that COMS be designed for proper functioning by providing the required information with cost figures. The top management is interested only in planning and budgeting the maintenance expenditure. This is clear from the reports generated by this MCCS sub-system.

## **REPORT GENERATED FROM THIS MODULE:**

- \* Maintenance Costing Report

## **MAINTENANCE COSTING REPORT:**

The cost of preventive maintenance, corrective maintenance and other maintenance activities like installing and commissioning of machines are separately shown in this quarterly report. In each category the costs are shown discipline-wise like mechanical,

electrical etc. The overall performance of the maintenance department can be reviewed through this vital report.

**INPUT REQUIREMENTS:**

The PM work orders, corrective maintenance work-orders are the basic regular input formats needed for this sub-system. If any other jobs are taken up for maintenance function, the corresponding work-orders need to be prepared regularly.

**FIELD HANDLED:**

The following are the files used for processing and producing the above mentioned report.

- 1. Preventive Maintenance Master Data File** - provides the details regarding all the maintenance activities including the cost figures of PM jobs.
- 2. Corrective Maintenance Master Data File** - Indicates the details about the corrective maintenance jobs including cost values for these jobs.

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