

COMPUTERISED MAINTENANCE MANAGEMENT SYSTEM FOR WORLD CLASS MAINTENANCE

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The primary objective of maintenance management is to achieve the optimum balance between plant availability and maintenance resource utilization. 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 computerized maintenance system is one of the successful ways for achieving the aforesaid goal. The selection and proper implementation of the correct CMMS is an integral part of achieving maintenance management success.

. The mission objectives of maintenance department include:

- Provide a quality of effective maintenance services that support facility operational requirements.
- Reduce unscheduled equipment downtime through effective maintenance planning.
- Utilize the CMMS report generator to provide meaningful management reports that will enhance control of maintenance.
- Utilize CMMS to ensure that maintenance is performed efficiently through organized planning and

coordinated use of material, manpower and time.

- Create and maintain measurements of maintenance performance within CMMS.

. The goals of a maintenance manager should be the measurable steps along the pathway toward meeting your objectives. One of the highest priorities should be keeping the equipment operating (reducing equipment downtime). The corresponding goal would be to reduce down time by some %. Assuming that your CMMS package has provisions for entering and tracking downtime, you will just need to carefully log all downtime and enter the information in CMMS; total as well as specific equipment downtime can be retrieved and compared with last month's, last year's, or last week's. This is as close as you can get to a 'real time' measurement of your progress toward achieving your objective. In the future, the manager who is best equipped to make the right decisions in the shortest span of time is going to be the manager who has the most facts available to him. Because you have CMMS, you are going to be expected to have inordinate amounts of information immediately available to you and you are going to be expected to make quick and effective decisions and recommendations.

One of your objectives should be to maximize maintenance program effectiveness by efficient performance of the maintenance program elements and measuring maintenance function effectiveness. How do you decide what is effective. All the information you have is in the data. If you can establish objectives and quantify them then you can measure effectiveness. Specific areas for measurement should include percent of rework, percent of planned

maintenance work, percent of unplanned maintenance work. Establish standards that will assign actual costs for equipment downtime and then track both planned and unplanned downtime.

Functions of a CMMS

Asset Management and Asset Register

This is the option, which will facilitate the creation of an asset register. The asset register will hold comprehensive details of each asset. Typical data to be stored would include Asset Number, Department, Asset Name, Model, Serial Number, Drawing numbers, Purchase Price, Location, Supplier, planned and unplanned maintenance history, etc.

Preventive Maintenance Scheduling

The maintenance schedule should have a flexible set up, allowing each asset to have a defined maintenance profile which may include details of various periods, trades required, procedures required, estimated job times and when the equipment is available, etc.

Preventive Maintenance Procedure Library Control

The preventive maintenance procedure library is generally a database of all the preventive maintenance procedures required for the maintainable assets in the system. In a paper system, records will be held which contain details of preventive maintenance to be carried out on all equipment. Each time a maintenance is scheduled the technician will require to refer to the procedure on file. It is generally desirable to have a system that allows many assets to be linked to a single procedure which will be convenient to use. If the procedure requires to be modified then this needs to be done once only, all linked assets will continue to use the modified version in the library.

Unplanned Work Reporting

When a defect or breakdown occurs, someone from production must notify the required trade group. This is done through the nearest terminal, by inputting brief details of the fault, the asset number or description and the reporter's name. When this is done the software offers the reporter a choice of the three printers. After one has been selected the work order is printed in the relevant workshop. The work order will then, automatically, be added to the list of *outstanding* work.

Scheduling of Planned Maintenance

Most systems include a maintenance scheduler. When the scheduler runs, it scans each asset in turn and checks the periods when maintenance is required. It then looks at the last maintenance date for each period and if due, creates a planned maintenance work instruction for the asset. Typically, the planned maintenance scheduler will be 'rolled forward' each week, producing work instructions and adding them to the list of outstanding work. Users may be required to decide whether they would prefer the scheduler to run automatically, in real time, or by intervention at a particular time each day or each week.

Planned Work Order Generation and Issue

In addition to the generation of unplanned work orders previously discussed, a means of outputting, that is producing hard copy of planned work orders, will be necessary. The system should allow the planned work orders to be separated into various trades, asset groups and locations, before they are printed. Other points to be considered are whether or not the user requires work order formats to be reconfigurable. Most companies prefer to be able to design their own work order forms.

Viewing Outstanding Work

Maintenance managers and supervisors will require to be able to quickly check work orders, which are outstanding. The system should support a quick and easy method of selectively displaying lists of these work orders by trade, work type, department, etc.

Stores Requisitioning, Stock Control and Purchasing

Most fully integrated packages support some kind of store's management option. If you elect to take this option it should be carefully specified to ensure that it would meet your local requirements. One benefit of opting for stock control is that trade groups can be provided with access to the store's database allowing them to find spare part numbers and check stock levels of maintenance spares. Some systems allow spares to be linked to assets thus simplifying the search for these and also ensuring that no obsolete spares are held in inventory. Some users consider that the greatest financial returns from a CMMS are to be achieved through improved stock control procedures.

Condition Monitoring

Condition monitoring is a form of predictive maintenance where continuous monitoring of the condition of specific areas of plant and equipment takes place. When any pre-defined limit is exceeded, an alarm output is turned on. This alarm output can be input to a CMMS so that a work order will be generated immediately. This is particularly suited to continuous process plant, say paper mills, where plant failure could be extremely costly.

Typical conditions, which can be monitored, are temperature, vibration, over voltage or current and liquid level; in fact any condition that can be detected by a sensor.

Statistical Data and Reports

In CMMS there will be extensive information readily available for fault analysis, costing and work statistics. *This is one of the most important functions of a CMMS system.*

LUBE DATA

The CMMS has all the data for doing it. The maintenance procedures used in your facility for lubrication should spell out the type of lubricant as a minimum. If the requirements were taken from manufacturer's literature, the procedure probably includes the lubricant manufacturer and lubricant

grade and brand name. By pulling out all lubricant data and application requirements in CMMS, you can develop a lubricant equivalency matrix, which in turn can be used to minimize the number of different brands and grades needed and will probably reduce the total quantity you must keep on hand by close to 50%. You can also produce a single Lube Map which can take the place of several procedures, and which can be performed by a Lube Team in much less time and in fewer separate efforts. Consolidating lubrication requirements is an obvious cost saving practice

Daily Scheduling and Job Control

This covers such areas as how work is allocated to the workforce, and how expectations are generated regarding a "reasonable" time for job completion. It also includes how daily priorities are set, and decisions made regarding the deferral or cancellation of planned work in order to incorporate daily breakdowns

Effective Weekly Scheduling Control and Management

An effective Weekly Scheduling system permits the allocation of jobs to specific days, so that parts can be delivered to the job site "just in time", and so that equipment can be shutdown and cleaned prior to the tradesman arriving to perform the maintenance task. It also compares the labour requirements of the schedule with the labour available from the work crew for each day of the schedule, and allows effective decision-making regarding the need for supplementary labour or the need to reschedule work before the schedule is finalized

Maintenance Budgeting and Cost Control

It is a motherhood statement that Maintenance costs are generated by Maintenance Activities. While some sites prepare Maintenance budgets that are based on a bottom-up assessment of the Maintenance activities that they expect to perform, how many then report actual costs against those budgeted **activities**? Most CMMS only permit the reporting of actual costs against budgeted **amounts**, and so an essential element

of cost control is lost, because the manual effort involved in reconciling the budgeted activities with those actually performed means that this task is not performed.

This being the case, the budgeting and cost control procedure should clearly be "owned" by these people, with people at this level being held responsible for preparing Maintenance budgets, and controlling costs to within those budgets.

Maintenance effectiveness -

Included in this process are activities such as failure analysis and Reliability Centred Maintenance analysis.

To make informed decisions regarding Equipment Maintenance Strategies and equipment design modifications we need to record information about:

- The number of failures
- The root causes of those failures
- The Maintenance costs associated with those failures
- The Production costs associated with those failures - note that these may incorporate more than just downtime costs.
- Any Safety or Environmental implications associated with those failures.

When evaluating CMMS's, there are six major factors that should be considered. Careful examination of these factors during the evaluation process will help ensure ongoing CMMS success.

1) Comprehensive Maintenance Management Functionality –

It should be made up of three major elements: Work Management, Physical Assets Management and Resource Management. The Work Management component of the CMMS optimizes day-to-day operations, manages corrective work orders and supports a preventive maintenance program

The Physical Asset Management component acts as the "filing cabinet" of the CMMS, providing quick and easy retrieval of important information such as: planned and unplanned work history, assets accounting information, warranty and service contracts, nameplate data, scanned documents, libraries of CAD drawings and complete descriptive information

The Resource Management component of a CMMS supports a full inventory and purchasing system. Furthermore, it tracks in-house labor and contracted service costs.

2) Extensive Management Reporting Capabilities

A CMMS is only as good as the information that can be retrieved from it. CMMS's provide extensive management reporting capabilities that include detailed and summary reports, graphical reports, and easy to use report writing tools that do not require programming knowledge.

3) PM Procedure Library

. This PM procedure library will minimize the start up time necessary to establish and implement your PM program and provide conformance to generally accepted PM inspection schedules. After a number of PM actions have been performed and recorded on the same equipment, sufficient data can be available to determine whether the equipment needs more or less frequent PM work and how PM frequency should be adjusted.

5) Multiple System Interfaces

Today's CMMS should be capable of working together effectively and transparently with multiple systems. Direct interfaces between the CMMS and other diagnostic and monitoring systems such as predictive maintenance can assist greatly in streamlining the maintenance process, by allowing maintenance personnel to respond to early warning signals before they escalate into critical repair problems. CMMS build upon these types of interfaces to automatically create work orders and update equipment histories based upon alarms and test results received through these interfaces.

6) Reliability Centered Maintenance Integration

Select a CMMS system that fully integrates and takes advantage of Reliability Centered Maintenance

A formal review to determine the Key Performance Indicators (KPIs) that you may want is a very good start. Then consider where the data to produce these KPIs is going to come from. Can the system easily provide you with a report that shows the percentage of last week's weekly schedule that was achieved, for example? Frequently you will find that producing these KPIs will require data to come from different systems - for example Maintenance Costs per tonne may require data from the CMMS (or accounting system) and the Production systems. Maintenance safety statistics may need data from a totally separate system again.

So the bottom line achievement that we want to realise by implementing CMMS is the advancement of the Maintenance Management workforce to the next level in the maintenance process or the Planned stage. This is indicated generally by the fact that we have greater control over our stores systems, we are able to utilise capacity scheduling techniques to better manage our human resources and we have a planned backlog of at least two weeks out. Giving us much improved maintenance preparedness. Reliability and maintainability indicators should look better also with MTBF rising and the MTTR measure, if we manage it correctly, staying at the pre-implementation low level.

This also gives us the strong base for our move onwards through the predictive stage of maintenance management through to the World Class/continuous improvement stage. Although worthy of additional comment these wont be addressed within this article.

A maintenance workforce in a reactive state will have a very low MTBF of equipment and an

equally low MTTR. This may be masked, if not measured and regularly reported, by the fact that machine availability may still be at a high level.

What the indicator is telling us is that we have a plant or piece of machinery that is unreliable and breaks down often. Also we have teams of workers that are very good at fixing these breakdowns. The heroic culture that is fostered in these sorts of situations can be the most difficult obstacle in the implementation of a CMMS and realising the possible gains of this.

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Machine Availability

A thorough CMMS system implementation will also take into account the KPI structure of the organisation. With the amount of day-to-day data that will now be available pinpointing problem areas and modifying processes, routines and / or other factors will be more easily achievable also. As such a reduction in the amount of Breakdown work, or increase in overall availability of plant and equipment of 5% is also a very realistic and achievable goal.

Stores Holdings

As the work content becomes more and more planned in nature the work of the, generally long suffering, stores department will become more and more predictive in nature. Requiring fewer requirements to keep large volumes of parts and materials on a "we might need it" basis.

If the stores holdings can be reduced the logistical requirements to manage the stores function also decreases dramatically. Particularly that of the purchasing department and actual stores management personnel.

RCM - Computerized maintenance management system should have the functionality to support a reliability-centered

maintenance effort. Reliability-centered maintenance (RCM) is the method that best addresses the requirement for maximum reliability at minimum cost, or more pragmatically, doing the right maintenance at the right time. RCM results in a maintenance program that focuses PM on specific probable failure modes only. It has a strong bias toward condition monitoring and trend analysis of equipment performance.

Non intrusive condition monitoring, such as vibration monitoring and oil analysis, can reveal deterioration in performance and warn of impending loss of equipment functionality or failure. When sufficient data are available, trending can be used and maintenance can be performed when measurements stray out of a predetermined safe operating range.

Performing the appropriate maintenance just in time can produce significant cost savings, in addition to increased equipment uptime. RCM is a powerful tool for optimizing just-in-time maintenance actions. RCM targets only preventable failure causes with actions intended to prevent them, predictable failure mechanisms with actions that take advantage of the predictability of the mechanism, or the tell-tale signs that show the failure mechanism is in its early stages so that steps can be taken to prevent the functional failure. RCM does not result in over maintaining the equipment with actions that do not address specific failure modes.

RCM can result in significant reductions in direct maintenance costs. The discussion that follows outlines the RCM approach and reviews the type of information support a properly configured computerized maintenance management system (CMMS) can bring to the process.

Maintenance Metrics -

One of the universal objectives of any maintenance improvement plan must be to improve the ratio of planned versus unplanned

work. Clearly, the ultimate aim must be to move the unplanned maintenance level as far as possible toward zero. In practise many unorganised maintenance departments will have a ratio of 90% unplanned to 10% planned work; much of their work will be reactive. A CMMS will make this easy to monitor and produce a suitable metric. Over a period it can be used, along with the other statistics which will be available, to reverse the trend.

Just a few of the many other maintenance metrics, which may be relevant, are listed below:

- % Overtime hours
- Cost of maintenance overtime
- Backlog of work
- Average time per breakdown job
- Cost of spares
- Cost of labour
- Equipment effectiveness
- Total maintenance cost per unit of output
- Cost of lost output due to unplanned downtime
- Cost of lost output due to planned downtime
- Downtime percentages, by area and by asset
- Mean Time Between Stops or Mean Time Between Failures

FUTURE OF CMMS -

The future CMMS will be judged a lot harsher than those of today. As a minimum the following Modules or areas of functionality will be demanded:

- Planning indicators and capabilities
- Automatic Scheduling as per forecast man hour capacity levels.
- Automatic scheduling as per materials availability levels.
- The ability to schedule work on the basis of equipment operation or condition.
- Control over inventory levels and materials planning to a distance of 3 to 5 years.

- Equipment condition monitoring and alarm generating capabilities.
- Asset register creation and the inclusion of equipment/ Component tracing capabilities
- Project Management Capabilities
- Shutdown Planning Capabilities

Conclusion -

To operate world class maintenance organization you need precise information combined with the ability to act quickly in response to impending emergencies. Today computerized maintenance management system and predictive maintenance technologies can help you reach the goal of eliminating vast majority of unscheduled equipment repairs.

At a minimum the pdM system should accurately monitor real time equipment performance and alert the maintenance professional to any changes in performance trends. There are a variety of measurements that a pdM package might be able to track including vibration , oil condition, temperature ,flow etc. CMMS is a great organizational tool but can not directly monitor equipment condition. A pdM system excel in monitoring the equipment condition . It is better to combine the two technologies in to a seamless system that avoids catastrophic breakdowns but eliminates need less repairs to equipments that is running satisfactory.