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Efficient Utilisation of C.B.M in Industry for Reducing Cost of Maintenance

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Abstract: *Every industry is dependent on some type of asset that keeps the business in business be it a computer, a CNC, or a megawatt transformer. In a large enterprise, reducing costs related to asset maintenance, repair, and ultimate replacement is at the top of management concerns. Downtime in manufacturing ultimately results not only in high repair costs, but in customer dissatisfaction and lower potential sales. In response to these concerns, this paper presents a methodology for creating an efficient Condition Based Maintenance (CBM) system in industry for reducing cost of maintenance. It provides valuable guidelines for planning an enterprise system that monitors critical maintenance processes and assets.*

Keywords: *CBM, Downtime, Maintenance, Condition Monitoring, CBM+,*

I. Introduction

The machines/equipments of every industry are his most valued assets. These are his source of income and thus they should be accorded the care that they deserve. Condition based maintenance generally is appropriate for machines that are highly relied on in every organization.

Condition Based Maintenance is a predictive maintenance technique. CBM is the method adopted to monitor and diagnose the condition of the process, machinery, or components under investigation. In short we can say that CBM is a technique of diagnosing failure mechanisms and making a prognosis of the remaining useful life before failure. Efficient maintenance systems are expected to detect early forms of degradation in predictive maintenance (pdm) practices in tandem with Condition Based Maintenance (CBM).

Condition based maintenance is triggered by a predefined event which indicates the extent of degradation of component or equipment. The difference between time based (periodic) and condition based maintenance can be defined in terms of the way in which they aim to prevent functional failure [1]:

- Time based (periodic) maintenance entails performing an action without first collecting component/equipment data;
- Condition based maintenance involves, on the contrary, collecting data, conducting an analysis, and performing a maintenance action if necessary.

Condition based maintenance leads not only to a reduction of unnecessary preventive maintenance actions and in shifting some maintenance operations away from the outage period (on-line maintenance) but ensures that actions are performed when justified by component/equipment condition. Condition based maintenance also helps ensure closer relation between operations and maintenance departments as well as among different maintenance personnel of different background skills.

CBM is carried out for two main reasons:

1. To detect sudden changes in condition that could lead to catastrophic failure, particularly for machinery that could represent a threat to the health and safety of people, or cause an environmental incident. This is known as 'Machinery Protection' or 'Protective Monitoring'.
2. To identify the early onset of incipient failures so that a prediction can be made about their most likely progress and suitable actions can be planned. This is known as 'Predictive Monitoring' or 'Predictive Maintenance', and is often abbreviated to 'PDM'.

An efficient CBM program is highly valuable for every industry in terms of productivity, quality, inventory control, and expenditure on plant and machinery; it also reduces the cost involved in false maintenance which leads towards increased profit for the industry.

II. EFFICIENT CBM

The term efficient implies that a CBM system is capable of understanding and making decisions without human intervention. Technologies making this possible include: sensors with built in intelligence (SMART Sensors) capable of transmitting relatively rich, high grade information; re-programmable on-line sensors, designed to be reconfigured with new rules in the event that detectable recognisable patterns change; algorithms, fuzzy logic and neural networking, designed to analyse trends within recovered sensory data, and produce decisions on the likelihood of failure of monitored plant items [2]; artificial intelligence algorithms capable of providing proxy data as a substitute for failing or a failed sensor, whilst the malfunctioning sensor is repaired [3]. Further it is also possible through integration of a CBM system with a company's computerised purchasing system, thus automating parts ordering [4].

As technological advancements have fed into CBM so the method of deploying CBM systems and integrating them with other business systems has changed.

It takes place gradually as new scientific discoveries are made, accepted and applied to CBM systems. Recent technological advances include improved knowledge of material failure mechanisms, advancements in failure forecasting techniques, advancements in monitoring and sensor devices, advancements in diagnostic and prognostic software, acceptance of communication protocols, developments in maintenance software applications and computer networking technologies to name a few.

III. IMPORTANCE OF CONDITION MONITORING

Condition monitoring involves determining the condition of a machine and its rate of change of measured parameters in order to determine the maintenance requirement. The condition of machine may be determined continuously or at regular intervals by monitoring measurable parameters.

The most common of types of techniques used in condition monitoring today include human senses which are visual observations, listening and touching. Such senses employ visual inspection, tactile inspection smelling, aural inspection and optical magnification [5]. An efficient condition based maintenance program shall utilize variety of technologies, the majority of industry equipment constitute of mechanical systems. An efficient condition based maintenance program must include various monitoring and diagnostic techniques. These techniques include:

- Vibration monitoring.
- Acoustic analysis.
- Motor current analysis technique.
- Motor operated valve testing.
- Thermography.
- Tribology.
- Process parameter monitoring.
- Visual inspections.
- Other non-destructive testing techniques.

A pre-requisite for condition based maintenance is the availability or development of non-destructive monitoring techniques. The goal is to detect degraded condition, and if possible, assess changes in them with a view to preventing failure.

IV. EXECUTION OF EFFICIENT CBM

The execution of efficient condition based maintenance can be done in the following four steps:

1. *Data collection*. The relevant data is collected (off line or online) through the use of process control systems, vibration measurements, oil sampling, and other methods.
2. *Data analysis*. Depending on the situation, the data needs to be cleaned; for example, during start-ups and shutdowns the plant may exhibit erratic behaviour, which is not to be misinterpreted as failure. The data can be analysed in several ways, for example by direct comparison with a threshold or by looking at trends or other remarkable behaviour.
3. *Decision making*. Based on the data and the analysis, a decision is made. Such a decision may involve a change in operating routines or the direct execution of a maintenance task. It may also lead to additional data collection and analysis.
4. *Implementation*. When a decision has been made, an intervention is planned. After the intervention, reports can be made and stored for future maintenance actions. Evaluations are conducted when deemed necessary.

V. BENEFITS ACHIEVED FROM EFFICIENT UTILIZATION OF CBM

- Reduction of scheduled preventive maintenance content.
- Escalation of preventive maintenance intervals.
- Early warning of impending failures through data link.
- Enable scheduling of unscheduled maintenance.
- Enhanced diagnostics for troubleshooting.
- Optimized logistics support.
- Pre-staging replacement parts for impending failures.
- Fewer components replaced for preventive maintenance over the life of the equipment.

The benefits of CBM can be enhanced if industries implement CBM+ it will also greatly support the maintenance system of the industry.

Conditioned Based Maintenance Plus (CBM+) is the application and integration of appropriate processes, technologies, and knowledge-based capabilities to improve the reliability and maintenance effectiveness of industrial systems and components. CBM+ is maintenance performed on evidence of need provided by Reliability Centered Maintenance (RCM) [6] analysis and other enabling processes and technologies. CBM+ uses a systems engineering approach to collect data, enable analysis, and support the decision-making processes for system acquisition, sustainment, and operations.

CBM+ encourages the use of portable maintenance aids to:

- Reference technical manuals and checklist
- Assist in production management
- Enable data recording and recall
- Provide a platform for training
- Access embedded diagnostics and prognostics

VI. Conclusion

In this paper we present an efficient condition-based maintenance approach for industries, which will improve maintenance performance and machine utilization. And the following key benefits can be achieved:

- Improved system reliability.
- Decreased maintenance costs.
- Decreased number of maintenance operations causes decreasing of human error influence.
- Increased profit.

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