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MAINTENANCE AND RELIABILITY STRATEGY OF MECHANICAL EQUIPMENT IN INDUSTRY

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Abstract – *The objective of maintenance and reliability in any industry having mechanical equipment is to maintain the capability of the system while controlling costs. Maintenance is all activities involved in keeping a system's equipment in working order by implementing or improving preventive maintenance and increasing repair capability whereas Reliability is the probability that a machine will function properly for a specified time. Reliability aims at improving individual components and provides redundancy. By adopting this strategy, industry benefitted by reduced inventory, improved quality, improved capacity, reputation for quality, continuous improvement, and reduced variability. Finally the aim of industry, i.e., reduced value of investment in plant and reduction in down time of equipment will be achieved by implementing correct maintenance strategy.*

Key Words*: *Maintenance, Reliability, strategy, redundancy, quality.

1. INTRODUCTION

In industry, regular maintenance of equipment is an important and necessary activity. The term 'maintenance' covers many activities, including inspection, testing, measurement, replacement and adjustment, and is carried out in all sectors and workplaces. It has a vital role to play in reducing the risk associated with some workplace hazards and providing safer and healthier working conditions. Insufficient/inadequate maintenance can cause serious accidents or health problems. Machinery that has a maintenance log needs to be kept up to date and maintenance operations need to be carried out safely. A risk assessment should be carried out before any maintenance work begins and work should be planned. It is best practice to keep a maintenance log which is regularly updated. Workers should be involved in the risk assessment process as those carrying out a maintenance task are often in the best position to identify hazards and the most efficient ways of dealing with them. The work area should be made safe (e.g. preventing unauthorised access) and the people performing the maintenance work should be equipped with the proper tools and equipment to do the work safely (including personal protective equipment – PPE). The work should be monitored and safe working procedures need to be followed at all times. The process needs to end with checks to ensure that the job has been completed satisfactorily.

1.1 Maintenance strategies

The rise of the industrial internet of things is making it possible for organizations to use intelligent maintenance software to collect data and integrate with connected devices to get smarter about manufacturing. While this particular type of maintenance has been gaining popularity, it's far from the only solution available to equipment-heavy organizations. There are a host of other maintenance types that work well for all kinds of organizations, from small shops drowning in paper work orders to data-driven enterprise operations for whom predictive maintenance is a reality. Let's compare these types of maintenance to see which ones work best for different scenarios.

2. Types of maintenance

The following four major types of maintenance are being followed widely on mechanical equipment

- Run-to-failure (Breakdown maintenance)
- Preventive (scheduled) maintenance
- Predictive maintenance (PdM)
- Reliability-Centered maintenance (RCM)

Details of these maintenance explained in detail below.

2.1 Run-to-failure (Breakdown maintenance)

Also known as breakdown or run-to-failure, reactive maintenance is pretty simple: fix things when they break. Since repairs are not planned, it's a good method to employ for equipment that is not essential for operations or has a low cost. While it requires minimal planning, the drawbacks of reactive maintenance can be substantial if it's not carried out correctly. If the approach is used for all equipment, there can be huge delays in production when a critical piece of equipment fails. Further, if you don't have the right parts and supplies on hand, the costs for rushed shipping can become significant. In short, reactive maintenance often means more downtime and higher maintenance costs when it's not used strategically.

2.2 Preventive (scheduled) maintenance

Also known as proactive maintenance, this method involves periodically taking assets offline and inspecting or repairing them at predetermined intervals (usually time or event-based triggers). The goal of this approach is to extend the useful life of an asset and prevent breakdowns from occurring.

Many organizations employing preventive maintenance use CMMS software to trigger work orders when a PM is due. This allows a facility to automate much of its scheduling efforts, which is a key ingredient of this preventive approach. Because planning is done in advance, it's much easier to have the right parts and resources on hand to complete each task. As with all maintenance types, there are potential drawbacks to relying solely on preventive maintenance. If the PM schedule isn't regularly monitored, audited, and improved, "PM creep" can occur. This is when technicians get bogged down by unnecessary tasks and cost the organization time and money.

Similarly, performing too many PMs can open the door for post-PM breakdowns. There are a number of ways to prevent this, but the risk gets higher as PMs get more frequent. The bottom line is, if a preventive maintenance program is used, it should go hand in hand with PM optimization.

2.3 Predictive maintenance (PdM)

Predictive maintenance (PdM) aims to predict failures before they happen so maintenance can occur at just the right time. PdM uses data from machine sensors and smart technology to alert the maintenance team when a piece of equipment is at risk of failing. For example, a sensor may use vibration analysis to alert the maintenance team that a piece of equipment is at risk of failing, at which point it will be taken offline, inspected, and repaired accordingly.

It is possible to carry out PdM via visual inspections of equipment, but the easiest way to establish a predictive maintenance strategy is by using a CMMS to track meter readings. The advantage of PdM (over PM) is the potential for cost savings from reduced man-hours spent on maintenance, and more insight as to the performance and potential issues arising with the machine. Additionally, a reliance on data and sensor information means maintenance is determined by the actual condition of equipment, rather than a best-guess schedule or gut feel. The most commonly applied condition-based maintenance techniques are vibration analysis, oil analysis, thermography, ultrasonics, electrical effects and penetrants.

Of course, relying so heavily on data means that there is a higher up-front cost to ensuring this maintenance approach can thrive. Another thing to keep in mind with predictive maintenance is that you have to walk before you can run. For an organization coming from a pen-and-paper or Excel-based maintenance program, you have to first build on the processes and insights that preventive maintenance provides in order to build an effective predictive maintenance plan.

2.4 Reliability-Centred maintenance (RCM)

Reliability-Centered Maintenance (RCM) addresses the fact that failure is not always linear. RCM is a highly-involved process that seeks to analyze all the possible failure modes for each piece of equipment and customize a maintenance plan for each individual machine. The ultimate goal of RCM is to increase equipment availability or reliability.

RCM is considered complex because each individual asset must be analyzed and prioritized based on criticality. The most critical assets are those that are likely to fail often or will result in large consequences in the event of failure. Because each piece of equipment is analyzed on its own, it's possible that the end result of embarking on an RCM effort is having as many different maintenance plans as you do pieces of equipment.

RCM is very sophisticated, to the extent where it is not a realistic or necessary technique for every organization. It's requires a very mature maintenance team that has mastered prevention, basic inspections, predictive maintenance, and has access to lots of existing data on their assets.

3.0 Analysis

The cost effectiveness of maintenance against failures plotted on Chart -1. The optimum cost of maintenance is balanced between reactive and preventive maintenance at breakeven point. Therefore the optimized cost of maintenance can be determined by combined effect of preventive and reactive maintenance.

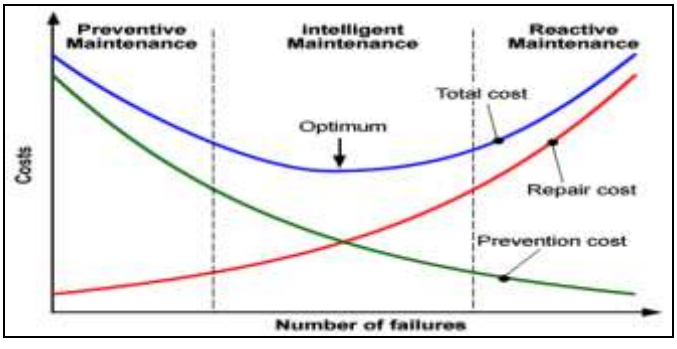

Chart -1: Cost effectiveness of maintenance

Various maintenance strategies with pros and cons with the effect of cost implementation analyzed and tabulated in Table-1.

Strategy	Outcome	Pros	Cons	Cost to Implement
Reactive	Fix it when it breaks	Ideal for low-priority equipment	Can lead to runaway repair costs	Low
Preventive	Maintenance on a predetermined schedule	Best strategy to implement without expertise	Without optimization, "PM creep" can occur	Average
Predictive	Condition-based monitoring triggering work orders	Timely and informed monitoring. More insight into causes of breakdowns	Can be expensive to set up	High
RCM	Investigation of failure modes to determine best maintenance strategy	If executed properly, provides the most efficient maintenance schedule	Requires time, skill and financial resources to be effective	Highest

Table-1 Analysis of maintenance strategies

Equipment maintenance strategies with respect to down time shown in the figure-1. It is inferred that reliability centred maintenance made improved availability of equipment over other maintenance types.

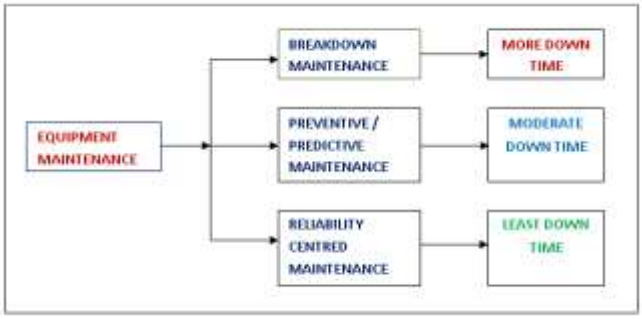

Figure-1, Equipment maintenance Vs Down time

3. CONCLUSION

Maintenance and reliability strategy of mechanical equipment in industry look at with motive of extending the useful life of equipment and machinery, to ensure the optimum availability of installed equipment for production or service and obtain the maximum possible return on investment, to ensure the operational readiness of all equipments required for emergency use, such as stand by units, fire fighting and rescue equipment, to ensure the safety of personnel using facilities. Strategic maintenance efforts to reduce or eliminate the need for maintenance are like the thumb, the first and most valuable digit. We are often so involved in maintaining that we forget to plan and eliminate the need at its source. Reliability engineering efforts should emphasize elimination of failures that require maintenance. This is an opportunity to pre-act instead of react in industry.

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BIOGRAPHIES

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