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Is Preventive Maintenance Necessary?

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Reliability Centered Maintenance has changed the way we think about Preventive Maintenance (PM). It has caused some to question whether it is even necessary to do preventive maintenance. The truth is most manufacturing facilities would benefit from a good preventive maintenance program. It would be especially beneficial for those plants that rely on breakdown or run-to-failure maintenance. But, a preventive maintenance program is potentially risky, so it must be administered and performed properly to be successful. This paper will examine both the benefits and risks of preventive maintenance and offer some ideas on how to make it successful. We will start with a definition of preventive maintenance.

What is Preventive Maintenance?

Preventive maintenance is planned maintenance of plant and equipment that is designed to improve equipment life and avoid any unplanned maintenance activity. PM includes painting, lubrication, cleaning, adjusting, and minor component replacement to extend the life of equipment and facilities. Its purpose is to minimize breakdowns and excessive depreciation. Neither equipment nor facilities should be allowed to go to the breaking point. In its simplest form, preventive maintenance can be compared to the service schedule for an automobile.

A bona fide preventive maintenance program should include:

1. Non-destructive testing
2. Periodic inspection
3. Preplanned maintenance activities
4. Maintenance to correct deficiencies found through testing or inspections.

The amount of preventive maintenance needed at a facility varies greatly. It can range from a walk through inspection of facilities and equipment noting deficiencies for later correction up to computers that actually shut down equipment after a certain number of hours or a certain number of units produced, etc.

Many reasons exist for establishing a PM program. Listed below are a few of these. Whenever any of these reasons are present, a PM program is likely needed.

Reasons for Preventive Maintenance

- Increased Automation
- Business loss due to production delays
- Reduction of insurance inventories
- Longer equipment life
- Production of a higher quality product
- Just-in-time manufacturing
- Reduction in equipment redundancies
- Cell dependencies
- Minimize energy consumption (5% less)
- Need for a more organized, planned maintenance function

Why Have a PM Program

The most important reason for a PM program is reduced costs as seen in these many ways.

- Reduced production downtime, resulting in fewer machine breakdowns.
- Better conservation of assets and increased life expectancy of assets, thereby eliminating premature replacement of machinery and equipment.
- Reduced overtime costs and more economical use of maintenance workers due to working on a scheduled basis instead of a crash basis to repair breakdowns.
- Timely, routine repairs circumvent fewer large-scale repairs.
- Reduced cost of repairs by reducing secondary failures. When parts fail in service, they usually damage other parts.
- Reduced product rejects, rework, and scrap due to better overall equipment condition.
- Identification of equipment with excessive maintenance costs, indicating the need for corrective maintenance, operator training, or replacement of obsolete equipment.
- Improved safety and quality conditions.

If it cannot be shown that a preventive maintenance program will reduce costs, there is probably no good reason other than safety to have a PM program.

The Law of PM Programs: There are many advantages for having a good preventive maintenance program. The advantages apply to every kind and size of plant. The ***law of PM programs*** is that the higher the value of plant assets and equipment per square foot of plant, the greater will be the return on a PM program. For instance, downtime in an automobile plant assembly line at one time cost $10,000 per minute. Relating this to lost production time an automobile manufacturer reported that the establishment of a PM program in their 16 assembly plants reduced downtime from 300 hours per year to 25 hours per year. With results such as this no well-managed plant can afford not to develop a PM program.[1]

Preventive Maintenance Program Risks

As mentioned in the beginning of this report, preventive maintenance does involve risk. The risk here refers to the potential for creating defects of various types while performing the PM task. In other words, human errors committed during the PM task and infant mortality of newly installed components eventually lead to additional failures of the equipment on which the PM was performed. Frequently, these failures occur very soon after the PM is performed. Typically, the following errors or damage occur during PM's and other types of maintenance outages.

- Damage to an adjacent equipment during a PM task
- Damage to the equipment receiving the PM task to include such things as:
    - Damage during the performance of an inspection, repair, adjustment, or installation of a replacement part.
    - Installing material that is defective, incorrectly installing a replacement part, or incorrectly reassembling material.
- Reintroducing infant mortality by installing new parts or materials.
- Damage due to an error in reinstalling equipment into its original location.

[1] E. T. Newbrough, *Effective Maintenance Management,* (New York: McGraw-Hill, 1967).

Especially disturbing about these types of errors is the fact that they go unnoticed – until they cause an unplanned shutdown. There is some published data that illustrates this point. It comes from the fossil-fuel power industry.

A review of the data from fossil-fueled power plants that examined the frequency and duration of forced outages **after** a planned or forced maintenance outage reinforces this concept. That data showed that of 3146 maintenance outages, 1772 of them occurred in less than one week after a maintenance outage. Clearly, this is pretty strong evidence that suggests that in 56% of the cases, unplanned maintenance outages were caused by errors committed during a recent maintenance outage.

Having performed and supervised many industrial PM's, I also support this concept. I can remember many instances where it would take days after a PM was performed to get everything back to normal. This was particularly true when many components that came in contact with the product being produced were replaced. I remember working with the quality people on many occasions to insure that every position on a multiple position machine was once again producing first quality product. Many times it required adjusting and/or replacing components that were adjusted or replaced on the PM.

How to Have a Successful PM Program

The key to a successful Preventive Maintenance (PM) program is scheduling and execution. Scheduling should be automated to the maximum extent possible. Priority should be given to preventive maintenance and a very aggressive program to monitor the schedule and ensure that the work is completed according to schedule should be in place.

Preventive Maintenance Execution: Traditional preventive maintenance was based on the concept of the bathtub curve. That is, new parts went through three stages, an infant mortality stage, a fairly long run stage, and a wear-out stage. The PM concept was to replace these parts before they entered the wear-out phase. Unfortunately, Reliability Centered Maintenance based on research done by United Airlines and the rest of the aircraft industry showed that very few non-structural components exhibit bathtub curve characteristics. Their research showed that only about 11% of all components exhibit wear-out characteristics, but 72% of components do exhibit infant mortality characteristics. These same characteristics have been shown to apply in Department of Defense systems as well as power plant systems. It is very likely that they apply universally as well. Therefore, they should be taken into account when configuring preventive maintenance on industrial equipment.

In order to have a successful PM program, the message is clear. The PM should focus on cleaning, lubrication, and correcting deficiencies found through testing and inspections. When there is a need to adjust or replace components, it should be done by highly trained and motivated professionals. Predetermined parts replacement should be minimal and done only where statistical evidence clearly indicates wear-out characteristics. In the absence of data to support component replacement, an age exploration program or the collection of data for statistical analysis to determine when to replace components should be initiated. Borrowing from the Japanese, lubrication points should be clearly marked with bright red circles to ensure that lubrication tasks are not missed. Cleaning should be carried our to remove dust, dirt, and grime because these things mask defects that can cause unplanned maintenance outages.

Motivating Preventive Maintenance Workers: A quality preventive maintenance program requires a highly motivated preventive maintenance crew. To provide proper motivation, the following activities are suggested:

- Establish inspection and preventive maintenance as a recognized, important part of the overall maintenance program.

- Assign competent, responsible people to the preventive maintenance program.
- Follow-up to assure quality performance and to show everyone that management does care.
- Provide training in precision maintenance practices and training in the right techniques and procedures for preventive maintenance on specific equipment.
- Set high standards.
- Publicize reduced costs with improved up-time and revenues, which are the result of effective preventive maintenance.

In addition to explaining the importance of a good preventive maintenance program and the benefits that can be derived from it, training is probably the most effective motivational tool available to the maintenance supervisor. Maintenance and training professionals have estimated that a company should spend $1200 per year for training of supervisors and $1000 per year for each craftsperson. In fact, due to advances in technology, if the company has not provided any training for craftspeople in the past 18 months, their skills have become dated.

Conclusion

It is possible to have a successful preventive maintenance program. From a cost reduction viewpoint it is essential, but it does entail risk. When the proper care is taken, the risks, however, can be minimized. In order to minimize risk, preventive maintenance has to be carefully planned and carried out by well-trained and motivated workers. The biggest benefits of a PM program occur through painting, lubrication, cleaning and adjusting, and minor component replacement to extend the life of equipment and facilities.

William (Bill) C. Worsham was a Senior Consultant for Reliability Center, Inc. Mr. Worsham had over 30 years experience in the field of Maintenance and Reliability program management. He had participated in and led teams in the development, design and implementation of three separate maintenance management systems. He had also participated in the design and implementation of specialized reliability inspection programs such as lubrication scheduling, vibration monitoring, instrument inspection and preventive maintenance. Mr. Worsham was a practitioner of root cause analysis in the field with his clientele as well as an educator. Our friend and colleague has passed away since writing this article. If you would like to make an inquiry on this topic please contact us at 804/458-0645 or info@reliability.com.