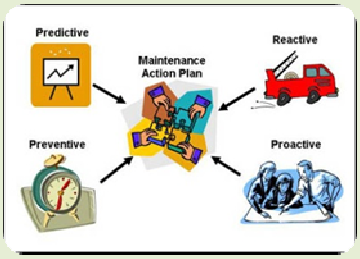
Importance of Machine Maintenance

Nothing lasts forever!

Not even US.

Everything on this earth has associated life expectancy or operational life. Belts need adjustment, alignment needs to be maintained, proper lubrication on rotating equipment is required, and so on. In our daily life too, certain components need replacement, e.g., a wheel bearing on a motor vehicle, to ensure the main piece of equipment last for its design



life. Anytime "**We**" fail to perform maintenance activities intended by the equipment's designer, we shorten the operating life of the equipment.

But what options do we have? →

The dictionary defines maintenance as follows:

"The work of keeping something in proper condition."

This would imply that maintenance should be actions taken to prevent a device or component from failing or to keep it in proper working order.

Why do you take your car for regular service?

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Ask yourself.

In addition to waiting for a piece of equipment to fail (reactive maintenance), we can utilize :

- Preventive maintenance
- Predictive maintenance
- Reliability centred maintenance.

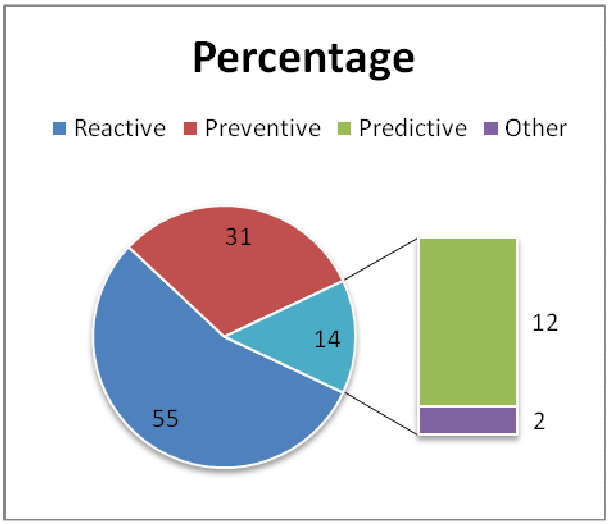
Reactive Maintenance

Reactive maintenance is basically:

"**run it till it breaks**"

maintenance mode. No actions or efforts are taken to maintain the equipment as the designer originally intended to ensure design life is reached, we can also call it "**fire fighting**". Studies indicate this is still the predominant mode of maintenance.

The referenced study breaks down the average maintenance program as follows:



Advantages

- Low cost.
- Less staff.

Disadvantages

- Increased cost due to unplanned downtime
- Increased labor cost, especially if overtime is needed.
- Cost involved with repair or replacement
- Possible secondary equipment or process damage
- Inefficient use of staff resources.

Note that more than 55% of maintenance resources and activities of an average facility are still reactive. Advantages to reactive maintenance can be viewed as a double-edged sword. If we are dealing with new equipment, we can expect minimal incidents of failure. If our maintenance program is purely reactive, we will not expend manpower dollars or incur capitol cost until something breaks. Since we do not see any associated maintenance cost, we could view this period as saving money. The downside is reality. In reality, during the time we believe we are saving maintenance and capitol cost, we are really spending more dollars than we would have under a different maintenance approach.

Preventive Maintenance

Preventive maintenance can be defined as follows:

Actions performed on a time- or machine-run-based schedule that detect, preclude, or mitigate degradation of a component or system with the aim of sustaining or extending its useful life through controlling degradation to an acceptable level.

By simply expending the necessary resources to conduct maintenance activities intended by the equipment designer, equipment life is extended and its reliability is increased. In addition to an increase in reliability, dollars are saved over that of a program just using reactive maintenance. Studies indicate that this savings can amount to as much as 12% to 18% on the average.

Advantages

- Cost effective in many capital intensive processes.
- Flexibility allows for the adjustment of maintenance periodicity.
- Increased component life cycle.
- Energy savings.
- Reduced equipment or process failure.
- Estimated 12% to 18% cost savings over reactive maintenance program.

Disadvantages

- Catastrophic failures still likely to occur.
- Labor intensive.
- Includes performance of unneeded maintenance.
- Potential for incidental damage to components in conducting unneeded maintenance.

Depending on the facilities current maintenance practices, present equipment reliability, and facility downtime, there is little doubt that many facilities purely reliant on reactive maintenance could save much more than 18% by instituting a proper preventive maintenance program.

While preventive maintenance is not the optimum maintenance program, it does have several advantages over that of a purely reactive program. By performing the preventive maintenance as the equipment designer envisioned, we will extend the life of the equipment closer to design. This translates into dollar savings. Preventive maintenance (lubrication, filter change, etc.) will generally run the equipment more efficiently resulting in dollar savings. While we will not prevent equipment catastrophic failures, we will decrease the number of failures.

Predictive Maintenance

Predictive maintenance can be defined as follows:

Measurements that detect the onset of a degradation mechanism, thereby allowing causal stressors to be eliminated or controlled prior to any significant deterioration in the component physical state.

Results indicate current and future functional capability. Basically, predictive maintenance differs from preventive maintenance by basing maintenance need on the actual condition of the machine rather than on some preset schedule. Activities such as changing lubricant are based on time, like calendar time or equipment run time. For example, most people change the oil in their vehicles every 3,000 to 5,000 miles travelled. This is effectively basing the oil change needs on equipment run time. No concern is given to the actual condition and performance capability of the oil. It is changed because it is time. This methodology would be analogous to a preventive maintenance task. If, on the other hand, the operator of the car discounted the vehicle run time and had the oil analysed at some periodicity to determine its actual

condition and lubrication properties, he/she may be able to extend the oil change until the vehicle had travelled 10,000 miles. This is the fundamental difference between predictive maintenance and preventive maintenance, whereby predictive maintenance is used to define needed maintenance task based on quantified material/equipment condition.

Advantages

- Increased component operational life/availability.
- Allows for pre-emptive corrective actions.
- Decrease in equipment or process downtime.
- Decrease in costs for parts and labor.
- Better product quality.
- Improved worker and environmental safety.
- Improved worker moral.
- Energy savings.
- Estimated 8% to 12% cost savings over preventive maintenance program.

Disadvantages

- Increased investment in diagnostic equipment.
- Increased investment in staff training.
- Savings potential not readily seen by management.

A well-orchestrated predictive maintenance program will all but eliminate catastrophic equipment failures. We will be able to schedule maintenance activities to minimize or delete overtime cost. We will be able to minimize inventory and order parts, as required, well ahead of time to support the downstream maintenance needs. We can optimize the operation of the equipment, saving energy cost and increasing plant reliability. Past studies have estimated that a properly functioning predictive maintenance program can provide a savings of 8% to 12% over a program utilizing preventive maintenance alone.

Reliability Centered Maintenance

Reliability centered maintenance (RCM) can be defined as:

"a process used to determine the maintenance requirements of any physical asset in its operating context."

Basically, RCM methodology deals with some key issues not dealt with by other maintenance programs. It recognizes that all equipment in a facility is not of equal importance to either the process or facility safety. It recognizes that equipment design and operation differs and that different equipment will have a higher probability to undergo failures from different degradation mechanisms than others. It also approaches the structuring of a maintenance program recognizing that a facility does not have unlimited financial and personnel resources and that the use of both need to be prioritized and optimized. **In a nutshell, RCM is a systematic approach to evaluate a facility's equipment and resources to best mate the two and result in a high degree of facility reliability and cost-effectiveness.** RCM is highly reliant on predictive maintenance

but also recognizes that maintenance activities on equipment that is inexpensive and unimportant to facility reliability may best be left to a reactive maintenance approach.

Advantages

- Can be the most efficient maintenance program.
- Lower costs by eliminating unnecessary maintenance or overhauls.
- Minimize frequency of overhauls.
- Reduced probability of sudden equipment failures.
- Able to focus maintenance activities on critical components.
- Increased component reliability.
- Incorporates root cause analysis.

Disadvantages

- Can have significant start-up cost, training, equipment, etc.
- Savings potential not readily seen by management.

The following maintenance program breakdowns of continually top-performing facilities would echo the RCM approach to utilize all available maintenance approaches with the predominant methodology being predictive.

- <10% Reactive
- 25% to 35% Preventive
- 45% to 55% Predictive.

Because RCM is so heavily weighted in utilization of predictive maintenance technologies, its program advantages and disadvantages mirror those of predictive maintenance. In addition to these advantages, RCM will allow a facility to more closely match resources to needs while improving reliability and decreasing cost.

Reference

Piotrowski, J. April 2, 2001. *Pro-Active Maintenance for Pumps, Archives, February 2001*, Pump-Zone.com [Report online]. Available URL: http://www.pump-zone.com. Reprinted with permission of Pump-Zone.com.