# An Effective Maintenance Strategy

**Part 1:**

Maintenance exists to protect your plant's physical assets. An effective maintenance strategy ensures that you get the maximum life from your building, utilities and production equipment for the most economical cost. Maintenance does this by managing the aging process, for at some point in time, all equipment will fail. Maintenance manages the aging process by:

- monitoring the equipment conditions,
- making adjustments,
- lubricating equipment,
- repairing damage due to external forces such as:
    - wind damage,
    - forklift-truck impact,
    - machine crashes due to limit switch failure, etc.
- It replaces worn and failed parts.

Your maintenance strategy can keep your plant's equipment functional however, maintenance does not extend the design life. In order to do that, overhauls and rebuilds become necessary and are normally over and above what maintenance does. It is then considered a *capital expense*.

Would you always overhaul your existing equipment? Will the refurbished machine function as well as a new machine? Keep in mind that rebuilding will probably cost at least 50% the cost of a new machine, if not more. In some instances, such as re-tubing a boiler, or turbine re-blading, it does make sense. The effect maintenance has on a facility's *bottom line* must be considered.

Maintenance has evolved into at least 5 distinct programs of ever increasing complexity. They range from allowing equipment to run until it fails, to trying to prevent every possible failure. Each of these programs has its place in the overall maintenance strategy. These five programs have generally been labeled as:

1. *Breakdown,*
2. *Planned Preventative Maintenance,*
3. *Predictive Maintenance,*
4. *Reliability Centered Maintenance, and*
5. *Total Productive Maintenance*.

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**Part 2:**

**Breakdown Maintenance**

Breakdown maintenance works on the premise of if it ain't broke, don't fix it.

Example: Automotive lights are a prime example of a part of your car that you would run to failure. You simply replace the bulb when it is burnt out, an easy simple fix with no adverse effect on your vehicle. However, if you run your brakes to failure, it becomes very costly to repair or replace. Using break down maintenance, you allow the brake linings to wear out, scoring your rotors, and ultimately heating a wall because you cannot stop, never mind the safety hazard you are creating. Anyone who has experienced this knows that's not very cost effective.

In the past, the results of a failure were not perceived as avoidable or serious. As a consequence, maintenance was viewed as a necessary evil. The only maintenance functions performed with a break down maintenance plan are those of a routine nature such as lubrication, tightening of loose bolts, and watching for signs of trouble. Repairs take place when a machine has worn to the point that the machine's performance is intolerably poor or an actual break down has occurred. In effect, the machine controls the maintenance cycle.

Machines allowed to run to failure require more extensive and expensive repairs. There are several reasons for this.

- Failures always happen at the most inopportune time such as in the middle of a critical production run, and as a result,

- Repairs are rushed by production managers.
- Little can be done beforehand such as allocating manpower, tools, and replacement parts.

There is no reason to expect that breakdowns will limit themselves to the capabilities of the plant's workforce. A maintenance staff of any size and collection of skills will almost always be feast or famine. Some failures can be catastrophic and may require the replacement of the entire machine. Again, added costs of this approach can include

- the direct costs of the repairs,
- investigative costs to determine the root cause, or expect repeat lost production
- production scrap or production marginally on specification that gets shipped to the customer who may complain about declining quality.
- salaries for idled production workers
- overtime pay for maintenance staff and any outside contractors
- parts expediting costs
- extra expense of having someone else produce your product
- missed or delayed shipments

It could take anywhere from 3 to 24 or more months to replace the machine..

**Part 3:**

**PLANNED PREVENTATIVE MAINTENANCE**

Preventative maintenance entails stopping a machine to measure and examine its moving parts to determine if they are still satisfactory for continued use or ready for regular replacement.

Planned preventative maintenance includes both operational maintenance and planned maintenance.

Operational Maintenance

Operational maintenance refers to activities performed while equipment is in service. Typical activities include:

- Lubrication.
- Changing duplex filters or strainers.
- Testing alarms and other safety features.
- Tightening loose bolts and joints.
- Continuous vibration monitoring.
- Watching and listening for signs of trouble.

For most equipment, it will include maintaining logs of:

- Important parameters.
- Maintenance and preservation activities.
- Any changes and significant observations.

An effective log program should include:

- Regular gathering of information.
- Collection of enough information for intelligent interpretation.
- Periodic review of data.

The logs and records should be subject to review by the maintenance department and verified by audit.

## Planned Maintenance

Planned maintenance systems (PMS) are those in which maintenance is scheduled based on elapsed time or on a specific number of operating cycles. Selecting correct intervals between performances of maintenance tasks is critical to the success of the program. If the intervals are too large, breakdown maintenance is the result. If too small, the shutdown of equipment to replace good parts quickly results in the perception that the program is nothing more than “going through the motions.” Sooner or later, the persons responsible for the tasks will do nothing but “go through the motions,” or worse, feel free to document work not actually performed. Breakdown maintenance will again result.

When intervals in a PMS have been selected, extensions should not be allowed without compelling reasons. Valid support for such an extension might include documenting a careful review of operating parameters to detect any subtle deterioration, an analysis by an outside consultant, or an “on the fly” borescope or other examination of critical areas. Requests for extensions should be documented and require the approval of top management. Production convenience must not be permitted to dictate.

Inspection frequencies should be assigned based upon:

- The importance of equipment and the consequences of its failure.
- Previous inspection results and failure history.
- Service conditions.
- Time in service.
- Jurisdictional requirements.
- Insurance company recommendations.

There are disadvantages to this approach also.

First, periodic disassembly and inspection of every critical piece of machinery is costly and time consuming. The second problem is how to establish the maintenance intervals. Thirdly, a machine that is actually operating properly can be degraded by frequent disassembly.

**Part 4:**

**Predictive Maintenance**

Predictive maintenance is maintenance directed by the condition of the machine. It is the most promising approach to maintenance and overcomes the disadvantages of the predictive maintenance approach based on the operating hours or operating cycles. Detection and diagnosis of equipment problems while a machine is on-line is the most desirable way to maintain a machine.

In industrial applications,preventive maintenance can be quite effective in reducing the number of maintenance outages for such things as routine bearing changes every 4 months. The cost of the part is insignificant when compared to the value of the production that is lost due to a work stoppage. If the value of that machine's production is $500.00/hour, each time a bearing is changed it costs $1,500 - $2,000. The elimination of one or two of these bearing changes is a significant savings, even when factoring in the cost of monitoring at about $500.00/ year.

If a problem with a machine can be detected early, they are generally minor and the machine operations are not affected. If the problems can be diagnosed while the machine is in operation, repairs can be scheduled for a convenient time along with determining the parts, manpower and tools needed.
As a result, the extent of damage to a machine is reduced, and repairs are minor. Since maintenance is done at the inception of a problem, the downtime of the machine is also minimal.

Equipment monitoring continues until readings are such that a failure is predicted, and arrangements are made to replace the part that is wearing out before the predicted failure time, thereby getting the maximum useful life from the component and reducing the number of machine outages for maintenance.

**Reliability Centered Maintenance**

Reliability Centered Maintenance can be basically described as a methodology used to determine the appropriate maintenance level required to allow the equipment to continue to perform reliably in its current operating requirements. It does this by answering these seven basic questions in this order

1. What is its current function and performance standards
2. How does it fail to fulfill these functions and standards
3. What are the causes of each functional failure
4. What happens when each failure occurs
5. How does each failure matter
6. How do you predict or prevent each failure
7. What if you can't predict or prevent a failure

Reliability Centered Maintenance (RCM) requires the accumulation of data that is used to answer the above questions, so in effect; it takes time to see any results. This need for time causes management to lose interest and look for short cuts, both of which will defeat the program. Also, it requires an investment of time and money to train staff to use the methodology. Once these hurdles are eliminated, results can be significant.

RCM takes input from all interested parties, does a formal analysis that leads to courses of action that modify the existing planned, predictive, breakdown and jurisdictional maintenance programs so that overall the plant's maintenance performance improves.

**Total Productive Maintenance**

TPM is a way of conducting your business. It takes a holistic approach to plant operations, sales, marketing, finance as well as maintenance and how they contribute to the effective functioning of the plant. TPM is a methodology that can be employed to help maintenance become more efficient. With traditional maintenance programs up to ⅓ of a plant's maintenance budget is wasted.

TPM is a structured program that a plant can use to identify the problems that limit the effectiveness of installed equipment and provides the tool kit to overcome these problems.

TPM in no circumstances can be considered as an instant fix. It typically takes up to 5 years to fully integrate into a plant. TPM takes the plants assets and examines them for inherent weaknesses and develops methods to overcome these weaknesses and improve upon the assets.

**Conclusion:**

At this point, you need to assess your maintenance operations, the performance of the assets and benchmark the results. This will tell you how well you are doing on the maintenance course you have chosen and if the path is the appropriate one for the asset in question.  An effective maintenance strategy recognizes each program has a place in your plant, if you want your maintenance department to contribute to your plant's economic well being.