Maintenance 101

Understanding maintenance strategies

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Overview

In today's process industry, while managers are desperately trying to reduce production costs, an estimated one-third of maintenance expenditures are wasted.

Maintenance averages 14% of the cost of goods sold in many industries, making it a prime target for cost-reduction efforts. According to a DuPont report, "The largest single controllable expenditure in a plant today is maintenance, and in many plants the maintenance budget exceeds annual net profit."

Optimizing the return on maintenance is now a key strategy for most process plants. This course outlines various maintenance strategies that you can combine to develop an overall plant maintenance strategy — and make a dent in those rising costs.

Hint: As you go through the topics in this course, watch for answers to these questions:

- *What are some indications that you need to improve maintenance strategies?*

- *Which maintenance practice runs the greatest risk of lost production?*
- *Which maintenance practice reduces the risk of random failures?*

Why do I need a strategy?

Without a well-thought-out maintenance strategy, you may see patterns like these in your operation:

- Equipment failures result in lost production and expensive repairs.
- The same equipment failures happen again and again.
- Maintenance schedules are the same for all similar equipment, regardless of application or economic impact.
- No maintenance standards or best practices exist.

A good maintenance strategy can address all of these symptoms, improving process operations while reducing costs. In fact, your maintenance strategy can be as important to your business results as your quality program.

Most strategies are built on one or more of four basic maintenance approaches

- Reactive
- Preventive
- Predictive
- Proactive

Reactive maintenance

The oldest maintenance approach is **reactive**, or "run-to-failure." Equipment isn't repaired or replaced until it breaks.

Companies that rely solely on reactive maintenance find they have:

- **Costly downtime.** Equipment fails with little or no warning, so the process could be down until replacement parts arrive, resulting in lost revenue.
- **Higher maintenance costs.** Unexpected failures can increase overtime labor costs, as well as expedited delivery of replacement parts.
- **Safety hazards.** Failure with no warning could create a safety issue with the failing equipment or other units that might be affected.

Reactive maintenance can be appropriate in some circumstances, such as for non-critical and low cost equipment with little or no risk of collateral damage or lost production. It makes little sense to change a light bulb before it burns out. It's important, however, to make sure that a failure won't create a chain reaction to more critical equipment.

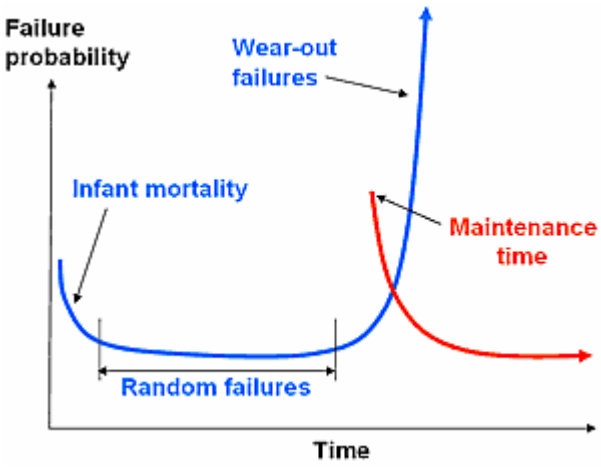
Preventive maintenance

The **preventive** maintenance philosophy is also known as **time-based** or **planned** maintenance.

The goal of this approach is to maintain equipment in a healthy condition. Selected service and part replacements are scheduled based on a time interval for each device — whether it needs it or not.

For example, transmitter calibrations may be performed every six months in critical areas. While this approach may uncover possible problems, most of the checks are unnecessary because they're performed on healthy instrumentation.

The curves below show how preventive maintenance applies to the equipment-failure cycle.



The cycle starts with a high probability of premature (infant) failures that result from manufacturing or installation errors. The probability of failures is then relatively level until the equipment begins to wear out. Preventive maintenance is scheduled to take place before this probability increases significantly.

In reality, the maintenance schedule is rarely optimal. Time-based preventive maintenance is typically carried out too soon, which increases costs and decreases reliability (because the failure cycle again begins with a higher rate because of maintenance errors). Or the preventive maintenance comes too late, increasing the risk of wear-out failures. To time the maintenance correctly, you need to know the actual equipment condition and be able to predict the failure point.

Disadvantages of depending solely on the preventive approach include:

- **Wasteful.** Equipment or components may be replaced prematurely, while they still have plenty of useful life left.

- **Inventory costs.** A larger inventory is typically needed to support a preventive maintenance program.
- **Application-dependent wear often ignored.** In light wear applications, equipment may receive excessive and unneeded maintenance. In severe wear applications, equipment may receive insufficient maintenance. In addition, identical equipment in different applications may require different maintenance intervals.
- **No complete prevention of failures.** A misalignment could be causing bearing wear, creating a possible failure before the next scheduled maintenance.

While preventive practices can be an important part of your maintenance strategy, there's a growing need to include predictive and proactive maintenance as well.

Predictive maintenance

In predictive maintenance, equipment condition rather than time intervals determines the need for service. Online condition monitoring helps you identify when wear-out risk begins to increase and predict when failure is likely to occur.

This approach can save time and money because it enables you to correct the problem before the equipment actually fails. You avoid the downtime and repair costs caused by unexpected failure — as well as the costs and lost production caused by unnecessary preventive maintenance.

Advanced predictive maintenance programs frequently modify the definition of a failure. Traditionally, a failure is defined as the point where the equipment breaks down and is no longer available for production. A more appropriate definition is that the equipment is no longer able to produce the right quality at the right production rate and the right cost. At this point, the plant is losing profitability and maintenance should be considered.

Proactive maintenance

While predictive maintenance uses online condition monitoring to help predict when a failure will occur, it doesn't always identify the **root cause** of the failure.

That's where **proactive maintenance** comes in. Proactive maintenance relies on information provided by predictive methods to identify problems and isolate the source of the failure.

Take the case of a pump that has periodic bearing failures. A condition-monitoring program may apply vibration sensors to the bearings, monitor the bearing temperature, and perform periodic analysis of the lube oil. These steps will tell you when but not why the bearings are failing.

Proactive maintenance might add laser alignment and equipment balancing during installation to reduce bearing stress, lowering failure rates and extending bearing life. But it will also take the next step to find the sources of failures — for example, looking at cleaning procedures before tear-down to see if contamination during rebuild is a root cause for early bearing failures.

By determining these root causes and acting to eliminate them, you can not only prolong the life of the equipment. You'll also eliminate many seemingly random failures — and avoid repairing the same equipment for the same problem again and again.

Choosing a strategy

For most plants, the best maintenance strategy combines several or all of these approaches. The combination you choose will both affect and be affected by work processes, expertise, technology, and management.

The right mix will differ from plant to plant, as well as for different types of equipment. Generally, the more critical the process, the more expensive the equipment, the higher the potential for collateral damage, the more the maintenance practices move toward predictive and proactive.

The Emerson advantage

Emerson has the services and tools to support all four maintenance approaches. Our proven work processes, expertise, and technology can help you optimize your process equipment, electrical systems, process equipment, instruments, and valves.
Our consulting and training expertise can help you set maintenance goals, evaluate your organization's skills and work processes, and develop and execute the continuous improvement plans needed to meet your maintenance goals.