Beyond FMEA

By Ricky Smith, CMRP

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It seems that preventive maintenance (PM) is now a misguided and misused term, says Ricky Smith in this month's Boiler Room. A little deeper thinking can lead to more effective preventive maintenance.

It seems that preventive maintenance (PM) is now a misguided and misused term. I don't believe most PM programs today prevent anything.

Think about what you need for an effective PM program. If you intend to prevent failure (or, better yet, mitigate the consequences of failure), you need to identify known and likely causes of failure (failure modes). To identify failure modes, it's critical to understand and consider the equipment's function and operating context. It's only when you identify the failure modes that you're prepared to make effective PM program decisions.

Be specific when defining a failure mode. For instance, consider a common failure: a gearbox failure, perhaps caused by a lack of oil. The lack of oil tracks to a worn seal. Over time, the seal wears, becomes brittle and cracks, shows glazing and leaks. Eventually, the gearbox oil level drops until the bearings seize.

The failure mode in this scenario isn't a failed gearbox, it's lack of lubrication. Declaring a failure mode at too high a level misses the possibilities of different outcomes and actions, depending on which components are affected. This is exactly what happens when you don't consider function.
I acknowledge that a leaking seal might be acceptable in a poorly performing environment, but not when you're running on a lean budget in a high-performance plant. We might want to consider that gearboxes and hydraulic systems don't have to leak. We've accepted it only because we've become accustomed to reactive, unplanned, unscheduled, non-value-added maintenance. I think we're due for a wake-up call.

Understanding the equipment's function and operating context helps you document failures' early warning signs and define the right ways to mitigate the consequences. Act as soon as early warning signs appear but before the equipment loses its intended function: its functional failure. With the right effort, you'll uncover the earliest level of detection (point P on the P-F curve).

In this case, the seal is cracked and brittle. If you manage the asset's health, it won't fail functionally when the seal leaks. The early warning allows you to continue monitoring and initiate the control portion, the "fix it" part of the business process, at a later date.

You also reduce inventory by being proactive. You might wait until the gearbox is leaking 10 drips to 20 drips per day before buying a new seal. Maintenance is then controlled only by equipment availability (operating context) and the length of time required to complete the corrective action (seal replacement might take one hour while access to the seal might take four hours).

Don't forget to identify the maintenance/inspection task. Depending on the asset and operating context, you might need to verify the lubricant level. If you start at too high a level, you'll need to drill down to the seal's condition. Here, the indicators are a cracked, brittle, whetted seal and leaking oil.

Remove subjectivity by having inspectors choose from a predefined list of possible failure definitions. This approach enables each person conducting an inspection to do so in a consistent manner.

Inspection frequency depends on how quickly the gearbox is likely to fail once seal degradation is apparent. It would be advantageous to have some historical data to help determine inspection frequency but in most cases that history doesn't exist.

The next best method is asking operators and maintenance personnel about their experience with this specific failure mode. They often have a wealth of knowledge that can be used to build an effective PM program. For example, an operator might spot a noticeable dampness around the seal area two months before it fails. As a general rule, set your inspection frequency as one-half of the interval between the points when signs of degradation are detected and functional failure occurs are detected. In this example, a monthly inspection is adequate. If you're familiar with failure modes and effects analysis (FMEA), take note. What I've described above goes beyond FMEA to consider not only the operating context of the equipment but also the equipment's function, functional failure and the consequences of a failure to ensure tasks are technically feasible and worth doing. I've used these simple concepts to improve the effectiveness of many PM programs. Try it yourself. The result will be increased equipment reliability and, ultimately, increased capacity and reduced cost.

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