Using Predictive Maintenance in a Plant Wellness Paradigm

Abstract: Traditional Predictive Maintenance strategy results in out of control production from random planned equipment outages. A Plant Wellness strategy reduces the need for condition monitoring because you get ahead of failure and eliminate all root causes so there cannot be failure.

Keywords: predictive maintenance strategy, condition based maintenance, plant wellness

Prediction is foretelling the future. It is prophesy. Predictive Maintenance (PdM) is the collection and assessment of equipment condition data to forecast future maintenance. Many technologies are available to observe equipment condition in order to determine an item's operating health and prophesise its future. Doing maintenance depending on the state of the equipment is called Condition Based Maintenance (CBM). Predictive maintenance and condition based maintenance are often interchanged to mean the same thing. PdM is the strategy and CBM is its practice.

Humans have applied predictive maintenance strategy and practiced condition monitoring since the start of civilisation using our body as the sensing instrument to determine the state of an item or the health of a person. What technology does that our bodies cannot do is to quantify a condition variable and trend it across time. With that capability came the ability to prophesise maintenance.
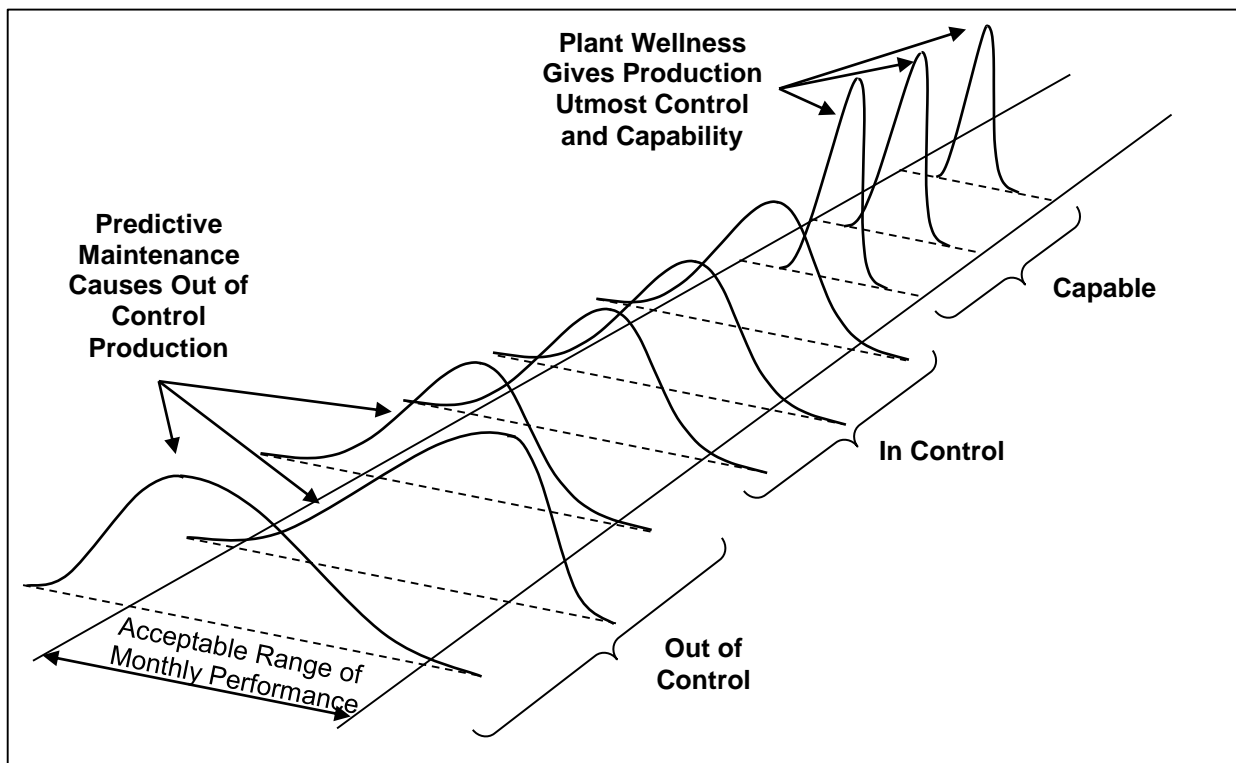

Figure 1 – The Most Successful Processes are Always Well In-Control and Capable

The risk in doing PdM strategy on production assets is you act only if a condition variable starts to get too bad to let the equipment continue in use. Because you observe conditions deteriorating you schedule maintenance into the production plan to address an impeding failure. The practice of inspecting equipment condition and acting on severe degradation leads to "reactive" predictive maintenance. Though you prevent a breakdown the timing is random. Running an operation randomly cannot produce the best business result except by luck. Random maintenance signifies out of control operational processes because production is disrupted. Figure 1 shows the aim of all business processes: to always be in control and capable. PdM puts Production out of control.

Target 100% Reliability for Operational Excellence Production

A truly effective production process never goes out of control and is always highly capable, with performance well inside its specification boundaries. To achieve that there must be no interruption to production from equipment stoppage—either because of breakdown or due to planned random maintenance. In control and capable production requires that there are no failure causes that arise which need to be fixed at random times. Using predictive maintenance to observe degrading equipment conditions allows the plant to degrade until it must be stopped. PdM brings value because it prevents breakdowns and thereby reduces maintenance costs but it prevents outstandingly successful production. Watching failures come towards you on a graph of plotted condition monitoring readings will predict stoppages but it cannot eliminate them. To put production totally in control and make it finely capable it is degradation that must be controlled and prevented, not the final failure. To become a truly great company you need to focus on eliminating the causes of the causes of your failures. You need to create outstanding reliability, not predict when you are going to lose it.

A strategy for the greatest production success would be one where there was 100% reliability for the entire service life of equipment because nothing goes wrong with the asset. The production plant and its equipment would never fail nor need more than minor maintenance. Every production run would be optimal and all orders would be fully completed to schedule. The ability to deliver phenomenal production like that is the aim of Operational Excellence. You can get outstandingly reliable production assets once you adopt a mindset of expecting 100% lifetime reliability and use the right methods that produce that result. A paradigm of lifelong uptime and finely capable production could not use predictive maintenance strategy in the traditional way to find degrading or damaged parts. By the time you spotted a problem you would also have to stop the equipment, and then production goes out of control.

Equipment will not fail if its parts do not deteriorate

You get maximum chance of failure-free production when every component in a production asset is in superb condition and health and it remains so all its service life. It requires more than a "machinery health" paradigm: you need an "equipment wellness" paradigm. Machinery health applies only to what happens to the parts in an operating asset, whereas wellness applies to what happens to the asset's components during their whole life cycle, including design, manufacture, assembly, installation and operation.

Using Predictive Maintenance in a Plant Wellness paradigm gets you looking at the root causes of degradation and eliminating them, such as induced forces from unbalance, parts misalignment, structural distortion; operating the equipment out of the design envelope or having wildly fluctuating process variables, such as out of control operating temperatures, pressures and loads; out of control lubrication chemistry; out of specification components; production overloads; out of design fits and tolerances; and so on. You do not observe the state of equipment components as does conventional PdM, you observe the state of the factors that destroy the components. You monitor, control and prevent the causes of the causes of failure.

In a company using a plant wellness philosophy you only do minor maintenance at long intervals. There is little need for regular use of traditional condition monitoring because the data you require to prove equipment wellness comes from the asset's fabrication, manufacture, installation and maintenance history, and from trending the production process variables that impact component health conditions when it is in use. You do not look for failing components as is the conventional purpose of PdM and CBM, rather you look for failing life cycle and operating processes and correct them to insure parts are always outstandingly reliable when in service.

Predictive maintenance strategy in a plant wellness paradigm proves the presence of the conditions that cause great reliability. You prove assets are designed, built and installed to the specific quality standards that bring outstanding uptime. You would not do predictive maintenance to observe parts' degrading in a machine, you would observe the mechanisms that failed the parts to ensure they were not present. When all conditions for outstanding equipment reliability exist you could then prophesise a long production run without any maintenance.

Maximizing the component reliability of plant and equipment is foundational to amazing production success. In a company that practiced plant and equipment wellness the PdM strategy is to focus on ensuring the factors that deliver strong, healthy operating components were inbuilt at the start of an asset's life and they are always present every second of its operating service so parts failure can never happen because the causes of the causes of their failure do not exist.

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