Predictive Maintenance That Performs

For many years, preventive maintenance (PM) has been the gold standard in manufacturing. But, the problem with conventional PM is that schedules and tasks are based primarily on assumption and estimation, rather than fact. As in so many other areas, data is becoming a critical asset in business success, and the manufacturing floor is no exception.

Predictive Maintenance That Performs **eBook provides expert guidance on maintenance systems and metrics, from building a better maintenance organization, to understanding the reasons why facilities need PM.**

EBOOK:
PREDICTIVE MAINTENANCE THAT PERFORMS

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BUILDING A BETTER MAINTENANCE ORGANIZATION

BY JILL JUSKO

No maintenance organization wants to be characterized by a cliché, specifically this one: Rather than keeping equipment operating in optimal condition, maintenance technicians race around in fire-fighting mode, galloping from one completely broken-down piece of machinery to another that is operating so poorly it can't produce components to spec more than one time out of three.

For most manufacturers that cliché is — it is hoped — an exaggeration. Nevertheless, it is the rare organization that isn't rife with opportunities to improve asset reliability. The challenge is how to make it happen.

Ken Maulsby has some ideas. Maulsby is a 25-year veteran in the maintenance and reliability field as well as a maintenance leader at Owens Corning's insulation manufacturing plant in Fairburn, Ga. The facility employs approximately 270 workers, more than 40 of whom are manufacturing technicians.

Ken Maulsby likes to think of maintenance as a profit center: build uptime, increase capacity, improve money-making opportunities. He can outline a wealth of techniques designed to help improve the maintenance challenge: lubrication excellence, autonomous maintenance, FMEA – all of which are effective.

However, he says the best bet to getting started on the road to maintenance excellence, and then sustaining it, is to focus on the fundamentals and do them with discipline. Maulsby shared some of Owens Corning's efforts during the annual Society of Maintenance & Reliability Professionals conference.

OWENS CORNING RELIABILITY WORK PROCESS

The Fairburn manufacturing plant where Maulsby works, as well as Owens Corning manufacturing plants across the globe, employs a maintenance system the Toledo, Ohio-based company calls Reliability Work Process, or RWP. It is the manufacturing company's standard for managing maintenance resources and one of the fundamental components of Owens Corning's global manufacturing strategy focused on the reliability of plant assets.

It is disciplined both in structure and in its specific steps. In terms of structure, the RWP includes several key roles, including the process champion (which is Maulsby at his location), the operations leader, the operations maintenance coordinator, planners, schedulers/supervisors, and technicians and other plant personnel.

This structure emphasizes a key relationship required to improve reliability – production and maintenance working together, not in opposition. For example, the operations manager supports the maintenance process, leading by example and demonstrating to operators that they have a role to play in reliability. Additionally, the operations maintenance coordinator is responsible for ensuring a balance between production demands and the maintenance organization's strategy to keep equipment healthy.

"The operations maintenance coordinator has a vested interest in both sides," Maulsby said.

Further emphasizing this key relationship between departments, one of the maintenance metrics tracked at the Fairburn site is its daily contract with production. The maintenance department schedules also are posted on a wall and online for quick visibility by everyone.

The four steps that comprise the Reliability Work Process sound deceptively simple – work identification, planning, scheduling and execution – but their success relies on rigor and discipline. Each of those steps is clearly defined and significant emphasis is placed on performing actions in the precise order and providing the correct documentation, beginning with maintenance requests submitted through the computerized maintenance management system (SAP in this instance, Maulsby says).

Continuous improvement also is part of the process. Maintenance technicians are required to complete work order feedback forms, which include the question: What can we do to prevent this problem in the future?

So how is the Fairburn plant performing as it pursues maintenance excellence? Maulsby shared several of the metrics tracked by division, including percentage of reactive maintenance (approximately 20%) and SAP utilization (nearly perfect). ●

8 REASONS MANUFACTURING FACILITIES NEED PREDICTIVE MAINTENANCE

For many years, preventive maintenance (PM) has been the gold standard in manufacturing. On a regular cycle, crews take equipment out of service and perform routine tasks that are designed to, theoretically at least, keep it running in tip-top shape and prevent unexpected failures. While PM does interrupt production, the impact is minimal compared to the extended downtime that can accompany equipment failures.

But, the problem with conventional PM is that schedules and tasks are based primarily on assumption and estimation, rather than fact. The PM routine is designed around experience and time—not on actual in-service performance, wear-and-tear or documented impact of production on the equipment. That means facilities might take equipment down for PM when it's not necessarily warranted, wasting valuable production time, crew resources and parts and materials, and still may not fully mitigate their risk of a failure.

Predictive Maintenance (PdM) is giving manufacturers a more efficient, data-driven method for managing routine equipment maintenance to maximize production, safety and efficiency while ensuring ideal operation and reliability of equipment. Rather than relying on a regimented, and often arbitrary, schedule, PdM uses a conditions-based approach that measures and earmarks factory equipment, scheduling repairs and upgrades according to the machine's actual health and performance.

This new approach has the potential to be a game- changer when it comes to optimizing maintenance, production and cost-efficiency, not to mention providing a more reliable method to detect and prevent potential failures. Why is PdM the wave of the future? Here are the top 8 reasons facilities why manufacturers should implement Predictive Maintenance.

Predictive Maintenance (PdM) is giving manufacturers a more efficient, data-driven method for managing routine equipment maintenance.

1) **PdM identifies problems typical PM and visual inspection cannot.** PdM uses advanced diagnostic and sensing technologies, such as ultrasound, thermography, vibration and oil analysis, to identify problems in situ and in real time—as the equipment is running. This provides performance data and insight that cannot be identified when the machine is taken off line for traditional PM, and it gives maintenance staff a clearer picture of the actual wear-and-tear on equipment, rather than making assumptions.
2) **PdM enables lean manufacturing.** Traditional Preventative Maintenance techniques could take equipment offline far more than necessary, and still not provide assurance against a failure. PdM, on the other hand, can actually improve production and provide long-term savings. Performing maintenance when it's required avoids unnecessary halts in production and means less time, money, parts and supplies consumed by unnecessary maintenance. In fact, PdM has been shown to eliminate as much as 30 percent of time-based PM tasks, freeing up those capital and human resources for other critical tasks.
3) **PdM provides continuous insight to improve processes.** The data and analysis gathered through baselining, tracking and documenting equipment performance offers tremendous visibility that can inform production improvements. Knowing that specific conditions or factors help equipment to operate at peak performance, facilities can begin looking at environmental adjustments to ensure those optimal conditions. This not only extends the time between maintenance tasks, but also improves overall production results.
4) **PdM technologies integrate with CMMS and other work order systems.** By integrating this data into maintenance software, PdM provides a seamless solution that adds no further burden to the workflow and ensures that repair/replacement work is conducted in a timely manner. This eases the supervisory burden, again freeing up those resources to address more strategic initiatives.
5) **PdM could minimize recall and liability risk.** In the event of a contamination or recall event, having a documented log of equipment

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Every day, maintenance technicians face the challenge of ensuring maximum machine availability while keeping the amount of materials consumed by maintenance and repairs to a minimum – a demand that existing preventative maintenance models are usually unable to fulfill.

Advanced Technology Services (ATS) uses predictive technologies to identify problematic issues in a premature stage that cannot be detected by visual or other equipment inspections. This proactive approach helps prevent catastrophic failures and considerable downtime. Our team of certified technicians establishes the necessary data collection points for capturing and comparing machine status on a routine basis. Predictive Maintenance can be scheduled annually, semi-annually or quarterly based on your facilities needs providing analysis reports along with improvement recommendations.

Our Predictive Maintenance certified technicians:
- Isolate and identify degrading components
- Monitor machinery condition on a service schedule
- Infrared thermography assessments
- Ultrasound testing
- Vibration analysis
- Oil analysis

As in so many other areas, data is becoming a critical asset in business success, and the manufacturing floor is no exception. By understanding more about exactly how process equipment is performing during production and reducing unnecessary downtime, manufacturers can find previously untapped opportunities to improve production efficiencies and save money. PdM is proving to be the template of the future for equipment maintenance, ensuring optimal performance, minimal downtime and maximum safety and productivity.

Benefits of Predictive Maintenance

Maintenance
- Identify potential failures
- Scheduled repairs
- Reduced downtime

Operations
- Increased machine reliability
- Better equipment reliability
- Increased profitability
- Improved workforce utilization

Purchasing
- Reduced maintenance costs through reduction of repeat failures
- Reduction of supplier base
- Achieved cost savings goals
- Reduction of Energy

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statistics can help to demonstrate that your facility took every possible precaution to prevent the situation. The data could help to provide some relief to help lessen the damage impact.

6) **PdM can improve plant safety.** By better understanding how equipment is performing and where potential risks lie, facilities can mitigate safety situations, such as fluid leaks, overheating, and dangerous electrical or hydraulic situations that could put staff at risk.
7) **PdM can aid in asset attrition planning.** With greater insight into equipment performance, issues and expected useful life, facilities can better plan and budget for replacement. The data gleaned from PdM can help to optimize capital expenditure planning while ensuring daily optimal performance of the assets still in place.
8) **Partnering with a PdM provider can amplify the benefits.** Working with a PdM maintenance and industrial parts service provider enables CPG companies to benefit from economies of scale, advanced analysis, best practices from across the industry and preferred parts and components pricing. By taking advantage of best-in-class services, companies can save millions of dollars and reduce downtime by up to 65 percent by relying on the knowledge, experience and partner supplier networks of an integrated PdM provider.

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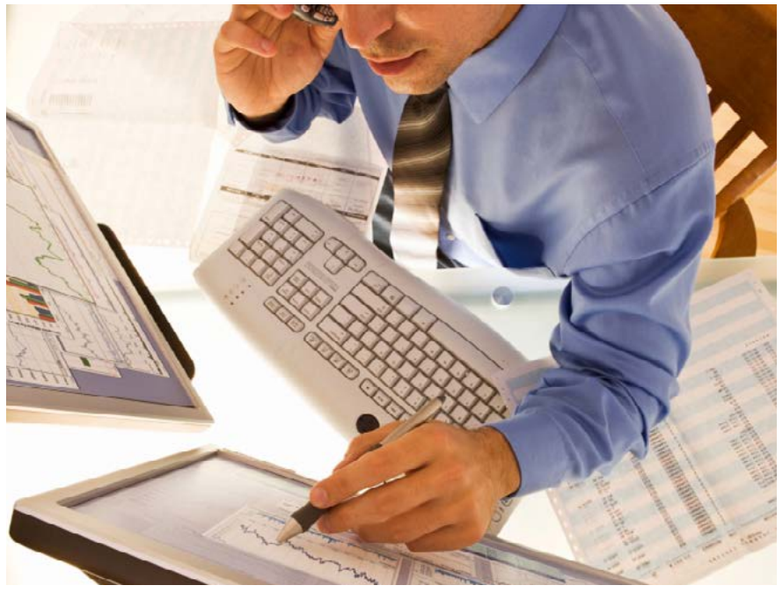
OPERATIONS: MAINTENANCE METRICS THAT MATTER

BY JILL JUSKO

Review the right performance indicators to improve reliability.



The financial impact of unexpected equipment failure can be costly, as AK Steel Corp. shared recently. The West Chester, Ohio-based steel maker reported that an unplanned outage at one of its blast furnaces in June would contribute approximately $12 million to the company's loss column for the third quarter, with additional losses related to the mechanical failure trickling into the fourth quarter.

While the AK Steel incident has reaped particularly expensive consequences, every day manufacturers across the globe experience equipment failures. Machines stop running, operate at less-than-optimal speeds, or don't perform as expected in some other way.

Given the obvious imperative for better reliability, what metrics should the corporate reliability professional review to drive improved performance?

It takes more than one or two. "Metrics drive behaviors," says Jeff Shiver, managing principal of People and Processes Inc., a maintenance consulting and training firm. "If you look at one metric, you will box yourself into a corner and drive behaviors you didn't anticipate, and not necessarily good ones."

Moreover, reliability is a function of more than just the maintenance department, says Shiver. Production operations and engineering also play roles, he points out. Given their influence, "we have to work together as a whole team to improve reliability. It is never a good thing if we silo functions."

Shiver, whose background includes maintenance management at Mars' Waco, Texas, confectionary plant, outlined 10 maintenance metrics to drive better decision-making. They include:

1. **Maintenance cost per unit of production.** Manufacturers must determine the right balance between running equipment to failure and spending too much.
2. **Maintenance cost as a percentage of replacement asset value.** A world-class percentage is less than 2%, Shiver says.
3. **Preventive maintenance compliance.** "We want 100% compliance, but what typically happens is that only about 60% are done, and only 20% to 30% are done right," Shiver says.
4. **Planned versus unplanned maintenance.** A world-class level is 90% planned.
5. **OEE (overall equipment effectiveness) or availability.** Aim for 85% OEE and/or 95% availability. While neither measure is strictly maintenance-oriented, Shiver says maintenance can influence both of them.
6. **First-pass yield or first-pass good.** Typically considered a quality metric, first-pass yield can be influenced by maintenance, hence its inclusion on Shiver's list.
7. **Storeroom inventory value.** A benchmark level is .5% to .75% of replacement asset value. Further, Shiver suggests inventory turns should number two to three per year. "I want to rotate the inventory because it ages," he says.
8. **Backlog of work orders in man weeks.** Because companies calculate the measure differently, it is hard to identify an optimal number. If the correct practices are in place and the backlog is high, staffing may be an issue. On the other hand, operations decisions can drive the metric, in which case "it could be a maintenance-operations partnership issue."
9. **Schedule compliance** or "Did we do what we put on the maintenance schedule to do?" Aim for 80% to 85%.
10. **Critical events.** "This is not a benchmark metric, but it is something a corporate guy should be looking at," Shiver says. As the description implies, a critical event is about big issues. It may be two-hour downtime on a production line or four hours on a packaging line, but it should spur a root-cause examination.

As a final caution, Shiver advises against rolling metrics up to a corporate level without the ability to examine plant-level details. "We need to be able to drill down and ask, 'Why?' " he says.

HOW TO SUSTAIN YOUR LEAN EQUIPMENT MAINTENANCE PROGRAM

BY TOM VOSS & TONY RODRIGUEZ

"Asset utilization, also called Overall Equipment Effectiveness (OEE) or equipment capacity, is not just the responsibility of one department. It is the responsibility of the entire company. It has the focus of ensuring that nowhere in the world does another company have the same assets or produces greater capacity from those assets. It means being the best at getting the most out of the assets by measuring and managing availability, performance efficiency, and quality rate." – Terry Wireman, author, Zero Breakdown Strategies

Overall equipment effectiveness (OEE). Total productive maintenance (TPM). Reliability Centered Maintenance (RCM). The guidelines are not new. But for companies that truly want to maximize their equipment uptime, productivity and quality, a disciplined approach is critical. So is creating a culture where everyone understands and carries out their role in the maintenance continuum.

SITUATION 1:

A machine shop decided to adopt the TPM approach to proactively care for their large machines. They trained the maintenance team to implement the program for key equipment. The team developed a "war wagon" with all the tools, critical parts and chemicals to perform scheduled maintenance and emergency repairs on machines throughout the facility.

However, the wagon wasn't maintained, so when mechanics went on a call, components hadn't been restocked. Tooling was missing. Chemical supplies dropped to low levels or were completely exhausted. Because the maintenance store was disorganized, restocking the wagon took longer. Frustrated, the maintenance team took matters into their own hands, dedicating one wagon to unplanned machine stoppages and another to planned maintenance efforts.

SITUATION 2:

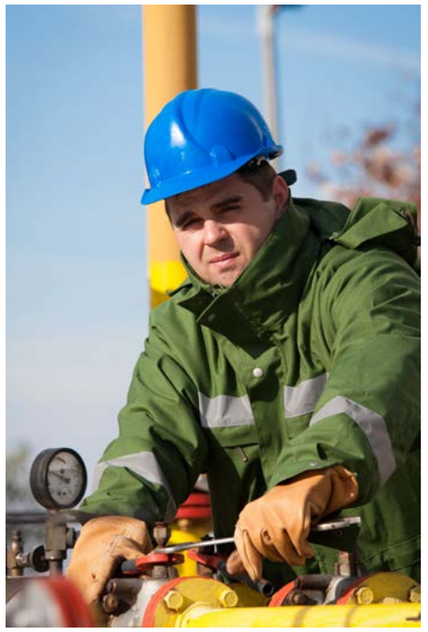
A chemical processing facility we visited had more motors in their maintenance stock room than the plant had in service. More than half of the motors and several electronic control components in stock were for equipment the company no longer owned. And because the right spares for current equipment were not on hand, unscheduled downtime stretched into weeks.

Certainly, maintenance priorities in a heavy machining plant will be different from an assembly plant or a chemical processing plant. Regardless, these practices can be applied across most production facilities:

1. Borrow from successful lean production techniques and **process map your maintenance workflow.** The Marshall Institute recommends beginning the mapping effort at the very beginning of your maintenance process and the flow of the process from one step to the next. Once the map is done, you'll see and eliminate as many of these extra maintenance steps as possible.
2. **Give machine operators process ownership.** According to a recent blog post in Paper Advance, the Canadian pulp-and-paper industry's trade resource, a number of real-time digital condition monitoring and reporting systems now support the positive trend to operator-driven reliability (ODR). The Total Productive Maintenance (TPM) approach shifts basic maintenance work (and problem notification) to machine operators, freeing up maintenance personnel to work on planned maintenance. The idea is to give workers ownership of their machine and the process, maximize equipment effectiveness,

increase employees' skills and reduce manufacturing costs through continuous monitoring. For their part, the maintenance team should respond to requests within a pre-determined time window.

3. **Schedule your facility's planned maintenance program far in advance,** just as any other operation, to maximize productivity and meet order deadlines. Annual checks are going to be more comprehensive than a monthly or quarterly check, meaning the machine will be down for longer, so make sure they synch with your production commitments.
4. **Use your ERP system to plan for downtime,** just as it does for jobs. The ERP ties in with the procurement function, and if properly described with consumption amounts and order lead times, maintenance parts will have been ordered in advance and arrive at your plant in time for the machine to be serviced. Use your ERP or CMMS system to specify the maintenance mechanic who will work on the machine, and to specify the parts and chemicals needed to complete the maintenance activity.
5. **Schedule more frequent checks for older equipment.** As equipment ages, parts and components will start to wear out sooner, and the maintenance window narrows. What were annual checks when the equipment was new may move to semi-annual or even monthly. The service parts required will have to be ordered more often. However, the planned downtime will affect production schedules less than a breakdown.



6. **Engineer machine improvements for maintainability and operability.** Windows cut into guarding to give easier viewing of gauges will make the daily checks easier to perform and more likely to be completed. Access doors installed on equipment will allow for easier periodic maintenance. Consolidation of lubrication points into a single manifold also contributes to more consistently performed maintenance.
7. **Conduct daily operator walk-arounds to pinpoint issues and opportunities for improvement.** Whether it's a check sheet, whiteboard or, in some cases, a bar-coded activity, the operator's checks are the essential element of a TPM-oriented operation.
8. **Address operator alerts immediately.** Beyond the operator and the proper performance of the checks, the maintenance organization must be ready to respond immediately to an abnormality that's been raised as part of the operator checks. Nothing will take the energy of TPM efforts faster than operators raising issues that aren't addressed immediately.
9. **Continually review spare part requirements.** Remove any spare parts from stock as equipment and machines are retired.
10. **Document and continually re-visit your operation's maintenance history,** including how critical items have addressed. **Develop and regularly review metrics** that correlate equipment up and down time with production volume, quality and delivery.

Whether you use a computer-based maintenance system, or you rely on a card file, or you have a white board in the maintenance area, the strategies, opportunities and approaches remain the same. Once implemented, the entire workforce – from senior management all the way down to the last mechanic hired, must adhere to the basic tenet: minimize unplanned downtime through proper preventive maintenance. ●

WHY PREVENTIVE MAINTENANCE FAILS (AND HOW TO FIX IT)

BY KENNETH J. STALLER

Is your facility struggling to design an effective preventive maintenance (PM) program? An endless parade of books and articles tell us how to "do" PM. But it's one thing to read and another entirely to implement.

If you're on this path, know that preventive maintenance (PM) should not be confused with predictive maintenance (PDM), which is a series of dynamic inspections of machine components while the machines are operating in their normal production modes.

Here's what great preventive maintenance programs should include:

- Scheduled inspections and lubrication samplings that determine the physical state of machine components.
- The lubrications, adjustments and documentation of needed repairs identified during inspections, which prevent unnecessary wear and failure of machine components.

- To ensure safety and maximize production uptime, inspections and repairs should happen during scheduled plant shut downs when all machines are safely locked out.

If developing a PM program is such no brainer, why doesn't every company have one in place?

1. **We didn't lay the groundwork/ have the right systems.** Designing and implementing a PM program requires a very different mind-set than operating and managing a normal maintenance department. PM begins with understanding your facility's goals, setting performance standards for equipment, documenting preventive maintenance procedures and schedules, then uploading it all to your computerized maintenance management system (CMMS). If your company's in-house experts can initiate and manage these tasks, great. If not, find a qualified PM manager, or contract with a capable PM consulting firm that can get (and keep) the ball rolling.
2. **Other things got in the way; we never finished.** Companies delay or stall their PM program for a variety of reasons: A big order comes in and it's all hands on deck. Raw materials are delayed and we have to play catch up when they arrive. We can't seem to find a week when all our key maintenance employees don't have other priorities. But the main reason companies fail at PM is because they haven't included a profit motive: They haven't incorporated a way to benchmark and track the savings that their PM program generates.
3. **We didn't roll it out correctly.** Companies that fail quickest simply hand over PM implementation to their maintenance staff without the proper training and oversight/management.

   Make sure you focus your objectives, create PM tasks correctly the first time around, train your team, oversee all the implementation details and ensure you create a management program that will sustain your PM program's success.
4. **Our PM activities aren't correctly weighted because we don't understand why breakdowns occur.** When PM task details are not written to address the root causes of breakdowns, you may be focusing on things that don't really impact productivity. If your company has a good work order system in place, measurements can easily be made using basic CMMS reports to measure the effectiveness of your program over time.

To minimize unplanned machine downtime, a well-designed PM program typically allocates 80% to 90% of its time to machine component inspections and 10% to 20% to lubrications.

WHAT PERCENTAGE OF TIME SHOULD LEAN LEADERS SPEND ON MAINTENANCE ACTIVITY?

BY LARRY FAST

QUESTION: What percentage of time should lean leaders spend on maintenance activity?

ANSWER: We have two questions this time from a reader who is rightfully concerned about the role of maintenance in any continuous improvement initiative that is expected to be sustained for the long-term.

Specifically, here are the questions: "What % of time should lean leaders spend on maintenance activity? Do you have any maintenance spend targets to build a robust maintenance excellence program?"

I'll deal with the first of these today and will respond to the second question next time.

In response to the first question, the answer of how much time lean leaders should spend on maintenance activity is: "It depends."

It depends on whether maintenance is already an important part of the solution or a major part of the problem. For example, what do the maintenance metrics tell you, e.g. what is the breakdown maintenance rate (BMR) on constrained work centers (total constraint machine hours actual vs. total hours scheduled)? What is the on-time performance to the preventive maintenance schedules? How accurate is the data being used to create the proper intervals for PM? How robust is the PM system for the management of spare parts?

These results will tell you a lot about what the mindset is of the maintenance leadership. (My experience is that maintenance is usually one of the top three priorities in a poorly performing plant along with safety and quality.)

Whatever the situation, it's important that the lean leader's focus stay on whatever the operations' three most important priorities are. Do not dilute scarce resources trying to tackle too many things at once.

FIGHT THE 'RUN UNTIL IT BREAKS' MENTALITY

Is the prevailing attitude "run it until it breaks"? This mentality always results in more serious breakdowns and much higher costs of repairs.

This culture is easily exposed since the maintenance crew is constantly in a firefighting mode and rushes from one emergency to another to save the day, every day. In contrast, an orderly, in-control process finds the maintenance crew engaged and working in a culture of fire prevention.

Very simply, if maintenance is constantly fire-fighting that is confirmation of there not being a robust preventive and predictive maintenance process in place. Likely, if there is a CMMS (computerized maintenance management system) in place at all, it has been poorly implemented and is not a key resource to support maintenance excellence. This is basic formal infrastructure that must be in place to ever achieve and sustain excellence.

Assuming maintenance is one of the top priorities causing poor plant performance, there is surely the need to critically evaluate the maintenance manager, supervisors, group leaders and any maintenance engineers on the current staff. Clearly their expectations aren't nearly high

enough, and some simply aren't technically competent leaders to be in their roles.

The reality is that the talent must be upgraded. The plant manager must start with the maintenance manager and go from there. Importantly, it is the plant manager's responsibility to drive this and make the necessary changes, not the lean leader's.

In the maintenance environment I've just described, the lean leader may need to assist in the collection of the necessary data, with the help of maintenance staff, supervisors, accounting staff, to quantify the negative impact that maintenance is having on the business, e.g. OEE performance on constraints, negative customer service and financial performance.

This is the first step in convincing those who control the purse strings that they're going to have to spend some serious money to get maintenance moving on a path to excellence.

In a turnaround situation maintenance costs always go up before they start trending downward. This is one of those critical times when the lean leader must have the ear of the plant manager to get the necessary support to put the priority and the money behind a major maintenance improvement initiative once effective leadership is in place.

If you are fortunate enough to be in a business that has the correct mindset in the maintenance leadership; has robust metrics and systems in place; and competent technicians/mechanics; then maintenance isn't one of the top three priorities and the lean leader should be focusing elsewhere. ●

RESOURCES

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FOOD MANUFACTURING Q&A: Predictive Maintenance with Mark Cox of ATS
http://www.foodmanufacturing.com/blog/2016/02/food-manufacturing-q-predictive-maintenance-mark-cox-ats

ARTICLE: Moving from Reactive to Predictive Maintenance in your Food Facility
http://www.foodqualityandsafety.com/article/moving-from-reactive-to-predictive-maintenance-in-your-food-facility/

ARTICLE: Top 2016 Manufacturing Investment Predictions
http://www.manufacturing.net/data-focus/2016/02/2016-predictions-three-best-investments-manufacturers

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