

The Basics of Lean Maintenance

Excerpts from “Lean Maintenance” by Ricky Smith and Bruce Hawkins

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**“The productivity of work is not the responsibility of the worker
but of the manager.” - Peter F. Drucker**

The late Dr. W. Edwards Deming emphasized, “When quality is poor, blame the system, not the people, and management is the system.” The same insight applies to maintenance. Others would say, hey, bad workers, but Deming said, no, bad system. He insisted on questioning the company’s culture and management philosophy . . . telling clients that 85% of quality problems are the result of management errors. When a good performer is pitted against a poor system, the system wins almost every time.

Productivity gain requires a total commitment. Reforms do not work well in isolation. You must do a lot right if you want to make a quantum leap forward. It is not just the building blocks, but also how they are placed and held together.

The First Step: Top Level Management Buy-in

Executives in the most successful companies instill a passion for excellence in their entire organization. Executives lead these companies with a passion for excellence that pervades the business and creates an identity and focus for every employee.

Senior executives at the top of these companies articulate consistent, direct messages that enable employees throughout the organization to understand how the company works, how performance is measured and how the company is organized around its core strategies.

Without this kind of top management enthusiasm for making the Lean transformation, the ripple effect of indifference will certainly kill the effort before it has even begun to show any improvements.

Managers up and down the line take their cues from their own immediate bosses. **For the maintenance operation this begins with a changeover from reactive maintenance to the proactive approach of TPM.**

Convincing top management of the gains, in terms of return on investment (ROI), that will be realized with the implementation of TPM and gaining its firm commitment to the process is a very necessary first step in the entire Lean transformation.

The Good

Proactive Maintenance Characteristics Control over the Maintenance

Resources—With the advent of correct maintenance planning and scheduling procedures there is often a vast and rapid change in the understanding of what is required of the maintenance resources from week to week. This often can easily extend to monthly planning periods.

Increased Inventory Control—The dual effects of increased equipment reliability and better planning and scheduling will lead directly to increased control over the operation of the maintenance stores.

Elimination of much of the “Waste” of the business processes—With accurate planning and scheduling processes, much of the waste in the processes will cease to exist. Waste appears generally in the form of waiting times for materials, equipment availability and in the provision of inaccurate information.

Increased Accuracy in Maintenance Budgeting—With the increases in equipment reliability, large gains in budget accuracy are immediately possible.

The ability to forecast maintenance requirements, either by equipment or activity, are vastly enhanced when we reach the planned stage of maintenance.

Reduced Maintenance Costs—In conservative terms *a task that has been planned and scheduled is at least 50% more efficient in terms of both costs and time to complete.* Using this as a standard and applying it to the number of tasks that are now executed in an unplanned fashion we can easily see the range of savings that are possible.

Proactive TPM combined with a Proactive Maintenance initiative has been documented to produce a Return on Investment (ROI) of as much as a **10 :1 within three years.**

In addition, a proactive TPM organization that has adopted the principles of Proactive Maintenance will spend approximately 2% of the site’s estimated replacement value annually in maintenance labor, materials, subcontracts, spare parts and overhead.

This 2% target has been proven to be achievable. It is not uncommon for organizations to achieve at least 30–50% reduction in maintenance spending within 3–5 years.

However, capacity increases and total production cost per unit decreases should be realized within the first year.

The Bad and the Ugly

Reactive Maintenance Characteristics Low Equipment Reliability

(MTBF—Mean Time Between Failure—measured by dividing time by number of breakdowns or emergency work orders)—When MTBF is not measured one may look only at the “squeaky wheel” (problems you face day to day) and not necessarily the biggest reliability issue. Frequent breakdowns can be a drain not only on production capacity, but also on maintenance resources.

Low Mean Time to Repair (MTTR)—This indicator can often be very misleading as to the performance of plant equipment. In a reactive state it is often exceptionally low. This is because the workforce is accustomed to having to repair equipment and to do so in an amazingly fast manner. Although a positive, in terms of workforce abilities, it often indicates a situation in which the plant itself is often failing.

Inaccurate Inventory Planning—One of the significant effects of low equipment reliability is the inability of maintenance stores to accurately control the level of inventory required. When they cannot be sure what will be required tomorrow it is impossible to construct anything like a long-range plan for managing the inventory levels in a satisfactory manner.

Uncontrolled Storeroom—An additional effect of poor inventory planning is the number of uncontrolled or personal stores that maintenance departments are inclined to keep. This is because maintenance has no confidence in the stores department to adequately maintain the levels of stock required and stems from the poor equipment reliability.

Highly Reactive Workforce—With the effects of all the factors previously stated, the workforce in this situation is generally extremely reactive in nature. When trying to change the corporate culture of an organization, this can often be one of the most difficult areas to change.

The workforce takes a great deal of pride in its abilities to keep the plant running and rightly so. *There is a tendency to want to run off and “save the day” and become the “Hero of the Day”.*

Selling at Each Level

How is change that yields progress initiated? It starts with awareness and education that change is required. “You don’t know what you don’t know” may be a cliché, but it is one that is profoundly accurate. One must be able to sell why moving in this direction is critical to different levels of an organization.

Attaining the competitive advantage required to meet the challenges we face today certainly requires constant scrutiny of emerging technologies and new thinking, but much of the problem is neither with new technology nor new thinking. It is merely lack of understanding of the subtle influences that our current thinking and work processes have on our business. Many executive-level managers focus solely on production.

Production results are certainly the shortest link to profitability, but such a narrow focus is the downfall of many businesses. Like root-cause analysis, everything affecting both production and cost-per-unit produced must be examined.

Successful and profitable businesses understand the value of total integration of all the business functions.

Maintenance is a production enabler, in other words, maintenance helps to determine what percentage of capacity (full run output) can be produced, which in turn is utilized by production to define product output level.

Reactive maintenance practices cannot yield production levels at desired capacity. Only proactive maintenance, maintenance that prevents failure and preserves operational production assets, can deliver the near capacity production levels required to sustain our businesses.

A key ingredient that cannot be overemphasized for successful implementation of change, whether to proactive TPM or to a Lean Enterprise, is that ***support and participation at all levels is essential***. Upper management does not usually carry out steps in an action plan; they merely drive it and remove the roadblocks that get in the way and ensure that the plan and its execution are conforming to the company’s mission and its short- and long-range objectives.

Management commitment, or rather the lack of it, is the single most common reason for failure to fully achieve expected results. Only when management is fully committed to the change and to creating the environment to allow and promote change to occur, and dedicated to its successful completion, can the organization succeed in a fully realized implementation of progressive and meaningful change. ***Leadership at every level is critical and prerequisite for sustaining change and is often the missing ingredient.***

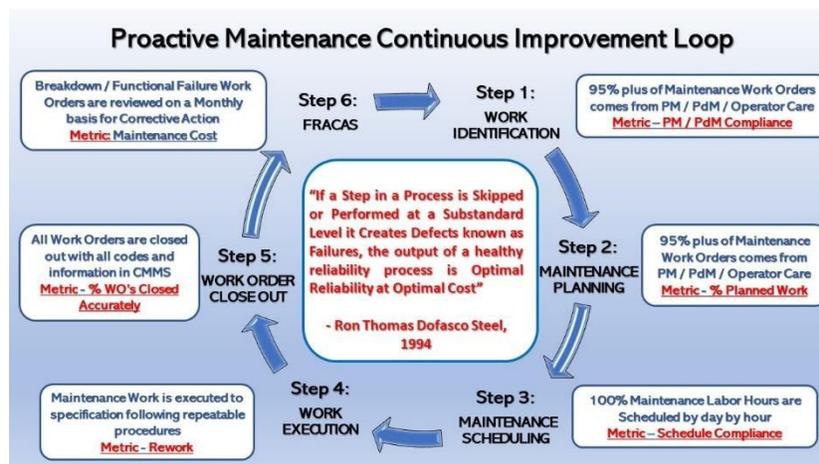
Measuring Progress

“Without the Right Leading and Lagging Metrics (KPIs) sustained success cannot be achieved.

We often refer to metrics, which is just a term meaning “to measure” (either a process or a result). The combinations of several metrics yield indicators, which serve to highlight some condition or highlight a question that we need an answer to. Key Performance Indicators (KPIs) combine several metrics and indicators to yield an assessment of critical or key processes. KPIs for maintenance effectiveness have been discussed, defined, and refined for as long as proactive maintenance has been around. KPIs combine key metrics and indicators to measure maintenance performance in many areas.

We need to be able to define where we are headed as a corporation, regarding our maintenance management goals, and define the KPIs that we will need to monitor to reach our eventual goals. This process is unique to each corporation and needs to be developed independently.

One of the more interesting points here is that KPIs can be created in a hierarchical and interlinked fashion, which allows management to pinpoint the root causes of system failures. In order to determine maintenance strengths and weaknesses, KPIs should be broken down into those areas for which you need to know the performance levels.



“If a step in a process is skipped or performed at a substandard level it creates defects known as failures”

In maintenance these are areas such as preventive maintenance, materials management process, planning and scheduling, and so on. **Depending on KPI values we classify them as either leading or lagging indicators.**

Leading indicators are indicators that measure performance before a problem arises. To illustrate this, think of key performance indicators as yourself driving a car down a road. As you drive, you deviate from the driving lane and veer onto the shoulder of the road, the tires running over the “out of lane” indicators (typically a rough or “corrugated” section of pavement at the side of the road that serves to alert you to return to the driving lane before you veer completely off the pavement onto the shoulder of the road).

These “out of lane” indicators are the KPI that you are approaching a critical condition or problem. Your action is to correct your steering to bring your car back into the driving lane before you go off the road (proactive condition).

If you did not have the indicators on the pavement edge, you would not be alerted to the impending crisis and you could veer so far out of the driving lane that you end up in the ditch. The condition of your car, sharply listing on the slope of the ditch, is a lagging indicator. Now you must call a wrecker to get

you out of the ditch (reactive condition). **Lagging indicators (such as your budget), yield reliability issues, which will result in capacity issues.**

A manager must know if his department is squarely in the driving lane and that everything is under control, if possible before it approaches and goes into the ditch. A list of some of the key performance indicators of the leading variety is illustrated in the Key Performance Indicators table below. Note that some of these indicators could be both leading and lagging when combined with and applied to other KPIs.

Key Performance Indicators

<p>Reliability/Maintainability</p> <ul style="list-style-type: none"> ➤ MTBF (mean time between failures) by total operation and by area and then by equipment. ➤ MTTR (mean time to repair) maintainability of individual equipment. ➤ MTBR (mean time between repairs) equals MTBF minus MTTR. ➤ OEE (overall equipment effectiveness) $\text{Availability} \times \text{Efficiency (slow speed)} \times \text{Quality}$ (all as a percentage). <p>Preventive Maintenance (includes predictive maintenance)</p> <ul style="list-style-type: none"> ➤ PPM labor hrs. divided by Emergency labor hrs. ➤ PPM WOs (work orders) #s divided by CM (corrective maintenance, planned/scheduled work) WOs as a result of PM inspections. <p>Planning and Scheduling</p> <ul style="list-style-type: none"> ➤ Planned/Schedule Compliance—(all maintenance labor hours for all work must be covered and not by “blanket work orders”). This a percentage of all labor hours actually completed to schedule divided by the total maintenance labor hours. ➤ Planned work—a % of total labor hours planned divided by total labor hours scheduled. 	<p>Materials Management</p> <ul style="list-style-type: none"> ➤ Stores Service Level (% of stock outs)—Times a person comes to check out a part and receives a stock part divided by the number of times a person comes to the storeroom to check out a stocked part and the part is not available. ➤ Inventory Accuracy as a percentage. <p>Skills Training (NOTE: A manager must notify maintenance craft personnel about the measurement of success of skills training.)</p> <ul style="list-style-type: none"> ➤ MTBF. ➤ Parts Usage—this is based on a specific area of training such as bearings. <p>Maintenance Supervision</p> <ul style="list-style-type: none"> ➤ Maintenance Control—a % of unplanned labor hours divided by total labor hours. ➤ Crew efficiency—a % of the actual hours completed on scheduled work divided by the estimated time. ➤ Work Order (WO) Discipline—the % of labor accounted for on WOs. <p>Work Process Productivity</p> <ul style="list-style-type: none"> ➤ Maintenance costs divided by net asset value. ➤ Total cost per unit produced. ➤ Overtime hours as % of total labor hours.
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NOTE: KPIs must answer questions that you as a manager ask in order to control your maintenance process. Listed is a sampling of recommended KPIs. They are listed by the areas in which a maintenance manager must ask questions.

Thoughts and Recommendations:

- Everyone in Maintenance must understand Lean Maintenance and its correlation with Proactive Maintenance.
- Education in Lean Maintenance is critical at all levels from senior leadership to floor level employees.
- Managing with the Right Leading and Lagging KPIs using scoreboards so everyone knows their score in the game is critical.
 - A Plant Scoreboard where all employees enter the plant or site
 - A Production Scoreboard where employees work
 - A Maintenance Scoreboard in the Maintenance Shop
 - A Maintenance Storeroom Scoreboard at door or gate to Maintenance Storeroom