Lean Maintenance for Lean Manufacturing

(Using Six Sigma DMAIC)

Before putting new and 30 or 40 year old machines together into Lean Manufacturing lines, do you know how to get the near 100% uptime required? Or, will "maintenance" become the "tail that wags your dog"? 'Your Achilles heel?

A Barrier To Lean

To compete in today's global economy and to increase profits, many factories are moving to "Lean Manufacturing," the next step beyond "Just In Time." Others claim "lean" but hedge on the concept with hidden WIP inventories because they fear what they've seen in the past, when critical path machines go down for a "maintenance break." Other managers simply budget for and bolster their maintenance department with people, training, equipment and spare parts so they can more quickly "put out the fires" when downtime occurs. Others increase budget (expense) to hand off maintenance responsibility to outside subcontractors. Outside service vendors may or may not service you better, but its sure nice to be able to point the finger outside when downtime cripples production. But, its still your downtime.

The Maintenance Problem

The underlying problem here is equipment reliability and uptime (some call it maintenance reliability). The solution is to find ways to eliminate unscheduled equipment downtime. The problem with downtime is that most maintenance people think, "It just happens. Then we fix it." The problem with downtime is, "You can monitor it, measure it, log it, report it, track it, attack it, or delegate it, but downtime will not go away until you "**eliminate it**" - prevent it from happening in the first place.

A Solution (Lean Maintenance)

What? How does one "fix a machine so it doesn't break down again"? Answer: To prevent downtime from happening before it occurs, you must eliminate the basic stresses that cause the downtime. What is needed is a methodology for protecting computers, automation controllers, PLCs, CNC machines, etc. and protect their electronic and hydraulic control systems from the stresses that cause malfunctions and failures. The author has been applying this methodology and perfecting it since 1977. He calls it "Lean Maintenance™ for Lean Manufacturing." This practical and most cost effective methodology can help most any facility from data centers to telecom to medical, from semi-conductor manufacturing to plastics & metal manufacturing. Within 30 - 60 days, you can thus avoid malfunctions, failures, unscheduled downtime, scrap parts, re-work, missing delivery schedules, etc. and get the near 100% reliability, repeatability, yield, and uptime needed to increase profits.

Improved uptime is also needed as companies push to lower costs by shedding:

1. Onsite spare parts
2. Onsite board or component repair, and
3. Onsite technicians, maintenance engineers, etc.

The few skilled technicians are getting old. In 3 - 7 years most of this rare breed will be retiring and replacements are not present in training. "Lean Maintenance" can help by providing methods that allows reduced maintenance support and reduced maintenance overhead (often 50% or better) while achieving maximum *permanent reduction of unscheduled downtime, typically;*

- 50% reduced mechanical downtime
- 80% reduced hydraulic systems downtime
- 92% reduced electronic systems downtime

Cost of Downtime

So what is the cost of downtime? Is it something worth eliminating? Different companies calculate or toss different figures; typically $500 per hour for a stand-alone machine, $1,500 - $8,500 per hour for a cell or line of machines, and up to $3,500 per minute ($181,500 per hour) for an entire auto factory line. One practical way to give your "cost of downtime" figures a reality check is to compare them to the price you would pay, or do pay, when you have to "farm out" a part or assembly because your capacity is temporarily or permanently limited. What do they charge you per hour for this capacity? That's the cost of your downtime. Believe it. Any profit margin they have calculated in is quickly offset by your own continued need to pay support and regular production personnel who often stand idle. Add to this your scrap and rework costs and you see the true hourly cost of downtime.

(Manually add your costs as calculated here.)

Cost of Scrapped Parts	$	
+ Other Error Costs	$	
+ Cost of Hourly Downtime	$	
x Hours of Downtime		Hours
TOTAL COST OF DOWNTIME	$	

Cost of Scraped Parts + Error Cost + Hourly Cost of DT x DT Hrs. = $_____.____

Only after you have a firm grasp on your cost of downtime can you then calculate the importance and impact Lean Maintenance methods can provide by way of increased profits, decreased cost of goods sold and the impact this can have on increased market share.

In Lean Manufacturing the cost of a single machine going down for maintenance is multiplied by the number of machines in that cell. With no parts in inventory, a single machine going down results in no parts shipped. Broken delivery schedules that cannot be made up, if the next parts made are "just-in-time." It's not only lost sales, its reduced level of integrity and less satisfied customers which can result in long term loss of sales revenue. Downtime then results in a higher cost-of-goods sold which means reduced ability to expand or maintain sales and business volume.

Lean Maintenance - Methodology

The key objective of Lean Maintenance is to give your company the near 100% equipment uptime and reliability it demands while cutting your maintenance expense, often by 50% or more. This is done by systematically surveying or analyzing each machine and control system to determine which basic stresses are effecting each machine, over time, and laying out a scheme to protect each machine, computer, or control system from the stresses to which it is subject. This certainly includes but goes far beyond the normal oil change, filter change PM procedures given in the maintenance manual. You must first understand the three categories of downtime:

1. Downtime from Operator or Programmer Error
2. Downtime from inadequate PM procedure or performance
3. Downtime from chronic wear & stress to circuit boards, hydraulic components and other system components. Stresses such as: a. Heat b. Vibration c. Oxidation & Corrosion d. Dirt build-up e. Electrical voltage transients and current surges f. Hydraulic contaminations of dirt, water & acids, etc.

Six-Sigma, ISO-9000 and TPM books and strategies often cover the first two issues (above), yet they often get passed over. "Lean Maintenance" stresses the importance of all three (above) and focuses on the third. "It's like preventing fire hazard," You can have fuel stored or flowing anywhere, but do away with oxygen and heat and you cannot have a fire. Similarly if you do away with the chronic stresses that cause 'maintenance fires,' then you cannot have maintenance malfunctions, errors, failures, rework, scrap and downtime. The beautiful thing about this method is, for the most part, it's all "one time installation" of protective devices to produce ongoing savings. It in no way changes your current product flow, personnel, procedures, operations, or policies. Yet, you are able to reclaim older or less reliable systems to near 100% uptime." You might call this kaizen for maintenance reliability, or how to jump from "four sigma" to "six sigma."

Six Sigma, D.M.A.I.C. - Steps to implement Lean Maintenance

Define the problem:

Unscheduled equipment malfunctions and the resulting rework, scrap parts, downtime and lost production.

Why is this a problem? Because now days the machines and computers do all our work. If you don't believe it, just go unplug all your computers and machines for two or three

days and see how much product goes out the back door. Watch the 99% decrease in information or services provided. We must realize that the machines and computers are productive employees of the company. The machines are just as much employees as the humans. Each is paid a per hour wage based on their value to the companies products and services. Usually the machine's wages are much higher than human wages. When they take a break, make a mistake, or take a day off, the company looses profits.

To state the problem clearly, reminds me of a plaque that used to hang in my mother's kitchen which read, "When Momma ain't happy, ain't no one happy." Maybe we should hang a plaque in the company office that reads, "When machines ain't runnin', ain't nothin' gettin' done!" That's the problem.

Monitor & Measure the problem:

Monitor your downtime and measure or calculate what it is really costing (see above).

If you have a CMMS (computer maintenance management system) or a good purchase order and work order system, then we can estimate the potential savings and increased profits that should come from addressing this "problem." Measure and report the following (from the past year)

1. How many "work orders" or "tickets" for maintenance assistance on unscheduled downtime have you had the past few months, and the past year?

2. How many hours of unscheduled downtime, from your CMMS or "work orders." How many maintenance hours by in-house or by contracted support personnel? How many electrical, hydraulic, mechanical?

3. From your "purchase orders," how many dollars in equipment repair?

4. How many dollars in electronic module repair (in-house or out sourced)?

5. How many dollars in hydraulic module repairs (in-house or out sourced)? 6. How may dollars spent on hydraulic fluid?

7. How many dollars spent on hydraulic oil disposal?

8. How many hydraulic systems?

9. How many machines or computer controlled systems are employed here?

10. Where are the most critical areas or departments needing equipment reliability? (Critical Path Machines)?

11. What is your average "cost per hour" for equipment downtime?

12. Multiply this hourly "cost of downtime" by the total downtime hours in #1 & #2 above.

If you had eliminated 70% - 92% of #12, is it a number worth your attention? Is it worth the Companies attention?

Analyze how to solve or eliminate the problem:

Your maintenance engineer, or an experienced consultant or contract engineer will analyze and identify, for each computer, each machine and each control system how to most cost-effectively achieve ongoing protection from the above stresses. Have them write a report detailing, machine by machine, the exact means to protect from each these stresses (as each may apply) and give protective device model numbers, connection points and installation instructions along with costs for each and a total cost summary. The investment needed can then be justified against increased uptime benefits and increased profits that will come from item #12 in the above measurement section.

Then Install and Implement

Installation instructions from above should be specific enough that your own maintenance personnel can easily and quickly install the needed protective devices, methods, or changes.

Controlling this project

Controlling Lean Maintenance in the future should require little to no effort. Steps taken to avoid hydraulic system malfunctions and downtime can actually reduce by 90% current labor for hydraulic system PM and scheduled downtime, while prolonging machine tool life. Most other methods are single step protective methods that need no future monitoring or PM labor effort.

How Amemco Can Help

We can have Lean Maintenance installed and effective within 30 days! Our first time through the process took five years. The second company took two years. We then got it down to 3 - 6 months. Now, after 25 years experience, we help most clients maximize uptime, reliability, yield and profits and do it within 30 days! Engage Amemco for 30 days, "It does't cost, it pays."

Amemco conducts an Analysis survey of your facility and equipment. We start with a three hour in-plant Lean Maintenance orientation seminar for all responsible personnel from VP of Mfg. down to engineers and maintenance technicians. This orientation reveals exactly how these stresses cause malfunctions and downtime and our various proven methods for eliminating these stresses once and for all! We also discuss and look at other common or factory specific anomalies, causing you unscheduled downtime. We then do a 2 - 4 day equipment stress/reliability analysis survey, taking notes on each system and machine to later generate a 20 - 30 page report detailing a protective solution package for each machine and control system.

Conclusion

"Lean Maintenance" is basically reliability and reduced need for maintenance troubleshooting and repairs. Lean Maintenance comes from protecting against the real causes of equipment downtime -- not just their symptoms. Any maintenance engineer or manager can begin Lean Maintenance by protecting automation, electronics, hydraulics

and computer-controlled equipment from the real cause of malfunctions, failures, and downtime-chronic stress discussed above. Circuit board failures, hydraulic system failures and other malfunctions are only symptoms, not the underlying cause of unscheduled equipment downtime. Over 25 years of experience, Amemco has learned to move client companies through implementation of **Lean Maintenance** in 30 days (normally), rather than taking years. Which means;

1. Increased Profits,
2. Near 100% uptime required for Lean Manufacturing,
3. Greatly reduced maintenance overhead, and
4. Reduced dependence on outside support.

Lean Maintenance is maximizing uptime, yield, productivity, and profitability.

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