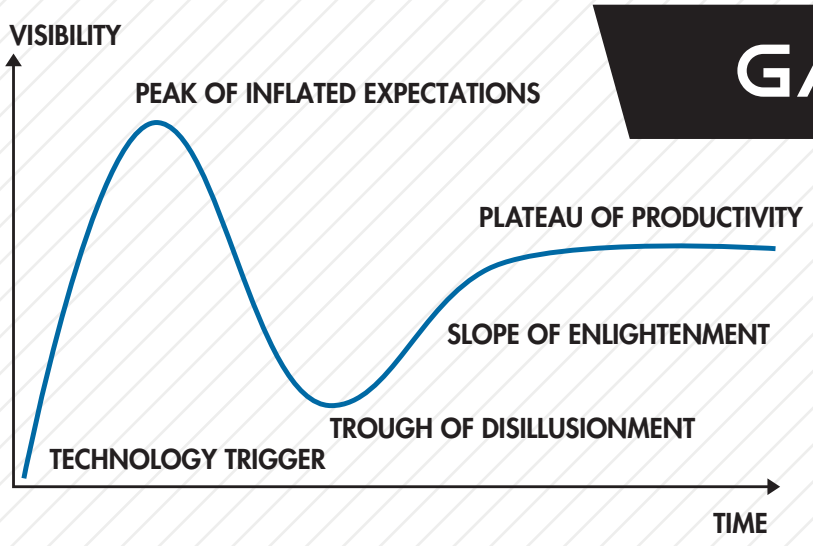
THE IMPORTANCE OF GETTING IT RIGHT

If you're looking for what the latest advancements in technology are in the manufacturing reliability world all you need to do is spend a couple of hours on LinkedIn. Scrolling through the endless number of posts one will find articles, videos, and tutorials on the advancements in Smart Machines, Machine Learning, the Industrial Internet of Things (IIoT) and Digital Twins. Without a doubt, it's an exciting to witness the evolution and to envision the potential future state of manufacturing and maintenance. The reality however is nearly every post conveniently leaves out the requirements one must have in place to make the advancements work for you.

The truth is, without the foundational elements of a sound asset management program in place, and a group of skilled/trained technicians to maintain this new equipment, the state-of-the-art Smart Machine won't deliver. You'll have more alarms, more unscheduled shutdowns, more meetings to discuss the causes of all the alarms and without a strong commitment and understanding of what needs to be done to make the new equipment work, the sensors and alarms will be disabled, or the operator will be given permission to acknowledge them and continue.

While it's important to keep up with emerging technologies, one should also be aware of the Gartner Hype Curve (fig 1) which accurately illustrates the cycle we experience when implementing new technologies.

GARTNER HYPE CURVE



PROGRESSIVE RELIABILITY

UNDERSTANDING THE FOUNDATIONAL ELEMENTS

Regardless of the age of your plant and your equipment, the ability to achieve the inherent designed reliability of your assets is dependent on your ability to properly operate and maintain the assets. If I've learned one thing in the past forty years, changing the name of what we do and how we do it, did nothing to change the fact that if you ignore the Foundational Elements of Maintenance, you will spend the better part of your time fighting fires and your equipment will never achieve its designed reliability. Calling it equipment maintenance won't change it, calling it Equipment Reliability didn't change it, calling it Asset Management hasn't changed it and adding Smart Machines with the best advancements in technology won't change it. You still must do the work, and you need to put safeguards in place to ensure we sustain the structure and discipline required to continuously improve.

Before I move on to describe the foundational elements of a sound maintenance program, I would like to remind readers that when CMMS (Computerized Maintenance Management System) software was first made available in the late 80's and early 90's it was sold as a game changer. Technology had advanced and along with this advancement, the way we maintained our assets was about to change. We would now be able to plan, schedule and perform our work and on top of that we would have the data to show where we were spending our time and money. As a result, equipment performance would increase and maintenance would; cost less, become more efficient and improve utilization/wrench time of our tradespeople.

?

1. HOW MANY COMPANIES RECOGNIZED THAT PROMISE?

2. WHY DID WE FALL SHORT?

The answer to the second question is the software was developed before those in the world of manufacturing maintenance had any idea the foundational elements even existed. While the US Military, the Airline Industry and Nuclear Power industries had been using them for a couple of decades, the folks in the manufacturing community were totally ignorant so when the software was purchased by the folks in corporate and dropped in their laps, they simply put in just enough information (hierarch) to make the system run. The end result was a software program that was slightly more efficient than paper work orders.

!

How do we make the CMMS work for us? How can we recognize the benefits of a sound, reliable design?

We need to go back to the basics. We need to implement the foundation elements that can support a failure modes-based maintenance strategy.

EQUIPMENT HIERARCHY DEVELOPMENT

Also know as building the equipment register, much has been written over the years on the proper way to go about doing this and today if instruct clients to refer to ISO Standard 14224 to determine the proper structure for an equipment hierarchy/register. To this I would add that to get the full benefit a CMMS can provide, at a minimum, your hierarchy must be written to the component level.

In my twenty years working as a consultant, only 1 in every 20 companies I have worked with took the time to properly develop their equipment hierarchy/register. The 19 who failed to do so continue to be puzzled as to why their continuous improvement efforts get off to a good start and then ultimately fail. On a day to day level, they struggle to get beyond firefighting, can't complete their PM (Preventive Maintenance, Corrective Maintenance, PdM (Predictive or Condition Based) tasks and rarely have the correct parts in their store room. Those who have failed will have a backlog of maintenance work that would take a month to complete if their entire maintenance crew worked on only backlog work.

I can also tell you having helped customers finally develop their hierarchy/register that when It's finally complete and they begin implementing the other foundational elements, the drive to fully understand and utilize the CMMS to its potential increases exponentially. With an intelligently designed hierarchy comes the sudden realization of:

- Our machines that were supposed to be alike, are actually quite different.
- The number of different brands of pumps, motors, valves, actuators, and switches we have on site.
- We suddenly know and have data to prove where we are spending our time and money.
- The ability to plan jobs becomes easier but scheduling work is still a problem.

With the equipment hierarchy/register complete we can now move on to the next part of our foundation.

EQUIPMENT CRITICALITY RANKING

Equipment Criticality Ranking is a process that requires participation from all segments of your business. In facilitating this effort we will need to discuss the impact on or business should a given asset or piece of equipment fail. In doing so, each piece of equipment will be given a unique criticality ranking based the consequence of its failure to:

- EMPLOYEE HEALTH
- SAFETY
- ENVIRONMENTAL IMPACT
- IMPACT TO CUSTOMER (INCLUDING FOOD SAFETY)
- SHIPPING
- COST OF THE FAILURE IN TERMS OF LOST PRODUCT
- COST OF REPLACEMENT PARTS
- COST OF MAINTENANCE
- IMPACT ON PRODUCT QUALITY
- PROBABILITY OF FAILURE

A thorough Criticality Analysis is an exercise that requires an experienced cross-functional team that will first develop ranking criteria for each of the above categories. With the ranking criteria set and agreed upon, the team will then begin to assess the consequences of failure at the equipment level. It should be noted that many have attempted to perform this exercise one or even two levels higher in their equipment hierarchy and the end result is always the same, they understand what product line is most critical but the detail to schedule work leaves them with far too many work orders with the exact same criticality ranking. The same issue will also occur when we attempt to use a simple criticality ranking of 1 thru 5 so it should be noted, the range of your criticality ranking should be the square root of the number of assets at your site or building. (If you have 100 assets, the range of criticality should be 1 to 10, if you have 10,000 assets your range would be 1 to 100).

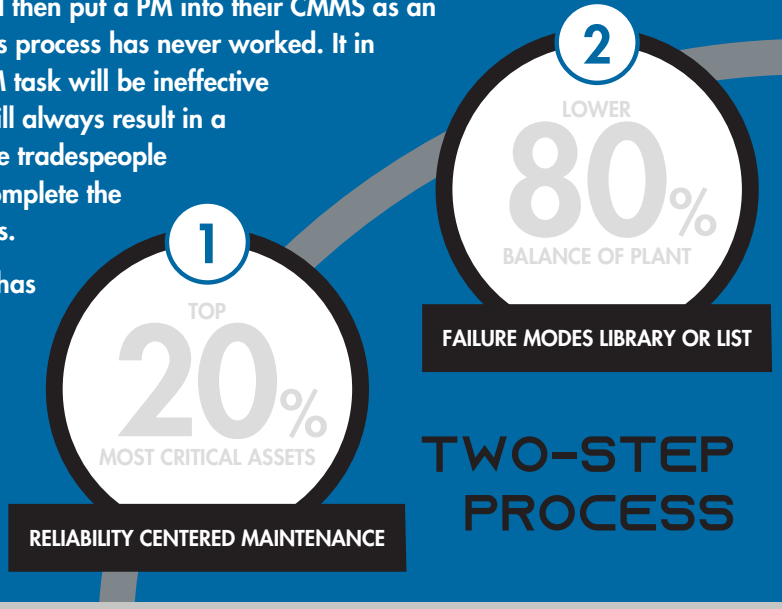
IN COMPLETING YOUR ASSET CRITICALITY RANKING, YOU WILL NOW BE ABLE TO:

- Easily schedule and prioritize your work.
- Have a working tool to help focus where to spend time and capital.
- Make sound decisions throughout your business.
- Effectively allocate resources.

FAILURE MODES IDENTIFICATION

Failure Modes Identification is the first step in the process of developing a comprehensive maintenance strategy. To do this, we must first train those who will be charged with building this piece of the foundation. In the past most companies developed their maintenance task through a process of trial and error. They purchase a new machine or piece of equipment, wait for it to fail, go out and make the repair and then put a PM into their CMMS as an attempt to replace the item before the next failure occurs. This process has never worked. It in fact always results in a massive list of PM tasks where the PM task will be ineffective at preventing the failure. Trial and error task development will always result in a maintenance organization that is focused on fighting fires, the tradespeople simply become component replacers who look for ways to complete the job faster instead of identifying and eliminating failure modes.

Failure Modes Identification is a two-step process. Once one has completed the Criticality Analysis portion of their foundation, failure modes identification will be completed by performing a RCM (Reliability Centered Maintenance) analysis on the top 20% most critical assets. Failure Modes identification for the balance of plant (lower 80%) will be accomplished through a failure modes library or list.



MAINTENANCE STRATEGY DEVELOPMENT

The last piece of the foundation, Maintenance Strategy Development is accomplished in combination with Failure Modes Identification. Strange as it might seem, while this process without a doubt will take the most time and resources, I have never seen a company who had a ISO 14224 compliant hierarchy that didn't have a failure modes based strategy as well. The development and application of a comprehensive failure modes-based maintenance strategy is the only way one can achieve and sustain the inherent designed reliability of their assets.

WHAT IS A COMPLETE OR COMPREHENSIVE MAINTENANCE STRATEGY?

A complete maintenance strategy identifies one of five maintenance task types to mitigate each failure mode.

THE 5 MAINTENANCE TASK TYPES

ON-CONDITION MAINTENANCE

Also known as PdM (Predictive Maintenance) CBM (Condition Based Maintenance) CM (Condition Monitoring). The intent of an on-condition task is to detect potential failures through the use of condition monitoring or inspection techniques so a corrective work order can be planned, scheduled, and executed before the failure occurs.

PREVENTIVE MAINTENANCE

Preventive Maintenance is time based and is only effective in preventing wear-based failure modes. The interval of the PM task should be based on the known useful life of the component and in many cases the wear of the item should be measurable allowing for a go/no-go measure to be developed.

FAILURE FINDING TASKS

Failure Finding tasks are time-based inspections of a hidden function device intended to ensure it is still capable of performing its intended function. As an example, the testing of your emergency stop switches on a regular basis. Should the e-stop fail closed (its normal condition) your machine will continue to run when the button is activated.

REDESIGN

Redesign is any change in equipment, process, or procedures that when implemented, eliminates the failure mode from reoccurring.

CONSEQUENCE REDUCTION

Consequence reduction tasks are put in place to reduce the downtime of failure modes that can not be detected with on-condition maintenance, prevented with a PM task and where a redesign task is not applicable or effective.

With the foundational elements now in place, your comprehensive maintenance strategy can now be planned, scheduled, and executed. The resulting affect will be everything your CMMS provider promised. A drastic reduction of emergency/demand maintenance work, an increase in machine efficiency and output, and a reduction in maintenance costs.

IMPLEMENTING MAINTENANCE STRATEGIES

Implementing the developed maintenance strategies for your equipment is the next step in the Back-to-Basics processes. Action and dedication to implementing the strategies in a disciplined manner is crucial for success. The work identified needs to be completed in an efficient manner. Efficiency processes to accomplish these tasks can be summarized in 4 major steps as listed below:

1 WORK IDENTIFICATION PROCESS:

Work is identified by implementing the maintenance strategies on the equipment. Work needs to be captured and categorized for later analysis using these work types in a EAM or CMMS listed below. It is critical for an organization to understand what type of work is being identified and eventually executed. Organizations need to monitor and strive to complete the right proactive work to improve production and quality and reduce costs.

- CBM tasks workorders (proactive work)
- CBM tasks follow up workorders (proactive corrective work)
- PM tasks workorders (proactive work)
- PM tasks follow up workorders (proactive corrective work)
- Failure finding tasks workorders (proactive work)
- Redesign and modifications workorders (proactive work)
- Equipment Failures workorders (reactive corrective work)

2 WORK PLANNING PROCESS:

Stephen R Covey in his bestselling book, "7 Habits of Highly effective People" introduced the concept that everything in life is created twice. First there must be a mental creation that precedes any physical creation.

Work planning is the mental creation of the work. Work planning is the what, the where, the how, the needed steps, and all pertinent information needed to efficiently complete the work. Work planning completed before work execution sets the stage for the physical execution of the work to be completed efficiently.

Work planning is done at least a week ahead of work execution to allow for development of all procedures, purchasing of needed parts, delivery of parts. Therefore, work planning focuses on the proactive work identified above. Planning reactive work really is not planning at all. It is possible to have template job procedures to attempt to make reactive work more efficient when executed.

3 WEEKLY WORK SCHEDULING PROCESS:

Weekly work scheduling is also another step in mental creation of the work. Weekly work scheduling is the "when" or window when the work can be completed. The weekly schedule consists of planned work orders that have all parts, tools, procedures available for the upcoming week. The schedule is developed by a team of operations and maintenance leaders in a specific plant or area of the plant. This team must be aware of production schedules and resource availability each week to be able to produce a realistic schedule of work for the upcoming week.

4 DAILY WORK COORDINATION PROCESS:

The daily work coordination is the process to adjust work execution on the weekly schedule on a daily and/or hourly basis to accommodate the changing facility operations and changing resource, parts, and tool availability. The work is normally completed by work supervisor in consultation from operations, procurement, and engineering. The goal is to maintain the weekly schedule for work execution efficiency while balancing the immediate needs of the facility operations. This step supervises the physical creation of the work.

IMPLEMENTING MAINTENANCE STRATEGIES CONT'D

5 MANAGING BACKLOG WORK

While some would like you to believe there is an ideal for backlog work, the companies who have mastered the planning and scheduling process typically maintain a 4-to-6-week backlog of work and have developed techniques to ensure the backlog doesn't grow beyond six weeks. To accomplish this, they typically look at three factors to help keep work from sitting indefinitely in backlog.

- Equipment Criticality Ranking
- Work Order Prioritization
- Number of Weeks in Backlog

SAFEGUARDING YOUR EFFORTS

Completing the foundation is a significant piece of work that will provide benefits for decades provided you also put measures in place to safeguard your work. Companies who do this well have implemented a MOC (Management of Change) process that requires all capital projects (large and small) as well as any demolition work to provide appropriate changes to the equipment hierarchy, criticality, maintenance strategy and spare parts. Failure to provide these safeguards will result in a slow increase in emergency/demand maintenance work.

ADDRESSING THE ACHILLES HEEL OF MAINTENANCE

YOUR COMPANY HIRED A ASSET MANAGEMENT CONSULTANT A YEAR AGO AND OVER THE PAST 12 MONTHS YOUR TEAM HAS WORKED DILIGENTLY TO DEVELOP YOUR EQUIPMENT REGISTER, COMPLETE A CRITICALITY ANALYSIS FOR THE PLANT, DEVELOP A COMPREHENSIVE MAINTENANCE STRATEGY AND YOU'VE EVEN BEGUN TO PERFORM THE TASKS HE/SHE CLAIMED WOULD TURN THINGS AROUND. SADLY HOWEVER, NOTHING HAS CHANGED.

THE PEOPLE PERFORMING THE ON-CONDITION TASKS CLAIM A LARGE PERCENTAGE OF YOUR ROTATING ASSETS ARE IN ALARM, EMERGENCY/DEMAND MAINTENANCE COMING IN AND ACCOUNTS FOR MORE THAN 50% OF THE IN PROCESS WORKORDERS AND THE MAINTENANCE BACKLOG CONTINUES TO GROW. THE PLANT MANAGER HAS GONE QUIET, YOUR TOLD HE IS FUMING ABOUT THE TIME AND MONEY SPENT TO BUILD A FOUNDATION THAT NEVER PROVIDED A RETURN ON INVESTMENT.

WHAT HAS GONE WRONG?

Forty years ago, I was hired by a company who clearly understood that if you want the most out of your manufacturing assets, you need to ensure they are maintained by highly skilled tradespeople. To achieve this goal, they developed a separate skilled trades apprentice program for Machinists, Millwrights, AEM (Automated Equipment Mechanics) Electricians, Instrumentation Techs, Pipefitters, and Welders. As an apprentice you work with a Journeyman who works with you to apply the techniques learned in your training program are applied to assets at the plant site. The result is a highly skilled workforce that is capable of working to the level of precision required to ensure your equipment operates at its inherent designed reliability.

Incredibly, in the past twenty years, I have worked with only two companies who had formal apprentice programs to ensure the people they entrust to maintain their assets have the skillsets to ensure reliability. The other companies, they continue to play a game of chance hoping that somehow their HR department will be able to look someone in the eye and be able to tell they have the skills to do the job right. The result is a maintenance workforce that keeps your equipment running by simply replacing components over and over again.

If you want the foundation you worked hard to build to support a world-class organization, you need to invest in the training and certification of your tradespeople. Failing to do so will only result in a continuing cycle of early life failures causally related to improper installation.

I have found that instilling a Precision attitude in the workforce that builds, installs and maintains a plant's equipment can be very challenging. I have encountered the "Good Enough" attitude in equipment design and building, led normally on the theme of cost control.

ADDRESSING THE ACHILLES HEEL OF MAINTENANCE CONT'D

My experience is that few OEMs truly understand what the requirements are to have a precision-built machine. They equate the "precision" to mean it costs a lot more. Many expect a precision built, precision balanced, precision aligned machine to take much longer to build and install. This is seldom the case. It takes attention to much more detail and an educated, motivated workforce and the small amount additional cost is saved in operating and maintenance costs over the life of the equipment. Additionally, many times in a competitive bid situation, this extra detail can be obtained with no cost. In other words, "Precision is Free."

WHEN SPECIFYING EQUIPMENT TO BE BUILT AND INSTALLED, INSIST ON:

- Precision balance specification
- Precision alignment standards
- Precision fit and tolerances standards
- Precision torque standards for mechanical and electrical equipment
- Precision lubrication standards that include microscopic particle contamination control procedures

During all maintenance work, the precision activities above are just as vital. The craftspeople must be educated and motivated to "sweat the details" when repairing and maintaining plant equipment. For most craftspeople, this is not a tough sell. They want to do work right but normally are held back by the leadership and work environment that rewards actions motivated by speed and cost control.

So short of spending the money to create an apprentice program, how does one ensure the tradespeople they are hiring are capable of doing the work? Being honest, the answer isn't simple. I had a client tell me last year they hired a machinist who showed up the first day on the job with a toolbox that wasn't much bigger than a lunchbox. He has a carpenter's hammer, channel loc's, a crescent wrench and a ½ socket set. The tools still had the sticker on them. "He interviewed well, said he had been working in the trades as a machinist for 10 years, grew up on a farm and had been working on tractors his entire life. He claimed his actual toolbox and tools were back on the farm and the next time he went home he would bring them in. By the end of the first week, it was clear he had zero experience and it took a month of paperwork to let him go. Was he capable of replacing a gearbox, coupling or pump? I'm sure he could have, but if asked to align it to within plus or minus three thousandths, it wasn't going to happen."

Hiring qualified maintenance technicians takes hands on experience. Someone involved in the interview process who knows how to ask the right questions specific to each trade. In today's world it's rare to find maintenance Managers and Supervisors with actual skilled trades experience, so it's a must to have someone who works in the same trade involved in the interview process. Direct, trade specific questions are what separate those with real experience from the pretenders.

PUTTING IT ALL TOGETHER

While ensuring we have tradespeople who are capable of working with the precision required to maintain the inherent designed reliability of your assets and building a foundation that allows this to occur might seem overwhelming, we will never rise from Gartners Trough of Disillusionment until both are achieved. The path forward simply requires an experienced leader, some discipline, and a plan to return to the basics. If you don't have the experience and knowledge to implement sound foundational elements on-site, bring someone with a proven record for six months and get it done.

The key to making all the exciting new advancements work for your company is fully dependent on the basics and the importance of getting it right!

PROGRESSIVE
RELIABILITY