RELIABILITY SOLUTIONS FOR INDUSTRY WITH A HUMAN TOUCH

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PRESIDENT'S MESSAGE

Maintenance and the Third Law of Thermodynamics

How's that for a title? The engineers among you may even remember this Law of Physics: Entropy (the state of disorder in the universe) is increasing. Is that interesting? And what does it have to do with Maintenance?

When it comes to running a plant effectively, it means everything!

Successful plants implement comprehensive systems to create order. "Best practices" are widely known, but not often systematically practiced. It takes a great amount of work (energy) to teach and reinforce practices that keep a plant running well (order in this part of the universe). The more stable the system, the less energy is required to maintain it. Conversely, to change the work paradigm, or steady state, usually requires a great deal of effort.

Reactive maintenance is the least ordered, highest entropy system. In it, the equipment tells us what to do, and when to do it. The order created by a repair is usually less than the original equipment state. Why? Repairs often (our benchmarks show 25%) fail during the first month. Even if they don't, the system is changed during the intervention. For instance, nuts are not properly torqued, alignments may be altered, some collateral damage not perceived may be initiated.

A high correlation exists, according to major benchmarking organizations, between profitable performers and the *reliability of the systems they implement.* We often think of reliability of equipment as a cause for productive equipment, and of course it is. But equipment reliability is the *effect* typically, of valuable and reliably performed work practices.

Let's give an example to help illustrate:

Plant A and Plant B are both refineries of nominally 100,000 barrels of crude processed each day. Plant A has implemented a reliable planning and scheduling process, in which 80% of the maintenance crew day, across the plant, is spent on scheduled work. Plant B is primarily reactive, where the equipment is the boss. (This is reminiscent of a plant manager who told me that each day on his drive to work he knows what kind of day he will have, depending on the content of the plant's smoke stacks).

In Plant A, wrench time is typically measured at 50-60%, compared with Plant B at 25-30%. Plant A spends 40% of its crew hours on preventive and predictive maintenance (PPM), and has a 90% record of getting preventive work done per schedule. Plant B spends 10% of its work hours on PPM, and doesn't know or track its PM compliance.

The size of the work force at both locations is the same, with Plant A's costs somewhat lower, due to smaller overtime and materials costs.

How does this play out over time?

S. Bradley Peterson
SAMI President

Refinery A plans each repair and outage. Parts are always available before work is started. A good scheduling process ensures that equipment is almost always prepared by the operator in advance of the maintenance work. Work is distributed to each craftsman before he leaves in the afternoon, and he mentally plans his day before he arrives in the morning. Because he has the tools, parts, permits, equipment ready, his corrective maintenance is usually done right the first time. He discusses the job with his supervisor before and after the work, and they note if there needs to be a follow-up for the planner to schedule a root-cause failure analysis. Equipment condition actually improves through the maintenance process, because the repair is also an inspection activity.

Predictive and preventive maintenance locate problems before they occur, and schedule interventions according to priority. Part of the craftsman's days are scheduled to do failure analysis and small design tasks to improve reliability and maintainability. When the

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We are a consulting group for industrial organizations working to improve profitability, efficiency and equipment reliability. Our Mission is to improve our clients' production equipment health, by tapping the desire, creativity and dedication of all plant staff, and our vision is to be the firm consistently chosen by companies serious about making change; because our values of integrity, content knowledge, advanced practices and compassion for the workforce match the values of our clients.

The Operational Reliability Maturity Continuum:
Part 4 Look-Ahead Scheduling

By Dave Army

In my last article, I discussed the development of a Long-Range scheduling tool. This tool, if developed with some thought should contain routine activities and identify instances where resources may be constrained (such as vacations, outages, etc.). If you consider the long range plan to function the same as your "Day Planner," then you are ready to enter the world of look ahead scheduling.

Often when we visit prospective clients we enter into a discussion about work scheduling. Most of the maintenance people we talk to promptly respond that all of their work is scheduled. But what does this really mean? In most cases, this means that all work is put onto the schedule the same day it is scheduled. Their "look ahead" horizon is less than one day! It looks really great on their reports when a high level of "scheduled activities" is reported. However, while living within the letter of the law, they're missing the intent of scheduling.

Why schedule at all? Well, I can think of many (and probably not all) the reasons for scheduling work. Some of these reasons are:

1. Coordination of activities between maintenance and production
2. Having parts and support available prior to work commencement
3. Combining many tasks to occur at the same time
4. Taking advantage of resources availability
5. Reducing wait time
6. Completing more work per unit of time

You can probably think of many more reasons to schedule as the list goes on. As a maintenance professional, life gets a lot easier when you can schedule your work. If you make production a partner in schedule development, you create closer ties and a sense of organizational ownership.

So, how do we go about scheduling? First of all, set your scheduling horizons high. Look-ahead scheduling, as the name implies, requires that you look at least one week into the future. With our clients, we set the horizon at **six weeks**! To most maintenance personnel that are part of a reactive organization, this window seems completely unrealistic. However, if I can slot (schedule) work six weeks into the future, I help my Planner by identifying his planning priorities. I also give the planner up to six weeks to identify and secure parts, materials, permits, production assistance, and anything else required as part of a work plan.

There are a couple of thing that are required to implement look ahead scheduling. First is a long-range plan, second is a "quality" backlog of work, and lastly an organization that is willing to work together to facility and not department priorities.

We'll talk about developing a one week look-ahead schedule (tiny baby steps). Starting with the long range schedule, look at the routine activities that are planned for the following weeks. Using the backlog, look for any work that can be associated with those routine activities. Prepare a list of those activities. Distribute this list to the member of the organization that will attend the weekly planning meeting. In most cases, at a minimum, this will be maintenance foremen, the planner and the on-duty shift supervisor (or his counterpart) representing production. Some organizations choose to increase this list, but a note of caution, don't have too many!

At the weekly planning meeting, the planner presents the list for review and discussion. The **group** concurs on the list (add or delete) and adds any other high priority work that should be accomplished during the next week (remember emergency work is addressed as it occurs). The list is adjusted for resource constraints and committed to by all present. The list is distributed to the appropriate locations, shops, control rooms and plant managers' office. The planner prepares and distributes the work packages to the appropriate foremen. You do have a planner, don't you? The only steps remaining are execution and reporting on success.

There are some points one could argue on. For example, do we schedule to 100% or greater of maintenance capacity? Well this depends on the organization. Normally I would say that when you embark on this journey, if your reactive work load is at 25% or higher, you should set your planning/scheduling sights a little lower. In this case I would recommend setting the scheduling load at about 70% of your total available resources. This will allow you to deal with the reactive load during the work week. This is not to say that you can't place additional "interruptible" work on the daily schedule to accommodate a daily load of 100%. The key indicator is how you comply with the written schedule. As an organization, you should be shooting for 100% compliance against the schedule. As you get better with compliance and execution, you can continue to raise the bar until you reach the 95% one-week-out schedule load.

In the next article, I'll discuss how the "weekly" schedule translates into the "daily" schedule. This step focuses on work execution and adherence to agreed upon work.

If you have any questions or comments on the article, or any aspects of the Work Management process, please feel free to contact me.

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Ralph Hedding is the Vice President of Business Analysis for SAMI. During 21 years in industry, he managed the maintenance and engineering operations for some of the country's largest non-ferrous metal producers. He is a degreed and registered professional engineer, and he currently oversees all SAMI assessment activities.

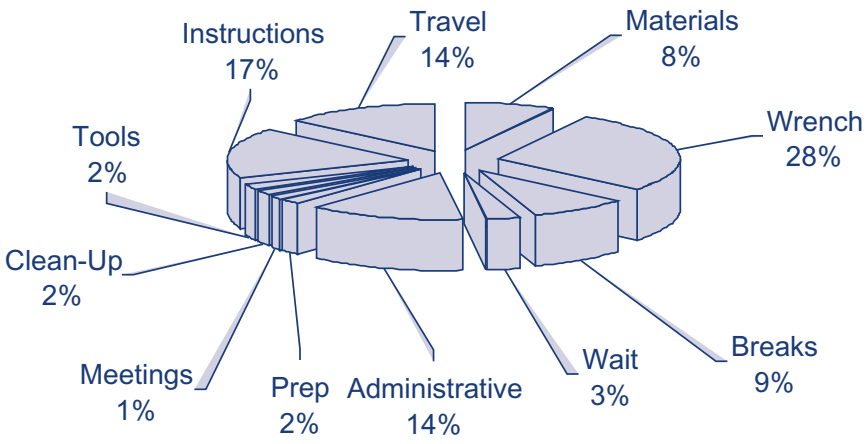
Barriers to the Efficient Execution of Work

By Ralph Hedding

In the last issue of the SAMI Times we discussed the efficient model for the maintenance organization. The theme this month centers on work execution, the first component of the "ELI Model." In this installment, we will discuss what we observe in execution effectiveness during initial assessments at various manufacturing operations.

Performance of work, all types of work, is the primary mission of the Execution Group. All of the elements of the maintenance operation manifest themselves in how well this group performs. This is the barometer of how healthy the processes and procedures used by the organization are functioning. It still surprises us on how few organizations know how efficiently their maintenance crews are performing; no measurements are at hand to check this important key process indicator.

As we perform assessments, a major tool that we employ to determine the bottom line measurement of "Wrench Time" is a "Day in the Life" study. Simply put, we spend several days with the maintenance craftsmen on the job and record what they are doing and the time for the activity from their start time until the end of their shifts. We are not looking to see how hard they are working or what their skill levels are, but rather we are looking for those barriers that are keeping them from being on their wrenches. When the studies are completed, we summarize the total time that we record across a variety of categories and develop a pie chart to show the effective wrench time and the percentages of time spent in all categories. The chart shows the results of a recent assessment.



The client was surprised that the net time that their crews were productively performing direct work was only 28%. In other words, they were getting only 2.2 hours "work" out of 8 hours on the job. We found the craftsmen to be a dedicated group that were trying their best to get work accomplished, but a variety of factors were standing in their way. Let's look a little closer at some of these barriers that were affecting productivity.

The major barrier we discovered was that there was no planning function (Logistics in the ELI Model). Jobs requests were transmitted to the maintenance group and the craftsmen were given the requests to perform. Because they were starting from scratch their initial attempts to determine the solution problem caused them to spend 17% of their time in "Instruction", contacting the requester, visiting the site of the problem, and generally turning the request into a fully understood maintenance job. Part of the issue was that maintenance customers were not instructed on the proper requirements for requesting work. In reviewing hundreds of work requests, we found only 27% contained sufficient information so that maintenance could react promptly.

Travel accounted for 14% of the day. In the client's zest for cost control, they did not provide a means for maintenance to get to and from the job efficiently. The plant site was scattered in many buildings over a lot of geography. One driver and a single van was employed to transport people and materials. This was truly false economy.

Further travel time was incurred in searching for materials, another 8% of the day. Again, no pre-planning was done. To compound the problem, no warehouse had been established on site for common parts and materials. Parts were scattered, in private lockers controlled by individuals, and there was no comprehensive method of assuring parts were available before attempting work.

Administrative requirements of filling out paperwork to report on jobs, time reporting and for ordering materials accounted for another 14% of their day. Once all of these major barriers were identified, it became clear to the management of the facility that the root cause of inefficiencies of the craftsman was in the managerial processes that had been established over a period of years that continually eroded on the job performance. Solutions to the issues were developed and implemented and today this group averages a wrench time of over 65%, in effect more then doubling the size of the organization without adding headcount. A logistics function was established that included planners and a scheduler, and a warehouse. The personnel were funded internally by the improvements in the department's productivity.

Does this case study represent an extreme? Not really. Over the past ten years our assessments have found that average wrench times range between 26% and 34% prior to an intervention to cure the root causes of inefficiencies. This case does illustrate the need for assuring that the organization is properly structured and the execution group supported. The main purpose of the organization is to promote asset management at the least cost possible. Measuring the efficiency of the work force and reducing the barriers to inefficiencies are the only way to assure that maintenance output is optimized.

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craftsman leaves the plant each day, on schedule, he has a sense of accomplishment.

Refinery B may also set out a work schedule, but it is considered interruptible. The priority system is not well-defined or enforced, so new jobs appear during the day. Part of this is due to the "downward spiral"; emergencies preempt prevention, which creates more emergencies, which further preempts prevention. The craftsman spends his day running from one job to the next, seldom completing any, as the parts aren't available, and "just get it up and running" is the order of the day.

The craftsman is asked each morning if he wants overtime that day. A "yes" response will assure that he can work as much overtime as he desires. There are very few days when work is caught up. Safety suffers, production suffers, and the craftsman's home life suffers in spite of the extra money he takes home.

In one case, Refinery A, systems are in place to minimize the impact of entropy. In Refinery B, entropy has a field day, every day!

Many plant managers believe their job is to make product. Successful managers know that their job is to ensure that their equipment and people are ready to make product, and put in the systems to assure that is the case. Changing a plant culture from reactive to proactive, in equipment maintenance or any aspect of operation turns out to be a very large undertaking. Many companies look for easy methods: purchasing software, reliability-centered maintenance, predictive tools, etc. Typically results from these efforts are dependent on a proactive organization already being in place, and only add cost until the organization is ready.

At SAMI our job is to help create order in your organization, in your processes, and ultimately in your equipment. We know how to overcome entropy in your organization, which ultimately reflects in your equipment and production numbers.

If the Third Law of Thermodynamics has got hold of your organization, give us a call. At a minimum we can give you some ideas about moving ahead; at most, we can help you claim your rightful place in the manufacturing hierarchy!

SMRPCO Certification Exam

Don't miss this one! SMRP is offering the first ever **certification exam** for maintenance & reliability professionals at their annual conference this year, October 7-10, in San Antonio.

This certification will provide a valuable career credential from the leaders in our field, the Society for Maintenance and Reliability Professionals. For more information, go to www.smrpco.org.