TMG News

The Manufacturing Game®

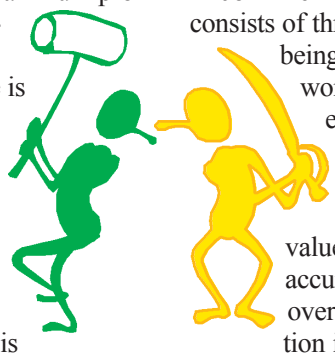
July 17, 2006

"Sharing Information to Improve Reliability"

Operations versus Maintenance

By Winston P. Ledet

Everyone who works in a manufacturing facility recognizes that there is always a conflict between Operations and Maintenance, and most would like to see a solution for the ongoing difference of opinions. This problem, however, is just a manifestation of two functions with opposing values created when a facility is built to produce a product. Operations people value maximum production. Maintenance people value preservation of the equipment. Thus, there is a conflict of Utilization of the facilities versus Availability of the facilities.



From an Operations point of view, running the equipment and producing product 100% of the time is the ultimate goal. However, from a Maintenance point of view, taking the equipment down for repair or renewal is equally as important. Anyone who has worked in both Operations and in Maintenance will tell you that there is a completely different experience of manufacturing between the two functions. The clearest difference I observed was the "consequences of doing nothing." In much of Maintenance work, if something is not going right, the work can be stopped with no detrimental effect. In Operations, if something is going wrong and work is stopped, the situation usually worsens. The reason this is generally true is that all of the dynamic energy is disconnected from the equipment before Maintenance work is started. Therefore, in Maintenance work, all that is required is to deal with the potential energy in the situation. In Operations work, the potential energy is stable but all of the dynamic energy must be directed to the proper places to avoid negative consequences. One conclusion that can be made about the difference between Operations and Maintenance is that Maintenance deals with the potential energy in a situation while the Operations people have to deal with the dynamic energy in a situation.

John Bennett's model of experience consists of three elements: function, being, and will. In this framework of experience, Bennett equates behavior with the functional element of experience. From a functional point of view, the causes of value loss are defects. Defects accumulate in equipment and, over time, cause loss of function in the equipment. The role of Maintenance is to remove these defects in order to restore the proper functioning capability of the equipment. The behavior of people dealing with these defects is what determines which Stable Domain the organization will occupy. If people wait until something breaks to repair it, the organization is in the Reactive Domain. If people repair things before they break, the organization is in the Planned Domain. If people find the root causes of the defects and eliminate the root causes, the organization is in the Precision Domain.

In the framework of experience, Bennett equates energy with the "being" element of experience. Since Operators deal with the dynamic aspect of energy, the more appropriate term for operator response is action. Behavior, on the average, can create the proper functioning but in the dynamic dealing with energy,

Operations... continued on page 2

Creation of "Super Wrench" Embodies Spirit of Action Teams

In May of 2006, an Action Team was created at a TMG workshop for BP Solar involving Monte Lewis, Jerrold Utz, Mike Bryant, Mashu Kobayashi, Phaisan Srirattanapirom, and Pat Campbell III. They began working to improve the wire management system on the wiresaws used to slice silicon into thin "wafers" at BP Solar. The wiresaws use a silicon carbide abrasive slurry delivered by a very thin wire to cut through the silicon brick, and the spent wire is collected on a takeup spool, and later disposed of. The process involves putting an empty takeup spool on the shaft that winds the spent wire for disposal, fed from the feed spool, which runs into and out of the saw. To attach the takeup spool, a large nut is used, to hold the takeup spool in place.

Operators had been having problems removing the split nut and were hammering on the nut to loosen it. The need to improve the split nut removal arose after an operator sustained a minor injury when the hammer he was using bounced off the nut and rebounded into his face. The safety repercussions of this unorthodox method of removing the nut were clear, and damage to a very precise shaft and spool alignment was another issue. Banging on the split nut was distorting it, compromising the fit of the nut and made each attachment and removal increasingly difficult.

In the process of investigating this problem, the incident investigation / Action Team discussed ways to ensure that operators followed the approved procedure, which had to do with removing the Allen screws to open the split nut into two pieces, and also discussed why this was not happening.

Super Wrench...continued on page 3

What's Inside?

Operations...continued from page 1

the average behavior is not sufficient. One wrong action in a year that causes an explosion can ruin everything that was created by good behavior in the previous year.

Many Maintenance people complain that they can't get Operations people interested in high reliability. So why would Operations people have an aversion to high reliability? When you analyze the activity of the Operations people in most modern manufacturing facilities, the equipment is highly automated so it takes care of itself when running routinely at a steady state. The need for quick, precise action comes when the process is upset by some event. Actually, operating people would not have an aversion to reliability if they had 100% utilization. If equipment never broke down, there would be no need for quick action and therefore no need to practice quick, appropriate responses. If, however, equipment broke fairly often, the operating people would get a lot of practice and would improve at performing the proper action to avoid any kind of major catastrophe or setback. The problem comes when the reliability gets high enough that each shift has very little experience in dealing with starting and stopping equipment. Most of the catastrophic events in manufacturing plants happen when equipment is being shut down or started up. This is the time when people are in control rather than the automated control system. Most control systems are not designed to deal with all the various ways upset conditions can happen. The role of the Operating people is to handle the times when the control systems can't cope with the upset that is happening.

The Stable Domains, from an Operations perspective, have Utilization as the measure of performance on the vertical axis and Action as the measure of people's role. In the Reactive Domain, the action is automatic, as a response to a stimulus, done through habit or by the instrumentation. The Reactive Domain from an Operations point of view requires failures to trigger action and therefore some loss of utilization. This domain is stable because the practice of dealing with failures creates the skill and competence to handle the next event.

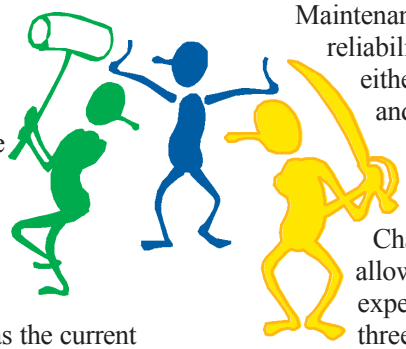
In the Planned Domain, people take action that is sensitive to the history of deviations from the targets as well as the current deviation. This control is accomplished by supervisory control. Here the operator takes action based on his experience of past patterns of deviations from targets. This is a problem for highly reliable facilities as there is very little experience to draw from to adjust targets based on history. The experience, where it does exist, is often in the habits of the more experienced operators and is typically not documented but is part of their muscle memory or mental recall from past events.

In the Precision Domain, people are conscious of the process being controlled and take action based on the expected outcomes of changes in certain input signals. This type of control requires very sophisticated calculations and is often done today by computers. In order to achieve this mode of Operation, sometimes the signals used to make these calculations can be in error, and it is difficult for the operators to diagnose the problem when the control system is not producing the right result. So again, reliability reduces the opportunity to learn from experience.

So how can this dilemma of Availability versus Utilization be reconciled?

A third element of experience is common to both Maintenance and Operations. That element is the "will" in the situation. A simple way to express this element is that a manufacturing organization exists because it has the will to produce a product that is needed by some portion of society. When the organization loses that will or has less will than the competition, it cannot exist for long. The role of leadership in our view is to get in tune with the "will" of the situation and to deal with the dilemma created by the conflicts between Availability and Utilization.

In our opinion this means that the conflict between Operations and Maintenance with regard to reliability is larger than either of the functions and has to be resolved as a leadership issue. A tool that we use in our Supervising the Change workshop, allows participants to experience each of the three domains in The Manufacturing Game®, and each is facilitated with a different management style. We are currently working on a new computer model of the Operations side of manufacturing and leadership. We hope to articulate more of our understanding of how to resolve this dilemma in future TMG News articles.



SCHEDULE

Throughout the year, The Manufacturing Game® holds workshops for the general public at various universities and/or professional organizations across the country.

TMG Public Workshops

SMRP 14th Annual Conference
October 25, 2006
Sheraton Birmingham
Birmingham, Alabama

To register or for more information please visit: **www.smrp.org**

Conferences of Interest

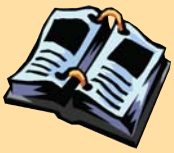
SMRP 14th Annual Conference
October 22–25, 2006
Sheraton Birmingham
Birmingham, Alabama

To register or for more information please visit: **www.smrp.org**

21st Annual International Maintenance Conference (IMC) "Manufacturing & Process Reliability"
December 5–8, 2006
Daytona Beach, FL

To register or for more information please visit:
www.MaintenanceConference.com
or call 888-575-1245

Mark Your Calendars!



Super Wrench...continued from page 1

John Foran (Operations Manager), Eric Stundtner (Maintenance Lead) and Mike Christ (Wiresaw Engineering) got involved with the problem and what the Action Team was doing to improve wire management processes in connection with the safety incident. Out of this mix of people, a new Action Team was born, in parallel with the ongoing effort to validate that the takeup spool was in tolerance.

It was discovered that residue and contamination from prior uses had not been cleaned from the threads of the split nut, which then made it difficult to tighten - they used the hammer to tighten the nut prior to using the wiresaw, and this in turn created further difficulty in removing the nut after the run was complete - a vicious circle. The more dirt, grit and slurry that built up, the harder it was to install and then remove, which provoked the hammering. To succeed, the Action Team needed to create a new discipline of cleaning the threads on the nut, using only undamaged spools, shafts and nuts and to get everyone to resist hammering on the nut in the future.

The Action Team wanted to take immediate action, and while no one was sure it would work, the idea to make a large wrench was hatched to see if this would help. Some on the team were skeptical of the idea and thought, that the operators would then make the hammering even more of a problem since the large wrench would provide even more tightening power, if they hammered on the wrench instead of just the nut. And what was to prevent the hammer from bouncing off the wrench and hitting someone on recoil?

Nevertheless, Eric Stundtner drew a hand sketch of the wrench they had been discussing, and recruited Jerrold Utz, a machinist at the plant to make the tool. The decision was made to "just do it" and see if the wrench could work without hammering.

Jerrold came in on his day off, and fabricated the wrench from a piece of aluminum bar stock that he could find. The lever arm on the wrench was determined by the size of the aluminum bar available. In this photo you can see the end result — the super wrench and the split nut inside the opening.

Jerrold Utz with the super wrench

Now the question: ***Would it work?***

Current Status: The consensus view at this point is that the wrench is not something to be used to remove the split nut and that more issues are created than solved by it. But as the learning unfolded, another set of good things happened. First of all, operators have been able to remove the split nut as intended, by loosening the Allen screws holding the nut together, and they are also cleaning the threads.

The success story here is not the wrench itself. The success is evolving away from a practice (hammering on precise equipment) that created safety risks, operational losses, and costs. In the process of trying the wrench, everyone contributed new thinking and insight that is paying off in improved results, and easier work for everyone.

The key is precise work. Start with a usable split nut, with clean threads, on a shaft that is not bent, against a takeup spool that is within tolerances, and then tighten the nut only to the correct torque—don't over tighten or hammer it on. Then, remove the nut by loosening the Allen screws, inspect the nut and shaft for damage, clean up both the nut and shaft, and do it all over again. If parts are out of tolerance, throw them away and use only "in tolerance" nuts and other parts.

Learning what is required and how to do work precisely is the big win. The wrench, as it turned out, was only a stop along the journey. Taking quick action provided the insights and learning needed to make the success. Congratulations to both teams for showing the way forward by action, not just talk.

Action Team Changes Direction

At an Operations Excellence Game™ workshop for BP North America Gas last November, an East Texas Action Team began work on a defect involving gas gathering system pressure. Team members Rory Richardson, Steve Halvorson, Ben Crochet and Oscar Esparza were determined to figure out a way to reduce back pressure on the liquid system, thereby increasing gas production.

They believed the defect would be easy to eliminate so they quickly outlined their initial plan:

1.) Design and execute a plan
2.) Meet to discuss the problem and after thorough investigations, define the scope
3.) Check the pump tanks design to evaluate environmental issues
4.) Batch treat for emulsion

The team was shocked when their investigations revealed the problem was not quite so simple. In fact, they had to completely change direction in resolving the defect.

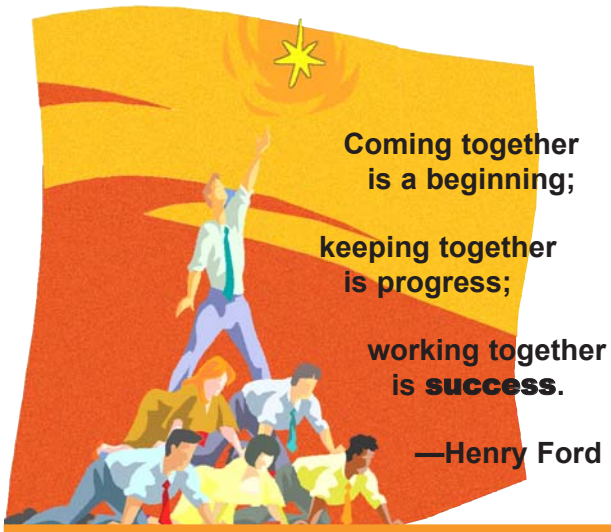
The investigation revealed that changing reservoir characteristics and the low lying lines were having problems with liquid accumulation, and they soon realized they were suffering greater losses than initially thought. And to add insult to injury, they were delayed by weather and engineering and having to change the direction of their plan half way through the project didn't help matters.

They put a staged project together to install larger field separation and

Action Team... continued on page 4

TMG News
The Manufacturing Game®
July 17, 2006

7702 FM 1960 East, Ste. 226
Humble, TX 77346
(281) 812-4148
(281) 812-4149 Fax
Web site: *http://www.ManufacturingGame.com*
email: *info@ManufacturingGame.com*



TMG News

Action Team... continued from page 3

redesigned tank inlets to reduce environmental exposure and minimize unplanned liquid slugging thus reducing producing well backpressure. The expectation was that this would drastically improve operations (reduce OPEX) and yield an increase in production, predicted to be approximately 500 MCFD.

Further review by team members also yielded the discovery of changing reservoir characteristics thus undersized field equipment. A project to up-size field separation and redesign tankage is underway. Due to the large scope of this defect, this project is being executed in stages due to long lead equipment time and competition with direct production adding projects taking higher priority. In addition, this defect has channeled engineering to investigate other separation locations within the same field where similar problems are inevitable. A third quarter total field separation upgrade project is being engineered as a direct result of this defect.

Most importantly, the team has realized that some defects are not so easily defined, and Action Team members must be willing to be flexible enough to change direction at any time in order to obtain the best results. These team members have created a temporary fix for the defect but are still working on a permanent solution, and they plan to keep working until that is accomplished. Most importantly, they've shared their finding with other locations that will inevitably face the same problem. They've showed a great deal of gumption and patience where others might have been disheartened or merely been satisfied with correcting the defect without working further to delve deeper into solving the problem on an ongoing basis.

This team continues their work and is looking forward to collecting and displaying their defect elimination hardhat stickers. Stay tuned for future updates on this tenacious Action Team!

Something to keep in mind...

In *Managing the Unexpected*, Karl E. Weick and Kathleen Sutcliffe argue that High Reliability Organizations exhibit "mindfulness". Basically, mindfulness indicates a combination of high alertness, flexibility, and adaptability. One of the characteristics of High Reliability Organizations is they are able to pick up very weak signals of future problems. This gives them time to act before the crisis hits.

Five habits of High Reliability Organizations:

- Don't be tricked by your success.
- Defer to your experts on the front line.
- Let the unexpected circumstances provide your solution.
- Embrace complexity.
- Anticipate—but also anticipate your limits.

Take a quiz to rate your company's mindfulness at:

www.fastcompany.com/magazine/58/chalktalk.html