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MRC NEWSLETTER

Maintenance & Reliability Center
The University of Tennessee
"where industry & academia meet"

Editor
Kim Kallstrom
kkallstr@utk.edu

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co-located with the

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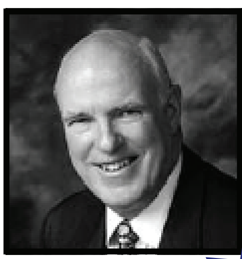

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Inside this issue:

Director's Corner


Tom Byerley

Can it really be 2008 already? What happened to 2007? Actually, a lot happened in 2007 – which is probably why it seemed to have whizzed by so quickly. The MRC continued on course as the premier academic institution serving the industrial maintenance and reliability community. And I completed my term as Chairman of the Society for Maintenance and Reliability Professionals (SMRP) – a role that was challenging and time-consuming, but also rewarding, and it provided great visibility for the MRC to a larger community.

2007 saw two great Members' meetings, one hosted by the folks at Arnold Engineering Development Center in Tullahoma and one held in Knoxville. Our thanks go to our AEDC hosts and to all the presenters at each of the meetings.

We experienced a significantly increased attendance at MARCON 2007. This was our first year to partner with Reliabilityweb.com and that proved to be very positive. Their involvement included a greatly expanded exhibition area and their marketing acumen and supplier contacts helped with the attendance increase.

Our undergraduate intern program continued to provide some great experiences for both students and companies. While the number of positions was down a bit, those students who were placed all had outstanding summers. Utilizing the college's Office of Professional Practice helped ease our administrative work, but we struggled with some of the placements and thus have asked Dr. Toby Boulet to return to his previous role of helping match interns and companies in 2008.

Our partnership with Monash University to deliver a Master's Degree program continued strong and we extended our agreement for five (5) additional years during 2007. We had 24 students in the program in 2007 and seven of them earned their MS during the year.

2007 was another excellent year for the MRC and we sail into 2008 at "full speed ahead". You can read about several of our plans on other pages in this newsletter. We encourage you to optimize your MRC member experience by maximizing your MRC involvement. Come be part of our success!

Tom

At the fall members' meeting we had...


Ron Moore

Professional Development


Networking & Fellowship

The MRC is going to Albuquerque!!

WHAT: MRC Members' Winter Meeting

WHEN: February 20 - 21, 2008

WHERE: Albuquerque, New Mexico

HOSTED BY: Sandia National Laboratory

Location:
Rio Grande Best Western Inn
1015 Rio Grande Boulevard NW
(505) 843.9500

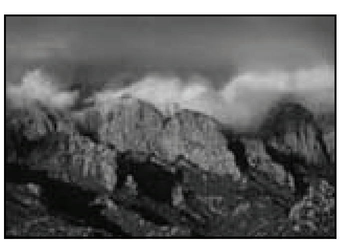
Ask for the UT MRC rate of $80/day

The hotel is located within walking distance of Old Town, the Plaza, and several museums and other attractions. You might consider spending some extra days and bringing others of your family to take advantage of the location.

Registration Includes:

- Several Best Practice Presentations
- Tour of Sandia National Lab facilities
- Dinner & networking at the National Atomic Museum

Call Robbyn at (865) 974-9627 and register *NOW* if you haven't already!



About the Museum

The National Atomic Museum is located in the heart of Old Town Albuquerque, along Museum Corridor. Within walking distance are three additional museums, including Albuquerque Museum, New Mexico Museum of Natural History and Science and Explora Children's Museum. The National Atomic Museum is located at 1905 Mountain Road NW, Albuquerque New Mexico 87104. The museum is located 2 blocks east of Rio Grande Boulevard and just north of Old Town, Albuquerque.

Managing the Iceberg through Planning & Scheduling

By: Bob Welnick, Reliability Manager, Michelin Tire Corp

Breakdown Prevention Model

Translating Total Productive Maintenance (TPM) foundations leads to several key principals. The first phase of the TPM process focuses on initial cleaning with the purpose of identifying defects, with the ultimate goal of restoring the equipment to a 'Like New' condition. An analogy would show equipment defects as an iceberg (Figure 1). Many of these defects are under that surface and have yet to cause a breakdown. Finding and correcting these potential breakdowns before an actual breakdown occurs is a primary goal. Finding and correcting potential defects is analogous to reducing the size of the iceberg underneath the water. As the size underneath the water is reduced the number of breakdowns (represented by the ice above the water) also decreases.

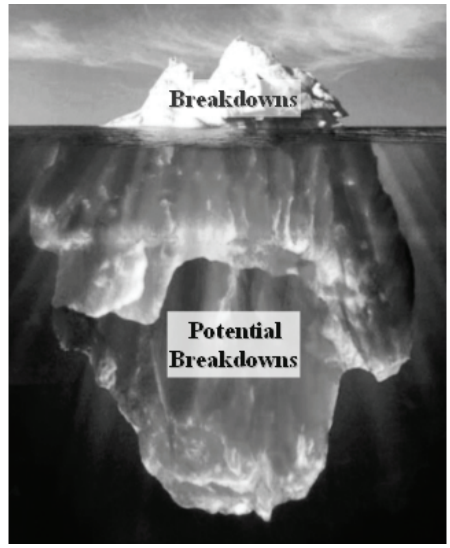


Figure 1: Iceberg Model of Breakdowns

How to Reduce the Submerged Iceberg?

To map out a plan to shrink the iceberg we have to understand what causes the iceberg to grow and what causes it to shrink.

Phenomena that cause the iceberg to grow:

Component deterioration: the faster the deterioration of components the faster the iceberg grows.

Improper operations: operations or adjustments causing component failure or deterioration.

Improper maintenance: maintenance practices that introduce premature failures.

Inadequate design: equipment not capable of the operational requirements. Overloading components causes premature failures.

Phenomena that cause the iceberg to shrink:

Restoring broken or faulty components: through a system to manage maintenance repair work.

Reducing or eliminating deterioration: Basic Conditions.

Developing expert operators: (TPM Autonomous Maintenance).

Good maintenance practices: methods for executing maintenance tasks & maintenance skill training.

Design reliability: preventing failures through proactive equipment design & installation.

This article will focus on *restoring broken or faulty components* through planning & scheduling.

Practical Example

Okay, let's consider a practical example. Assume that the machinery in a given manufacturing area is operated and maintained in a reactive environment. Maintenance primarily fixes what is broken. Some preventive maintenance is done based on experience, but components are primarily operated on a run-to-failure basis. A decision maker in the organization sees another company successfully implementing TPM and decides that this facility is going to adopt TPM. Plans are made, money is spent and changes are initiated.

However, with all this effort, little positive change is accomplished. Breakdowns do not decrease significantly. Why? In step one of the TPM implementation process for autonomous maintenance, operators initially clean the machine and record defects discovered. The defects are potential failures or part of the iceberg that is under the water. Operators fix what they can, but most of the defects require maintenance expertise to address. The defect list is given to the maintenance department. Maintenance adds these defects to their existing list of other defects and projects. Operators wait and wait. Maintenance cannot get to the operators' defect lists. They are too busy just keeping the equipment running. Lo and behold operators get frustrated when their defects don't get fixed. Momentum is lost and whatever inertia for change existed has been stopped cold in its tracks. Surprise, surprise! A good sound philosophy has failed.

So how can these handcuffs of mediocrity be unlocked? How can we break out of this perpetual cycle of failure and reactionism? First, we have to recognize that maintenance must be given the tools to be successful. To transition from a reactive mode to a planned mode something fundamentally has to change. In the process of this transformation the equipment still has to run and produce the lifeblood of the facility.

The key fundamental change of the maintenance department is a system of planning and scheduling. Notice the word, "system." A system requires organizational change. The organizational change for maintenance here enables them to improve their maintenance productivity and therefore empower them to reduce the size of the iceberg. Again, reducing the size of the iceberg reduces the number of breakdowns. Breakdowns interrupt the flow of products through the facility and result in larger work-in-process to overcome the unreliability.

So what does planning and scheduling actually do to improve maintenance productivity?

Figure 2 shows pictorially that the maintenance productivity gains come from reducing delays. Delays are anything that keeps the maintenance person away from being at the job site and doing the maintenance task required. Delays include such things as work travel, set-up and take down, work assignment, wrap-up, waiting for materials, waiting for tools, waiting for instructions, interference etc. Such delays will always exist, but the goal of planning & scheduling is to drive out unnecessary delays to maximize wrench time.

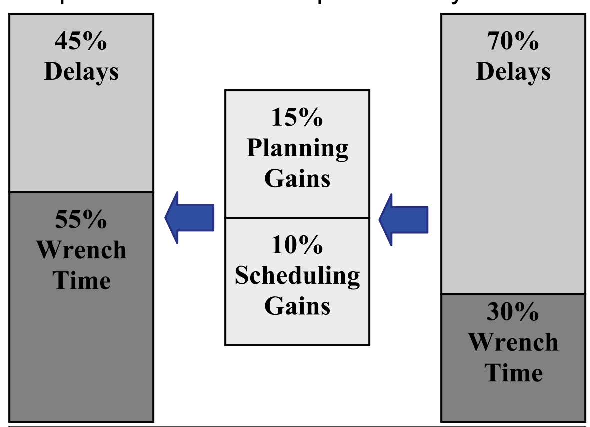


Figure 2: Planning & Scheduling Gains

Two distinct aspects need to be discussed to reduce delays of maintenance productivity improvement.

- First, a job needs to be planned. Planning a job means the job is prepared for execution. This means the scope of the job has been determined, parts have been procured and kitted, technical information is collected, estimates on the trades required and specialized tools determined and obtained. This process can give anywhere from a 10-20% reduction in the delays related to job execution (versus an unplanned job).
- Second, a job needs to be scheduled. Scheduling is distinct from planning. Scheduling is the matching of available trade resources to the planned job on equipment that is available to be worked on. A perfectly planned job without either the proper trade or machine availability is of little use. Gains from scheduling range from 5-15% reduction in delays.

A system of planning and scheduling must address both the, 'planning' and the 'scheduling' aspects to be totally successful.

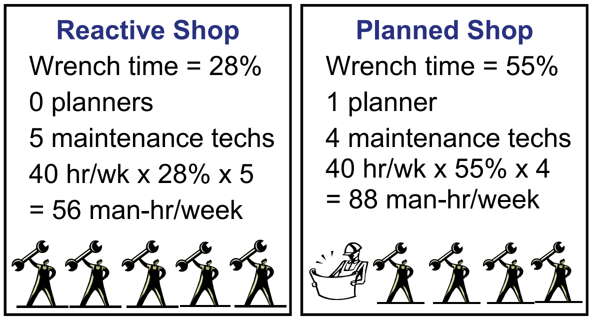


Figure 3: Reactive versus a Planned Shop

Figure 3 compares a reactive shop with a wrench time of 28% and a planned shop with a world class wrench time of 55%. A maintenance transformation would be to change one of the five positions to a planner. The transformed shop would have four maintenance people to execute work and one planner/scheduler. Since the wrench time improves, the shop effectively adds the equivalent of 3 more people to execute work. This net increase in maintenance productivity is a key tool that allows the iceberg below the water to be reduced.

To summarize, making an improvement strategy, such as TPM or another PM optimization system, effective, a corresponding increase in the amount of maintenance tasks is required. In other words, if you add work to the maintenance department, which all improvement strategies will, you must improve the maintenance productivity. If not, a recipe for failure is in place.

Example from Experience:

In a pilot production area a focus was placed on improving the amount of planned work completed in relationship to reactive work. The goal was set to achieve 45% planned work in the first year and then 15% more each of the next two years. A dedicated planner was established by changing the most experienced maintenance technician to a new role.
By focusing on improving the percent planned work, the maintenance shop in this area has steadily progressed, from 10% to 55% planned work in 18 months. What is interesting is the trend of down time for the equipment maintained by this maintenance shop has dropped, from 2.5% to 1.0%. This production area has never seen such dramatic, sustainable reductions of down time. Where did these gains come from? Let us step back and look at this more closely.

During this period of time the primary focus was on increasing the amount of planned work. The type of work that constituted planned work was primarily preventive maintenance tasks and planned repair tasks. No improvements were made on the preventive maintenance tasks (they already existed prior to starting the planning & scheduling focus). So where did the downtime improvements come from? The shop believed that as it increased the planned work, the reactive work would decrease, and this proved to be true.

We believe that the two primary causes for the decrease in downtime are:

1. Reducing the size of the iceberg (correcting the latent equipment defects before they caused a breakdown).
2. Improving the effectiveness of preventive maintenance by establishing a means where inspection or predictive maintenance findings were promptly corrected (also reducing the size of the iceberg).

Key aspects of Planning & Scheduling

1. **Planner & planner skill requirements needs to be matched.** A good planner skill set includes good organizational skills and a detail oriented mindset. Putting someone who may be knowledgeable, but not organized can be a recipe for frustration to both the new planner and the maintenance shop. It is better to have a person with organization skills and propensity for detail as a planner than high knowledge. Obviously, the best fit is to have both.
2. **Planner must quickly process new work to allow for scheduling.** The goal here is allow the iceberg potential failures to be addressed prior to causing a failure (shrink the iceberg). Planner's priorities need to be clearly communicated and monitored.

3. Establishment of KOI's to set goals & monitor progress is critical. As the saying goes, "You get what you inspect." It is important not to get carried away. Establish what the most important indicators are and then manage by them. Examples of good indicators:

- ***Percent of planned work:*** This is the overall leading key indicator that measures the maintenance shop improvement. This is a simple measure of planned work divided by planned and reactive work.
- ***Number of open jobs greater than 2 weeks from origination:*** Measure of how well the planner is doing moving jobs from an open status to a planned status.
- ***Number of scheduled jobs greater than 2 weeks past current date:*** Measure of how well the scheduler is managing work that is on the schedule.
- ***Number of follow-ups from PM's:*** Measure of PM effectiveness. PM's should be uncovering equipment defects. Low numbers here could mean too high of a PM frequency or PM's not being properly done.

If these indicators show continuous improvement, you will reduce unplanned maintenance downtime.

4. Organizational changes are required to execute planned work. Partnership between the maintenance department and production is required. The maintenance department will be required to take the lead and present a proposal of how this partnership can work. Maintenance must overcome past bad experiences that the production department has experienced and develop credibility.

5. Maintenance department cultural change is required. Putting in a CMMS system and sending people to planning & scheduling training will accomplish very little without management leadership to change how maintenance operates. Key to these organization changes are establishing clear expectations including:

- ***Planners are dedicated planners.*** They must be taken out of the reactive environment. This takes discipline, especially by management that has made the practice of living reactively.
- ***Schedulers must fill up the scheduling calendar.*** Initially start with a goal of 70% of all available time scheduled. As the percent of planned work increases move towards 100% of available time scheduled.
- ***Maintenance technicians previously dedicated to reactive work must start transitioning to accomplishing planned work.*** This is a cultural change that requires leadership and vision communication. Clear expectations have to be set, monitored and managed.
- ***Feedback to planners is critical to continuous improvement.*** It is better to have a system that continuously improves, than to have a perfectly planned job. Maintenance technicians executing work must have an easy method to route feedback to the planners and planners must use the feedback to continuously improve.

About the Author: Bob Welnick has 20 years experience in manufacturing environments including; engineering, machinery reliability, machinery maintenance and utilities maintenance management. Bob also has five years experience with US Navy submarine operations, maintenance and shipyard activities. He holds the following certifications and licenses: CMRP and PE.

MRC Intern Program -
Act Now Before You Miss Out !!!

One of the really valuable benefits that MRC membership offers is access to our engineering students through the MRC Intern Program. Each year we seek out engineering students who are interested in learning about or pursuing maintenance and reliability opportunities and careers. We then work with our member companies to offer these students summer positions. This year we are again working hard to maximize the number of participating engineering students and companies.

The basic program will remain essentially the same:

1) Total Internship of 13 weeks – 1 week training at UT, 12 weeks on job site
2) UT will assist in matching up interns and companies
3) Salary guidelines are based on intern experience
   $2,470/month for first-time MRC interns
   $2,840/month for second- time MRC interns
   $3,100/month for third-time MRC interns
4) Companies should apply for interns with position descriptions and preferences noted – the sooner the better

Companies and students who have participated in our intern program have generally had excellent experiences and typically want to repeat in following years. We hope that you will join in this program in 2008 and help us fill the pipeline for future maintenance and reliability professionals. But you better hurry as we are experiencing earlier-than-normal demand for the interns.

See the facing page for a 2008 application. For more details and additional applications visit our website at www.engr.utk.edu or call the MRC office at (865) 974-9625.

Excerpts from a note from a very happy intern employer:

"I was really impressed with the quality of our student intern…….. Wow! His work ethic, personality, and approach were refreshing and restored confidence in the ability of the younger generation to contribute and be part of a larger organization. …… was eager to learn, self-sufficient, and a real contributor. He integrated well into the …… culture and became fast friends with many of our staff members. He was a real team player on a RCM event examining a complex fire alarm system and he provided an excellent analysis of Ultrasonic Testing tools and technology available in today's market that became the decision basis of what tools we purchased to implement an ultrasonic program here. …. is bright, articulate, and easy to work with, we would more than welcome his return …..in the future. ……… really speaks well for the MRC program at the University of Tennessee and I really appreciate the opportunity to work with such an outstanding individual."

Maintenance and Reliability Center

Summer 2008 Intern Request Form

(Please complete a separate form for each intern requested)

MRC Company: ____

Address: ____

City: ________________________ State: __________ Zip: _________

Company Representative: ____________________________________

Phone: ______________ Fax: ____________ Email: ______________

Engineering Discipline Preference: 1st ___________________________

2nd ___________________ 3rd ___________________________

Citizenship Required? __________ Clearance Required? ____________

Special Skills Required: ______________________________________

____

Location of Assignment: ______________________________________

Intern Supervisor: Name ______________________________________

Telephone ________________E-Mail ______________

Description of the work for which the intern is requested:

____

____

____

____

Other information (continue on back): ____________________________

____

For additional information contact the MRC at (865) 974-9625 or Tom Byerley at (865) 974-4749

Traditional Maintenance Management Techniques are Obsolete, Expert Says

By: James McCanney

*****Editor's Note: This is a reprint of a "Staff Report" article that appeared in the May 1989 issue of IMPO Magazine. The article features MRC Member Ramesh Gulati, from the Arnold Engineering and Development Center. 18 years later, the information contained in the article is still relevant to the Maintenance and Reliability field.***

Forget traditional maintenance management methods. A leading maintenance consultant says they no longer apply.

Changes must be made in traditional maintenance in order to increase productivity and to reduce costs, says Ramesh C. Gulati, manager of industrial engineering for Sverdrup Technology, Inc., Arnold Air Force Base, TN.

"The objective of maintenance is to keep equipment and other assets in a condition that will best facilitate organizational goals," Gulati told attendees of the fifth annual International Maintenance Conference sponsored by the Institute of Industrial Engineers and held in Atlanta, GA.

"Maintenance activities should be evaluated in light of the total operating system and optimized to reduce the total cost," Gulati continues. "Therefore, maintenance goals should be: 1) improve equipment/facility availability, and 2) optimize maintenance activities to reduce total costs."

Equipment availability is a function of reliability and maintainability, Gulati says. Reliability is usually expressed in Mean Time Between Failures (MTBF). Maintainability is often considered Mean Time to Repair (MTTR). Thus: Availability = MTBF/(MTBF + MTTR).

To improve availability, uptime (or MTBF) has to be improved. In other words, the number of failures must be decreased to cause MTBF to go up. And downtime (or MTTR) has to be slashed.

An equipment-history database ought to be created to establish MTBF and MTTR, according to Gulati. The database should contain:

- Failure – breakdown events.
- Preventive Maintenance (PM) performed.
- Planned/scheduled repairs.
- Operating/usage hours.
- Repair time and costs.

It could also include:

- Equipment nameplate and specifications.
- Spare Parts/component data.
- Drawings data.

"Information from the equipment data base can be used to perform failure analyses to identify problem areas," Gulati says. "This allows cost-effective corrective actions to be taken to reduce failure rates and repair time, thereby increasing plant/facility availability."

For example, failure data on one facility's 45 hydraulic systems identified three major failure modes. The information exposed an upward trend in problems due to leaks, contamination, and equipment out of adjustments.

Further investigation showed that the difficulties were caused by equipment vibration and poor workmanship by new employees. System redesign corrected the vibration situation and a training program alleviated the workmanship difficulties. A well-organized database allowed the plant engineer to identify and correct the problems.

Just as a database is essential to improving equipment availability, it is also necessary in determining the optimum level of maintenance, which significantly affects total costs.

“As maintenance activities go up, maintenance costs go up but operating costs go down,” says Gulati. “You have to look for that optimum level of activity.”

There are two types of maintenance activities: planned and unplanned. Within planned activities are preventive and predictive maintenance. Gulati suggests it’s possible to have either too little or too much maintenance. Too little will result in excessive repairs and failures. Too much will mean few failures or repairs but high costs.

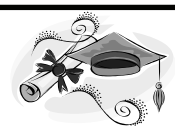
To develop an optimum level of maintenance, repair activities should be collected and tracked by break down repair costs, PM inspection/repair costs, and scheduled repair cost. Gulati says the cost of preventive, predictive or failure maintenance must be evaluated for every application in order to optimize total costs.

“A well-organized equipment database can provide information to develop a cost model (see chart) using the concept of expected value,” says Gulati. “This model helps in the decision process for establishing cost-effective maintenance policies.”

MODEL TO DETERMINE OPTIMUM CREW SIZE

	Crew Size:			
	1	**2**	**3**	**4**
Breakdown rate	4	4	4	4
Service rate	6	12	18	24
Number of machines waiting for service	2	½	2/7	1/5
Crew cost/hour	$20	$40	$60	$80
Downtime cost/hour	$400	$100	$57.10	$40
Total cost/hour	$420	$140	$117.10	$120

In this model, an analyst is attempting to establish the optimum size for a maintenance crew to meet service needs in a 40-machine plant area. The breakdown rates assume there will be four required service calls per hour in the area. The service rate is based on the belief that one worker can fix six machines in one hour. It is also assumed that it costs $200 /hr for each machine down. Based on these numbers, the analyst ascertains that the optimum crew size for the plant area is three.



Is this the year you go for a Master’s Degree?

UT offers two different Masters’ Degree programs – both available to you at your location through distance delivery techniques. Why not stop putting off that plan to earn your MS and take advantage of one of these two programs?

The UT-Monash program is now in its 9th year at UT and continues with an impressive number of students. Starting in 2008, it has returned to a semester-based calendar. Semester 1 runs from February through June with an application deadline of January 15. Semester 2 runs from July through October with a June 15 application deadline. Program information and course descriptions are available at www.engr.utk.edu/mrc under the Professional Development bullet.

The UT COE program is in the first year and still building momentum. It runs on the typical U.S. semester basis from September through December and January through May. Details of this program can be found at www.engr.utk.edu/rme.

Both of these programs offer a unique way for you to separate yourself from the pack, to increase your value and worth. Distance delivery makes it easy and convenient for you to participate. Current students and graduates attest to the value. Why wait – apply now!

Maintenance & Reliability Center
The University of Tennessee
"*where industry & academia meet*"

Maintenance & Reliability Center
University of Tennessee
506 East Stadium Hall
Knoxville, TN 37996-0750

Phone: 865-974-9625
Fax: 865-974-4995

Email: mrc@utk.edu
tbyerley@utk.edu
rcollin8@utk.edu
kkallstr@utk.edu

We're on the Web!
www.engr.utk.edu/mrc

MRC 2008 Calendar of Events

January 15	UT-Monash Semester 1 Application Deadline
Jan 23-24	SMRP Executive Meeting, Charlotte, NC
Jan 28-31	RAMS Conference, Las Vegas, NV
Feb 20-21	MRC Winter Meeting, Albuquerque, NM
Mar 18-20	RCM Conference, Las Vegas, NV
Apr 14-17	MARTS, Rosemont, IL
Apr 16-17	SMRP Executive Meeting, Chicago, IL
May 6-8	MARCON & Plant Engineering and Maintenance Show, Knoxville, TN

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