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# PROCEDURE BASED MAINTENANCE

WHY YOU NEED REPEATABLE, EFFECTIVE PROCEDURES  
IN YOUR FACILITY

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# WHY DO YOU NEED EFFECTIVE, REPEATABLE PROCEDURES?

“My maintenance staff is highly trained and do not like using procedures.”

If the statement above is valid, and the cost of asset failure is not important to our operation, then your staff must have an unlimited and infallible memory – congratulations!

Did you know that the most complex equipment ever built was a nuclear submarine and that the first nuclear submarines experienced failures due to lack of effective procedures, thus ending in catastrophic failure?

If safety is number one in your organization, then repeatable, effective work procedures should be as well.

The Safety Manager cannot make the facility safe:

- Support facility with tools, training, facilitation, measures, etc.
- Safety is everyone’s responsibility.

The Reliability Manager cannot make the facility reliable:

- Support facility with tools, training, facilitation, measures, etc.
- Reliability is everyone’s responsibility..

An EMP can be created for a specific piece of equipment, as is commonly done when performing an RCM analysis, or for a general equipment type, such as centrifugal pumps or AC motors.

When creating an EMP, it is important to first decide how the EMP will be used and if the strategy will be applicable to other areas or equipment within the overall facility or enterprise.

To ensure that you have a safe work environment, you must have a reliable one and repeatable, effective procedures are a requirement. Without a repeatable procedure, you have chaos.

# AWARENESS IS THE FIRST STEP TOWARD CHANGE

“We have learned to live in a world of mistakes and defective products as if they were necessary to life.” – Dr. W. Edward Deming

There are a few things to look for with your maintenance staff. Remember, errors or areas of concern are not their fault at this time; however, it is time to change.

1. Are torque wrenches being used by mechanics and electricians? If they are not, you are having component level failures that you should not be experiencing.
2. Are specifications for bearing lubrication known and being followed?
3. Does anyone know the hydraulic fluid micron level required for critical hydraulic systems?
4. Are PMs executed with PM variation? For example, a 30-day PM may be accomplished on the 3<sup>rd</sup> of the month this month and on the 20<sup>th</sup> of the month next month, resulting in equipment problems. PM is a “controlled experience” and, as such, requires repeatable, effective, and on-time procedures. (See Figure 3.)
5. Is PM being performed on equipment that continues to experience total and partial functional failures?
6. Is the use of a torque wrench for hydraulic fittings seen as not important, yet leaking fittings are always a problem? Remember, oil out means contamination in.
7. Are maintenance staff and contractors welding on equipment without using known Best Practices?
8. Does everyone truly understand their roles and responsibilities when it comes to procedure development and execution?

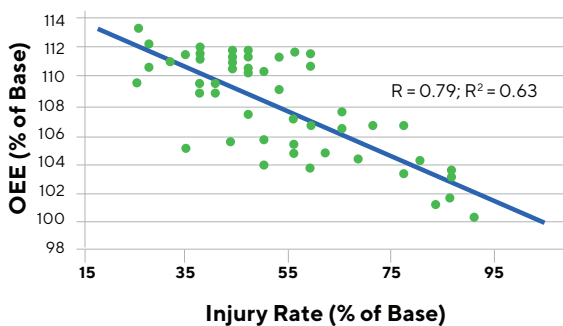


Figure 1: Injury Rates



Figure 2: Bearing Failure

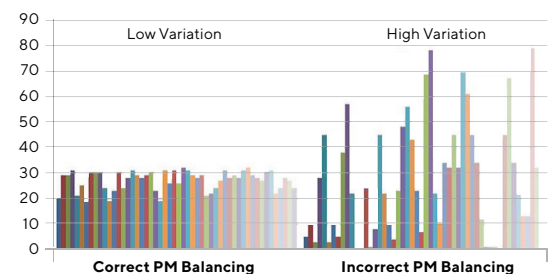


Figure 3: Balancing Your PM Execution for the Year (Sample)

We may not know why this bearing failed, but looking at Figure 2, it is easy to surmise that the correct lubricant, quantity, and re-lubrication interval were likely not clearly specified in the maintenance instructions related to the equipment.

# PROCEDURE BASED MAINTENANCE - CAN YOU LIVE WITHOUT IT?

Yes, of course one could live without procedure based maintenance; however, there can be consequences with any decision one makes.

The final expected result from any procedure based maintenance organization is that the human factors for variation (human error) in the maintenance process are mitigated or eliminated. This results in higher asset availability and reliability. Unfortunately, few companies can achieve this status.

In the field of maintenance, the traditional approach has been to rely on the intuitive knowledge and skill of the craftspeople who conduct it. There is a great deal of pride of workmanship and, in too many organizations, a great deal of psychic income in addition to significant overtime pay for successful emergency repairs to return equipment to operation after unplanned shutdowns.

There is a mystique that accompanies all of this that many skilled craftspeople would like management to believe firmly: there are too many variables in maintenance, which makes compliance with written procedures impossible and impractical, and the "way we have always done it" is the best and only way to conduct maintenance.

This idea spills over into preventive maintenance, as well. Examples:

- Check the pump
- Check seal for leaks
- Check bearings for noise
- Lubricate the bearing until grease comes out

A typical craftsman believes that his or her own intuitive knowledge is preferable to a written procedure and a thoroughly defined checklist. Aside from these problems, most organizations have allocated no resources to creation and on-going support of procedures and checklists. Accordingly, these organizations are focusing on the wrong way of conducting maintenance in order to obtain optimized asset reliability at optimal cost.

## WHAT ARE THEY THINKING?

"Maybe a craftsman has an unlimited or infallible memory..."

Is it possible? Yes, for a robot or computer.

Is it probable? No.

To help make roles and responsibilities clear during the procedure development process, use a RACI Chart like the one shown in Figure 4 to identify the specific tasks and individual responsibilities.

TASKS DECISIONS/ FUNCTIONS	Maintenance Supervisor	Maintenance Planner	Maintenance Technician	Maintenance Manager	Reliability Engineer	Maintenance Support Administrator	Plant Engineering Manager
Define the Process	I	C	I	A	R	R	C
Verify Equipment Critically	C	I	I	A	R	R	I
Measure MTBF/ Emergency Unplanned Work	I	I	I	A	R	R	I
Develop Procedures	R	C	C	A	R	R	I
Execute Procedures	A	C	R	I	I	I	I
Measure Effectiveness of Procedures	C	I	I	A	R	R	I
Management of Change	V	I	C	I	I	R	I

**R** Responsible: The Deer

**A** Accountable: The "buck stops here (only one person can be accountable)

**C** Consulted: Two-way communication

**I** Informed: One-way communication

Figure 4: Sample RACI Chart for Work Procedures

Think about how many times a maintenance person must return to the maintenance shop because he did not have the right tool, part, information, etc.

This method of thinking and experimenting results in at least a lost opportunity for increased profits from existing assets. If a company is not aware of this loss, then is it truly a loss?

Management is gambling with profits and losing big time with the approach that emphasizes pride of workmanship over an approach that has been proven to work.

# ENSURING AND SUSTAINING RELIABILITY

Lost in all of this is the concept of ensuring and sustaining reliability as both corrective and preventive maintenance are performed.

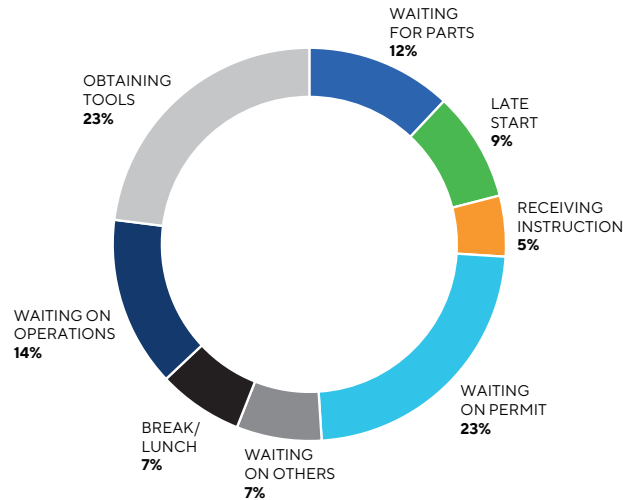


Figure 5: Sample Wrench Time Losses

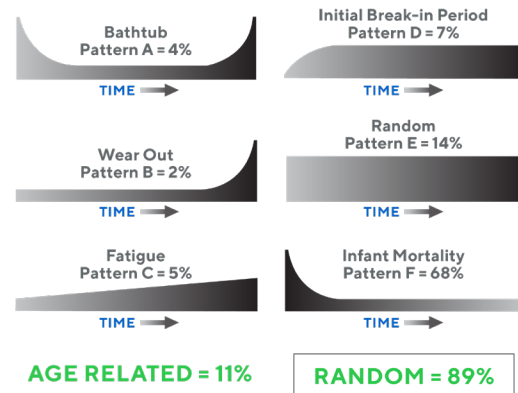


Figure 6: Equipment Failure Patterns

Ideas about how things fail that we used to rely on as a basis for preventive maintenance have been shown in failure profile studies over the past 40 years to apply to only a minor percentage of failures. In gambling terms, this means that odds are very long against a “win”. From this it can be shown that time directed maintenance, in general, should also apply to only a minor portion of the failure modes that an organization must correct or mitigate. (See Figure 6.)

Furthermore, it can be shown that intrusive, time directed maintenance can be detrimental to reliability because humans are involved and they produce “infant failures”.

Non-intrusive maintenance and monitoring tasks should be sought, instead. Indeed, because of the known distribution of failure profiles, the only logical approach for mitigating failures in the majority of equipment is through the use of non-intrusive tasks supported by the use of procedures to ensure consistent results.

As modern predictive maintenance tools and analysis methods have come into use, most of which are non-intrusive, the requirement for procedure based maintenance becomes even more important.

Analysis of data from modern tools such as vibration monitoring, lubricant and wear particle techniques, infrared observations, motor electrical condition monitoring, and almost all other technologies depends on knowledge of the operating state of the equipment for accuracy.



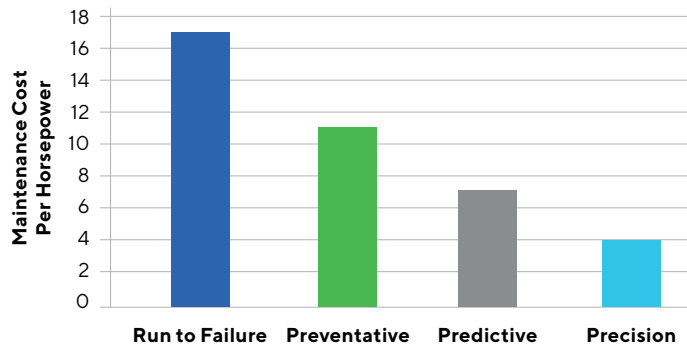


Figure 7: Cost Comparison of Maintenance Programs

Operating conditions and surrounding environmental parameters must be carefully established and recorded for thorough analysis to be performed. This can only be established by adherence to carefully written, detailed procedures and checklists. Such procedures may be embedded into equipment designed for data collection. However, procedures for collecting data must be carefully prepared and followed in order to ensure that there is complete agreement between embedded and non-embedded details.





## MOVING FORWARD

The steps to success can vary depending on your organization's resistance to change; however, here are a few suggestions for moving forward that may be of value to you.

### STEP 1: AWARENESS

Making people aware that they have a problem is the first step in any successful endeavor. Begin identifying failures due to the lack of an effective, repeatable procedure. Make sure no one is blamed for any failures. They have always occurred, so you want your staff to be seen as part of the solution and not part of the problem.

### STEP 2: TRAINING

Train a few of your key staff in procedure based maintenance to the point where they can write repeatable, effective procedures for any type of procedure.

### STEP 3: IMPLEMENTATION

Implement the first procedures and measure the results.

### STEP 4: CONTINUOUS IMPROVEMENT

Once the data is showing positive results train others and post the results. Ask for input from your team as to the best method to implement Procedure Based Maintenance throughout the organizations.

### STEP 5: MONITORING

It is important to monitor the results following implementation and continuous improvement to verify that the changes continue to be followed and that you are seeing positive results.

## LAST THOUGHTS

Thomas, former Reliability Engineering Manager for Dofasco Steel, used to make this statement:

"A proactive reliability process is a supply chain. If a step in the process is skipped, or performed at a substandard level, the process creates defects known as failures. The output of a healthy reliability process is optimal asset reliability at optimal cost."

**Is variation our enemy? Yes. So let's do something about it today!**

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