10 Thing to Know about Maintenance Best Practices

By Ricky Smith CMRP

Knowledge of “Known Best Practices” is a Requirement for Success of any “Maintenance Organization”

by Ricky Smith CMRP, CMRT, CRL

- BS Industrial Education, University of Georgia
- Over 35 Years as Maintenance Professional as a Practitioner and Consultant working with companies all over the world

Where did Maintenance Best Practices Originate?

Established by John Day, PE in 1975

From a basic point of view there are two maintenance approaches.

One approach is REACTIVE and the other is PROACTIVE. In practice there are many combinations of the basic approaches.

The REACTIVE system responds to a work request or identified need, usually production identified, and depends on rapid response measures if effective.

The goals of this approach are to reduce response time to a minimum (the CMMS helps) and to reduce equipment down time to an acceptable level. It may well incorporate what is termed as a preventive maintenance program and may use proactive technologies.

The PROACTIVE approach responds primarily to equipment assessment and predictive procedures.

The overwhelming majority of corrective, preventative, and modification work is generated internally in the maintenance function as a result of inspections and predictive procedures.

The goals of this method are continuous equipment performance to established specifications, maintenance of productive capacity, and continuous improvement. Alumax of SC practiced the proactive method.

Maintenance Best Practices

Alumax Mt Holly (Alcoa Mt Holly)
World Class Maintenance Certification Report

"Continuous / Successful Improvement Fundamentals"

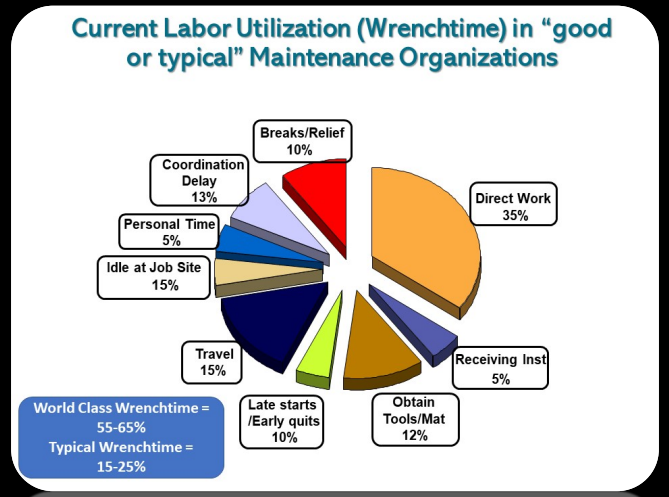
Category	Alumax	WCM
Maintenance Spending / Replacement Asset Value	3.4	2.0-2.5
Budget Compliance	-0.5%	+/- 5.0%
Overtime / Straight Time	1.0	6-8%
Number of Crafts	4	4 or less
Planners per Tradesperson	1:20	1:20
Absenteeism	1.6%	1-2%
Backlog in Crew Weeks (Per Tradesperson)	4.4	2-3 weeks
Schedule Compliance	95%	90 -100%
Percent of Urgent (Interruption) Work	10.5%	<10%
Percent of PM / PdM to all Work Orders	32%	> 30%
PM Accomplishment	96%	95- 100%
Inventory Accuracy	96%	95- 100%
Inventory Turns	3.31	2-4
Maintenance Training $'s as % Total Payroll $'s	4.2%i	> 6%

Maintenance Best Practices Attributes

Maintenance Rework is low

This metric is used to identify and measure work that is the result of premature failures caused by errors in maintenance or operation (e.g. start-up) of the equipment or material quality issues. Measuring rework and its root causes enables plant management to develop and implement effective strategies designed to minimize or eliminate these errors. Typical strategies include: maintenance training, operations training, defective parts elimination, maintenance work procedures development or revision, operating procedures development or revision and improved purchasing and/or warehouse practices.

Wrench-Time is high



#1 – Maintenance Requires Discipline…

1. … in Execution of all work to Specifications
2. … in Planning and Scheduling to ensure of optimal wrench-time
3. … through use of Repeatable procedures are used to mitigate “Human Induced Failure”
4. … by executing Preventive Maintenance as a “Controlled Experience

Maintenance Technician KPI Dashboard

PM /PdM Compliance	PM/PdM Yield	Schedule Compliance	Rework	Stockouts	Emergency Labor Hours
100%	34%	90%	14%	22%	14%

PM & PdM Compliance = PM & PdM work orders completed by due date ÷ PM & PdM work orders due

PM / PdM Yield = Corrective Work Identified from Preventive and Predictive Maintenance Work Orders (hours) ÷ PM & PdM (hours)

Schedule Compliance (%) = [Scheduled Work Performed (hrs) ÷ Total Time Available to Schedule (hrs)] × 100

Rework (%) = [Corrective Work Identified as Rework (hours) ÷ Total Maintenance Labor Hours] × 100

Stock Outs (%) = (Number of Inventory Requests with Stock Out ÷ Total Number of Inventory Requests) × 100

Emergency Labor Hours (%) = (Total number of EM Labor Hours ÷ Total number of Labor Hours Available

#2 – Maintenance Requires a Scorecard

- All personnel need to know how effective their team is at meeting targets and goals (they need to know the score in the area they impact)
- Scorecards in Maintenance must be able to:
  - Measure efficiency and effectiveness
  - Allow everyone to know their score

Maintenance Scorecard			
	Best practice	**10/12/2020**	**YTD**
Maintenance Schedule Performance	>70%	62%	67%
Maintenance Break In Work	<15%	38%	33%
PM/PDM Work Scheduled	> 30%	18%	35%
PM/PDM Compliance	>80%	36%	67%
Notification Entered from PM/PdM find	1 for every 6 inspections	2	3
Equipment Not Available	Weekly	0	1.45
P1 Notifications	Weekly	12	11.43
Core Shift Mechanic	Weekly	4	3.95
Polymer Shift Mechanic	Weekly	9	6.22
No Information P1's (Still open)	Weekly	0	1.55
		Shift & Core worked on 1 P1 together	

#3 – Best Practice Knowledge and Skills

All personnel should be trained in “Known Best Practices” which are aligned and integrated

- Maintenance Best Practices
- Maintenance Technician Best Practices
- Maintenance Planning and Scheduling Best Practices
- Maintenance Storeroom Best Practices
- Preventive Maintenance Best Practices
- Root Cause Analysis Techniques and Triggers
- Repeatable Procedures

WO # 12033	Asset # 12332 – Line 1
Job Description:	
Lubricate Bearings	

Frequency:	Monthly
Estimated Craft Hours:	1 x 1.0
Estimated Production Downtime:	0

Originator:	Bill Hill	Origination Date:	01/12/2020
Owner:	Maintenance Dept	Version #:	1
Previous Version(s) Modifications:			
Approval:	RAS	Version #:	1.0

Cautions:	Failure to follow PM Requirements could result in equipment failure
Personal Protective Equipment Required:	Gloves, hearing protection

Part # (Stores ID)	Part Description	Quantity	Quantity Description
C-1395	Synthetic Lube	1	Each

Consumables Needed:
Lint Free Towels

Special Tools Required:
Single Pump Grease Gun - Type 237 (Synthetic Grease Gun)

Mobile/Special Equipment:
None

Required Departmental Coordination:
Production Lead will be notified before execution of Lubrication

ID	Description	Craft Type	# of Crafts	Craft Hours	Initial Steps
1	Ask Operator if any issues with asset	M	1	.3	KL
2	Inspect asset for any leaks or abnormalities	M	1	.3	KL
3	Clean grease fitting with lint free rag	M	1	.1	KL
4	Insert grease into 4 “Zerk fittings” (2 Pumps per fitting)	M	1	.1	KL
5	Notify Production work is complete	M	1	.1	KL
6	Complete Work Order	M	1	.1	KL
	Total Hours			1	KL

Condition (As Found): (Required)

Leaks coming from #1 Gearbox

Condition (As Left): (Required)

Clean up oil, notified production leader to keep area clean of oil

Comment(s): (Optional)

None

Craft's Feedback on Procedures: (Optional)

All Good

Craft's Signature(s): (Required)

Jim Jimbo

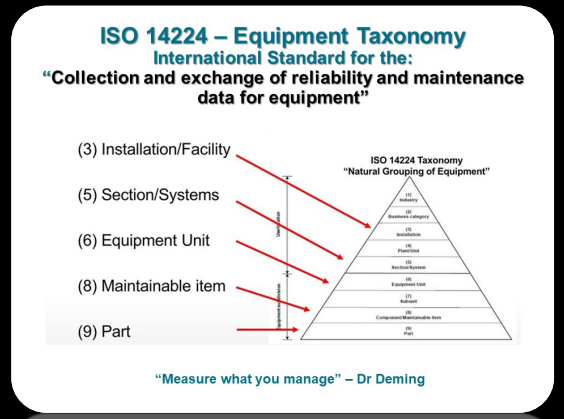
Date:

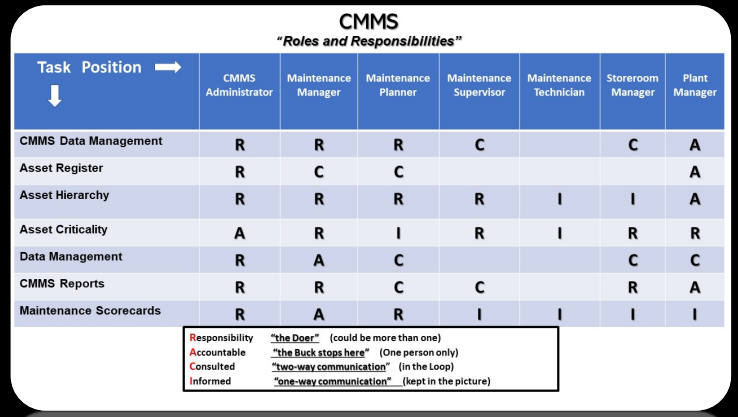
10/11/2019

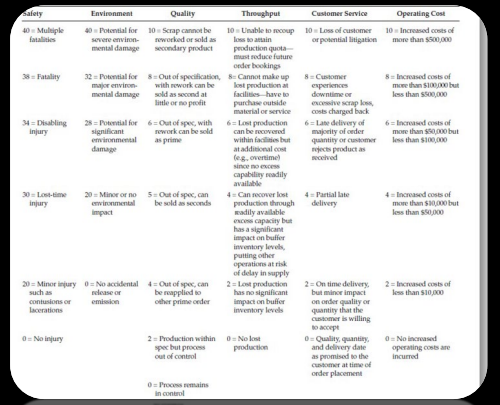
“Repeatable Procedure Example”

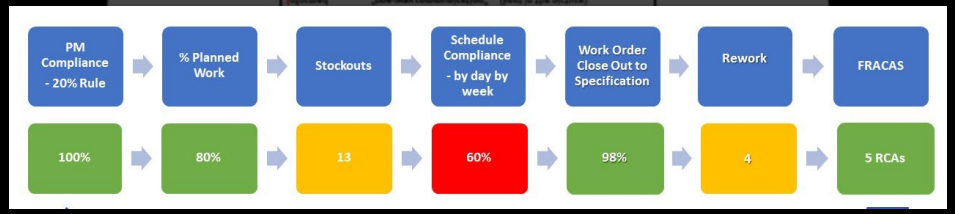
#4 – CMMS Must be Fully Functional and Utilized

1. CMMS setup according to ISO 14224
2. CMMS Users Guide is followed by everyone
3. RACI Chart created to ensure everyone knows their role in CMMS Utilization
4. Leading and Lagging KPIs posted for all to see and difficult to manipulate
5. Asset Criticality and Defect Severity is used to Plan and Schedule Maintenance Work
6. ALL Maintenance Work is charged to a Work Order which is charged to an asset



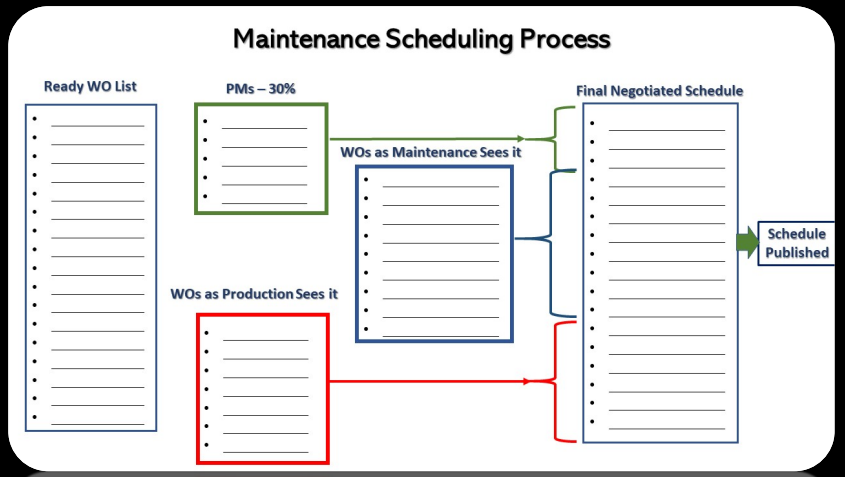


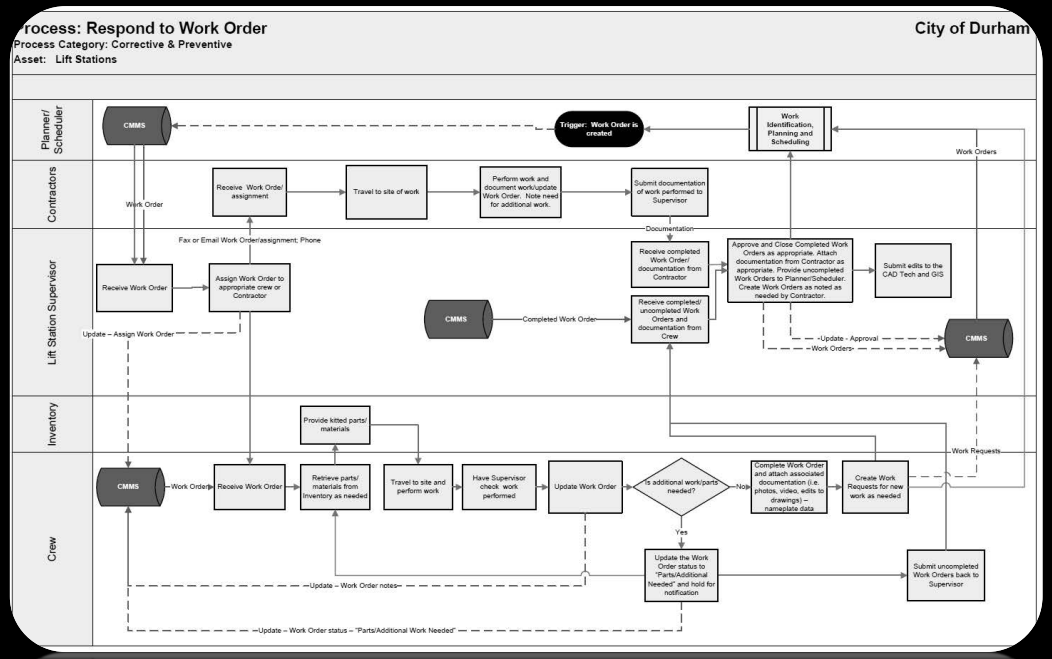


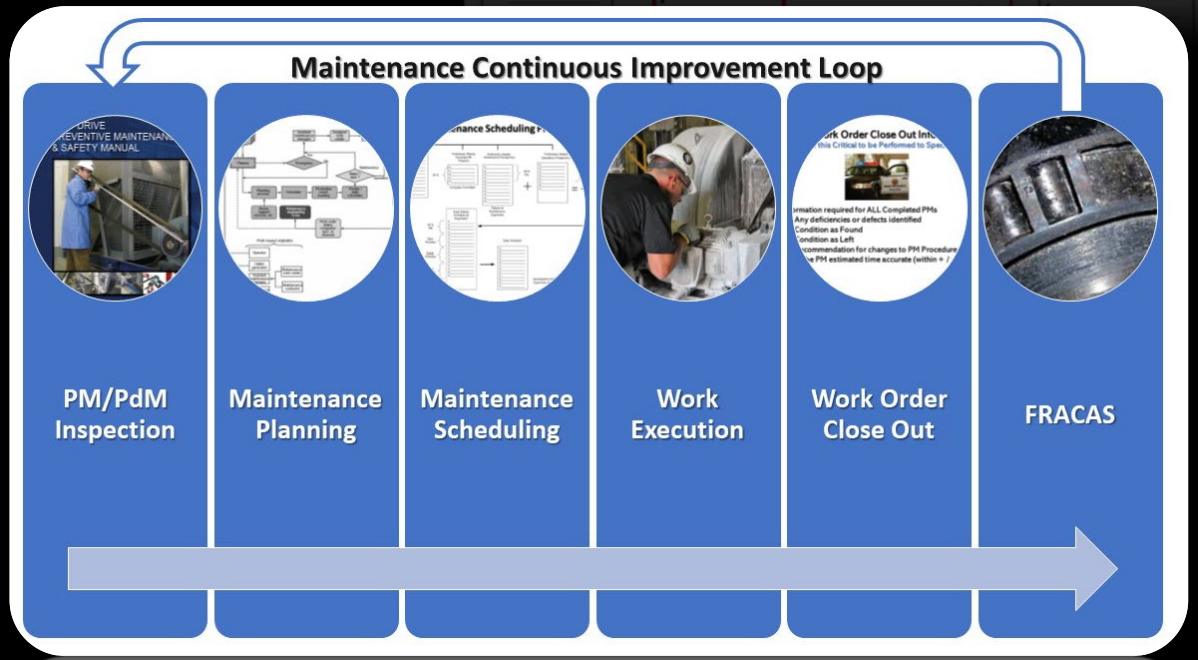


#5 – Maintenance Process Maps are Followed

- High Level Process
- Work Identification
- Maintenance Planning
- Maintenance Scheduling
- Work Order Close Out
- Stores Parts Process
- Failure Reporting, Analysis, and Corrective Action System



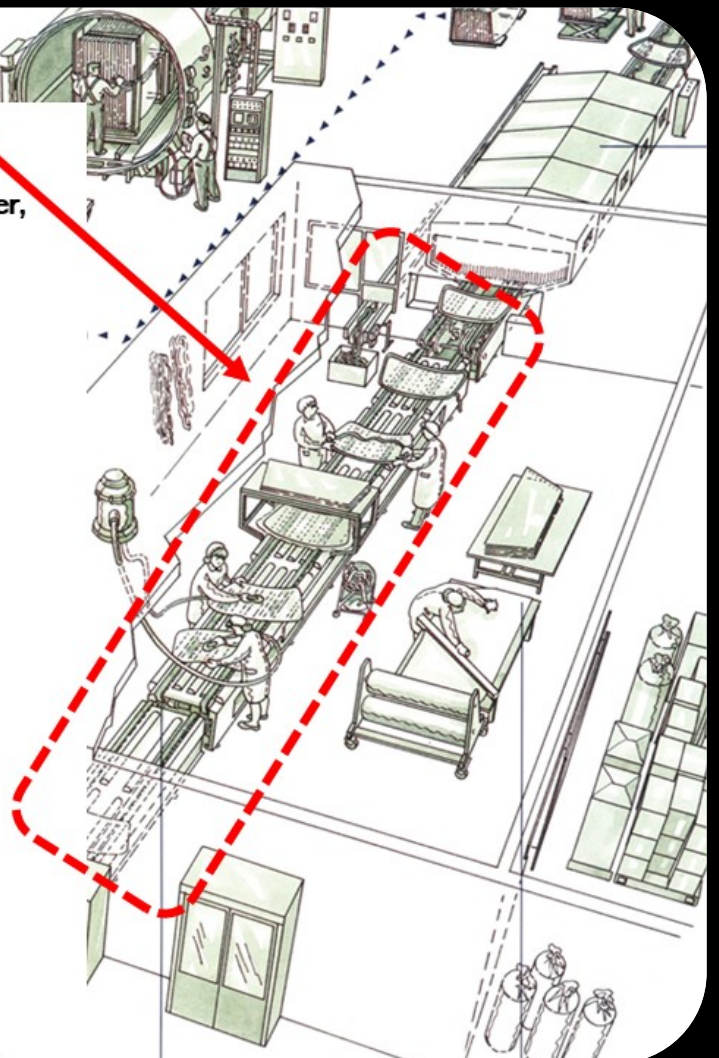




#6 – Conducting a PM Optimization

PM Optimization Process

1. Identify which asset or functional area the PM Optimization will be executed
2. Identify a cross functional team (Operator, Maintenance Tech, Reliability Engineer, Maintenance Planner)
3. Establish expectations from everyone engaged in this process
4. Define end goal of this process
5. Define how you will measure if the PM Optimization Process is effective or not
6. Present copies of PMs to all parties
7. Review equipment history for the past 30, 60, and 180 days
   - # of breakdowns
   - Causes of critical breakdowns based on a formal RCA
   - PM Labor Hours vs EM/Urgent Labor Hours
8. Review Current PMs and PdMs to identify:
   - PM procedure may need to be rewritten
   - Training which may be required
   - PM Frequency may be inaccurate and may need to be adjusted
   - If the equipment is in a "Maintainable Condition"
9. Rewrite PMs or write new PMs
10. Monitor and measure to ensure New PMs or Modified PMs are Effective



Results from PM Optimization

PM Evaluation / Optimization Results

PM Eval Recommendation	# of Tasks	% of Total Tasks	Labor Hrs. Represented
No Value – Delete Task	1,740	15.2%	1,832
Reassign to Lube Route	1,167	10.0%	3,980
Reassign to Operator Care	1,889	16.1%	4,987
Replace with PdM	1,983	17.3%	4,876
Re-Write Task	2,387	20.8%	11,043
Task is Good as Found	2,289	20%	3,923
Total PM Tasks	11,455	100%	30,641

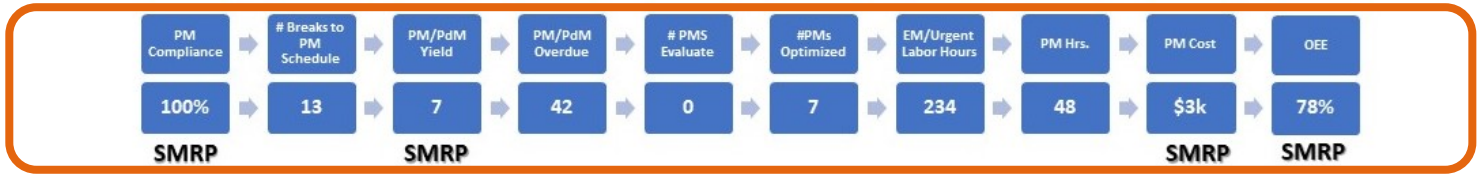
#7 – Mitigating Failures 101

1. Ensure all Work Order data is accurate before closing out by Maintenance Planner
    - Asset Number
    - Asset Criticality
    - Downtime Cost (Losses in production)
    - Downtime (in hours or minutes)
    - Maintenance Labor Hours Estimated (if planned and scheduled)
    - Maintenance Labor Hours Actual
    - Parts are charged to an asset
2. Measure and Manage Failures through accurate data collection from Closed Out Work Orders
3. Identify asset/assets with highest number of failures and maintenance labor hours
4. Created a standing team (FAT- Failure Analysis Team) consisting of Maintenance Techs, Reliability Engineer, Production Personnel, Maintenance Planner, Storeroom Manager, etc.
5. Define “End State” (Production running at Rate)

#8 – Mitigating Failures with Teams

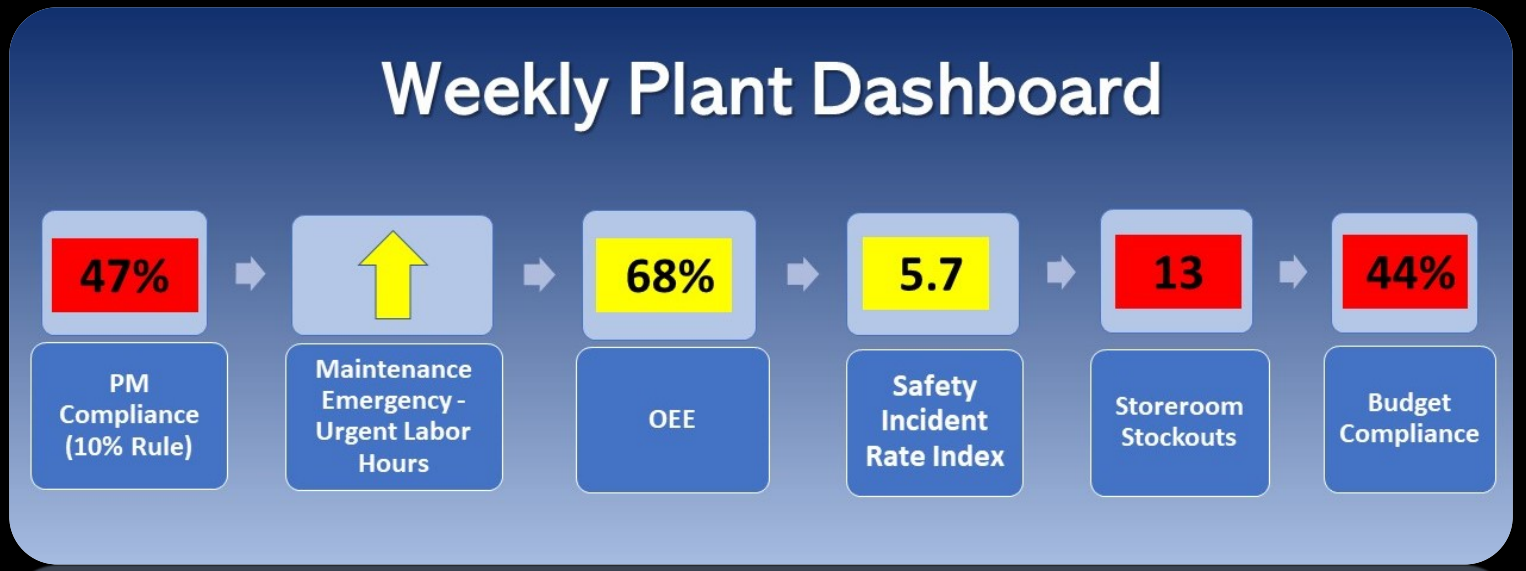
Reliability Teams

- **Failure Analysis Team (FAT)** (Monthly)
  - Cross-functional Standing Team Meeting Monthly
  - Led by Maintenance/Reliability Engineers
  - Review Equipment with Highest # Unplanned Work Orders, Hours and Cost
  - Take Actions to Prevent Recurrence of Failures
- **Equipment Reliability Team (ERT)** (Based on triggers set for Specific Lagging KPIs)
  - Cross-functional Ad Hoc Team Meeting
  - Led by Reliability designee
  - Focus Only on One Equipment/System
  - Use RCA to Identify Root Causes
- **Process Reliability Team (PRT)** (Based on triggers set for Specific Lagging KPIs)
  - Cross-functional Team Meeting
  - Co-led by Maintenance/Reliability Engineer and Production designee
  - Focus on reducing Process Functional Failures
  - Use RCA to Identify Root Causes
- **PM Optimization Team (POT)** (Based on triggers set for Specific Lagging KPIs)
  - Cross-functional Team Meeting focuses on assets not meeting production requirements
  - Performs RCA to identify causes and remedies when PM is not meeting expectations
  - Makes decisions based on PM Dashboard



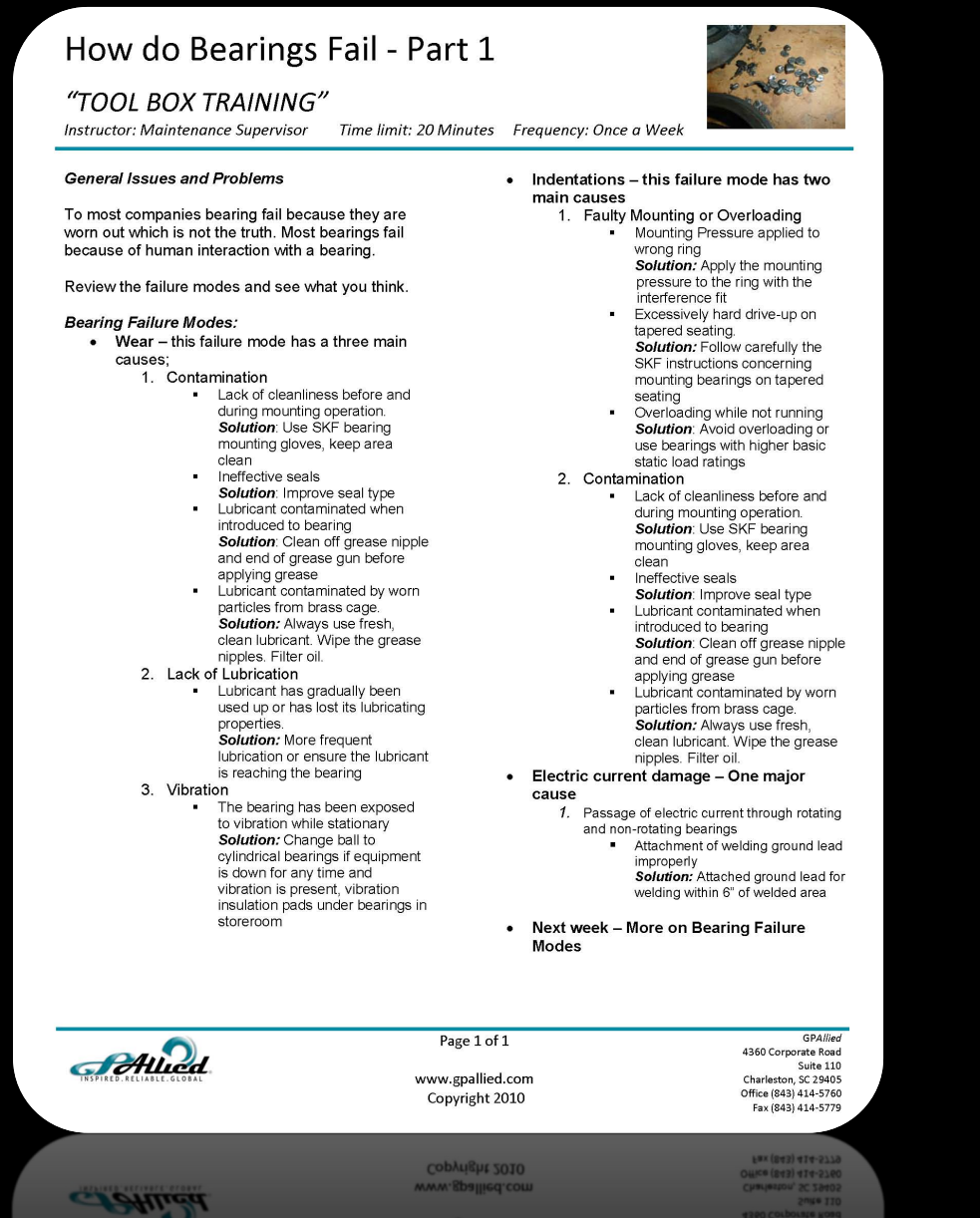
#9 – Be Aware How Reactivity Begins in Proactive Maintenance

1. New Leadership – Effective Maintenance Dashboards make it hard to mark changes
2. Complacency – Never be complacent, always be looking to improve everyday
3. No Maintenance Scorecard Posted for all to see – Post the Scorecard in the maintenance shop and begin each day reviewing data (everyone becomes aware of their score in maintenance) (5-minute huddle)



#10 – Weekly Education (Tool-Box Training)

1. Weekly meeting – 15 minutes, Maintenance Supervisor host meeting
2. Focus on a Topic which needs to be discussed (ex: Bearing Failures increasing)
3. Give everyone a copy of Tool-Box Talk focused on specific topic (Bearings) 2 days before session and post a copy in the shop
4. Ask Questions to stimulate "knowledge sharing"
   (example: "Which one of the causes of bearing failures have you seen?")



How do Bearings Fail - Part 1

"TOOL BOX TRAINING"

Instructor: Maintenance Supervisor Time limit: 20 Minutes Frequency: Once a Week

General Issues and Problems

To most companies bearing fail because they are worn out which is not the truth. Most bearings fail because of human interaction with a bearing.

Review the failure modes and see what you think.

Bearing Failure Modes:

- **Wear** – this failure mode has a three main causes;
  1. Contamination
     - Lack of cleanliness before and during mounting operation. ***Solution***: Use SKF bearing mounting gloves, keep area clean
     - Ineffective seals ***Solution***: Improve seal type
     - Lubricant contaminated when introduced to bearing ***Solution***: Clean off grease nipple and end of grease gun before applying grease
     - Lubricant contaminated by worn particles from brass cage. ***Solution:*** Always use fresh, clean lubricant. Wipe the grease nipples. Filter oil.
  2. Lack of Lubrication
     - Lubricant has gradually been used up or has lost its lubricating properties. ***Solution:*** More frequent lubrication or ensure the lubricant is reaching the bearing
  3. Vibration
     - The bearing has been exposed to vibration while stationary ***Solution:*** Change ball to cylindrical bearings if equipment is down for any time and vibration is present, vibration insulation pads under bearings in storeroom
- **Indentations – this failure mode has two main causes**
  1. Faulty Mounting or Overloading
     - Mounting Pressure applied to wrong ring ***Solution:*** Apply the mounting pressure to the ring with the interference fit
     - Excessively hard drive-up on tapered seating. ***Solution:*** Follow carefully the SKF instructions concerning mounting bearings on tapered seating
     - Overloading while not running ***Solution***: Avoid overloading or use bearings with higher basic static load ratings
  2. Contamination
     - Lack of cleanliness before and during mounting operation. ***Solution***: Use SKF bearing mounting gloves, keep area clean
     - Ineffective seals ***Solution***: Improve seal type
     - Lubricant contaminated when introduced to bearing ***Solution***: Clean off grease nipple and end of grease gun before applying grease
     - Lubricant contaminated by worn particles from brass cage. ***Solution:*** Always use fresh, clean lubricant. Wipe the grease nipples. Filter oil.
- **Electric current damage – One major cause**
  1. Passage of electric current through rotating and non-rotating bearings
     - Attachment of welding ground lead improperly ***Solution:*** Attached ground lead for welding within 6" of welded area
- **Next week – More on Bearing Failure Modes**

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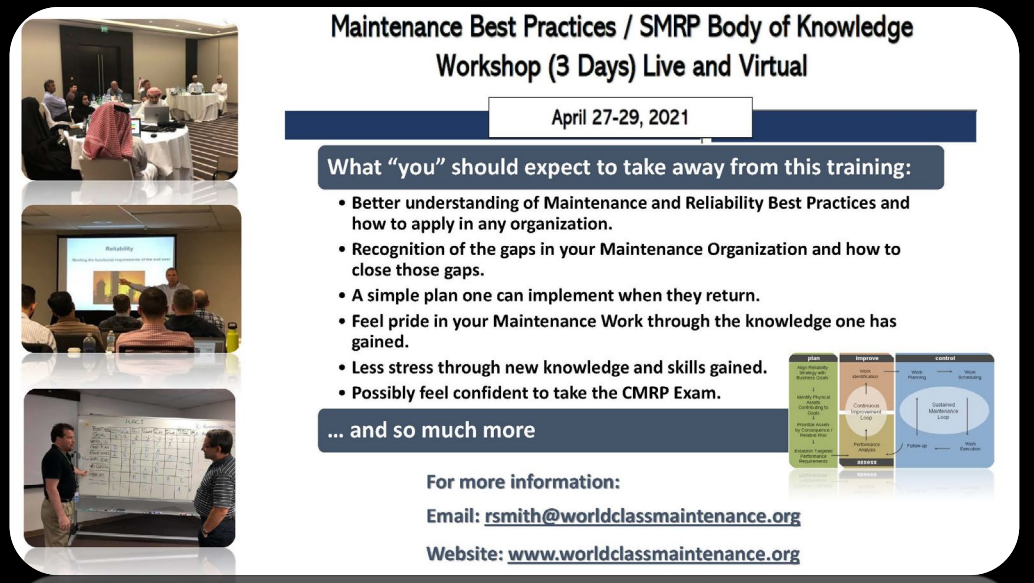
Questions?



MAINTENANCE PLANNING AND SCHEDULING

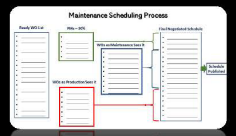
THREE DAY WORKSHOP WITH RICKY SMITH, CMRP, CMRT, CRL

DATE: May 4-6, 9:00AM - 4:00PM EST
VIRTUAL: EACH PERSON WILL JOIN A ZOOM LINKTO JOIN EACH DAY
or LIVE: SOUTERN WESLEYAN UNIVERSITY, CENTRAL, SC (4 MILES FROM CLEMSON, SC)

This workshop is "activity based" (hands on) with the focus on "Best Practices in Maintenance Planning and Scheduling" with the focus on optimization of Maintenance Wrench-Time.

Who should attend this course:

- Maintenance Planners
- Maintenance Schedulers
- Maintenance Planner/Schedulers
- Maintenance Supervisors
- Senior MaintenanceTechnicians
- Maintenance Managers
- Maintenance Planning/Scheduling Managers/Leaders



For more information go to: www.worldclassmaintenance.org