ROOT CAUSE ANALYSIS TECHNIQUES/FUNDAMENTALS

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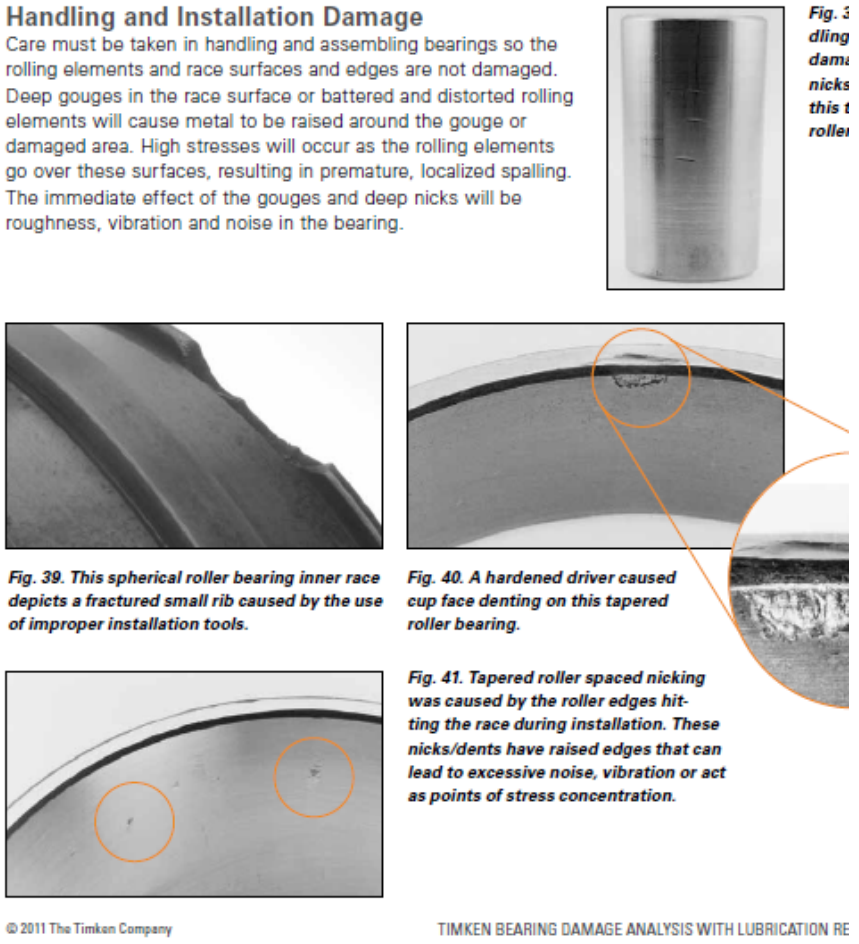
How Knowledgeable are you in RCA? "Quick Poll"

1 –No very knowledgeable …… 10 –Expert

What is Root Cause Analysis

- A root cause is defined as a factor that caused a nonconformance and should be permanently eliminated through process improvement.
- The root cause is the core issue—the highest-level cause—that sets in motion the entire cause-and-effect reactionthat ultimately leads to the problem(s).
- Root cause analysis (RCA) is defined as a collective term that describes a wide range ofapproaches, tools, and techniquesused to uncover causes of problems.
- Some RCA approaches are geared more toward identifying true root causes than others, some are more general problem-solving techniques, and others simply offer support for the core activity of root cause analysis.



Handling and Installation Damage

Care must be taken in handling and assembling bearings so the rolling elements and race surfaces and edges are not damaged. Deep gouges in the race surface or battered and distorted rolling elements will cause metal to be raised around the gouge or damaged area. High stresses will occur as the rolling elements go over these surfaces, resulting in premature, localized spalling. The immediate effect of the gouges and deep nicks will be roughness, vibration and noise in the bearing.

Fig. 39. This spherical roller bearing inner race depicts a fractured small rib caused by the use of improper installation tools.

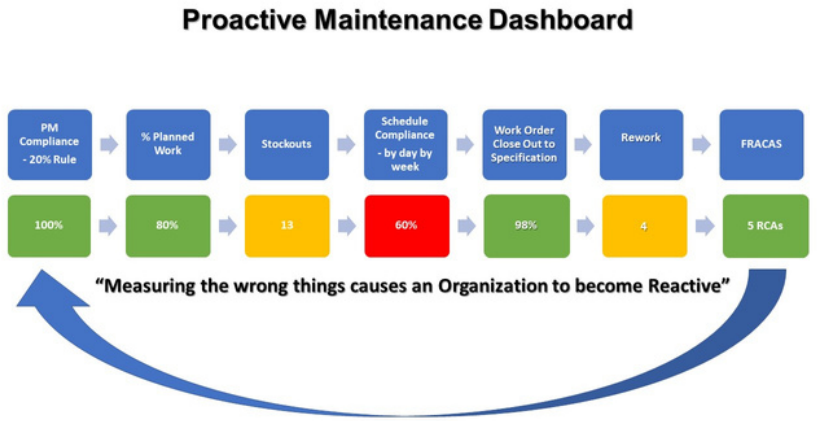
Fig. 40. A hardened driver caused cup face denting on this tapered roller bearing.

Fig. 41. Tapered roller spaced nicking was caused by the roller edges hitting the race during installation. These nicks/dents have raised edges that can lead to excessive noise, vibration or act as points of stress concentration.

TIMKEN BEARING DAMAGE ANALYSIS WITH LUBRICATION RE

Top 5 Reasons Why Companies Do use Root Cause Analysis Effectively

1. RCA is ad hoc at best
2. The organization has not been formally trained in RCA
3. The organization does not see the value in RCA (takes too long)
4. KPI Dashboards are not used to ensure everyone knows the “Score in the Game”
5. The CMMS is not effective in providing the right information at the right time.



Top 5 Reasons Why Companies use Root Cause Analysis

1. To mitigate failures
2. To optimize asset reliability
3. To optimize process reliability
4. To reduce cost
5. To reduce stress

Root Cause Analysis Techniques

The Five more common root cause analysis tools include:

- Pareto Chart
- Ishikawa or Fishbone
- The 5 Whys
- Scatter Diagram
- Failure Mode and Effects Analysis (FMEA)

Root Cause Analysis Triggers

<u>Triggers determine the following based on Triggers</u>:

- **RCA Type and # of Resources Applied**

Example:

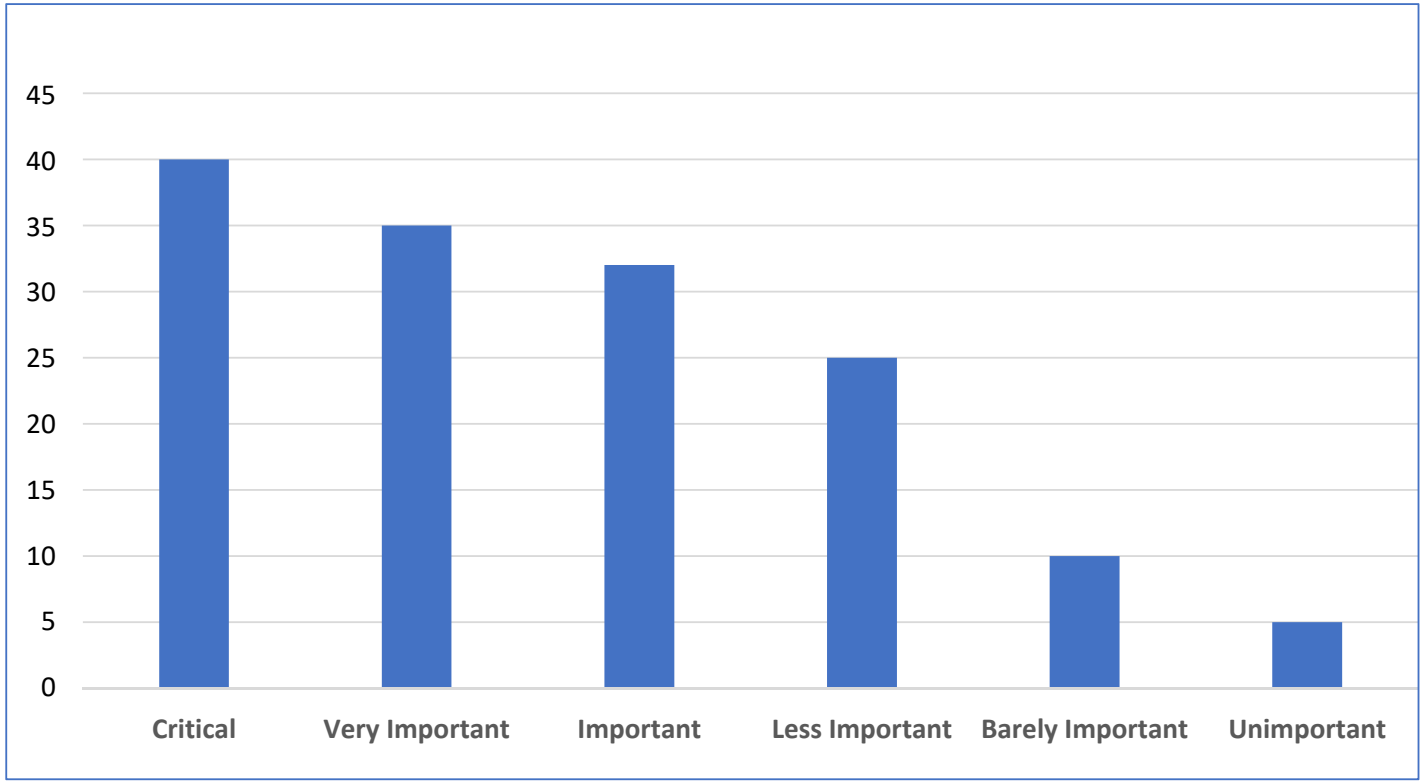
Problem: Rolling element bearing consumption trending up over past 6 months

RCA Team: 1 Maintenance Tech, 1 Reliability Engineer, Storeroom Manager

RACI Chart: Roles and Responsibilities Defined

What is a Pareto Chart?

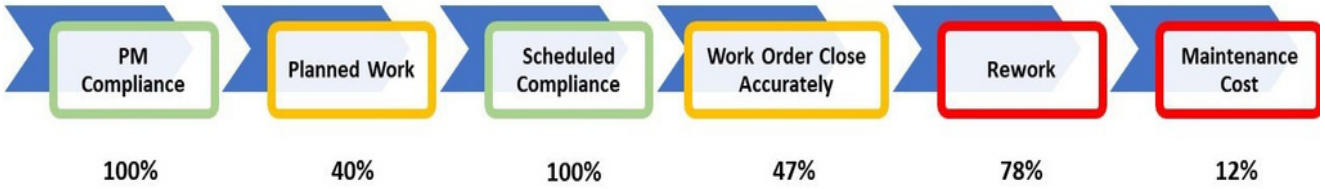
A Pareto chart is a type of chart that contains both bars and a line graph, where individual values are represented in descending order by bars, and the cumulative total is represented by the line.



What is the 5 Whys?

Five whys is an iterative interrogative technique used to explore the cause-and-effect relationships underlying a particular problem.

- The primary goal of the technique is to determine the root cause of a defect or problem by repeating the question "Why?".
- Each answer forms the basis of the next question.



Problem
Production not Meeting Rate

Why
Breakdowns high

Why
No Planning/Scheduling

Why
Tried it, did not work

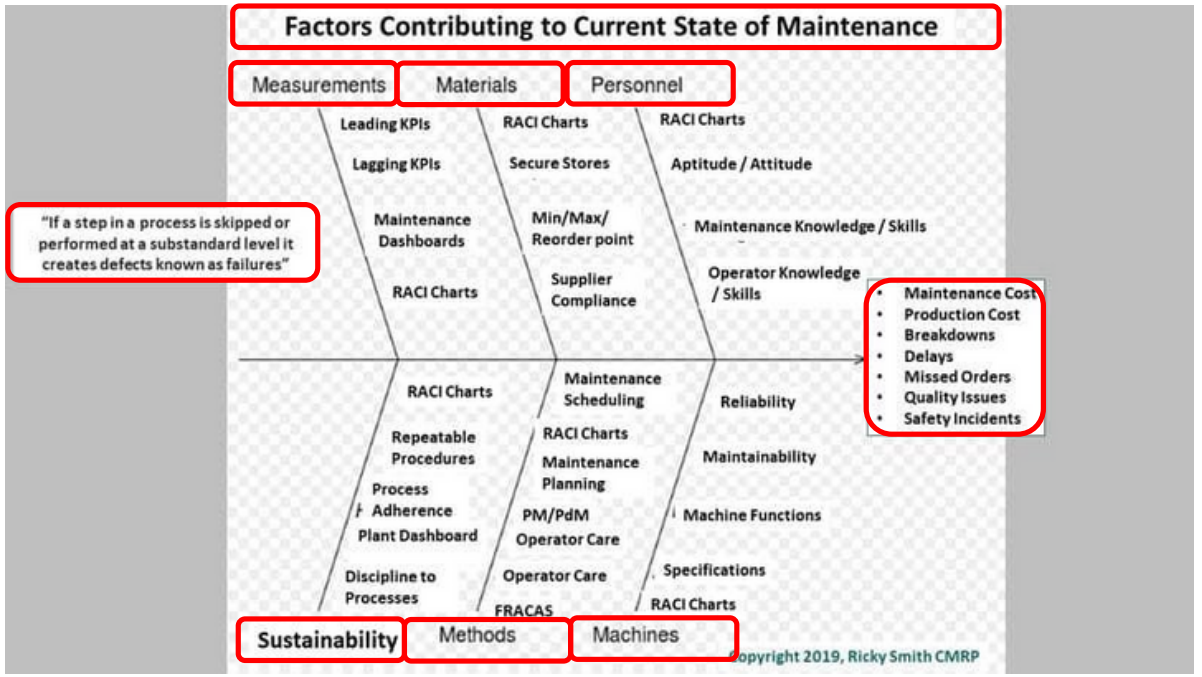
Why
Lack of Discipline

Why
No KPI Scoreboard

Ishakawa/Fishbone Diagram

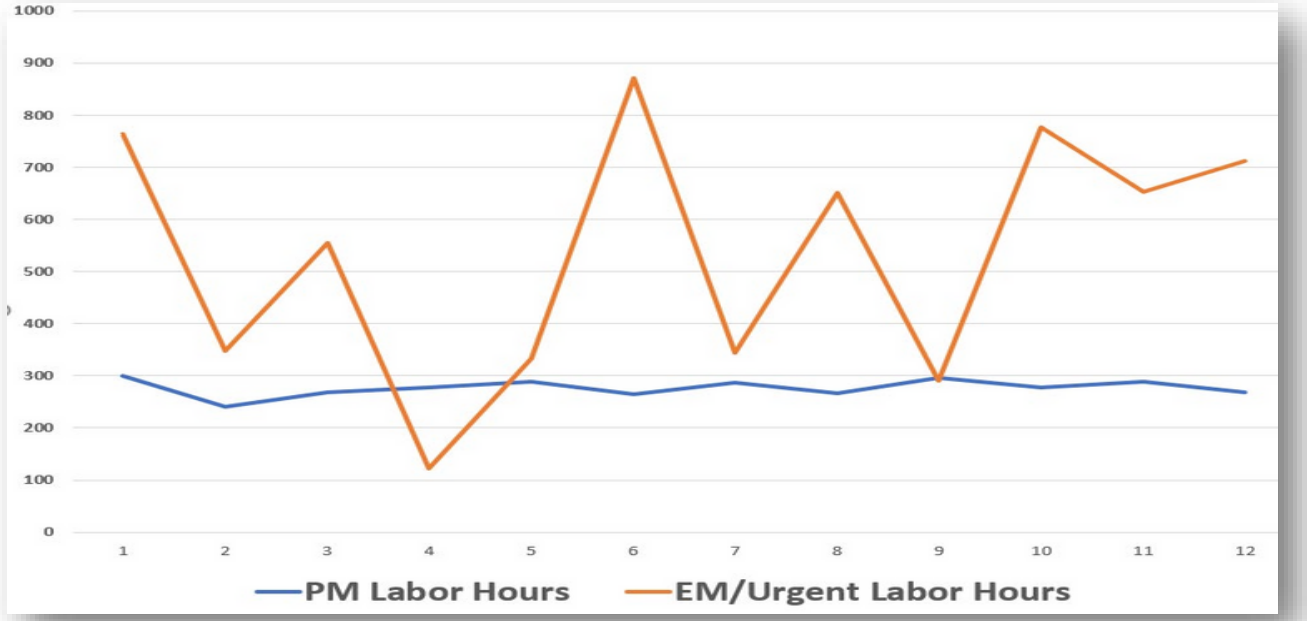
- Ishikawa (Fishbone) diagrams are causal diagrams created by Kaoru Ishikawa that show the potential causes of a specific event.

- Common uses of the Ishikawa diagram are Maintenance Process design and quality defect prevention to identify potential factors causing an overall effect.



Scatter Diagram / Plot

- A scatter plot is a type of plot or mathematical diagram using coordinates to display values for typically two variables for a set of data.
- If the points are coded, one additional variable can be displayed



Failure Mode and Effects Analysis (FMEA)

Failure Mode and Effects Analysis (FMEA)is a method which is used to identify and completely understand the potential failure modes and it's reason/causes, and the effects of failure on the system or end users for a given product or process.

Fundamentals of FMEAs

•Identify and fully understand potential failure modes and their causes, and the effects of failure on the system or end users, for a given product or process.
•Assess the risk associated with the identified failure modes, effects, and causes, and prioritize issues for corrective action.
•Identify and carry out corrective actions to address the most serious concerns.

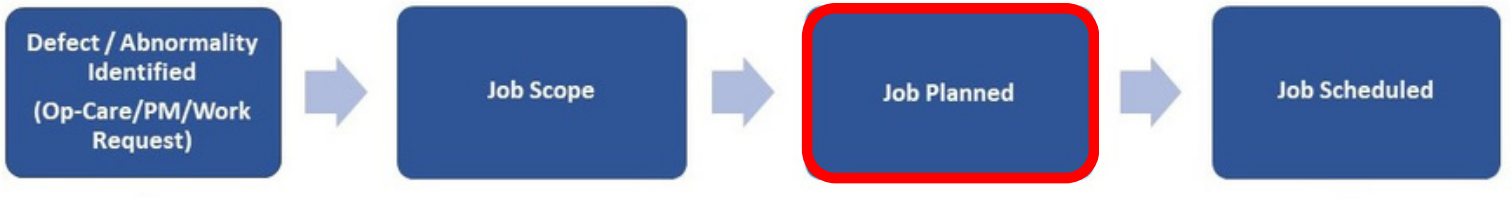
FMEA Spreadsheet

Example: Maintenance Planning Not Meeting Expectations

FMEA

Process being reviewed		Process Owner/Author		Peer reviewed by	
Issue/revision of process				Next review date:	
Date of review					
FMEA Owner/Co-ordinator					

											Action results				
Step No	Potential Failure Mode	Potential Failure Effect	Severity	Potential Causes	Occurrence	Controls	Detection	RPN	Recommended Actions	Owner	Actions taken	Severity	Occurrence	Detection	RPN
Process step being reviewed	How could the feature/step go wrong	What is the impact of the failure	1-10	What causes the step to go wrong	1-10	What existing controls are in place to prevent the cause or failure?	1-10		What actions can be undertaken to reduce occurrence/cause of risk	Who Owns the actions	What actions were taken	Severity 1-10 post risk reduction actions	Occurrence 1-10 post risk reduction actions	Detection 1-10 Post risk reduction actions	



The Risk Priority Number, orRPN, is a numeric assessment of risk assigned to a process, or steps in a process, as part of Failure Modes and Effects Analysis (FMEA), in which a team assigns each failure mode numeric values that quantify likelihood of occurrence, likelihood of detection, and severity of impact.

TheRPN is calculatedby multiplying the three scoring columns: Severity, Occurrence and Detection. For example, if the severity score is 6, the occurrence score is 4, and detection is 4, then theRPNwould be 96.

Defining Roles and Responsibilities

Defining Roles and Responsibilities are critical to success of identifying and mitigating failures.

Steps to Creating an Effective Failure Mitigation

RACI

1.Assemble a team of people involved Failure Mitigation/Elimination (ex: planner, supervisor, technician, reliability engineer, production)
2.Educate the team in the Failure Mitigation Strategy 3.Define the processes / tasks / steps required for
success of Failure Elimination
4.Facilitate the team through the RACI Process
5.Post the RACI Chart along with KPI Dashboard focused on the resolution for all to see
6.Perform RCA when a costly failure impacts production and cost

Blender Gearbox Failure Mitigation

"Roles and Responsibilities"

Task ⇩ Position ⇨	Prod Mgr.	Maint Mgr.	Plant Mgr.	Rel Engr.	Lead Tech	Prod Op.	Maint. Sup.
Critical Equipment Failure on Main Gearbox identified	I	I	A	I	R	R	I
Cost of Failure	R	C	C	A		R	C
Assemble Team	C	A	I	R	I		C
Review Equipment History on Asset – 30, 90, 120 days	C	A	I	R	C	C	C
Eliminate Potential Causes	C	C	A	R	C	I	C
Mitigation Plan Created	R	R	A	R	C	I	C
Measure Plan	I	A	I	R	I		C

Responsibility	"the Doer"	(could be more than one)
Accountable	"the Buck stops here"	(One person only)
Consulted	"two-way communication"	(in the Loop)
Informed	"one-way communication"	(kept in the picture)

Final Thoughts

- Any process can create failures if steps are not followed to requirement

  "If a step in a process is skipped or performed a substandard level it creates defects known as failures"

- Identification of the "Root Cause" of any failure is critical
- The RCA process you use require resources

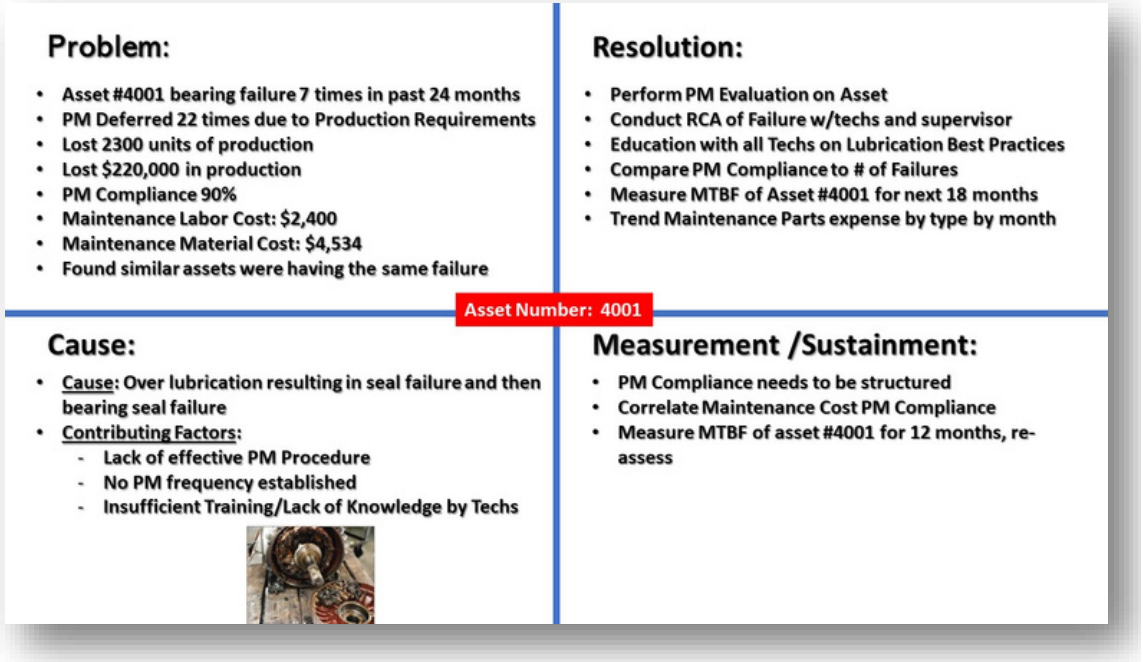
  Time

  People

  Money

- RCA Training is paramount to success
- RCA Triggers must be in place and utilized consistently
- Share knowledge of failure causes and remedies using the A3 Approach

A3 Failure Report Example



Questions/Comments

Join me for Maintenance Technician Best Practices –December 8-10

Questions? Send your request to rsmith@worldclassmaintenance.org

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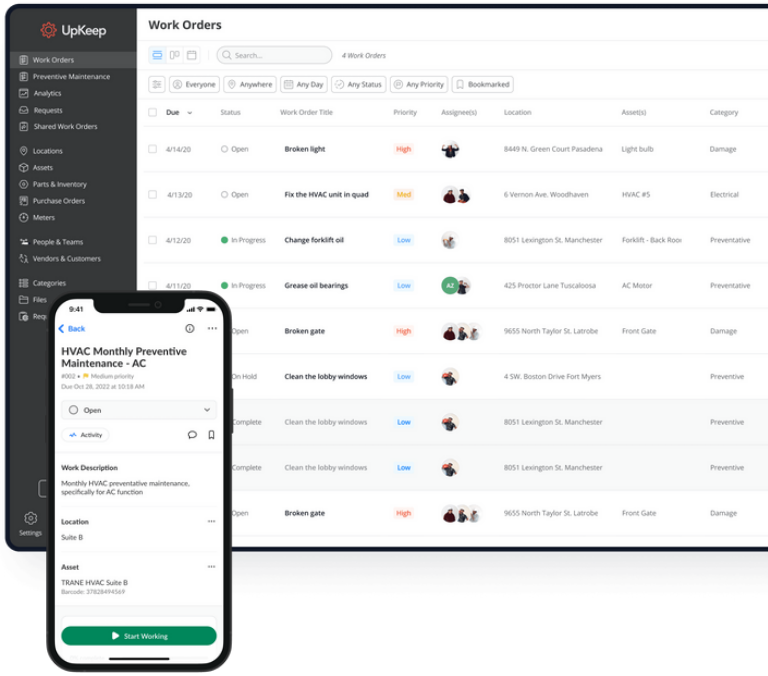

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TMCC THE MAINTENANCE COMMUNITY COALITION

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Committed to helping each other thrive in our individual professional journeys by sharing resources and expertise, granting scholarships, hosting events, and unlocking knowledge – always at no cost.