Demystifying Reliability-Centered Maintenance

FORUM RELIABILITY

Introductions – Devin Hugie, FASHE, CHFM

- **FASHE (2018)**
- **CHFM, CHC, CHSP-FSM, CHEP, CLSS-HC, CEPSS-HC, Six Sigma Green Belt**
- **Education**: BSBM & MBA, California Coast University
- **Volunteerism**: ASHE, CSHE, NFPA, IAHSS
- **Veteran**: US Army
- **Experience**: Exec. Dir. Support Services, CHOC, Orange CA
  Dir. Fac. & Support Serv., Providence, Torrance & San Pedro CA
- **Personal**: Product of Southern California now relocated to Indiana. Married to the best woman on the planet and raising three great kids. Two adult children and two grandsons.

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Introductions – Jim Carrel, CRL-BB, ISO Cat. III

- **Certified Reliability Leader – Black Belt (AMP, 2015)**
- **Category III Vibration Analyst (The Vibration Institute, 2005)**
- **Education**: BTh, The Way College of Emporia
- **Volunteerism**: ASHE – Author and Reviewer, RCM Guide
  Contributor, HFM Magazine
  AMP – CRL Domain Mastery Belt and Black Belt Programs
- **Veteran**: US Navy Nuclear Power Program
- **Experience**: 45+ years in Reliability & Physical Asset Management
- **Personal**: Married for 35 years, two sons, a daughter, a daughter-in-law, a son-in-law, two grandchildren. And I pull weeds.

Healthcare's History of Asset Reliability

Agenda

- The Elephant in the Room
- Why Reliability-Centered Maintenance?
- What RCM Is Not
- What RCM Is
- Now What Do We Do?

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The Elephant in the Room - Compliance

Alternative Equipment Maintenance (AEM) Programs

CMS – 2013 – Bio-Med

TJC – 2014 – CAH

2019 – Facilities Equipment Clarification

(Non-Critical Utilities)

2022 – 100% Compliant with AEMs

(Excludes AHJ Regulated)

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The Elephant in the Room - Compliance

CMS
CENTERS FOR MEDICARE & MEDICAID SERVICES

"Scheduled maintenance activities for high-risk utility systems components in an alternative equipment maintenance (AEM) program inventory must have a 100% completion rate."

EC.02.05.05, EP.4, Note 3 (April 2022)

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The Elephant in the Room - Compliance

"Scheduled maintenance activities for infection control utility systems components in an alternative equipment maintenance (AEM) program inventory must have a 100% completion rate."

EC.02.05.05, EP.5, Note 2 (April 2022)

The Elephant in the Room - Compliance

"Scheduled maintenance activities for non-high-risk utility systems components in an alternative equipment maintenance (AEM) program inventory must have a 100% completion rate."

EC.02.05.05, EP.6, Note (April 2022)

One Bite at a Time

- High-Risk Utility Systems
- Infection Control Utility Systems
- Non-High-Risk Utility Systems

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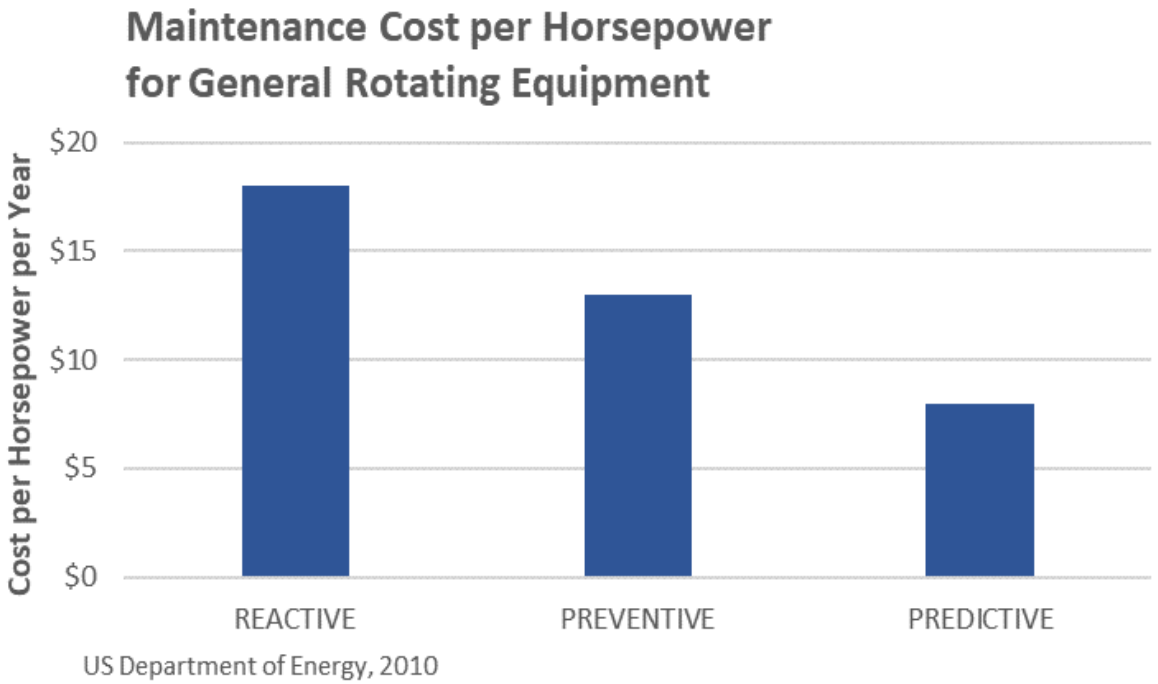
Why RCM?



A properly balanced strategy costs 43% less than the more common Break/Fix practices.

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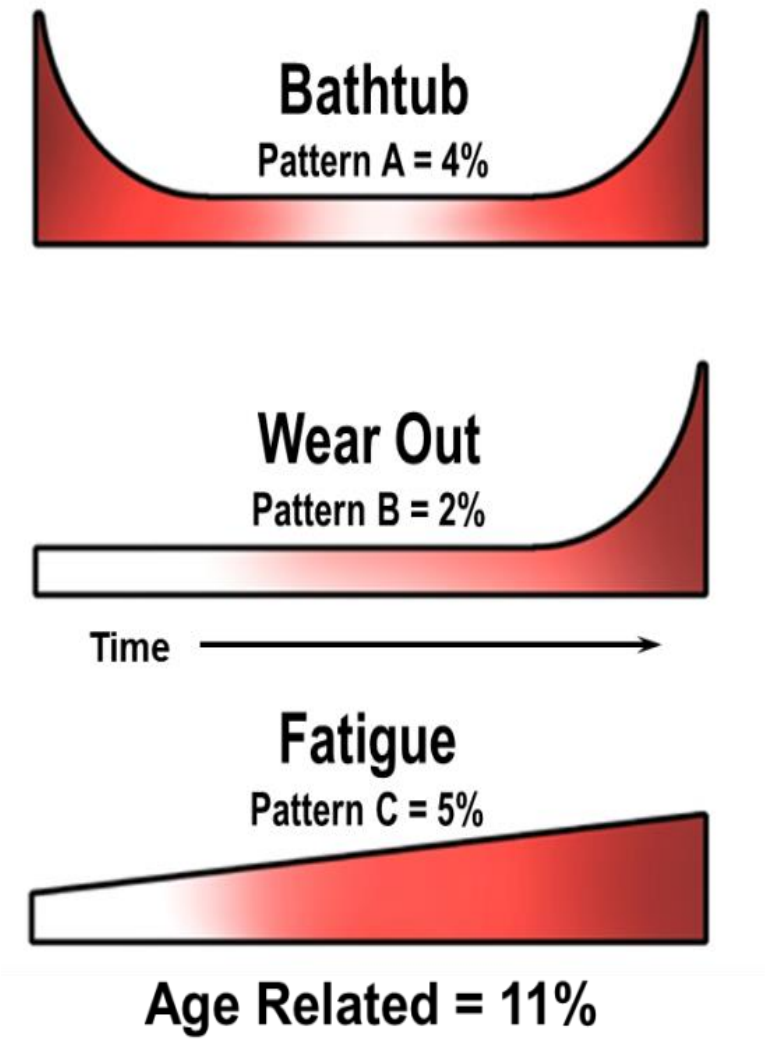
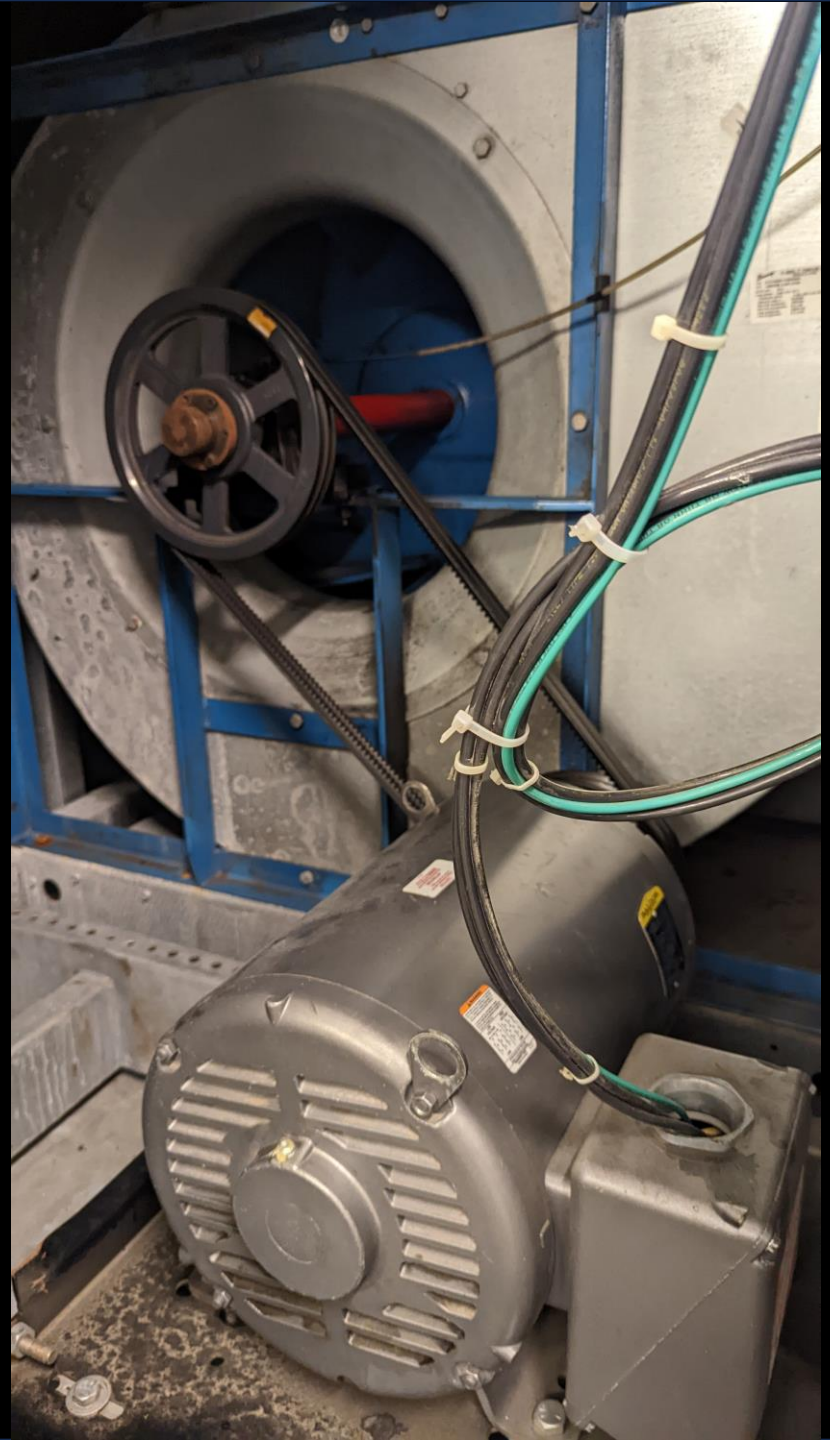
Why RCM?



Reliability-Centered Maintenance, F. Stanley Nowlan and Howard F. Heap, 1978

Age Related?

Check all electrical connections.



Age Related?

Maintain tower water chemistry.

Age Related?

Check coupling alignment.

Age Related?

Replace filters monthly.

Age Related?

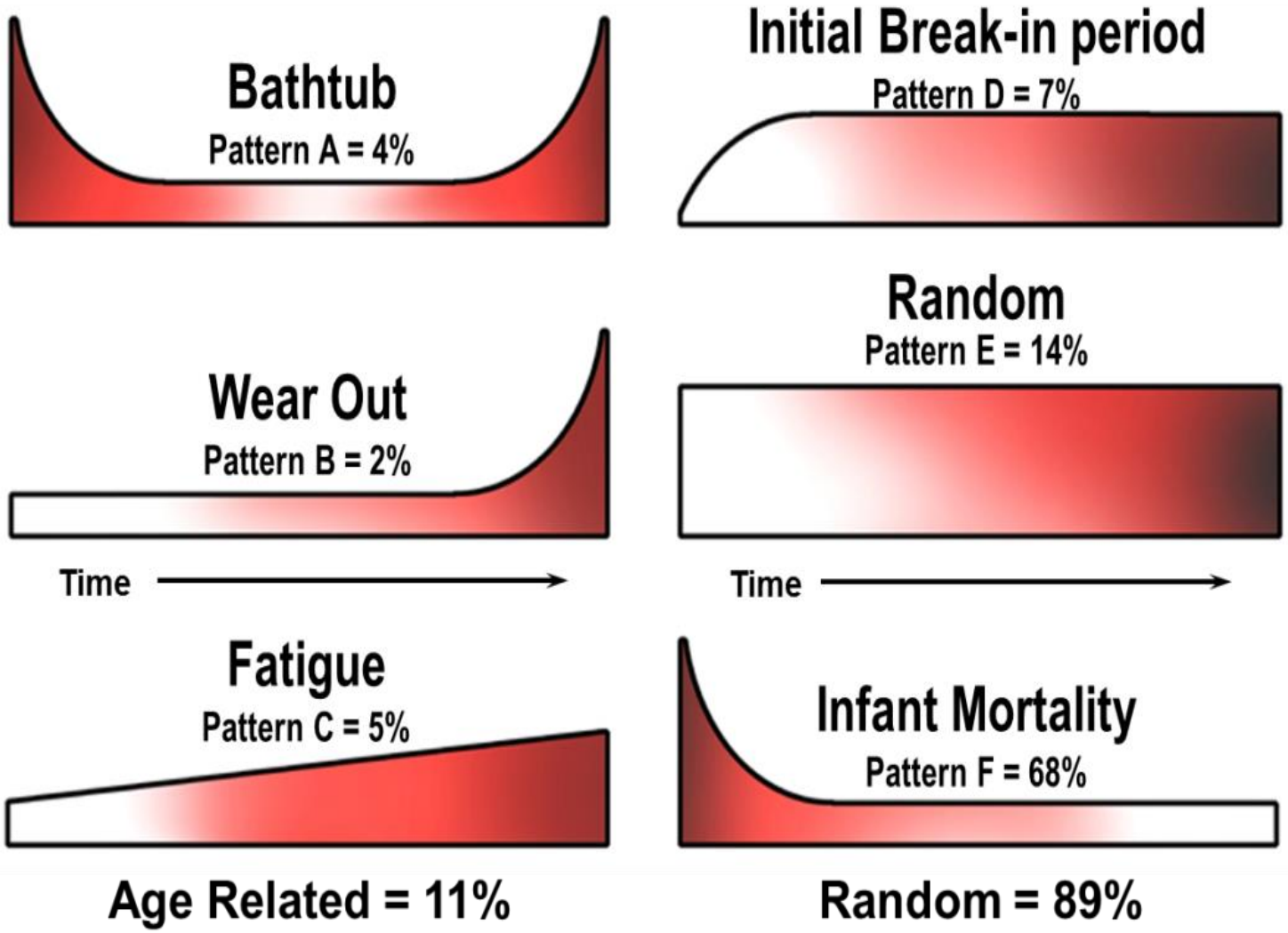
Lubricate fan bearings monthly.

Age Related?

Check the operation of the fan on the variable frequency drive.

What is the P in PM?
What are these PMs preventing?

Why RCM?



Reliability-Centered Maintenance, F. Stanley Nowlan and Howard F. Heap, 1978

What RCM Is NOT

Reliability-Centered Maintenance (RCM) is **NOT** maintenance.

"We do RCM."
"We have RCM."
"We RCM our equipment."
"We RCM'd one site and copied the rest."

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ATTENTION


Needle RST
51.8
Min 50.5 Max 51.5
Survey
SDT
SDT270


WARNING

What RCM Is NOT

Reliability-Centered Maintenance (RCM) is **NOT** maintenance.

RCM is not a maintenance style.

RCM is not a maintenance strategy.

RCM is not a maintenance technology.

RCM is not new.

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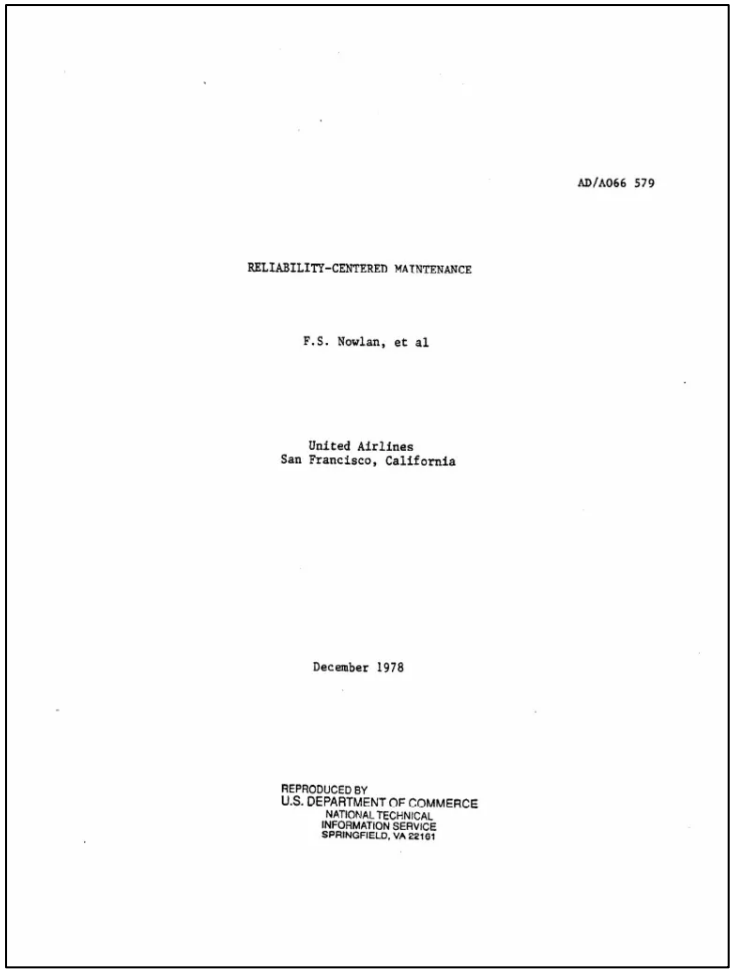
What Is Reliability-Centered Maintenance?



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RELIABILITY-CENTERED MAINTENANCE

F.S. Nowlan, et al

United Airlines
San Francisco, California

December 1978

REPRODUCED BY
U.S. DEPARTMENT OF COMMERCE
NATIONAL TECHNICAL
INFORMATION SERVICE
SPRINGFIELD, VA 22161

"The development of this program is towards the control of reliability through an analysis of the factors that affect reliability and provide a system of actions to improve low reliability levels when they exist."

F. Stanley Nowlan & Howard F. Heap, *Reliability-Centered Maintenance*, 1978, p.4

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What Is Reliability-Centered Maintenance?

"Reliability-centered Maintenance: a process used to determine what must be done to ensure that any physical asset continues to do what its users want it to do in its present operating context."

John Moubray, *Reliability-Centered Maintenance*, 2nd Edition, 1997

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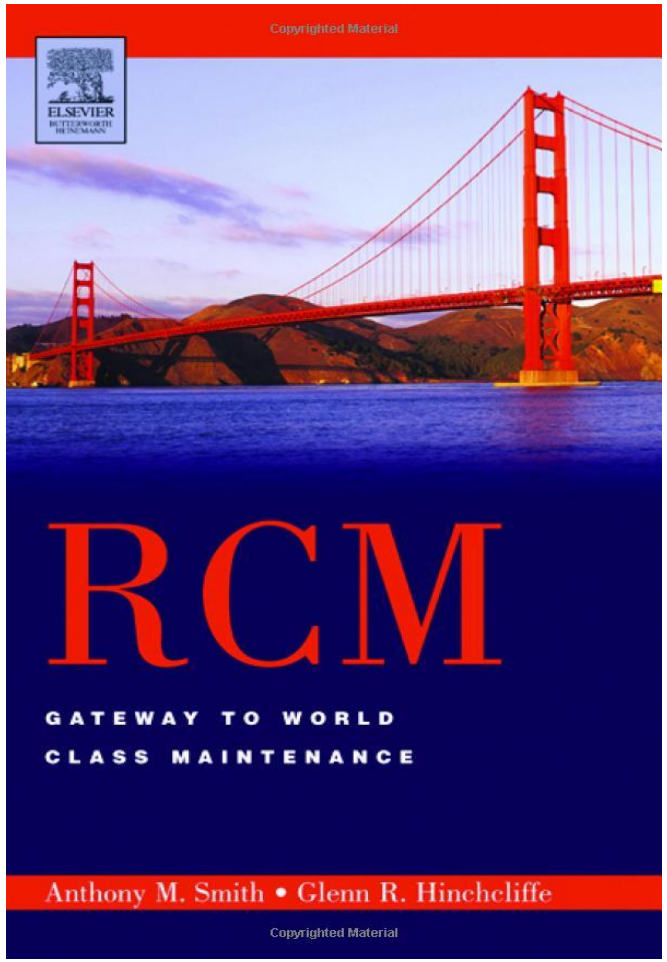
What Is Reliability-Centered Maintenance?



"In summary, then, the RCM methodology is completely described in four unique features:

1. Preserve functions.
2. Identify failure modes that can defeat the functions.
3. Prioritize function need (via failure modes).
4. Select applicable and effective PM (planned maintenance) tasks for the high priority failure modes."

Anthony (Mac) Smith, *RCM: Gateway to World Class Maintenance*, 2004

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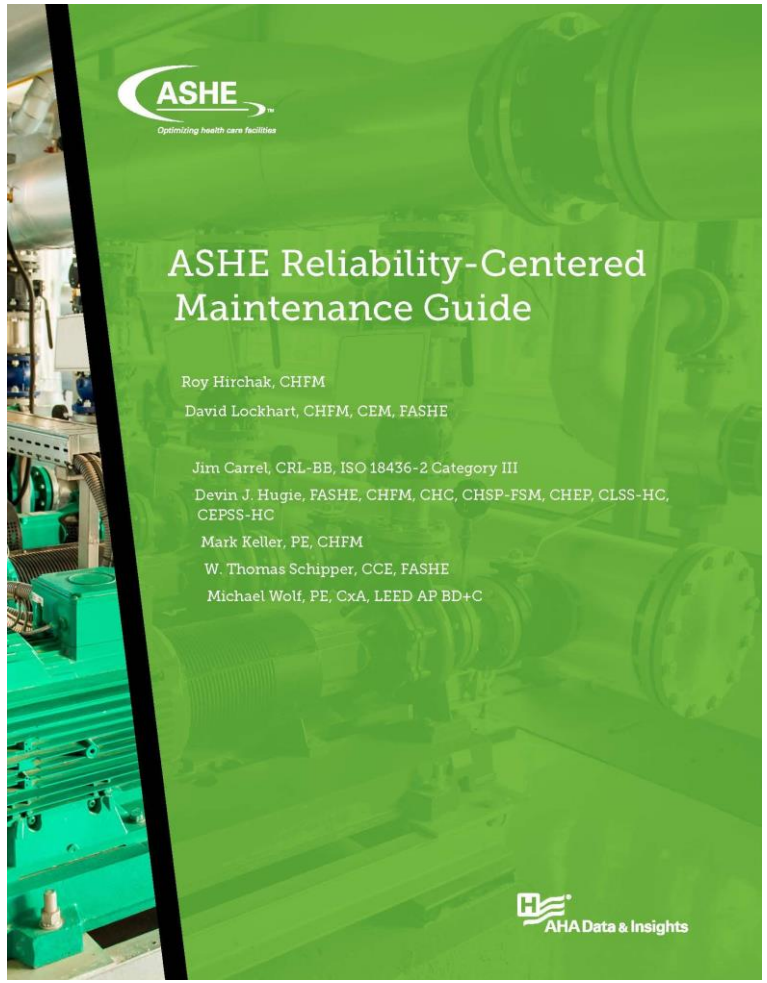
What Is Reliability-Centered Maintenance?

"Reliability-Centered Maintenance (RCM) determines the applicable and effective maintenance for each failure given the operational context of the equipment being assessed. The [analysis] technique can be described as a process to help people determine the best policies for managing the functions of physical assets and for managing the consequences of their failures."

Victor Borges, www.dnv.com, 2023

What Is Reliability-Centered Maintenance?



"RCM is a decision-making process that analyzes the structures, systems, and assets (SSA), defines its true design function…, and determines the risk and/or criticality of the SSA to the organization and the operation of the facility."

ASHE Reliability-Centered Maintenance Guide, 2022

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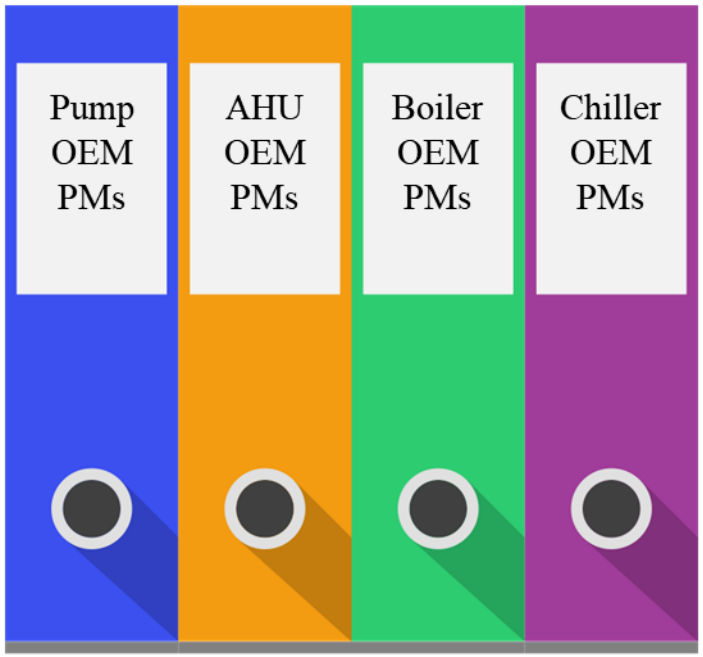
The Seven Questions

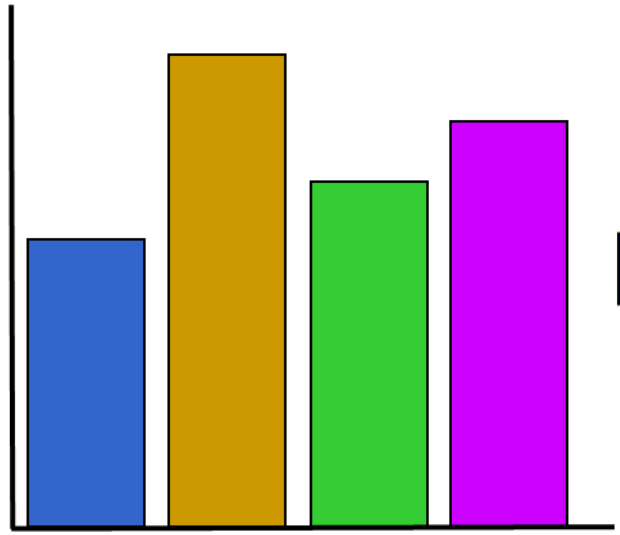
1. What are the functions and associated performance standards of the asset in its present operating context?
2. In what ways does it fail to fulfill its functions?
3. What causes each functional failure?
4. What happens when each failure occurs?
5. In what ways does each failure matter?
6. What can be done to predict or prevent each failure?
7. What should be done if a suitable proactive task cannot be found?

(*Evaluation Criteria for Reliability-Centered Maintenance Processes*, SAE JA1011, 1999)

Getting to Right



Original Equipment Manufacturer Preventive Maintenance Guidelines



Reliability-Centered Maintenance Analyses

Alternative Equipment Maintenance Risk Assessments

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The History of Maintenance Strategies

The History of Maintenance Strategies

<1940's

Reactive

Reactive (Breakdown) Maintenance

Unexpected repairs are performed when equipment has already broken.

Activity focused on restoring broken equipment to its design operating context.

Symptoms of a Reactive Maintenance strategy:

- Unusually loud noises
- Lots of yelling
- Even more running around
- Then everything gets quiet

Interruptions, overtime, high cost

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The History of Maintenance Strategies

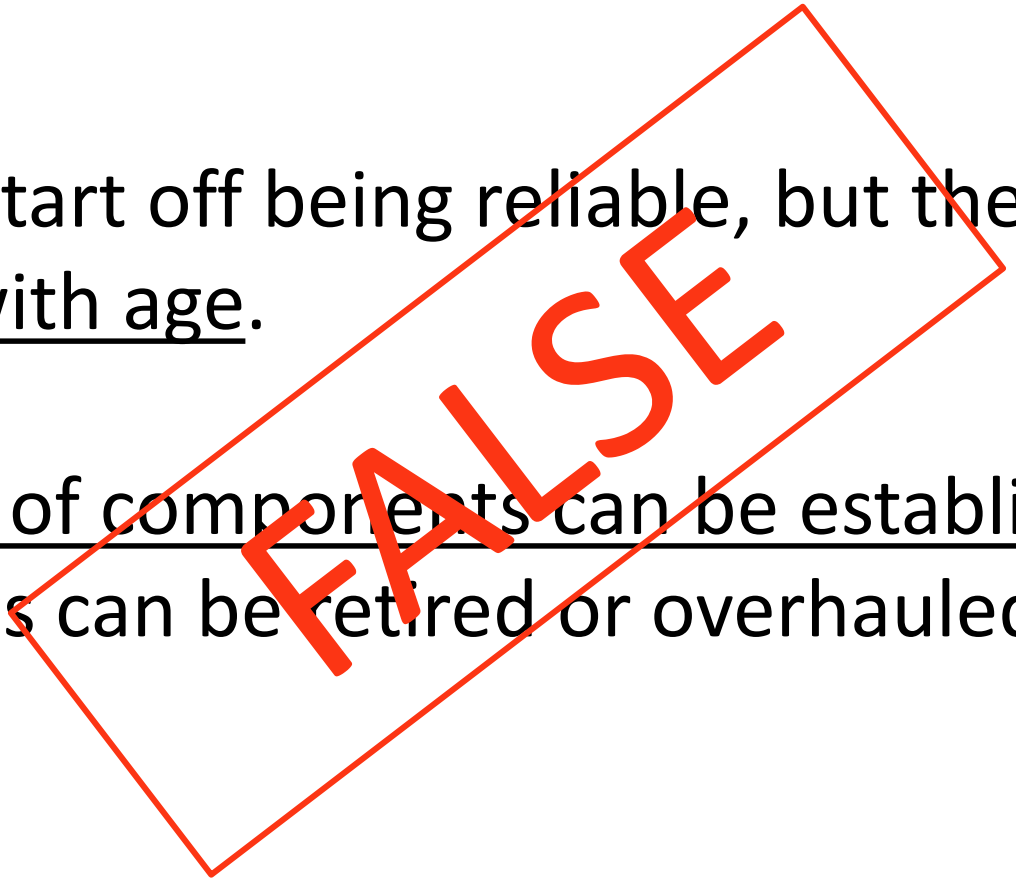
<1940's **1960's**

Reactive | Preventive

Two Maintenance Fallacies Widely Believed to Be Factual

Components start off being reliable, but their reliability deteriorates with age.

The useful life of components can be established statistically, so components can be retired or overhauled before they fail.



The History of Maintenance Strategies

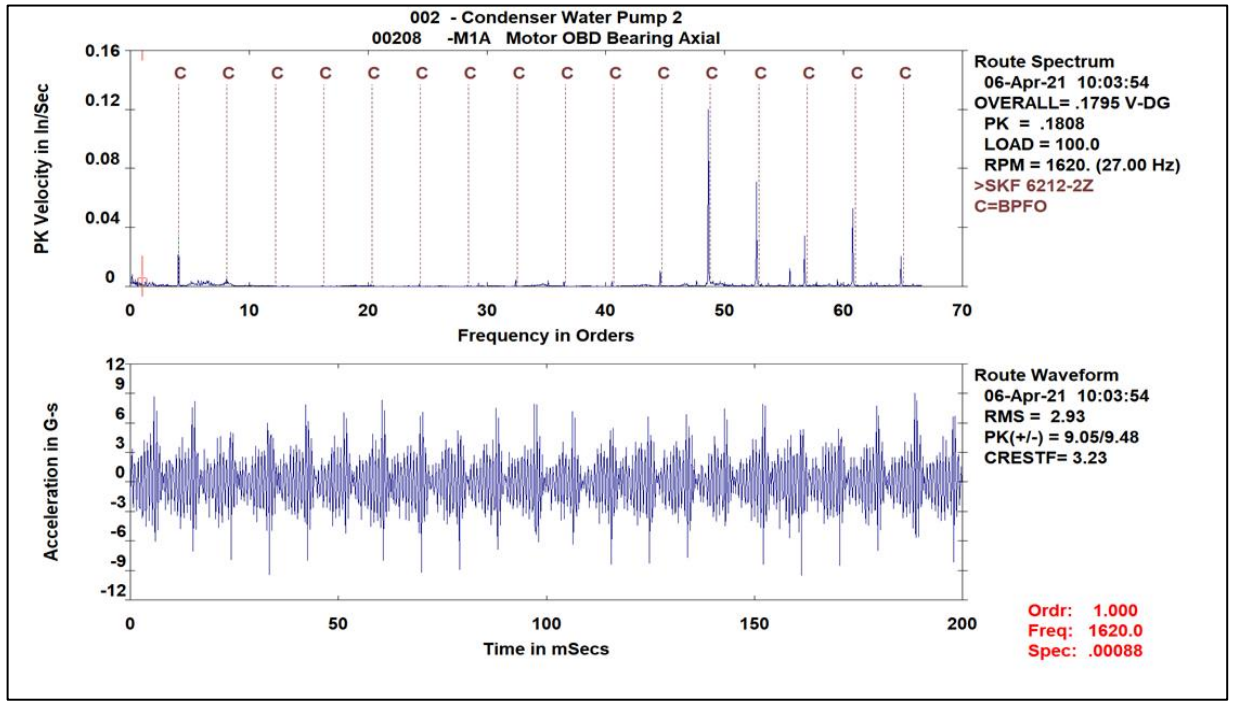
<1940's **1960's** **1970's**

Reactive | Preventive | ACM

Predictive Maintenance (Asset Condition Management)

Measurements that detect the onset of system or component degradation (lower functional state), thereby allowing casual stressors to be eliminated or controlled prior to any significant deterioration in the component physical state.

Results indicate current and future functional capability.



The History of Maintenance Strategies

<1940's	1960's	1970's	1980's
Reactive	Preventive	ACM	RCM

The History of Maintenance Strategies

<1940's	1960's	1970's	1980's	Now
Reactive	Preventive	ACM	RCM	RAM

Uptime® Elements

Technical Activities

REM Reliability Engineering for Maintenance

- **Ca** criticality analysis
- **Rsd** reliability strategy development
- **Re** reliability engineering
- **Rca** root cause analysis
- **Cp** capital project management
- **Rcd** reliability centered design

ACM Asset Condition Management

- **Aci** asset condition information
- **Vib** vibration analysis
- **Fa** fluid analysis
- **Ut** ultrasound testing
- **Ir** infrared thermal imaging
- **Mt** motor testing
- **Ab** alignment and balancing
- **Ndt** non destructive testing
- **Lu** machinery lubrication

WEM Work Execution Management

- **Pm** preventive maintenance
- **Ps** planning and scheduling
- **Odr** operator driven reliability
- **Mro** mro-spares management
- **De** defect elimination
- **Cmms** computerized maintenance management system

Leadership

LER Leadership for Reliability

- **Es** executive sponsorship
- **Opx** operational excellence
- **Hcm** human capital management
- **Cbl** competency based learning
- **Int** integrity
- **Rj** reliability journey

Business Processes

AM Asset Management

- **Sp** strategy and plans
- **Cr** corporate responsibility
- **Samp** strategic asset management plan
- **Ri** risk management
- **Ak** asset knowledge
- **Alm** asset lifecycle management
- **Dm** decision making
- **Pi** performance indicators
- **Ci** continuous improvement

A Reliability Framework and Asset Management System™

10 RIGHTS OF ASSET LIFECYCLE MANAGEMENT

1 R	2 R	3 R	4 R	5 R	6 R	7 R	8 R	9 R	10 R
Specify	Design	Source	Build/ Fabricate	Install/ Commission	Operate	Maintain	Improve/ Modify	Dispose/ Decommission	Manage

Area Served		Risk (NFPA 99-2012)		Age	
10	OR/Cath Labs/Labs/Sterile Processing/Pharmacy	10	Category 1	10	75-100%+ Asset Life
10	Patient Care	7	Category 2	7	Reconditioning Overdue
7	Common Area	5	Category 3	5	Median
5	Equipment Support	2	Category 4	2	Refurbished
2	Material Storage			1	Newly Commissioned
O&M Cost		**Equipment History**		**Redundancy**	
10	OEM Support Required	10	High Failure Rate	10	Zero Redundancy (N+0)
7	Outsourced Repairs	8	High Incident Rate	7	Seasonal Redundancy
5	Outsourced Maintenance	3	Few Incidents	5	N+1 Redundancy
3	Self-Performed	1	PM Activities Only	2	N+2 Redundancy
0	Run-to-Failure	0	No History	1	Seldom in Service

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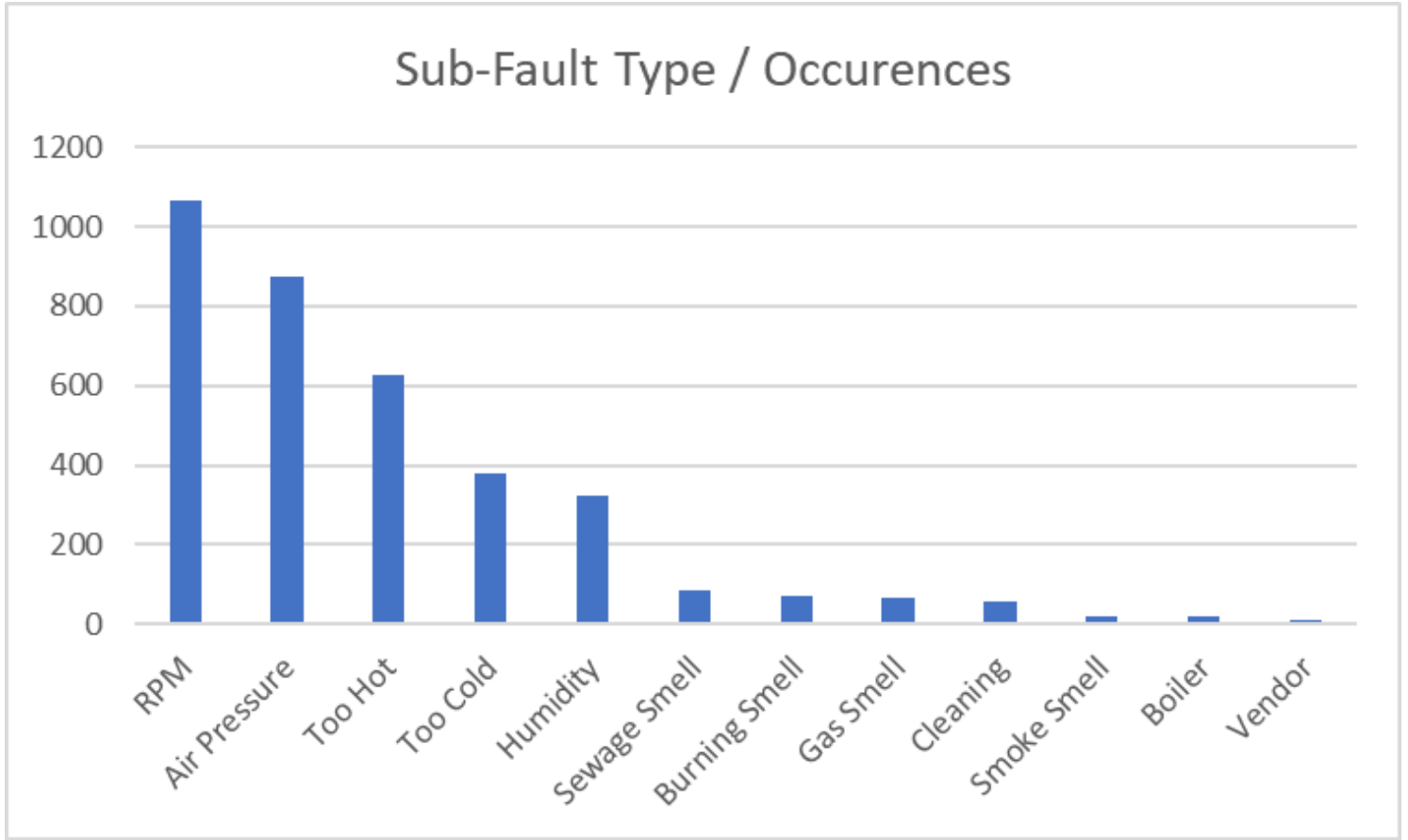
Where Do We Begin?

Sub-Fault Type	Occurance
RPM	1068
Air Pressure	874
Too Hot	625
Too Cold	379
Humidity	324
Sewage Smell	86
Burning Smell	70
Gas Smell	68
Cleaning	58
Smoke Smell	21
Boiler	18
Vendor	12



- WO Counts by Area
- WO Counts by Fault Type
- Cost per Fault Type
- Ave. Cost per WO by Fault Type

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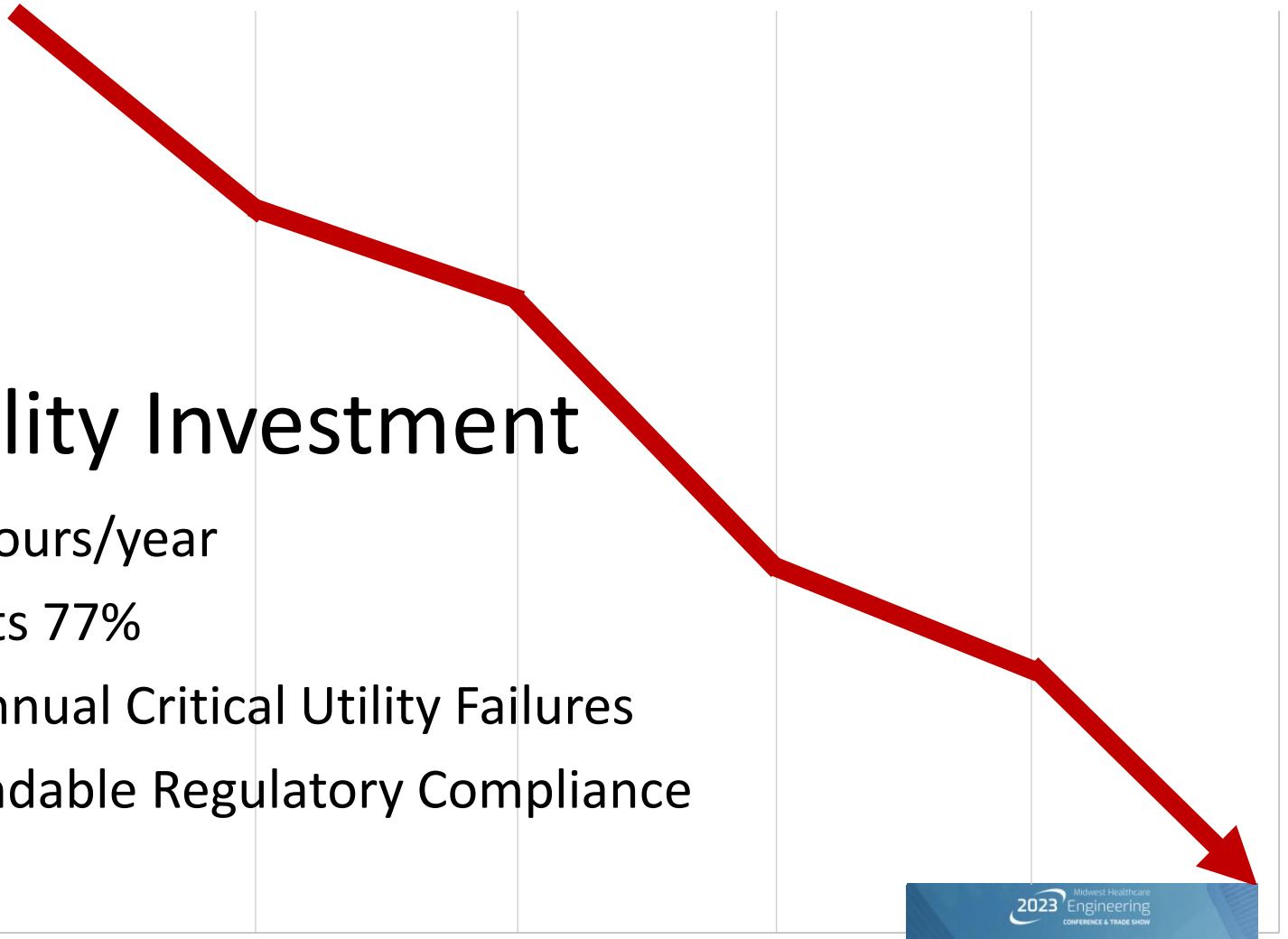
Actual ROI Results



Returns on the Reliability Investment

- Repurposed 24% total man-hours/year
- Reduced Outsourced PM Costs 77%
- Eliminated 78% of Average Annual Critical Utility Failures
- 100% Documented and Defendable Regulatory Compliance

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Just What the Doctor Ordered

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