



04



COLLECT DATA

Gather data within the facility to validate the hypotheses put forth by the team.

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ROOT CAUSE ANALYSIS PROCESS STEPS

A systematic approach to uncover the true causes and drive lasting improvement.



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IDENTIFY EVENTS

Identify undesirable events in the facility using human and digital data.

PRIORITIZE EVENTS

Identify the chronic events that account for 80% of the losses within the facility.

BUILD TEAM

Establish a cross functional team and appoint an unbiased RCA Facilitator.

COLLECT DATA

Gather data within the facility to validate the hypotheses put forth by the team.

ANALYZE

Leverage a logic tree approach that will guide the team in assessing root cause hypotheses and utilize data to validate each hypothesis.

COMMUNICATE ACTIONS

Convey RCA findings and corrective actions to stakeholders to ensure root causes are addressed.



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**Better Analysis.
Stronger Reliability.**

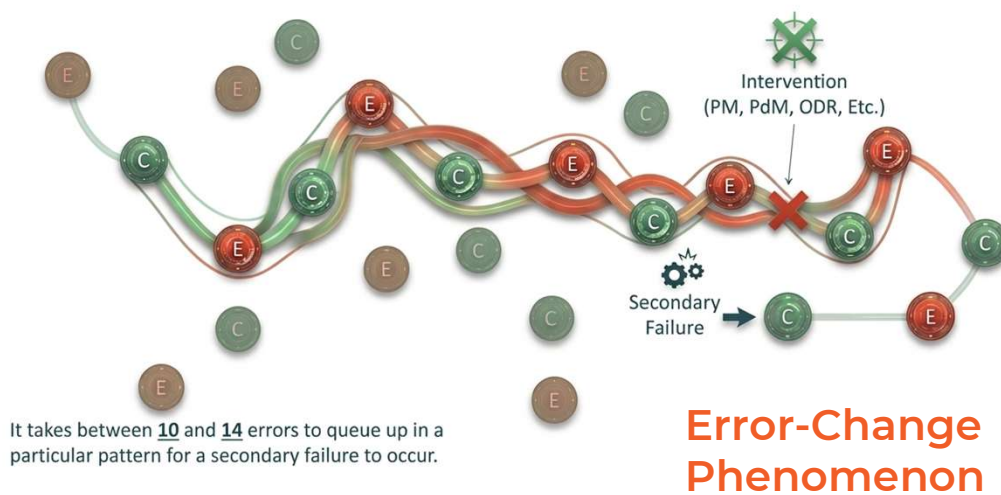
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Why Blame Does Not Work...



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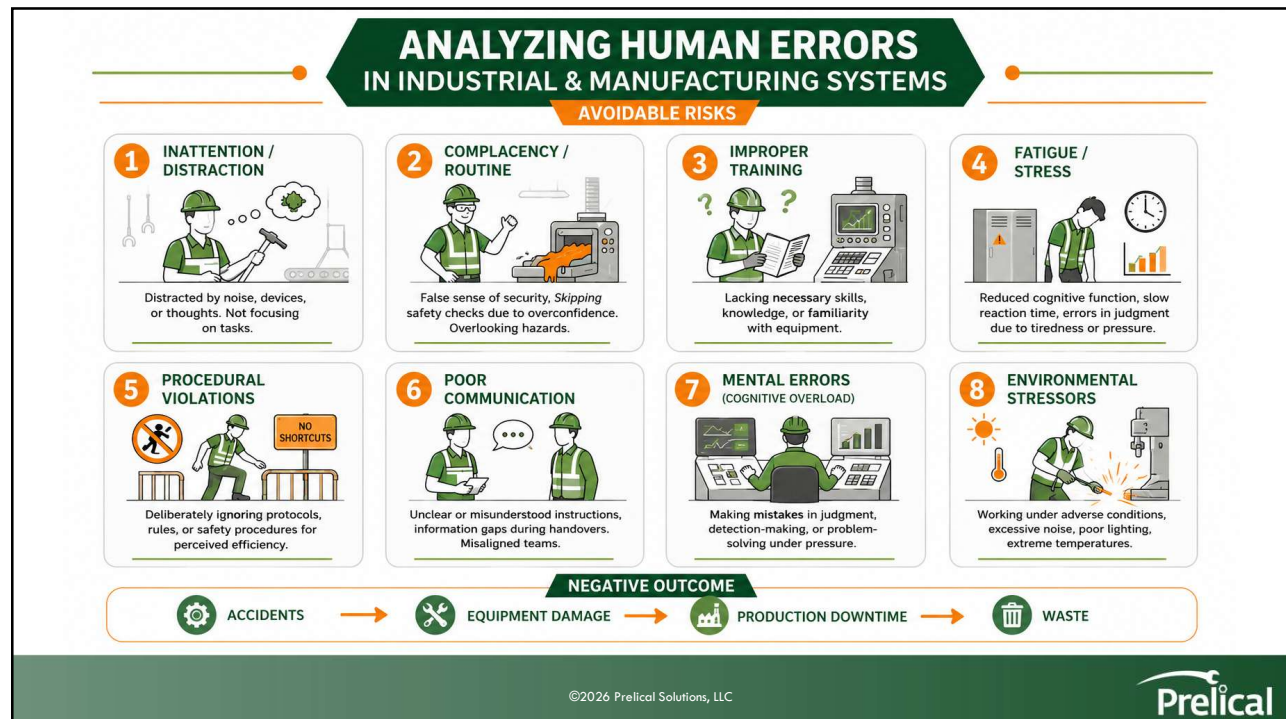
A deviation from intended performance caused by human behavior, decision, or perception

What is a Human Error?

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Blame Destroys Information

- RCA requires full, accurate truths
- Blame triggers self-protection
- People hide mistakes, skip details, or reshape the story
- Missing information = weak analysis

Blame Destroys Information

Fear shuts down honesty. Blame shuts down learning.



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Fear Changes Behavior

- People share only “safe” information
- Near misses and shortcuts stay hidden
- Assumptions and pressures go unspoken
- The truth becomes incomplete

Fear Changes Behavior

From Learning Mode to Survival Mode



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The Blame Loop



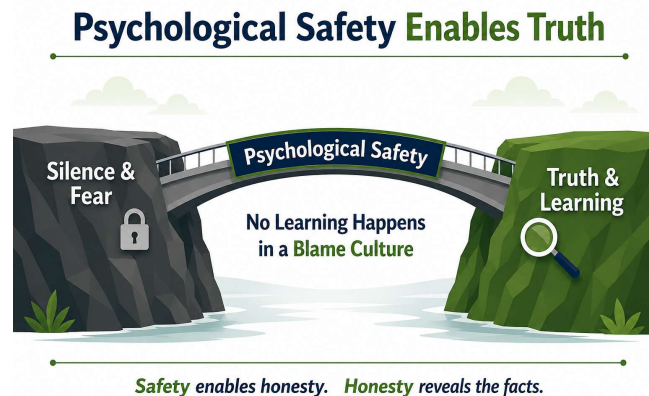
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Psychological Safety Enables Truth

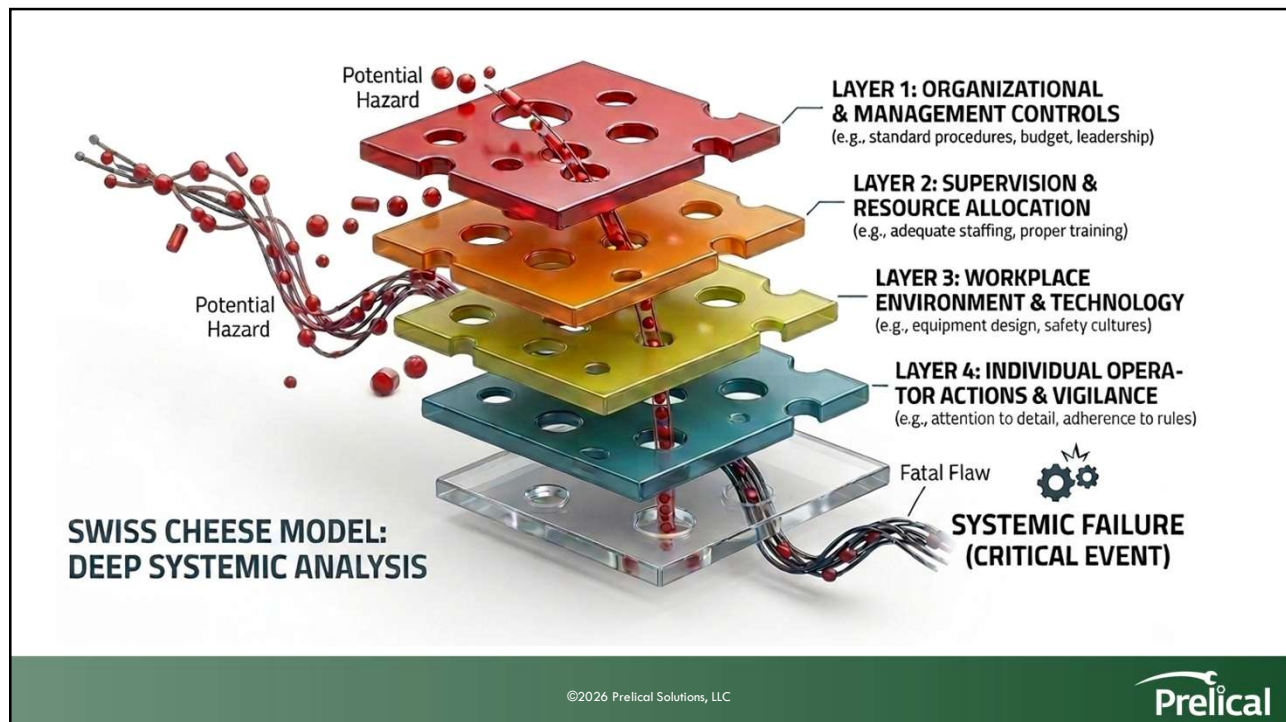
- Focus on systems, not individuals
- Reinforce that honesty is a contribution
- Celebrate transparency as a reliability behavior
- Truth protects the organization



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**Do we do this on
Triggered (Sporadic)
Failures?**

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Do we do this on Chronic Failures?

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What is the difference between data collection for Sporadic (triggered) events and Chronic Events?

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Provide a Designated Location for Failed Components

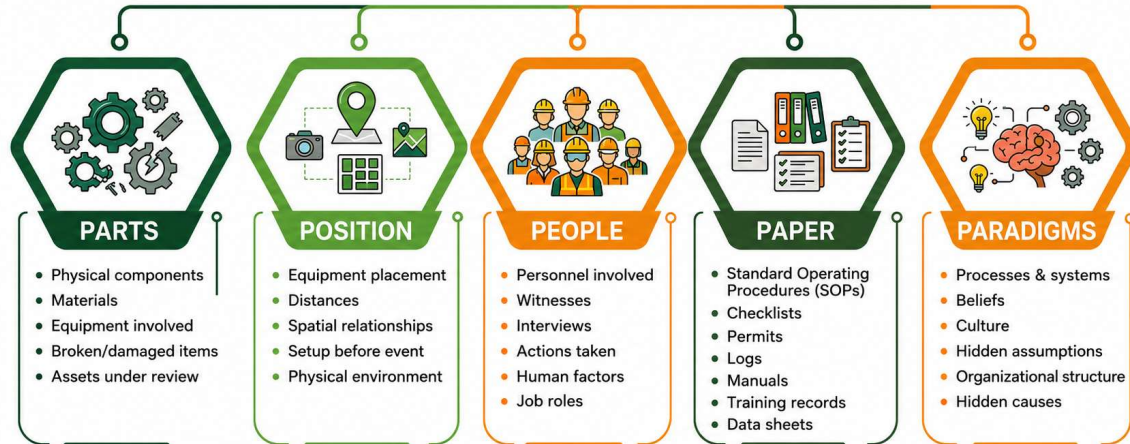


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5 Ps of DATA COLLECTION for RCA (Root Cause Analysis)



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Positional Data

- Functional Location of Failure
- Time of Failure (Day, Shift & Time of Year)
- Weather/Environmental Conditions
- Location of Fractured Parts
- Gauge Readings
- Where Were Relevant Personnel
- Failure Histories (Timing)
- Work Order Histories (Timing)
- Process Historian Trends



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TYPES OF POSITIONAL DATA

NOTES FROM SURROUNDINGS / ENVIRONMENT

LOCATION & OBSERVATIONS

- Location of failed components
- Location of employees during the event
- Visible leaks nearby
- Excessive vibration nearby
- Analog gauge readings
- Lighting of area
- Review any visual or video during the event (e.g., sheet breaks on a paper machine)

SEARCH FOR CORRELATIONS

- Events only occur when making a specific product/grade
- Events are more prevalent during colder months
- Events are more prevalent with a specific shift
- The time to failure is consistent from event to event
- Happens more on piping bends not straight runs
- Happens more often at certain speeds

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Paper Data

- Procedures
- Training Records
- Procurement Documentation
- Shift Logs
- Maintenance Plans (e.g., PMs)
- Maintenance Histories (e.g., Work Orders)
- Inspection Results (Visual, Predictive, PM)
- Chem & Metallurgical Lab Test Results
- P&IDs / Drawings
- HR Records
- Recent Process Changes
- Recent Storeroom Material Changes
- Recent Changes to Lubrication Suppliers
- Asset Strategies



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Beware of Paper Data Overload



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People Data

- Witnesses
- Maintenance Personnel
- Operations Personnel
- Quality Personnel
- Reliability Technicians
- E & I Personnel
- Mechanics
- Storeroom/Warehouse Personnel
- EH&S Personnel
- Purchasing/Accounting Personnel
- Chem/Metallurgical Lab Personnel
- Leadership/Sponsors/Mgmt. Peo
- Vendors/Suppliers



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Paradigms

- 'Management does not care about safety'
- 'Reliability is a just a Maintenance thing'
- 'Maintenance does not know what they are doing'
- 'Operators do not know how to operate the equipment'
- 'Those alarms are okay to bypass (nuisance)'
- 'It's a design problem, nothing we can do but just keep fixing it when it breaks'



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Parts Data

- Material Samples
- Review of Old vs New Parts
- Residue Samples
- Lubricant Samples
- Failed Parts (i.e. - Bearings, Gears)
- Calibration of Instruments/Gauges
- Samples From Leaking Fluids
- Water Samples
- Raw Material Samples

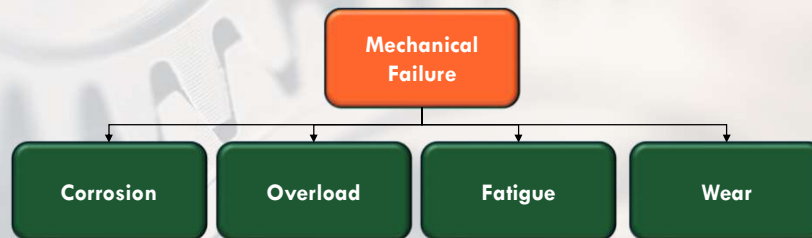


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Common Failures on Mechanical Components

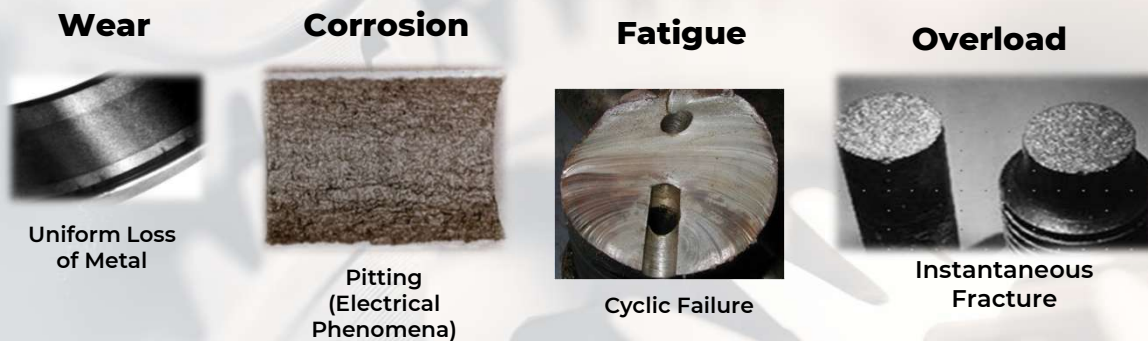


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Quick Lesson in Component Failure Metallurgy 101

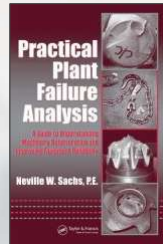


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Great Reference Books for Field Application



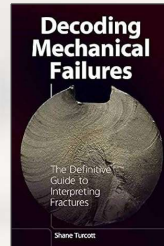
Practical Plant Failure Analysis

ISBN: 0849333768



How Components Fail

ISBN: 0871701898



Decoding Mechanical Failures

ISBN: 1777157609



Steel Isn't Hard (to Learn)

ISBN: 978-1777157616

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Develop a
“Stakeout”
plan to capture
the data for a
chronic failure
on the next
failure event

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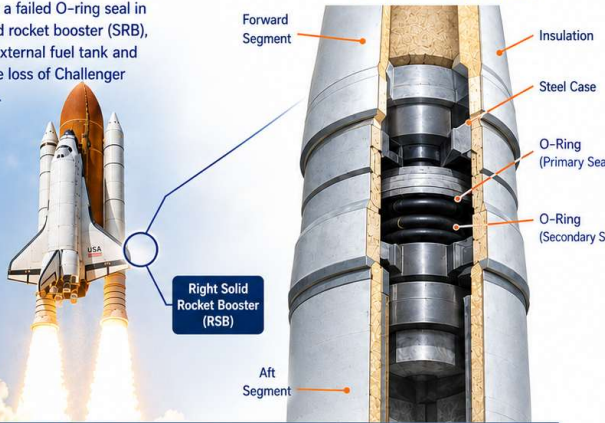


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SPACE SHUTTLE CHALLENGER

O-RING FAILURE – JANUARY 28, 1986

At 73 seconds after launch, hot gases escaped past a failed O-ring seal in the right solid rocket booster (SRB), igniting the external fuel tank and leading to the loss of Challenger and the crew.



SRB FIELD JOINT (SEGMENT CONNECTION)

- Forward Segment
- Insulation
- Steel Case
- O-Ring (Primary Seal)
- O-Ring (Secondary Seal)
- Aft Segment
- Right Solid Rocket Booster (RSB)

CONTRIBUTING FACTORS

- Cold weather launch (36°F / 2°C) caused O-ring material to lose elasticity.
- O-ring did not rebound and seal under pressure.
- Design relied on elasticity of the O-ring as the primary seal.
- Decision to launch despite concerns about low temperatures and O-ring performance.

THE FAILED O-RING

NORMAL (BEFORE LAUNCH)



O-ring is flexible and fills the groove, creating a tight seal that prevents hot gas from escaping.

FAILED (DURING LAUNCH)



A breach opened in the O-ring due to loss of elasticity (cold temperatures). Hot gases escaped past the O-ring.

O-RING CROSS SECTION

NORMAL



FAILED (BLOWN BY)



The O-ring was extruded (blown) out of its groove, reducing its ability to seal.

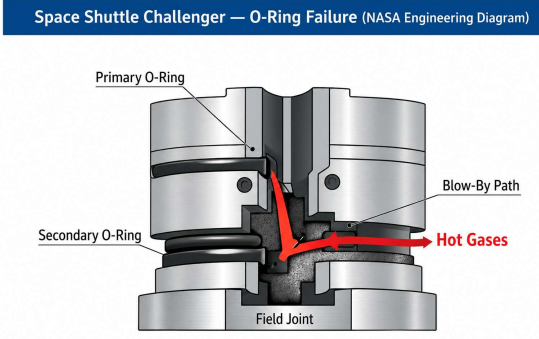
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Challenger Event Data

- 15/25 previous launches had **secondary o-ring erosion**
- 2 redesigns presented to NASA (12 -27 months)
- Criticality rating changed from **1R to 1**
- 748 criticality 1 items on Challenger (114 on SRB's)
- Elasticity tests performed on o-rings months prior to Challenger launch
- Launch temperature **36°F**

Space Shuttle Challenger — O-Ring Failure (NASA Engineering Diagram)



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Challenger Exercise




-  **Identify data** your team would like to collect related to the video case study shown.
-  **Utilize the data collection worksheets** that were distributed to document the strategy.
-  **Be prepared to share your results** with the other teams.

 **FYI – May be done in breakouts or in role playing where instructor is the team facilitator for everyone.**

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DATA COLLECTION EXERCISE

Develop a data collect strategy for the chronic failure that was used in the Problem Statement exercise.

Utilize the data collection worksheets that were distributed to document the strategy. Be prepared to share your results with the other teams.





Define
Clarify the failure and objectives.



Collect
Identify what data is needed and how to collect it.



Share
Be prepared to share your strategy and results.

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