

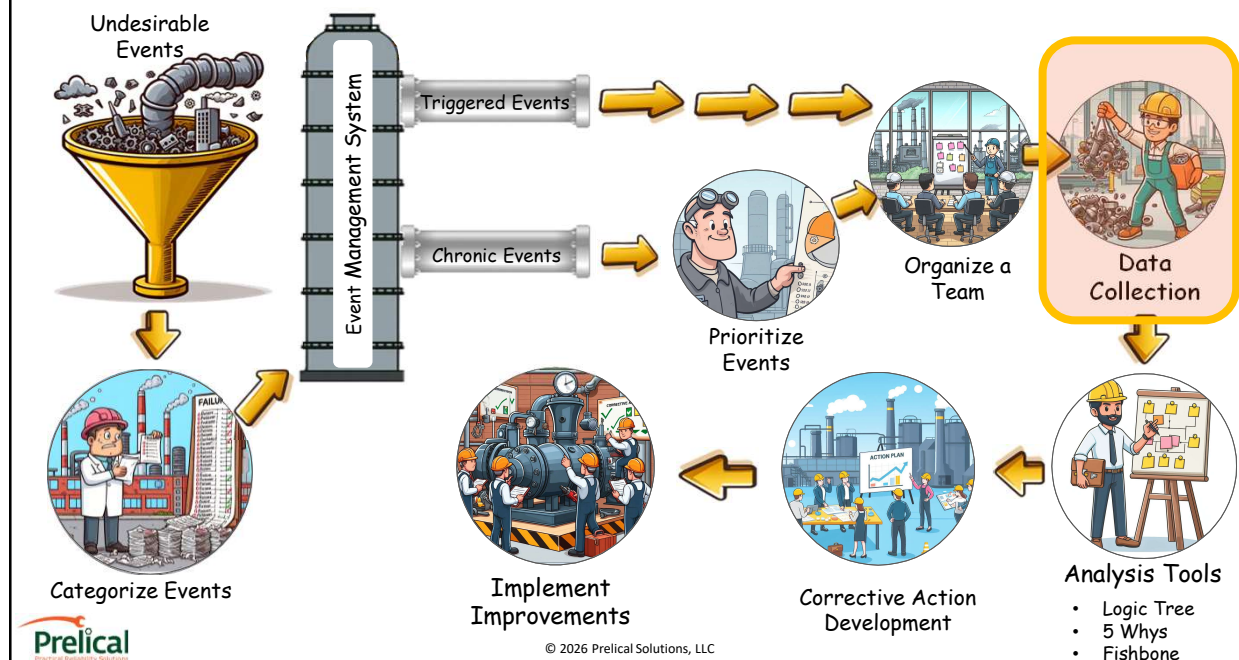
Data Collection



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1

Prelical Event Management System (PEMS)



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Become an Industrial Detective



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What Typically Happens After a Failure?

- Parts are discarded
- Area of failure is cleaned
- Poor job closure in the maintenance system
- No interviews take place
- Equipment is put back into service as fast as possible



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The Problem is:

**‘Root Causes’
cannot be
identified without
supporting data!**



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Why is Data Not Collected?

Common Paradigms

- Production comes first
- Not seen as important
- Management does not value data analysis
- I might be blamed for the failure



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6

6

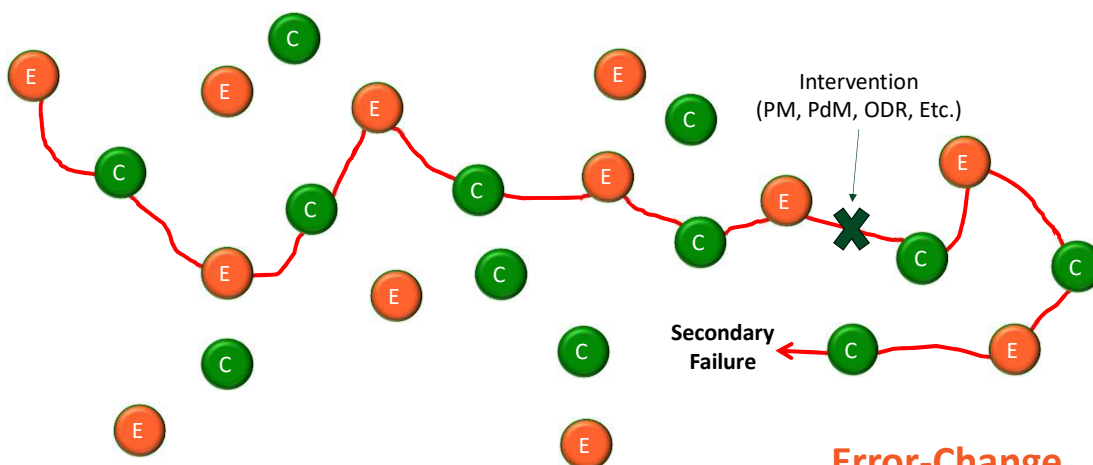
Why Blame Does Not Work

It takes multiple errors in a particular sequence to cause a failure



7

Why Blame Does Not Work...



It takes between 10 and 14 errors to queue up in a particular pattern for a secondary failure to occur.

**Error-Change
Phenomenon**

8

What is an Error?

An error is a mistake or deviation from what is accurate, correct, or expected. It represents a departure from a desired or intended outcome



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9

Common Causes of Human Error



Overconfidence

Excessive self-assuredness can lead to errors, as individuals might not double-check their work or may underestimate the complexity of a task.



Time Pressure

Working under tight deadlines or time constraints can lead to hurried decision-making and an increased risk of errors.



Distraction

Distractions, such as smartphones, noise, or multitasking, can divert attention away from the task at hand, causing errors.



Miscommunication

Misunderstandings or unclear communication can result in errors. Whether written or verbal, miscommunication can lead to misinterpretation and incorrect actions.



Fatigue

Mental or physical exhaustion can impair decision-making and reaction times, increasing the likelihood of errors.



Environmental Factors

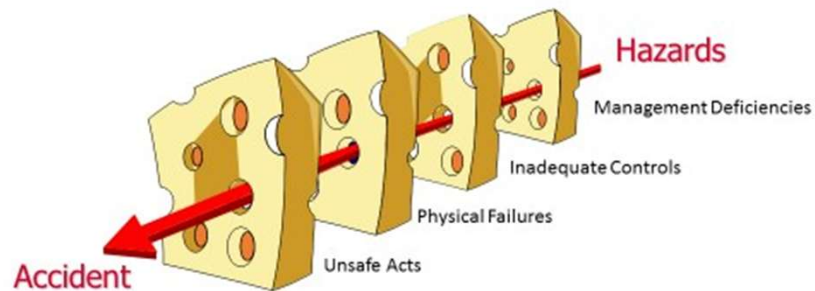
Factors like poor lighting, extreme temperatures, or uncomfortable working conditions can lead to errors.



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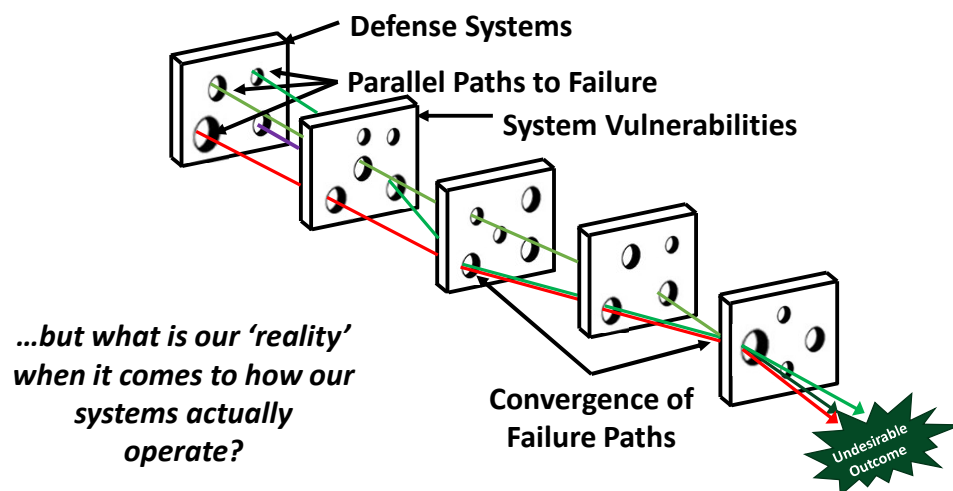
10

James Reason's "Swiss Cheese" Model of Accident Causation (1990)



11

The Bob Latino Interpretation of Reason's SCM



12

What Do Detectives Typically Do?

Evidence
Rope off area



What Do Detectives Typically Do?

Evidence	Sporadic	Chronic
Rope of area (freeze scene)	✓	
Take pictures/video	✓	
Interview witnesses	✓	
Note positions (chalk line)	✓	
Bag & tag evidence	✓	
Follow 'paper trails'	✓	



Data Collection Strategies

Unplanned



- **Triggered Events**

- Collect Physical Data
- Immediate Interviews
- Document Surroundings
- Collect it or Lose it

Planned



- **Chronic Events**

- Develop a **Data Collection Plan**
- Have Data Collection Tools Ready
- Execute Plan on Next Event



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Create a “Go Bag”



- High Resolution Camera w/Video Capability
- Flashlight
- Tags and Sharpie
- Safety Equipment (e.g., gloves)
- Tape & Measuring Tape
- Sample Containers and Baggies
- Basic Tools (hammer, wrench, screwdriver, pliers, etc.)



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16

Provide a Designated Location for Failed Components



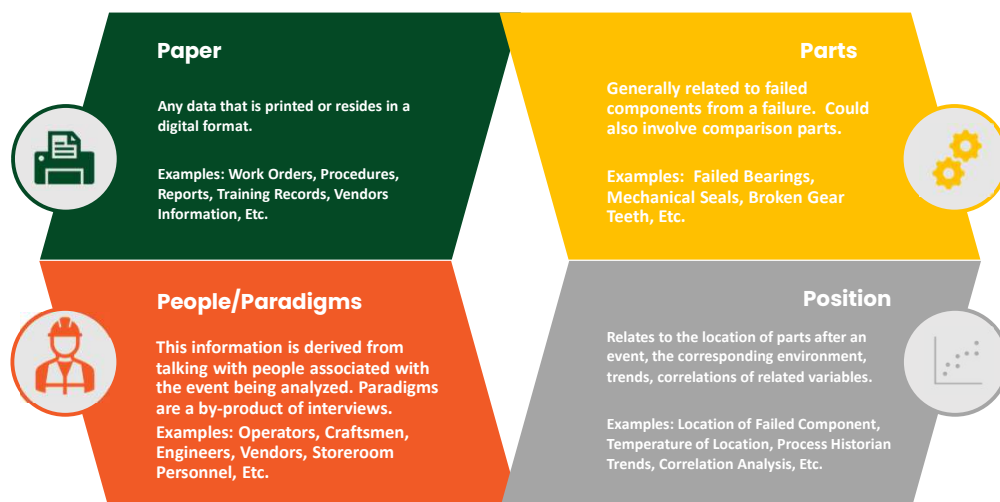
Equipment #:
Work Order Number:
Repair Date:
Craftsman:
Comments:



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17

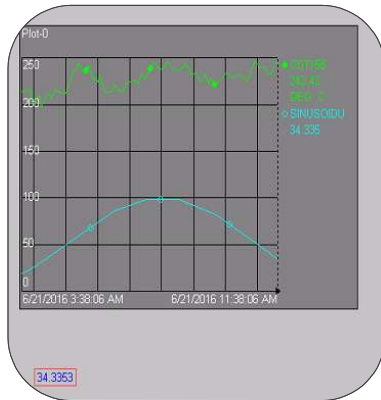
5Ps - Data Collection Categories



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18

Position



- 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

Position

Notes From Surroundings/ Environment

- 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

Paper



- 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

21

Be Careful of Documentation Overload



22

People



- 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
- Vendors/Suppliers

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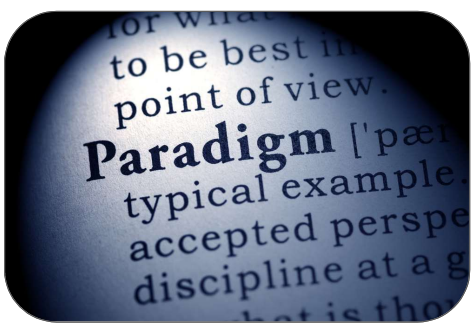
23

23

People/Paradigms - Examples

The By-Product of Interviews

- Management does not care about safety
- We always do it that way
- Maintenance does not know what they are doing
- Operators do not know how to operate the equipment
- Those alarms are okay to bypass (nuisance)
- We were never trained to do that task
- What's the problem, we're fixing it faster each time!!



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24

24

Interviewing Handout Available On Download Link Provided



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36

Parts



- 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

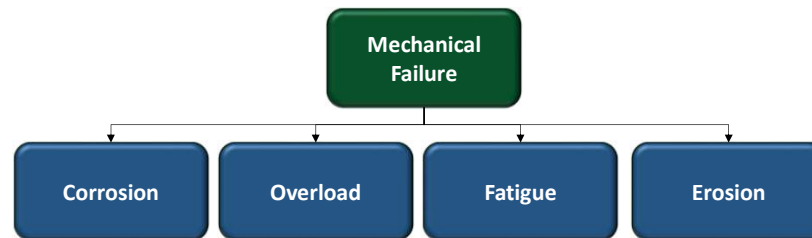


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37

37

Know Enough About Metallurgy to be Dangerous...Yet Stay Curious!



38

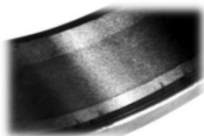
Quick Lesson in Component Failure Metallurgy 101

How Material Failure Occurs

Material Loss	Material is Overpowered
➤ Erosion (Wear) ➤ Corrosion	➤ Fatigue ➤ Overload

And many combinations of these four mechanisms!

Erosion



Uniform Loss of Metal

Corrosion



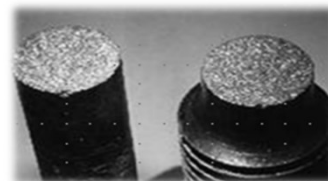
Pitting (Electrical Phenomena)

Fatigue



Cyclic Failure

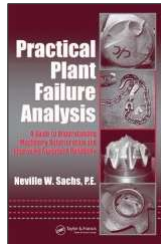
Overload



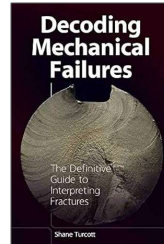
Instantaneous Fracture

39

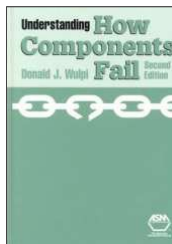
Great Reference Books for Field Application



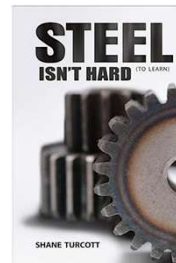
Practical Plant Failure Analysis
ISBN: 0849333768



Decoding Mechanical Failures
ISBN: 1777157609



How Components Fail
ISBN: 0871701898



Steel Isn't Hard (to Learn)
ISBN: 978-1777157616



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53

Data Collection Strategy for Chronic Events

Develop a Collection Strategy

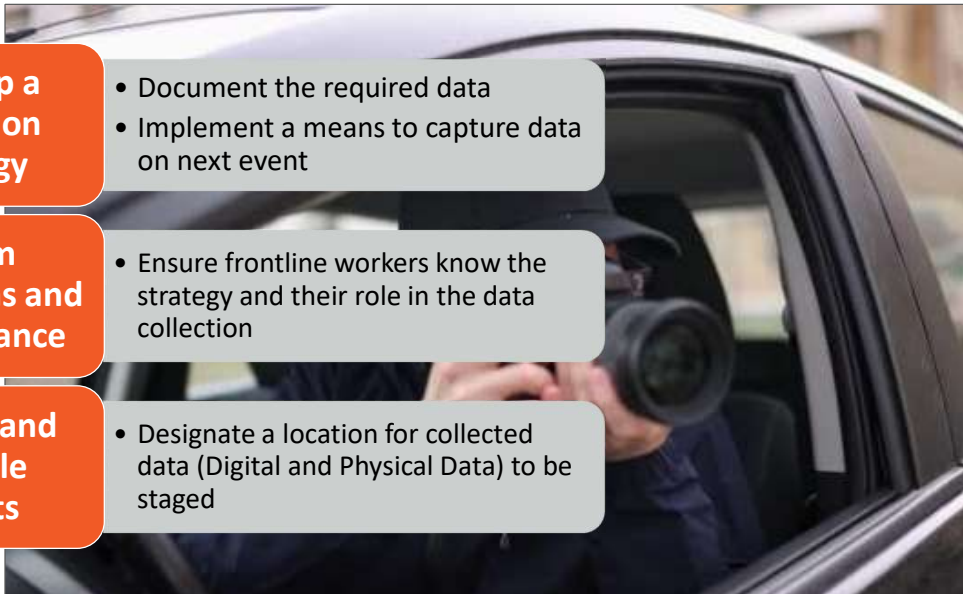
- Document the required data
- Implement a means to capture data on next event

Inform Operations and Maintenance

- Ensure frontline workers know the strategy and their role in the data collection

Execute and Compile Results

- Designate a location for collected data (Digital and Physical Data) to be staged



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54

Basic Data Collection Form

Data Category	Item	Collection Strategy	Assigned To	Target Completion Date
Documentation	2 Years of Work Order History	Get records from maintenance management system	Bill Smith	10/31/2024
Interviews	Operator on Duty	Setup with Operations Supervisor	John Doe	11/3/2024



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Basic Data Collection Form

Data Category	Item	Collection Strategy	Assigned To	Target Completion Date



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Utilizing Microsoft Teams for RCA Data Collection



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What Data Would You Need to Collect From the Scene?



**BP Texas City
Refinery
Explosion**



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58

58

Exercise – Data Collection

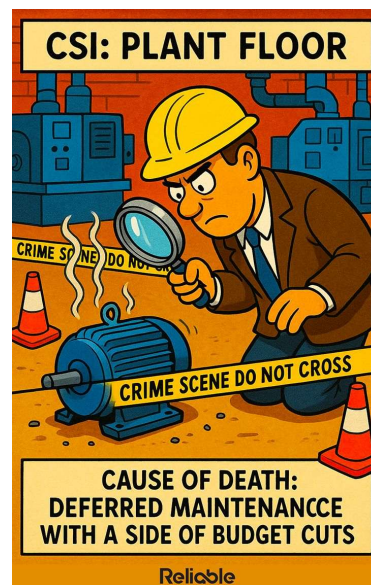
Develop a data collect strategy for the chronic failure that was used in the Problem Statement exercise. Utilize the data collection worksheets that were distributed to document the strategy. Be prepared to share your results with the other teams.



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59

An 'RCA' Without Data...Is Hearsay!
(Shallow Cause Analysis)



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63