



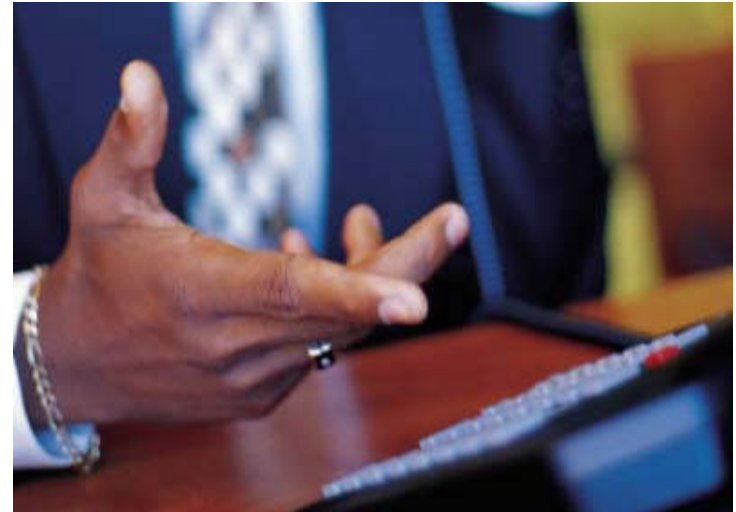
Module 3

Why People Commit Mistakes ?
(STUDYING HUMAN ERRORS)



HUMAN ERRORS

- Humans makes error, however with every error that we make there is typically an associated change or something out of the ordinary occurring in our environment. The difference between humans and machines is that people have the ability to sense change hear, smell, see, feel or taste something different & take the necessary actions to correct the anomaly. Humans are flexible while oftentimes machines are not

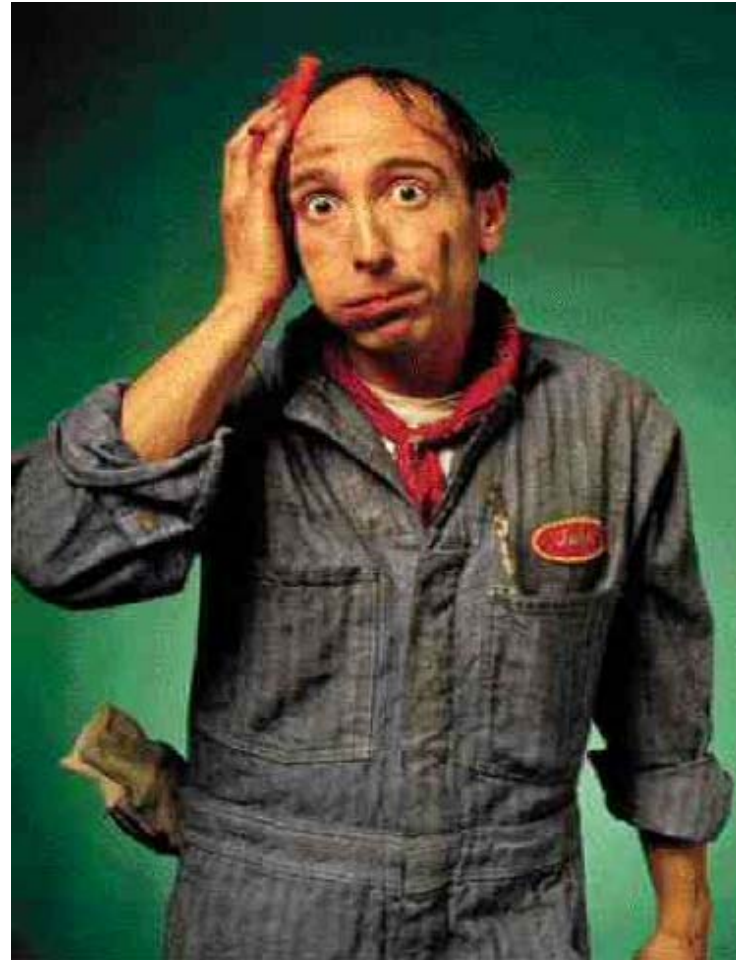


- An error can be defined as an action planned but not executed according to the plan. Research by Dr. James Reasons of the University of Manchester in England found that humans commit an average of 6 errors per week. With all the error that are occurring and all the ways that we could destroy our selves, life is still preserve, why, it is because humans have the ability to sense change & break the error chain

HUMAN ERRORS

The main causes of human errors are :

- Lack of Communication
- Complacency
- Lack of Knowledge
- Distractions
- Lack of Teamwork
- Stress and Fatigue
- Lack of Resources
- Pressure
- Lack of Assertiveness
- Lack of Awareness



HUMAN ERROR

- When considering the interaction of people and machines, human errors can be classified into 4 categories :
- **ANTHROPOMETRIC FACTORS**
- **HUMAN SENSORY FACTORS**
- **PHYSIOLOGICAL FACTORS**
- **PSYCHOLOGICAL FACTORS**
- Not all human error are necessarily the fault of the person who made the error. In many cases, the error is either force by external circumstances or by obsolete rules. So if blame is to be allocated for any error, care must be taken to identify the real root cause of the problem



A) ANTHROPOMETRIC FACTORS

- These are factors which relay to the size, shape and strength of the person.
- Errors occurs simply because the person simply cannot fit into the space provided, cannot reach something or is not strong that strong enough to move or lift something
- A taller person with a minimum height of 5ft 8inches minimum is required for this position since most of the operating buttons on the machine is located above the equipment. We cannot afford to allow the operators to jump just to reach this buttons because he or she is short on height

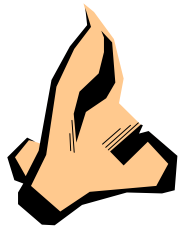


B) HUMAN SENSORY PERCEPTIONS

- These are the factors concern in which the ease with which people can see, hear, touch, feel and even smell what is going on around them
- Some failures will give some sort of a symptom or warning that they are in the process of occurring such as excessive vibration, loud noise, heat and smell which can be detected by the human senses
- Therefore if errors are occurring or thought to be likely for these reasons, the human error is not the root cause of the failure and we need to dig deeper into the real cause of the problem



SIGHT



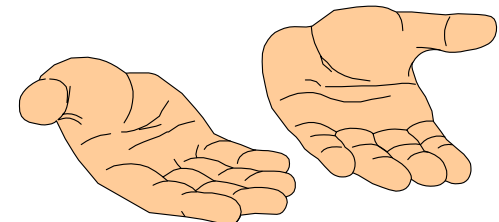
SMELL



HEAR



TASTE



TOUCH

C) PHYSIOLOGICAL FACTORS

- The term physiological factors refers to the environmental stresses which affect human performance. These stresses include high or low temperatures, loud or irritating noise, excessive humidity, high vibration, exposure to toxic chemicals, radiation or working too long without an adequate breaktime
- Exposure to these stresses leads to reduced sensory capacity, fatigue, and reduced mental alertness. These are all manifestations of human fatigue and all greatly increase the chances that the people concerned will make a slip, lapse or mistake.
- If errors occur or are thought to be likely to occur for any of these reasons then human error is not the root cause of the problem. Example reducing temperatures or providing hearing protection should minimize the persons exposure to noise



D) PSYCHOLOGICAL ERRORS

- Psychological human errors can be classified as those which are intended and those which are unintended
- An unintended error is one w/c occur when someone does a task which he or she should be doing but does it incorrectly (**Does the job wrong**)
- An intended error occurs when someone deliberately sets out to do something but what they do is inappropriate or wrong (**Does the wrong job**)
- Unintended error are divided into slip and lapses while intended error are divided into mistakes and violations



What if the guy using the sledge hammer missed and bonked the holder on the head? What if he lost his balance and fell out of the backhoe bucket? What if a chip of metal broke off and flew toward the holder's face? What if the holder slipped and fell into the trench behind him? What if the holder sneezed just as hammer was coming down?

ROOTCAUSE FAILURE ANALYSIS

D) PSYCHOLOGICAL ERRORS

HUMAN ERRORS

UNINTENDED ACTIONS

SLIP

ATTENTIONAL FAILURES
Carry out a planned tasks incorrectly or in the wrong sequence

LAPSES

MEMORY FAILURES
Missed out a step in a plan sequence of events

INTENDED ACTIONS

MISTAKE

RULED-BASED MISTAKES
Misapplication of a good rule or application of a bad rule
KNOWLEDGE-BASED
Inappropriate response to an abnormal situation

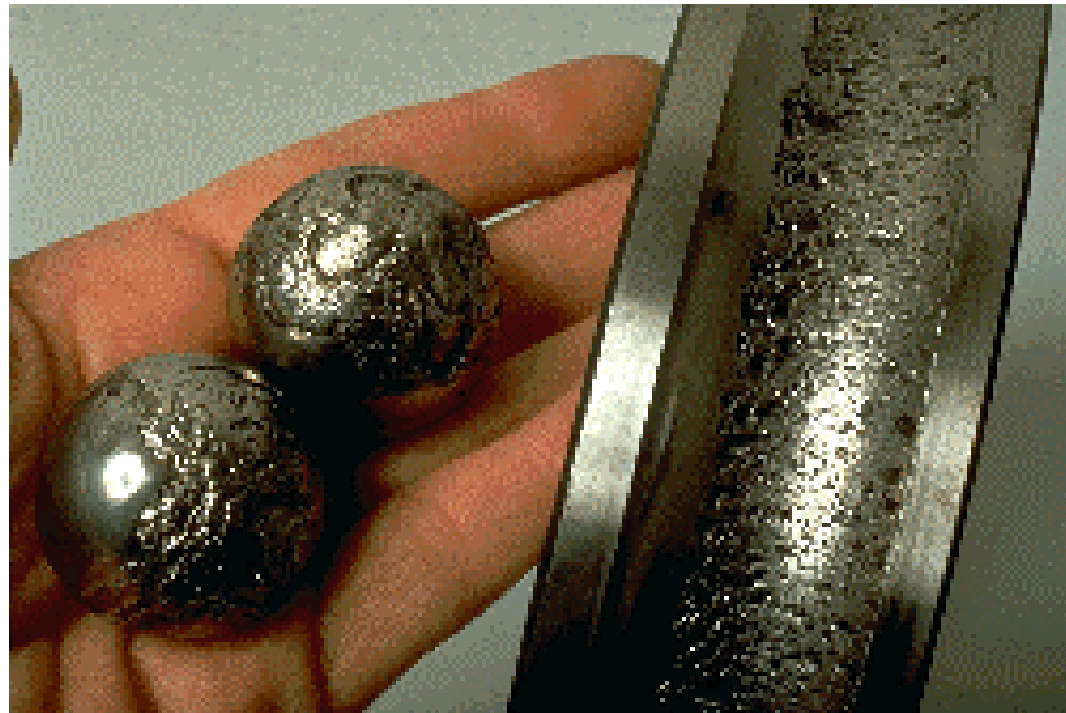
VIOLATION

ROUTINE VIOLATIONS
EXCEPTIONAL VIOLATION
ACTS OF SABOTAGE



Module 4

How Root Cause Analysis Works
(Case Study Samples)



RCFA CASE STUDY

CAUSE STUDY :

- A pump was declared failed since it was not discharging fluid at all. The pump failed due to a failure of the bearing. The maintenance decided to perform a Root Cause Analysis on the failed bearing to determine the real cause of the problem and have the failed bearing analyzed on a metallurgical laboratory. Arrange the causes in sequence to determine the real root cause of the problem

INSTRUCTION :

- Brainstorm and analyze the case study and rearrange the set of cards and prepare a RCFA Logic Tree Diagram

Clues :

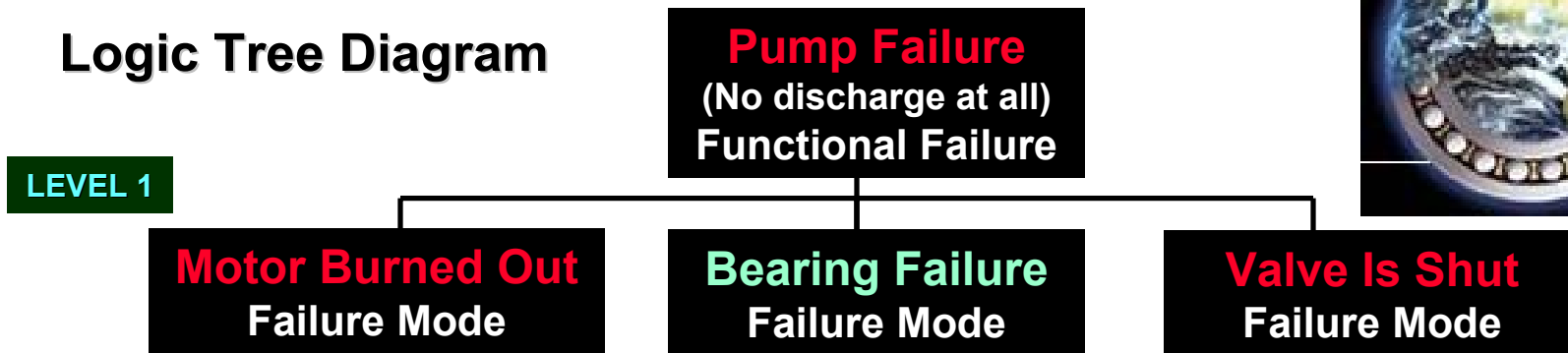
- There are 6 or 7 levels in the logic tree
- Metallurgical lab report indicates that the bearing failed due to fatigue w/c is a a type of wear
- The last level (Bottom part) will be the real root cause of the problem



ROOTCAUSE FAILURE ANALYSIS

ANALYZING THE BEARING FAILURE LOGIC TREE

Logic Tree Diagram



Lets analyzed the failure of a pump

- The pump failed since it is not discharging fluid at all
- All causes are hypothesis and must be proven if they exists
- The motor was checked and it was working, therefore, motor burned out had been disregarded
- The valve was open therefore, valve shut had been disregarded
- The bearing had been analyzed and it was evident that there was bearing failure, we now asked why the bearing had failed

ANALYZING THE BEARING FAILURE LOGIC TREE

LEVEL 2 : DIRT/DEBRIS and WEAR

- The bearing may fail on a variety of reasons, such as dirt entry or ingression which may have caused the accelerated wear of the bearing. All are probable causes and are still considered as hypothesis. Hence, to distinguished the facts from hearsay the bearing was sent to a metallurgical lab for further analysis to determine how did the bearing failed to fulfill its function.

LEVEL 3 : WEAR DUE TO FATIGUE

- The bearing had been analyzed and reviewed by metallurgist and the report concluded that there is strong evidence of **FATIGUE**, now the other probable causes had been therefore eliminated we ask ourselves how can fatigue occur on the bearing ?



ROOTCAUSE FAILURE ANALYSIS

ANALYZING THE BEARING FAILURE LOGIC TREE

Logic Tree Diagram

Pump Failure
(No discharge at all)
Functional Failure



LEVEL 1

Motor Burned Out
Failure Mode

Bearing Failure
Failure Mode

Valve Is Shut
Failure Mode

LEVEL 2

Dirt / Debris

Lack of Lubrication

Overloading

Wear

LEVEL 3

Have the bearing analyze for its metallurgical lab on why it failed

Adhesive

Abrasive

Erosive

Fatigue

Corrosive

How

- Lubrication in the bearing was checked and found out it is sufficient
- Vibration monitoring shows there is no indication of overloading
- The only possibility left was Dirt/Debris and Wear and so the team decided to have the bearing test on a metallurgical laboratory

ANALYZING THE BEARING FAILURE LOGIC TREE

LEVEL 4 : HIGH VIBRATION

- In Level 4 of our analysis we ask ourselves **How can Fatigue occur on the bearing ?** We hypothesize that it can come from high vibration. We check our vibration monitoring records and we are certain that there is evidence of excessive vibration. Excessive amplitude from our vibration data supports our hypothesis that fatigue occur on the bearing due to high or excessive vibration

LEVEL 5 : MISALIGNMENT

- As we dig deeper into the root cause, again we hypothesize, **How can we have excessive vibration?** Possibilities is that it can come from imbalance, resonance and misalignment
- Again the vibration analyst verifies his vibration records and find out the resonance and imbalance is not a major cause for the excessive vibration. We called the maintenance who aligned the pump to align it again and we observe his practices. From our observation we are certain that he does not know how to align the pump properly



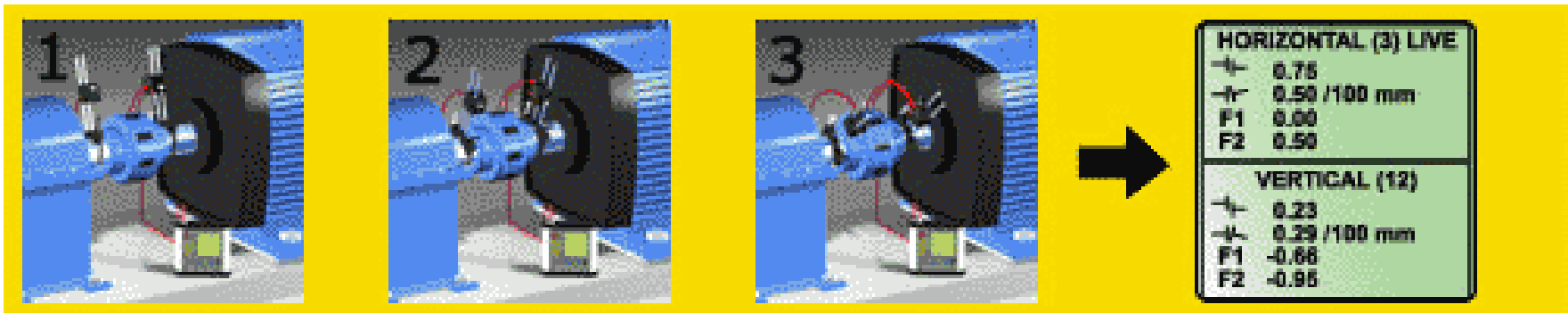
ANALYZING THE BEARING FAILURE LOGIC TREE

LEVEL 6 : NO PROCEDURE / NO TRAINING / IMPROPER TOOLS

- We asked the mechanic if he had been trained in the proper alignment and he said that he was never trained in how to align, there was no procedure for the alignment and how frequent it should be performed
- People often misalign because they were never trained in proper alignment practices, no procedure exists outlining alignment as a required practice with specification or the current alignment equipment we are using is worn out or inadequate for the application



THIS IS THE LATENT CAUSE



ROOTCAUSE FAILURE ANALYSIS

ANALYZING THE BEARING FAILURE LOGIC TREE

Logic Tree Diagram

Pump Failure
(No discharge at all)
Functional Failure



LEVEL 1

Motor Burned Out
Failure Mode

Bearing Failure
Failure Mode

Valve Is Shut
Failure Mode

LEVEL 2

Dirt / Debris

Lack of Lubrication

Overloading

Wear

LEVEL 3

Have the bearing analyze for its metallurgical lab on why it failed

Adhesive

Abrasive

Erosive

Fatigue

Corrosive

How

LEVEL 4

High Vibration

How

LEVEL 5

Imbalance

Misalignment

Resonance

How

LEVEL 6

Real Root Cause of the Problem

No Procedure

No Training

No Alignment Tools

WITHOUT RCFA WHAT DO THEY DO TO SOLVE THE PROBLEM

FROM A PREVENTIVE MAINTENANCE VIEWPOINT

- The maintenance will merely change or replace the bearing. If this part fails frequently then boss makes sure that there is enough stock in the warehouse department

FROM A PREDICTIVE MAINTENANCE VIEWPOINT

- Our CBM group can warn the operation of an impending failure to occur bought about by excessive vibration in the pump. Although the failure is predicted, the problem still does not seem to go away

FROM AN ENGINEERING VIEWPOINT

- Modify or change the bearing with a more heavy duty and put it in service. In short we conclude at once to change out the bearings with a New Design

FROM A CONTINUOUS IMPROVEMENT VIEWPOINT

- Brainstorming teams gather together with past history and data performance of the pump and sees a variety of causes, however they are not certain which is the real cause so they all agreed that it was due to the change in the lubricant

FROM AN OPERATIONS VIEWPOINT

- Hold countless hours of meeting blaming the maintenance for not doing their job

FROM TOP MANAGEMENT VIEWPOINT

- We penalize the culprits and even threaten to cut off their 13 month pay if the same problem arises in the future, or get another guy that can do the job better.

ACKNOWLEDGMENT

This is to thank the following people that have inspired me during the years in my study of Root Cause Failure Analysis

RCFA Consultants and Gurus

Bob Nelms Failsafe Network, Vee Narayan author of Risk Analysis,
Dr. Bill Corcoran, Robert Latino of Reliability Center Inc.
Mike Mulligan and the rest of the people from Root Cause
Analysis who have contributed and shared their knowledge
Thank You so much

My Wife and Children

But most of all to our dear God Almighty
for all the blessings . . .