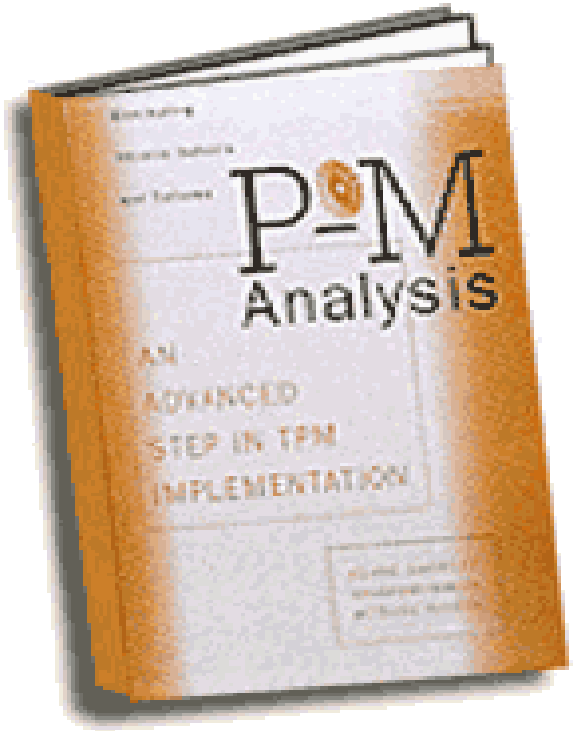
Eliminating Chronic Defects and Failures

Through

P-M ANALYSIS

Aiming for Zero Defects and Failures



P-M Analysis Modules

Module 1 : Nature of Chronic Losses

Module 2 : Understanding P-M Analysis

Module 3 : P-M Analysis Step by Step

Module 4 : P-M Analysis in Practice

Module 5 : Implementing P-M Analysis (Workshop)

Module 1 :

Nature of Chronic Losses

The Problem of Chronic Loss

Why does chronic losses persist ?

- **Failure to understand the nature of chronic loss**
- **Using ineffective approaches in dealing with chronic losses**

Chronic vs Sporadic Losses

Sporadic

- Indicate sudden often large deviations from the norm
- They result from a single cause that is relatively easy to identify
- Since rootcause is often a single cause corrective measures are easy to formulate and easy to correct

Chronic vs Sporadic Losses

	SPORADIC	CHRONIC
Characteristic	• Occur suddenly and infrequently , large deviations from the norm	• Smaller , frequent deviation, resist variety of corrective measures • Includes 1- 5%of the problem
Cause	• Single cause, problem is easy to identify	• Complex, tangled cause and effect relationship, difficult both to identify causes and clarify effect.
Countermeasure	• Restore to return to its previous level	• Requires innovative break through measures, that restore the mechanism or component to its original, defect-free state.
Approach	• Cause and Effect • Pareto Diagram	• P-M Analysis

Chronic vs Sporadic Losses

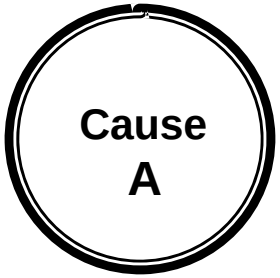
Sporadic Loss

- Requires restoration to return to previous level
- Large deviations from the norm

- Required innovation (corrective and improvement measures) to lower down the chronic loss rate
- Chronic losses become obvious when compared with optimal conditions

The Nature of Chronic Loss

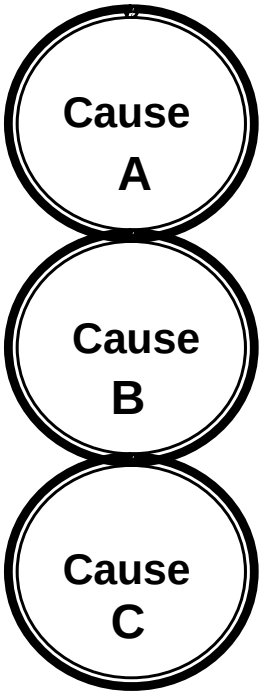
Case 1



A bearing seizes due to wear and tear. Bearing was replaced and problem was solved

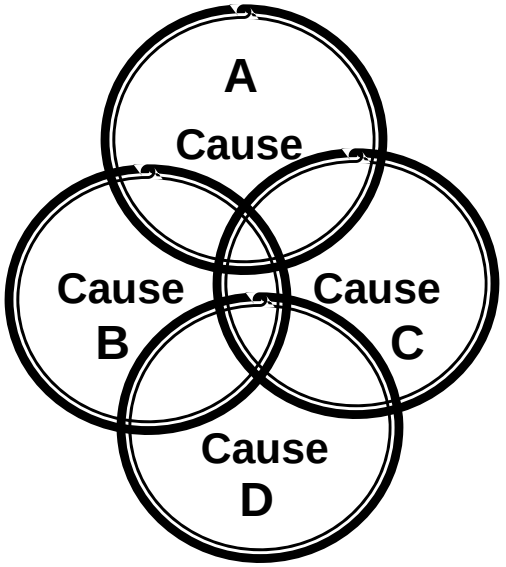
Single Cause Sporadic Loss

Case 2



One of multiple varying cause

Case 3



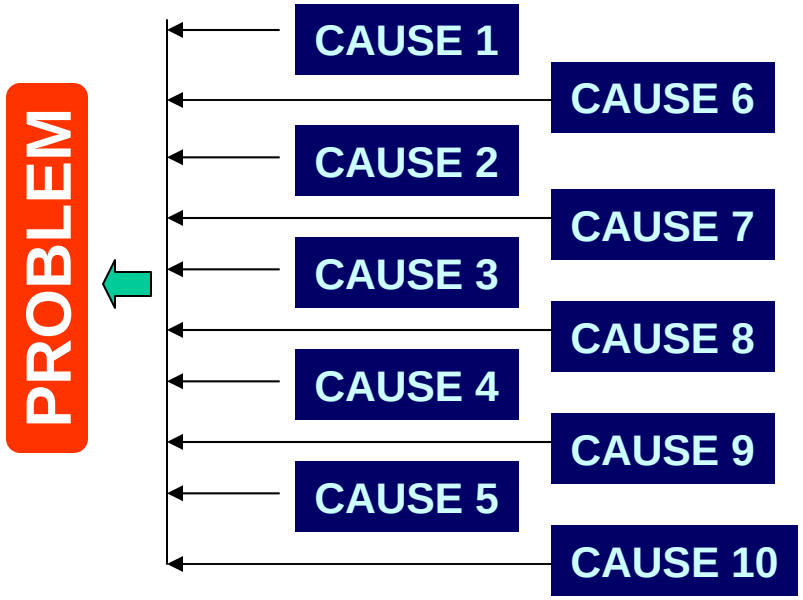
Each time the problem occurs a different combination of causes. Today it may be cause A, B tomorrow A, C, G and H

Varying complex combinations

Difficulty in pinpointing causes

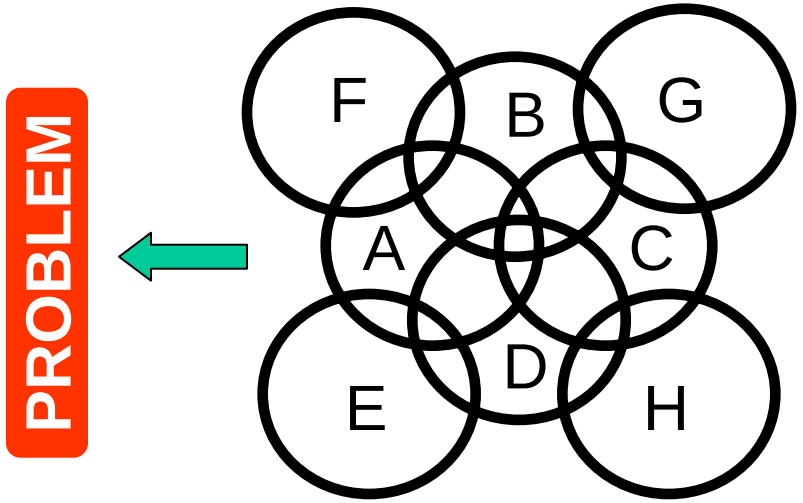
Even when measures taken against a single targeted cause are effective, the improvement is often temporary, hence the problem will resurface since we failed to eliminate the cause

Dealing With Chronic Loss



- A given problem with 10 potential causes , 1 to 10
- Each time the problem occurs, the cause is different
- Measure focused only 1 specific cause, cannot control the problem
- Today problem is caused by 1, 2, 3
  2nd shift is caused by 7, 8 and 10

How do you deal with this type of problem ?

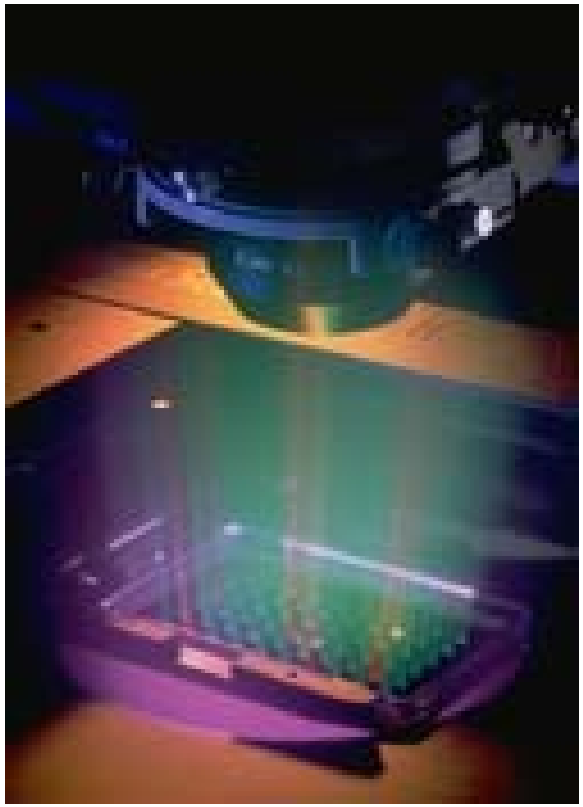


Varying Combination of Losses

- Identify all factors that contribute to a loss
- Thoroughly investigate each factor
- Eliminate any malfunctions or sub-optimal conditions discovered in the process

Why Chronic Losses Persists :

- ***Phenomena are insufficiently stratified and analyzed***
  - Defects and failures are not carefully observed and stratified
  - People do not notice the defect pattern (how), elements (where) periods (when)
- ***Some factors related to phenomena are overlooked***
  - Potential causes are overlooked and uncontrolled
  - Uncontrolled factors can easily lead to Chronic Losses
- ***Hidden abnormalities in individual factors are not addressed***
  - Failing to identify and respond to abnormal conditions
  - People are more alert to large problems since they appear more significant and the smaller the problem the more likely they are to be ignored
  - Slight abnormalities includes dirt, rust, vibration, loose-ness, slightly wear, dirty contact

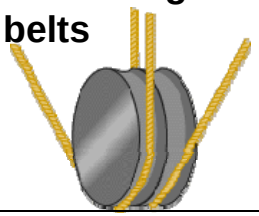


Phenomenon - the physical event or precisely what happens to produce the defect in question. This is the abnormal event to be controlled

Optimal Conditions :

- ***A thorough elimination of slight abnormalities is a prerequisite for achieving zero defects and breakdowns***

OPTIMAL = Necessary + Desirable

Mechanism	Necessary	Desirable
Pulley arrangement accommodating all three belts 	• At least one V-Belt must be installed for correct operation	• All 3 V-Belts should be installed for operation • All 3 V-Belts should have equal tension • The belts should be free of cracks & grease • Pulley should be free of abrasion • The motor and speed reducer should be aligned properly at all times
Grease supply 	• Grease must be supplied at specific locations	• Grease nipple should be kept clean • Area around the grease fitting should be wiped clean after each application • The condition and volume level of used lubricant should be checked constantly • Grease container should be kept clean • Used lubricant should be disposed of properly • The number of days for the lubricant to reach the end of piping should be estimated

Optimal Conditions :

- Represents equipment operating at its highest level - reliable maintainable performing to the full extent of its design capabilities. It is the sum of 2 categories namely necessary and desirable
- As good as new, it is what the equipment was designed and built

Necessary Conditions :

- Minimum requirement to support equipment conditions

Desirable Conditions :

- Desirable conditions are not essential for operation but they are needed to prevent breakdown and defects

Module 2 :

Understanding P-M Analysis

What is P- M Analysis ?

P

- **Phenomena** → Deviations from normal to abnormal state
- **Physical** → Physical Analysis to understand the physical principles behind an abnormal event

M

- **Mechanism** → Understand the mechanics of abnormal phenomena, How they are being produced
- **Machine** → Understand the mechanisms of the equipment
- **Man**
- **Machine**
- **Man**

Understand the relations between the abnormal event and the four production inputs (4M's)

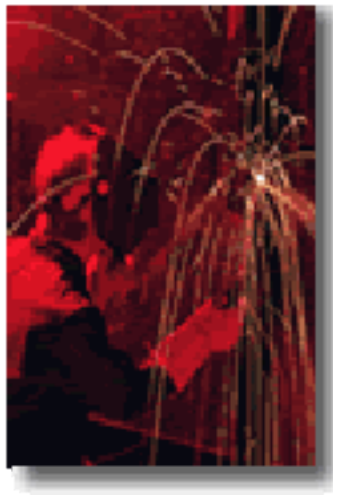
ANALYSIS → Analyze causes and effects

What is P- M Analysis ?

- Physical analysis physically analyzes chronic losses according to the inherent principles and naturals laws that govern them. It's principle asks in precise physical terms what happens when a machine break down or produces bad parts and how it happens

- P-M Analysis clarifies the mechanics of their occurrence and the conditions that must be controlled to prevent them

- Physically analyze chronic problems such as defects and failures according to the machine's operating principles.



Understanding Physical Analysis

Phenomena → **Physical Analysis** → **Cause**

Problem

How can it happen ?

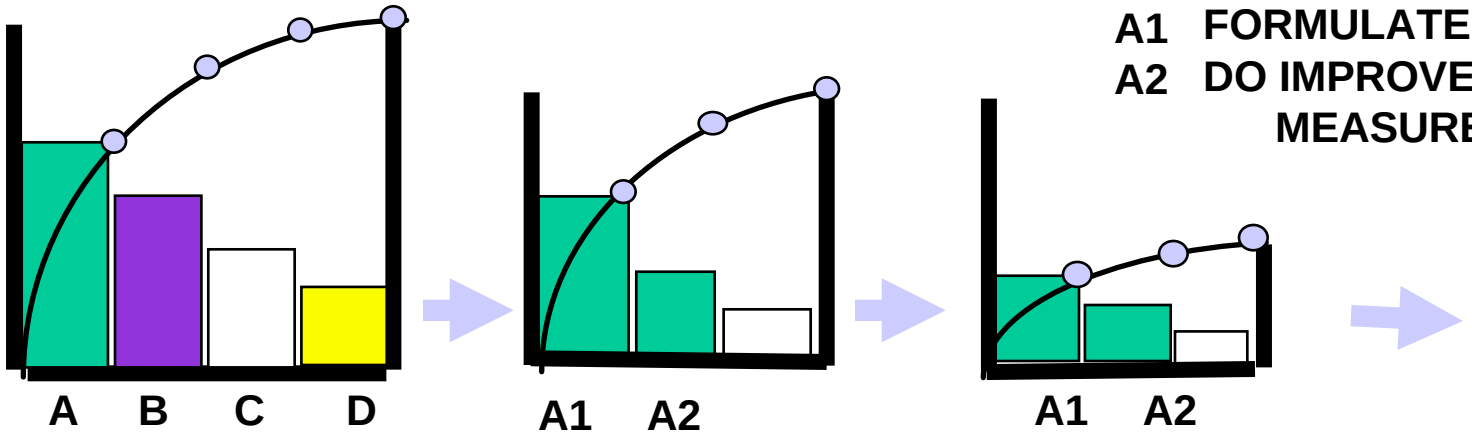
How can a phenomena occur ?

Why it happen ?

Physical Analysis, is a logical investigation of phenomena such as defects or breakdowns that explains how the phenomena occur in terms of its physical principles. To analyze means to breakdown a whole into several parts and learn their nature and relationships. Physical Analysis uses a machine's operating principles to clarify how various parts of a machine interact to generate the abnormal phenomena

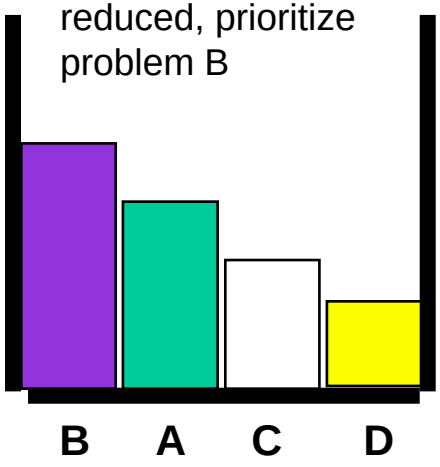
Physical Analysis, means logically explaining how a phenomena occurred, it does not necessarily explain why. It is a bridge that helps us draw logical relationship between a phenomena and their potential causes

CONVENTIONAL IMPROVEMENT APPROACH

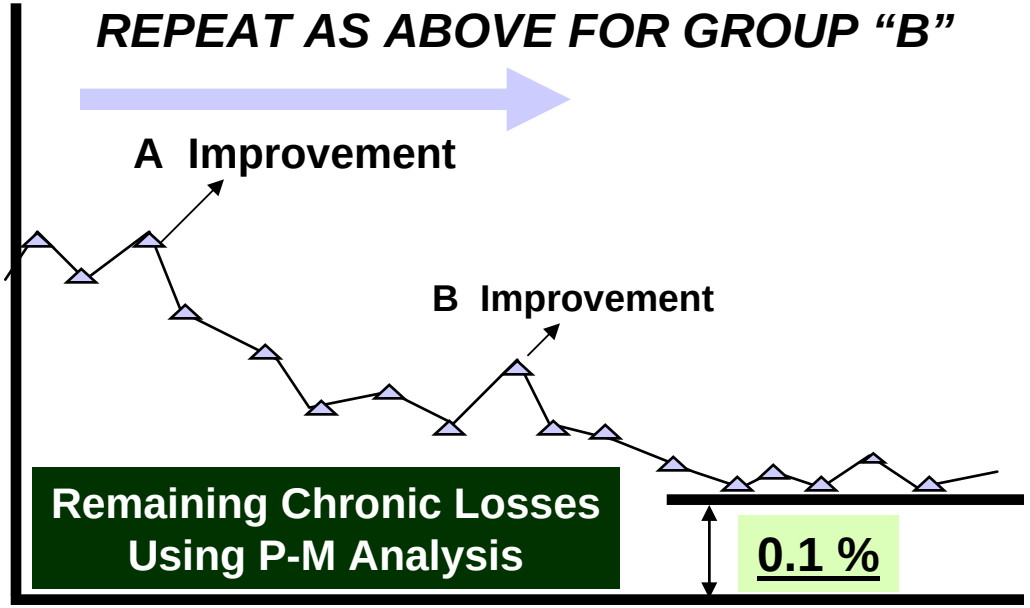


A1 FORMULATE AND
A2 DO IMPROVEMENT MEASURES

Problem A had been reduced, prioritize problem B



REPEAT AS ABOVE FOR GROUP "B"



Understanding Physical Analysis

Match Ignition Principles

A match lights when sufficient friction heat builds up between the red phosphorus on the matchbox and the potassium permanganate on the matchstick.

Physical Analysis why match does not light

The match does not ignite because friction heat is insufficient

Case 2 : Bicycle brakes function poorly

- Rubber brake pads are worn
- Rubber brake pads do not meet the wheel at the proper angle
- Rubber brake pads are contaminated with oil and dirt
- Brake cable is extended

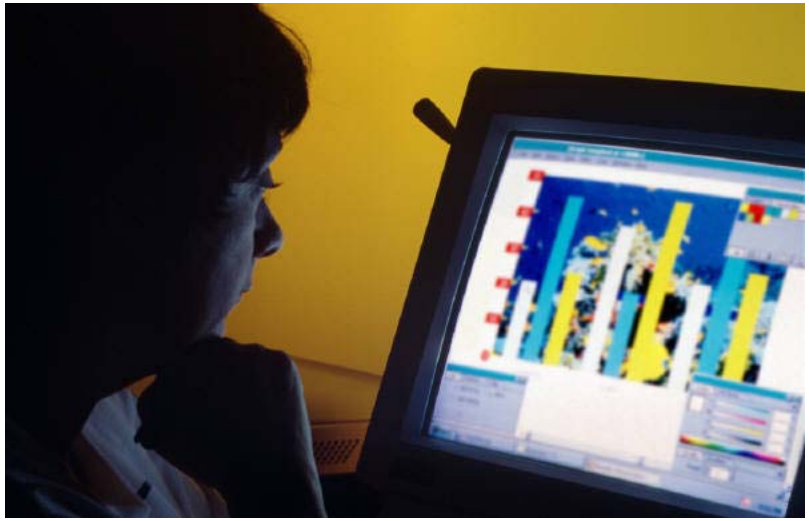
Physical Analysis

- Due to insufficient friction resistance, the brakes do not provide enough torque to control the bicycle's speed

Conventional Improvement Approach vs P-M Analysis

	Conventional Improvement	P-M Analysis
Objective	• Reduce to 1/2 or 1/4 its present level	• Reduce to zero
Concept	• Priority-Based • Focus on factors having the greatest impact • Carry countermeasures that are most effective	• Do not use priority based-approach • List all casual factors behind the defect • Investigate all factors & correct all abnormalities
Methodology	• Cause and effect diagram • Why-why analysis • Fishbone diagram	• P-M Analysis
Application	• Use where defect rate is high • Helps eliminate sporadic failures and defects	• Use where defect rate is low • Helps eliminate chronic losses and defects

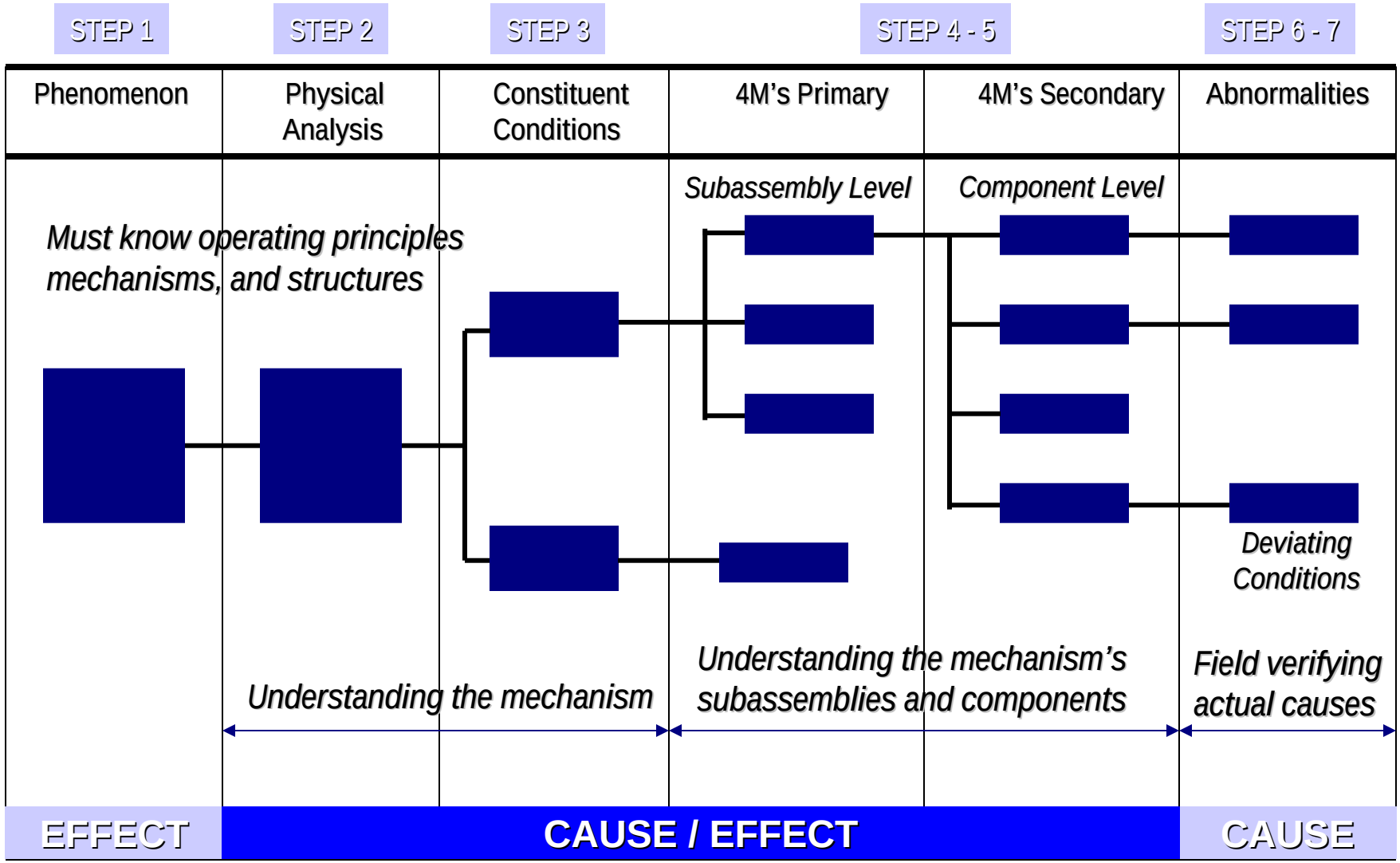
- **In areas where defect or failure rate is high first implement conventional improvement approach, and then adopting P-M Analysis to bring failure and defect rate to zero**



Steps in P-M ANALYSIS

Step 1 : Clarify the phenomenon	Define the abnormal occurrence or phenomenon
Step 2 : Conduct a physical analysis	Describe the phenomenon in physical terms on how the parts or process conditions change in relation to each other to produce the failure or defect
Step 3 : Define the phenomenon's constituent conditions	Identify all the possible conditions that will consistently constitute or produce the phenomenon
Step 4 : Study production input correlation (4m's)	Look for potential cause and effect relation between the constituent conditions and equipment, materials, work methods and human factors
Step 5 : Set optimal conditions	Set standard values and review the equipment's current precision levels to determine where new or revise standards are deficient
Step 6 : Survey casual factors for abnormalities	Confirm which factors identified in step 3 and 4 exhibit deviating conditions
Step 7 : Determine abnormalities to be addressed	Review survey results and lists all abnormalities including slight defects to be addressed
Step 8 : Propose and make improvements	Implement corrective measure or improvement for each abnormality uncovered then institute operating standards and PM procedures to maintain optimal conditions

Relationship Between P-M ANALYSIS and Cause & Effect



HOW TO CONDUCT A PHYSICAL ANALYSIS :

			Physical Analysis	
	Operating Principles	**Operating Standards**	**Interacting Elements**	**Quantifiable Changes**
Flashlight does not work	• Current flow in resistor wire causes thermal effect and lamp lights when temp reaches 1000 C	• Battery's electrostatic value must be no higher than the rated value • There must be sufficient contact between battery and filament • Bulb should not be burned or busted	• Battery and filament	• Current is not sufficient to light the bulb
Blown Fuse	• An electric charge with a higher than rated current pass through a fuse (a weak connection point for more than the time allowable causing heat to build up until fuse blows and circuit breaks	• Total electric charge must remain constant • Electric current must remain constant • The fuse capacitance must be 3 to 5 x rated current value	• Between equipment and fuse	• Excess current above rated value caused heat to rise until it melted the fuse