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8 STEP CLOSED LOOP PROBLEM SOLVING

Root Cause Analysis & Corrective Action

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March 5, 2014

IMEC

Objectives

- Introduction to IMEC
- 8 Step Closed Loop Problem Solving Process Review
- Rules for Problem Solving Success
- Summary

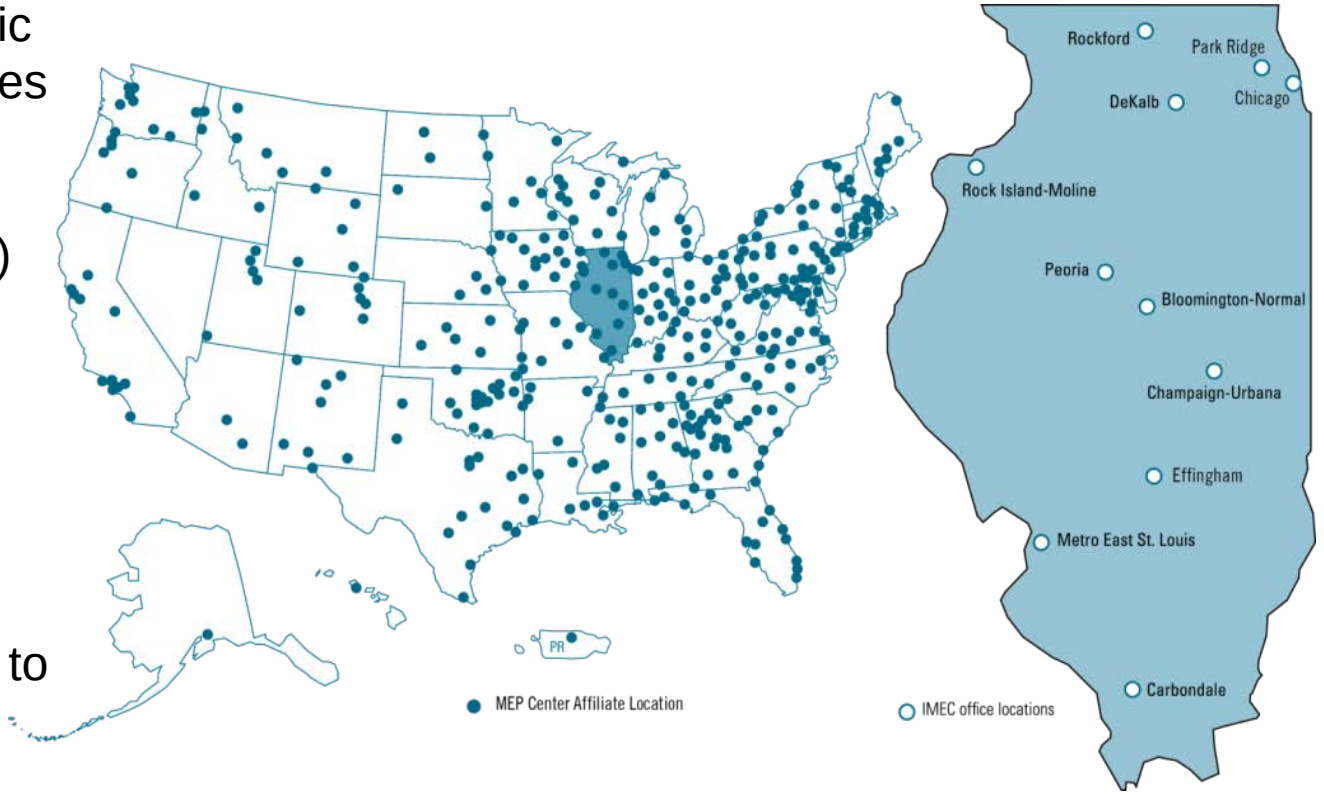
About IMEC

Who we are:

IMEC is a private, public partnership that operates through the National Institute of Standards and Technology (NIST)

What we do:

IMEC delivers customized training, hands on technical assistance, and leadership advisement to help manufacturers improve bottom line results



Catalysts for Transformation…

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"The significant problems we face cannot be solved at the same level of thinking we were at when we created them."

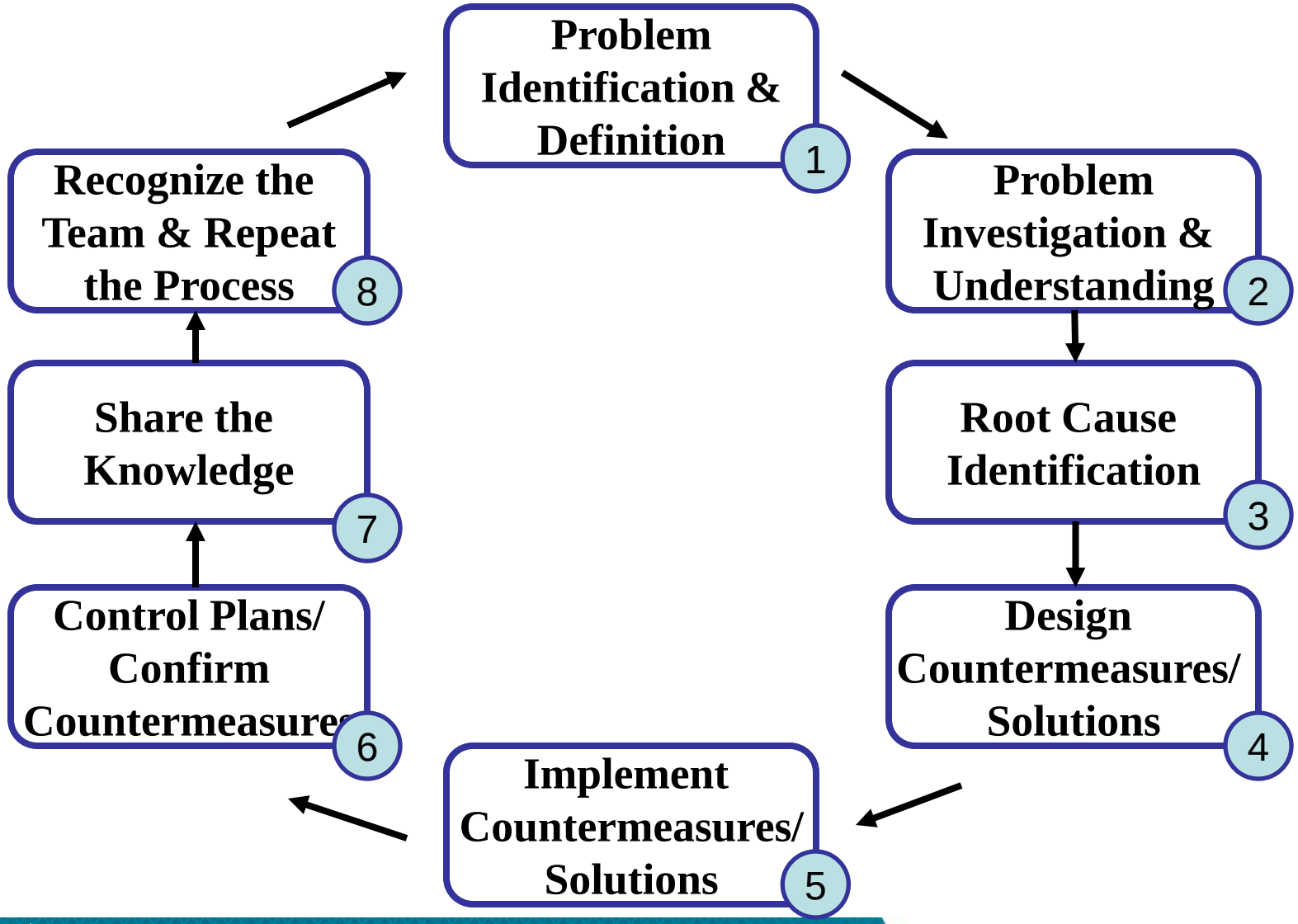
--*Albert Einstein*

Understanding the 8 Step Closed Loop Problem Solving Process

“Knowing” Truths

- We don’t know everything
- We don’t know what we don’t know.
- We can’t do what we don’t know.
- We need accurate data on which to decide what we know.
- We won’t know until we measure.
- We don’t measure what we don’t value.
- We don’t value what we don’t measure.
- We can’t not know what we do know.

Closed Loop Problem-Solving Process



Inhibitors to Effective Problem Solving

1. Lack of agreement that there is a problem.
2. Problem is described incorrectly.
3. Problem-solving effort is expedited (focus on solution rather than cause).
4. Potential cause is misidentified as the root cause.
5. Countermeasures are applied, but not confirmed.
6. Knowledge is not shared with other lines, departments, factories or divisions.

Team Approach to Problem Solving

Cross functional teams are more effective than “lone rangers”

- Involving all steps of the process will deliver improved results
- Choose members from all functions affected
- Don’t forget customers and suppliers

Creating Teams

- Teamwork Principles
- Roles of Team Members
- Team Code of Conduct
- Productive Meetings
- Groupthink

Step One

Problem Identification and Definition

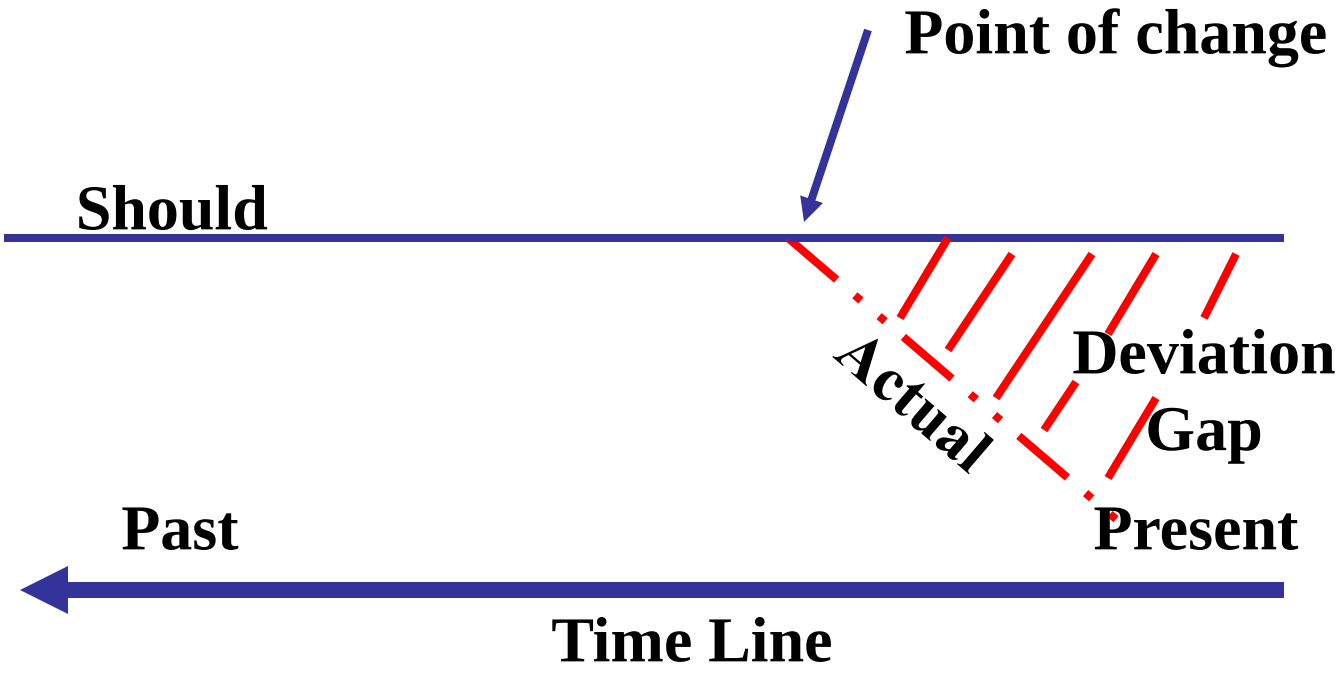
Problem Identification & Definition

1. Sudden Deviation
2. Deviation from Initial Start Up
3. Should has Changed
4. One Time Occurrence

All four types of problems have a deviation between what ***should*** be happening and what ***actually*** is happening.

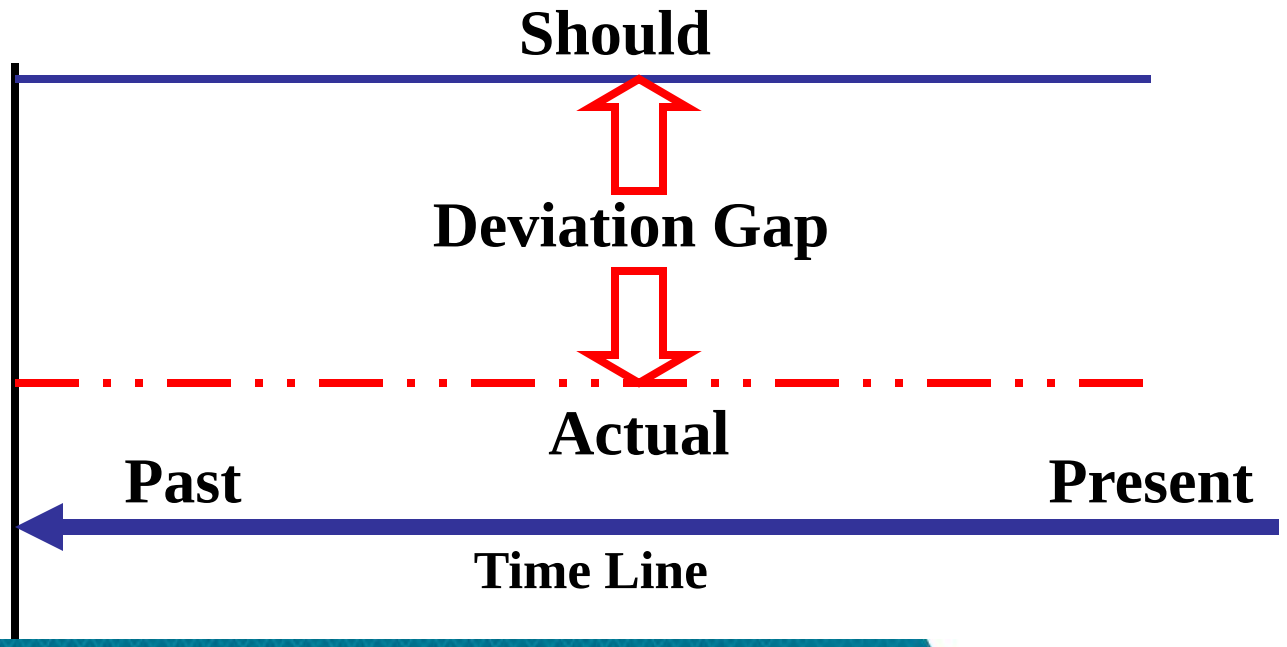
Problem Identification & Definition

- Sudden Deviation/Surfaced Over Time
  - ***Should*** has been attained in the past
  - Cause is unknown



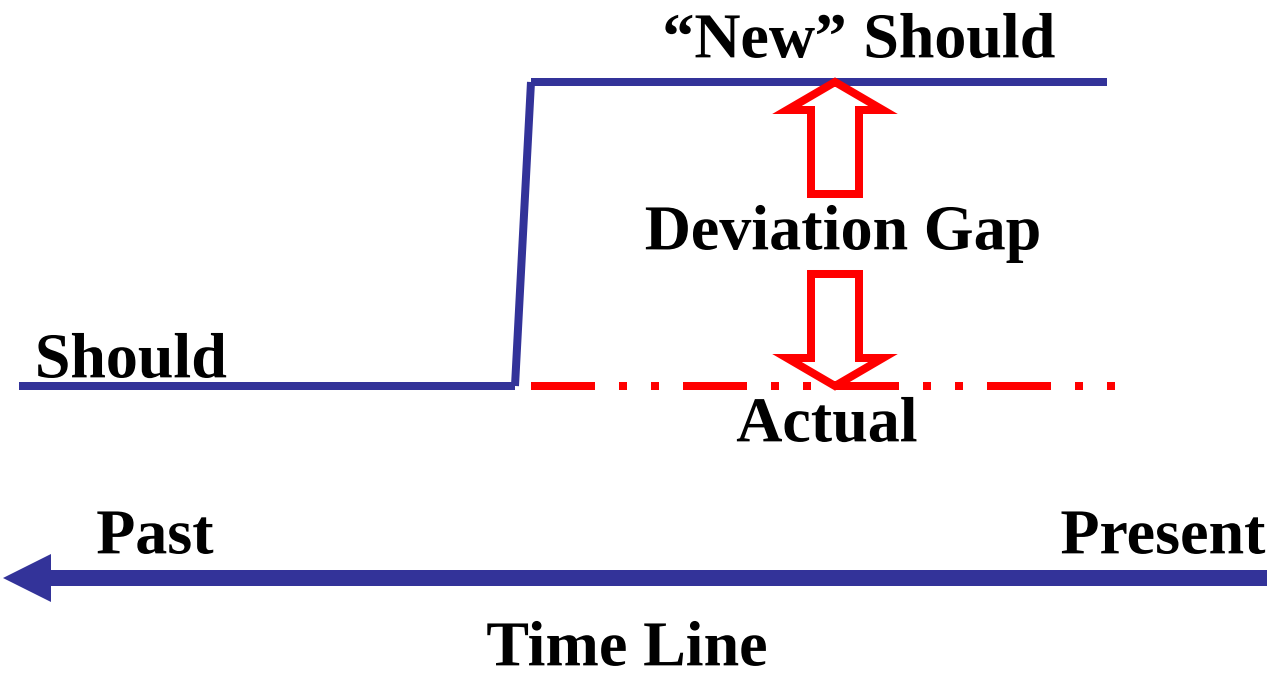
Problem Identification & Definition

- Deviation from Initial Start Up
  - The should has never been attained
    - Problem exists now & has always.
    - Is the should attainable?
  - The cause(s) may or may not be known



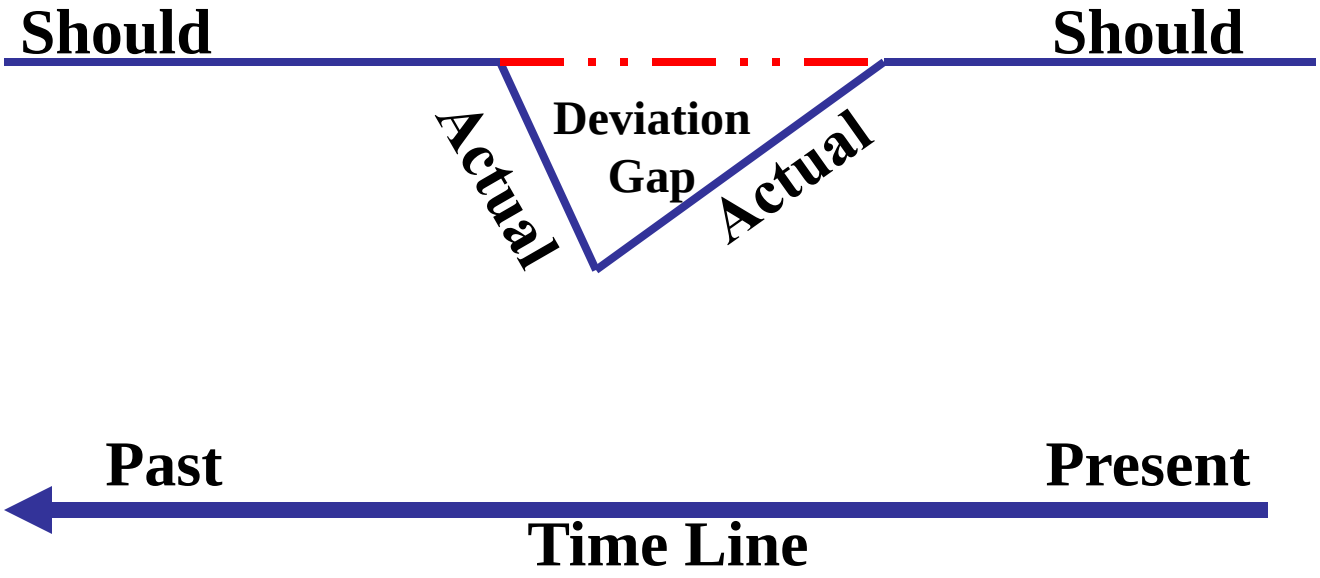
Problem Identification & Definition

- The ***Should*** has Changed
  - The should has been moved
  - The cause is known



Problem Identification & Definition

- One Time Occurrence
  - Cause may or may not be known
  - May be intermittent



Containment: Awareness

- Be aware that there is a problem/issue
- Note:
  - Who reported the problem?
  - When was the problem reported?
  - What was reported?
  - Where was the problem noted?
  - How many times has it happened, how many parts were found, etc.?

Containment comes FIRST

- **Stop the bleeding.**
- **Put out the fire.**
- **Turn off the water.**

Then worry about the problem statement.

Problem Identification & Definition

- ***Do's***
  - Safety/business issue identified
    - Should is identified
    - Actual is identified
  - Specific
    - The specific Object is identified
      - One Object only
    - The specific Defect is identified
      - One Defect only
  - Manageable in size
    - Scope is reasonable & attainable

Problem Identification & Definition

- ***Do Nots***
  - Do not state cause(s)
    - Root cause(s) not yet known
      - Guessing/hoping
  - Do not state solution(s)/countermeasure(s)
    - Root cause not yet known
      - Jump to solution
  - Do not blame
    - Non-productive
    - Hiding out/passing the buck

NOTE: Do not use the word “and”

Problem Identification & Definition

- **Object**
  - What specifically is having the problem?
    - JSA finding
    - OSHA finding
    - Machine Guard failures
    - Pinch-point incidents
    - Lock Out / Tag Out program ineffective
    - Confined Space permits not requested

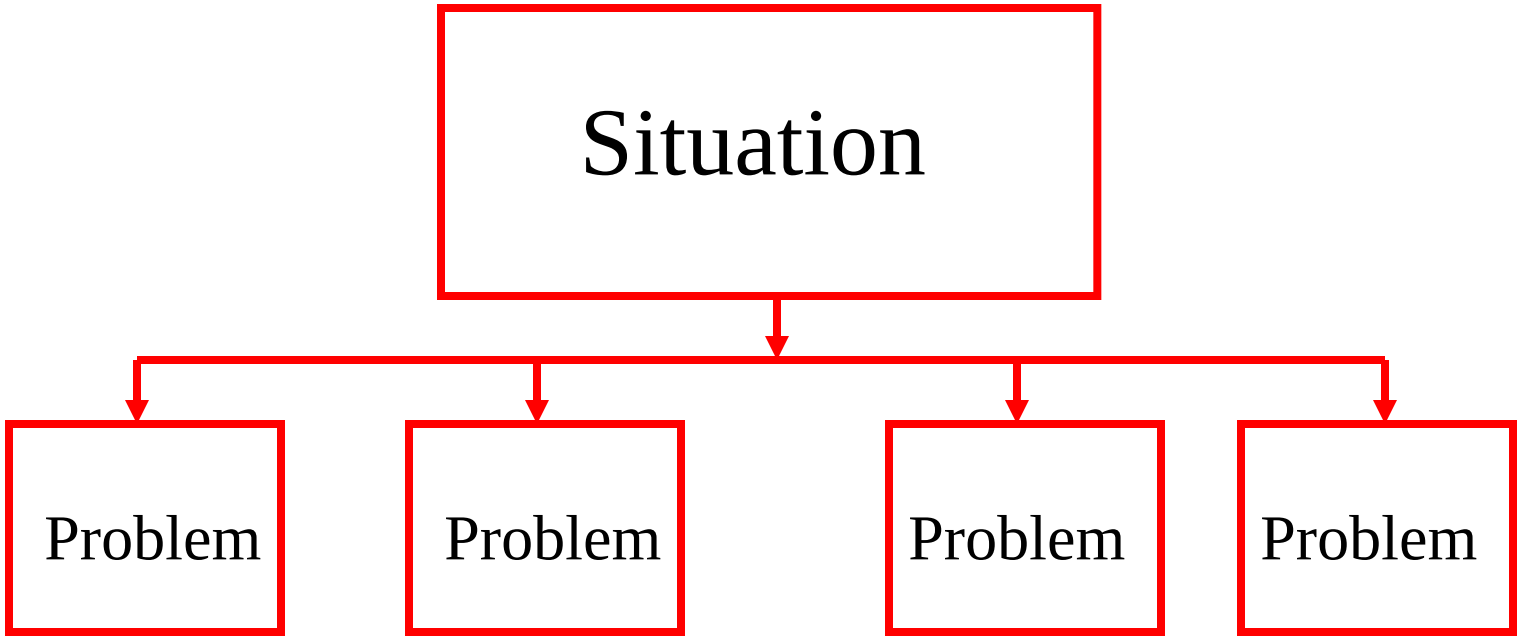
Problem Identification & Definition

- **Defect**
  - What is the problem specifically with the Object?
    - Inadequate or non-existent controls
    - Loss-time incident
    - Near miss requiring action
    - Employee complaint

Problem Statement Matrix

Situation	*Do's*			*Do Not's*		
	Issue	Specific	Manageable	Causes	Solutions	Blame
The maintenance department was cited again. Technicians are lazy and should be written up.	X					X
Maintenance received a request on press 23 on 2/12/14 that requires action for machine guarding on the operation.	X	X	X			

Problem Identification & Definition



Step Two

Problem Investigation/Understanding

Problem Investigation/Understanding

Symptom vs. Problem

Symptom	Problem
Eye injuries are escalating	Employees are not wearing required eye protection
Company incident rate slipped in 2013	A defined safety program is not effectively implemented
Insurance rates are climbing higher than ever before	Ineffective problem solving skills are not identifying root-causes of safety issues

Problem Investigation/Understanding

5W2H Problem Description

- ✓*Who?*
- ✓*What?*
- ✓*Where?*
- ✓*When?*
- ✓*Why?*
- ✓*How?*
- ✓*How Many?*

Answer these questions to specify the information/data about the problem to make certain that all of the relevant information is recorded.

Problem Investigation/Understanding

5W2H Problem Description

✓ *Who…*

- *specifically detected the problem?*
- *might be involved in the problem?*
- *may have special resources or access to useful information?*
- *might gain from a resolution of the problem?*

Problem Investigation/Understanding

5W2H Problem Description

✓ *What…*

- *is the Object with the Defect?*
- *what is the specific Defect?*
- *are the requirements of the situation?*
- *are there difficulties or risks involved?*
- *are there deviations or gaps that are being observed?*

Problem Investigation/Understanding

5W2H Problem Description

✓*Where…*

- *is the defect first found?*
- *geographically has the defect been found?*
- *is the defect on the object?*

Consider location; place; focal points of the problem.

Problem Investigation/Understanding

5W2H Problem Description

✓*When…*

- *was the defect first detected on the object?*
- *Specific date and time.*
- *Timeline*
- *since first detecting the defect, has it been detected again?*

Consider shifts; schedule; dates; timeliness of the situation.

Problem Investigation/Understanding

5W2H Problem Description

- ✓*When…*
  - *are there any patterns?*
    - *Continuous?*
      - *Once it begins, it continues*
    - *Sporadic?*
      - *No perceptible pattern*
    - *Periodic?*
      - *Very specific pattern*
      - *Pattern is often difficult to detect*

Problem Investigation/Understanding

5W2H Problem Description

✓ *Why is the defect occurring…*

- *at a certain place, location or sequence in the process?*
- *at a particular time of day, week, month, year?*
- *with a certain person, group or division?*

Problem Investigation/Understanding

5W2H Problem Description

✓ *How…*

- *are people or objects affected by the defect ?*
- *does the defect change if something in the environment is changed ?*

Problem Investigation/Understanding

5W2H Problem Description

✓ *How many (or to what extent)…*

- *objects are affected by the defect?*
- *many defects are on each object?*
- *complaints are attributed to the defect ?*
  - *Some or all*

Problem Investigation/Understanding

5W2H Problem Description

- ✓ *Is the trend…*
  - *Staying the same?*
  - *Getting worse?*
  - *Getting better?*
  - *Random?*

Problem Investigation/Understanding

Stratification

Does the problem exist on:

All shifts	*OR*	*Certain shifts*
All parts	*OR*	*Certain parts*
All operators	*OR*	*Certain operators*
	etc.	

Problem Investigation/Understanding

IS/IS NOT Analysis

	IS	IS NOT
What Object	Piston Pins	Shafts
What Deviation	OD oversize	OD undersize
Where Geographically	On Grind Line 1	On Grind Line 2,3
Where on Object	On the OD	On the ID
When detected	Feb. 4th, 8:00am	B4 Feb 4th, 8:00am
When found since	Feb 4th-present	B4 Feb 4th
When in mfg. cycle	In inspection	On Grind Line
How many objects	Entire box	Partial box
How many defects on the object	Entire OD	Portion of OD
What is the trend	Going down	Going up or stable

Problem Investigation/Understanding

Check Sheets – Data Collection

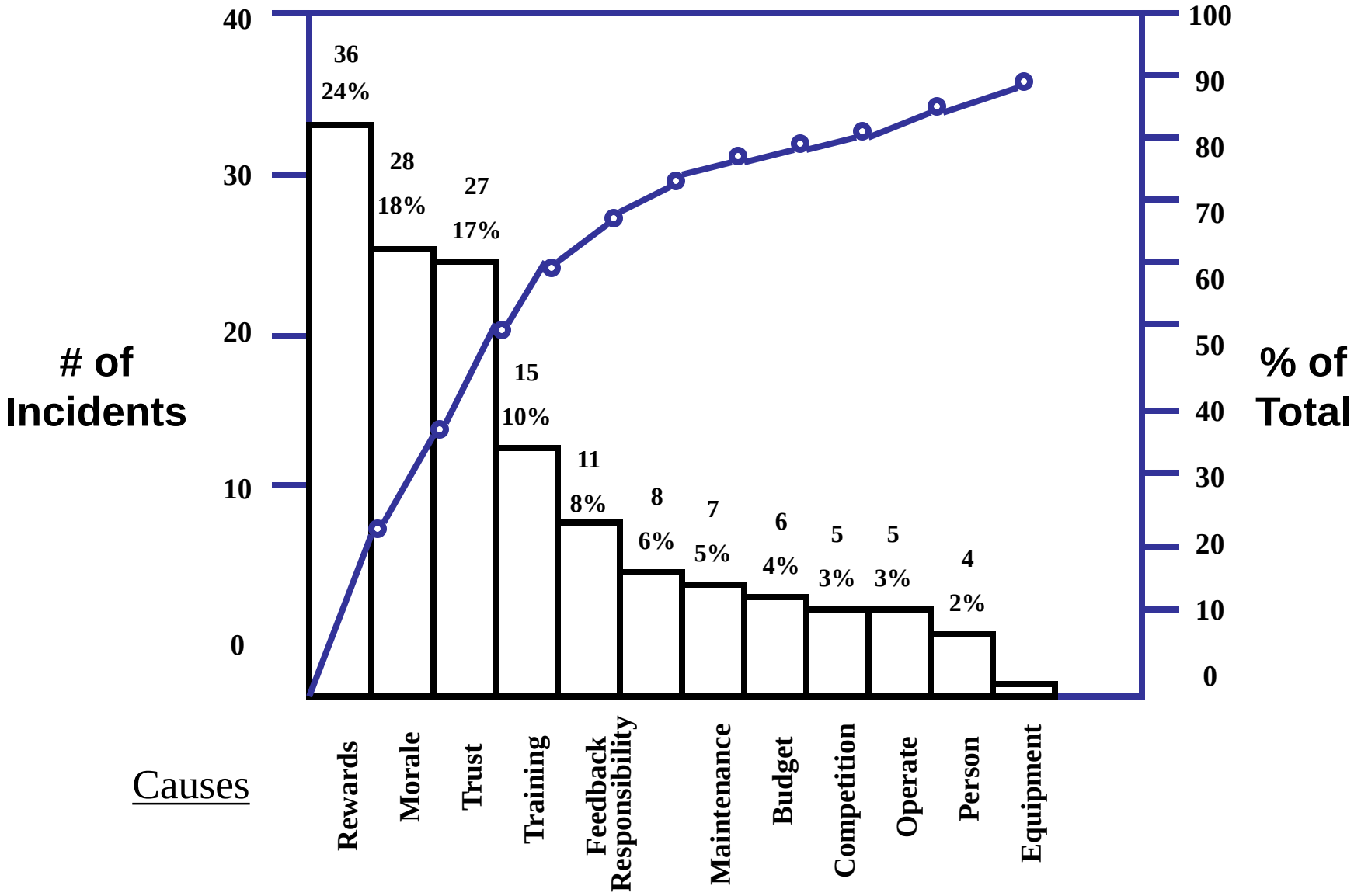
Cause of Incidents	Week 1	Week 2	Total per cause
Too little responsibility	/////	///	8
Wrong person on job	//	//	4
Poor training	///////	////////	15
Poor budgeting	////	//	6
Poor reward system	//////////////////	//////////////////////	36
Little feedback	/////	//////	11
Low trust	//////////////	//////////////	27
Low morale	//////////////	///////////////	28
Internal competition	///	//	5
Poor maintenance	////	///	7
Difficult to operate	///	//	5
Too little equipment	/	0	1
Total # of problems	**76**	**77**	**153**

Problem Investigation/Understanding

Pareto Chart – Separating “the vital few” from the “trivial many”

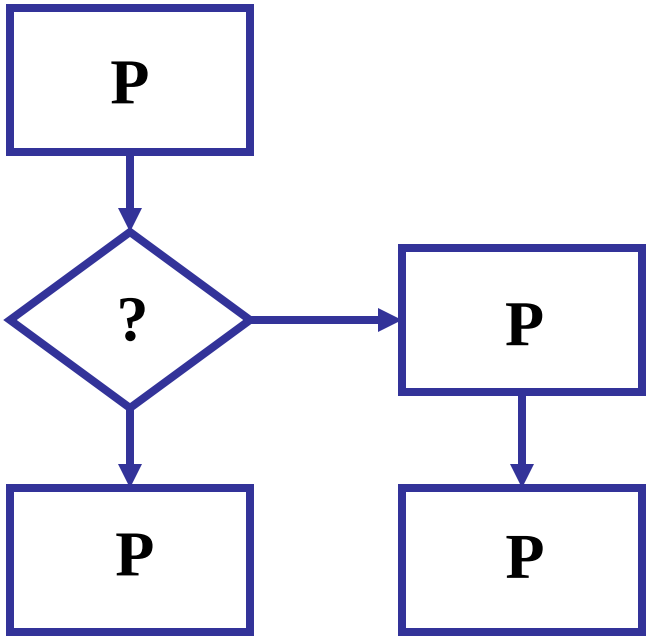
- ✓ Tool to organize data from checksheets
- ✓ View causes according to relative frequency and importance
- ✓ Understand which causes need further investigation
- ✓ Typically 80% of the problems result from 20% of the causes
- ✓ Can and should be done at many levels in the organization

Pareto Chart



Problem Investigation/Understanding

- Flow Charting / Process Mapping
  - Can be done at several levels
    - High level macro view with just text
    - Mid level view with symbols
    - Micro level view



Problem Investigation/Understanding

- Flow Charts
  - All team members on the same page
  - Everyone understands the entire process
  - Areas needing improvement can be identified
  - Excellent training tool

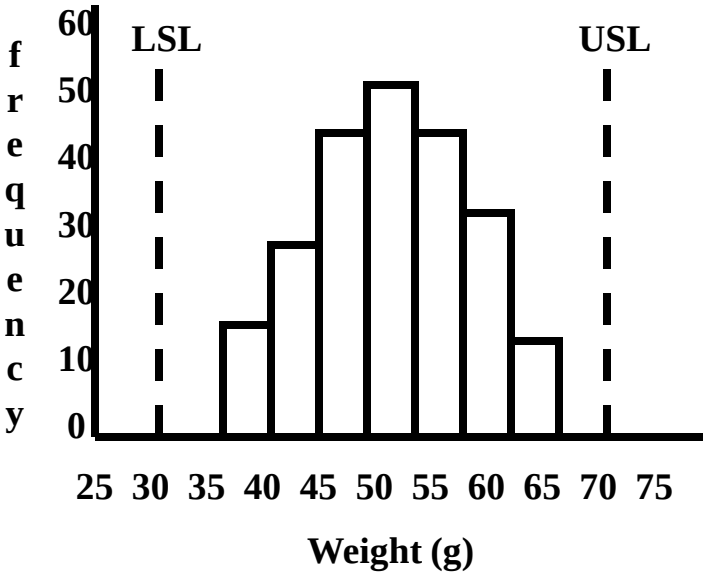
Problem Investigation/Understanding

- Histogram
  - A histogram is a type of graph that shows how a set of data is distributed.

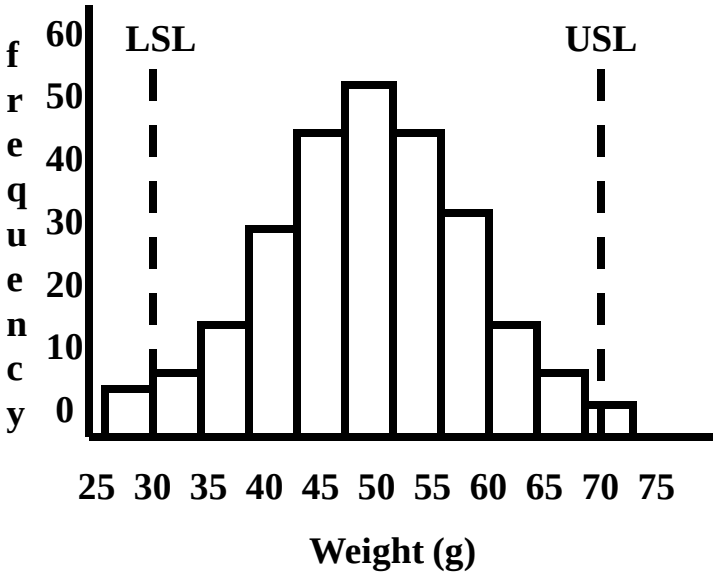
Histogram

- Provides a snapshot of a process
  - Shows the shape of the distribution of individual measurements
    - Clustering
    - Variation or spread
  - Shows how many times each measurement occurs
  - Histogram is the basis for other tools
    - Control charts
    - Capability studies

Histogram

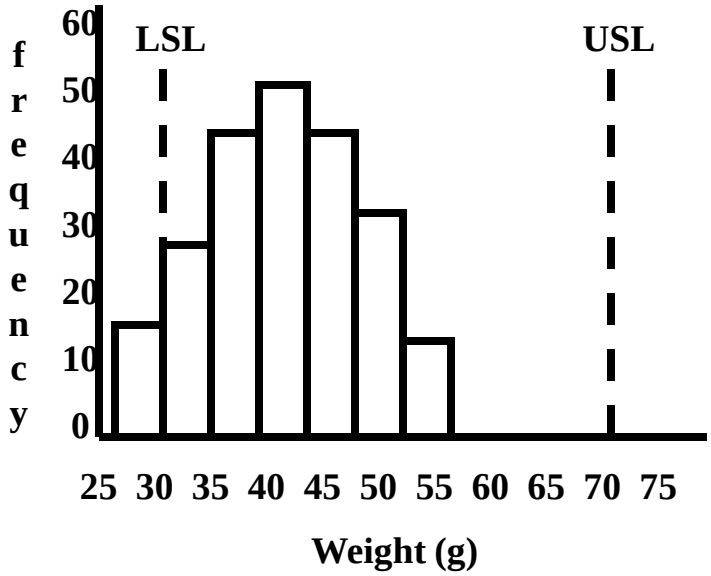


- This histogram shows what is likely to be a good situation.
- The data shown is centered and falls between the specification limits.
- A very small % of the total production from this process could fall outside specifications.



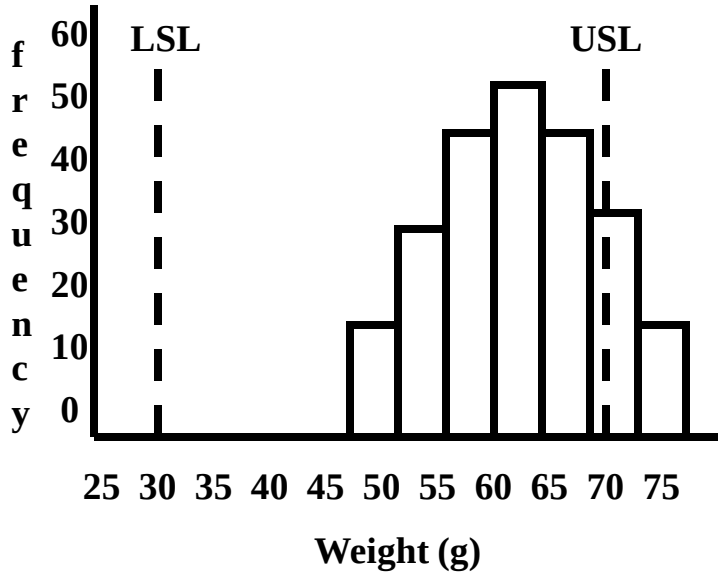
- This histogram shows a process producing defects.
- The data shown is centered, but some data falls outside specification limits.
- Variation due to common causes is too great.

Histogram



•This histogram shows a process producing defects.

What is wrong?

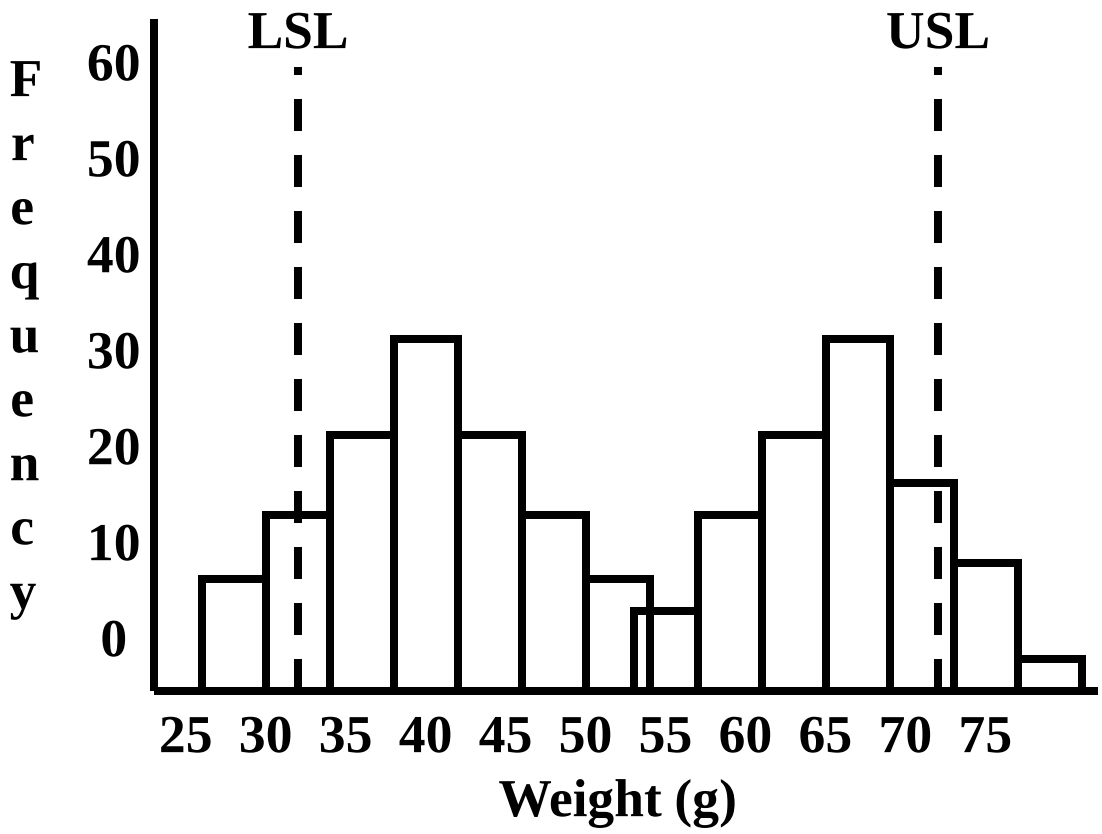


•This histogram shows a process producing defects.

What is wrong?

Histogram

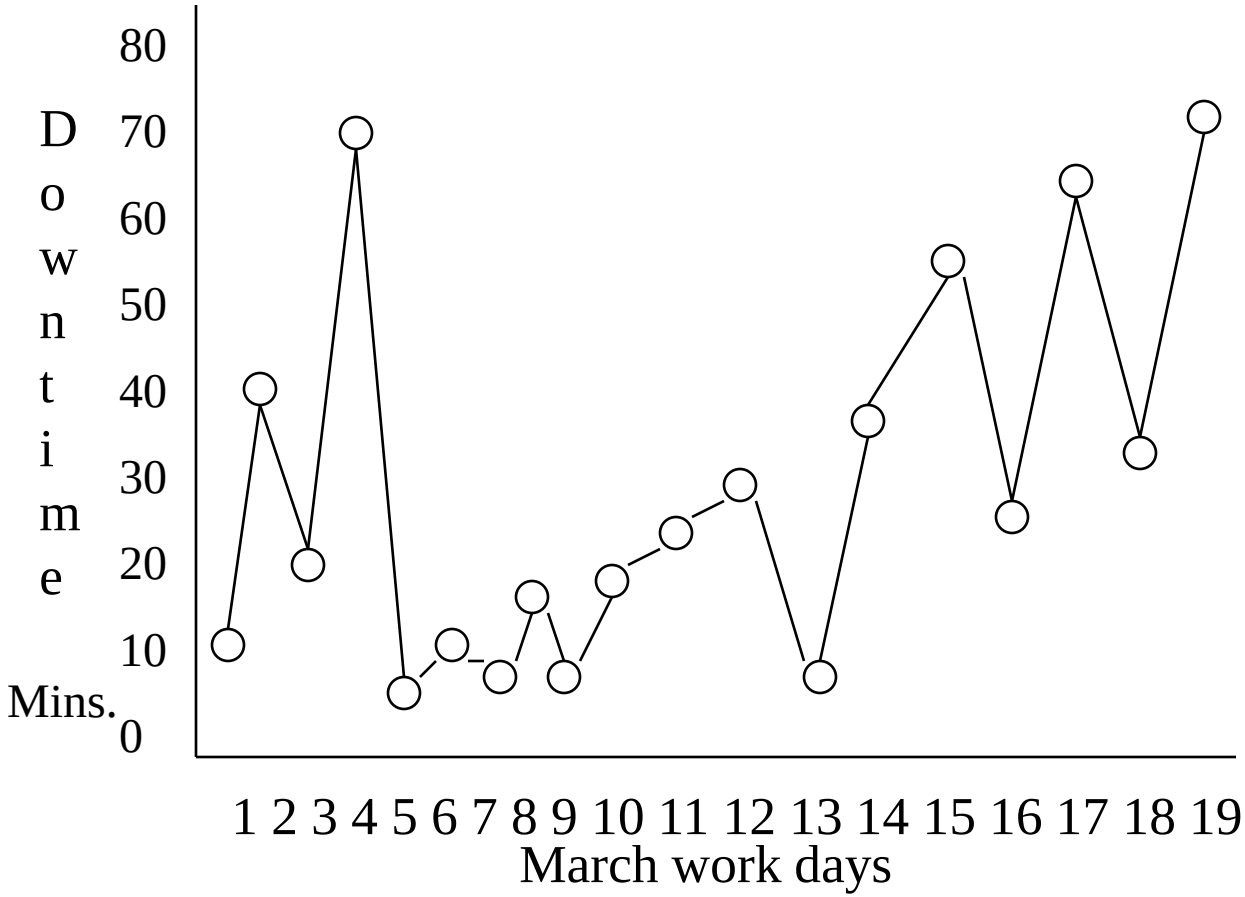
"What is wrong with this picture?"



Problem Investigation/Understanding

- Run Charts
  - A moving picture of the process in time order
  - Compare one time period to another time period
  - Reveal patterns
  - Can be used on any process in the office or in the factory

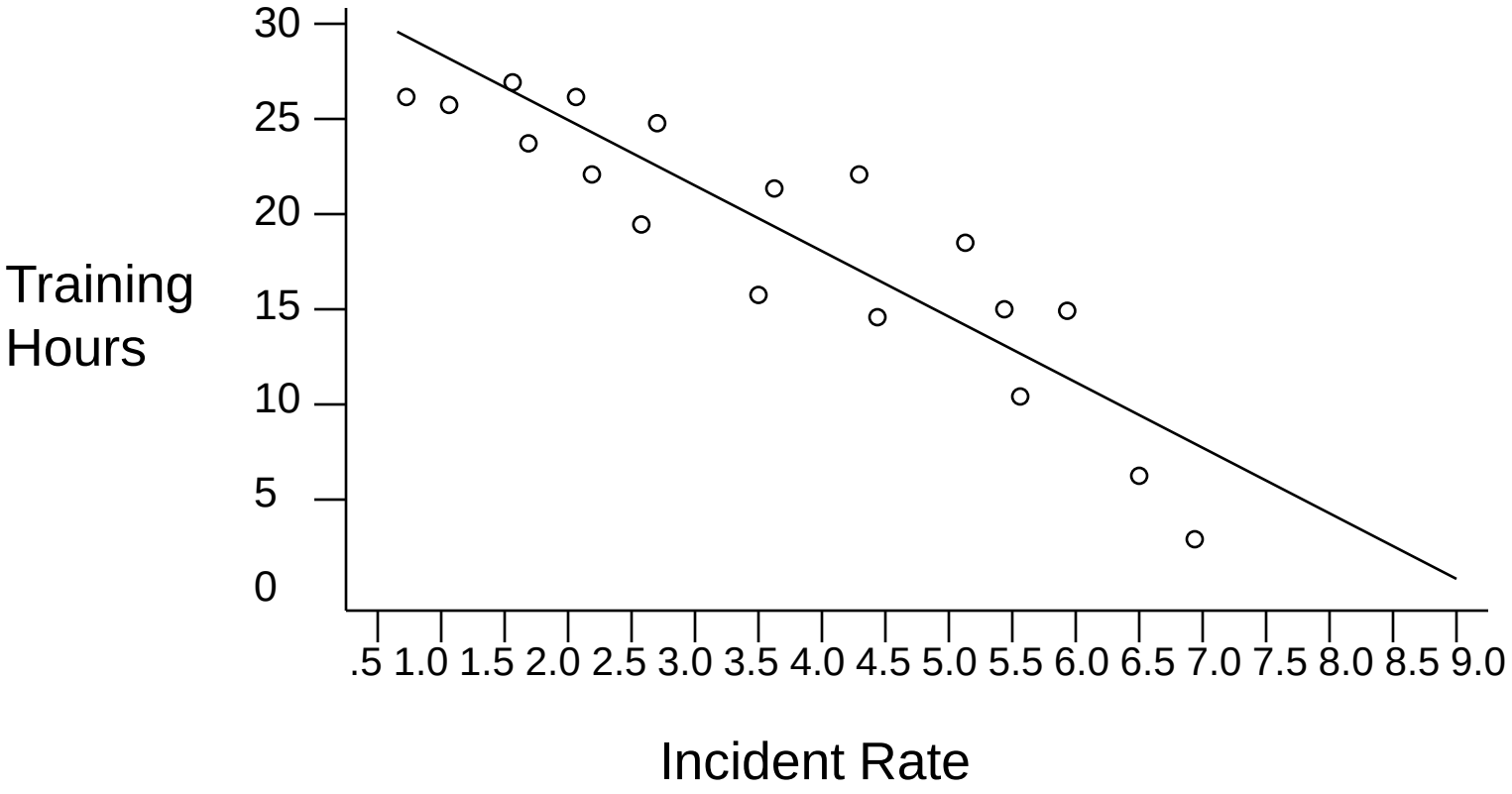
How to Create a Run Chart?



Problem Investigation/Understanding

- Scatter Diagram
  - Determine if there is a relationship between two variables
    - Cause and effect
      - Years of experience & closed sales
      - Surface hardness & service life
      - Feed rate & tool life
  - Determine if the relationship is positive or negative
  - Provides a clear picture that needs minimal explanation

Example Scatter Diagram



Analyze for correlation: Increase in training hours reduces incident rate

Problem Investigation/Understanding

- Brainstorming
  - A method of generating ideas
  - Put a time limit on the session
  - Identify an unbiased recorder
  - Set Ground Rules
  - Types of brainstorming
    - Catch-ball
    - Round Robin
    - Affinity Chart

Analysis

- Are there any other tools which may be useful in solving your problem?
  -
  -
  -

Step Three

Root Cause Identification

Root Cause Identification

Definition of Root Cause Analysis:

"A structured investigation that aims to identify the true cause of a problem, and the actions necessary to eliminate it."

Symptom Approach vs. Root Cause

Symptom Approach

- "Incidents are often a result of operator mistakes."
- "We need to tell our operators to be more careful."
- "We don't have the time or resources to really get to the bottom of this problem."

Root Cause

- "Incidents are the result of defects in the process. People are only part of the process."
- "We need to find out why this is happening, and implement mistake-proofs so it won't happen again."
- "This is critical. We need to fix it for good, or it will come back and burn us."

Types of Root Cause

- **Defect Root Cause**
  - What physically caused this problem?
- **Systemic Root Cause**
  - What failed in the system(s) to allow this to happen and/or not be detected?

Why look at two types of root cause?

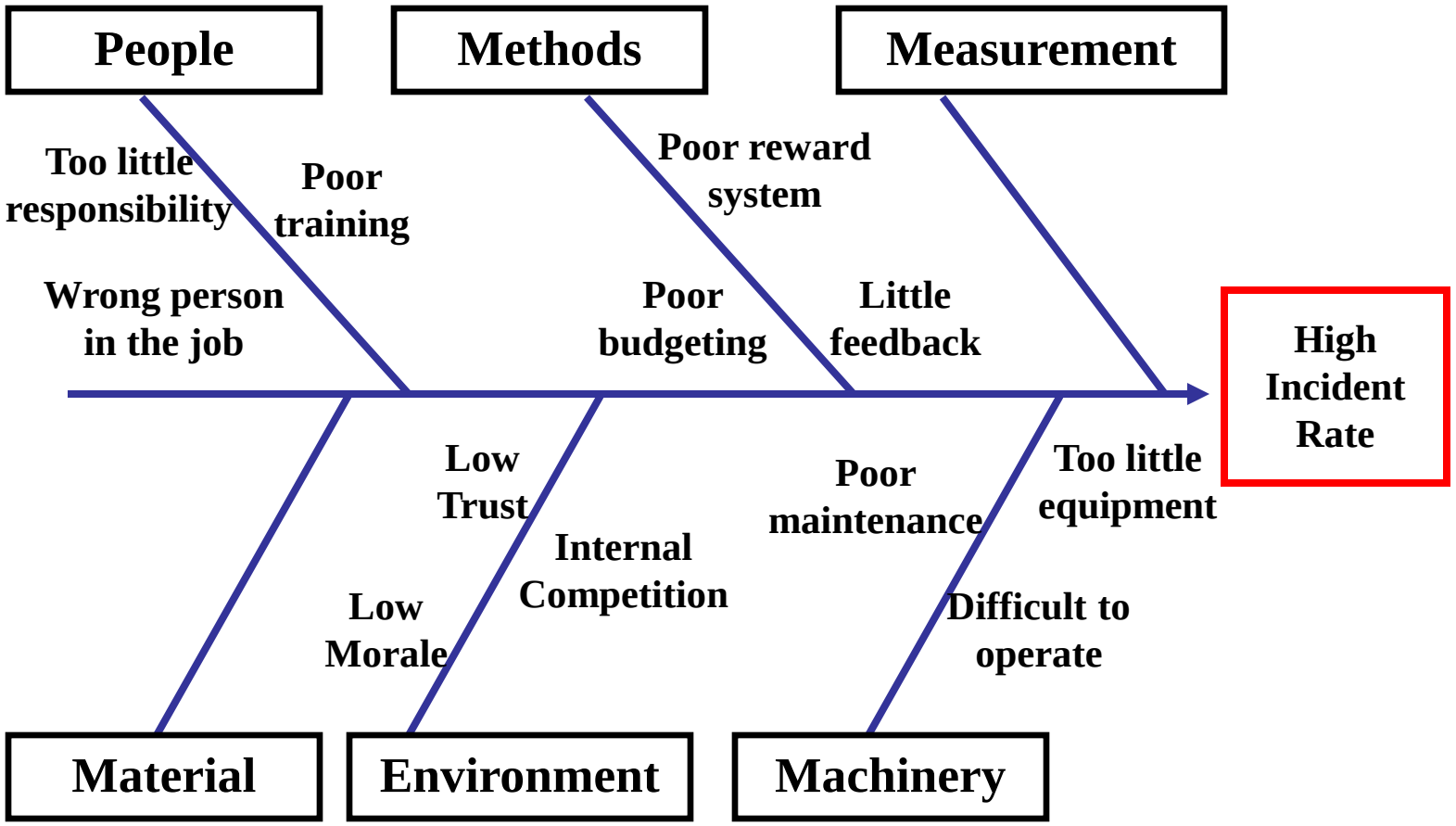
- Assures that all aspects of the problem are addressed:
  - Focus on Defect assures that the physical problem will be addressed.
  - Focus on Systemic keeps the problem from happening again (and again, and again, and again…)

Root Cause Identification

- Cause and Effect Diagram
  - Categorizes the cause ideas from the Brainstorming session in an orderly way
  - Further refines the cause ideas into major causes, possible causes and most likely causes
  - Identifies relationships between causes

Root Cause Identification

Cause and Effect Diagram



Root Cause Identification

Five Whys – Breaking it down further

Why?

Why?

Why?

Why?

Why?

Step Four

Design
Solutions/Countermeasures

Design Solutions/Countermeasures

- Avoid The “Silver Bullet”
  - A single fix for the problem
  - Difficult for many people to consider alternatives
  - Resources are wasted justifying it that should be used to consider better alternatives
    - People become emotionally invested
  - Almost always incomplete
  - Usually wrong

Design Solutions/Countermeasures

- Barriers to solutions & countermeasures
  - Technical
    - Specific to your products/industry
    - Impact 1X
  - Process
    - Flow and quality
    - Impact 10X
  - Cultural/emotional
    - Paradigms, behaviors, attitudes
    - Impact 100X
  - Perceptual
    - Methods

Design Solutions/Countermeasures

- Roadblocks you have probably never encountered!
  - It is against our policy.
  - The customer/supplier will never accept it.
  - We don't have problems now, why change it?
  - We've always done it this way.
  - It won't work.
  - I already know …
  - It needs higher approval.
  - It takes too long.
  - Engineering/purchasing/safety doesn't like changes
  - We can't tell the customer that we want a change now.
  - It will cost too much.
  - The boss won't like it.
  - I don't want to do it that way.
  - You are going to do it anyway.
  - We've tried that before.

It takes education, training and patience to overcome roadblocks.

Design Solutions/Countermeasures

- Active (Control)
  - Detects problem at the source and stops the process
  - Prevents the problem from occurring
  - Designed out of the process or product

- Passive (Warning)
  - Detects the problem downstream and triggers an alarm
  - Detects the problem downstream and segregates the defect
  - Technician training

Step Five

Implement Solutions/Countermeasures

Implement Solutions/Countermeasures

- Evaluation techniques
  - Individual evaluation
  - Unanimous vote
  - Team consensus
  - Ranking proposed solutions

Implement Solutions/Countermeasures

- Individual evaluation, unanimous vote and team consensus are okay, but are also ***subjective***
  - Difficult to make a case to others including Management
  - Not truly rational methods
- Ranking proposed solutions is preferred.

Ranking Solutions / Countermeasures Matrix

	Solution	A. Impact Low = 1 High = 3	B. Difficult to Implement High = 1 Low = 3	C. Risk High = 1 Low = 3	D. Cost High = 1 Low = 3	E. In-house Capability No = 1 Yes = 3	Rank A x B x C x D x E =
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

Implement Solutions/Countermeasures

- Force Field Analysis
  - Method of determining the forces for and against solutions
    - Driving forces
    - Restraining forces (obstacles)
  - By knowing the forces for and against solutions, teams can improve the success of implementing change
    - Develop strategies to
      - Capitalize on driving forces
      - Reduce the impact of opposing forces

Force Field Analysis

- Example forces you may encounter:
  - Resources available
  - Regulations
  - Customers
  - Suppliers
  - Attitudes
  - Values
  - Cost
  - Contracts
  - Direction from upper management
  - Organizational structure
  - Personal needs
  - Team needs
  - Paradigms
  - People
  - Traditions
  - Equipment condition

Force Field Analysis

Solution: Convert from Go/No-Go to Variable Gaging

Score	Driving Forces	Restraining Forces	Score
5	Variable Data	Cost	2
4	Fewer Adjustments	More Complex	2
2	Calibrate In-house	Who Will Calibrate?	3
4	More Precise	Need Training	3
5	Customer's Method	Easy to Damage	1
4	Data Collection	Takes More Time	3
5	Fewer Rejections	Operators Reject	2
29	1 = Weak / 5 = Strong		16

Other Analysis Tools

- Paired choice matrix
- Hard-to-do / easy-to-do / high impact / low impact matrix

Elevator Speech

- Your project is going well, but you need some help. You happen to run into the top manager at your facility on the elevator. You have 30 seconds to convince him/her to support and assist your project. Write your "elevator speech" for this situation. Be sure to include:
  - What your project is about
  - Why it is good for the company
  - Why it is good for the manager
  - What help you need
- Repeat for:
  - Influential hourly worker
  - Accounting/finance manager
  - Others that may influence the outcome of your project

Step Six

Control Plans & Countermeasure Confirmation

Control Plans / Countermeasure Confirmation

- Prove that the solutions / countermeasures are effective
- Hold the gains
  - Make the changes / improvements part of the way business is done
    - Rely on standards, not memories
      - OSHA requirements
      - Work instructions
      - Procedures
      - Policies

Control Plans / Countermeasure Confirmation

- Verify that the problem is solved
  - Documentation of solutions / countermeasures
  - Documentation that the solutions / countermeasures are effective
  - Documentation of how each was confirmed, the results, who confirmed it and the date on which it was confirmed
- This completes the Plan, Do, Check, Act cycle

Step Seven

Share the Knowledge

Share the Knowledge

- Share the problem, root causes and solutions / countermeasures with associates, departments, functions, management, plants, divisions customers and suppliers

- Keep others from having to reinvent the wheel!
  - Keeping tribal knowledge to yourself does not bring job security – it creates the potential for hazardous conditions

Step Eight

Recognize the Team and Repeat the Process

Recognize the Team

- Personal acknowledgement by upper management
  - Saying, “thank you & good work” personally costs nothing, but buys plenty
- Victory Log
- Newsletter
- Plaques
- $$ or certificates
  - Give $$ after taxes or certificates (no tax)
- Lunch & award ceremony
  - Recognized in front of peers
- Dinner & award ceremony
  - Spouse/family involvement

Repeat the Process

- Post results to reinforce using the process.
- Make the process part of Management Review
  - You get what you ***really*** measure!
  - Management must control the process, but not over-control it
    - Projects in process
    - Projects completed
    - New problems that will be assigned to teams
      - Not every problem requires the process
      - Prioritize projects
      - ***Make resources available***
- ***Review Plan, Do, Check, Act (Adjust)***

Rules for Problem Solving Success

- Containment means STOP -- Comes First
- Defect Root Cause is PHYSICAL
- A physical problem needs a physical corrective action
- Root Cause and Corrective Action have to match
- Any Corrective Action must have a switching action
- Verification is PHYSICAL proof
- Training is NOT a DEFECT corrective action

Summary

- Problem solving is best accomplished by a cross-functional team
- Fully describing the problem is the first, and *most important*, step in analyzing the causes of the problem
- Focus on finding the true cause(s) before considering any solutions
- Follow-up to verify the effectiveness of solutions / countermeasures to be sure you attacked the root cause
- Share the knowledge with others
- Reward the teams

Thank You

Questions?

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