

Module: **Automation**

Element: **Error Proofing**

Objectives

Target audience :

- Design, Operations, Quality, Manufacturing Engineering,

Purpose :

- To be able to deploy error proofing techniques into a production environment

Aims and Objectives :

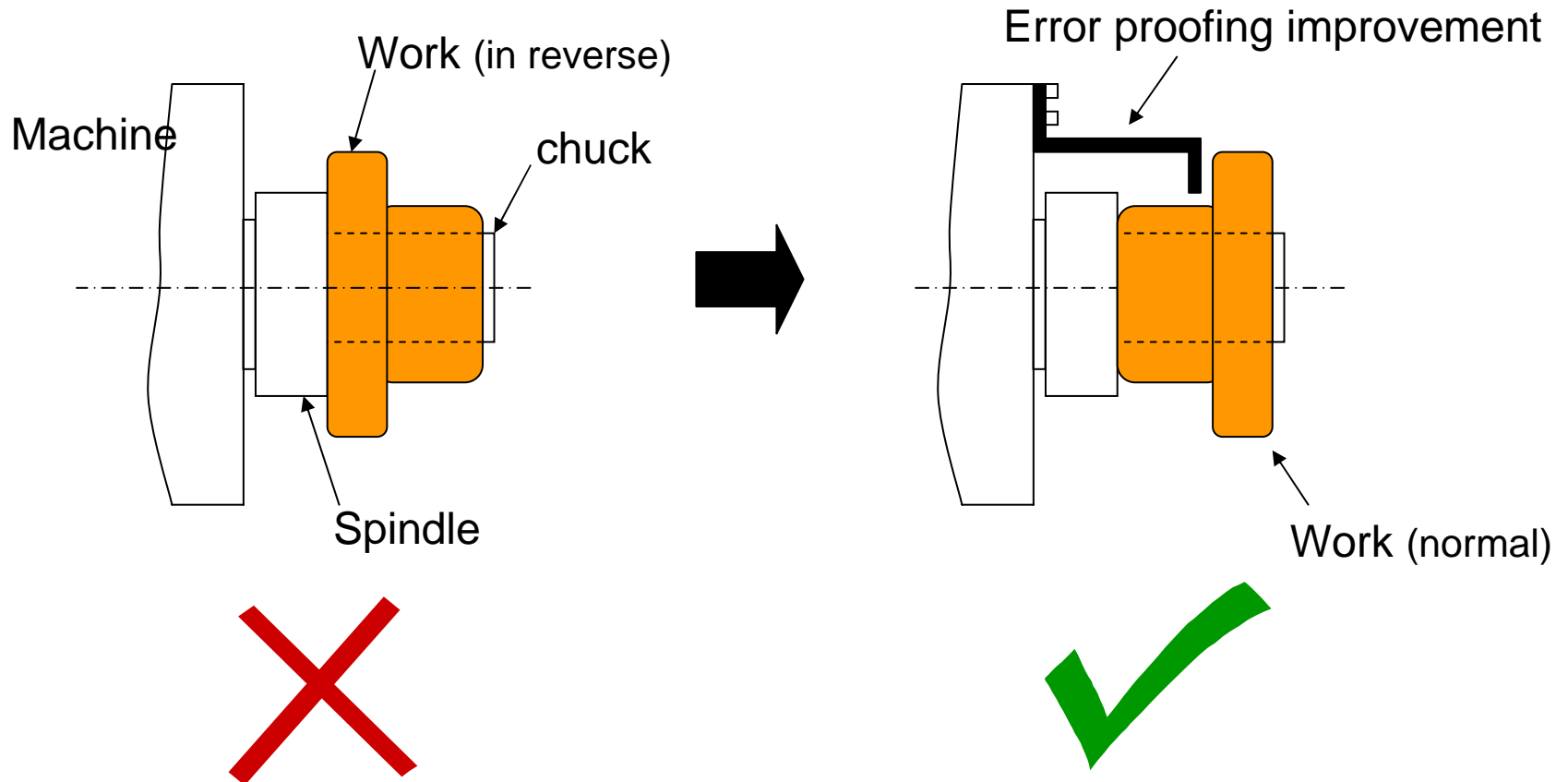
- To understand the fundamentals of error proofing
- Identify areas that require error proofing
- Understand how to introduce error proofing into a production environment

Agenda

- Introduction to error proofing
- Errors and defects
- Detecting errors
- Implementing error proofing
- Manual and automated systems
- Team work
- Group exercise
- Summary

Introduction -What is Error Proofing?

- **Error Proofing is a process improvement that is designed to prevent a specific defect from occurring**

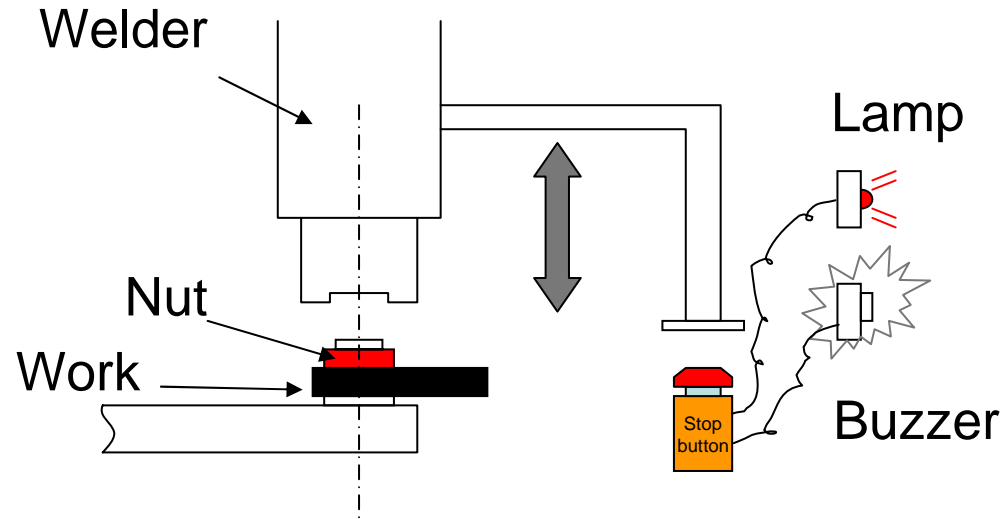


What is Error Proofing?

There are three elements which make up error proofing:

1. **Detection** — The operator or machine discovers a defect.
2. **Feedback** — Warning/Halt in machine/process due to a defect.
3. **Corrective/Preventive Action**—Improvement Team is formed and Problem Solving Process used to take corrective and preventive action.

What is Error Proofing?



- **Error Proofing is a process improvement system that prevents.....**
 - personal injury & promotes job safety
 - faulty products
 - machine damage
 - defective product from being produced or being passed to the next process

Examples of Error Proofing Devices.....

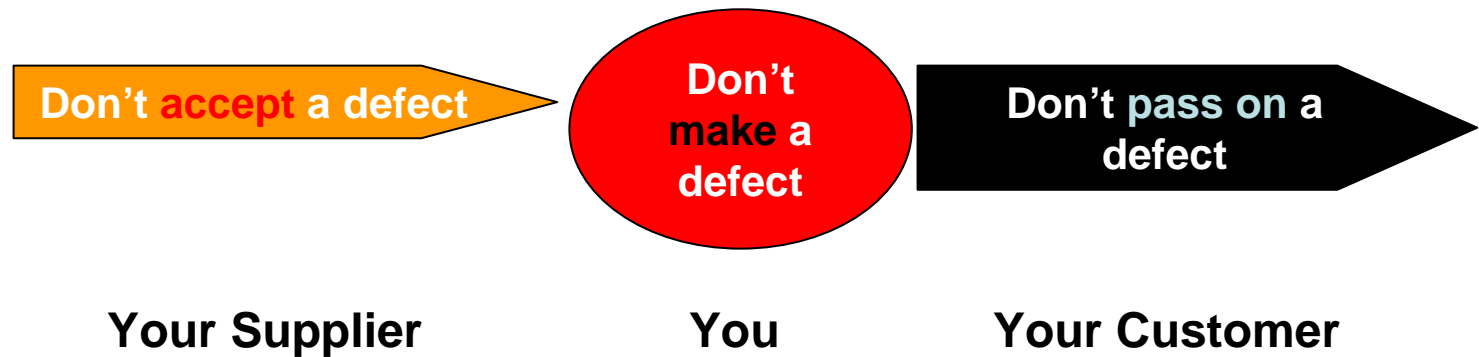
Types of Error Proofing devices

	Control	Warning
Contact	F1 cars height indicator Armrests on seats	Motorway maintenance vehicle height control Safety razor
Fixed Value	Infra-red part trays Pre-dosed medication	Trays with indentations Overflow in sink
Motion Step	Airline toilet doors Dual button operation on dangerous machinery	Spellcheck Lorry reverse sound



Remember 3 rules....

An error proofing system should take into consideration these 3 simple rules :



Ideally, design the product so that it **can't** be assembled incorrectly!!!

Why do we Need Error Proofing?

- Enforces operational procedures or sequences
- Ensures quality at the source instead of quality after the fact.
- Eliminates choices leading to incorrect actions

Everyday examples

Unleaded Fuel Tank Filler Opening on fuel Tanks

Record Prevent Tabs on VHS Videocassettes

Kettle cut off switch

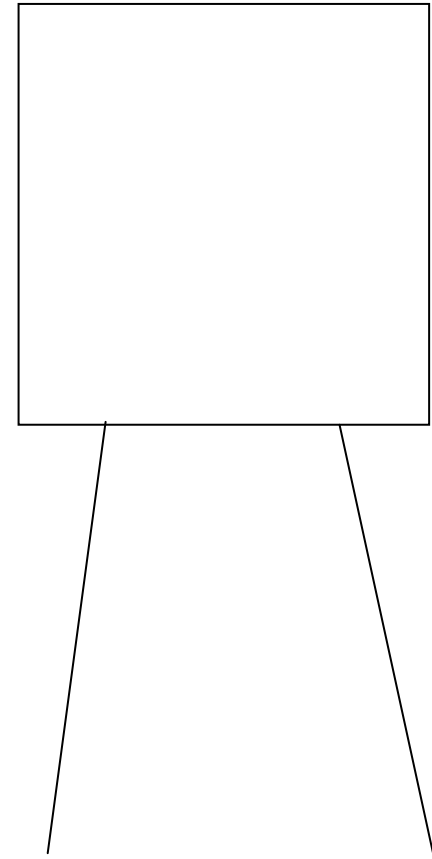
Ball cock in toilet cistern

Spell Check on Computers

Cassette loading on hi-fi

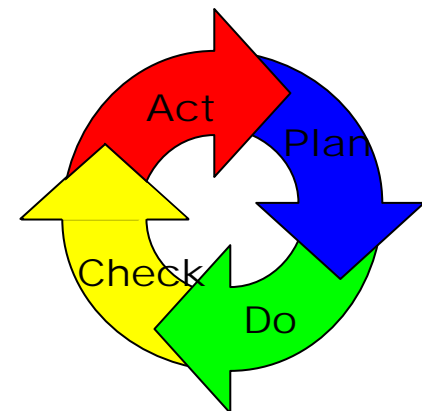
Sink Overflow Outlet

Phone Cord Plugs



What are the benefits?

- **Relieves workers of constant attention to detail & removes barriers caused by repetitive and cumbersome inspection procedures.**
- **Reduces cost by reducing waste**
- **Workers can focus on their skill rather than on problems that occur due to poor design or memory related procedures**
- **Focus is on continuous improvement**
- **Prevents personal injury**



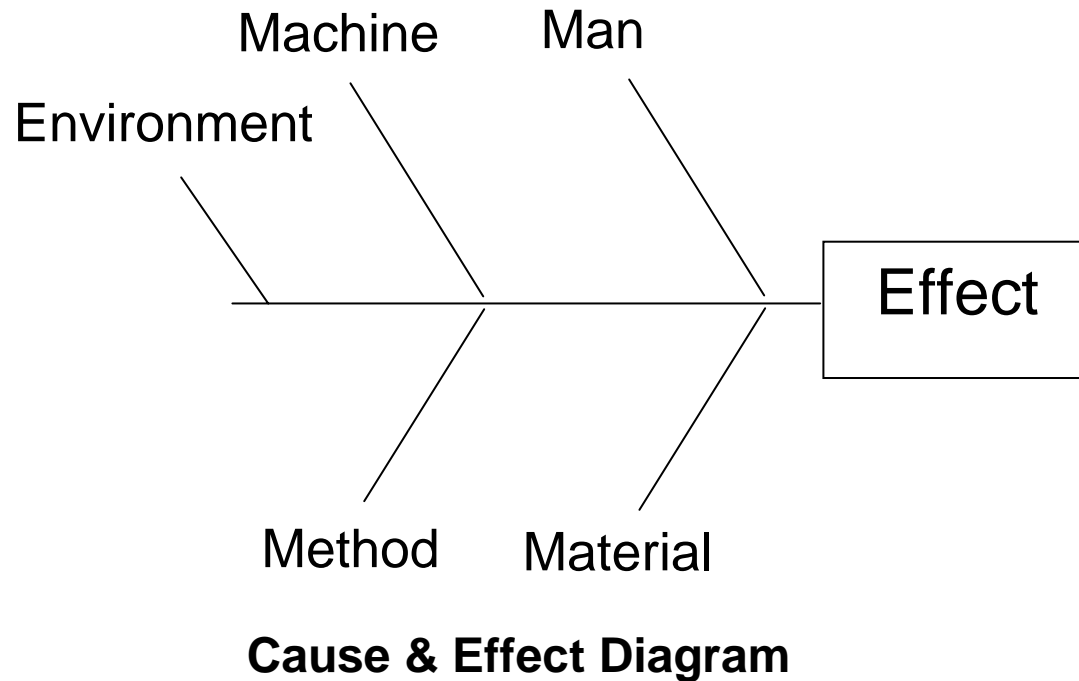
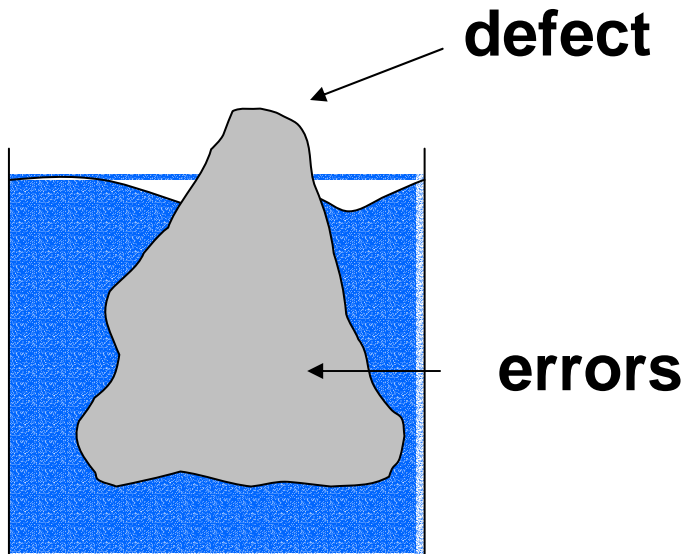
Error V's Defects

A defect is a product that deviates from specification or does not meet customer expectation

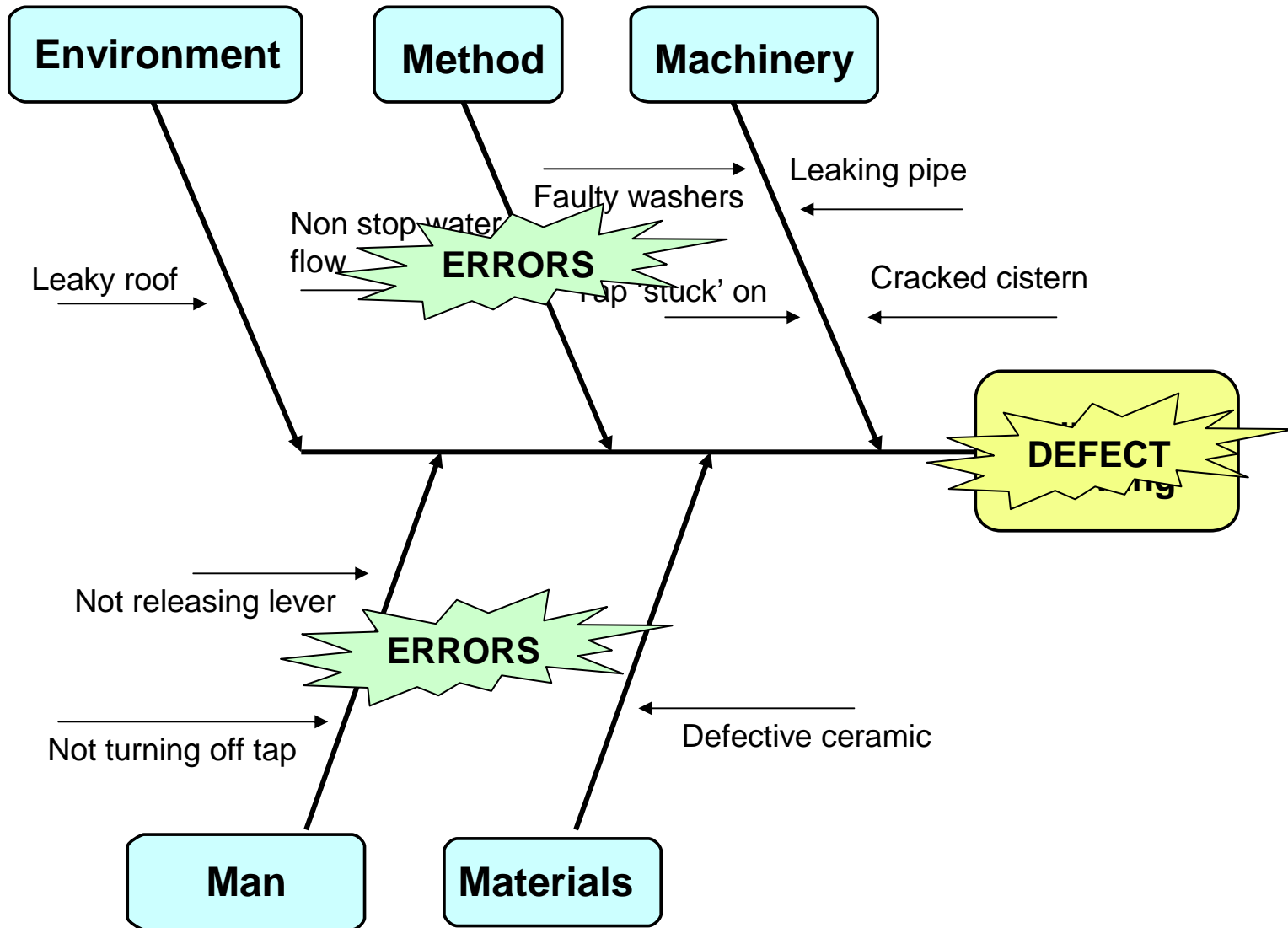
An error is any deviation from an intended process

All defects are created by errors

Compare it to an iceberg....



Errors Vs defects



The 10 Causes of Errors

There are ten common causes of errors which Error Proofing is designed to correct or eliminate.

1. Processing omissions

2. Processing errors

3. Error in setting up the workpiece

4. Missing parts

5. Improper part/ item

6. Processing wrong workpiece

7. Operations errors

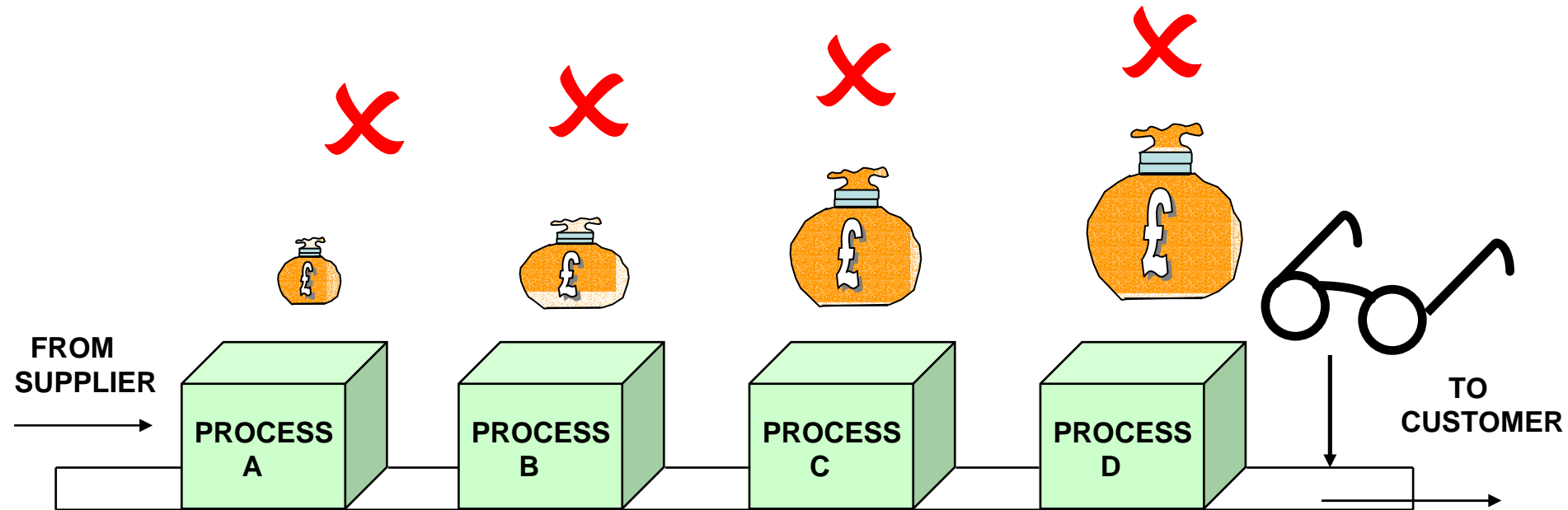
8. Adjustment, measurement, dimension errors

9. Errors in equipment maintenance or repair

10. Error in preparation of blades, jigs, or tools

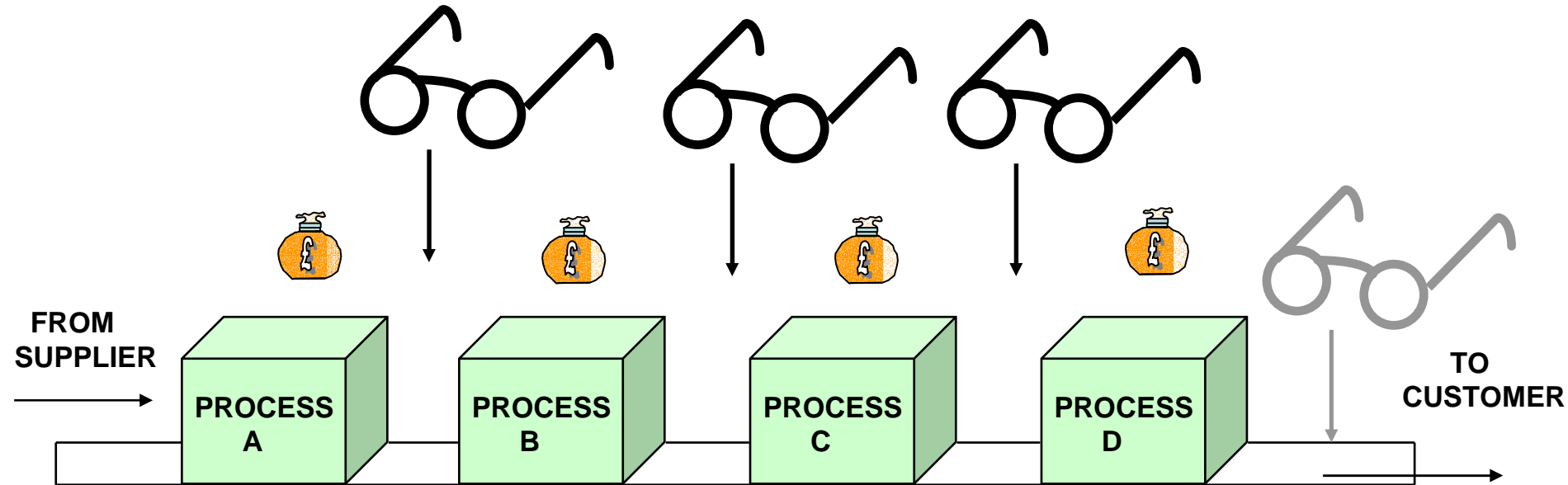
Detecting Errors..... Inspect after

INSPECTION AFTER ALL PROCESSES ARE COMPLETE



Detecting Errors..... At Source

CHECK FOR AN ERROR CLOSE TO THE SOURCE

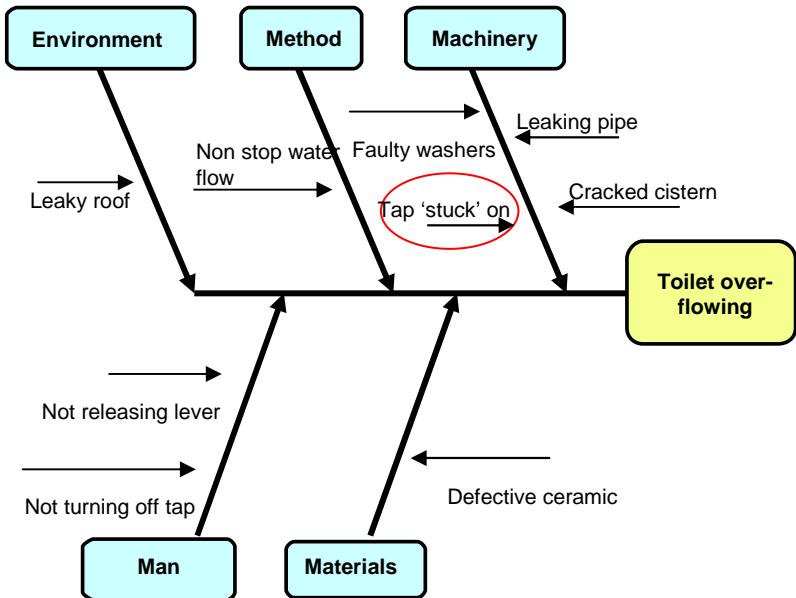


Implementing error proofing

Step 1. Locate the defect and isolate the process that created it – customer protection

Step 2. Gather the team , list all possible errors that cause this defect

Step 3. Determine the most likely error



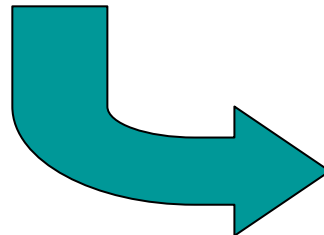
Step 4. Carry out 5-why and determine **ROOT CAUSE**

Implementing Error Proofing

Where to check
Source, Self
Successive

What to check
Feature Method,
Constant Value,
Step movement

Correcting Function
Warning,
Control



THINK!!

Don't **accept** a defect

Don't
make a
defect

Don't pass on a
defect



Where to check - the 3 checks

SELF CHECK

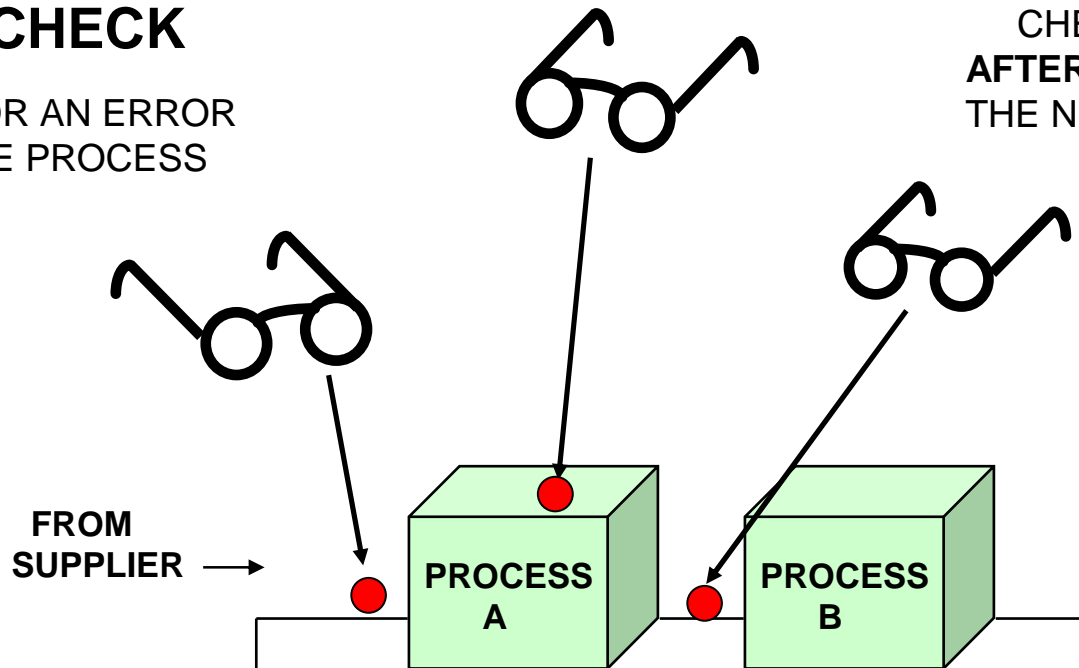
CHECKING FOR AN ERROR
DURING THE PROCESS

SUCCESSIVE CHECK

CHECKING FOR AN ERROR
AFTER THE PROCESS BEFORE
THE NEXT PROCESS BEGINS

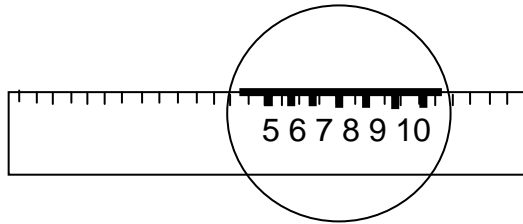
SOURCE CHECK

CHECKING FOR AN ERROR
BEFORE THE PROCESS

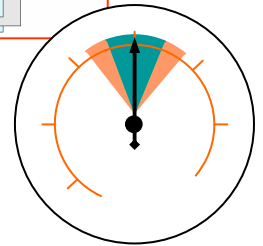
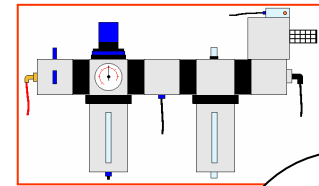


What to Check

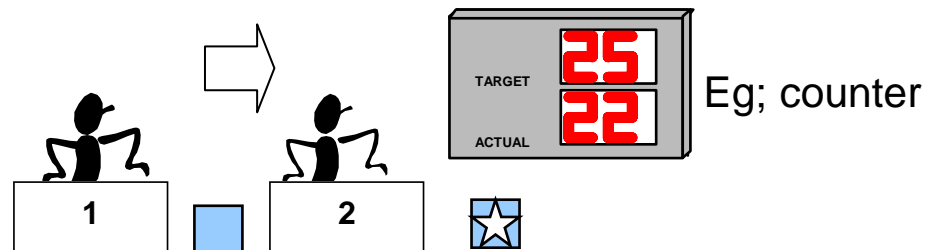
Feature Method - Physical characteristic of part is sensed to differentiate it from standard



Constant Value - A value monitored from measuring the process – eg; oil/water levels,

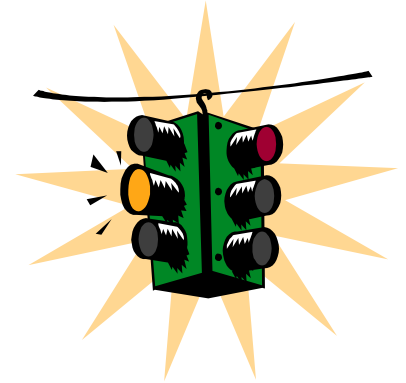


Step movement - Sequence of operator motion or process sequence.



Correction Function

Warning: Informs the operator that an error or defect has just occurred. Typically a light (flashing more effective), or audible alarm



Control: Interlocked to process. Required operator interaction before process can continue.



Implementing Error Proofing - Recap

Where to check

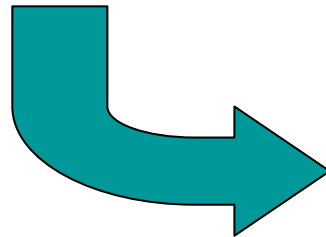
Source, Self
Successive

What to check

Feature Method,
Constant Value,
Step movement

Correcting Function

Warning,
Control



THINK!!

Don't **receive** a
defect

Don't
make a
defect

Don't pass on a
defect



Manual and Automated Systems

Manual systems :

Non automated error proofing **devices and techniques** that either **aid in production** or help **support an employee** in making the right decisions.

– Supports **STANDARD WORKING PRACTICES**

- **Improved tooling**
(positioning/orientation)

- **Visual error proofing**
(colour coding/status indicators)

- **Improved maintenance**
(torque cut-off, vibration)

- **Improved processing**
(methods/ handling)

- **Improving inspection**
(calibration/ gauges/ method)

- **Detection, Feedback and Action** are operator initiated
- **Dependent On Human Judgment**
- **Simple Error Proofing Devices**

Manual and Automated Systems

Automated systems :

Error proofing **systems** that **automatically** prevent or detect errors and alert operators to a problem.

Two categories :

1. Contact devices :

- Limit switch
- Touch switch

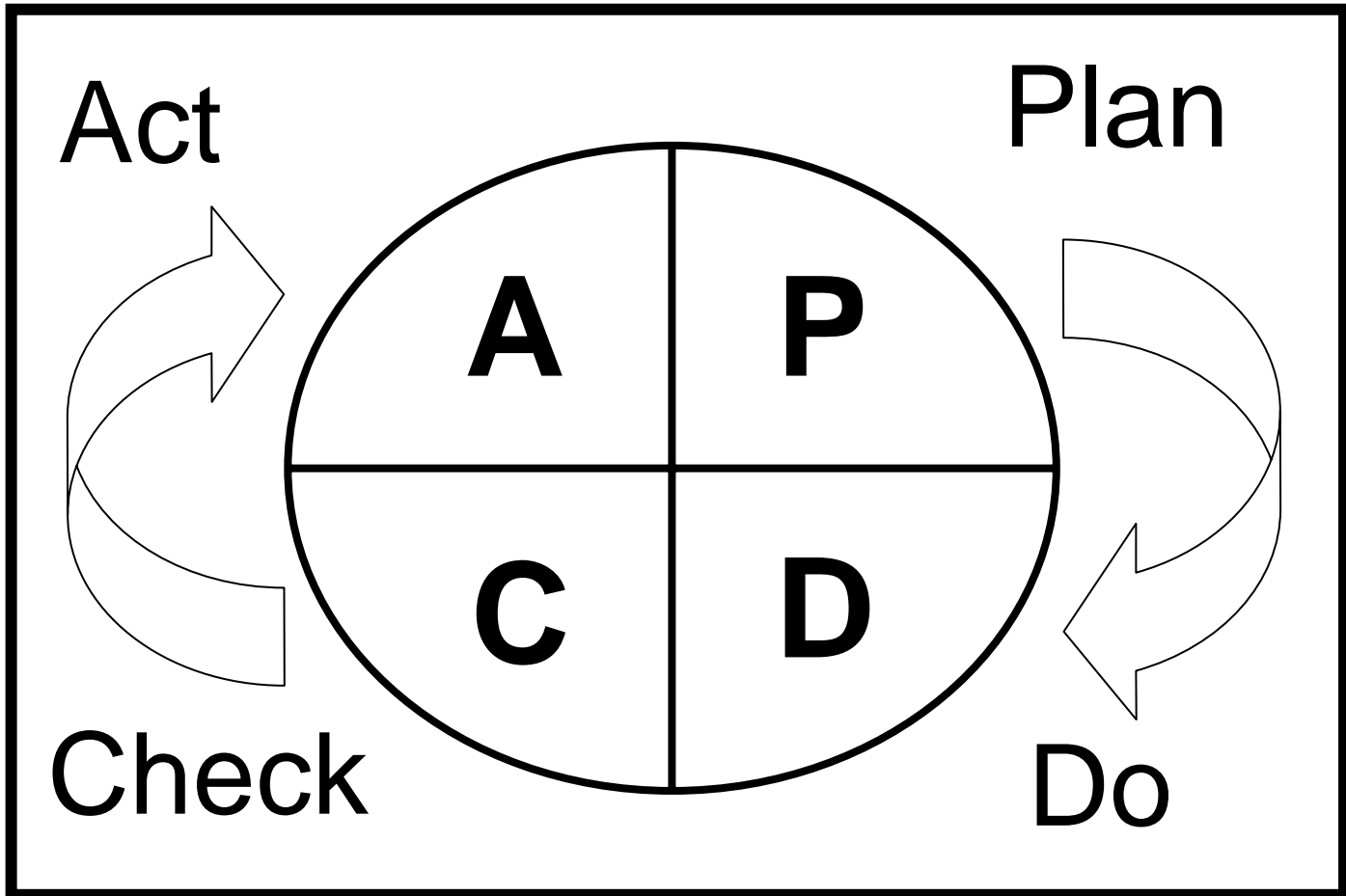
2. Non-contact devices :

- Photo-electric sensors
- Proximity switches
- Vision systems

- Automatically Performs **Detection** and **Feedback**.
- Typically Machine Dependent
- Sophisticated Error Proofing Devices

Implementing Error Proofing

Remember the problem solving PDCA cycle!

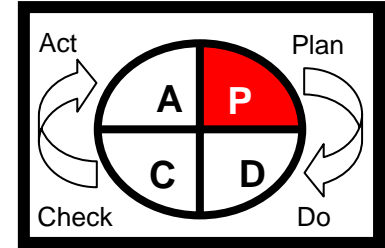


Error Proofing PDCA - 9 Steps

- 1 Customer Protection
- 2 Gather Team/ Brainstorm
- 3 Determine probable causes
- 4 5 Why's
- 5 Propose solutions
- 6 Evaluate & select
- 7 Plan the implementation
- 8 Measure the results
- 9 Standardise

Step 1 - Customer Protection

Step 1. Locate the defect and isolate the process that created it



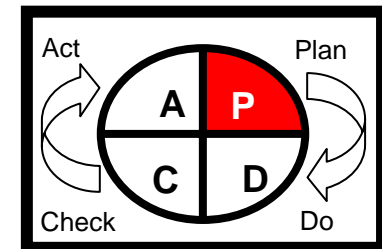
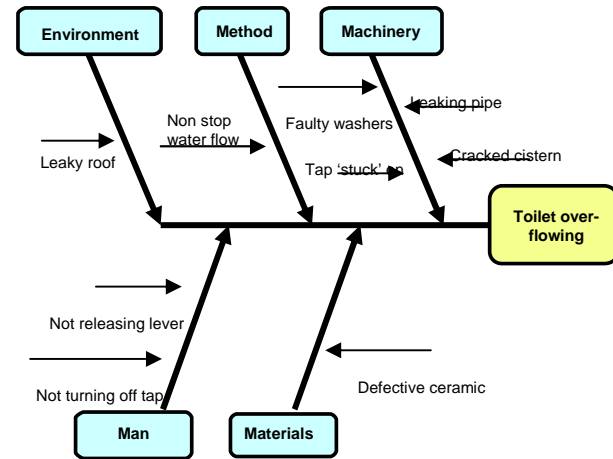
● **Action required within 24 hours .**

- **Focuses on eliminating the impact of the effect on the customer.**
- **Must be assigned to an individual for implementation.**
- **Includes a measure to ensure customer protection is effective.**
- **Communicated and reviewed through production structure.**
- **Has an agreed effective life span .**
- **Terminates when countermeasure is in place.**

Step 2 – Gather Team / Brainstorm

Step 2. Gather the team , list all possible errors that cause this defect

Set up the team to brainstorm the cause and effect diagram, and brainstorm possible error proofing ideas.



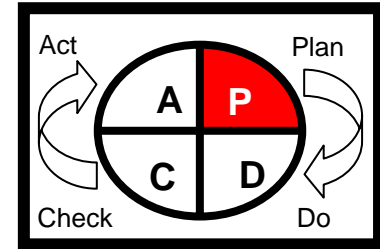
Step 2 – gather team / brainstorm

Remember the brainstorming rules....

- Have a clear and understood topic.
- Team activity, round the table or the board.
- Quantity not quality .
- No criticism for any ideas given .
- Record repeated ideas .
- Don't work an idea during the session .
- Write it down as the speaker has said it .
- Piggy back off other peoples idea's .
- Think *Out of the Box* .
- Use pass when no idea
- Run session for approx 10 - 15 Mins.
- Have a break after session before reviewing

Step 3 - Determine the Probable Cause

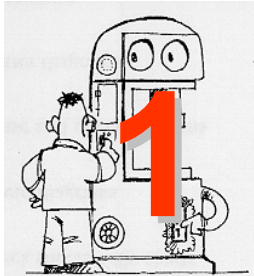
Step 3. Determine the most likely error



- Act on the findings of the cause and effect diagram, but try not to solve problems outside the teams experience or control.
- Quantify the problem and the causes, take special note of causes that appear repeatedly. Use other quality tools to help quantify Pareto analysis, histograms, control charts etc.
- If there are more causes identified than the team can handle, the team is to reach a consensus as to which are the most probable ones.
- TEST out the causes and verify with the quality tools data.

Step 4 - 5 Why

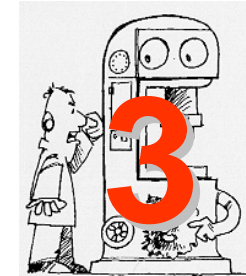
Step 4. Carry out 5-why and determine **ROOT CAUSE**



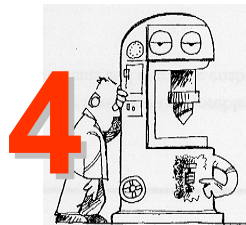
Q : **WHY** has machine stopped ?
A : Overload tripped out !



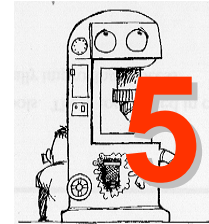
Q : **WHY** overload trip ?
A : Insufficient oil on shaft !



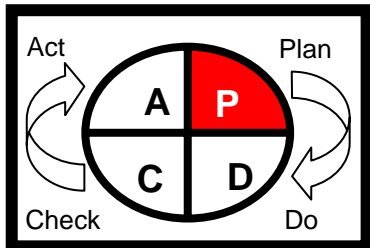
Q : **WHY** Insufficient oil ?
A : Oil pump in efficient !



Q : **WHY** is pump not efficient ?
A : Pump drive shaft worn !



Q : **WHY** is this shaft worn ?
A : Oil filter blocked with swarf !

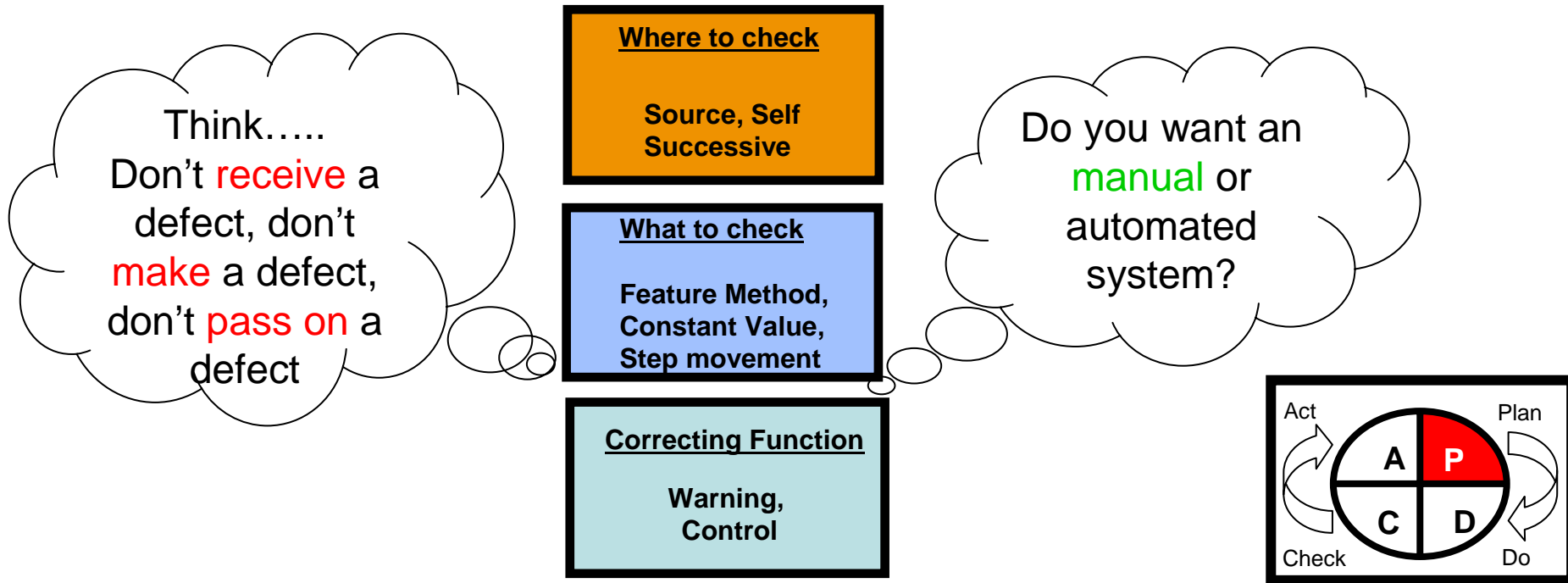


Root-cause →

Now start to think of solutions...

Step 5 – Propose Solutions

Step 5. Propose solutions (manual/ automated / where / what etc)



Error proofing teams should encourage the sharing of all ideas. Thomas Edison said, “The secret to having good ideas is to have a lot of them.”



Step 6 – Evaluate & Select

The following are guidelines for Error Proofing devices:

Error- proofing devices should be simple and low cost.

Look for low- cost, easy to implement devices

Upgrading or scrapping devices should not result in an expensive loss.

Assess feasibility of the device before appropriating capital.

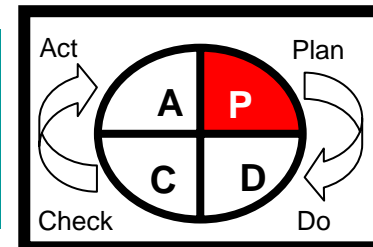
Error- proofing devices prevent / detect 100 % of defects.

At best, devices should prevent the ability to make a defect.

If the defect cannot be prevented, the device should prevent it from being passed to the next production process.

Error- proofing devices should provide immediate feedback.

The device should provide prompt identification of defect locations, allowing for quick troubleshooting

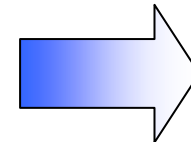
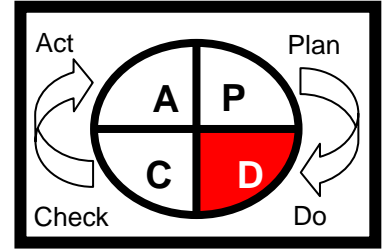


Step 7 – Plan the Implementation

Step 7. Develop a plan for implementation

- **Guide Lines**

- **Plan the implementation into smaller actions**
- **Organise any sequence for these actions.**
- **Assign who & when for these actions.**
- **Time scales ideal 1 week , maximum 1 month**
- **Review actions during daily review by exception.**
- **Escalate issues raised in a timely manner.**
- **Measure the actions impact - is the cause eliminated.**
- **Check for any reoccurrence for “n” cycles.**

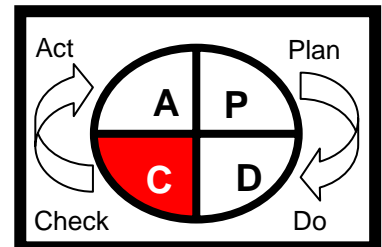


Just do it!

Step 8 – Measure the Results

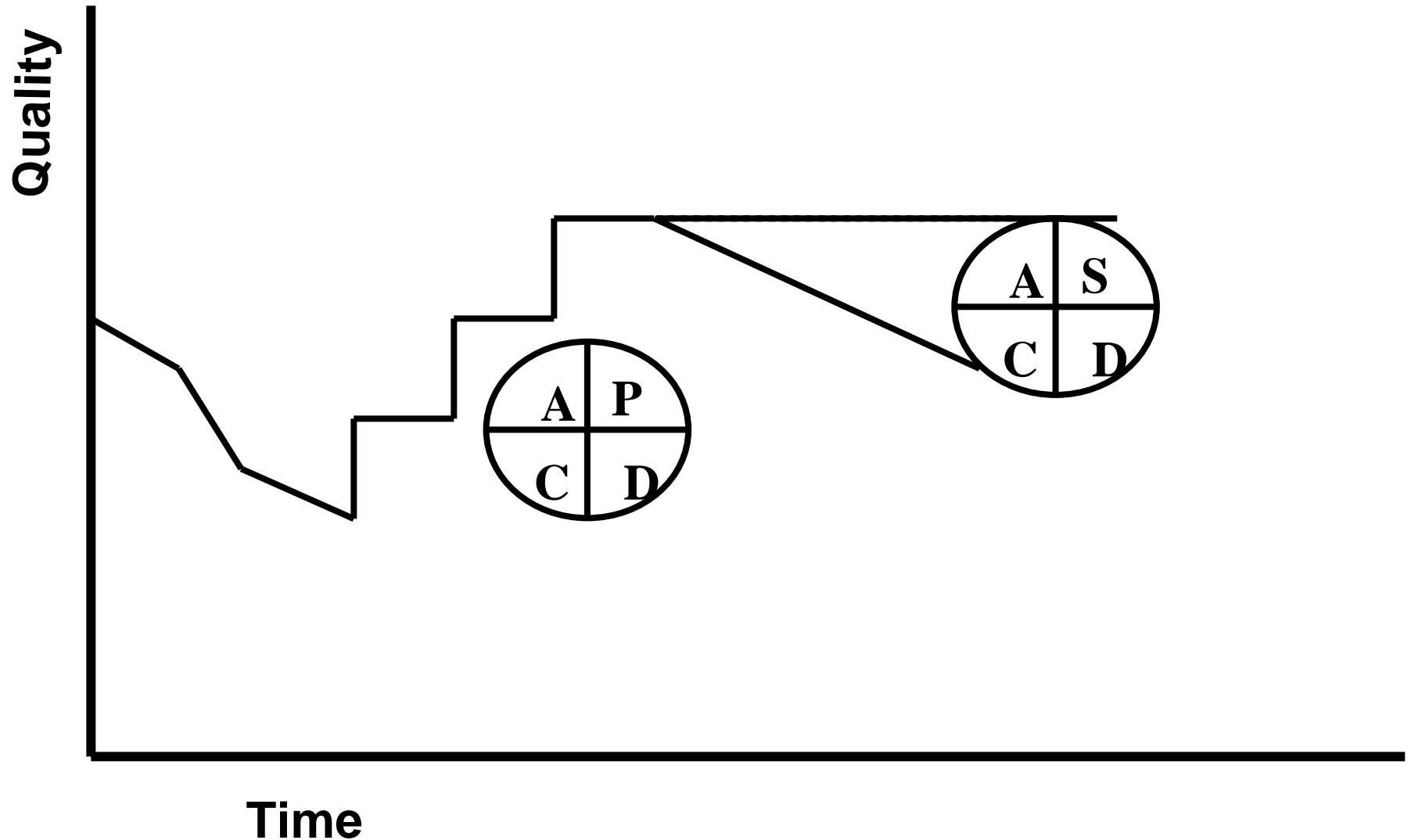
Step 8. Measure results / Analyse benefits

- Guide Lines
 - Check for any reoccurrence for “n” cycles.
 - Use data gathered to demonstrate trend.
 - If cost effective, remove countermeasure and review.



Step 9 – Standardise

Step 9. Update Standard work instructions/ standard documentation



Group exercise

Two teams,

Same problem

Groups have to come up with an error proofing solution to a problem

Present solution back to group

Discuss results

Summary

Error proofing is a continuous process.

Detection drives feedback, which drives corrective action, which generates more detection.

As the error proofing process matures, the trend will be to identify opportunities earlier in the product cycle.

