Deploying Advanced Quality and Lean Tools to Achieve Zero Defects

AQDT – Advanced Quality Team

Mistake Proofing – Poka-Yoke

AQDT
Advanced Quality & Digital Technology
INNOVATION. PRECISION. INSIGHT

LOCKHEED MARTIN

Agenda

- Training Objectives
- History
- Definitions
  - Error
  - Defect
- Myths and Mistakes
- When to use
- Benefits
- Mistake Proofing Procedure
- Examples

Training Objectives

- Identify the concept and importance of mistake proofing (poka-yoke)
- Enable participants to understand and effectively deploy/assess advanced quality tools “Mistake Proofing,” to help suppliers transition from a reactive to a preventive mindset
- Introduce the key concepts of Mistake Proofing
- Understand the benefits of element usage

History

- Shigeo Shingo (1960) is widely associated with a Japanese concept called poka-yoke (pronounced poker-yolk-eh) which means to mistake proof the process
- Mr. Shingo recognized that human error does not necessarily create resulting defects

History (cont.)

The success of poka-yoke is to provide some intervention device or procedure to catch the mistake before it is translated into nonconforming product.

Shingo (1960) lists the following characteristics of poka-yoke devices:

- They permit 100% inspection
- They avoid sampling for monitoring and control
- They are inexpensive

Definitions

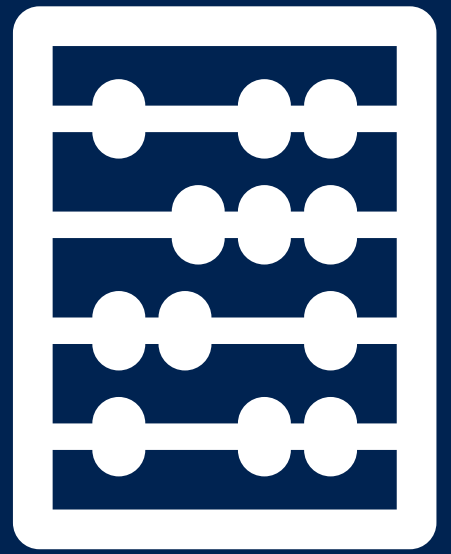
- Mistake Proofing is about preventing errors, notifying the operator when an error does occur and stopping the error from moving to the next operation or becoming a defect for our customers
- To achieve the highest levels of quality in our products or processes and reduce cost we must reduce errors and prevent defects

The goal of mistake proofing is ZERO defects

Definitions (cont.)

To be a defect:

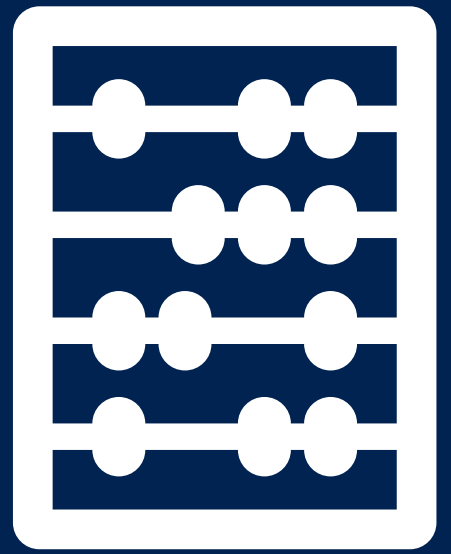
- The process or service must have deviated from specifications or standards of service (an error occurred)
- The process or service does not meet customer (internal or external) expectations



Definitions (cont.)

To be an error:

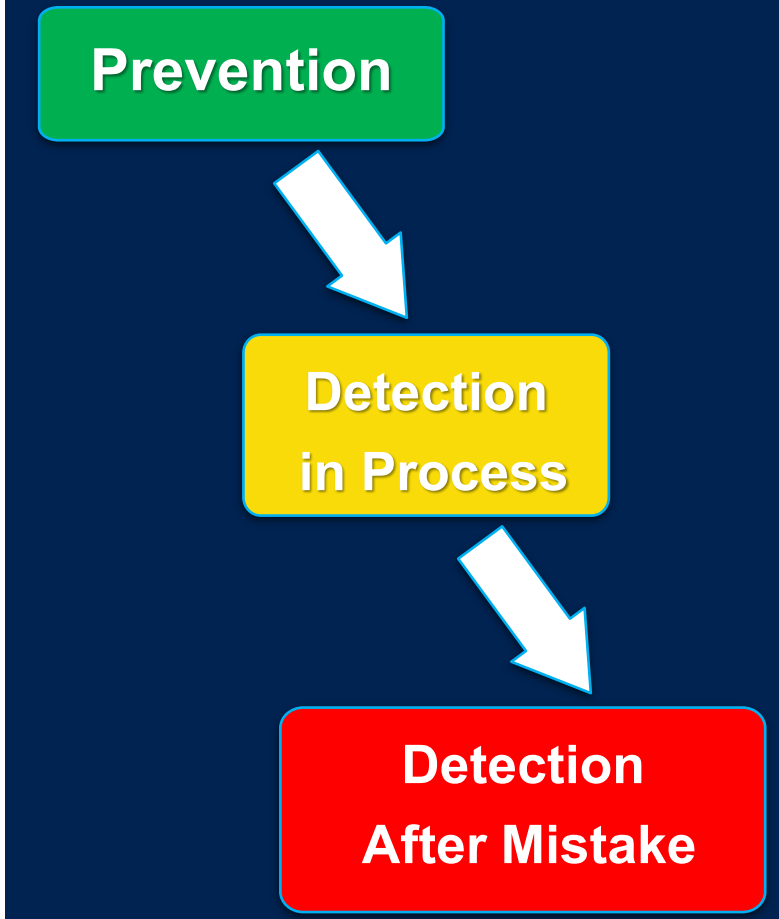
- Something must have deviated from an intended process
- The process must have deviated from specifications or standards that may or may not have been identified by the customer



All defects are created by errors, but not all errors result in defects!

Sources of Errors

- Forgetfulness
- Errors due to misunderstanding
- Errors in identification
- Errors made by untrained workers
- Willful errors (ignore rules)
- Inadvertent errors (distraction, fatigue)
- Errors due to delay in decision making
- Errors due to lack of standards
- Surprise errors (malfunctions)
- Intentional errors (sabotage)



Some Top Myths about Mistakes

- I don’t make mistakes so I don’t need this
- Others make mistake because they aren’t paying attention or need to try harder
- Mistakes aren’t an issue here
- If you make a mistake, you should quickly and privately take care of it
- We can’t mistake-proof everything, so why bother
- Mistake-proofing is too expensive

When to use Mistake Proofing

- When a process step has been identified where human error can cause mistakes or defects to occur, especially in processes that rely on the worker's attention, skill, or experience
- In a service process, where the customer can make an error which affects the output
- At a hand-off step in a process, when output (or for service processes, the customer) is transferred to another worker
- When a minor error early in the process causes major problems later in the process
- *When the consequences of an error are expensive or dangerous*

Benefits of Mistake Proofing

- Less time spent on training workers;
- Elimination of many operations related to quality control;
- Unburdening of operators from repetitive operations;
- Promotion of the work improvement-oriented approach and actions;
- A reduced number of rejects;
- Immediate action when a problem occurs;
- 100% built-in quality control;
- Preventing bad products from reaching customers;
- Detecting mistakes as they occur;
- Eliminating defects before they occur

Mistake Proofing Procedure

1. Form the Team.
2. Select the Process.
3. Obtain or create a flowchart of the process. Review each step, thinking about where and when human errors are likely to occur.
4. For each potential error, work back through the process to find its source.
5. For each error, think of potential ways to make it impossible for the error to occur. Consider:
   - *Elimination*: eliminating the step that causes the error.
   - *Replacement*: replacing the step with an error-proof one.
   - *Facilitation*: making the correct action far easier than the error.

Mistake Proofing Procedure (cont.)

6. If you cannot make it impossible for the error to occur, think of ways to detect the error and minimize its effects. Consider inspection methods, *setting functions*, and *regulatory functions* these will be explained on the next slide.
7. Choose the best mistake-proofing method or device for each error. Test it, then implement it.
8. Validation. Measure the effectiveness of the Poka-Yoke or Mistake Proofing device or method.
9. Continuous Improvement.

Setting and Regulatory Functions

Setting Functions, are the methods by which a process parameter or product attribute is inspected for errors:

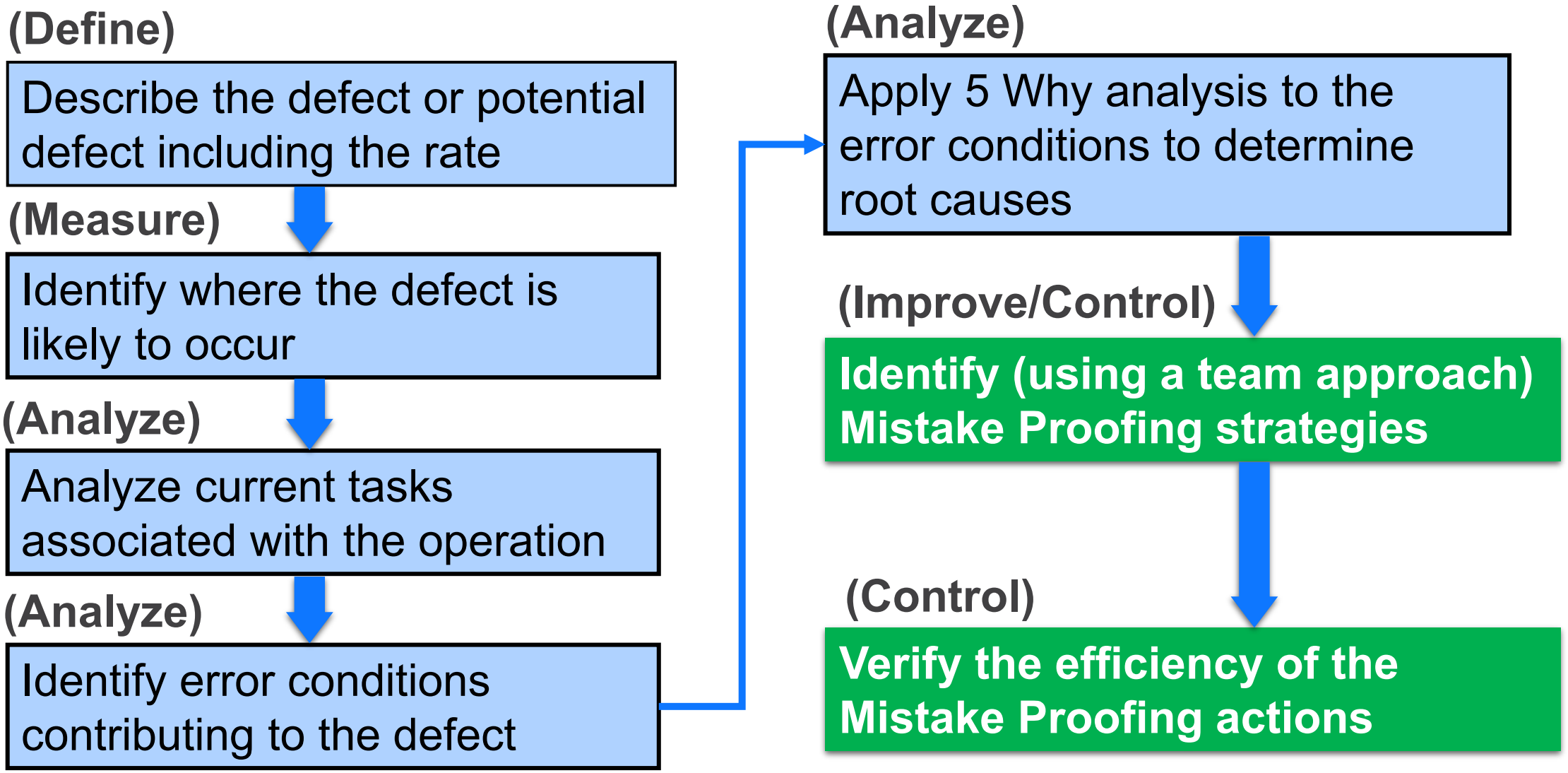
- The contact or physical method checks a physical characteristic such as diameter or temperature, often using a sensor.
- The motion-step or sequencing method checks the process sequence to make sure steps are done in order.
- The fixed-value or grouping and counting method counts repetitions or parts, or it weighs an item to ensure completeness.
- A fourth setting function is sometimes added, information enhancement, which makes sure information is available and perceivable when and where required.

Setting and Regulatory Functions

Regulatory Functions, are signals that alert the workers that an error has occurred:

- Warning functions are bells, buzzers, lights, and other sensory signals. Consider using color-coding, shapes, symbols, and distinctive sounds.
- Control functions prevent the process from proceeding until the error is corrected (if the error has already taken place) or conditions are correct (if the inspection was a source inspection and the error has not yet occurred).

Mistake Proofing Procedure (DMAIC)



The Five Steps to error proofing are:

1. Shift your paradigm.
2. Conduct analysis.
3. Standardize the work.
4. Create "alert" conditions.
5. Create error proof devices or systems.

Three levels of control

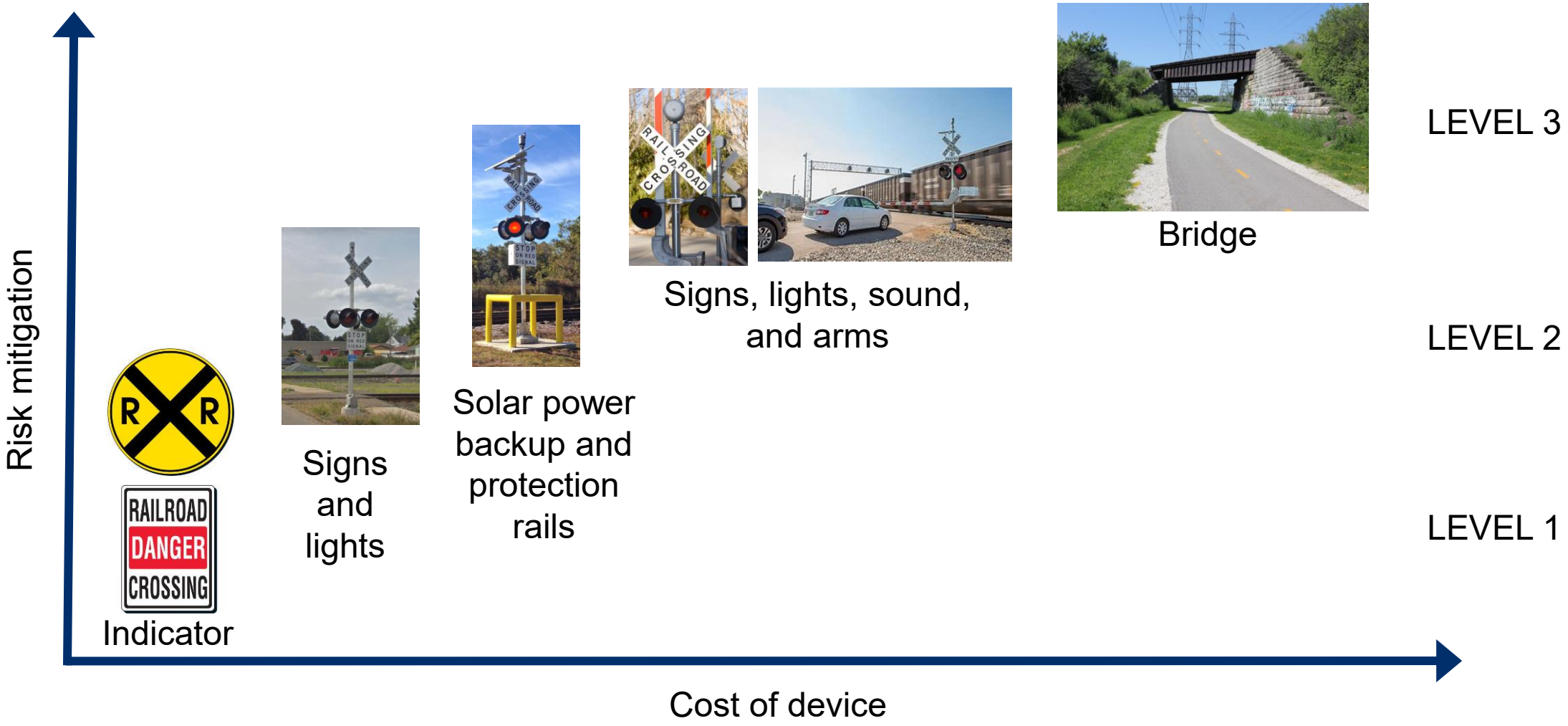
Level 1 – Indicators

Level 2 – Signals Conduct analysis.

Level 3 – Physical or Electronic

Clearly Level 3 is most desirable,
but not always possible or cost effective.

Rail Road crossing potential solutions



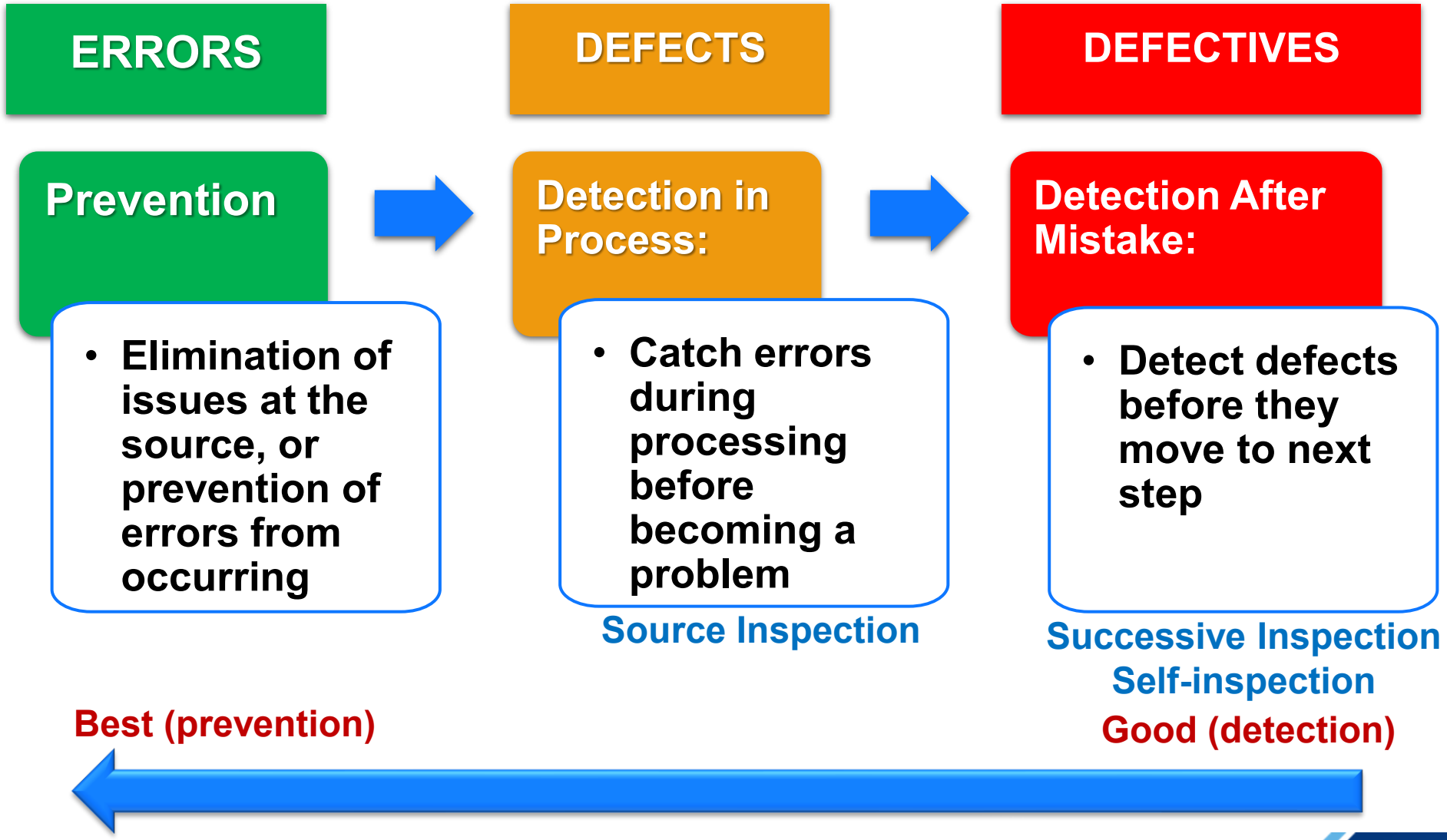
Inspection Methods vs Mistake Proofing

Three kinds of inspection methods provide rapid feedback. They are classified based on who does the operation and where in the process the inspection place relative to the possible error:

- *Successive inspection* is done at the next step of the process by the next worker
- *Self-inspection* means workers check their own work immediately after doing it
- *Source inspection* checks, before the process step takes place, that conditions are correct. Often it's automatic and keeps the process from proceeding until conditions are right

Source inspection is preferable to the other kinds

Mistake Proofing vs Inspection Methods



Mistake Proofing Examples

Error proofing In Action:

1. What are the error opportunities in this everyday item?
2. How has it been error proofed?
3. How could it be further error proofed?

Everyday Examples of Poka-Yoke

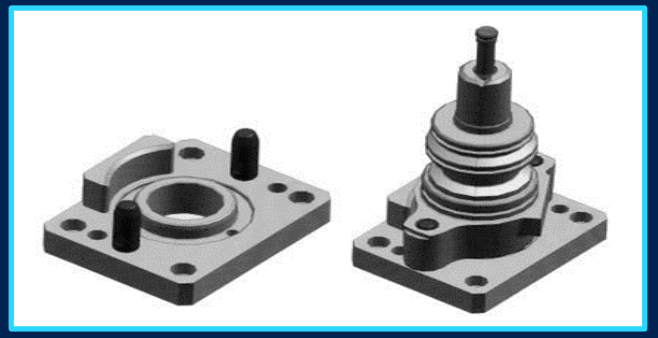
- Gas cap attached to a car
- Gas pumps with automatic shut-off nozzles
- 110V electrical plugs and polarized sockets
- Microwave automatically stops when door is opened
- Seatbelt buzzer to warn drivers and passengers
- Elevator electric eye to prevent door from closing on people
- Lawn mower safety shut-off when bar is released
- Car keys ground symmetrical to allow two-way insertion
- Product drawings on cash registers at fast food restaurants
- Bar codes for product identification during distribution

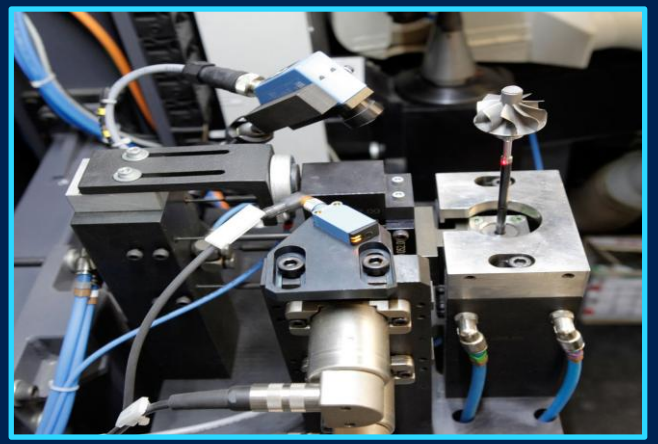
Examples of Poka-Yoke (Manufacturing environment)

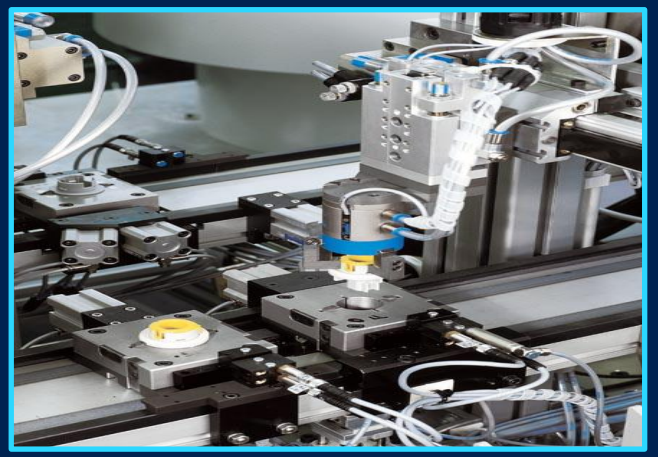
- A jig that will not allow wrong parts or that prevents the wrong alignment of parts

- Detection devices that will not allow a machine to start if a part is missing or out of place (e.g., proximity switch, electronic eye, light curtain)

- Detection devices that will not allow the next step in a process to occur if the previous steps have not been properly completed in the proper sequence (e.g., timers, sequence logic in control, limit switches, torque-controlled devices)



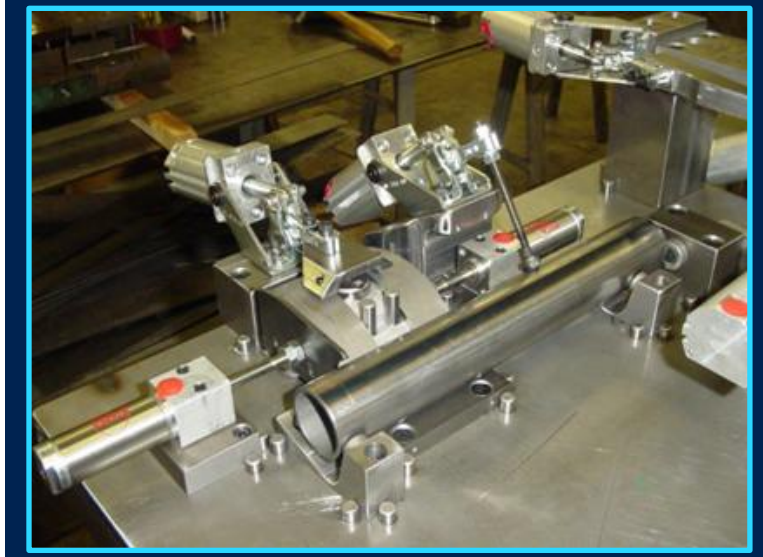




Examples of Poka-Yoke (Manufacturing environment)

- Devices that automatically adjust part or position so that manual placement/adjustment (which often introduces errors) is not required (e.g., tapered locating pins, parts pushers, locating clamps)

- Devices that inspect previous process to assure that it is properly completed before allowing part to proceed downstream (e.g., power clamps tied to detection device, automatic inspection station between process steps using signal lights, proximity or limit switches utilized for inspection)

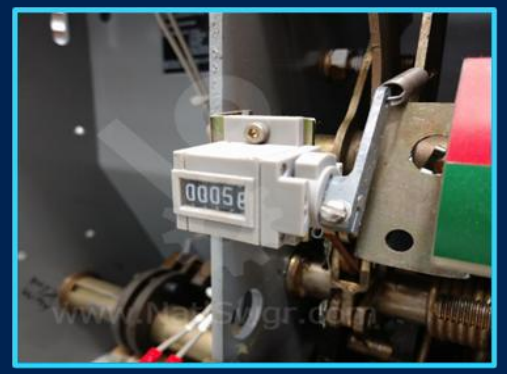


Examples of Poka-Yoke (Manufacturing environment)

- Guide Pins used to assure a one-way fit of a tool, fixture, or part to prevent incorrect orientation

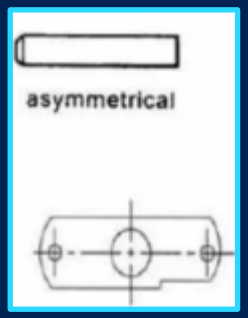
- An alarm used to alert an operator that a machine cycle has been attempted with a misaligned tool. The operator can take action to correct the problem

- Counters can be used to help an operator track the correct number of components needed in an assembly



Examples of Poka-Yoke (Manufacturing environment)

- Asymmetrical design of a nameplate that assures it is installed in only one possible orientation preventing backwards or upside down installation



- A left/right two button hand operated system with foot switch operation to ensure hands are free prior to cycling a forging press

Summary

- Mistake Proof devices cannot be implemented until the key items needing to be controlled have been identified and settings established
- Mistake Proofing (Poke Yoke) is a strategy for preventing errors in processes
- Effective Mistake Proofing requires two basic concepts:

  1. A focus on controlling the factors which cause errors
  2. Inspection which is effective and tireless

Resources

- Six Sigma DSI website,
  - Mistake-Proofing - Lean Six Sigma Glossary Term (sixsigmadsi.com)
- ASQ.org website,
  - What is Poka-Yoke? Mistake & Error Proofing | ASQ
- AS13006 – Process Controls Methods (App D – Guidance Materials)

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