

# Mistake-Proofing 101

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# Outline

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- I. Introduction & Definition
- II. Relation to RCCA and DMAIC
- III. Examples in Everyday Life
- IV. Old vs. New Approach
- V. Levels of Mistake-Proofing
- VI. Examples
- VII. Chase & Stewart's 21 Mistake-Proofing Principles
- VIII. Conclusion

# Introduction & Definition

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Mistake-Proofing – also known as

- Error Proofing
- Poka-Yoke
- Fool-Proofing
- The act of preventing a mistake from being made or making it obvious as soon as it is made
- Made famous by Shigeo Shingo
- Theory: Defects are caused by errors (usually human errors) that go undetected. So, to eliminate defects, prevent or detect errors

# Why Mistake-Proof?

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- Customers expect 100% defect-free products and services
- 100% inspection doesn't work
- Lean assumes 0% defective product
- Continual pressure to reduce costs
- Costs the least to fix a problem early in the process (\$1 - \$10 - \$100 rule)

# Relation to RCCA and DMAIC

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## Root Cause Corrective Action (RCCA)

- Determine the root cause of the problem
- When root cause is prevented from happening, the problem does not recur

## Six Sigma DMAIC Process

- Tool to sustain improvement in the control phase
- Considered the most effective tool!

# Mistake-Proofing in Everyday Life: Automobile

**Can't fit a diesel nozzle in the gas tank**

**Doors lock when speed is greater than 5 mph**

**Can't shift out of park unless brake applied**

**Can't start the car unless it's in park or clutched**

**Bell chimes when seatbelt not worn**

**Gas cap is attached to car by a lanyard**

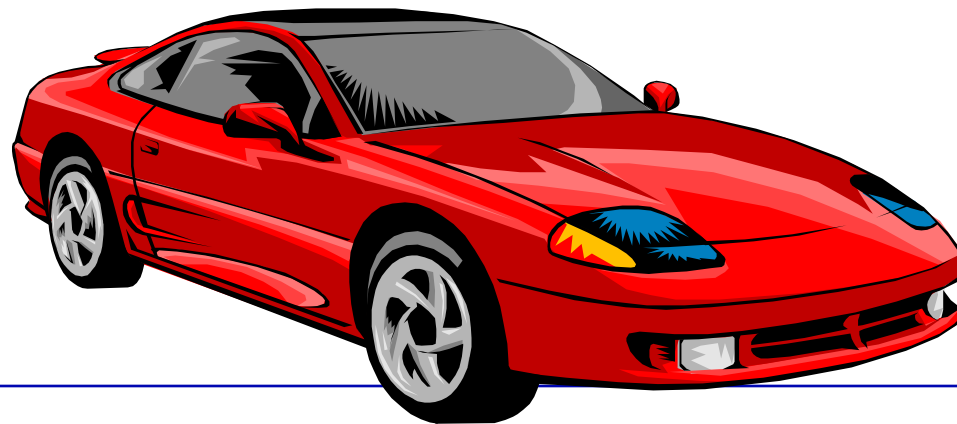
**Indicator lights when fuel is low**

**Headlights automatically burn & extinguish -- or bell chimes**

**Light indicates that parking brake is engaged**

**Light indicates low tire pressure**

**Oil & fuel specs are listed on caps or tanks**



# Mistake-Proofing in Everyday Life: Lawnmower

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- Safety bar on handle



# Mistake-Proofing in Everyday Life: Clothes Dryer

- Stops when door is opened



# Mistake-Proofing in Everyday Life: ATM

- Swipe card to use



# Mistake-Proofing in Everyday Life: Fast Food Restaurant

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- Hole in trash container is smaller than trays



# Mistake-Proofing in Everyday Life: Spell Checker

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The quick, brown fox jumped over the lazy dog.

# Common Mistake-Proofing Devices

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- Guide rods or pins
- Templates
- Limit or sensing switches
- Automatic counters
- Lockouts
- Asymmetric design
- Symmetric design
- Drop-down lists

# Old Approach vs. New Approach: Operator Errors

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## Old Approach

- Demand vigilance
- Traditional corrective action: “Re-trained employee in correct procedure” and/or “Issued disciplinary warning”
- Does this prevent recurrence?
- Does this eliminate the root cause?

# Old Approach vs. New Approach: Operator Errors

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## **New Approach**

- Operator still accountable
- All acknowledge that human errors will happen
- Design products/processes that either prevent the error from happening or give immediate feedback that an error has been made

# Levels of Mistake-Proofing

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- **Seek the highest level (lowest number) of mistake-proofing is consistent with your goals and objectives**

## **Level 1: Eliminate the error**

- Prevent the error from happening in the first place

# Levels of Mistake-Proofing

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## **Level 2: Detect the error**

- Automatically detect the error as soon as it happens
- Fix it automatically or stop the process

# Levels of Mistake-Proofing

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## **Level 3: Detect the Defect**

- Detect the defect through self-checks or successive checks
- Stop the operation until the defect is fixed

# Levels of Mistake-Proofing

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## **Level 4: Other process improvements**

- Checklists, visual aids, models
- Warning notices
- “Buddy inspection”
- Training
- Sampling and SPC

# Examples

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- Review the scenarios on the following slides and the five corrective actions for each problem. Determine the mistake-proofing level of each one

# Mars Climate Orbiter

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- The Mars Climate Orbiter was launched on December 11, 1998 to relay signals from the Mars Polar Lander. After entering the Martian atmosphere, it disappeared. The primary contractor for the project had measured the thruster firings in pounds of force even though NASA had specified metric units. This unit error sent the Climate Orbiter in too quickly and too low, causing the \$125 million spacecraft to burn up or break apart in Mars' atmosphere. This error went undetected in ground-based computer simulations.

## Corrective Actions

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- A. Discipline the engineers responsible and retrain all engineers involved.
- B. Place warning notices and checklists in the procedures used by the engineers to alert them.
- C. Maintain a real-time database/simulator to store and validate all calculated mission parameters as they are developed and provide immediate feedback to the design engineer.
- D. Provide time for integrated design reviews with all principle mission engineering functions.
- E. Pass a law to outlaw the use of the English system of units within NASA and any NASA subcontractor.

# The Challenger Disaster

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- The explosion of the Space Shuttle Challenger was caused by the human decision to launch in freezing conditions. A flexible O-ring that didn't seal properly allowed fuel to leak and ignite, eventually burning through the liquid oxygen tank causing the initial explosion. Some of the "fixes" that NASA considered implementing were:

# Corrective Actions

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- A. Discipline the engineers responsible and retrain everyone involved.
- B. Place warning notices and checklists used in the work instructions used to build the components of the shuttle.
- C. Disallow launches whenever the temperature is below 40 °F.
- D. Remove the O-ring seal from the design and go to a more robust seal interface.
- E. Reinforce the liquid oxygen tank to prevent burn through.

# Marking Parts

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- During the “marking parts” operation, there are numerous opportunities for errors. The marking itself may be incorrect, characters could be transposed or missed, and extra characters could also be present. The location or orientation of the marking may be wrong or the legibility might be poor. The following actions were proposed to error proof these common mistakes:

# Corrective Actions

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- A. Retrain operators in the proper techniques used in parts marking.
- B. Install lighted magnifiers at each marking workstation.
- C. Implement a check template for the operator to use to verify location, orientation, and character number.
- D. Rewrite the work instructions, placing messages and warnings in appropriate locations.
- E. Deploy bar code readers and automated part markers to gather the correct marking information from the routing and automatically generate the part marking.

# Chase & Stewart's 21 Mistake-Proofing Principles

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- Chase and Stewart, **Mistake-Proofing: Designing Errors Out** (1995)
- A way to generate mistake-proofing ideas
- Four main categories
  - Physical
  - Sequencing
  - Grouping and Counting
  - Information Enhancement

# Chase & Stewart's 21 Mistake-Proofing Principles

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- Physical
  1. Orientation and Placement
  2. Dispensers
  3. Lock-Ins / Lock-Outs
  4. Controlling Physical Space
  5. Detect Presence or Absence
  6. Use of Unusual Physical Attributes
  7. Improving Visibility
  8. Go / No-go Gauging

# Chase & Stewart's 21 Mistake-Proofing Principles

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- Sequencing
  - 9. Baiting
  - 10. Interlocks
  - 11. Task Substitution

# Chase & Stewart's 21 Mistake-Proofing Principles

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- Grouping and Counting
  - 12. Kits
  - 13. Arrangement
  - 14. Counting and Ordering
  - 15. Layout Mats
  - 16. Checklists

# Chase & Stewart's 21 Mistake-Proofing Principles

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- Information Enhancement
  - 17. Making Information Stand Out
  - 18. Moving Information Across Space
  - 19. Predicting Information
  - 20. Consolidating Information
  - 21. Storing Information

# **Eight Principles of Mistake-Proofing**

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1. Build quality into the process
2. All inadvertent errors and defects can be eliminated
3. Stop doing it wrong and start doing it right -- now
4. Don't think up excuses; think about how to do it right
5. A 60% chance of success is good enough – implement now
6. Zero defects requires commitment of the whole company
7. Ten heads are better than one
8. Seek out root causes

# Conclusion

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- Mistake-Proofing works!
- Mistake-Proofing fits in with continual improvement needs and requirements
- It is not a license to spend!

## For More Information. . .

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- John Grout's Mistake-Proofing page:  
<http://www.mistakeproofing.com>
- Error Proofing Techniques:  
[http://elsmar.com/Error\\_proofing/sld001.htm](http://elsmar.com/Error_proofing/sld001.htm)
- i Six Sigma: [http://www.isixsigma.com/tt/poka\\_yoke/](http://www.isixsigma.com/tt/poka_yoke/)
- ASQ: <http://www.asq.org/learn-about-quality/process-analysis-tools/overview/mistake-proofing.html>

**Questions?**