What causes defects?

- Cultural factors

- Variance

- Complexity

- Mistakes

What tools are used to achieve zero defects?

- Cultural factors:
  - Teams, Driving out fear, management commitment
- Variance
  - SPC, Taguchi & DOE,
- Complexity
  - Process Mapping, DFMA
- Mistakes
  - Mistake-proofing, Poka-Yoke, or ZQC

Motorola's findings about $C_p > 2$

...it became evident early in the project that achieving a C_p greater than 2 would go only part of the way. Mistake-proofing the design would also be required ... Mistake-proofing the design is an essential factor in achieving the [total number of defects per unit] goal.

Smith, B. IEEE Spectrum 30(9) 43-47

Evidence of the Effectiveness of Mistake-proofing

- AT&T Power Systems is first US manufacturer to win the Deming prize. Average outgoing defects reduced by 70%

- A washing machine drain pipe assembly line produced 180,000 units without a single defect (6 months).

- TRW reduced customer PPM's from 288 to 2.

Source: Productivity Inc. and Shingo prize profiles

Mistakes: to err is human

Have you ever done the following:

- Driven to work and not remembered it?

- Driven from work to home when you meant to stop at a store?

It happens to workers too.

- Workers finish the shift and don't remember what they have done.

- After building green widgets all morning, the workers put green parts on the red widgets in the afternoon.

You have two options:

- Demand vigilance. Exhort workers to "be more careful!"

- Mistake-proof. Eliminate the chance of making the mistake

A New Attitude toward Preventing Errors

"Think of an object's user as attempting to do a task, getting there by imperfect approximations. Don't think of the user as making errors; think of the actions as approximations of what is desired."*

*Source: The Design of Everyday Things, by D.A. Norman, 1988, Doubleday

A New Attitude toward Preventing Errors

- Make wrong actions more difficult
- Make it possible to reverse actions —to "undo" them—or make it harder to do what cannot be reversed.
- Make it easier to discover the errors that occur.
- Make incorrect actions correct.

*Source: The Design of Everyday Things, by D.A. Norman, 1988, Doubleday

What would YOU do?

GM welding machine

A) Make a worker responsible for it

B) Track the proportion of missing nuts on a chart

C) Increase preventative maintenance

D) Make the machine stop when the isn't present

E) Change the fasteners to a "clip-in" device

What would YOU do?
L'Hotel Louis XIV

A) Hire a floor manager who can unlock doors when needed

B) Rent only half the rooms in the hotel

C) Tear down and build new building with a bathroom for every room

D) Use a leather strap to keep both doors closed

E) Use electric door locks like a car

What would YOU do?

Nissan Stanza Van

A) Put a warning label on the fuel door and the sliding door

B) Reinforce the fuel pipe to withstand impact

C) Create a locking system that must be activated in order to take the gas cap off which keeps the sliding door from opening

D) Move the fuel door etc. out of the way of the sliding door (e.g. to the other side)

Approaches to Mistake-Proofing

- Mistake prevention in the work environment

- Mistake detection (Self-checks)

- Mistake prevention (Source inspection)

- Prevention of the influence of mistakes

Source: Yoshikazu Tsuda, in Quality through Engineering Design (ed. Kuo) 1993.

Examples of Mistake-Proofing

- 3.5" diskette
- Binney and Smith
- Trinity Industries
- Automobiles
- Computer Software
- Mail-order computer

Where Mistake-Proofing Works Well

- 1. manual operations where worker vigilance is needed

- 2. where mispositioning can occur.

- 3. where adjustment is required

- 4. where teams need common-sense tools and not another buzz-word.

- 5. where SPC is difficult to apply or apparently ineffective.

Where Mistake-Proofing Works Well

6. where attributes not measurements are important.

7. where training cost and employee turnover are high.

8. where mixed model production occurs.

9. where customers make mistakes and blame the service provider.

10. where special causes can reoccur.

11. where external failure costs dramatically exceed internal failure costs.

Where Mistake-Proofing does NOT work well

1. Destructive tests.

2. Production rate is very fast.

3. Shifts occur more rapidly than they can be responded to.

4. Self-checks when control charts are used effectively.

Shingo Shigeo :

Defects $= \emptyset$ is

absolutely possible!

John Grout:

If Defects $= \emptyset$ is possible,

Mistake-proofing will be in the
toolbox of those who achieve it.

Let's not wait 30 years...

John P. Lafferty wrote:

Shingo brought his Poka-Yoke devices to America in the mid-'80s...Unfortunately, the reception to Shingo's methods in this country is similar to our response to Dr. W. Edwards Deming in the 50's. It took us 30 years to become convinced Deming was right about statistical control. Must we wait 30 more to believe Shingo?