Mistake Proofing Overview

Mistake proofing is a technique for eliminating errors. It is based upon the premise that it is good to do something right the first time; it is even better to make it impossible to do it wrong the first time. The idea is to make it impossible to make a mistake. You may also hear the term, *Poka-Yoke* or *Error Proofing* applied to mistake proofing.

The objectives of this article are to provide participants with the information so they can:

- Understand the difference between errors and defects;
- Understand how defects originate
- Recognize the elements of source inspection and its role in defect elimination;
- Identify key mistake proofing devices;
- Show mistake proofing as a proactive tool, and;
- Show how mistake proofing fits into the Lean Six Sigma methodology.

Principles for Mistake Proofing

Mistake proofing is rooted in a deep respect for the intelligence of workers. It is a principle that seeks to take over repetitive tasks or actions thereby freeing a worker's time for creative and value-adding activities. Its objective is zero defects.

There are several examples of mistake proofing in everyday life. Consider automatic sinks and toilets in public rest rooms. They are designed to turn on and off without having to think about them. Automatic seat belts work the same way. All one needs to do is sit in the car and turn on the key and a shoulder harness moves into place. Mistake proofing focuses on eliminating the source of errors.

Errors vs. Defects

Errors are not the same as defects. **Errors cause defects.** Defects are many times the result of errors.

Walk into any public restroom and you are likely to see toilets that have not been flushed or sinks, with water running freely. In many cases, the hot water has been turned off in the sinks to conserve the costs of energy for heating the water. In these circumstances, what are the defects and what are the errors?

The defects are the filthy toilets and the running water. These are non-conformities in the process. They do not meet the pre-determined criteria that the public and management have established for a good restroom. As such, they must be corrected. If not corrected, they will cost management, both in terms of dollars and customers.

Hot water that runs unchecked involves a significant fuel expense. Filthy toilets discourage the public from returning to the business.

What is management to do?

One solution is to get out of the business. Many public places take this approach. Their restrooms are closed to the public. A modified version of this solution is to limit services to limit expenses. This is the approach taken when management turns off hot water. The hope is that the customer does not miss it. Another solution is to inspect for defects frequently and correct them when found. Yet this solution is only effective if its cost is less than or equal to the cost of the defect. Most often it is a stop gap measure that provides fewer defects but at greater costs. Mistake proofing offers a third solution.

The question is, can the error that causes the defect be minimized? Can it be eliminated?

The error in our public rest room example is human forgetfulness. People forget to operate the equipment. So, we build in an automated solution that takes care of this operation for them. They can no longer make the error; the defect is removed.

There are five general reasons why errors occur:

- Procedures are incorrect or non-existent. They do not fit the task, the environment, the equipment, the materials, the measurement, or the labor resources.
- There is excessive variation in the process
- There is excessive variation in the raw materials
- Measuring devices are inaccurate
- Human error

The last item on our list, human error, can be further broken down into ten categories:

- Forgetfulness, nor not concentrating;
- Misunderstanding, or jumping to conclusions without having all the information;
- Identification, or viewing the situation incorrectly (perhaps it is too far away);
- Training, or lack of it;
- Willful errors where the human ignores the rules;
- Inadvertent errors involving distraction or fatigue;
- Slowness, or delays in judgment;
- Lack of standards;
- Surprises when something does not go as planned, and;
- Intentional errors such as sabotage.

This list should give some food for thought. There are many things that contribute to human error. Among them are adjustments, multiple tasking, infrequent tasks, lack of standards, and repetition that is too rapid for the individual.

Such things can be controlled. Indeed, a great deal of planning and expense is involved in trying to do so. Yet errors still happen. A traditional approach to manufacturing and service industries is to think they are unavoidable. People *are* only human. Everything varies, and you can't plan for all contingencies. The traditionalist would say that everything must be inspected to control the inevitable defect. (Remember that defect is the result of error.)

The Lean Six Sigma view, however, differs. Many errors can be eliminated, not all of them, to be sure, but many. If many can be eliminated, and many more can be reduced, and if the focus of the efforts is in the Vital Few rather than the Trivial Many, then the need for inspection can be reduced or eliminated. Inspection for defects does not capture all of them. A Lean Six Sigma approach makes the *User* the inspector, and it controls the errors in the processes to assure that the user is satisfied with their inspections. Inspection happens in a Lean Six Sigma process; it is an inspector for ***error.***

Source Inspection

The chart below illustrates the traditional inspection process that focuses on finding the defect. Here the inspector stands at the end of the line and feeds back information to its various positions.

Mistake proofing provides immediate feedback at each step, prior to the creation of a defect. **Detection** is finding an error after it has occurred.

Indeed, action can be taken before errors occur. Immediate feedback and immediate proximity to the potential error allows for better **Prediction** and **Prevention.**

Mistake Proofing On the Job

Shutdown: Effective in both prediction and detection. An example of a shutdown device is a camera that will not function when there is not enough light to take a picture. The meter predicts the picture will not take, and it shuts down. Some clothes dryers shut down when they detect an overheating situation.

Control: A control device can make pending errors impossible. Erroneous items cannot be used in the process. When gas stations introduced unleaded gasoline, the nozzle on the leaded pump was designed to be too big to fit into an unleaded tank, thereby preventing error. A fruit orchard assures that only the biggest apples pass on to its customers by passing the apples through a sizer. Apples that are too small fall through and are sent to a discount outlet.

Warning: A warning device predicts when something is about to go wrong. It can also sound immediately when something does go wrong. Seat belt buzzers are warning devices used for prediction. Smoke detectors detect a hazardous situation.

Contact Methods: Contact with a part highlights errors. Electrical outlets have been mistake proofed to assure proper polarity. It is impossible to put a plug in an outlet incorrectly.

Fixed Value Methods: Errors are detected through counting. Many boxes should be shipped with four different hazardous material warning labels. When labels were on separate rolls, errors in shipping often occurred. By placing all labels on a common roll and aligning them for easy reference, the worker easily knew when a label was missed.

Motion Step Methods: Detect errors by motion, or the lack of it. Seven screws in various sizes were inserted in the final assembly of a CD-ROM drive. Often a screw would be forgotten. The seven Different screws were put into bins with photo-electric switches. When a screw is removed, the beam is broken. The part cannot move on to the next operation until the beam is broken on all seven bins.

As you begin to recognize the techniques and methods that apply to mistake proofing, it is easy to see how the principal has been applied. Limit switches are commonly applied to assure that machines are not operated beyond their design capacity or that they are operated in a safe manner. Guide pins are routinely used to assure that jigs and molds go together in the correct configuration. At the end of this module are eight mistake proofing challenges. How can the problems be solved?

When You Can't Mistake Proof

Some strategies can be employed to minimize mistakes, or make them easier to detect. Consider the following:

- Colors and color coding. Credit card receipts are almost always designed so the customer gets the yellow copy and the merchant gets the white copy.
- Use of shapes. Stop signs are always octagonal.
- Auto-detection. Word processors come with spell checkers. These reduce errors considerably.
- Make it easy to do it right. Use checklists. Have effective data collection forms that follow the process. Design work flows with fewer hand-offs.

5 Steps to Mistake Proofing

There are five steps to mistake proofing:

1. **Identify problems.** Look at customer returns, defective parts analyses, and error reports. Do a FMEA.

2. **Prioritize problems.** Look at problem frequency and cost. Identify wasted materials, rework time, detection time, and detection cost. Consider inspection costs.

3. **Seek out the root cause.** Drive down until you truly understand the source of the error. Correct mistakes at their source.

4. **Create solutions**. Make it impossible to do it wrong. Perform a cost benefit analysis to see how long the investment in the solution will take to repay itself. Be creative in solution generation.

5. **Measure the results**. Have errors been eliminated and what is the impact?
There is no doubt that mistake proofing offers several advantages when it is designed into the product. No formal training programs are required to implement it or to use the devices. It eliminates many inspection operations, and it relieves operators from repetitive tasks that take away from their creativity and value added activities. It results in defect-free work. It provides immediate action when problems do arise.

Mistake Proofing Challenges

Look at the following situations. What mistake proofing methods or techniques might you consider applying?

1. ATM customers complain that they never know the right way to insert their ATM card, and it usually takes a couple of tries to get it right.

2. A local bottling company wants to make sure that all bottles are filled with exactly the right amount of soda.

3. A large pharmaceutical company is trying to develop a way to assure elderly people living alone take their prescription medicine at the right time and in the correct dosage.

4. A manufacturer of home power tools wants to make sure that customers are wearing eye and hand protection before using their equipment.

5. A consumer electronic company has had several customer complaints lately that their instructions were missing from their product.

6. Nine different tools are needed to change a jig and die. Often, in the middle of changeover, the set-up operator realizes a tool is missing and has to stop to look for the tool.

7. An easy-to-assemble furniture manufacturer has received several complaints about holes not being tapped for all screws. Because the furniture is made from hardwood, the customers have to drill the holes themselves.

8. A contact lens solution manufacturer received complaints from distributors that some customers found empty boxes with their shipments. The company wants to make sure no more empty boxes are shipped.

Steven Bonacorsi is a Senior Master Black Belt instructor and coach. Steven Bonacorsi has trained hundreds of Master Black Belts, Black Belts, Green Belts, and Project Sponsors and Executive Leaders in Lean Six Sigma DMAIC and Design for Lean Six Sigma process improvement methodologies.

The AIT Group, Inc.
Steven Bonacorsi, Vice President
Lean Six Sigma Master Black Belt
3135 South Price Road, Suite 115
Chandler, AZ 85248-3549
Phone: +(1) 888.826.2484
E-mail: americas@theaitgroup.com
http://www.theaitgroup.com