

ERROR PROOFING

(The Road to Near Zero-Defect Manufacturing)

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Dr W. Edwards, whose theories and philosophies changed manufacturing throughout the world, said that quality must be built into the product during manufacture, it cannot be added economically later. The goal of manufacturers should be to install processes that produce little or no defects.

Key Elements of Quality

Quality is free, it does not cost money; it is the un-quality things that result from not doing things right the first time, that cost money.

Quality does not come from inspection, but must come from the improvement of the process (machine, process, human, etc.) that created the error. Instead of looking for errors in work that has already been manufactured, the efforts should go into fixing the process as soon as possible so no further errors can occur.

The key elements of any quality organization consist of the customer, the process, and the employee. Everything that is done in a world-class organization must focus on three elements:

- **The Customer** – expects quality products, delivered on time, and followed by good service. All three are necessary for a business to survive and satisfying the customer must be company's prime goal.
- **The Process** – must be examined from the customer's perspective to see if there are areas where great value or improvement can be added.
- **The Employee** – quality is the responsibility of every employee, therefore every employee must be trained in quality.

Productivity and Performance Improvement

The goal of manufacturing engineers across the world in these competitive times is to develop manufacturing processes where no defective parts are produced. Inspection and correction of defective products should be replaced by quickly finding the source of the error in the process and correcting it before more defective parts are produced.

Error-Proofing Advantages

The cost of a product error may be difficult to determine because it involves time, rework, repair or scrapping the part. It is far cheaper to fix the manufacturing process that created the error than to fix the manufactured part. It is very difficult or nearly impossible to add quality to a part after it has been manufactured.

1. **Market Advantage** - earns a company the reputation for producing consistent high-quality goods, an advantage in world markets.
2. **Better Workers** - often suggest improvements to the process and if implemented should receive credit; if not suggestions will stop coming.
3. **Product Predictability** - it is the goal of most management to have machines and processes that produce error-free parts.
4. **Company Productivity** - increases because there are no production stoppages due to faulty processes or equipment.

Poor Quality Causes

1. **People** - training not extensive enough so the learner fully understands the process or task to be performed.
2. **Equipment** – a piece of equipment out of adjustment may be the cause of the error. It should have been reported and repaired very quickly as soon as it was noted.
3. **Processes** – it could be wrong for the product or the type of work being performed.

Error-Proofing System Purpose

The purpose of implementing an error-proofing system in a company is generally to reduce the potential for variation in product quality and the waste this creates in time, money, and the company's reputation throughout the world. Two things about product quality that are considered a defect; a product that varies from design specifications and especially those not meeting customer specifications.

Types of Error-Proofing Devices

The use of physical devices that assist or substitute for the human senses and improve cost and reliability of the inspection activities are essential for Lean manufacturing. Optical, mechanical, electrical, pneumatic, or hydraulic devices to sense, signal, or prevent existing or potential error conditions can be used to achieve 100% inspection of errors.

Good data, gathered at the point of manufacture is the best of all. The equipment used to gather this data should be rugged to stand up to conditions encountered in manufacture. It should be able to measure 100% of the product at the point of manufacture and provide instant feed.

Common error-proofing devices include the following:

- **Visual and Audio Equipment** such as andons, limit switches, buzzers, etc.

- **Smart Machines** are being developed that use the latest technology to allow manufacturing equipment to make decisions based on acquired knowledge to making the "First Part right the first time"
- **On-Line Gaging Equipment**
 - **Non-Contact Measuring**
 - **Optical comparators**, laser measuring instruments, scanning technology instruments, video measuring tools, and vision systems are currently being used to measure work while it is being machined. Many of these have the capability of adjusting the machine automatically when the part quality nears its control limit.
 - **Photogrammetry** uses triangulation to produce 3-dimensional point measurements of an object within its camera focus. They can measure multiple points on the number of simultaneously triangulated points. The photographic measurements that produce the final XYZ coordinates of all the measured points are produced automatically to an accuracy of .001 to .002 in.