IENG/MANE112

Introduction to Industrial Engineering / Management Engineering

Lecture 12

Quality Control

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Introduction

- **Quality**
  - The ability of a product or service to consistently meet or exceed customer expectations.

The Evolution of Quality Management

- Prior to the 1970s and 1980s, quality was not a focal point of U.S. companies. They were concerned with *productivity* rather than quality.
- Foreign competition, due in part to a focus on quality, was able to capture significant shares of U.S. markets

- Prior to Industrial Revolution, skilled craftsman performed all stages of production
- Fredrick Taylor
- World War II→ sampling techniques
- 1950s: Quality assurance systems
- 1960s: concept of "zero defects"
- 1970s: Oil embargo → automobile industry

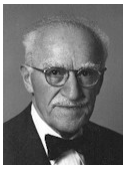
quality assurance in service and government

Quality Contributors

- **Walter Shewart**
  - "father of statistical quality control"
  - Control charts
  - Variance reduction

- **W. Edwards Deming**
  - Special vs. common cause variation
  - The 14 points

- **Joseph Juran**
  - *Quality Control Handbook*, 1951
  - Viewed quality as fitness-for-use
  - Quality trilogy–



quality planning, quality control, quality improvement

Quality Contributors

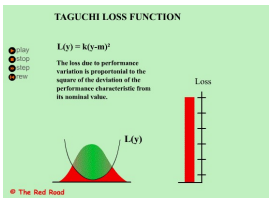
- **Armand Feigenbaum**
  - Quality is a "total field"
  - The customer defines quality

- **Philip B. Crosby**
  - Zero defects
  - *Quality is Free*, 1979

- **Kaoru Ishikawa**
  - Cause-and-effect diagram
  - Quality circles
  - Recognized the internal customer

Quality Contributors

- **Genichi Taguchi**
  - Taguchi loss function



- **Taiichi Ohno and Shigeo Shingo**
  - Developed philosophy and methods of ***kaizen*** (Japanese word for "continuous improvement")

Dimensions of **Product** Quality

- **Performance**– *main characteristics of the product*
- **Aesthetics**– *appearance, feel, smell, taste*
- **Special features**– *extra characteristics*
- **Conformance**– *how well the product conforms to design specifications*
- **Reliability**– *consistency of performance*
- **Durability**– *the useful life of the product*
- **Perceived quality**– *indirect evaluation of quality*
- **Servicebility**– *handling of complaints or repairs*

Examples of product quality for a car

Dimension	Examples
Performance	Everything works
Aesthetics	Exterior and interior design convenience
Features	Convenience: placement of gages High Tech: GPS system Safety anti-skid, airbags
Conformance	Car matches manufacturer's specifications
Reliability	Infrequent need of repair
Durability	Useful life in miles, resistance to rust
Perceived Quality	Top-rated
Servicability	Ease of repair

Dimensions of **Service** Quality

- **Convenience**– *the availability and accessibility of the service*
- **Reliability**– *ability to perform a service dependably, consistently, and accurately*
- **Responsiveness**– *willingness to help customers in unusual situations and to deal with problems*
- ***Time–*** *the speed with which the service is delivered*
- ***Assurance–*** *knowledge exhibited by personnel and their ability to convey trust and confidence*

Dimensions of **Service** Quality

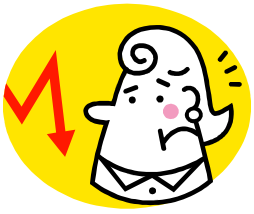
- ***Courtesy–*** *the way customers are treated by employees*
- ***Tangibles–*** *the physical appearance of facilities, equipment, personnel, and communication materials*
- ***Consistency–*** *the ability to provide the same level of good quality repeatedly*

Examples of service quality dimensions for having a car repaired

Dimension	Examples
Convenience	Was the service center conveniently located?
Reliability	Was the problem fixed?
Responsiveness	Were customer service personnel willing and able to answer questions?
Time	How long did the customer have to wait?
Assurance	Did the customer service personnel seem knowledgeable about the repair?
Courtesy	Were customer service personnel and the cashier friendly and courteous?
Tangibles	Were the facilities clean??
Consistency	Was the service quality good, and was it consistent with previous visits?

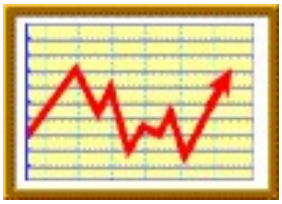
The Consequences of Poor Quality

- Loss of business
- Liability costs
- Productivity decrease
- Costs increase

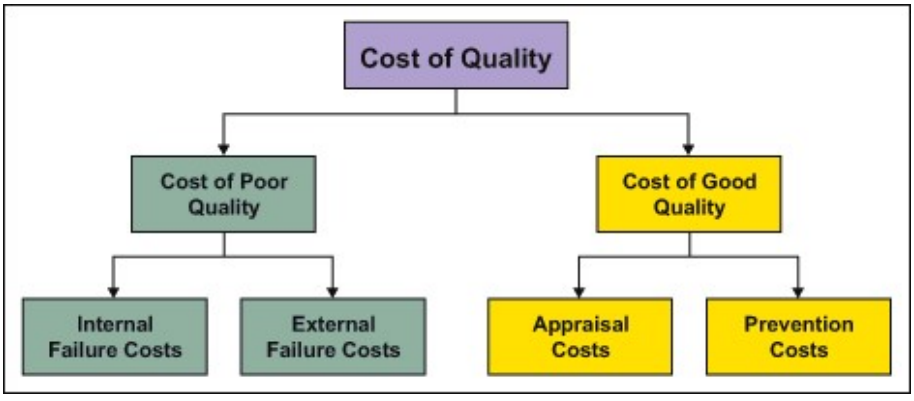


Benefits of Good Quality

- Enhanced reputation for quality
- Ability to command higher prices
- Increased market share
- Greater customer loyalty
- Lower liability costs
- Fewer production or service problems
- Higher profits



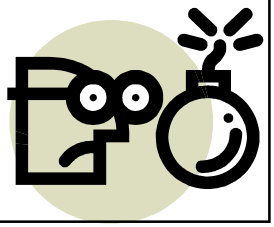
Cost of Quality



Derived from: Feigenbaum, Armand V. (1991), Total Quality Control (3 ed.), New York, New York: McGraw-Hill, p. 109, ISBN 978-0-07-112612-0.

Costs of Quality

- **Failure Costs** - costs incurred by defective parts/products or faulty services.
  - **Internal Failure Costs**
    - Costs incurred to fix problems that are detected before the product/service is delivered to the customer.
  - **External Failure Costs**
    - All costs incurred to fix problems that are detected after the product/service is delivered to the customer



Costs of Quality

- **Appraisal Costs**
  - Costs of activities designed to ensure quality or uncover defects
- **Prevention Costs**
  - All quality training, quality planning, customer assessment, process control, and quality improvement costs to prevent defects from occurring

Summary of Quality Costs

Category	Description	Examples
Appraisal Costs	Costs of activities designed to ensure quality or uncover defects	Inspection equipment, testing, labs, inspectors, and interruption of production to take samples
Prevention Cost	All quality training, quality planning, customer assessment, process control, and quality improvement costs to prevent defects from occurring	Quality improvement programs, training, monitoring, data collection and analysis, and design costs
Internal failure costs	Costs incurred to fix problems that are detected before the product/service is delivered to the customer.	Rework costs, problem solving, material and product losses, scrap, and downtime
External failure costs	All costs incurred to fix problems that are detected after the product/service is delivered to the customer	Returned goods, reworking costs, lost of goodwill, liability claims, and penalties

Basic Quality Tools

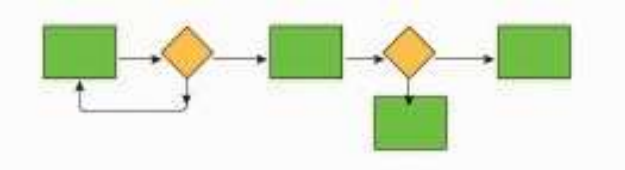
1. Flowcharts
2. Control Chart
3. Check sheets
4. Histograms
5. Pareto Chart
6. Cause-and-effect Diagram
7. Scatter Diagram

Flowcharts

- A diagram of the steps in a process

What is its use?

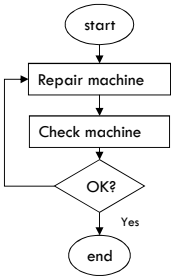
- A Flow chart lets a process or procedure be understood easily. It also demonstrates the relationships between the elements.



Flow Charts

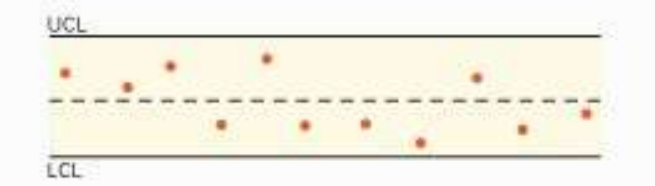
Example:

- You intend to repair a certain machine.
- First you perform the repair thought to be necessary
- Then You check it
- If it does not work you continue with repairs
- If it works you finish



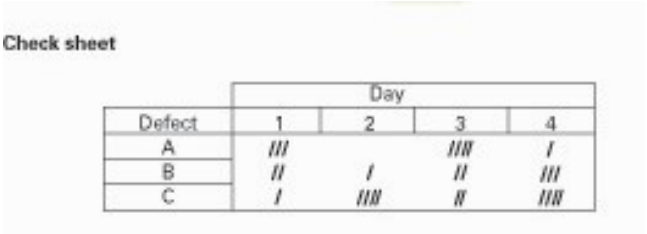
Control Chart

- A statistical chart of time-ordered values of a sample statistic. It is used to see if a process output is random. Control charts also can indicate when a problem occurred and give insight into what caused the problem.



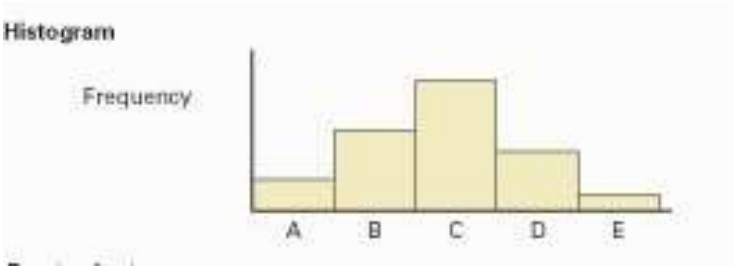
Check Sheets

- A tool for recording and organizing data to identify a problem.



Histograms

- A chart of an empirical frequency distribution.

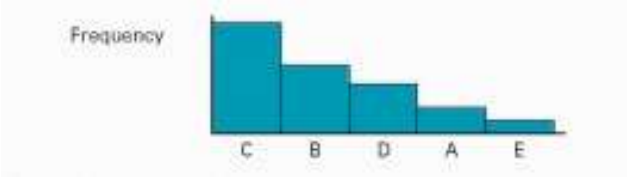


Pareto Chart

- Technique for classifying problem areas according to degree of importance, and focusing on the most important.

What is its use?

- Pareto Charts are used to apply the 80/20 rule of Joseph Juran which states that 80% of the problems are the result of 20% of the problems. A Pareto Chart can be used to identify that 20% route causes of problem.



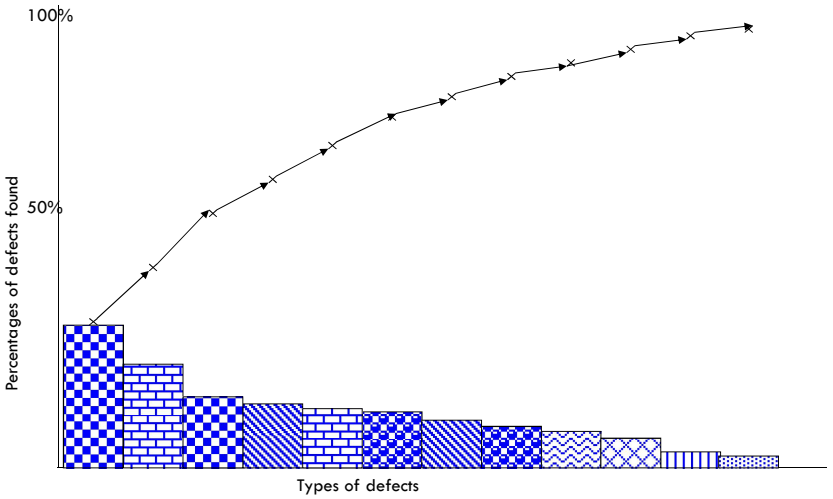
Pareto Charts

Example:

- A certain machine has different kinds of failures that occur. The Maintenance department identifies these types of failures and counts their occurrence over a period of 3 month. The Data is then added up. The Failures are ranked by their occurrence values starting with the most frequently occurring failure.
- A histogram is drawn with bars representing the types of failures. Furthermore are cumulative values assigned to the failure types and drawn into the diagram.
- Now determine the point were the cumulative line crosses the 80% mark. Concentrate of the failure types that lie left of this mark.

Pareto Charts

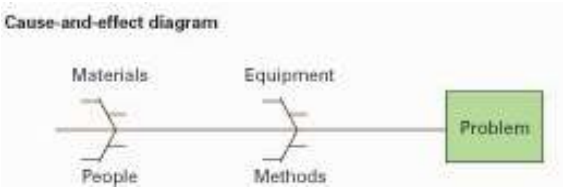
27



Quality Tools - http://www.kwaliteg.co.za

Cause-and-effect Diagram

- A diagram used to search for the cause(s) of a problem; also called ***fishbone diagram.***



Scatter Diagram

- A graph that shows the degree and direction of relationship between two variables.

What is its use?

- Demonstrating correlations between values and showing trends for value changes