University of Jordan
Chemical Engineering Department
905509 Statistical Quality Control

Introduction and Basic Concepts

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Wisdom

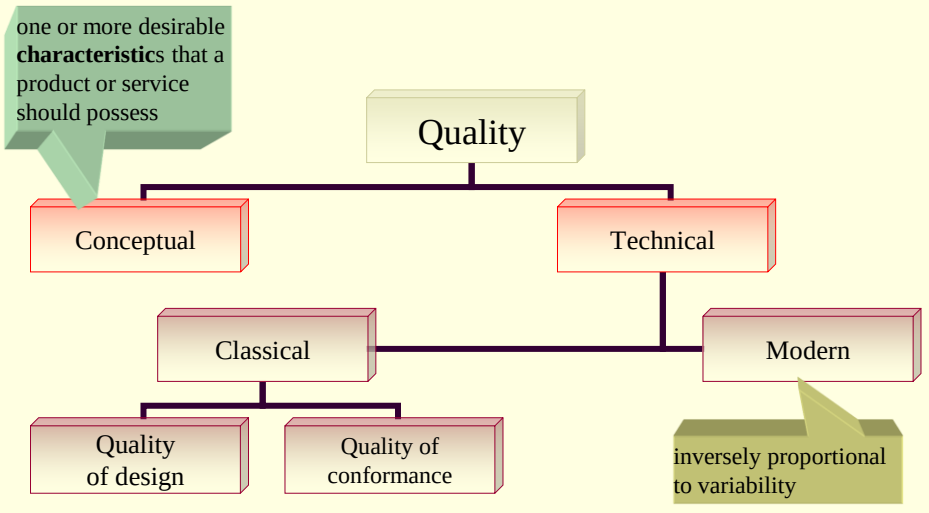
When a wise man does not understand, he says, '*I do not understand.*' The fool and the uncultured are ashamed of their ignorance. They remain silent when a question could bring them wisdom."

Saying of the ABBODS
from *The God Makers*
by Frank Herbert

Outline

- Quality and quality improvement.
- Definition of quality.
- Dimensions of quality.
- Quality characteristics
- Quality engineering terminology.

What is Quality



Quality Improvement

- If we accept the modern definition of quality then any action leading to the reduction of variability in processes and products is **quality improvement.**
- Another way of looking at quality improvement is to define it as **"waste reduction".**

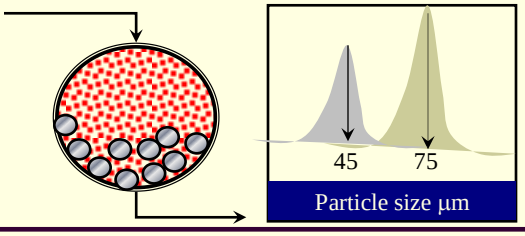
Quality Dimensions

- To asses the quality of any product we need a criterion to do so.
- There are eight (8) main criterion (dimensions) to asses the quality of products.

Performance

Will the process/product do the intended job?

- A ball mill running to produce a fine particle size distribution with an average size less than 50 μm.
  - Particle size distribution consistently yielded an average size of 45 μm.
  - Particle size distribution consistently yielded an average size of 75 μm.



Reliability

How often does the Process/product fail?

- Potash
  - A certain yield of brines was harvested out of a carnalite pan. Suddenly, the pan failed to provide the required composition or expected yield. How many times does this scenario happen?
  - How often do you need to shut down the cold/hot crystallization for failure of a crystallizer?

Durability

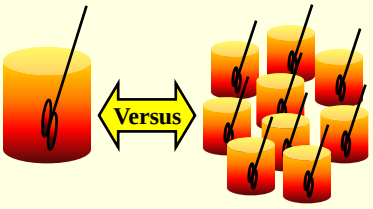
How long does the process/product last?

- Corrosion
  - The Dead Sea environment is demanding on the materials of construction used. How long does an **inconel** alloy last? A mild steel pipe?
- Environmental
  - How long does it take to replace filter media or ion exchange resins in water purification?

Serviceability

How easy is it to repair a process or product?

- H_3PO_4 industry
  - Is it easier to fix one large crystallizer (reactor) or a tank of smaller crystallizers (reactors) with the same throughput?
  - Take JPMC reactor as an example.



Aesthetics

What does the product look like?

- Are potash crystals clean or dirty?
- Do they appear uniform in size?
- Is the product visually appealing to the consumers?


Features

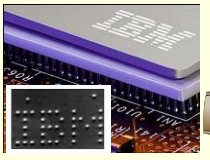
What does the product do?

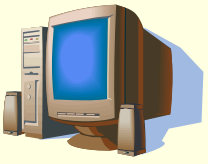
- What makes the product more marketable than similar competing products?
- Extra features beyond the basic performance of the competition
  - Less bromine content, higher purity of the potash etc?
  - Phosphoric acid with less heavy metals content.
  - Antacid drug with short time of relief.
  - Light versus heavy crude oil.


Perceived Quality

What is the reputation of the company?

- IBM brand computers vs. a generic made computer.
- A Mercedes-Benz versus any other brand.
- A certain drug e.g., Viagra versus a generic drug.

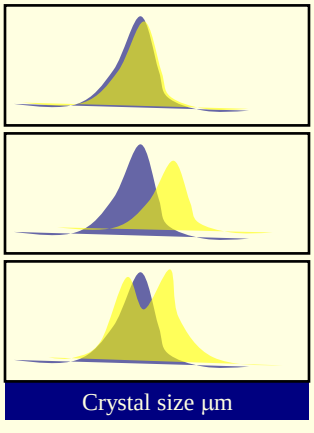




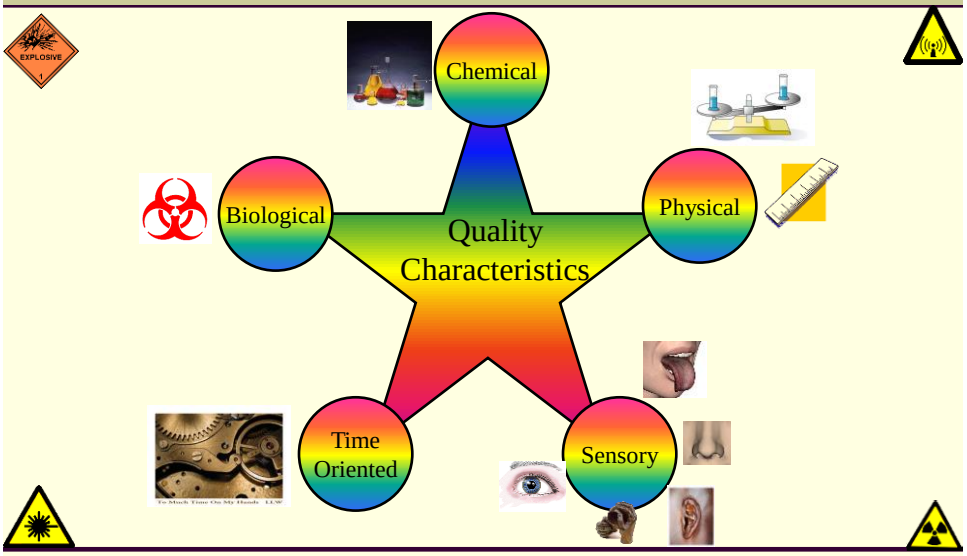
Conformance to Standards

Is the product made exactly as the designer intended?

- Potash
  - Does the potash crystal size distribution match design specs?
  - Does the chemical composition of potash match these the process was designed for?
- Petroleum
  - Is the octane number of gasoline same as design specs?
  - Is the Reid vapor pressure for gasoline the same as design specs?



Quality Characteristics



Types of Quality Characteristics

- **Variables.** Usually involve continuous measurements e.g., length, mass, viscosity, density, thermal conductivity, active matter concentration etc.
- **Attributes.** Usually discrete data, often taking the form of counts e.g., number of defective parts, fraction accepted or rejected etc.

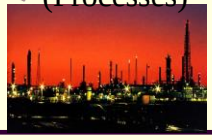
Causes of Variability (M^4)

Man + Machine + Materials +Methods= M^4

Human (Man)

Materials

Machines (Processes)



Desirability of Reduced Variability

- Design and production of inherently safe products.
- Economics
  - Increased productivity.
  - Increased efficiency of processes.
  - Reduced costs.
  - Greater profitability
- Increased competence in a tough market and enhanced market penetration.
- Environmental (Reduced Waste).
- Legal (Avoid litigations and law suits).

- Why is it desirable to reduce variability in industry? Mention at least three reasons.

Specification of a Quality Characteristic

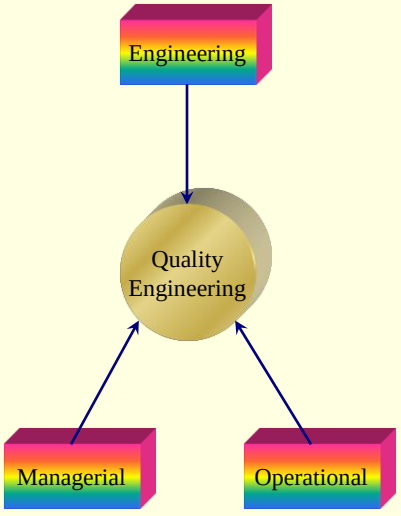
- Quality characteristics are usually evaluated against **specifications**.
- **Specification** is the process by which the desired measurements for the quality characteristics on the **components and subassemblies that make up the product**, as well as the desired values for the quality characteristics in **the final product**.

Specification Levels

- Three levels of values
  - **Lower Specification Limit (LSL)** is the smallest allowable value for a quality characteristic
  - **Nominal (target)** value is the desired value for a quality characteristic.
  - **Upper Specification Limit (USL)** is the largest allowable value for a quality characteristic.
- Some quality characteristics have specification limits on only one side of the target.

Quality Engineering

- **Quality engineering** is the set of **operational**, **managerial**, and **engineering** activities that a company uses to ensure that the quality characteristics of a product are at the nominal or required levels.



Design Approaches

- **Over-the-wall**. Specification limits are usually determined by the **design engineer**.
- **Concurrent engineering**. A team approach to design with specialists in manufacturing, quality engineering and other disciplines working together with the product designer at the earliest stages of the product design process.

Nonconforming, Defective and Defects

- When a component or product does not meet one or more of its specifications, they are considered to be **nonconforming**.
- A nonconforming product is considered **defective** if it has **one or more** defects.
- **Defects** are nonconformities that may seriously affect the **safe** or **effective** use of the product.

Final Thoughts

- Quality function is not responsible for quality!
- Quality department does not design, manufacture, distribute, or service the product.
- The entire company is responsible for quality.