University of Jordan
Chemical Engineering Department
905509 Statistical Quality Control

History of Quality Control and Introduction to TQM

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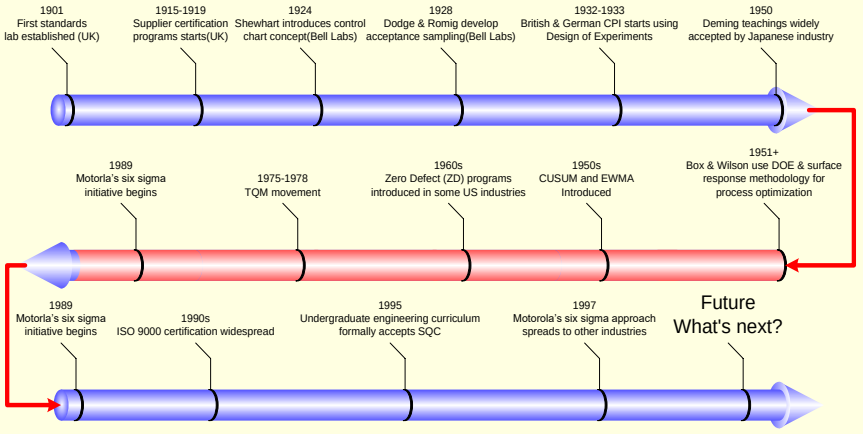
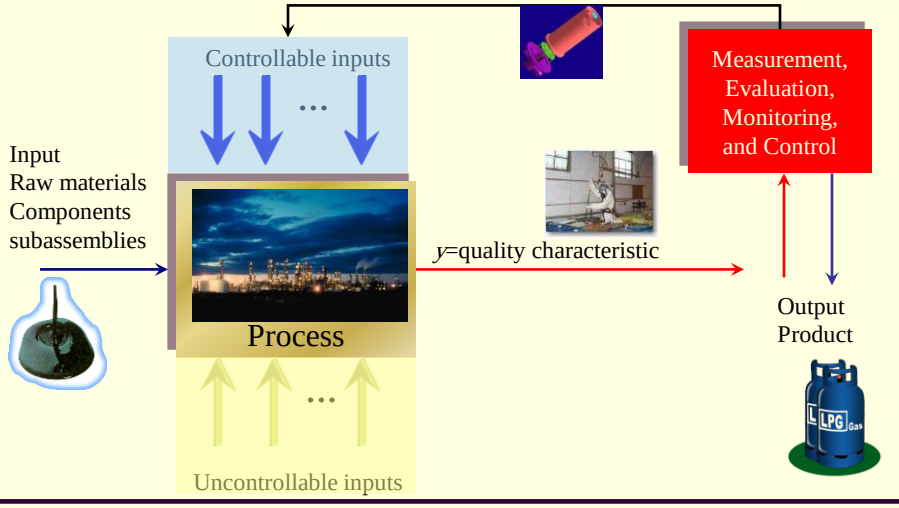
Outline

- History of quality engineering.
- Statistical methods for quality control and improvement.
- Quality philosophy and management strategies.
- Quality costs, legal aspects of quality.
- Implementing quality improvement.

Quality Control History Timeline



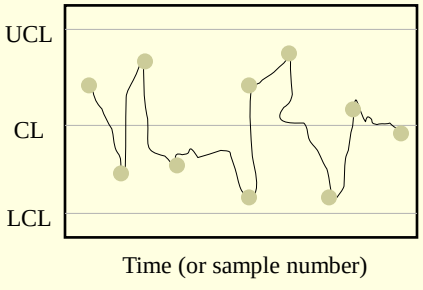
Process, Inputs and Outputs



Statistical Methods for Quality Control & Improvement

Statistical Process Control (SPC)

- A control Chart is one of the primary techniques of SPC.
- Plots averages of measurements of a quality characteristic in samples taken from the process versus time (or sample number).



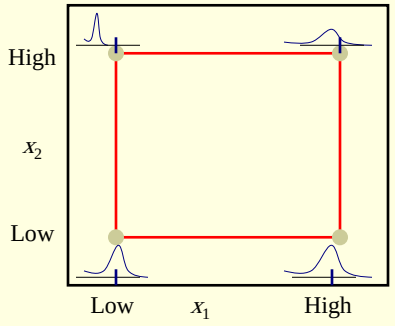
Control Charts II

- Three lines
  - Center line (CL), where the process characteristic is expected to fall if there are no unusual sources of variability present.
  - UCL and LCL are determined from some statistical considerations! (later)
- Applied usually to output variables.
- On-line (in-process) process monitoring technique.

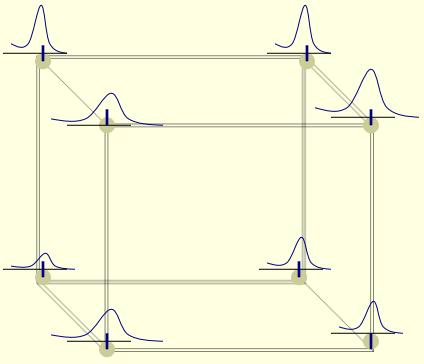
Design of Experiments (DOX)

- A designed experiment is an approach to systematically varying the controllable input factors in the process and determining the effects these factors have on the output product characteristics.
- It helps determine the important factors affecting the output.
- Major off-line quality control tool.

DOX Illustration: Factorial



a) Two factors x_1, and x_2

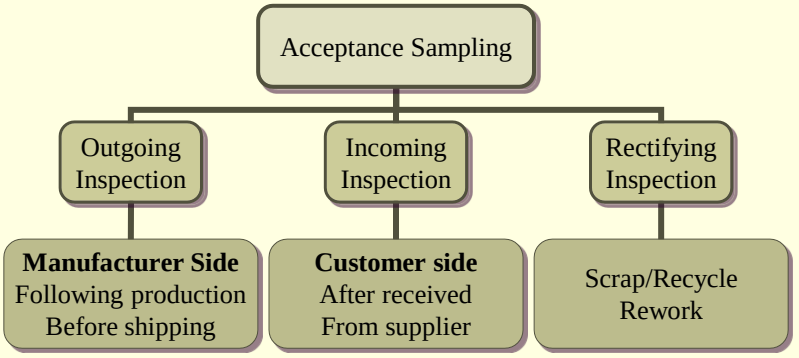


b) Three factors x_1, x_2, and x_3

Acceptance Sampling

- Inspection and classification of a sample of units selected at random from a larger batch or lot.
- Ultimate decision about disposition of the lot usually occurs at two points:
  - Incoming raw materials or components.
  - Final production.

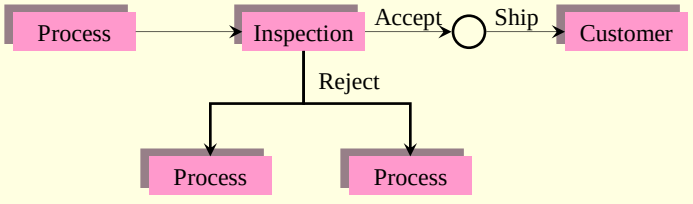
Types of Acceptance Sampling



a) Outgoing inspection

b) Incoming (Receiving) inspection

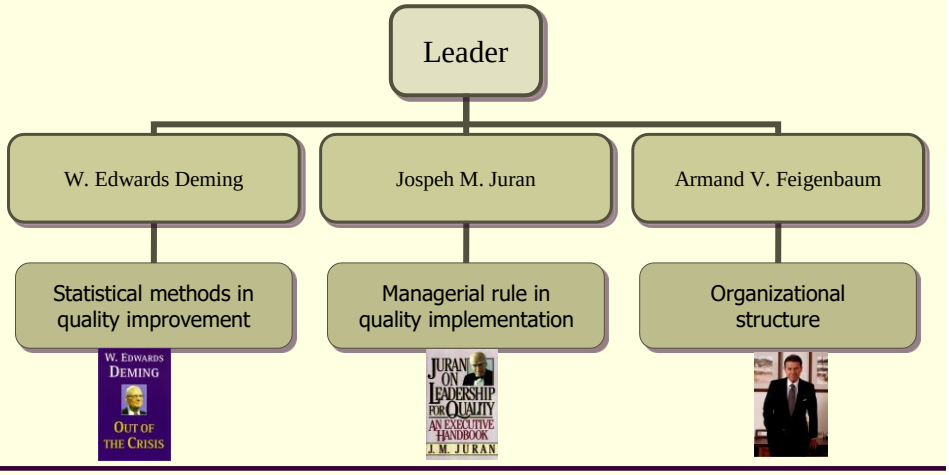
c) Rectifying (Disposition of lots) inspection



Modern Quality Assurance (QA) Perspective

- Modern QA philosophy
  - Places less emphasis upon acceptance sampling.
  - Reasoning
    - Acceptance sampling enforces the "conformance to specification" perspective of quality.
    - Does not provide any feedback into either the production process or engineering design and development leading to quality improvement.
  - Attempts to make SPC and DOX the focus of QA efforts.

Quality Philosophy & Management Strategy



Demings' 14 Points (Change Based)

1. Create a **constancy of purpose** focused on the **improvement of products and services**.
2. Adopt a new philosophy of **rejecting poor workmanship, defective products, or bad service**.
3. **Do not rely on mass inspection to "control" quality**.
4. Do not award business to suppliers **on the basis of price alone**, consider quality also.
5. Focus on **continuous improvement**.
6. Practice modern training methods and **invest in training for all employees**.
7. Practice **modern supervision methods**.
8. **Drive out fear**.
9. **Teamwork** (break down the barriers between functional areas of business.)
10. **Eliminate targets, slogans, and numerical goals for the workforce**.
11. **Eliminate numerical quotas and work standards**.
12. **Remove the barriers** that discourage employees from doing their jobs.
13. Institute an **ongoing program of training and education** for all employees.
14. **Create a structure in top management that will vigorously advocate the first 13 points.**

Total Quality Management (TQM)

- Strategy for implementing and managing quality improvement activities on an organization-wide basis.
- Other names:
  - Company-Wide Quality Control (CWQC).
  - Total Quality Assurance (TQA).
  - Six-Sigma.
- Three teams
  - Quality councils (high-level teams) deals with strategic quality initiative.
  - Workforce-level teams that focus on routine production or business activities.
  - Cross-functional teams that address specific quality improvement issues.

If you do it right every time then you don't need to worry about its quality!

TQM is not Working!

- Lack of top-down, high-level management commitment and involvement.
- Inadequate use of statistical methods and insufficient recognition of variability reduction as a prime objective.
- Diffuse as opposed to focused, specific objectives.
- Too much emphasis on widespread training as opposed to focused technical education
  - It is not just training.
  - There is a difference between "successful" employee training, and a positive impact on the production itself because of this training.

Quality Standards and Registration

- Organizations
  - ISO: International Standards Organization.
  - ANSI: American National Standards Institute.
- ISO/ANSI have developed many quality standards e.g.,
  - ISO-9000 concerned with quality management.
  - ISO-14000 concerned with environmental management.
  - ISO-18000 concerned with OSHAs.

HW#1: Read the ISO basics from the website and write no more than one page summary of these basics.

http://www.iso.org/iso/iso_catalogue/management_standards.htm

ISO 9000 Standard Components

1. Management responsibility for quality.
2. Design control.
3. Document and data control.
4. Purchasing and contract management.
5. Product identification and traceability.
6. Inspection and testing, including control of measurement and inspection equipment.
7. Process control.
8. Handling of nonconforming product, corrective and preventive actions.
9. Handling, storage, packaging, and delivery of product, including service activities.
10. Control of quality records.
11. Internal audits.
12. Training.
13. Statistical methodology.

ISO 9000 Pitfalls

- Too much effort devoted to paperwork and bookkeeping and not nearly enough to actually reducing variability and improving processes and products.
- Many third party registrars, auditors, and consultants who are not sufficiently educated or experienced enough in the technical tools of quality improvement.
- Many quality engineering experts believe that a fraction of the money spent on ISO registration can be better used to reduce the variability in the production and products.

Six Sigma

- Focus on aspects that have **both quality** and **significant economic** impact.
- High technology products with many complex components have many opportunities for failures or defects to occur.

Mobile Phone	Car	Airplane
		
1,000	200,000	1000,000s

- Under six sigma quality, the probability that any specific unit of a hypothetical product is nondefective is 0.9999998 or 0.2 ppm.
- Due to certain assumptions in the formulation of the six sigma the estimated number of defective products is raised to 3.4 ppm.

Other Initiatives for Improvement

- Just-in-time
- Reengineering
- Agile manufacturing
- Lean manufacturing
- Poka-Yoke (mistake proofing)

Other Initiatives for Improvement

- **Just-in-time** approach emphasizing in-process inventory reduction, rapid set-up, and pull-type production system
- **Reengineering**. Fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service, and speed. Theory of constraints
- **Agile manufacturing** (resource integration; technology-people-management)
- **Lean manufacturing** (waste reduction or resource minimization)

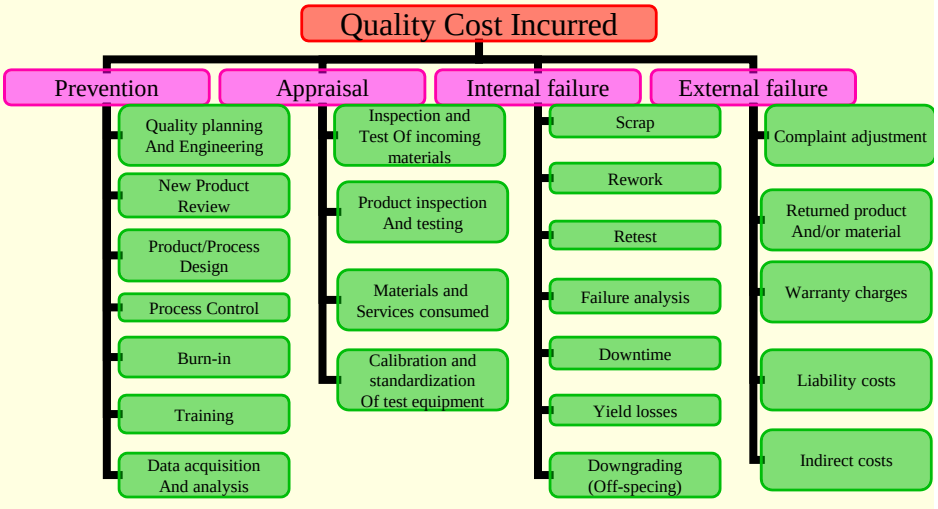
Poka-Yoke

- Introduced by Shigeo Shingo (a Toyota engineer).
- Devices are used either to prevent the special causes that result in defects, or to inexpensively inspect each item that is produced to determine whether it is acceptable or defective.
- A Poka-Yoke device is any mechanism that either prevents a mistake from being made or makes the mistake obvious at a glance.

Link between Quality and Productivity

- Dimensions of an optimal process
  - Economy
  - Efficiency
  - Productivity
  - Quality
- Effective quality improvement can be instrumental in increasing productivity and reducing cost.
- The cost of achieving quality improvements and increased productivity is often negligible.

Quality Costs



Legal Aspects of Quality

- The rule of consumerism and product liability.
  - Increased production volume increases the liability exposure of the manufacturer.
  - Decreased consumer tolerance for minor defects and aesthetic problems.
- Strict product liability rules
  - Responsibility of manufacturer and merchandiser.
  - All advertising statements must be supportable by valid company quality or certification data.

Implementing Quality Improvement

- Management must be aware that "strategic management of quality" is the best approach.
  - Understand the multifaceted aspects of quality.
  - Selection of dimensions along which the business will compete.
  - Assure the quality of suppliers. Consider **quality, schedule and cost** not just cost.
  - Quality is a company-wide approach. Train and educate everybody in the company about quality.
- **Don't follow the rules, set them.**
- **Don't settle for the minimum, look for excellence**