Reliability Engineering

Notes 9

Quality

- In traditional and general view, quality can be defined as conformance to specifications. This is something that can be measured and quantified. If it can be quantified, it can be improved.

Quality

- Quality can been defined from several perspectives.
- Conformance to acceptable standards or the specifications. (Engineering perspective)
- Fitness for use. (User perspective)
- Satisfaction of wants ,needs and expectations (service perspective)
- Loss to the society (societal perspective)

Customer-Driven Definitions of Quality

- Conformance to specifications – Conformance to advertised level of performance
- • Value – How well the purpose is served at a particular price.
- Fitness for use – Mechanical feature of a product, convenience of a service, appearance, style, durability, reliability, serviceability
- • Performance – The ability to satisfy the stated or implied need, operate without deficiencies and faults

Quality and Competitive Advantage

- The better customers judge the quality of a product, the more they will pay for it.
- It is cheaper to do a job right the first time than do it over.
- When the production line runs smoothly with predictable results, inventory levels can be reduced.

- A customer who is satisfied with quality will tell 8 people about it; a dissatisfied customer will tell 22 (A.V. Feigenbaum, Quality Progress, February 1986, p. 27)

- “Higher quality is less expensive to produce than lower quality.” — W. Edwards Deming

Evolution of Quality

- Quality function in modern organizations has been evolved through main four steps:
- Inspection
- Quality Control
- Quality Assurance
- Total Quality Management

Dimensions of Quality

- **Performance**
- Will the product do the intended job?
- It is about evaluation of product or service performance with respect to certain specific functions
- **Features**
- What does the product can actually do?
- Customers tend to purchase products that have more value added features. Feature may also be definite as addition or secondary characteristics attached and supplements primary functionary of a product.
- **Reliability**
- How often the product can fail within a specified time?
- It is about probability of not failing of components while on service for a specified time period. Less the reliability, more of repair or replacement.

Dimensions of Quality

- **Conformance**
- Is the product made exactly as the designed?
- It is meeting the standards defined in the design phase after the product is manufactured or while the service is delivered.
- **Durability**
- How long can the product last?
- This is the effective life of the product or longevity before it is declared as unfit for use. Repair is not possible after this phase of life.
- **Serviceability**
- How easy is it to repair the product?
- Customer's view on quality is also influenced by how quickly and economically a repair or routine maintenance activity can be accomplished.

Dimensions of Quality

- **Aesthetics**
- How appealing does the product look like?
- This is all about visual appeal of the product, often taking into account factors, such as style, color, shape, packaging
- **Perceived quality**
- What is the customer's feeling about the product after intended use?
- This is all about impression of a customer after using the product and/or service. This dimension is directly influenced by any failures of the product that are highly visible to the public.
- For example, if you make regular business trips by a particular airline, which almost always arrives late , you will probably prefer not fly and prefer its competitor.

Differences between Quality and Reliability

- Quality is a much broader aspect than reliability.
- Quality is present while Reliability is the future.
- Quality is every thing until put into operation (i.e t=0 hours), while reliability is every thing that happens after t=0 hours.
- Product's quality is measured prior to customer's initial product use. However the Product reliability is measured during/after the customer's product use.

Differences between Quality and Reliability

- Quality is a static measure of product meeting its specification, whereas Reliability is a dynamic measure of product performance.
- You buy based upon quality. You come back and buy again based upon reliability.
- Poor quality system can have better reliability and a good quality system can have poor reliability.

Types of Quality

- Quality of design develops products from a customer perspective, aiming to yield products which are suited to the needs of the market, at a given cost. Needs are determined by consumer research and by analysis of feedback from salespersons.

Types of Quality

- Quality of conformance refers to the ability of an organisation to produce goods or services with a predictable uniformity and dependability at a reasonable cost, and which conform with the quality characteristics determined in the quality of design studies. In other words, the goal in quality of conformance studies is to reduce the variability in products with respect to specifications.

Types of Quality

- Quality of performance focuses on performance of the product or service in the marketplace. The focus is on how satisfied customers are with the performance of the good or service, in actual use. Tools used to measure quality of performance include analysis of service calls, customer satisfaction surveys, analysis of reasons why consumers do not purchase the company's goods, and maintenance and reliability studies.

Cost of Quality

- Quality affects all aspects of the organization and organizations have gained an understanding of the high cost of poor quality.
- Quality cots can be divided into two categories.
- The first category consists of costs necessary for achieving high quality, which are called *quality control costs*. These are of two types: *prevention costs* and *appraisal costs*.
- The second category consists of the cost consequences of poor quality, which are called *quality failure costs*. These include *external failure costs* and *internal failure costs.*

Cost of Quality

- **Prevention costs** are all costs incurred in the process of preventing poor quality from occurring. They include quality planning costs, costs of product and process design, employee training, costs of maintaining records of information and data.
- **Appraisal costs** are incurred in the process of uncovering defects. They include the cost of quality inspections, product testing, and performing audits to make sure that quality standards are being met.

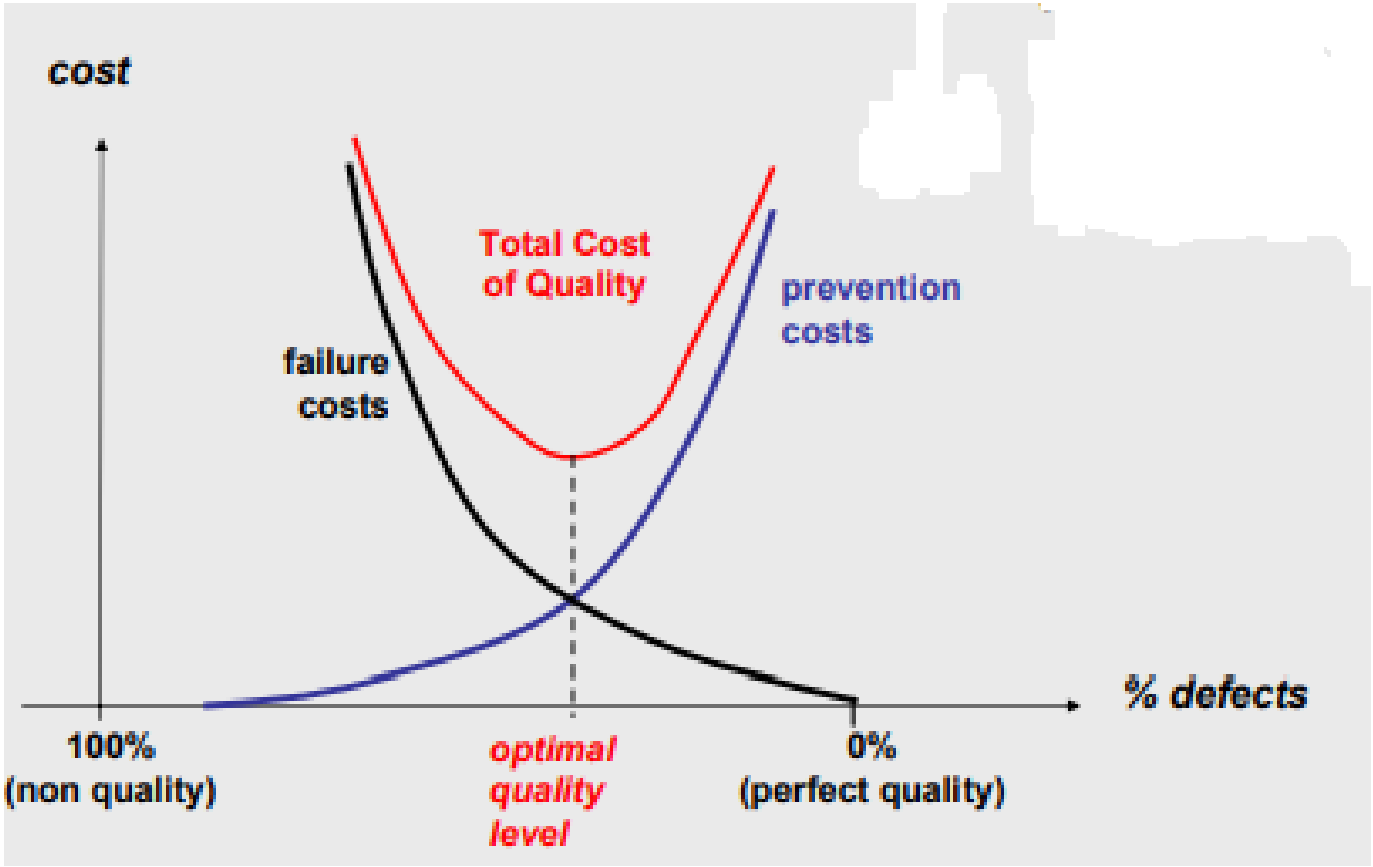
Cost of Quality

- **Internal failure costs** are associated with discovering poor product quality before the product reaches the customer site. One type of internal failure cost is *rework*, which is the cost of correcting the defective item. Sometimes the item is so defective that it can not be corrected and must be thrown away. This is called *scrap*, and its costs include all the material, labor, and machine cost spent in producing the defective product. Other types of internal failure costs include the cost of machine downtime due to failures in the process and the costs of discounting defective items for salvage value.

Cost of Quality

- **External failure costs** are associated with quality problems that occur at the customer site. These costs can be particularly damaging because customer faith and loyalty can be difficult to regain. They include everything from customer complaints, product returns, and repairs to warranty claims, recalls. A final component of this cost is lost sales and lost customers.

Cost of Quality

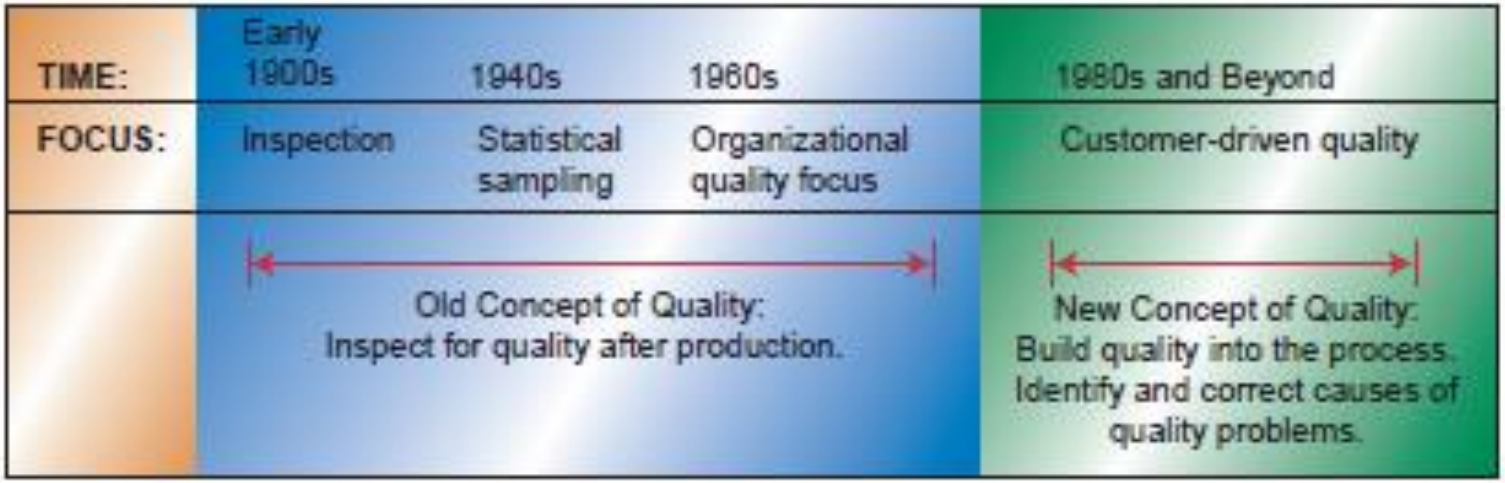


Total Quality Management (TQM)

- **Total quality management(TQM)** is an integrated organizational effort designed to improve quality at every level.
- Total quality is an approach in doing business that attempts to maximize the competitiveness of an organization through the continual improvement of the quality of its products, services, people, processes, and environments.

Total Quality Management (TQM)

- According to Feigenbaum (1983)
- Total quality control is an effective system for integrating the quality-development, quality maintenance, and quality-improvement efforts of the various groups in an organization so as to enable marketing, engineering, production, and service at the most economical levels which allow for full customer satisfaction.


TIME:
Early 1900s
1940s
1960s
1980s and Beyond
FOCUS:
Inspection
Statistical sampling
Organizational quality focus
Customer-driven quality
Old Concept of Quality:
Inspect for quality after production.
New Concept of Quality:
Build quality into the process.
Identify and correct causes of quality problems.

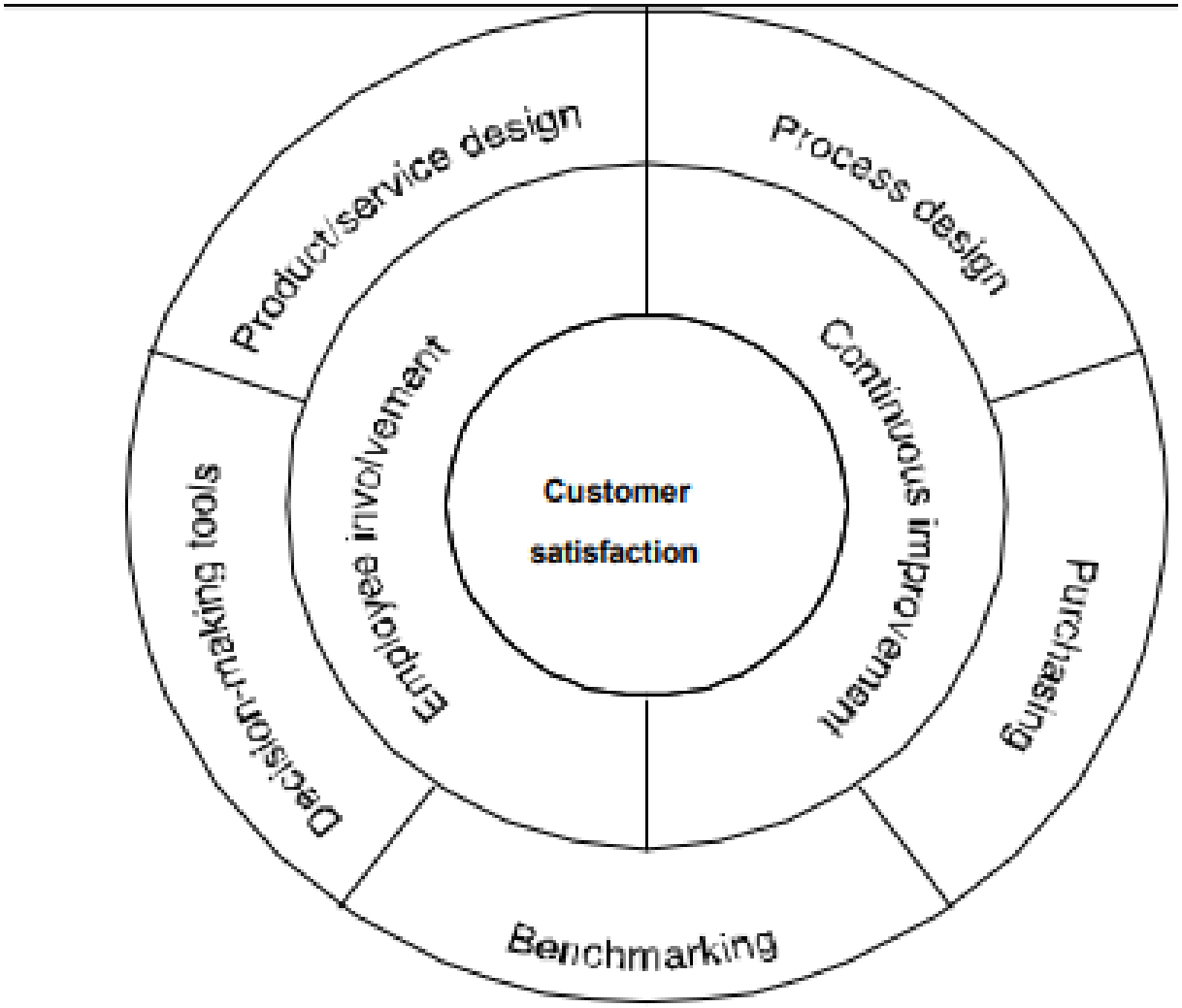
Total Quality Management (TQM)

- The total quality is a total systems approach, not a separate area or program, this is to be
- looked into; that means, whenever you talk about the total systems approach under total
- quality; that means, entire organization must be its domain of application and an integral part of the high-level strategy.

Total Quality Management (TQM)

- Total : Made up of the whole
- Quality: Degree of Excellence a product or service provides to the customer
- Management: Act , art, or manner of handling , controlling, directing
- TQM requires that the company maintain this quality standard in all aspects of its business.
- This requires ensuring that things are done right the first time and that defects and waste are eliminated from operations.

TQM Wheel


Product/service design
Process design
Purchasing
Benchmarking
Decision-making tools
Employee involvement
Continuous improvement
Customer satisfaction

Concept	Main Idea
Customer focus	Goal is to identify and meet customer needs.
Continuous improvement	A philosophy of never-ending improvement.
Employee empowerment	Employees are expected to seek out, identify, and correct quality problems.
Use of quality tools	Ongoing employee training in the use of quality tools.
Product design	Products need to be designed to meet customer expectations.
Process management	Quality should be built into the process; sources of quality problems should be identified and corrected.
Managing supplier quality	Quality concepts must extend to a company's suppliers.

Implementing TQM

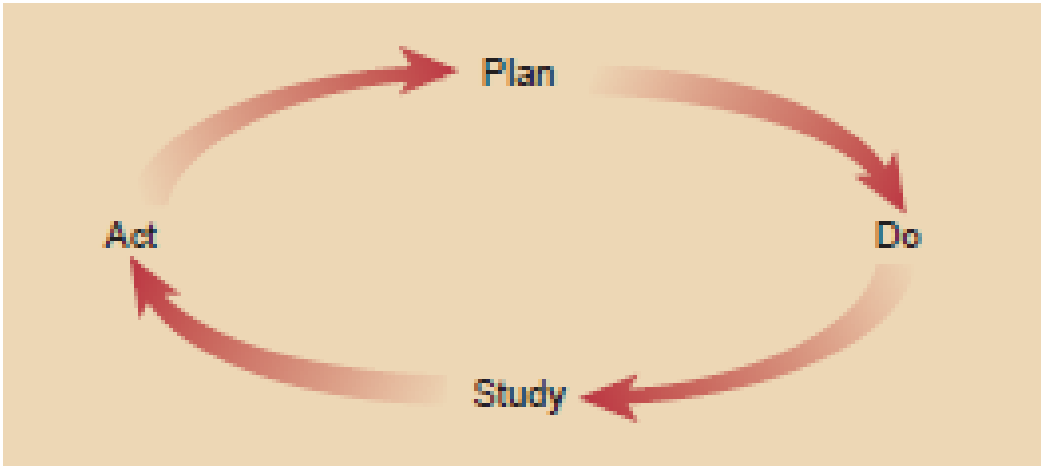
1. Use benchmarking to discover the best practices that will produce quality results
2. Shift from a management-driven culture to a participative, team-based one
3. Modify the reward system to encourage teamwork and innovation
4. Train workers constantly to give them the tools they need to produce quality and to upgrade the company's knowledge base

5. Train employees to measure quality with the tools of statistical process control (SPC)
6. Use Pareto's Law to focus TQM efforts
7. Share information with everyone in the organization
8. Focus quality improvements on astonishing the customer
9. Don't rely on inspection to produce quality products and services
10. Strive for continuous improvement in processes as well as in products and services

Benefits of TQM

- Improved Quality
- Employee Participation
- Team Work
- Internal & External Customer Satisfaction
- Productivity ,Communication

Deming wheel or plan–do–study(check)–act (PDSA) cycle



- **Plan** The first step in the cycle is to *plan*. Managers must evaluate the current process and make plans based on any problems they find. They need to document all current procedures, collect data, and identify problems.
- **Do** The next step in the cycle is implementing the plan (*do*). During the implementation process managers should document all changes made and collect data for evaluation.

- **Study** The third step is to *study (check)* the data collected in the previous phase. The data are evaluated to see whether the plan is achieving the goals established in the *plan* phase.
- The results are analyzed, it is to be verified if the difference between the customer needs and the process performance is reduced by the proposed action.
- **Act** The last phase of the cycle is to *act* on the basis of the results of the first three phases. The best way to accomplish this is to communicate the results to other members of the company and then implement the new procedure if it has been successful. Note that this is a cycle; the next step is to plan again.

Deming's 14 Points

1. Constantly strive to improve products and services
2. Adopt a total quality philosophy
3. Correct defects as they happen rather than rely on mass inspection of end products
4. Don't award business on price alone
5. Constantly improve the system of production and service

Deming's 14 Points

6. Institute training
7. Institute leadership
8. Drive out fear
9. Break down barriers among staff areas
10. Eliminate superficial slogans and goals
11. Eliminate standard quotas
12. Remove barriers to pride in workmanship
13. Institute education and retraining
14. Take demonstrated management action to achieve transformation

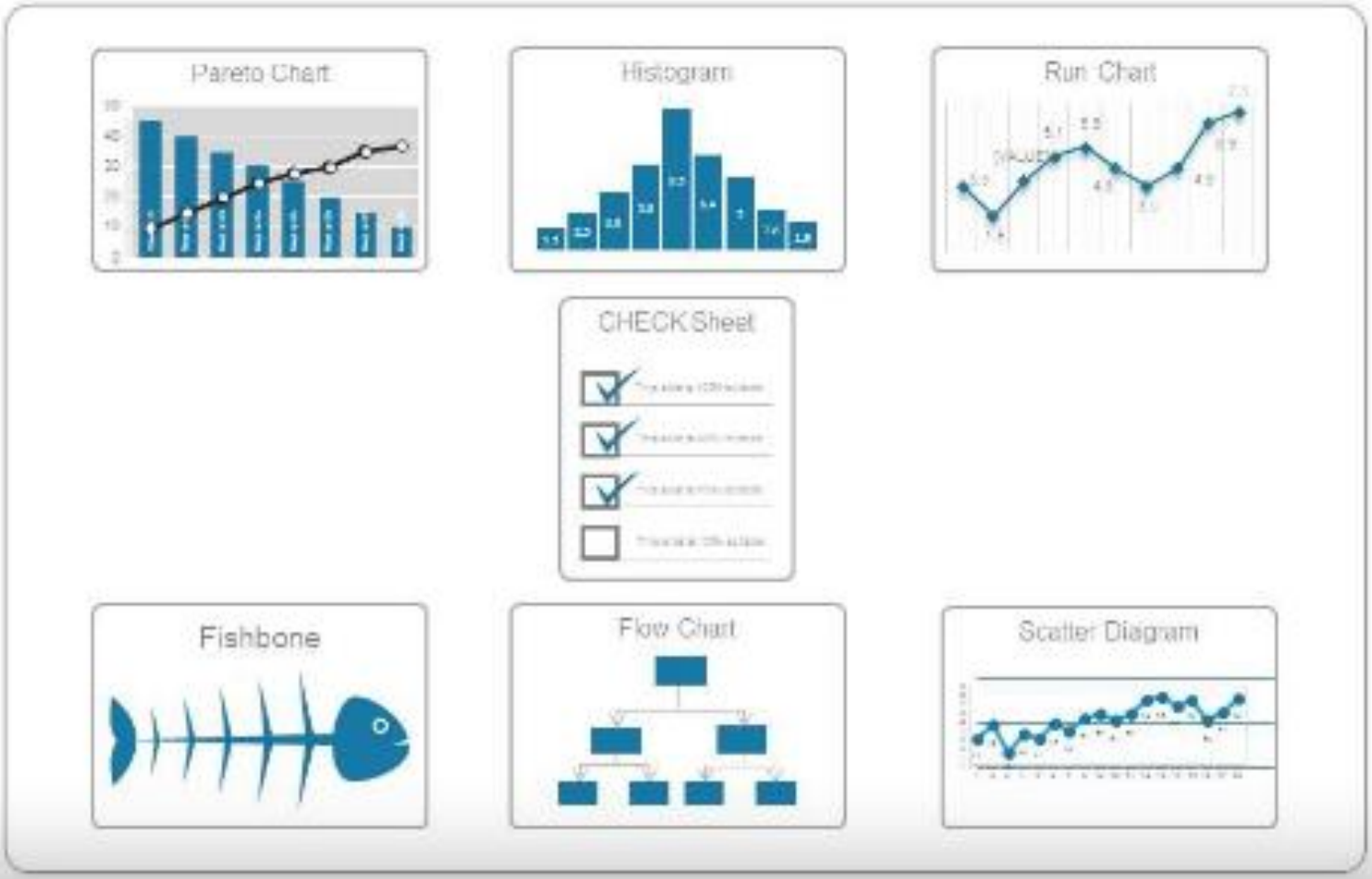
- According to Feigenbaum, crucial benchmarks for total quality success are that:
- Quality is a company-wide process.
- Quality is what the customer says it is.
- Quality and cost are a sum, not a difference.
- Quality is a way of managing.
- Quality and innovation are mutually dependent.
- Quality is an ethic.
- Quality requires continuous improvement.
- Quality is the most cost-effective, least capital-intensive route to productivity.

Quality is implemented with a total system connected with customers and suppliers.

- There can be used different tools to analyze the data.
- The methods describe the data sets graphically. Graphical methods are easy to understand and they provide comprehensive information, they are viable tool for the analysis of product and process data.
- They help us determine whether this characteristic are close to the desired norms.

Seven Tools of TQM

- Histograms
- Check Sheets
- Pareto Charts /Diagrams
- Fishbone Diagrams (Cause and Effect Diagrams)
- Run Charts
- Scatter Diagrams
- Control Charts


Pareto Chart
Histogram
Run Chart
CHECK Sheet
Fishbone
Flow Chart
Scatter Diagram

Resources

- Quality Design and Control, Lecture – 07 Management of Quality- I, Prof. Pradip Kumar Ray, Department of Industrial and Systems Engineering Indian Institute of Technology, Kharagpur
- Quality Design and Control, Lecture – 01 History and Evolution of Quality Control and Management, Prof. Pradip Kumar Ray, Department of Industrial and Systems Engineering Indian Institute of Technology, Kharagpur
- Quality Design and Control, Lecture – 09 Management of Quality- I (Contd.)Prof. Pradip Kumar Ray, Department of Industrial and Systems Engineering Indian Institute of Technology, Kharagpur
- Quality Design and Control, Lecture – 13 Management of Quality- I I (Contd.)Prof. Pradip Kumar Ray, Department of Industrial and Systems Engineering Indian Institute of Technology, Kharagpur
- Quality Design and Control, Lecture – 03 History and Evolution of Quality Control and Management, Prof. Pradip Kumar Ray, Department of Industrial and Systems Engineering Indian Institute of Technology, Kharagpur
- R. Dan Reid, Nada R. Sanders, Operations Management , An Integrated Approach, Fourth Edition, John Wiley & Sons, Inc.
- PRODUCTION AND *Operations Analysis, Steven Nahmias and Tava Lennon Olsen,* SEVENTH EDITION, Waveand Press Inc.

Resources

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https://nptel.ac.in/content/storage2/courses/110101010/downloads/mod1/Module%20I-Lec3.pdf, Module I. Introduction to Quality Management
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http://faculty.ksu.edu.sa/sites/default/files/9_3.ppt , Chapter 17 Supply Chain Management Lecture Notes