



# Know Your Faculty

- B Tech (Mechanical Engineering from BIT Sindri)
- Aeronautical Engineers' Degree Course ( Air Force Technical College, IAF)
- M Tech ( Reliability Engineering from IIT Kharagpur)
- Ph.D. (Mechanical Engineering from IIT Delhi)
- Industrial Experience : 23 Years (Indian Air Force)
- Worked at all levels of Maintenance , Repair and Overhaul of Fighter Aircraft , Aero engines and their Components. Indigenization, Manufacturing
- Academic Experience: 06 years ( SCSQR IIT Kharagpur).
- Projects: Around 10 ( Research and Consultancy)
- Publications: around 28 including Book -01, and 03 book chapters. In SCI indexed including IEEE Transactions, IMechE, RESS, IJQRM, IJRQSE e.t.c.
- Research Interests: Aerospace Reliability and Maintenance, Repairable Systems Reliability Analysis, Maintenance Engineering, Quality Management and Engineering, Machine Diagnostics and Prognostics, MCDM.



# Know Your Course

- **RE 61001: QUALITY CONTROL AND ANALYSIS;**
- LTP: 3-1-0; CREDITS: 4
- Two Tests : Mid Term and End Term (  $30+50=80$ ) marks
- Class Attendance, Assignments, Surprise Tests and Day to day evaluation : 20 marks



# Know Your Course

- **Course Contents (09 Modules)**
  - Module 1: Quality in Modern Business
  - Module 2: Statistics for Quality
  - Module 3: Quality Control Tools
  - Module 4 : Control Charts for Variables
  - Module 5: Control Charts for Attributes
  - Module 6: Acceptance Sampling Plans
  - Module 7: Process Capability Analysis
  - Module 8: Six Sigma
  - Module 9: DMAIC



# Know Your Course

- Recommended Books:
  1. D.C. Montgomery, Introduction to statistical Quality Control
  2. Amitava Mitra, Fundamentals of Quality Control and Improvement.
  3. J Banks, Principles of Quality Control
  4. E.L.Grant and R.S. Leavenworth, Statistical Quality Control



# Quality In Modern Business

Dr. Rajiv Nandan Rai  
SCSQR  
IIT Kharagpur



# Quality -Introduction



- Most people have a conceptual understanding of quality as relating to one or more desirable characteristics that a product or service should possess.
- Quality has become one of the most important consumer decision factors in the selection among competing products and services.
- Consequently, understanding and improving quality are key factors leading to business success, growth, and enhanced competitiveness.
- There is a substantial return on investment from improved quality and from successfully employing quality as an integral part of overall business strategy.

# Quality -Introduction

## Eight Dimensions of Quality





# Quality -Introduction

## Dimensions of Quality

Garvin (1987) provides an excellent discussion of eight components or dimensions of quality.

- 1. Performance (Will the product do the intended job?)**
- 2. Reliability (How often does the product fail?)**
- 3. Durability (How long does the product last?)**
- 4. Serviceability (How easy is it to repair the product?).**
- 5. Aesthetics (What does the product look like?).**
- 6. Features (What does the product do?)**



# Quality -Introduction



## Dimensions of Quality

- 7. Perceived Quality (What is the reputation of the company or its product?)**
- 8. Conformance to Standards (Is the product made exactly as the designer intended?)**

These eight dimensions are usually adequate to describe quality in most industrial and many business situations. However, in service and transactional business organizations (such as banking and finance, health care, and customer service organizations) we can add the following three dimensions:



# Quality -Introduction



## 1. Responsiveness.

How long does it take the service provider to reply to your request for service? How willing to be helpful was the service provider? How promptly was your request handled?

## 2. Professionalism.

This is the knowledge and skills of the service provider, and relates to the competency of the organization to provide the required services.

## 3. Attentiveness.

Customers generally want caring and personalized attention from their service providers. Customers want to feel that their needs and concerns are important and are being carefully addressed.



# Quality -Definition

- **Garvin(1984)**  
Identifies a framework of eight attributes that may be used to define quality: performance, features, reliability, conformance, durability, serviceability, aesthetics, and perceived quality.
- **Crosby(1979):**  
“Quality is conformance to requirements or specifications.”
- **Juran(1974):** A more general definition proposed by is as follows:  
“Quality is fitness for use.”



# Quality -Definition



**Quality** is inversely proportional to variability.

Note that this definition implies that if variability in the important characteristics of a product decreases, the quality of the product increases.

**Quality improvement** is the reduction of variability in processes and products.

Excessive variability in process performance often results in waste. Therefore, an alternate and frequently very useful definition is that

**Quality improvement** is the reduction of waste.



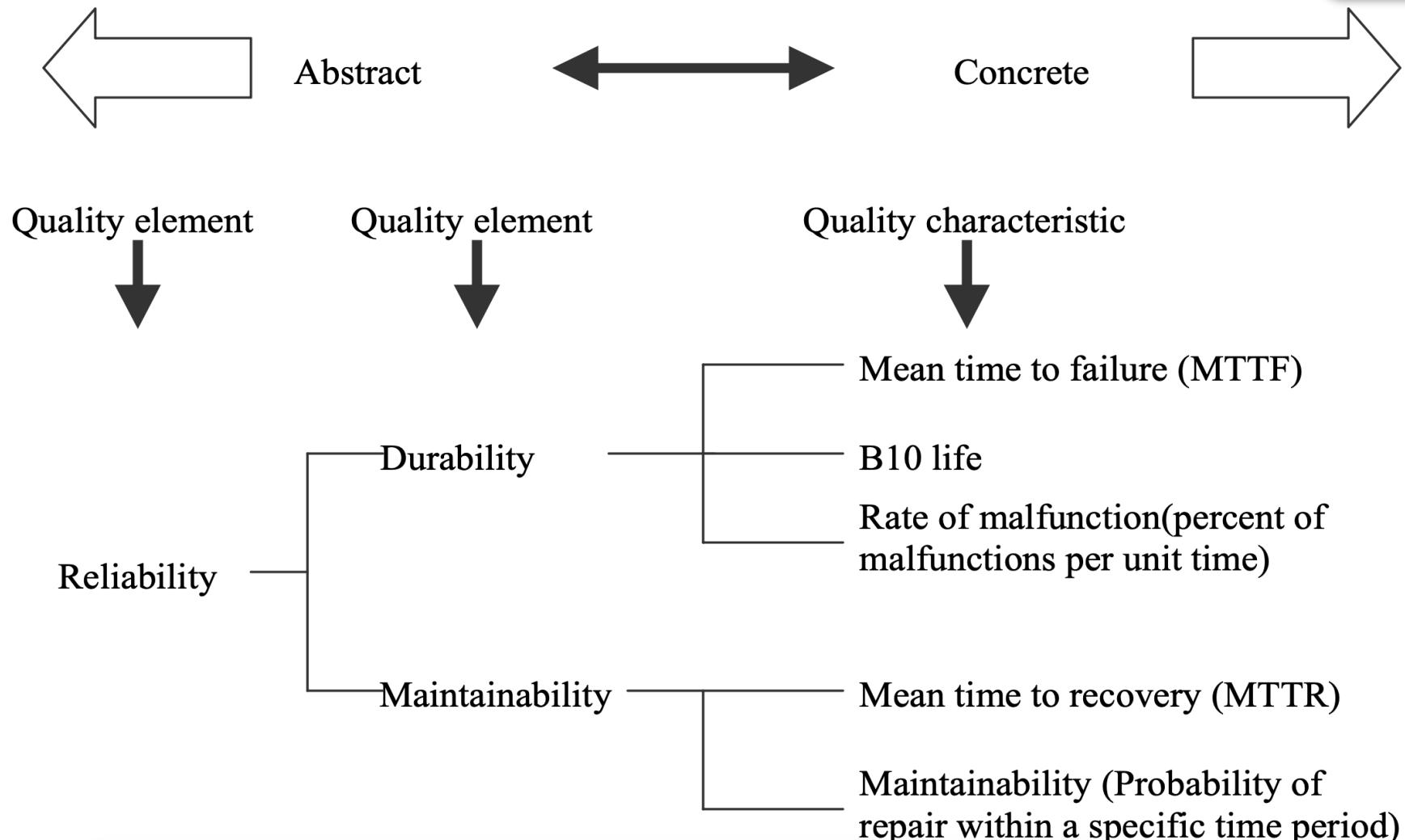
# Quality Characteristics



- Elements that define the intended quality level of a product or service are known as quality characteristics.
- Structural characteristics include such elements as the length of a part, the weight of a can, the strength of a beam, the viscosity of a fluid.
- Sensory characteristics include the taste of good food, the smell of a sweet fragrance, and the beauty of a model.
- Time-oriented characteristics include such measures as time to process a purchase order, warranty, reliability, and maintainability associated with a product.
- Ethical characteristics include honesty, courtesy, friendliness, and so on.



# Quality Characteristics





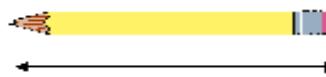
# Variables and Attributes

- Quality characteristics fall into two broad classes: variables and attributes.
- Characteristics that are measurable and are expressed on a numerical scale are called variables. The waiting time in a bank before being served, expressed in minutes ,is a variable, as are the density of a liquid in grams per cubic centimeter and the processing speed of a computer.

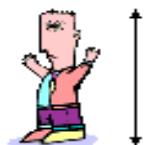
## Variable and Attributes

Variables data can be measured on a continuous scale.  
Examples include:

Length



Height



Weight



# Variables and Attributes

- A **Nonconformity** is a quality characteristic that does not meet its stipulated specifications. Let's say that the specification on the fill volume of soft drink bottles is  $750\pm3$  milliliters(mL). If we have a bottle containing 745mL, its fill volume is a nonconformity.



# Variables and Attributes

- A nonconforming unit has one or more nonconformities such that the unit is unable to meet the intended standards and is unable to function as required. An example of a nonconforming unit is a cast iron pipe whose internal diameter and weight both fail to satisfy specifications, thereby making the unit dysfunctional.





# Variables and Attributes



- A quality characteristic is said to be an attribute if it is classified as either conforming or nonconforming to a stipulated specification.
- A quality characteristic that cannot be measured on a numerical scale is expressed as an attribute.
- For example, the smell of a cologne is characterized as either acceptable or is not; the color of a fabric is either acceptable or is not.

# Variables and Attributes





# Variables and Attributes



- However, there are some variables that are treated as attributes because it is simpler to measure them this way or because it is difficult to obtain data on them.
- Examples in this category are numerous. For instance, the diameter of a bearing is in theory, a variable. However, if we measure the diameter using a go/no-go gage and classify it as either conforming or nonconforming (with respect to some established specifications), the characteristic is expressed as an attribute.

# Variables and Attributes



go/no-go gage





# Defects



- A defect is associated with a quality characteristic that does not meet certain standards.
- Furthermore, the severity of one or more defects in a product or service may cause it to be unacceptable (or defective).
- The modern term for defect is nonconformity, and the term for defective is nonconforming item.



# Standard or Specification

- **Specification:** a set of conditions and requirements, of specific and limited application, that provide a detailed description of the procedure, process, material, product, or service for use primarily in procurement and manufacturing. Standards may be referenced or included in a specification.

## Product Specification include

- **PRODUCT SUMMARY**
- **BUSINESS CASE**
- **USER STORIES**
- **USER PERSONAS**
- **PRODUCT DESIGN**
- **FUNCTIONAL SPECS**



# Standard or Specification

- **Standard:** a prescribed set of conditions and requirements, of general or broad application, established by authority or agreement, to be satisfied by a material, product, process, procedure, convention, test method; and/or the physical, functional, performance, or conformance characteristic there of.

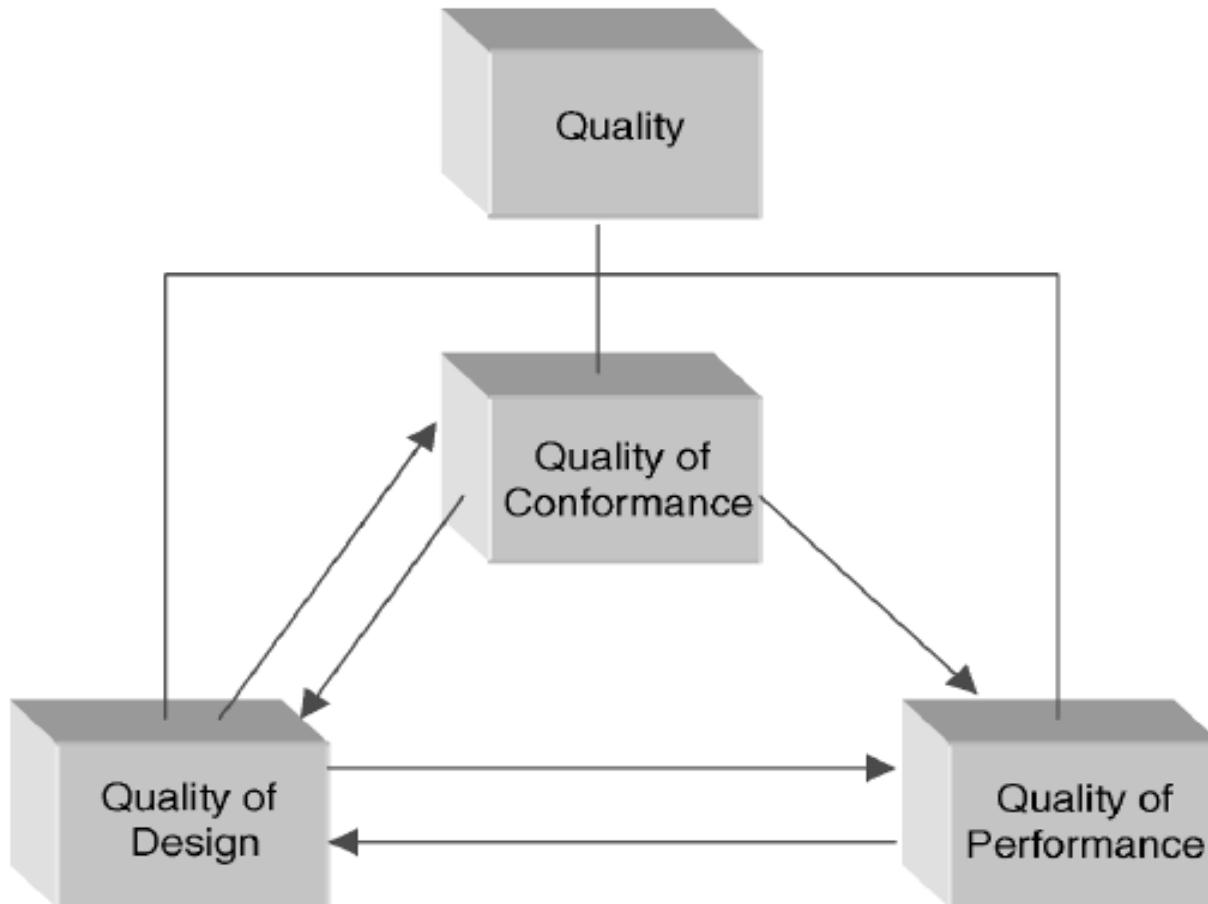


**Code,  
Standard &  
Specification**





# Quality: Aspects



## Three Aspects of Quality



# Quality of Design



- Quality of design deals with the stringent conditions that a product or service must minimally possess to satisfy the requirements of the customer.
- Quality of design is influenced by such factors as the type of product, cost, profit policy of the firm, demand for product, availability of parts and materials, and product safety.
- In most situations, the effect of an increase in the design quality level is to increase the cost at an exponential rate. The value of the product, however, increases at a decreasing rate, with the rate of increase approaching zero beyond a certain designed quality level.

# Quality of Design





# Quality of Conformance



- Quality of conformance implies that a manufactured product or a service rendered must meet the standards selected in the design phase.
- With respect to the manufacturing sector, this phase is concerned with the degree to which quality is controlled from the procurement of raw material to the shipment of finished goods.
- It consists of the three broad areas of :
  - Defect prevention,
  - Defect finding
  - Defect analysis and rectification.



# Quality of Conformance



- Defect prevention deals with the means to deter the occurrence of defects and is usually achieved using statistical process control techniques.
- Locating defects is conducted through inspection, testing, and statistical analysis of data from the process.
- Finally, the causes behind the presence of defects are investigated, and corrective actions are taken.



# Quality of Conformance



## Conformance Quality

- Meeting Our Customer's Requirements
- Doing (the Right) Things Right the First Time; Freedom from Failure (Defects)
- Consistency (Reduction in Variation)
- Continuous Improvement
- Quality in Everything We Do

*Irwin/McGraw-Hill*

3



# Quality of Performance



- Quality of performance is concerned with how well a product functions or service performs when put to use.
- It measures the degree to which the product or service satisfies the customer.
- This is a function of both the quality of design and the quality of conformance.
- If a product does not function well enough to meet these expectations, or if a service does not live up to customer standards, adjustments need to be made in the design or conformance phase.



# Quality of Performance

This feedback from the performance to the design phase, as shown in Figure may prompt a change in the design because the current design does not produce a product that performs adequately.

## QUALITY OF PERFORMANCE

### THE CONCEPT OF QUALITY:

#### Quality

- A quality product does what it is supposed to do.
- Customers often perceive quality as the extent to which a product meets a customer's expectations.
- Quality refers to a good/service's ability to satisfy a specific need.
- The quality of a product or service is measured against specific criteria, for example:
  - The ability of a product to do what it is supposed to do.
  - Reliability.
  - Affordability.
  - Design.



# Quality Planning



- Quality planning is a strategic activity, and it is just as vital to an organization's long-term business success
  - The product development plan
  - The financial plan
  - The marketing plan
  - And plans for the utilization of human resources.
- Quality planning involves
  - identifying customers, both external and those that operate internal to the business.



# Quality Planning



- and identifying their needs [this is sometimes called listening to the voice of the customer (VOC)].
- Then products or services that meet or exceed customer expectations must be developed.
- The eight dimensions of quality discussed earlier are an important part of this effort.
- The organization must then determine how these products and services will be realized.
- Planning for quality improvement on a specific, systematic basis is also a vital part of this process.



# Quality Planning

## Define Opportunity & Stakeholders Needs

- Problem/Opportunity to Address
- Identify clients/stakeholders and needs
- Translate stakeholders needs
- Establish performance measures based on needs

## Take Action

- Fully implement if expected outcomes achieved
- Initiate QI if outcomes not achieved

## Design & Pilot Service/Process

- Develop activity to meet needs
- Establish outcome measures
- Implement service/process

## Monitor Impact/Results of Service

- Measure Outputs and Outcomes
- Compare actual results to expected results



# Quality Assurance



- Quality assurance is the set of activities that ensures :
  - the quality levels of products and services are properly maintained
  - and that supplier and customer quality issues are properly resolved.
- **Role and purpose of the quality assurance function.**
  - A system that ensures that all procedures that have been designed and planned are followed.



# Quality Assurance



- **Objective of the quality assurance function**
- To have in place a formal system that continually surveys the effectiveness of the quality philosophy of the company.
- The quality assurance team thus audits the various departments and assists them in meeting their responsibilities for producing a quality product.

# Quality Assurance





# Quality Control and Improvement



- Quality control and improvement involve the set of activities used to ensure that the products and services meet requirements and are improved on a continuous basis.
- Quality control may generally be defined as a system that maintains
  - a desired level of quality, through feedback on product/service characteristics .
  - and implementation of remedial actions, in case of a deviation of such characteristics from a specified standard.



# Quality Control and Improvement



- Since variability is often a major source of poor quality, statistical techniques, including SPC and designed experiments, are the major tools of quality control and improvement.
- Quality improvement is often done
  - on a project-by-project basis
  - and involves teams led by personnel with specialized knowledge of statistical methods and experience in applying them.



# Quality Control and Improvement



## Quality Control



Product Oriented

Defect Identification

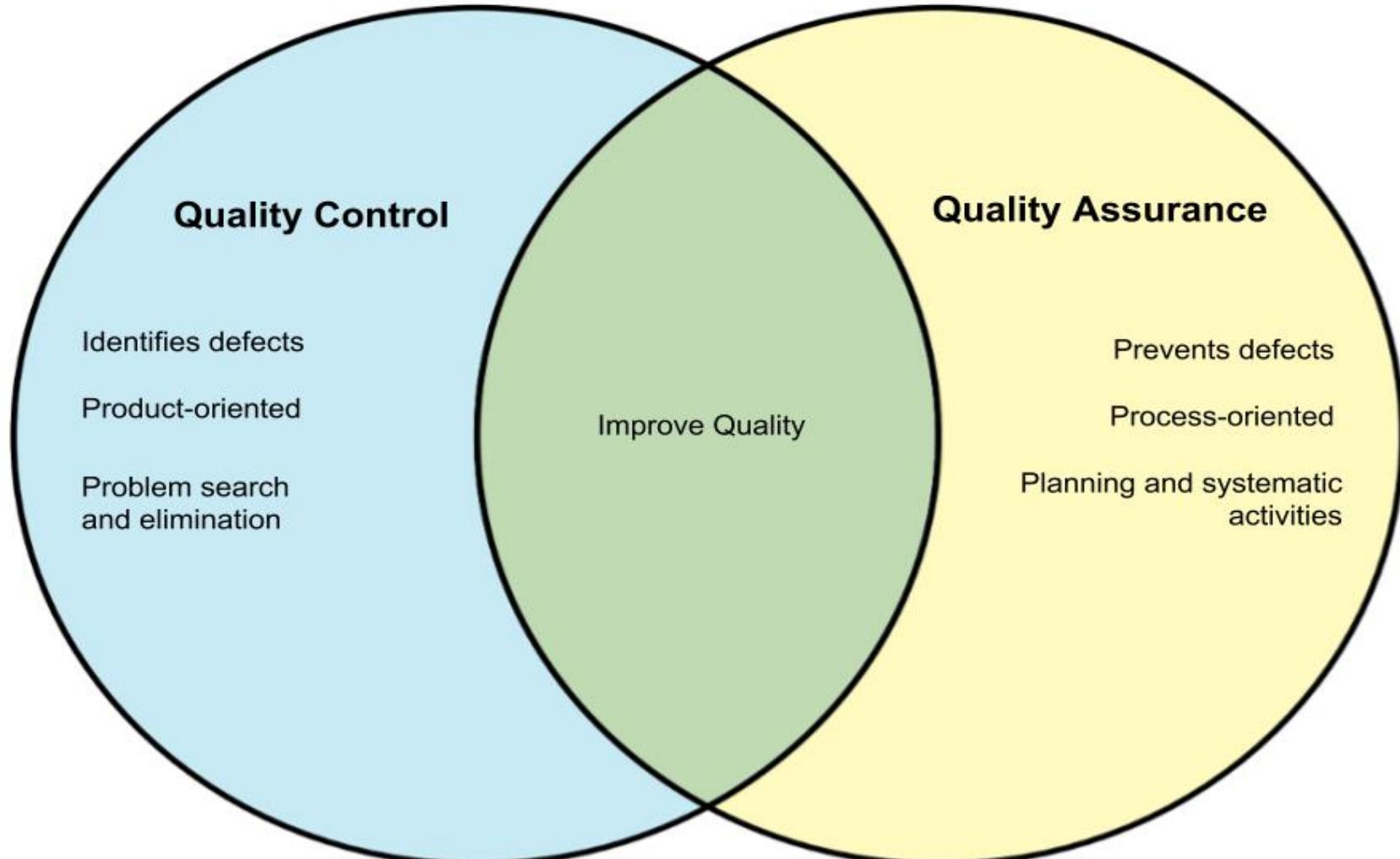
Reactive Approach

Corrective Tool

Specific Team's Responsibility



# Quality Control and Improvement





# Off-Line Quality Control



- Off-line quality control procedures deal with measures to select and choose controllable product and process parameters in such a way that the deviation between the product or process output and the standard will be minimized.
- Much of this task is accomplished through product and process design.
- The goal is to come up with a design within the constraints of resources and environmental parameters such that when production takes place, the output meets the standard.
- Thus, to the extent possible, the product and process parameters are set before production begins.



# Off-Line Quality Control



- Principles of
    - Experimental design
    - and Robust Design (Taguchi method),
- provide information on off-line process control procedures.



# Statistical Process Control



- Statistical process control involves comparing the output of a process or service with a standard and taking remedial actions in case of a discrepancy between the two.
- It also involves determining whether a process can produce a product that meets desired specifications or requirements.
- Online statistical process control means
  - that information is gathered about the product, process, or service while it is functional.
  - When the output differs from a determined norm, corrective action is taken in that operational phase.



# Statistical Process Control



- It is preferable to take corrective actions on a real-time basis for quality control problems.
- This approach attempts to bring the system to an acceptable state as soon as possible, thus minimizing either the number of unacceptable items produced or the time over which undesirable service is rendered.



# Acceptance Sampling Plans



- Acceptance sampling plans involve inspection of a product or service.
- When 100% inspection of all items is not feasible, a decision has to be made as to how many items should be sampled or whether the batch should be sampled at all.
- The information obtained from the sample is used to decide whether to accept or reject the entire batch or lot.
- In the case of attributes, one parameter is the acceptable number of non conforming items in the sample. If the number of non conforming items observed is less than or equal to this number, the batch is accepted. This is known as the acceptance number.



# Quality Circles and Quality Improvement Teams



- A quality circle is typically an informal group of people that consists of operators, supervisors, managers, and so on, who get together to improve ways to make a product or deliver a service.
- The concept behind quality circles is that in most cases the persons who are closest to an operation are in a better position to contribute ideas that will lead to an improvement in it.

# Quality Circles and Quality Improvement Teams





# Quality Circles and Quality Improvement Teams



- A quality improvement team is another means of identifying feasible solutions to quality control problems. Such teams are typically cross-functional in nature and involve people from various disciplines.
- It is not uncommon to have a quality improvement team with personnel from design and development, engineering, manufacturing, marketing, and servicing.
- A key advantage of such a team is that it promotes cross-disciplinary flow of information in real time as it solves the problem.

# Quality Circles and Quality Improvement Teams

## Roles for QI teams

- In addition to solving quality problems, QI teams help:
- provide a means of participation for employees in quality decision-making.
- aid employee development: leadership, problem-solving skills.
- lead to quality awareness which is essential for organizational culture change.

Quality Improvement Teams:





# Quality Costs



- The various components of quality costs are designated based on product/service conformance or nonconformance.
- The achievement of requirements, identified by product or service conformance, consists of a cost component, identified as prevention costs
- While non conformance consists of the cost components of appraisal and failure costs .
- To summarize, quality costs may be interpreted as the difference between the actual cost and the reduced cost if products and services were all conforming.
- The four major categories of quality costs are discussed here.



# Prevention Costs



- Prevention costs are incurred in :
  - planning,
  - implementing, and maintaining a quality system to prevent poor quality in products and services.
- They include :
  - Salaries and developmental costs for product design,
  - Process and equipment design
  - Process control techniques (through such means as control charts)
  - Information systems design
  - Costs associated with making the product right the first time.
  - Education and training



# Prevention Costs

- Costs associated with defect cause and removal,
- Process changes,
- Cost of a quality audit.
- Prevention costs increase with the introduction of a quality system and, initially, may be a significant proportion of the total quality costs.
- However, the rate of increase slows with time. Even though prevention costs increase, they are more than justified by reductions in total quality costs due to reductions in internal and external failure costs.



# Appraisal Costs



- Appraisal costs are associated with
  - Measuring,
  - Evaluating,
  - Auditing products, components, purchased materials, or services to determine their degree of conformance to the specified standards.
  - Costs include dealing with the inspection and testing of incoming material
  - Product inspection and testing at various phases of manufacturing and at final acceptance.
  - Cost of calibrating and maintaining measuring instruments and equipment.
  - Cost of material and products consumed in a destructive test or devalued by reliability tests.



# Appraisal Costs



- Appraisal costs typically occur during or after production but before the product is released to the customer.
- Hence, they are associated with managing the outcome, whereas prevention costs are associated with managing the intent or goal.
- Appraisal costs normally decline with time as more non conformities are prevented from occurring.



# Internal Failure Costs



- Internal failure costs are incurred :
  - When products, components, material, and services fail to meet quality requirements prior to the transfer of ownership to the customer.
  - These costs would disappear if there were no nonconformities in the product or service.
- Internal failure costs include:
  - Scrap and rework costs for the material, labor, and overhead associated with production.
  - Costs involved in determining the cause of failure or in re inspecting or retesting reworked products .



# Internal Failure Costs



- The cost of lost production time due to non conformities (e.g., if poor quality of raw material requires re tooling of equipment).
- Downgrading costs, the revenue lost because a flawed product has to be sold at a lower price.
- As a total quality system is implemented and becomes effective with time, internal failure costs will decline. Less scrap and rework will result as problems are prevented.



# External Failure Costs



- External failure costs are incurred when a product does not perform satisfactorily after ownership is transferred to the customer or services offered are nonconforming.
- If no non conforming units were produced, this cost would vanish. Such costs include:
  - Customer complaints, which include the costs of investigation and adjustments, and those associated with receipt, handling, repair, and replacement of nonconforming products.
  - Warranty charges (failure of a product within the warranty time)
  - Product liability costs (costs or awards as an outcome of product liability litigation).
- A reduction in external failure costs occurs when a quality control system is implemented successfully.



# Hidden Failure Costs

- The measurable components of failure costs include
  - Scrap,
  - Rework,
  - Warranty, Which are easily tracked by accounting systems.

A significant segment of the failure costs are “hidden.” These include:

- Management and engineering time associated with cause identification and determination of remedial actions associated with failures.
- Line downtime
- Increased inventory,
- Decrease in available capacity,
- Orders lost due to poor quality are examples of costs not easily tracked by accounting systems.

Hence, what is typically reported as failure costs is but a minute portion of the true failure costs.

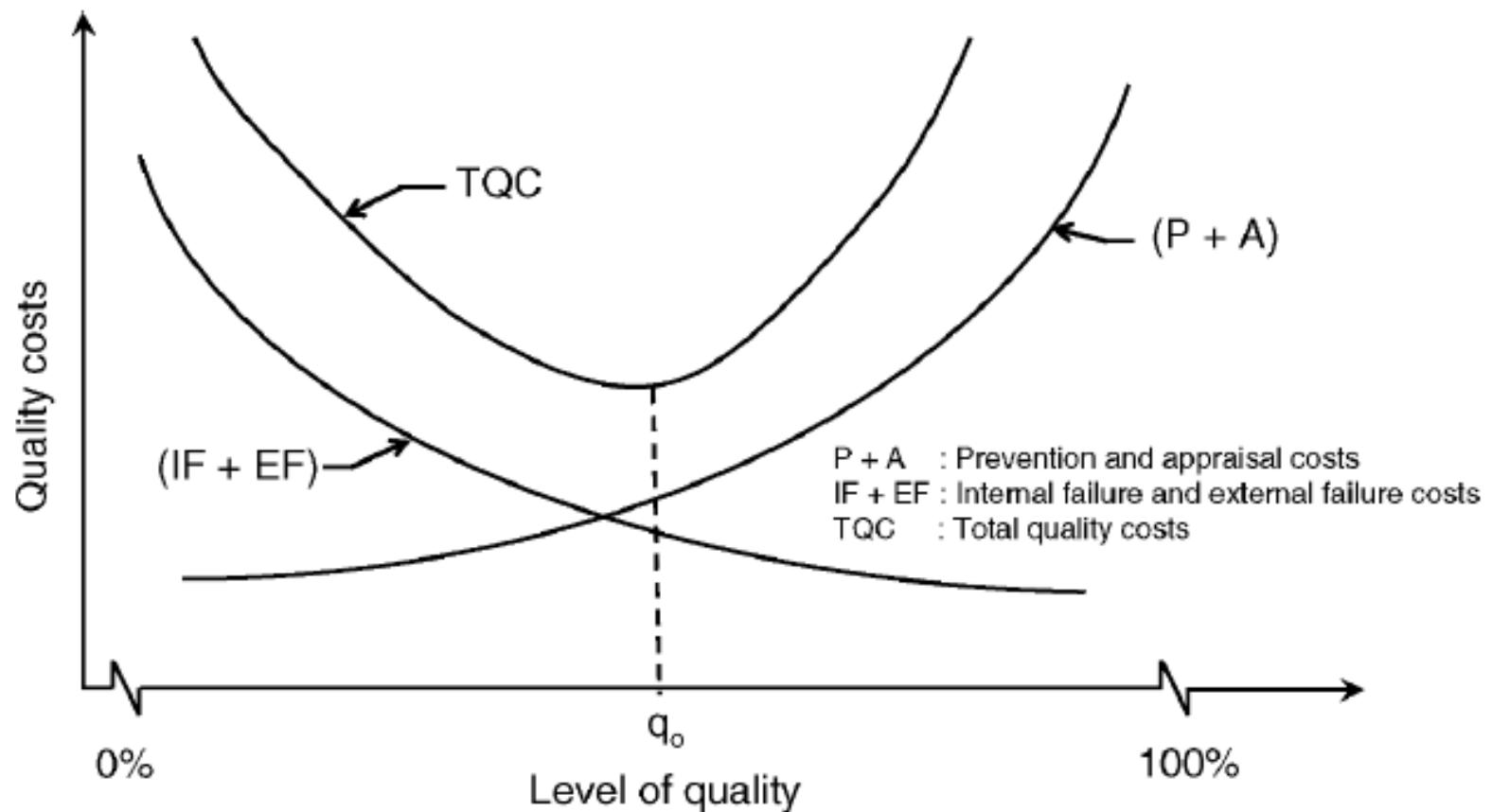


# Impact of Quality Improvement on Quality Costs



- Minimization of total quality costs to determine the optimal operational level of quality using a traditional static concept is shown in Figure.
- In this case, prevention costs increase at an exponential rate with an improvement in the level of quality.
- Appraisal costs, however, may not increase rapidly with the level of quality.
- The combined prevention and appraisal cost function is dominated by the prevention costs, leading to the shape of the function in Figure.
- On the contrary, as the level of quality improves, a decline in the internal and external failure costs take place, demonstrated by the nonlinear decay function.
- The total quality cost function, the sum of the prevention and appraisal costs and the internal failure and external failure costs, is also shown in Figure.
- The minimization of the total quality cost function leads to an optimal quality level( $q_0$ ).

# Impact of Quality Improvement on Quality Costs



**Quality costs versus level of quality.**

# A Brief History of Quality Control and Improvement

1700–1900	Quality is largely determined by the efforts of an individual craftsman. Eli Whitney introduces standardized, interchangeable parts to simplify assembly.
1875	Frederick W. Taylor introduces “Scientific Management” principles to divide work into smaller, more easily accomplished units—the first approach to dealing with more complex products and processes. The focus was on productivity. Later contributors were Frank Gilbreth and Henry Gantt.
1900–1930	Henry Ford—the assembly line—further refinement of work methods to improve productivity and quality; Ford developed mistake-proof assembly concepts, self-checking, and in-process inspection.
1901	First standards laboratories established in Great Britain.
1907–1908	AT&T begins systematic inspection and testing of products and materials.
1908	W. S. Gosset (writing as “Student”) introduces the <i>t</i> -distribution—results from his work on quality control at Guinness Brewery.
1915–1919	WWI—British government begins a supplier certification program.
1919	Technical Inspection Association is formed in England; this later becomes the Institute of Quality Assurance.
1920s	AT&T Bell Laboratories forms a quality department—emphasizing quality, inspection and test, and product reliability. B. P. Dudding at General Electric in England uses statistical methods to control the quality of electric lamps.
1922	Henry Ford writes (with Samuel Crowther) and publishes <i>My Life and Work</i> , which focused on elimination of waste and improving process efficiency. Many Ford concepts and ideas are the basis of lean principles used today.
1922–1923	R. A. Fisher publishes series of fundamental papers on designed experiments and their application to the agricultural sciences.
1924	W. A. Shewhart introduces the control chart concept in a Bell Laboratories technical memorandum.
1928	Acceptance sampling methodology is developed and refined by H. F. Dodge and H. G. Romig at Bell Labs.

# A Brief History of Quality Control and Improvement

1931	W. A. Shewhart publishes <i>Economic Control of Quality of Manufactured Product</i> —outlining statistical methods for use in production and control chart methods.
1932	W. A. Shewhart gives lectures on statistical methods in production and control charts at the University of London.
1932–1933	British textile and woolen industry and German chemical industry begin use of designed experiments for product/process development.
1933	The Royal Statistical Society forms the Industrial and Agricultural Research Section.
1938	W. E. Deming invites Shewhart to present seminars on control charts at the U.S. Department of Agriculture Graduate School.
1940	The U.S. War Department publishes a guide for using control charts to analyze process data.
1940–1943	Bell Labs develop the forerunners of the military standard sampling plans for the U.S. Army.
1942	In Great Britain, the Ministry of Supply Advising Service on Statistical Methods and Quality Control is formed.
1942–1946	Training courses on statistical quality control are given to industry; more than 15 quality societies are formed in North America.
1944	<i>Industrial Quality Control</i> begins publication.
1946	The American Society for Quality Control (ASQC) is formed as the merger of various quality societies. The International Standards Organization (ISO) is founded. Deming is invited to Japan by the Economic and Scientific Services Section of the U.S. War Department to help occupation forces in rebuilding Japanese industry. The Japanese Union of Scientists and Engineers (JUSE) is formed.
1946–1949	Deming is invited to give statistical quality control seminars to Japanese industry.
1948	G. Taguchi begins study and application of experimental design.
1950	Deming begins education of Japanese industrial managers; statistical quality control methods begin to be widely taught in Japan.

# A Brief History of Quality Control and Improvement

1950–1975	Taiichi Ohno, Shigeo Shingo, and Eiji Toyoda develops the Toyota Production System an integrated technical/social system that defined and developed many lean principles such as just-in-time production and rapid setup of tools and equipment. K. Ishikawa introduces the cause-and-effect diagram.
1950s	Classic texts on statistical quality control by Eugene Grant and A. J. Duncan appear.
1951	A. V. Feigenbaum publishes the first edition of his book <i>Total Quality Control</i> . JUSE establishes the Deming Prize for significant achievement in quality control and quality methodology.
1951+	G. E. P. Box and K. B. Wilson publish fundamental work on using designed experiments and response surface methodology for process optimization; focus is on chemical industry. Applications of designed experiments in the chemical industry grow steadily after this.
1954	Joseph M. Juran is invited by the Japanese to lecture on quality management and improvement. British statistician E. S. Page introduces the cumulative sum (CUSUM) control chart.
1957	J. M. Juran and F. M. Gryna's <i>Quality Control Handbook</i> is first published.
1959	<i>Technometrics</i> (a journal of statistics for the physical, chemical, and engineering sciences) is established; J. Stuart Hunter is the founding editor. S. Roberts introduces the exponentially weighted moving average (EWMA) control chart. The U.S. manned spaceflight program makes industry aware of the need for reliable products; the field of reliability engineering grows from this starting point.
1960	G. E. P. Box and J. S. Hunter write fundamental papers on $2^{k-p}$ factorial designs. The quality control circle concept is introduced in Japan by K. Ishikawa.
1961	National Council for Quality and Productivity is formed in Great Britain as part of the British Productivity Council.
1960s	Courses in statistical quality control become widespread in industrial engineering academic programs. Zero defects (ZD) programs are introduced in certain U.S. industries.

# A Brief History of Quality Control and Improvement

1969	<i>Industrial Quality Control</i> ceases publication, replaced by <i>Quality Progress</i> and the <i>Journal of Quality Technology</i> (Lloyd S. Nelson is the founding editor of <i>JQT</i> ).
1970s	In Great Britain, the NCQP and the Institute of Quality Assurance merge to form the British Quality Association.
1975–1978	Books on designed experiments oriented toward engineers and scientists begin to appear. Interest in quality circles begins in North America—this grows into the total quality management (TQM) movement.
1980s	Experimental design methods are introduced to and adopted by a wider group of organizations, including the electronics, aerospace, semiconductor, and automotive industries. The works of Taguchi on designed experiments first appear in the United States.
1984	The American Statistical Association (ASA) establishes the Ad Hoc Committee on Quality and Productivity; this later becomes a full section of the ASA. The journal <i>Quality and Reliability Engineering International</i> appears.
1986	Box and others visit Japan, noting the extensive use of designed experiments and other statistical methods.
1987	ISO publishes the first quality systems standard. Motorola's Six Sigma initiative begins.
1988	The Malcolm Baldrige National Quality Award is established by the U.S. Congress. The European Foundation for Quality Management is founded; this organization administers the European Quality Award.
1989	The journal <i>Quality Engineering</i> appears.
1990s	ISO 9000 certification activities increase in U.S. industry; applicants for the Baldrige award grow steadily; many states sponsor quality awards based on the Baldrige criteria.

# A Brief History of Quality Control and Improvement

1995	Many undergraduate engineering programs require formal courses in statistical techniques, focusing on basic methods for process characterization and improvement.
1997	Motorola's Six Sigma approach spreads to other industries.
1998	The American Society for Quality Control becomes the American Society for Quality (see <a href="http://www.asq.org">www.asq.org</a> ), attempting to indicate the broader aspects of the quality improvement field.
2000s	ISO 9000:2000 standard is issued. Supply-chain management and supplier quality become even more critical factors in business success. Quality improvement activities expand beyond the traditional industrial setting into many other areas, including financial services, health care, insurance, and utilities. Organizations begin to integrate lean principles into their Six Sigma initiatives, and lean Six Sigma becomes a widespread approach to business improvement.



# Quality Philosophy and Management Strategies

## W. Edwards Deming.

- W. Edwards Deming was educated in engineering and physics at the University of Wyoming and Yale University. He worked for Western Electric and was influenced greatly by Walter A. Shewhart, the developer of the control chart. After leaving Western Electric, Deming held government jobs with the U.S. Department of Agriculture and the Bureau of the Census. During World War II, Deming worked for the War Department and the Census Bureau.
- Following the war, he became a consultant to Japanese industries and convinced their top management of the power of statistical methods and the importance of quality as a competitive weapon. This commitment to and use of statistical methods has been a key element in the expansion of Japan's industry and economy. The Japanese Union of Scientists and Engineers created the Deming Prize for quality improvement in his honor.



# Quality Philosophy and Management Strategies



- Until his death in 1993, Deming was an active consultant and speaker; he was an inspirational force for quality improvement in the United States and around the world.
- He firmly believed that the responsibility for quality rests with management—that is, most of the opportunities for quality improvement require management action, and very few opportunities lie at the workforce or operator level. Deming was a harsh critic of many American management practices.
- The focus of Deming's philosophy is management. Since a major proportion of problems can be solved by management, Deming noted that management cannot “pass the buck.” Only a minority of problems can be attributed to suppliers or workers, so in Deming's view, what must change is the fundamental style of management and the corporate culture.



# Deming's 14 Points for Management



The Deming philosophy is an important framework for implementing quality and productivity improvement. This philosophy is summarized in his 14 points for management.

## 1. Create a constancy of purpose focused on the improvement of products and services.

Deming was very critical of the short-term thinking of American management, which tends to be driven by quarterly business results and doesn't always focus on strategies that benefit the organization in the long run. Management should constantly try to improve product design and performance. This must include investment in research, development, and innovation, which will have long-term payback to the organization.



# Deming's 14 Points for Management

## 2. Adopt a new philosophy that recognizes we are in a different economic era.

Reject poor workmanship, defective products, or bad service. It costs as much to produce a defective unit as it does to produce a good one (and sometimes more). The cost of dealing with scrap, rework, and other losses created by defectives is an enormous drain on company resources

## 3. Do not rely on mass inspection to “control” quality.

All inspection can do is sort out defectives, and at that point it is too late—the organization already has paid to produce those defectives. Inspection typically occurs too late in the process, it is expensive, and it is often ineffective. Quality results from prevention of defectives through process improvement, not inspection.



# Deming's 14 Points for Management

## 4. Do not award business to suppliers on the basis of price alone, but also consider quality.

Price is a meaningful measure of a supplier's product only if it is considered in relation to a measure of quality. In other words, the total cost of the item must be considered, not just the purchase price. When quality is considered, the lowest bidder frequently is not the low-cost supplier. Preference should be given to suppliers who use modern methods of quality improvement in their business and who can demonstrate process control and capability. An adversarial relationship with suppliers is harmful. It is important to build effective, long-term relationships.

## 5. Focus on continuous improvement.

Constantly try to improve the production and service system. Involve the workforce in these activities and make use of statistical methods, particularly the statistically based problem-solving tools



# Deming's 14 Points for Management

## 6. Practice modern training methods and invest in on-the-job training for all employees.

Everyone should be trained in the technical aspects of their job, and in modern quality- and productivity-improvement methods as well. The training should encourage all employees to practice these methods every day. Too often, employees are not encouraged to use the results of training, and management often believes employees do not need training or already should be able to practice the methods. Many organizations devote little or no effort to training.

## 7. Improve leadership, and practice modern supervision methods.

Supervision should not consist merely of passive surveillance of workers but should be focused on helping the employees improve the system in which they work. The number-one goal of supervision should be to improve the work system and the product.



# Deming's 14 Points for Management

## 8. Drive out fear.

Many workers are afraid to ask questions, report problems, or point out conditions that are barriers to quality and effective production. In many organizations the economic loss associated with fear is large; only management can eliminate fear.

## 9. Break down the barriers between functional areas of the business.

Teamwork among different organizational units is essential for effective quality and productivity improvement to take place.

## 10. Eliminate targets, slogans, and numerical goals for the workforce.

A target such as “zero defects” is useless without a plan for the achievement of this objective. In fact, these slogans and “programs” are usually counterproductive. Work to improve the system and provide information on that.



# Deming's 14 Points for Management

## 11. Eliminate numerical quotas and work standards.

These standards have historically been set without regard to quality. Work standards are often symptoms of management's inability to understand the work process and to provide an effective management system focused on improving this process.

## 12. Remove the barriers that discourage employees from doing their jobs.

Management must listen to employee suggestions, comments, and complaints. The person who is doing the job knows the most about it and usually has valuable ideas about how to make the process work more effectively. The workforce is an important participant in the business, and not just an opponent in collective bargain.



# Deming's 14 Points for Management

## **13. Institute an ongoing program of education for all employees.**

Education in simple, powerful statistical techniques should be mandatory for all employees. Use of the basic SPC problem-solving tools, particularly the control chart, should become widespread in the business. As these charts become widespread and as employees understand their uses, they will be more likely to look for the causes of poor quality and to identify process improvements. Education is a way of making everyone partners in the quality improvement process.

## **14. Create a structure in top management that will vigorously advocate the first 13 points.**

This structure must be driven from the very top of the organization. It must also include concurrent education/training activities and expedite application of the training to achieve improved business results. Everyone in the organization must know that continuous improvement is a common goal.



# Deming's Seven Deadly Diseases of Management



1. Lack of constancy of purpose
2. Emphasis on short-term profits
3. Evaluation of performance, merit rating, and annual reviews of performance
4. Mobility of top management
5. Running a company on visible figures alone
6. Excessive medical costs
7. Excessive legal damage awards

- The **first, lack of constancy of purpose**, relates to the first of Deming's 14 points. Continuous improvement of products, processes, and services gives assurance to all stakeholders in the enterprise (employees, executives, investors, suppliers) that dividends and increases in the value of the business will continue to grow.



# Deming's Seven Deadly Diseases of Management



- The **second disease, too much emphasis on short-term profits**, might make the “numbers” look good, but if this is achieved by reducing research and development investment, by eliminating employees’ training, and by not deploying quality and other business improvement activities, then potentially irreparable long-term damage to the business is the ultimate result.
- Concerning the **third disease**, Deming believed that **performance evaluation** encouraged short-term performance, rivalries and fear, and discouraged effective teamwork. Performance reviews can leave employees bitter and discouraged, and they may feel unfairly treated, especially if they are working in an organization where their performance is impacted by system forces that are flawed and out of their control.



# Deming's Seven Deadly Diseases of Management



- The **fourth disease, management mobility**, refers to the widespread practice of job-hopping—that is, a manager spending very little time in the business function for which he or she is responsible. This often results in key decisions being made by someone who really doesn't understand the business. Managers often spend more time thinking about their next career move than about their current job and how to do it better.
- Frequent reorganizing and shifting management responsibilities are barriers to constancy of purpose and often a waste of resources that should be devoted to improving products and services.
- Bringing in a new chief executive officer to improve quarterly profits often leads to a business strategy that leaves a path of destruction throughout the business.



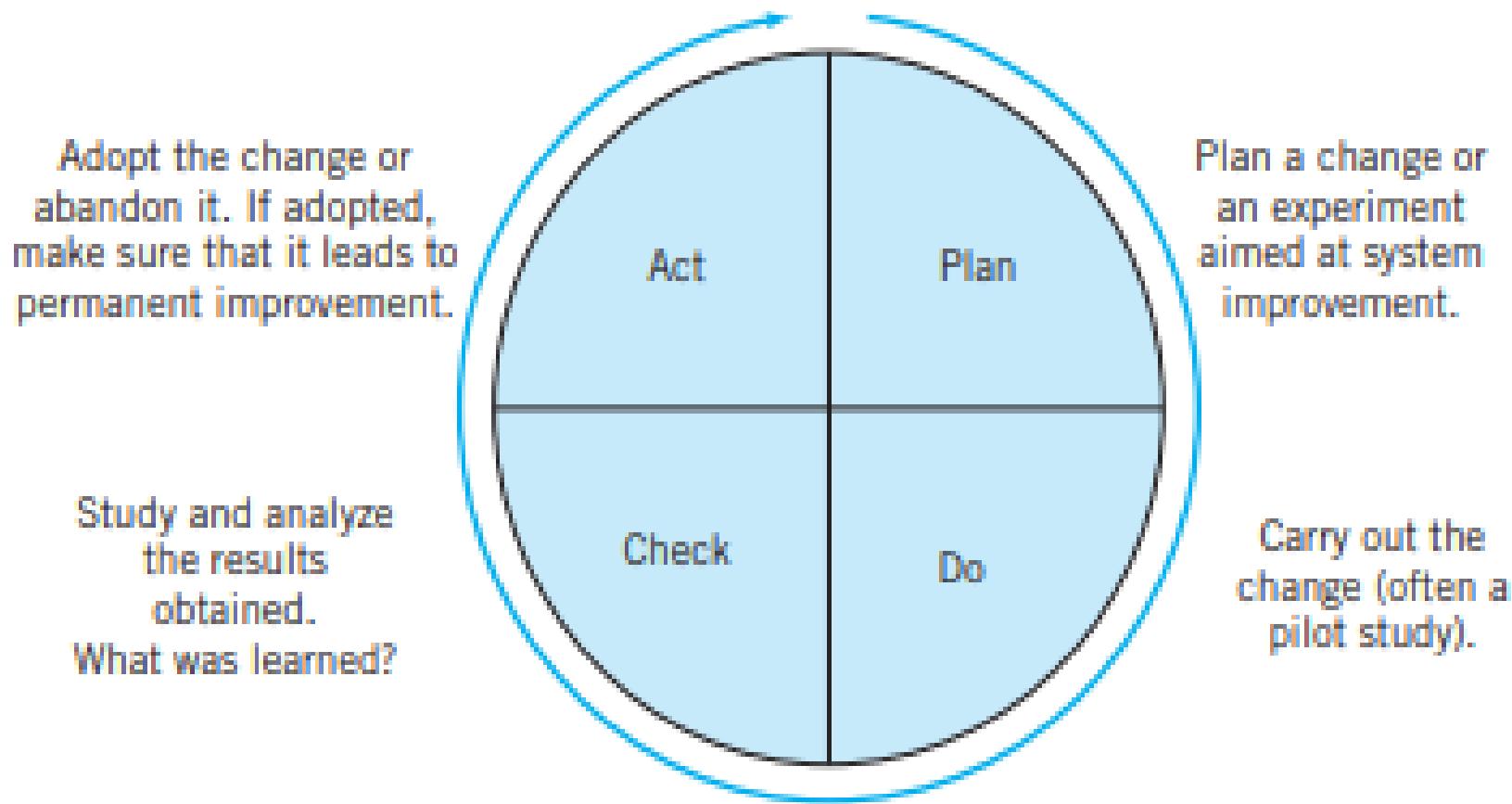
# Deming's Seven Deadly Diseases of Management



- Deming's cautions about **excessive medical expenses—his sixth deadly disease**—are certainly prophetic: Health care costs may be the most important issue facing many sectors of business in the United States today. For example, the medical costs for current and retired employees of United States automobile manufacturers General Motors, Ford, and Chrysler currently are estimated to be between \$1200 and \$1600 per vehicle, contrasted with \$250 to \$350 per vehicle for Toyota and Honda, two Japanese automobile manufacturers with extensive North American manufacturing and assembly operations.
- The **seventh disease, liability and excessive damage awards**, is also a major issue facing many organizations. Deming was fond of observing that the United States had more lawyers per capita than any other nation. He believed that government intervention likely would be necessary to provide effective long-term solutions to the medical cost and excessive liability awards problems.

# Deming's PDCA Cycle

Deming recommended the Shewhart cycle, shown in Figure below as a model to guide improvement.



**The Shewhart cycle**

# Deming's PDCA Cycle



- The four steps, **Plan-Do-Check-Act**, are often called the **PDCA** cycle. Sometimes the Check step is called Study, and the cycle becomes the **PDSA** cycle.
- In **Plan**, we propose a change in the system that is aimed at improvement.
- In **Do**, we carry out the change, usually on a small or pilot scale, to ensure that the results that are desired will be obtained.
- **Check** consists of analyzing the results of the change to determine what has been learned about the changes that were carried out.
- In **Act**, we either adopt the change or, if it was unsuccessful, abandon it.
- The process is almost always iterative, and may require several cycles for solving complex problems.



# Deming's Obstacles to Success



1. The belief that automation, computers, and new machinery will solve problems.
2. Searching for examples—trying to copy existing solutions.
3. The “our problems are different” excuse and not realizing that the principles that will solve them are universal.
4. Obsolete schools, particularly business schools, where graduates have not been taught how to successfully run businesses.
5. Poor teaching of statistical methods in industry: Teaching tools without a framework for using them is going to be unsuccessful.
6. Reliance on inspection to produce quality.
7. Reliance on the “quality control department” to take care of all quality problems.
8. Blaming the workforce for problems.
9. False starts, such as broad teaching of statistical methods without a plan as to how to use them, quality circles, employee suggestion systems, and other forms of “instant pudding.”



# Deming's Obstacles to Success



10. The fallacy of zero defects: Companies fail even though they produce products and services without defects. Meeting the specifications isn't the complete story in any business.
11. Inadequate testing of prototypes: A prototype may be a one-off article, with artificially good dimensions, but without knowledge of variability, testing a prototype tells very little. This is a symptom of inadequate understanding of product design, development, and the overall activity of technology commercialization.
12. “Anyone that comes to help us must understand all about our business.” This is bizarre thinking: There already are competent people in the organization who know everything about the business—except how to improve it. New knowledge and ideas (often from the outside) must be fused with existing business expertise to bring about change and improvement.



# Quality Philosophy and Management Strategies

## Joseph M. Juran.

Juran was born in 1904 and died in 2008. He was one of the founding fathers of the quality-control and improvement field. He worked for Walter A. Shewhart at AT&T Bell Laboratories and was at the leading edge of quality improvement throughout his career. Juran became the chief industrial engineer at Western Electric (part of the Bell System). He was an assistant administrator for the Lend-Lease Administration during World War II and played an important role in simplifying the administrative and paper work processes of that agency.

After the war, he became the head of the Department of Administrative Engineering at New York University. He was invited to speak to Japanese industry leaders as they began their industrial transformation in the early 1950s. He also created an active consulting practice (the Juran Institute) and lectured widely through the American Management Association. He was the co-author (with Frank M. Gryna) of the Quality Control Handbook, a standard reference for quality methods and improvement since its initial publication in 1957.



# Juran's Quality Trilogy Process



- Juran proposed a universal way of thinking about quality, which he called the quality trilogy:
  - **quality planning,**
  - **quality control,**
  - **and quality improvement.**
- This concept fits all functions, levels of management, and product lines.
- The quality trilogy process starts with quality planning at various levels of the organization, each of which has a distinct goal.
- At the upper management level, planning is termed strategic quality management. Broad quality goals are established. A structured approach is selected in which management chooses a plan of action and allocates resources to achieve the goals.



# Juran's Quality Trilogy Process



- Planning at the middle management level is termed operational quality management. Departmental goals consistent with the strategic goals are established.
- At the work force level, planning involves a clear assignment to each worker. Each worker is made aware of how his or her individual goal contributes to departmental goals.
- After the planning phase, quality control takes over. Here, the goal is to run the process effectively such that the plans are enacted.
- Quality control will try to prevent any shortcomings of the planning stage. If unusual symptoms are detected sporadically, quality control will attempt to identify the cause behind this abnormal variation. Upon identifying the cause, remedial actions will be taken to bring the process back to control.



# Juran's Quality Trilogy Process



- The next phase of the trilogy process is quality improvement, which deals with the continuous improvement of the product and the process. This phase is also called the quality break through sequence.
- Such improvements usually require action on the part of upper and middle management, who deal with such actions as creating a new design, changing methods or procedures of manufacturing, and investing in new equipment.



# Juran's Quality Trilogy Process



## Universal Process for Managing Quality

Quality Planning	Quality Control	Quality Improvement
Establish quality goals	Choose control subjects	Prove the need
Identify customers	Choose units of measure	Identify projects
Discover customer needs	Set goals	Organize project teams
Develop product features	Create a sensor	Diagnose the causes
Develop process features	Measure actual performance	Provide remedies, prove that the remedies are effective
Establish process controls, transfer to operations	Interpret the difference	Deal with resistance to change
	Take action on the difference	Control to hold the gains



# Quality Philosophy and Management Strategies

## Armand V. Feigenbaum.

- Feigenbaum was born in 1922. He first introduced the concept of company wide quality control in his historic book Total Quality Control (first published in 1951). This book influenced much of the early philosophy of quality management in Japan in the early 1950s. In fact, many Japanese companies used the term “total quality control” to describe their efforts.
- He proposed a three-step approach to improving quality:
  - quality leadership,
  - quality technology,
  - and organizational commitment.

By quality technology, Feigenbaum means statistical methods and various technical and engineering methods.



# Quality Philosophy and Management Strategies

Feigenbaum is concerned with organizational structure and a systems approach to improving quality.

He proposed a 19-step improvement process, of which use of statistical methods was step 17.

He initially suggested that much of the technical capability be concentrated in a specialized department. This is in contrast to the more modern view that knowledge and use of statistical tools need to be widespread.

However, the organizational aspects of Feigenbaum's work are important, as quality improvement does not usually spring forth as a "grass roots" activity; it requires a lot of management commitment to make it work.



# Quality Philosophy and Management Strategies

## Philip B.Crosby

- **Philip Bayard "Phil" Crosby**, (June 18, 1926 – August 18, 2001) was a businessman and author who contributed to management theory and quality management practices.
- Crosby initiated the Zero Defects program at the Martin Company. As the quality control manager of the Pershing Missile program, Crosby was credited with a 25 percent reduction in the overall rejection rate and a 30 percent reduction in scrap costs.
- Crosby was born in Wheeling, West Virginia, in 1926. He served in the Navy during World War II and again during the Korean War. In between, he earned a degree from the Ohio College of Podiatric Medicine .

# Crosby's Quality Management Grid

Measurement Categories	Stages of Maturity				
	Stage I: Uncertainty	Stage II: Awakening	Stage III: Enlightenment	Stage IV: Wisdom	Stage V: Certainty
Management understanding and attitude	No comprehension of quality as a management tool. Tend to blame quality department.	Recognizing that quality management may be of value but not willing to provide money or time.	While going through an improvement program, learn about quality management.	Participating.	Consider quality management as essential part of company system.
Quality organization status	Quality is hidden in manufacturing or engineering departments. Emphasis on appraisal and sorting.	A stronger quality leader is appointed, but the main emphasis is still on appraisal and moving the product.	Quality department reports to top management, all appraisal is incorporated.	Quality manager conducts as an officer of company, effective status reporting and preventive action. Involved with consumer affairs.	Quality manager on board of directors. Prevention is main concern.
Problem handling	Problems are fought as they occur; no resolution; inadequate definition.	Teams are set up to attack major problems. Long-range solutions are not solicited.	Corrective action established. Problems are faced openly.	Problems are identified early. All functions are open to suggestions.	Except in the most unusual cases, problems are prevented.
Cost of quality as a percentage of sales	Reported: unknown Actual: 20%	Reported: 3% Actual: 18%	Reported: 8% Actual: 12%	Reported: 6.5% Actual: 8%	Reported: 2.5% Actual: 2.5%
Quality improvement actions	No organized activities. No understanding of such activities.	Trying obvious "motivational" short-range efforts.	Implementation of the 14-step program with thorough understanding.	Continuing the 14-step program.	Quality improvement is a continued activity.
Summary of company quality posture	"We don't know why we have problems with quality."	"Is it always absolutely necessary to have problems with quality?"	"Through management commitment and quality improvement we are identifying and resolving our problems."	"Defect prevention is a routine part of our operation."	"We know why we do not have problems with quality."



# Crosby's Quality Management Grid



## Four Absolutes of Quality Management

- To demonstrate the meaning of quality, Crosby identified four absolutes of quality management.
- **Definition of quality.** Quality means conformance to requirements.
- **System for achievement of quality.** The rational approach is prevention of defects.
- **Performance standard.** The only performance standard is zero defects.
- **Measurement.** The performance measurement is the cost of quality. In fact, Crosby emphasized the **costs of “unquality,”** such as scrap, rework, service, inventory, inspection, and tests.

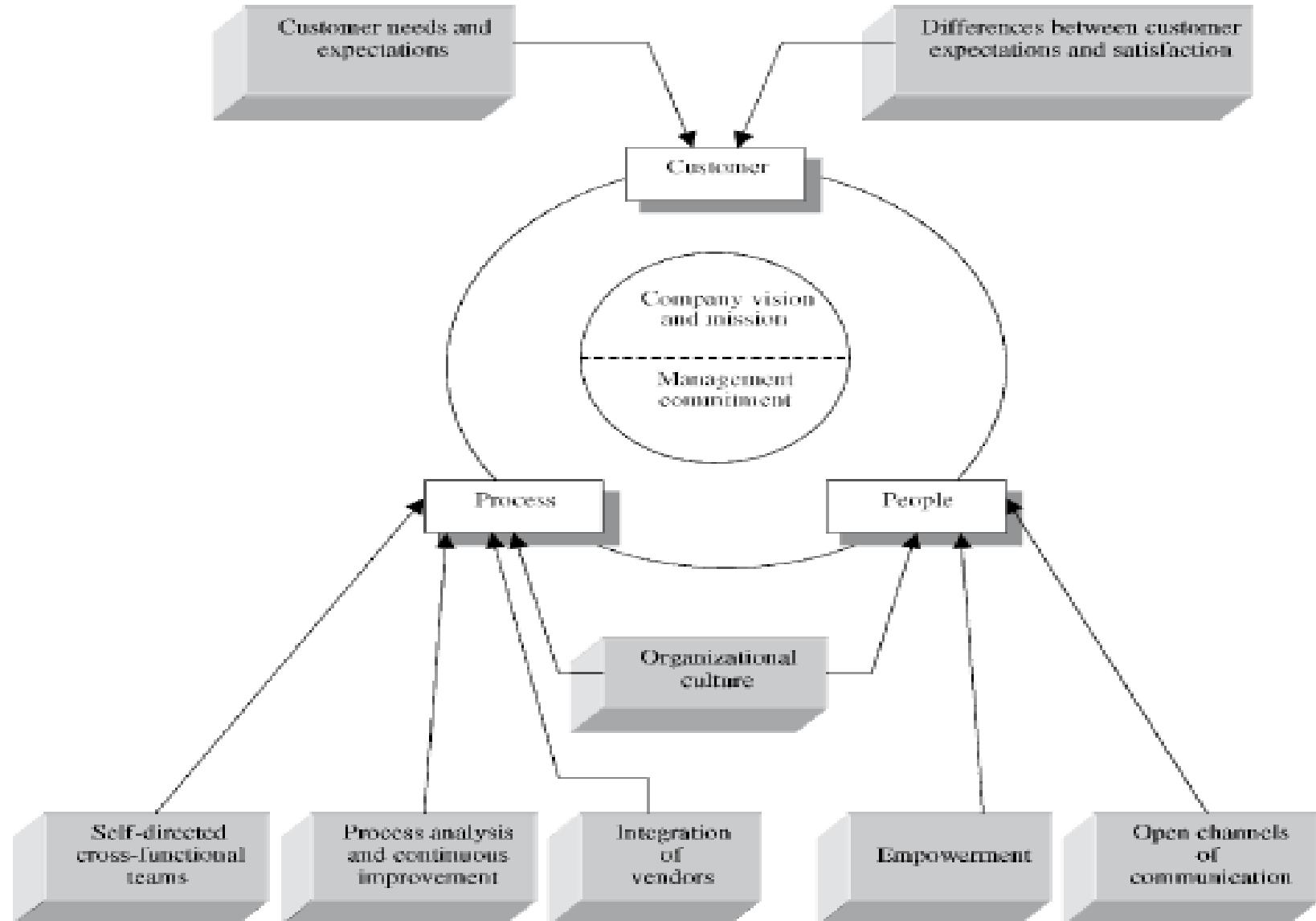


# Total Quality Management



- Total quality management revolves around three main themes: the customer, the process, and the people. Figure (next slide) shows some basic features of a TQM model.
- At its core are the company vision and mission and management commitment. They bind the customer, the process, and the people into an integrated whole.
- A company's vision is about what the company wants to be. The mission lays out the company's strategic focus. Every employee should understand the company's vision and mission so that individual efforts will contribute to the organizational mission.
- When employees do not understand the strategic focus, individuals and even departments pursue their own goals rather than those of the company, and the company's goals are inadvertently sabotaged. The classic example is maximizing production with no regard to quality or cost.

# Total Quality Management





# Total Quality Management



- Satisfying customer needs and expectations is a major theme in TQM . In fact, it is the driving force.
- Without satisfied customers, market share will not grow and revenue will not increase. Management should not second-guess the customer.
- Direct feedback using a data-driven approach is the best way to identify customer expectations and needs. A company's strategic plan must conform to these needs.
- The Second theme in TQM is the process. Management is responsible for analyzing the process to improve it continuously.
- In this framework, vendors are part of the extended process, as advocated by Deming. Integrating vendors into the process improves the vendors' products, which leads to better final products.



# Total Quality Management



- Technical tools and techniques along with management tools come in handy in the quest for quality improvement.
- Self-directed teams are given the authority to make decisions and to make appropriate changes in the process.
- The third theme deals with people. Human “capital” is an organization’s most important asset.
- Empowerment—Involving employees in the decision-making process so that they take ownership of their work and the process—is a key factor in TQM. It is people who find better ways to do a job, and this is no small source of pride. With pride comes motivation. There is a sense of pride in making things better through the elimination of redundant or non-value-added tasks or combining operations.
- In TQM, managing is empowering.



# Quality Auditing

- The effectiveness of management control programs may be examined through a practice known as quality auditing.
- One reason that management control programs are implemented is to prevent problems. Despite such control, however, problems can and do occur, so, quality audits are undertaken to identify problems.
- In any quality audit, three parties are involved.
  - The party that requests the audit is known as the **client**,
  - The party that conducts the audit is the **auditor**,
  - And the party being audited is the **auditee**.



# Quality Auditing



- Auditors can be of two types, **internal or external**.
- An **internal auditor** is an employee of the auditee.
- **External auditors** are not members of the auditee's organization. An external auditor may be a single individual or a member of an independent auditing organization.

Quality audits fulfill two major purposes.

- **In-depth evaluation of the quality** program against a reference standard, usually predetermined by the client. Reference standards are set by several organizations, including the ANSI/ASQ, ISO, and British Standards Institute(BSI).



# Quality Auditing



- The second purpose, performed in the conformity quality audit, deals with a thorough evaluation of the operations and activities within the quality system and the degree to which they conform to the quality policies and procedures defined.
- Quality audits may be categorized as one of three types.
- The most extensive and inclusive type is the **system audit**.
- ✓ This entails an evaluation of the quality program documentation (including policies, procedures, operating instructions, defined accountabilities, and responsibilities to achieve the quality function) using a reference standard.
- ✓ It also includes an evaluation of the activities and operations that are implemented to accomplish the quality objectives desired.



# Quality Auditing



- ✓ Such audits therefore explore conformance to quality management standards and their implementation to specified norms.
- ✓ They encompass the evaluation of the phases of planning, implementation, evaluation, and comparison.
- ✓ An example of a system audit is a pre-award survey, which typically evaluates the ability of a potential vendor to provide a desired level of product or service.
- A second type of quality audit (not as extensive as the system audit) is the **process audit**, which is an in-depth evaluation of one or more processes in the organization.
- ✓ All relevant elements of the identified process are examined and compared to specified standards.



# Quality Auditing

- ✓ Because a process audit takes less time to conduct than a system audit, it is more focused and less costly.
- ✓ If management has already identified a process that needs to be evaluated and improved, the process audit is an effective means of verifying compliance and suggesting places for improvement.
- ✓ A process audit can also be triggered by unexpected output from a process.
- ✓ For industries that use continuous manufacturing processes, such as chemical industries, a process audit is the audit of choice.



# Quality Auditing



- The third type of quality audit is the **product audit**, which is an assessment of a final product or service on its ability to meet or exceed customer expectations.
- ✓ This audit may involve conducting periodic tests on the product or obtaining information from the customer on a particular service.
- ✓ The objective of a product audit is to determine the effectiveness of the management control system.
- ✓ Such an audit is separate from decisions on product acceptance or rejection and is therefore not part of the inspection system used for such processes.
- Customer or consumer input plays a major role in the decision to undertake a product audit. For a company producing a variety of products, a relative comparison of product performance that indicates poor performers could be used as a guideline for a product audit.



# Quality Systems and Standards



- The International Standards Organization (founded in 1946 in Geneva, Switzerland), known as ISO, has developed a series of standards for quality systems. The first standards were issued in 1987.
- The current version of the standard is known as the ISO 9000 series. It is a generic standard, broadly applicable to any type of organization, and it is often used to demonstrate a supplier's ability to control its processes. The three standards of ISO 9000 are:
  - ISO 9000:2005 Quality Management System—Fundamentals and Vocabulary
  - ISO 9001:2008 (2015) Quality Management System—Requirements
  - ISO 9004:2009 Quality Management System—Guidelines for Performance Improvement
  - ISO 9000 is also an American National Standards Institute and an ASQ standard



# Quality Systems and Standards

- The ISO 9001:2008 standard has eight clauses:
  - (1) Scope
  - (2) Normative References,
  - (3) Definitions,
  - (4) Quality Management Systems,
  - (5) Management Responsibility,
  - (6) Resource Management,
  - (7) Product (or Service) Realization, and
  - (8) Measurement, Analysis, and Improvement.
- Clauses 4 through 8 are the most important, and their key components and requirements are shown in Table (subquent Slide).
- To become certified under the ISO standard, a company must select a registrar and prepare for a certification audit by this registrar.



# Quality Systems and Standards

- Many organizations have required their suppliers to become certified under ISO 9000, or one of the standards that are more industry-specific.
- Examples of these industry-specific quality system standards are:
  - AS 9100 Revision D (2016) for the aerospace industry; ([SAE](#))
  - ISO/TS 16949 (2016) ([IATF](#)) and QS 9000 ([General Motors, Chrysler and Ford](#)) for the automotive industry; QS 9000 superseded by IATF 16949:2016 (current version).
  - TL 9000 ([QuEST Forum](#)) for the telecommunications industry.
  - Many components of these standards are very similar to those of ISO 9000.



# Quality Systems and Standards

**SAE** : Society for Automotive Engineers

**IATF** : International Automotive Task Force

**QuEST (Quality Underwriting Ethics Standards And Trust) Forum**: is a global association of companies dedicated to impacting the quality and sustainability of products and services in the ICT (Information and Communication Technology) industry.



# ISO 9000 series Quality Management Principles



The ISO 9000 series are based on seven quality management principles (QMP)  
The seven quality management principles are:

- QMP 1 – Customer focus
- QMP 2 – Leadership
- QMP 3 – Engagement of people
- QMP 4 – Process approach
- QMP 5 – Improvement
- QMP 6 – Evidence-based decision making
- QMP 7 – Relationship management

## Principle 1 – Customer focus

Organizations depend on their customers and therefore should understand current and future customer needs, should meet customer requirements and strive to exceed customer expectations.



# ISO 9000 series Quality Management Principles



## Principle 2 – Leadership

Leaders establish unity of purpose and direction of the organization. They should create and maintain the internal environment in which people can become fully involved in achieving the organization's objectives.

## Principle 3 – Engagement of people

People at all levels are the essence of an organization and their full involvement enables their abilities to be used for the organization's benefit.

## Principle 4 – Process approach

A desired result is achieved more efficiently when activities and related resources are managed as a process.



# ISO 9000 series Quality Management Principles



## Principle 5 – Improvement

Improvement of the organization's overall performance should be a permanent objective of the organization.

## Principle 6 – Evidence-based decision making

Effective decisions are based on the analysis of data and information.

## Principle 7 – Relationship management

An organization and its external providers (suppliers, contractors, service providers) are interdependent and a mutually beneficial relationship enhances the ability of both to create value.

# ISO 9001:2008 Requirements

## 4.0 Quality Management System

### 4.1 General Requirements

The organization shall establish, document, implement, and maintain a quality management system and continually improve its effectiveness in accordance with the requirements of the international standard.

### 4.2 Documentation Requirements

Quality management system documentation will include a quality policy and quality objectives; a quality manual; documented procedures; documents to ensure effective planning, operation, and control of processes; and records required by the international standard.

## 5.0 Management System

### 5.1 Management Commitment

- a. Communication of meeting customer, statutory, and regulatory requirements
- b. Establishing a quality policy
- c. Establishing quality objectives
- d. Conducting management reviews
- e. Ensuring that resources are available

### 5.2 Top management shall ensure that customer requirements are determined and are met with the aim of enhancing customer satisfaction.

### 5.3 Management shall establish a quality policy.

### 5.4 Management shall ensure that quality objectives shall be established. Management shall ensure that planning occurs for the quality management system.

### 5.5 Management shall ensure that responsibilities and authorities are defined and communicated.

### 5.6 Management shall review the quality management system at regular intervals.

# ISO 9001:2008 Requirements

## 6.0 Resource Management

- 6.1 The organization shall determine and provide needed resources.
- 6.2 Workers will be provided necessary education, training, skills, and experience.
- 6.3 The organization shall determine, provide, and maintain the infrastructure needed to achieve conformity to product requirements.
- 6.4 The organization shall determine and manage the work environment needed to achieve conformity to product requirements.

## 7.0 Product or Service Realization

- 7.1 The organization shall plan and develop processes needed for product or service realization.
- 7.2 The organization shall determine requirements as specified by customers.
- 7.3 The organization shall plan and control the design and development for its products or services.
- 7.4 The organization shall ensure that purchased material or product conforms to specified purchase requirements.
- 7.5 The organization shall plan and carry out production and service under controlled conditions.
- 7.6 The organization shall determine the monitoring and measurements to be undertaken and the monitoring and measuring devices needed to provide evidence of conformity of products or services to determined requirements.

# ISO 9001:2008 Requirements

## 8.0 Measurement, Analysis, and Improvement

- 8.1 The organization shall plan and implement the monitoring, measurement, analysis, and improvement process for continual improvement and conformity to requirements.
- 8.2 The organization shall monitor information relating to customer perceptions.
- 8.3 The organization shall ensure that product that does not conform to requirements is identified and controlled to prevent its unintended use or delivery.
- 8.4 The organization shall determine, collect, and analyze data to demonstrate the suitability and effectiveness of the quality management system, including
  - a. Customer satisfaction
  - b. Conformance data
  - c. Trend data
  - d. Supplier data
- 8.5 The organization shall continually improve the effectiveness of the quality management system.



# ISO 9001:2015

Contents of ISO 9001:2015 are as follows:

- Section 1: Scope
- Section 2: Normative references
- Section 3: Terms and definitions
- Section 4: Context of the organization
- Section 5: Leadership
- Section 6: Planning
- Section 7: Support
- Section 8: Operation
- Section 9: Performance evaluation
- Section 10: Continual Improvement



# ISO 9001:2015



The 2015 version is also less prescriptive than its predecessors and focuses on performance. This was achieved by combining the process approach with risk-based thinking, and employing the Plan-Do-Check-Act cycle at all levels in the organization.

Some of the key changes include:

- High-Level Structure of 10 clauses is implemented. Now all new standards released by ISO will have this high-level structure.
- Greater emphasis on building a management system suited to each organization's particular needs.
- A requirement that those at the top of an organization be involved and accountable, aligning quality with wider business strategy.



# ISO 9001:2015

- Risk-based thinking throughout the standard makes the whole management system a preventive tool and encourages continuous improvement.
- Less prescriptive requirements for documentation: the organization can now decide what documented information it needs and what format it should be in
- Alignment with other key management system standards through the use of a common structure and core text
- Inclusion of Knowledge Management principles
- Quality Manual & Management representative (MR) are no longer mandatory



# The Malcolm Baldrige National Quality Award



The Malcolm Baldrige National Quality Award (MBNQA) was created by the U.S. Congress in 1987. It is given annually to recognize U.S. organizations for performance excellence.

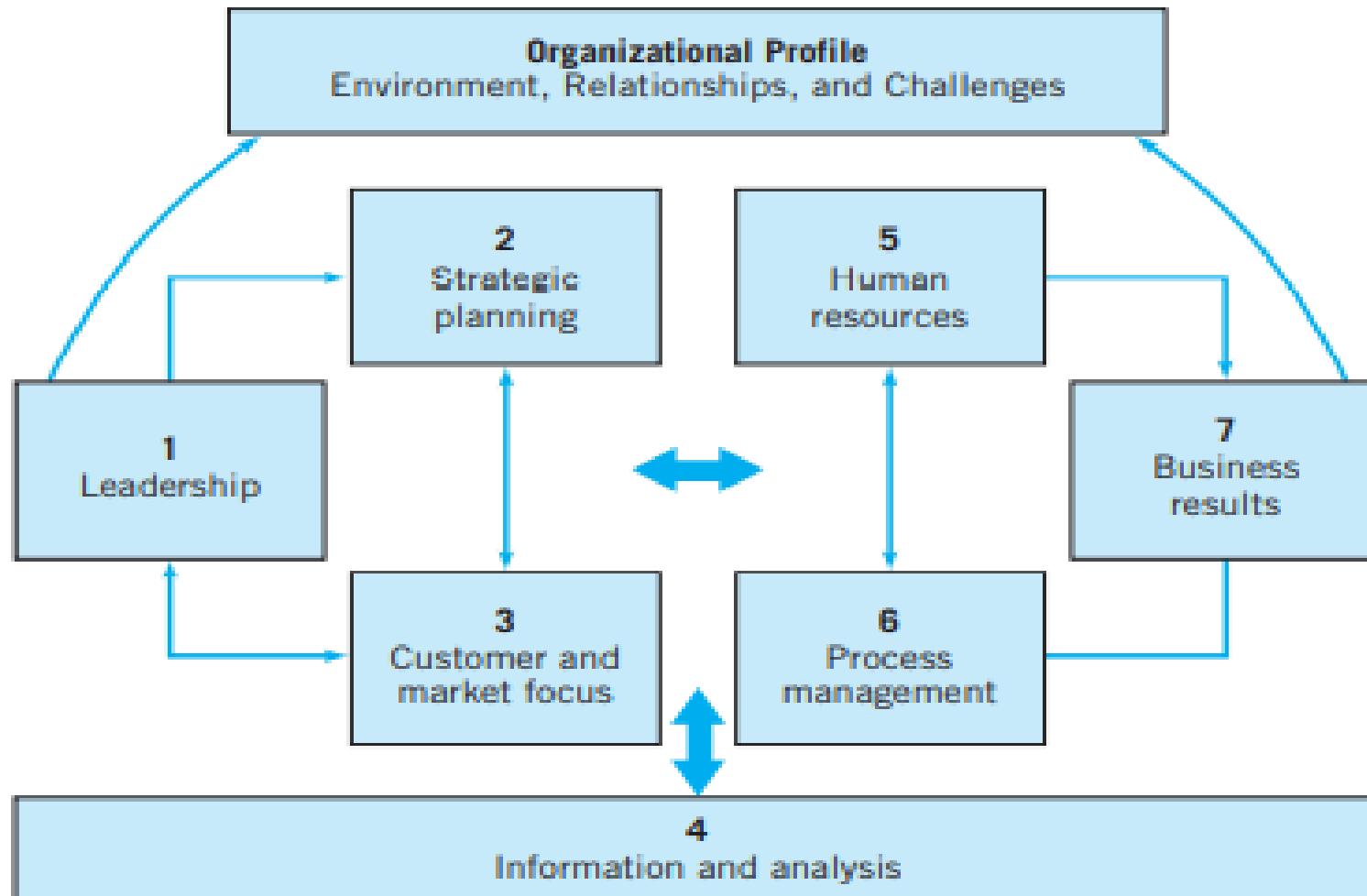
Awards are given to organizations in five categories: manufacturing, service, small business, health care, and education. Three awards may be given each year in each category.

Many organizations compete for the awards, and many companies use the performance excellence criteria for self-assessment.

The award is administered by NIST (the National Institute of Standards and Technology).

The performance excellence criteria and their interrelationships are shown in Figure (next slide). The point values for these criteria in the MBNQA are shown in Table (next slide).

# The Malcolm Baldrige National Quality Award



The structure of the MBNQA performance excellence criteria.

# The Malcolm Baldrige National Quality Award

## Performance Excellence Categories and Point Values

<b>1 Leadership</b>		<b>120</b>
1.1 Leadership System	80	
1.2 Company Responsibility and Citizenship	40	
<b>2 Strategic Planning</b>		<b>85</b>
2.1 Strategy Development Process	40	
2.2 Company Strategy	45	
<b>3 Customer and Market Focus</b>		<b>85</b>
3.1 Customer and Market Knowledge	40	
3.2 Customer Satisfaction and Relationship Enhancement	45	
<b>4 Information and Analysis</b>		<b>90</b>
4.1 Measurement and Analysis of Performance	50	
4.2 Information Management	40	
<b>5 Human Resource Focus</b>		<b>85</b>
5.1 Work Systems	35	
5.2 Employee Education, Training, and Development	25	
5.3 Employee Well-Being and Satisfaction	25	
<b>6 Process Management</b>		<b>85</b>
6.1 Management of Product and Service Processes	45	
6.2 Management of Business Processes	25	
6.3 Management of Support Processes	15	
<b>7 Business Results</b>		<b>450</b>
7.1 Customer Results	125	
7.2 Financial and Market Results	125	
7.3 Human Resource Results	80	
7.4 Organizational Results	120	
<b>Total Points</b>		<b>1,000</b>