

History of Quality (cont'd)

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.
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 www.asq.org), 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.

2 Management Aspects of Quality

Management Aspects of Quality & Quality Improvement

1 *Quality Planning*

- Identifying customer needs.
- Developing products/services that surpass expectations considering quality dimensions.
- Planning systematic quality improvements for product realization and customer satisfaction.

2 *Quality Assurance*

- Ensuring product/service quality and resolving supplier and customer issues.
- Documenting the quality system – policy, procedures, work instructions, and records.
- Tracking production, addressing complaints, and maintaining updated specifications for effective operations and customer satisfaction.

Management Aspects of Quality & Quality Improvement (cont'd)

3 *Quality Control and Improvement*

- Ensuring products meet standards and undergo continuous enhancement.
- Using statistical methods and designed experiments to address variability.
- Involving specialized teams working on projects essential for successful quality control and enhancement.

Quality Philosophy & Management Strategies



Figure: W. Edwards Deming (1900-1993). A prominent figure in quality management and is known for his significant contributions to the field of quality control and improvement.

The *Deming Philosophy* is summarized in *14 points* for management.

- Stressed on *continual never-ending* improvement.
- Wrote about the *seven deadly diseases* of management.
- Recommended the *Shewhart cycle* model to guide improvement.
- Wrote about the *obstacles to success* for management.

Deming's 14 Points for Management

- 1 Create *constancy of purpose* toward improvement.
- 2 Adopt a new philosophy, recognize that we are in a *time of change*, a new economic age.
- 3 Cease reliance on *mass inspection* to improve quality.
- 4 End the practice of *awarding business* on the basis of price alone.
- 5 Improve *constantly* and *forever* the system of production and service.
- 6 Institute *training*.
- 7 Improve *leadership*, recognize that the aim of supervision is help people and equipment to do a better job.

Deming's 14 Points for Management (cont'd)

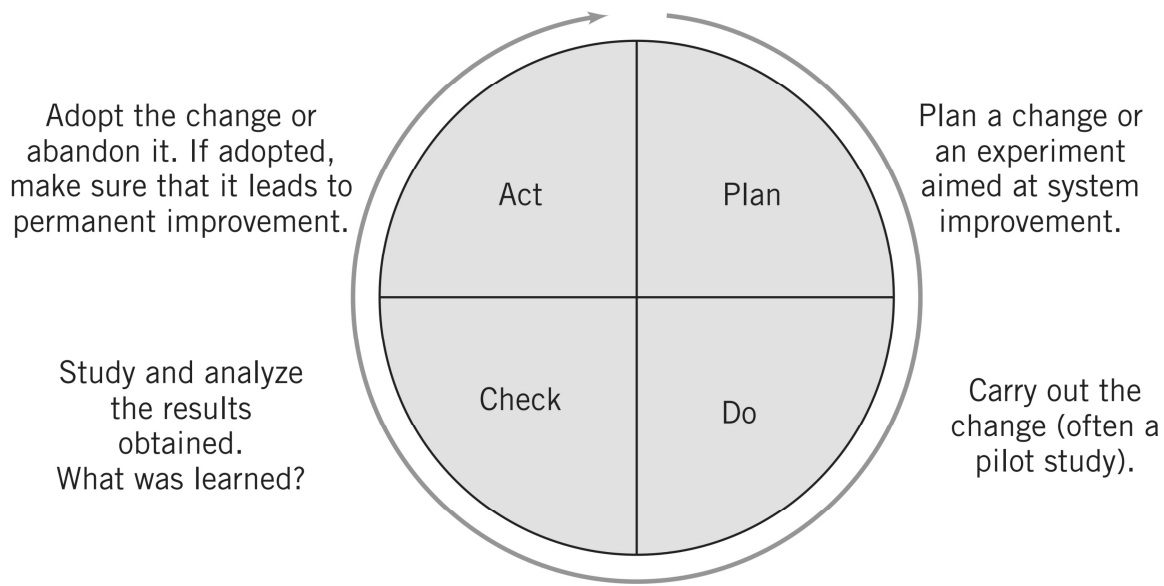
- 8 Drive out *fear*.
- 9 Break down *barriers* between departments.
- 10 Eliminate slogans and targets for the workforce such as *zero defects*.
- 11 Eliminate *work standards*.
- 12 Remove barriers that rob workers of the *right to pride* in the quality of their work.
- 13 Institute a vigorous program of *education* and *self-improvement*.
- 14 Put *everyone to work* to accomplish the transformation.

Deming's 7 Deadly Diseases of Management

Each disease is a barrier to the effective implementation of his philosophy.

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

The Shewhart/PDCA Cycle



The four stages of Shewhart cycle: *Plan-Do-Check-Act*.

Deming's Obstacles to Success

- 1 The belief that automation, computers, and new machinery will solve all 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.
- 6 Reliance on inspection to produce quality.
- 7 Reliance on *quality control department* to take care of all quality problems.

Deming's Obstacles to Success (cont'd)

- 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.
- 10 The fallacy of “*zero defects*”: Companies fail even though they produce products and services without defects.
- 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.
- 12 “*Anyone that comes to help us must understand all about our business.*” This is bizarre thinking. New knowledge and ideas must be fused with existing business expertise to bring about change and improvement.

Some of Other Quality Gurus

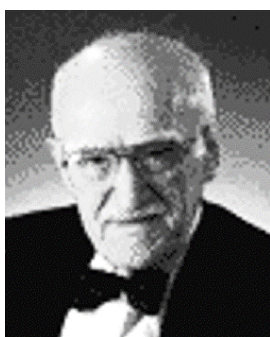


Figure: Joseph M. Juran (1904-2008): Born in Romania, immigrated to the US. Worked at Western Electric, influenced by Walter Shewhart.

Joseph M. Juran

- The *Juran Trilogy*
 - 1 Planning
 - 2 Control
 - 3 Improvement
- These three processes are interrelated; control versus breakthrough, project-by-project improvement.

Armand V. Feigenbaum

- Author of the book “*Total Quality Control*”
- Three-step approach emphasized quality leadership, quality technology, and organizational commitment

Philip B. Crosby, Kaoru Ishikawa, Genichi Taguchi, Shigeo Shingo, Taiichi Ohno

Total Quality Management (TQM)

Total quality management (TQM) is a strategy for implementing and managing quality improvement activities in an organization-wide basis.

- Originated in the early 1980s, centered around Deming and Juran's philosophies.
- Expanded to encompass broader ideas: participative organizations, customer focus, supplier quality enhancement, and aligning quality systems with business objectives.
- Involves various activities aiming to align the entire organization towards quality improvement goals.

Total Quality Management (TQM) (cont'd)

Organizations *practicing TQM* often have:

- *Quality councils/high-level teams* handling strategic quality initiatives.
- *Workforce-level teams* focusing on routine production/business activities.
- *Cross-functional teams* addressing specific quality improvement issues.

Reasons for *TQM's lack of success*:

- Lack of top-level management commitment.
- Inadequate use of statistical methods and variability reduction.
- Setting general, not specific, business-results-oriented objectives.
- Excessive emphasis on widespread training over focused technical education.

Quality Systems and Standards

The *International Standards Organization (ISO)*, founded in 1946 in Geneva, Switzerland, 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.
- A *generic standard*, broadly applicable to any type of organization, and often used to demonstrate a supplier's ability to control its processes.

ISO 9000 is also an *American National Standards Institute (ANSI)* and an *American Society for Quality (ASQ)* standard.

The three standards of *ISO 9000* series are:

- *ISO 9000:2005* Quality Management System – Fundamentals & Vocabulary
- *ISO 9001:2008* Quality Management System – Requirements
- *ISO 9004:2009* Quality Management System – Guidelines for Performance Improvement

Quality Systems and Standards (cont'd)

Companies seeking *ISO certification* choose a registrar and undergo a certification audit.

Preparation for *ISO certification* involves:

- Initial audits
- Team establishment
- Personnel training
- Documentation development
- Implementing new quality system components

Certification includes *periodic surveillance* audits by the registrar, typically annually or semi-annually post-certification.

Organizations often demand *supplier certification* under ISO 9000 or industry-specific standards like *AS 9100* (aerospace), *ISO/TS 16949*, *QS 9000* (automotive), and *TL 9000* (telecommunications).

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.

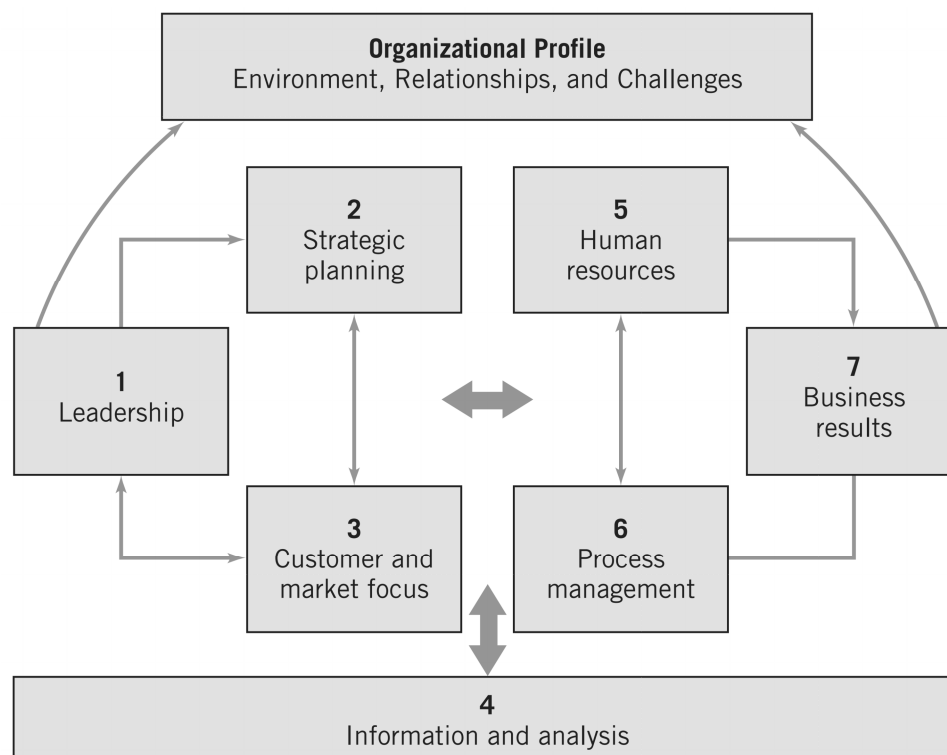
The award is administered by the *National Institute of Standards and Technology (NIST)*.

Awards are given to organizations in *five categories*:

- 1 Manufacturing
- 2 Service
- 3 Small business
- 4 Health care
- 5 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 as a *self-assessment* tool.

Structure of MBNQA Assessment Criteria



Supply Chain Management (SCM) for Quality

The *supply chain* is a network where companies depend on suppliers for materials and distribution, creating an interconnected system.

Supply chain management (SCM) optimizes designing, planning, executing, and controlling supply chain activities.

- Globalization and business changes have expanded supply chain networks over the past years.
- The supply chain significantly contributes to product value and quality.

Key Supply Chain Management Activities

1 Supplier Qualification

- Involves visits to suppliers.
- Inspection of facilities.
- Evaluating production systems for adequate product delivery, quality, and overall business operations.
- Aims to provide a basis for supplier selection.

2 Supplier Development

- Includes activities to enhance supplier performance, such as evaluation, training, data sharing.
- Joint projects for quality improvement, capacity expansion, cost reduction.
- Companies might assist in Six Sigma deployment and offer awards to preferred suppliers.

Key Supply Chain Management Activities (cont'd)

3 Supplier Audits

- Regular visits to ensure product quality, standards, and operational objectives are met.
- Audits include environmental and social responsibilities. .
- Identifies nonconformances in manufacturing, logistics, engineering, and billing processes.
- Jointly implements corrective actions within agreed timelines.
- Third parties may conduct audits, especially for environmental and ethical compliance.

Key Supply Chain Processes

- *Service Management*: Ensures efficient service provision.
- *Demand Management*: Predicts and manages customer demands.
- *Order Fulfillment*: Manages order processing and completion.
- *Quality Management*: Ensures product/service quality.
- *Manufacturing Flow Management*: Optimizes production flow.
- *Supplier Relationship Management*: Maintains supplier partnerships.
- *Logistics and Distribution*: Manages product delivery.
- *Returns Management*: Handles product return processes.

Quality Costs

Quality costs serve as a *financial control tool* for organizations.

Organizations formally assess quality-related costs due to:

- Increased complexity in product manufacturing due to technological advancements.
- Rising awareness of life-cycle costs, including maintenance, spare parts, and field failures.
- Enhanced communication of quality issues to management by quality engineers.

Quality Costs (cont'd)

Quality costs broadly categorize into *four* groups:

- 1 Prevention Costs:** Costs associated with preventing defects.
- 2 Appraisal Costs:** Expenses involved in evaluating products for defects.
- 3 Internal Failure Costs:** Costs incurred due to defects found before delivery.
- 4 External Failure Costs:** Expenses from defects found after delivery.

Prevention Costs

Prevention costs include expenses in design and production aimed at avoiding nonconformance.

These costs emphasize getting it right the first time and include:

- *Quality planning and engineering cost*: Creating quality plans, inspection procedures, and manuals.
- *New products review cost*: Evaluating new designs and conducting tests during development.
- *Product/process design cost*: Involves design or process selections to enhance product quality.
- *Process control cost*: Implementing techniques like control charts to monitor and reduce variation.
- *Burn-in cost*: Pre-shipment operations to prevent early-life field failures.
- *Training cost*: Developing and maintaining formal quality training programs.
- *Quality data acquisition and analysis cost*: Gathering and analyzing data for product and process performance assessment.

Appraisal Costs

Appraisal costs involve expenses related to measuring, evaluating, or auditing products for adherence to set standards.

These include:

- *Inspection and test of incoming material cost*: Costs linked to examining and testing all incoming materials, including receiving inspections, vendor facility inspections, and audits of the quality-assurance system.
- *Product inspection and test cost*: Expenses incurred during the various stages of product manufacturing, including final acceptance testing, shipping checks, and tests conducted at the customer's facilities.
- *Materials and services consumed cost*: Costs of materials and products used in destructive or reliability tests.
- *Maintaining accuracy of test equipment cost*: Costs to operate systems ensuring the calibration of measuring instruments and equipment.

Internal Failure Costs

Internal failure costs arise when products fail to meet quality standards before delivery to the customer.

These include:

- *Scrap cost*: Net loss of labor, material, and overhead due to defective products that can't be economically repaired or used.
- *Rework cost*: Cost of correcting nonconforming units to meet specifications, sometimes involving additional steps in the manufacturing process.
- *Retest cost*: Expense of re-inspecting and retesting modified products.
- *Failure analysis cost*: Cost incurred to determine the causes of product failures.
- *Downtime cost*: Expense of idle production facilities due to nonconforming materials or other quality issues.
- *Yield losses cost*: Cost of lower-than-expected process yields due to inadequate controls.
- *Downgrading/off-specing cost*: Price gap between standard sales and products failing to meet customer needs impacts profits and overhead.

External Failure Costs

External failure costs arise when a product doesn't meet requirements after delivery, impacting customer satisfaction.

These include:

- *Complaint adjustment*: Expenses for investigating and addressing justified complaints related to nonconforming products.
- *Returned product/material*: Costs associated with receiving, handling, and replacing nonconforming products or materials returned from the field.
- *Warranty charges*: Expenses involved in servicing products under warranty agreements.
- *Liability costs*: Expenses or settlements incurred from product liability lawsuits.
- *Indirect costs*: Beyond direct operational expenses, indirect costs stem from customer dissatisfaction. They cover loss of business reputation, future business, and market share due to delivering products not meeting customer expectations for intended use.

The Analysis and Use of Quality Costs

Quality costs vary among organizations, typically ranging from *4% to 40% of sales*. The goal is continuous reduction through appraising, analyzing, and identifying opportunities for improvement.

- Though *reducing costs to zero is impossible*, focusing on quality costs combined with variance reduction efforts can lead to a *50% to 60% reduction*.
- Organizations often *emphasize appraisal over prevention*, with appraisal costs overshadowing prevention costs by an unreasonable ratio.
- *Tracking quality-cost figures can be challenging* due to limited alignment with accounting records.
- *Reporting is usually in ratio form*, comparing quality costs to activity measures. Trend analyses compare current and past performance.

Sample Questions

- Q2.1** What do you understand by dimensions of quality? Name any three quality dimensions and briefly discuss what they represent and what customer concerns they address.
- Q2.2** Explain the two main types of quality definitions. What do you understand by quality improvement? Explain nonconforming and defective products.
- Q2.3** Deming's philosophy was summarized in 14 points. Discuss any three of these points and provide your opinion on the same.
- Q2.4** Discuss any three of the Deming's seven deadly diseases of management. Plot the Shewhart cycle and discuss the four steps briefly.
- Q2.5** Name four main types of quality costs and briefly explain each type.