

Quality Assurance basics, Quality Gurus and Quality Standards

Michael Hausner (2 October, 2020)

Quality makes the product attractive, satisfying customers, brings profit to the producer and enables him to stay in the business and to grow. Since we recognize that inspections and tests of optical elements and assemblies connected strongly to quality, it is an important part of assuring the conformance of the goods to their requirements and serves organization's needs, goals and objectives. This chapter will present some basic information of quality assurance that the optics quality inspector or tester should be aware of.

Quality: A subjective term for which each person or sector has its own definition. In technical usage, quality can have two meanings: 1. The characteristics of a product or service that bears on its ability to satisfy stated or implied needs; 2. A product or service free of deficiencies.

Quality Assurance/Quality Control (QA/QC): Two terms that have many interpretations because of the multiple definitions of the word "assurance" and "control". For example, "assurance" can mean the act of giving confidence, the state of being certain of the act of making certain; "control" can mean an evaluation to indicate needed corrective responses, the act of guiding the state of a process in which the variability is attributable to a control system of chance causes. One definition for Quality Assurance is: all the planned and systematic activities implemented within the quality system that can be demonstrated to provide confidence that a product or service will fulfill requirements for quality. One definition for Quality Control is the operational techniques and activities used to fulfill requirements for quality. Often, however, "Quality Assurance" and "Quality Control" are used interchangeably, referring to the actions performed to ensure the quality of a product, service or process.

Quality Engineering: The analysis of a manufacturing system at all stages to maximize quality of the process itself and the products it produces.

Quality Management (QM): The application of a quality management system in managing a process to achieve maximum customer satisfaction at the lowest overall cost to the organization while continuing to improve the process.

Quality Management System (QMS): A formalized system that documents the structure, responsibilities and procedures required to achieve effective quality management.

Quality Management Theories

Quality Management Theories refer to theoretical rules and customs stated by organizations and supported by practical actions to ensure that product or service is consistent, meets the requirements stated by the organization or its customer and satisfies both of them.

Basically, Quality Management Theory has four main components:

1. Quality planning
2. Quality control
3. Quality assurance
4. Quality improvement

Early management systems focused on industrial products using simple random sampling inspection. During the years since the industrial revolution, the theories of managing have improved and become Quality Management. Later on, when standardization became an important issue in the global market, standards based on the Quality Management Theories and their principles came to be the leading guide in managing organizations.

Quality Management Theories developed by what we call Quality Gurus, persons that during their work recognized the importance of Quality Management and each of them, according to his knowledge and experience established theory and principles for achieving higher quality of products and services.

The most well-known persons (Quality Gurus) with significant impact on Quality Management, theoretical and practical are:

- William Edwards Deming (October 14, 1900 – December 20, 1993)
- Philip B. Crosby (June 18, 1926 – August 18, 2001)
- Joseph Moses Juran (December 24, 1904 – February 28, 2008)
- Kaoru Ishikawa (July 13, 1915 - April 16, 1989)
- Armand V. Feigenbaum (April 6, 1922 – November 13, 2014)
- Walter Andrew Shewhart (March 18, 1891 – March 11, 1967)
- David A. Garvin (May 12, 1952 – April 30, 2017)

Following are the principles of the Quality Management Theories of the above mentioned Quality Gurus.

Deming's theory

Deming's theory, known as TQM (Total Quality Management) based on 14 points, is a set of management principles to help organizations increase their quality and productivity.

The 14 points are:

1. Create constancy of purpose for improvement of product and services
2. Adopt the new philosophy
3. Cease dependence on mass inspection
4. End the practice of awarding business on price tag alone
5. Constantly and forever improve the systems of production and services
6. Institute modern methods of training on the job
7. Institute modern methods of supervision and leadership
8. Drive out fear
9. Break down barriers between departments
10. Eliminate numerical goals for the work force
11. Eliminate work standards and numerical quotas
12. Remove barriers to pride of workmanship
13. Institute a vigorous program of education and training for everyone
14. Create a structure in top management that will push every day on the above 13 points.

Another Deming's theory that should be mentioned in short is the "System of Profound Knowledge" which is the basis for application of Deming's famous 14 Points for Management, described above.

The "System of Profound Knowledge" includes four parts:

- **Appreciation of a system** - understanding the overall processes involving suppliers, producers and customers (or recipients) of goods and services
- **Knowledge of variation** - the range and causes of variation in quality and use of statistical sampling in measurements
- **Theory of knowledge** - the concepts explaining knowledge and the limits of what can be known
- **Knowledge of psychology** - concepts of human nature

Famous Quotes related to W. Edwards Deming:

- "The result of long-term relationships is better and better quality and lower and lower costs"
- "It is not enough to do your best; you must know what to do, and then do your best"
- "Whenever there is fear, you will get wrong figures"
- "If you can't describe what you are doing as a process, you don't know what you're doing"
- "Quality is everyone's responsibility"
- "We should work on our process, not the outcome of our processes"
- "He who runs his company on visible figures alone will soon have neither company nor visible figures to work with"
- "Happy customer that comes back for more is worth 10 prospects"



PDCA (Plan–Do–Check–Act) is a four-step management method used in business for the control and continuous improvement of processes and products. It is also known as the **Deming cycle**. The **PDCA cycle** was in fact originally developed by Walter A. Shewhart, Bell Laboratories scientist who was Deming's friend and mentor, and the developer of Statistical Process Control (SPC) in the late 1920s. So sometimes this is referred to as the "Shewhart Cycle". It was renamed the Deming cycle by the Japanese in 1950.

Crosby's theory

Philip B. Crosby's solution to the quality crisis was to develop and promote the principle of **"Doing It Right the First Time"**

Crosby dissected this into four major principles:

- Quality is conformance to requirements
- The management system should be directed to prevention
- The performance standard should be pointed to zero defects
- The measurement system based on cost of quality

Crosby states that zero defects is not something that originates from the assembly line, but is more of a principles, standards and values that management should adopt and promote, setting an atmosphere and tone for employees to follow. Crosby developed 14 steps for an organization to follow in building an effective quality program:

1. Attain total commitment from management
2. Form a quality improvement teams
3. Create metrics for each quality improvement activity
4. Determine cost of quality and show its use as a management tool
5. Raise the awareness to quality and concern of all employees
6. Take actions to correct problems identified through previous steps
7. Create a zero-defects program committee
8. Ensure that employees and supervisors understand the steps to quality
9. Demonstrate your company's commitment by holding a zero defects day
10. Encourage all individuals to establish improvement goals for themselves and their groups
11. Determine root causes of errors, remove them from processes
12. Create incentives programs for employees
13. Create a quality council to communicate on a regular basis
14. Repeat all over again to emphasise that the quality improvement programme never ends

Famous Quotes related to Philip B. Crosby:

- "Quality is free. What cost money is un-quality - all the activities resulting from not doing the job right the first time"
- "Good things happen when planned. Bad things happen on their own"
- "It is always cheaper to do the job right the first time"
- "Selecting the right person for the right job is the largest part of coaching"

Juran's theory

Juran's Quality Trilogy consists of quality planning, quality control and quality improvement:

1. Quality Planning provides a system that is capable of meeting quality standards
2. Quality Control is used to determine when corrective action is required
3. Quality Improvement seeks better ways of doing things

For successful quality improvement project, all quality improvement actions must be carefully planned out and controlled. Juran believed there were ten steps to quality improvement.

These steps are:

1. Build awareness of the need and opportunity for improvement
2. Set goals for improvement
3. Organize to reach the goals
4. Provide training
5. Carry out projects to solve problems
6. Report progress
7. Give recognition
8. Communicate results
9. Keep score of improvements achieved
10. Maintain momentum by making annual improvement part of the regular systems and processes of the company

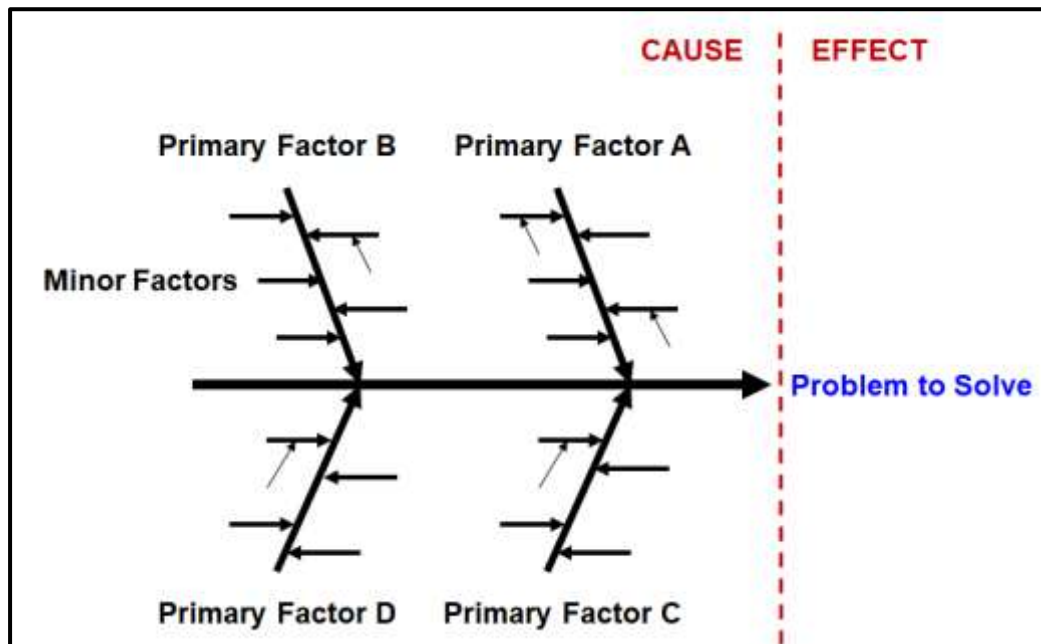
Famous Quotes related to Joseph Moses Juran

- "Quality does not happen by accident, it must be planned"
- "Without a standard there is no logical basis for making a decision or taking action"
- "Goal setting has traditionally been based on past performance. This practice has tended to perpetuate the sins of the past"
- "All improvement happens project by project and in no other way"

Ishikawa's theory

Kaoru Ishikawa known best for his "Quality Circles", the "Cause and Effect diagram" (also called "Fishbone diagram" or "Ishikawa diagram") and the "Company Wide Quality Control" (CWQC) movement.

"Quality Circles" are small teams of employees that form a group to define and solve a quality or performance related problem within a company.



Ishikawa (Cause and Effect or Fishbone) diagram

"Company Wide Quality Control" (CWQC) – under this designation, control means involvement and participation in quality of all, from top management to the lower ranking employees and all of them should study statistical methods. By all of them, we mean all the departments in the organization: engineering, manufacturing, sales, purchasing, administration, management and so on. Quality Control concepts and methods are used for solving problems in all organizations' departments.

The result of this activity is:

1. Product quality is improved and becomes uniform. Defects are reduced.
2. Reliability of goods is improved.
3. Cost is reduced.
4. Quantity of production is increased, and it becomes possible to make rational production schedules.
5. Wasteful work and rework are reduced.
6. Technique is established and improved.
7. Expenses for inspection and testing are reduced.
8. Contracts between vendor and vendee are rationalized.
9. The sales market is enlarged.
10. Better relationships are established between departments.
11. False data and reports are reduced.
12. Discussions are carried out more freely and democratically.

13. Meetings are operated more smoothly.
14. Repairs and installation of equipment and facilities are done more rationally.
15. Human relations are improved.

Famous quotes related to Kaoru Ishikawa

- “Think of at least four factors which influence your problem. See if a shift in one of these causes can give you a different effect to explore.”
- “Quality control starts and ends with training.”
- “Quality control is applicable to any kind of enterprise. In fact, Quality Control must be applied in every enterprise.”
- “The ideas of control and improvement are often confused with one another. This is because quality control and quality improvement are inseparable.”
- “In management, the first concern of the company is the happiness of people who are connected with it. If the people do not feel happy and cannot be made happy, that company does not deserve to exist.”
- “Quality control which cannot show results is not quality control. Let us engage in QC which makes so much money for the company that we do not know what to do with it.”

Feigenbaum's theory

Feigenbaum's contributions to the quality body of knowledge include:

- **Total Quality Control** (related to Feigenbaum) is an effective system for integrating the quality development, quality maintenance, and quality improvement efforts of the various groups in an organization so as to enable production and service at the most economical levels which allow full customer satisfaction.
- **The concept of a "hidden" plant** - the idea that so much extra work is performed in correcting mistakes that there is effectively a hidden plant within any factory.
- **Accountability for quality:** Because quality is everybody's job, it may become nobody's job - the idea that quality must be actively managed and have visibility at the highest levels of management.
- **The concept of quality costs** (or cost of quality is a means to quantify the total cost of quality - related efforts and deficiencies).

“Total quality control is an effective system for integrating the quality development, quality maintenance and quality improvement efforts of the various groups in an organization so as to enable production and service at the most economical levels which allow full customer satisfaction”

Armand V. Feigenbaum

Shewhart's theory

Father of **Statistical Quality Control (SQC)** methods. Shewhart identified two categories of variation which he called “assignable-cause” (“special-cause”) and “chance-cause” (“common-cause”) variation. He devised the control chart as a tool for distinguishing between the two. The various control charts that Shewhart proposed for variables and attributes include mean, range, np , p , c , and u charts. Shewhart reported that bringing a process into a state of statistical control where there is only chance-cause (common-cause) variation and keeping it in control was needed to reduce waste and improve quality.

Shewhart developed the Shewhart Cycle Learning and Improvement cycle, combining management thinking with statistical analysis. This cycle contains four continuous steps: Plan, Do, Study and Act. These steps (commonly referred to as the **PDSA Cycle**). Most people referred to Shewhart Cycle as the Deming Cycle (Deming in "The New Economics", second edition – p. 132, refers to the **PDCA Cycle** as "The Shewhart Cycle for Learning and Improvement").

This cycle is used to make changes that lead to improvement in a manner of continuous quality improvement - a never ending process.

Shewhart Cycle

The Shewhart cycle has the following four stages:

- **Plan** – decide on desirable changes and evaluate existing data, and consider if new information is required.
- **Do** – make changes decided upon, preferably in a small, experimental way.
- **Check** – evaluate the effects of the experiment.
- **Act** – implement the required changes.

PDCA (Plan–Do–Check–Act) is a four-step management method used in business for the control and continuous improvement of processes and products. It is also known as the **Deming cycle**. The **PDCA cycle** was in fact originally developed by Walter A. Shewhart, Bell Laboratories scientist who was Deming’s friend and mentor, and the developer of Statistical Process Control (SPC) in the late 1920s. So sometimes this is referred to as the “Shewhart Cycle”. It was renamed the Deming cycle by the Japanese in 1950.



Famous quotes related to Walter Andrew Shewhart

- "All chance systems of causes are not alike in the sense that they enable us to predict the future in terms of the past"
- "Constant systems of chance causes do exist in nature"
- "Assignable causes of variation may be found and eliminated"
- "In other words, the fact that the criterion we happen to use has a fine ancestry of highbrow statistical theorems does not justify its use. Such justification must come from empirical evidence that it works"
- "Original data should be presented in a way that will preserve the evidence in the original data for all the predictions assumed to be useful"
- "Both pure and applied science have gradually pushed further and further the requirements for accuracy and precision. However, applied science, particularly in the mass production of interchangeable parts, is even more exacting than pure science in certain matters of accuracy and precision"

Garvin's Theory

Among his many books and articles, David A. Garvin is a well-known Quality Guru of the Quality Assurance Community for his Eight Dimension of Quality published in his article "**Competing on the eight dimensions of quality**" (Harvard Business review - 1987).

Those eight dimensions include:

- 1. Performance:** Product's primary operating characteristics. This dimension of quality involves measurable attributes; brands can usually be ranked objectively on individual aspects of performance.
- 2. Features:** Additional characteristics that enhance the appeal of the product or service to the user.
- 3. Reliability:** Likelihood that a product will not fail within a specific time period. This is a key element for users who need the product to work without fail.
- 4. Conformance:** Precision with which the product or service meets the specified standards.
- 5. Durability:** Measure of the length of a product's life. When the product can be repaired, estimating durability is more complicated. The item will be used until it is no longer economical to operate it. This happens when the repair rate and the associated costs increase significantly.
- 6. Serviceability:** The speed with which the product can be put into service when it breaks down, as well as the competence and the behavior of the serviceperson.
- 7. Aesthetics:** Subjective dimension indicating the kind of response a user has to a product. It represents the individual's personal preference.
- 8. Perceived Quality:** The quality that is attributed to a good or service based on indirect measures.

In his article "Building a Learning Organization" (July 1993 issue) David Garvin writes:

Systematic problem solving

This first activity rests heavily on the philosophy and methods of the quality movement. Its underlying ideas, now widely accepted, include:

- Relying on the scientific method, rather than guesswork, for diagnosing problems (what Deming calls the "Plan, Do, Check, Act" cycle, and others refer to as "hypothesis-generating, hypothesis-testing" techniques).
- Insisting on data, rather than assumptions, as background for decision making (what quality practitioners call "fact-based management").
- Using simple statistical tools (histograms, Pareto charts and cause-and-effect diagrams) to organize data and draw inferences.

And some important quotes from the same article

- "Successful programs require an incentive system that favors risk taking"
- "Customers can provide competitive comparisons and immediate feedback about service. And companies need these insights at all levels, from the executive suite to the shop floor"
- "Learning organizations cultivate the art of open, attentive listening. Managers must be open to criticism"

Quality Management Standards

Glossary

ISO - International Organization for Standardization. ISO is an independent, non-governmental international organization with a membership of 164 national standards bodies (including ANSI with about 585 participants). Through its members, it brings together experts to share knowledge and develop voluntary, consensus-based, market relevant International Standards that support innovation and provide solutions to global challenges.

(From: <https://www.iso.org/about-us.html>).

Standard - An established norm or requirement in regard to technical or administrative systems. It is usually a formal document that establishes uniform engineering or technical criteria, methods, processes, and practices. A technical standard may be developed privately or unilaterally, for example by a corporation, regulatory body, military, etc. Standards can also be developed by groups such as trade unions and trade associations. (From Wikipedia, the free encyclopedia).

IATF - International Automotive Task Force - The IATF is an “ad hoc” (for a specific purpose) group of automotive manufacturers and their respective trade associations, formed to provide improved quality products to automotive customers worldwide.

TL – Telecom Leadership. When the TL 9000 started developing, TS for Telecom Systems been used. Later it was changed by QuEST Forum to TL for the TL 9000. [QuEST Forum is a global association of companies dedicated to impacting the quality and sustainability of products and services in the ICT industry. (ICT - Information and Communications Technology) industry)].

AS – Aerospace Standard

Quality Managements Standards followed the Quality Theories of the Quality Gurus. They differed from the Gurus theories by setting rules for Quality Management by International organization (ISO) for organizations. These rules are not mandatory but being adopted voluntary by organizations willing to improve their performance and profit in the market. Later on, organization that adopt the Quality Standard, demanded their suppliers to adopt the quality standard to.

Today, most organizations' managing activities are based on the international "Quality Managing Systems". This "Quality Managing Systems" (QMS) is covered by ISO standards.

The purpose of these standards is to standardize the managing activities with a focus on quality products and services, satisfying customers and continually to improve the quality of all organization's activities.

The leading ISO Quality Standard is the **ISO 9001 “Quality management systems - Requirements”** and its last version was published in **2015** (first edition published in 1987). It can be used by any size organization in any field of activity. This standard is based on a number of Quality Management principles including focus on customer, commitment of top management, process approach, continual improvement and other important principles. The

outcome of adopting the **ISO 9001** standard should help to ensure customer satisfaction, good quality products and services, improvements and profit to the organization.

Additional standards that are connected to the leading ISO 9001 standard are:

ISO 9000:2015 - Quality management systems - Fundamentals and vocabulary

ISO 9004:2018 - Quality management systems - Guidelines for performance improvements

ISO 14001:2015 - Environmental management systems - Requirements with guidance for use

ISO 45001:2018 - Occupational health and safety management systems - requirements

ISO 19011:2018 - Guidelines for quality and/or environmental management systems auditing

Additional standards based on the ISO 9001 standards with additional requirements and directed to specific industries are:

ISO 13485 (2016) – Medical devices - Quality Management Systems - Requirements for regulatory purposes

IATF 16949:2016 - Quality Management System requirements for automotive production and relevant service parts organizations

TL 9000 (2016) - Quality Management System Requirements for Suppliers of Telecommunication

AS 9100D (2016) - **Quality Management Systems - Requirements for Aviation, Space, and Defense Organizations**

Important note: The mentioned above quality standards are updated from time to time so be aware of the updates and changes.

- Any ISO standard can be bought at ISO Store on Webstore: <https://www.iso.org/store.html>
- IATF 16949:2016 standard can be bought at AIAG Store on Website: <https://www.aiag.org/store/publications/details?ProductCode=IATF-1>
- TL 9000 (2016) standard can be bought at TIA QuEST Forum store on Website: https://www.tl9000.org/handbooks/buy_handbooks.html
- AS 9100D (2016) standard can be bought at SAE International (previously known as the Society of Automotive Engineers) at Webstore: <https://www.sae.org/standards>