

# Glossary of Quality Terms

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## A

**Academic Quality Improvement Project (AQIP):** A forum for higher education institutions to review one another's action projects.

**Acceptance quality limit (AQL):** In a continuing series of lots, a quality level that, for the purpose of sampling inspection, is the limit of a satisfactory process average.

**Acceptance number:** The maximum number of defects or defectives allowable in a sampling lot for the lot to be acceptable.

**Acceptance sampling:** Inspection of a sample from a lot to decide whether to accept that lot. There are two types: attributes sampling and variables sampling. In attributes sampling, the presence or absence of a characteristic is noted in each of the units inspected. In variables sampling, the numerical magnitude of a characteristic is measured and recorded for each inspected unit; this involves reference to a continuous scale of some kind.

**Acceptance sampling plan:** A specific plan that indicates the sampling sizes and associated acceptance or nonacceptance criteria to be used. In attributes sampling, for example, there are single, double, multiple, sequential, chain and skip-lot sampling plans. In variables sampling, there are single, double and sequential sampling plans. For detailed descriptions of these plans, see the standard ANSI/ISO/ASQ A3534-2-1993: Statistics—Vocabulary and Symbols—Statistical Quality Control.

**Accreditation:** Certification by a recognized body of the facilities, capability, objectivity, competence and integrity of an agency, service or operational group or individual to provide the specific service or operation needed. The term has multiple meanings depending on the sector. Laboratory accreditation assesses the capability of a laboratory to conduct testing, generally using standard test methods. Accreditation for healthcare organizations involves an authoritative body surveying and verifying compliance with recognized criteria, similar to certification in other sectors.

**Accreditation body:** An organization with authority to accredit other organizations to perform services such as quality system certification.

**Accuracy:** The characteristic of a measure.

**ACLASS Accreditation Services:** An ANSI-ASQ National Accreditation Board company that provides accreditation services for: testing and calibration laboratories in accordance with ISO/IEC 17025; reference material producers in accordance with ISO Guide 34; and inspection bodies in accordance with ISO/IEC 17020.

**Activity based costing:** An accounting system that assigns costs to a product based on the amount of resources used to design, order or make it.

**Activity network diagram:** An arrow diagram used in planning.

**Advanced Product Quality Planning (APQP):** High level automotive process for product realization, from design through production part approval.

**Adverse event:** Healthcare term for any event that is not consistent with the desired, normal or usual operation of the organization; also known as a sentinel event.

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**Affinity diagram:** A management tool for organizing information (usually gathered during a brainstorming activity).

**Alignment:** Actions to ensure that a process or activity supports the organization's strategy, goals and objectives.

**American Association for Laboratory Accreditation (A2LA):** An organization that formally recognizes another organization's competency to perform specific tests, types of tests or calibrations.

**American Customer Satisfaction Index (ACSI):** Released for the first time in October 1994, an economic indicator and cross industry measure of the satisfaction of U.S. household customers with the quality of the goods and services available to them. This includes goods and services produced in the United States and imports from foreign firms that have substantial market shares or dollar sales. ASQ is a founding sponsor of the ACSI, along with the University of Michigan Business School and the CFI Group.

**American National Standards Institute (ANSI):** A private, nonprofit organization that administers and coordinates the U.S. voluntary standardization and conformity assessment system. It is the U.S. member body in the International Organization for Standardization, known as ISO.

**American National Standards Institute-American Society for Quality (ANSI-ASQ):** Organization that accredits certification bodies for ISO 9001 quality management systems, ISO 14001 environmental management systems and other industry specific requirements.

**American Society for Nondestructive Testing (ASNT):** A technical society for nondestructive testing (NDT) professionals.

**American Society for Quality (ASQ):** A professional, not-for-profit association that develops, promotes and applies quality related information and technology for the private sector, government and academia. ASQ serves more than 108,000 individuals and 1,100 corporate members in the United States and 108 other countries.

**American Society for Quality Control (ASQC):** Name of ASQ from 1946 through the middle of 1997, when the name was changed to ASQ.

**American Society for Testing and Materials (ASTM):** Not-for-profit organization that provides a forum for the development and publication of voluntary consensus standards for materials, products, systems and services.

**American Society for Testing and Materials (ASTM) International:** Not-for-profit organization that provides a forum for the development and publication of voluntary consensus standards for materials, products, systems and services.

**American Society for Training and Development (ASTD):** A membership organization providing materials, education and support related to workplace learning and performance.

**American standard code for information interchange (ASCII):** Basic computer characters accepted by all American machines and many foreign ones.

**Analysis of means (ANOM):** A statistical procedure for troubleshooting industrial processes and analyzing the results of experimental designs with factors at fixed levels. It provides a graphical display of data. Ellis R. Ott developed the procedure in 1967 because he observed that nonstatisticians had difficulty understanding analysis of variance. Analysis of means is easier for quality practitioners to use because it is an extension of

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the control chart. In 1973, Edward G. Schilling further extended the concept, enabling analysis of means to be used with non-normal distributions and attributes data in which the normal approximation to the binomial distribution does not apply. This is referred to as analysis of means for treatment effects.

**Analysis of variance (ANOVA):** A basic statistical technique for determining the proportion of influence a factor or set of factors has on total variation. It subdivides the total variation of a data set into meaningful component parts associated with specific sources of variation to test a hypothesis on the parameters of the model or to estimate variance components. There are three models: fixed, random and mixed.

**NEW! Andon board:** A production area visual control device, such as a lighted overhead display. It communicates the status of the production system and alerts team members to emerging problems (from andon, a Japanese word meaning "light").

**NEW! ANSI ACS X12:** Transaction standards for electronic communication and shipping notification.

**Appraisal cost:** The cost of ensuring an organization is continually striving to conform to customers' quality requirements.

**Arrow diagram:** A planning tool to diagram a sequence of events or activities (nodes) and their interconnectivity. It is used for scheduling and especially for determining the critical path through nodes.

**AS9100:** An international quality management standard for the aerospace industry published by the Society of Automotive Engineers and other organizations worldwide. It is known as EN9100 in Europe and JIS Q 9100 in Japan. The standard is controlled by the International Aerospace Quality Group (see listing).

**Asia Pacific Laboratory Accreditation Cooperation (APLAC):** A cooperative of laboratory accreditation bodies.

**Assessment:** A systematic evaluation process of collecting and analyzing data to determine the current, historical or projected compliance of an organization to a standard.

**Assignable cause:** A name for the source of variation in a process that is not due to chance and therefore can be identified and eliminated. Also called "special cause."

**Assn. for Quality and Participation (AQP):** Was an independent organization until 2004, when it became an affiliate organization of ASQ. Continues today as ASQ's Team and Workplace Excellence Forum.

**Attribute data:** Go/no-go information. The control charts based on attribute data include percent chart, number of affected units chart, count chart, count per unit chart, quality score chart and demerit chart.

**Attributes, method of:** Method of measuring quality that consists of noting the presence (or absence) of some characteristic (attribute) in each of the units under consideration and counting how many units do (or do not) possess it. Example: go/no-go gauging of a dimension.

**Audit:** The on-site verification activity, such as inspection or examination, of a process or quality system, to ensure compliance to requirements. An audit can apply to an entire organization or might be specific to a function, process or production step.

**Automotive Industry Action Group (AIAG):** A global automotive trade association with about 1,600 member companies that focuses on common business processes, implementation guidelines, education and training.

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**Autonomation:** A form of automation in which machinery automatically inspects each item after producing it and ceases production and notifies humans if a defect is detected. Toyota expanded the meaning of jidohka to include the responsibility of all workers to function similarly—to check every item produced and, if a defect is detected, make no more until the cause of the defect has been identified and corrected. Also see “jidohka.”

**Availability:** The ability of a product to be in a state to perform its designated function under stated conditions at a given time.

**Average chart:** A control chart in which the subgroup average, X-bar, is used to evaluate the stability of the process level.

**Average outgoing quality (AOQ):** The expected average quality level of an outgoing product for a given value of incoming product quality.

**Average outgoing quality limit (AOQL):** The maximum average outgoing quality over all possible levels of incoming quality for a given acceptance sampling plan and disposal specification.

**Average run lengths (ARL):** On a control chart, the number of subgroups expected to be inspected before a shift in magnitude takes place.

**Average sample number (ASN):** The average number of sample units inspected per lot when reaching decisions to accept or reject.

**Average total inspection (ATI):** The average number of units inspected per lot, including all units in rejected lots (applicable when the procedure calls for 100% inspection of rejected lots).

## B

**Baka-yoke:** A Japanese term for a manufacturing technique for preventing mistakes by designing the manufacturing process, equipment and tools so an operation literally cannot be performed incorrectly. In addition to preventing incorrect operation, the technique usually provides a warning signal of some sort for incorrect performance. Also see “poka-yoke.”

**Balanced plant:** A plant in which the capacity of all resources is balanced exactly with market demand.

**Balanced scorecard:** A management system that provides feedback on both internal business processes and external outcomes to continuously improve strategic performance and results.

**Balancing the line:** The process of evenly distributing both the quantity and variety of work across available work time, avoiding overburden and underuse of resources. This eliminates bottlenecks and downtime, which translates into shorter flow time.

**Baldrige award:** See “Malcolm Baldrige National Quality Award.”

**Baseline measurement:** The beginning point, based on an evaluation of output over a period of time, used to determine the process parameters prior to any improvement effort; the basis against which change is measured.

**Batch and queue:** Producing more than one piece and then moving the pieces to the next operation before they are needed.

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**Bayes' theorem:** A formula to calculate conditional probabilities by relating the conditional and marginal probability distributions of random variables.

**Benchmarking:** A technique in which a company measures its performance against that of best in class companies, determines how those companies achieved their performance levels and uses the information to improve its own performance. Subjects that can be benchmarked include strategies, operations and processes.

**Benefit-cost analysis:** An examination of the relationship between the monetary cost of implementing an improvement and the monetary value of the benefits achieved by the improvement, both within the same time period.

**Best practice:** A superior method or innovative practice that contributes to the improved performance of an organization, usually recognized as best by other peer organizations.

**Big Q, little q:** A term used to contrast the difference between managing for quality in all business processes and products (big Q) and managing for quality in a limited capacity—traditionally only in factory products and processes (little q).

**Black Belt (BB):** Full-time team leader responsible for implementing process improvement projects—define, measure, analyze, improve and control (DMAIC) or define, measure, analyze, design and verify (DMADV)—within a business to drive up customer satisfaction and productivity levels.

**Blemish:** An imperfection severe enough to be noticed but that should not cause any real impairment with respect to intended normal or reasonably foreseeable use. Also see “defect,” “imperfection” and “nonconformity.”

**Block diagram:** A diagram that shows the operation, interrelationships and interdependencies of components in a system. Boxes, or blocks (hence the name), represent the components; connecting lines between the blocks represent interfaces. There are two types of block diagrams: a functional block diagram, which shows a system's subsystems and lower level products and their interrelationships and which interfaces with other systems; and a reliability block diagram, which is similar to the functional block diagram but is modified to emphasize those aspects influencing reliability.

**Board of Standards Review (BSR):** An American National Standards Institute board responsible for the approval and withdrawal of American National Standards.

**Body of knowledge (BOK):** The prescribed aggregation of knowledge in a particular area an individual is expected to have mastered to be considered or certified as a practitioner.

**Bottleneck:** Any resource whose capacity is equal to or less than the demand placed on it.

**Bottom line:** The essential or salient point; the primary or most important consideration. Also, the line at the bottom of a financial report that shows the net profit or loss.

**Brainstorming:** A technique teams use to generate ideas on a particular subject. Each person on the team is asked to think creatively and write down as many ideas as possible. The ideas are not discussed or reviewed until after the brainstorming session.

**Breakthrough improvement:** A dynamic, decisive movement to a new, higher level of performance.

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**BS 7799:** A standard written by British commerce, government and industry stakeholders to address information security management issues, including fraud, industrial espionage and physical disaster. Might become an International Organization for Standardization standard.

**Business process reengineering (BPR):** The concentration on improving business processes to deliver outputs that will achieve results meeting the firm's objectives, priorities and mission.

## C

**C chart:** See "count chart."

**Calibration:** The comparison of a measurement instrument or system of unverified accuracy to a measurement instrument or system of known accuracy to detect any variation from the required performance specification.

**Capability:** The total range of inherent variation in a stable process determined by using data from control charts.

**Capability maturity model (CMM):** A framework that describes the key elements of an effective software process. It's an evolutionary improvement path from an immature process to a mature, disciplined process. The CMM covers practices for planning, engineering and managing software development and maintenance to improve the ability of organizations to meet goals for cost, schedule, functionality and product quality.

**Capacity constraint resources:** A series of nonbottlenecks (based on the sequence in which jobs are performed) that can act as a constraint.

**Cascading:** The continuing flow of the quality message down to, not through, the next level of supervision until it reaches all workers. Also see "deployment."

**CASCO:** An International Organization for Standardization policy development committee for conformity assessment.

**Cause:** An identified reason for the presence of a defect or problem.

**Cause and effect diagram:** A tool for analyzing process dispersion. It is also referred to as the "Ishikawa diagram," because Kaoru Ishikawa developed it, and the "fishbone diagram," because the complete diagram resembles a fish skeleton. The diagram illustrates the main causes and subcauses leading to an effect (symptom). The cause and effect diagram is one of the "seven tools of quality" (see listing).

**Cell:** An arrangement of people, machines, materials and equipment in which the processing steps are placed next to each other in sequential order and through which parts are processed in a continuous flow. The most common cell layout is a U shape.

**Cellular manufacturing:** Arranging machines in the correct process sequence, with operators remaining within the cell and materials presented to them from outside.

**Centerline:** A line on a graph that represents the overall average (mean) operating level of the process.

**Central tendency:** The tendency of data gathered from a process to cluster toward a middle value somewhere between the high and low values of measurement.

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**Certification:** The result of a person meeting the established criteria set by a certificate granting organization.

**Certified biomedical auditor (CBA):** An ASQ certification.

**Certified calibration technician (CCT):** An ASQ certification.

**Certified HACCP auditor (CHA):** An ASQ certification.

**Certified manager of quality/organizational excellence (CMQ/OE):** An ASQ certification; formerly certified quality manager (CQM).

**Certified quality auditor (CQA):** An ASQ certification.

**Certified quality engineer (CQE):** An ASQ certification.

**Certified quality improvement associate (CQIA):** An ASQ certification.

**Certified quality inspector (CQI):** An ASQ certification; formerly certified mechanical inspector (CMI).

**Certified quality process analyst (CQPA):** An ASQ certification.

**Certified quality technician (CQT):** An ASQ certification.

**Certified reliability engineer (CRE):** An ASQ certification.

**Certified Six Sigma Black Belt (CSSBB):** An ASQ certification.

**Certified Six Sigma Green Belt (CSSGB):** An ASQ certification.

**Certified software quality engineer (CSQE):** An ASQ certification.

**Chain reaction:** A chain of events described by W. Edwards Deming: improve quality, decrease costs, improve productivity, increase market with better quality and lower price, stay in business, provide jobs and provide more jobs.

**Chain sampling plan:** In acceptance sampling, a plan in which the criteria for acceptance and rejection apply to the cumulative sampling results for the current lot and one or more immediately preceding lots.

**Champion:** A business leader or senior manager who ensures resources are available for training and projects, and who is involved in periodic project reviews; also an executive who supports and addresses Six Sigma organizational issues.

**Change agent:** An individual from within or outside an organization who facilitates change in the organization; might be the initiator of the change effort, but not necessarily.

**Changeover:** A process in which a production device is assigned to perform a different operation or a machine is set up to make a different part—for example, a new plastic resin and new mold in an injection molding machine.

**Changeover time:** The time required to modify a system or workstation, usually including both teardown time for the existing condition and setup time for the new condition.

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**Characteristic:** The factors, elements or measures that define and differentiate a process, function, product, service or other entity.

**Chart:** A tool for organizing, summarizing and depicting data in graphic form.

**Charter:** A written commitment approved by management stating the scope of authority for an improvement project or team.

**Checklist:** A tool for ensuring all important steps or actions in an operation have been taken. Checklists contain items important or relevant to an issue or situation. Checklists are often confused with check sheets (see listing).

**Check sheet:** A simple data recording device. The check sheet is custom designed by the user, which allows him or her to readily interpret the results. The check sheet is one of the “seven tools of quality” (see listing). Check sheets are often confused with checklists (see listing).

**Classification of defects:** The listing of possible defects of a unit, classified according to their seriousness. Note: Commonly used classifications: class A, class B, class C, class D; or critical, major, minor and incidental; or critical, major and minor. Definitions of these classifications require careful preparation and tailoring to the product(s) being sampled to ensure accurate assignment of a defect to the proper classification. A separate acceptance sampling plan is generally applied to each class of defects.

**Closed-loop corrective action (CLCA):** A sophisticated engineering system to document, verify and diagnose failures, recommend and initiate corrective action, provide follow-up and maintain comprehensive statistical records.

**Code of conduct:** Expectations of behavior mutually agreed on by a team.

**Common causes:** Causes of variation that are inherent in a process over time. They affect every outcome of the process and everyone working in the process. Also see “special causes.”

**Company culture:** A system of values, beliefs and behaviors inherent in a company. To optimize business performance, top management must define and create the necessary culture.

**Complaint tracking:** Collecting data, disseminating them to appropriate persons for resolution, monitoring complaint resolution progress and communicating results.

**Compliance:** The state of an organization that meets prescribed specifications, contract terms, regulations or standards.

**Computer aided design (CAD):** A type of software used by architects, engineers, drafters and artists to create precision drawings or technical illustrations. CAD software can be used to create 2-D drawings or 3-D models.

**Computer aided engineering (CAE):** A broad term used by the electronic design automation industry for the use of computers to design, analyze and manufacture products and processes. CAE includes CAD (see listing) and computer aided manufacturing (CAM), which is the use of computers for managing manufacturing processes.



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**Concurrent engineering (CE):** A way to reduce cost, improve quality and shrink cycle time by simplifying a product's system of life cycle tasks during the early concept stages.

**Conflict resolution:** The management of a conflict situation to arrive at a resolution satisfactory to all parties.

**Conformance:** An affirmative indication or judgment that a product or service has met the requirements of a relevant specification, contract or regulation.

**Conformité Européenne Mark (CE Mark):** European Union (EU) conformity mark for regulating the goods sold within its borders. The mark represents a manufacturer's declaration that products comply with EU New Approach Directives. These directives apply to any country that sells products within the EU.

**Conformity assessment:** All activities concerned with determining that relevant requirements in standards or regulations are fulfilled, including sampling, testing, inspection, certification, management system assessment and registration, accreditation of the competence of those activities and recognition of an accreditation program's capability.

**Consensus:** A state in which all the members of a group support an action or decision, even if some of them don't fully agree with it.

**Constraint:** Anything that limits a system from achieving higher performance or throughput; also, the bottleneck that most severely limits the organization's ability to achieve higher performance relative to its purpose or goal.

**Constraints management:** See "theory of constraints."

**Consultant:** An individual who has experience and expertise in applying tools and techniques to resolve process problems and who can advise and facilitate an organization's improvement efforts.

**Consumer:** The external customer to whom a product or service is ultimately delivered; also called end user.

**Consumer's risk:** Pertains to sampling and the potential risk that bad products will be accepted and shipped to the consumer.

**Continuous flow production:** A method in which items are produced and moved from one processing step to the next, one piece at a time. Each process makes only the one piece that the next process needs, and the transfer batch size is one. Also referred to as one-piece flow and single-piece flow.

**Continuous improvement (CI):** Sometimes called continual improvement. The ongoing improvement of products, services or processes through incremental and breakthrough improvements.

**Continuous quality improvement (CQI):** A philosophy and attitude for analyzing capabilities and processes and improving them repeatedly to achieve customer satisfaction.

**Continuous sampling plan:** In acceptance sampling, a plan, intended for application to a continuous flow of individual units of product, that involves acceptance and rejection on a unit-by-unit basis and employs alternate periods of 100% inspection and sampling. The relative amount of 100% inspection depends on the quality of submitted product. Continuous sampling plans usually require that each period of 100% inspection be continued until a specified number,  $i$ , of consecutively inspected units are found clear of defects. Note: For single level continuous sampling plans, a single  $d$  sampling rate (for example, inspect one unit in five or one

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unit in 10) is used during sampling. For multilevel continuous sampling plans, two or more sampling rates can be used. The rate at any time depends on the quality of submitted product.

**Control chart:** A chart with upper and lower control limits on which values of some statistical measure for a series of samples or subgroups are plotted. The chart frequently shows a central line to help detect a trend of plotted values toward either control limit.

**Control limits:** The natural boundaries of a process within specified confidence levels, expressed as the upper control limit (UCL) and the lower control limit (LCL).

**Control plan (CP):** Written descriptions of the systems for controlling part and process quality by addressing the key characteristics and engineering requirements.

**Coordinate measuring machine (CMM):** A device that dimensionally measures 3-D products, tools and components with an accuracy approaching 0.0001 inches.

**Corrective action:** A solution meant to reduce or eliminate an identified problem.

**Corrective action recommendation (CAR):** The full cycle corrective action tool that offers ease and simplicity for employee involvement in the corrective action/process improvement cycle.

**Correlation (statistical):** A measure of the relationship between two data sets of variables.

**Cost of poor quality (COPQ):** The costs associated with providing poor quality products or services. There are four categories: internal failure costs (costs associated with defects found before the customer receives the product or service), external failure costs (costs associated with defects found after the customer receives the product or service), appraisal costs (costs incurred to determine the degree of conformance to quality requirements) and prevention costs (costs incurred to keep failure and appraisal costs to a minimum).

**Cost of quality (COQ):** Another term for COPQ. It is considered by some to be synonymous with COPQ but is considered by others to be unique. While the two concepts emphasize the same ideas, some disagree as to which concept came first and which categories are included in each.

**Count chart:** A control chart for evaluating the stability of a process in terms of the count of events of a given classification occurring in a sample; known as a "c-chart."

**Count per unit chart:** A control chart for evaluating the stability of a process in terms of the average count of events of a given classification per unit occurring in a sample.

**Cp:** The ratio of tolerance to 6 sigma, or the upper specification limit (USL) minus the lower specification limit (LSL) divided by 6 sigma. It is sometimes referred to as the engineering tolerance divided by the natural tolerance and is only a measure of dispersion.

**Cpk index:** Equals the lesser of the USL minus the mean divided by 3 sigma (or the mean) minus the LSL divided by 3 sigma. The greater the Cpk value, the better.

**Critical processes:** Processes that present serious potential dangers to human life, health and the environment or that risk the loss of significant sums of money or customers.

**Cross functional:** A term used to describe a process or an activity that crosses the boundary between functions. A cross functional team consists of individuals from more than one organizational unit or function.

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**Cross pilot:** See “scatter diagram.”

**Cultural resistance:** A form of resistance based on opposition to the possible social and organizational consequences associated with change.

**Culture change:** A major shift in the attitudes, norms, sentiments, beliefs, values, operating principles and behavior of an organization.

**Culture, organizational:** A common set of values, beliefs, attitudes, perceptions and accepted behaviors shared by individuals within an organization.

**Cumulative sum control chart (CUSUM):** A control chart on which the plotted value is the cumulative sum of deviations of successive samples from a target value. The ordinate of each plotted point represents the algebraic sum of the previous ordinate and the most recent deviations from the target.

**Current good manufacturing practices (CGMP):** Regulations enforced by the U.S. Food and Drug Administration for food and chemical manufacturers and packagers.

**Customer:** See “external customer” and “internal customer.”

**Customer delight:** The result of delivering a product or service that exceeds customer expectations.

**Customer relationship management (CRM):** A strategy for learning more about customers’ needs and behaviors to develop stronger relationships with them. It brings together information about customers, sales, marketing effectiveness, responsiveness and market trends. It helps businesses use technology and human resources to gain insight into the behavior of customers and the value of those customers.

**Customer satisfaction:** The result of delivering a product or service that meets customer requirements.

**Customer-supplier model (CSM):** A model depicting inputs flowing into a work process that, in turn, add value and produce outputs delivered to a customer. Also called customer-supplier methodology.

**Customer-supplier partnership:** A long-term relationship between a buyer and supplier characterized by teamwork and mutual confidence. The supplier is considered an extension of the buyer’s organization. The partnership is based on several commitments. The buyer provides long-term contracts and uses fewer suppliers. The supplier implements quality assurance processes so incoming inspection can be minimized. The supplier also helps the buyer reduce costs and improve product and process designs.

**Cycle:** A sequence of operations repeated regularly.

**Cycle time:** The time required to complete one cycle of an operation. If cycle time for every operation in a complete process can be reduced to equal takt time, products can be made in single-piece flow. Also see “takt time.”

## D

**Data:** A set of collected facts. There are two basic kinds of numerical data: measured or variable data, such as “16 ounces,” “4 miles” and “0.75 inches;” and counted or attribute data, such as “162 defects.”

**D chart:** See “demerit chart.”

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**Decision matrix:** A matrix teams use to evaluate problems or possible solutions. For example, a team might draw a matrix to evaluate possible solutions, listing them in the far left vertical column. Next, the team selects criteria to rate the possible solutions, writing them across the top row. Then, each possible solution is rated on a scale of 1 to 5 for each criterion, and the rating is recorded in the corresponding grid. Finally, the ratings of all the criteria for each possible solution are added to determine its total score. The total score is then used to help decide which solution deserves the most attention.

**Defect:** A product's or service's nonfulfillment of an intended requirement or reasonable expectation for use, including safety considerations. There are four classes of defects: class 1, very serious, leads directly to severe injury or catastrophic economic loss; class 2, serious, leads directly to significant injury or significant economic loss; class 3, major, is related to major problems with respect to intended normal or reasonably foreseeable use; and class 4, minor, is related to minor problems with respect to intended normal or reasonably foreseeable use. Also see "blemish," "imperfection" and "nonconformity."

**Defective:** A defective unit; a unit of product that contains one or more defects with respect to the quality characteristic(s) under consideration.

**Delighter:** A feature of a product or service that a customer does not expect to receive but that gives pleasure to the customer when received. Also called an "exciter."

**Demerit chart:** A control chart for evaluating a process in terms of a demerit (or quality score); in other words, a weighted sum of counts of various classified nonconformities.

**Deming cycle:** Another term for the plan-do-study-act cycle. Walter Shewhart created it (calling it the plan-do-check-act cycle), but W. Edwards Deming popularized it, calling it plan-do-studyact. Also see "plan-do-check-act cycle."

**Deming Prize:** Award given annually to organizations that, according to the award guidelines, have successfully applied companywide quality control based on statistical quality control and will continue to do so. Although the award is named in honor of W. Edwards Deming, its criteria are not specifically related to Deming's teachings. There are three separate divisions for the award: the Deming Application Prize, the Deming Prize for Individuals and the Deming Prize for Overseas Companies. The award process is overseen by the Deming Prize Committee of the Union of Japanese Scientists and Engineers in Tokyo.

**Dependability:** The degree to which a product is operable and capable of performing its required function at any randomly chosen time during its specified operating time, provided that the product is available at the start of that period. (Nonoperation related influences are not included.) Dependability can be expressed by the ratio: time available divided by (time available + time required).

**Dependent events:** Events that occur only after a previous event.

**Deployment:** Dispersion, dissemination, broadcasting or spreading communication throughout an organization, downward and laterally. Also see "cascading."

**Design of experiments (DoE):** A branch of applied statistics dealing with planning, conducting, analyzing and interpreting controlled tests to evaluate the factors that control the value of a parameter or group of parameters. Design for Six Sigma (DFSS): See "DMADV."

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**Design record:** Engineering requirements, typically contained in various formats; examples include engineering drawings, math data and referenced specifications. Designing in quality versus inspecting in quality: See “prevention versus detection.”

**Deviation:** In numerical data sets, the difference or distance of an individual observation or data value from the center point (often the mean) of the set distribution.

**Diagnosis:** The activity of discovering the cause(s) of quality deficiencies; the process of investigating symptoms, collecting and analyzing data, and conducting experiments to test theories to determine the root cause(s) of deficiencies.

**Diagnostic journey and remedial journey:** A two-phase investigation used by teams to solve chronic quality problems. In the first phase, the diagnostic journey, the team journeys from the symptom of a chronic problem to its cause. In the second phase, the remedial journey, the team journeys from the cause to its remedy

**Dissatisfiers:** The features or functions a customer expects that either are not present or are present but not adequate; also pertains to employees’ expectations. Distribution (statistical): The amount of potential variation in the outputs of a process, typically expressed by its shape, average or standard deviation.

**DMADV:** A data driven quality strategy for designing products and processes, it is an integral part of a Six Sigma quality initiative. It consists of five interconnected phases: define, measure, analyze, design and verify.

**DMAIC:** A data driven quality strategy for improving processes and an integral part of a Six Sigma quality initiative. DMAIC is an acronym for define, measure, analyze, improve and control.

**Dodge-Romig sampling plans:** Plans for acceptance sampling developed by Harold F. Dodge and Harry G. Romig. Four sets of tables were published in 1940: single sampling lot tolerance tables, double sampling lot tolerance tables, single sampling average outgoing quality limit tables and double sampling average outgoing quality limit tables.

**Downtime:** Lost production time during which a piece of equipment is not operating correctly due to breakdown, maintenance, power failures or similar events.

**Driving forces:** Forces that tend to change a situation in desirable ways.

## E

**Effect:** The result of an action being taken; the expected or predicted impact when an action is to be taken or is proposed.

**Effectiveness:** The state of having produced a decided on or desired effect.

**Efficiency:** The ratio of the output to the total input in a process.

**Efficient:** A term describing a process that operates effectively while consuming minimal resources (such as labor and time).

**Eight wastes:** Taiichi Ohno originally enumerated seven wastes (muda) and later added underutilized people as the eighth waste commonly found in physical production. The eight are: 1. overproduction ahead of demand; 2. waiting for the next process, worker, material or equipment; 3. unnecessary transport of materials (for example, between functional areas of facilities, or to or from a stockroom or warehouse); 4. over-

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processing of parts due to poor tool and product design; 5. inventories more than the absolute minimum; 6. unnecessary movement by employees during the course of their work (such as to look for parts, tools, prints or help); 7. production of defective parts; 8. under-utilization of employees' brainpower, skills, experience and talents.

**Eighty-twenty (80-20):** A term referring to the Pareto principle, which was first defined by J. M. Juran in 1950. The principle suggests most effects come from relatively few causes; that is, 80% of the effects come from 20% of the possible causes. Also see "Pareto chart."

**Electric data interchange (EDI):** The electronic exchange of data from customers to suppliers and from suppliers to customers.

**Employee involvement (EI):** An organizational practice whereby employees regularly participate in making decisions on how their work areas operate, including suggestions for improvement, planning, goal setting and monitoring performance

**Empowerment:** A condition in which employees have the authority to make decisions and take action in their work areas without prior approval. For example, an operator can stop a production process if he or she detects a problem, or a customer service representative can send out a replacement product if a customer calls with a problem.

**EN 46000:** Medical device quality management systems standard. EN 46000 is technically equivalent to ISO 13485:1996, an international medical device standard. The two are similar enough that if an organization is prepared to comply with one, it could easily comply with the other.

**EN 9100:** An international quality management standard for the aerospace industry (see AS9100).

**End user:** See "consumer."

**Equipment availability:** The percentage of time during which a process (or equipment) is available to run. This can sometimes be called uptime. To calculate operational availability, divide the machine's operating time during the process by the net available time.

**Error detection:** A hybrid form of error proofing. It means a bad part can be made but will be caught immediately, and corrective action will be taken to prevent another bad part from being produced. A device is used to detect and stop the process when a bad part is made. This is used when error proofing is too expensive or not easily implemented.

**Error proofing:** Use of process or design features to prevent the acceptance or further processing of nonconforming products. Also known as "mistake proofing."

**Ethics:** The practice of applying a code of conduct based on moral principles to day-to-day actions to balance what is fair to individuals or organizations with what is right for society.

**European Cooperation for Accreditation (EA):** A cooperative organization of accreditation bodies.

**Exciter:** See "delighter."

**Expectations:** Customer perceptions about how an organization's products and services will meet their specific needs and requirements.

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**Experimental design:** A formal plan that details the specifics for conducting an experiment, such as which responses, factors, levels, blocks, treatments and tools are to be used.

**External customer:** A person or organization that receives a product, service or information but is not part of the organization supplying it. Also see “internal customer.”

**External failure:** Nonconformance identified by the external customers.

**External setup:** Die setup procedures that can be performed safely while the machine is in motion. Also known as outer exchange of die. Also see “internal setup.”

## F

**Facilitator:** A specifically trained person who functions as a teacher, coach and moderator for a group, team or organization.

**Failure:** The inability of an item, product or service to perform required functions on demand due to one or more defects.

**Failure cost:** The cost resulting from the occurrence of defects. One element of cost of quality or cost of poor quality.

**Failure mode analysis (FMA):** A procedure to determine which malfunction symptoms appear immediately before or after a failure of a critical parameter in a system. After all possible causes are listed for each symptom, the product is designed to eliminate the problems.

**Failure mode effects analysis (FMEA):** A systematized group of activities to recognize and evaluate the potential failure of a product or process and its effects, identify actions that could eliminate or reduce the occurrence of the potential failure and document the process.

**Failure mode effects and criticality analysis (FMECA):** A procedure performed after a failure mode effects analysis to classify each potential failure effect according to its severity and probability of occurrence.

**Feedback:** Communication from customers about how delivered products or services compare with customer expectations.

**Feeder lines:** A series of special assembly lines that allow assemblers to perform preassembly tasks off the main production line. Performing certain processes off the main production line means fewer parts in the main assembly area, the availability of service ready components and assemblies in the main production area, improved quality and less lead time to build a product.

**First in, first out (FIFO):** Use of material produced by one process in the same order by the next process. A FIFO queue is filled by the supplying process and emptied by the customer process. When a FIFO lane gets full, production is stopped until the next (internal) customer has used some of that inventory.

**First pass yield (FPY):** Also referred to as the quality rate, the percentage of units that completes a process and meets quality guidelines without being scrapped, rerun, retested, returned or diverted into an offline repair area. FPY is calculated by dividing the units entering the process minus the defective units by the total number of units entering the process.

**First time quality (FTQ):** Calculation of the percentage of good parts at the beginning of a production run.

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**Five-phase lean approach:** A systematic method for implementing lean manufacturing that helps improve the production process and sustains gains made in the production cycle in an area or plant. The five phases are: 1. stability (provides an environment with controlled process variables, decreased waste and increased business impact); 2. continuous flow (characterized by reduced work in process inventory, time loss and defects, and increased process flexibility and repeatable processes between workstations); 3. synchronous production (characterized by disciplined process repeatability and synchronization between operations and customer requirements); 4. pull system (creates an environment in which material replenishment links operations with customer demand); 5. level production (reduces response time or changes in demand and upstream schedule variability).

**Fishbone diagram:** See “cause and effect diagram.”

**Fitness for use:** A term used to indicate that a product or service fits the customer’s defined purpose for that product or service.

**Five S’s (5S):** Five Japanese terms beginning with “s” used to create a workplace suited for visual control and lean production. Seiri means to separate needed tools, parts and instructions from unneeded materials and to remove the unneeded ones. Seiton means to neatly arrange and identify parts and tools for ease of use. Seiso means to conduct a cleanup campaign. Seiketsu means to conduct seiri, seiton and seiso daily to maintain a workplace in perfect condition. Shitsuke means to form the habit of always following the first four S’s.

**Five whys:** A technique for discovering the root causes of a problem and showing the relationship of causes by repeatedly asking the question, “Why?”

**Flow:** The progressive achievement of tasks along the value stream so a product proceeds from design to launch, order to delivery and raw to finished materials in the hands of the customer with no stoppages, scrap or backflows.

**Flowchart:** A graphical representation of the steps in a process. Flowcharts are drawn to better understand processes. One of the “seven tools of quality” (see listing).

**Flow kaizen:** Radical improvement, usually applied only once within a value stream.

**Focus group:** A group, usually of eight to 10 people, that is invited to discuss an existing or planned product, service or process.

**Force field analysis:** A technique for analyzing what aids or hinders an organization in reaching an objective. An arrow pointing to an objective is drawn down the middle of a piece of paper. The factors that will aid the objective’s achievement, called the driving forces, are listed on the left side of the arrow. The factors that will hinder its achievement, called the restraining forces, are listed on the right side of the arrow.

**14 Points:** W. Edwards Deming’s 14 management practices to help companies increase their quality and productivity: 1. create constancy of purpose for improving products and services; 2. adopt the new philosophy; 3. cease dependence on inspection to achieve quality; 4. end the practice of awarding business on price alone; instead, minimize total cost by working with a single supplier; 5. improve constantly and forever every process for planning, production and service; 6. institute training on the job; 7. adopt and institute leadership; 8. drive out fear; 9. break down barriers between staff areas; 10. eliminate slogans, exhortations and targets for the workforce; 11. eliminate numerical quotas for the workforce and numerical goals for management; 12. remove barriers that rob people of pride of workmanship, and eliminate the annual rating or merit system; 13. institute a rigorous program of education and self-improvement for everyone; 14. put everybody in the company to work



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to accomplish the transformation. **Frequency distribution (statistical):** A table that graphically presents a large volume of data so the central tendency (such as the average or mean) and distribution are clearly displayed.

**Function:** A group of related actions contributing to a larger action.

**Functional layout:** The practice of grouping machines (such as grinding machines) or activities (such as order entry) by type of operation performed.

**Functional verification:** Testing to ensure a part conforms to all engineering performance and material requirements.

**Funnel experiment:** An experiment that demonstrates the effects of tampering. Marbles are dropped through a funnel in an attempt to hit a flat surfaced target below. The experiment shows that adjusting a stable process to compensate for an undesirable result or an extraordinarily good result will produce output that is worse than if the process had been left alone.

## G

**Gage repeatability and reproducibility (GR&R):** The evaluation of a gauging instrument's accuracy by determining whether its measurements are repeatable (there is close agreement among a number of consecutive measurements of the output for the same value of the input under the same operating conditions) and reproducible (there is close agreement among repeated measurements of the output for the same value of input made under the same operating conditions over a period of time).

**Gain sharing:** A reward system that shares the monetary results of productivity gains among owners and employees.

**Gantt chart:** A type of bar chart used in process planning and control to display planned and finished work in relation to time.

**Gap analysis:** The comparison of a current condition to the desired state.

**Gatekeeper:** A timekeeper; in team meetings, a designated individual who helps monitor the team's use of allocated time.

**Geometric dimensioning and tolerancing (GD&T):** A set of rules and standard symbols to define part features and relationships on an engineering drawing depicting the geometric relationship of part features and allowing the maximum tolerance that permits full function of the product.

**George M. Low Trophy:** The trophy presented by NASA to NASA aerospace industry contractors, subcontractors and suppliers that consistently maintain and improve the quality of their products and services. The award, which was formerly called the NASA Excellence Award for Quality and Productivity, is given in two categories: small business and large business. George M. Low was the NASA administrator for nearly three decades.

**Goal:** A broad statement describing a desired future condition or achievement without being specific about how much and when.

**Go/no-go:** State of a unit or product. Two parameters are possible: go (conforms to specifications) and no-go (does not conform to specifications).

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**Good laboratory practices (GLP) or 21 CFR, part 58:** 144 requirements that control the procedures and operations of toxicology laboratories.

**Good manufacturing practices (GMP) or 21 CFR, parts 808, 812 and 820:** Requirements governing the quality procedures of medical device manufacturers.

**Green Belt (GB):** An employee who has been trained in the Six Sigma improvement method and will lead a process improvement or quality improvement team as part of his or her full-time job.

**Group dynamic:** The interaction (behavior) of individuals within a team meeting.

**Groupthink:** A situation in which critical information is withheld from the team because individual members censor or restrain themselves, either because they believe their concerns are not worth discussing or because they are afraid of confrontation.

## H

**Hawthorne effect:** The concept that every change results (initially, at least) in increased productivity.

**Hazard analysis and critical control point (HACCP):** A quality management system for effectively and efficiently ensuring farm to table food safety in the United States. HACCP regulations for various sectors are established by the Department of Agriculture and the Food and Drug Administration.

**Heijunka:** A method of leveling production, usually at the final assembly line, that makes just-in-time production possible. It involves averaging both the volume and sequence of different model types on a mixed model production line. Using this method avoids excessive batching of different types of product and volume fluctuations in the same product. Also see “production smoothing.”

**Highly accelerated life test (HALT):** A process for uncovering design defects and weaknesses in electronic and mechanical assemblies using a vibration system combined with rapid high and low temperature changes. The purpose of HALT is to optimize product reliability by identifying the functional and destructive limits of a product at an early stage in product development.

**Highly accelerated stress audits (HASA):** A technique in which a sample of parts (as opposed to 100% of the production as in HASS,) is subjected to stresses similar to the levels and duration for HALT. In monitoring the production process, the intent of HASA is to detect slight shifts in the attributes of the product so corrective actions can be taken and implemented before the performance of outgoing product approaches the specifications.

**Highly accelerated stress screening (HASS):** A technique for production screening that rapidly exposes process or production flaws in products. Its purpose is to expose a product to optimized production screens without affecting product reliability. Unlike HALT, HASS uses nondestructive stresses of extreme temperatures and temperature change rates with vibration.

**Histogram:** A graphic summary of variation in a set of data. The pictorial nature of a histogram lets people see patterns that are difficult to detect in a simple table of numbers. One of the “seven tools of quality” (see listing).

**Honorary member, ASQ:** ASQ’s highest grade of membership. As specified in ASQ’s constitution, “An honorary member shall have rendered acknowledged eminent service to the quality profession or the allied arts and sciences.” To attain this level, an individual must be nominated by at least 10 regular members and

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must be approved unanimously by the board of directors. For a listing of current honorary members, go to [www.asq.org/aboutasq/who-we-are/honorary-members.html](http://www.asq.org/aboutasq/who-we-are/honorary-members.html).

**Hoshin kanri:** The selection of goals, projects to achieve the goals, designation of people and resources for project completion and establishment of project metrics. Also see “policy deployment.”

**Hoshin planning:** Breakthrough planning. A Japanese strategic planning process in which a company develops up to four vision statements that indicate where the company should be in the next five years. Company goals and work plans are developed based on the vision statements. Periodic submitted audits are then conducted to monitor progress. Also see “value stream.”

**Hotelling’s T2 model:** A multivariate profile for detecting differential expressions in microarrays.

**House of quality:** A product planning matrix, somewhat resembling a house, that is developed during quality function deployment and shows the relationship of customer requirements to the means of achieving these requirements.

## I

**Imagineering:** Developing in the mind’s eye a process without waste.

**Imperfection:** A quality characteristic’s departure from its intended level or state without any association to conformance to specification requirements or to the usability of a product or service. Also see “blemish,” “defect” and “nonconformity.”

**Improvement:** The positive effect of a process change effort.

**In-control process:** A process in which the statistical measure being evaluated is in a state of statistical control; in other words, the variations among the observed sampling results can be attributed to a constant system of chance causes. Also see “out-of-control process.”

**Incremental improvement:** Improvement implemented on a continual basis.

**Indicators:** Established measures to determine how well an organization is meeting its customers’ needs and other operational and financial performance expectations.

**Information flow:** The dissemination of information for taking a specific product from order entry through detailed scheduling to delivery. Also see “value stream.”

**Informative inspection:** A form of inspection for determining nonconforming product. Also see “judgment inspection.”

**Inputs:** The products, services and material obtained from suppliers to produce the outputs delivered to customers.

**Inspection:** Measuring, examining, testing and gauging one or more characteristics of a product or service and comparing the results with specified requirements to determine whether conformity is achieved for each characteristic.

**Inspection cost:** The cost associated with inspecting a product to ensure it meets the internal or external customer’s needs and requirements; an appraisal cost.

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**Inspection, curtailed:** Sampling inspection in which inspection of the sample is stopped as soon as a decision is certain. Thus, as soon as the rejection number for defectives is reached, the decision is certain and no further inspection is necessary. In single sampling, however, the whole sample is usually inspected in order to have an unbiased record of quality history. This same practice is usually followed for the first sample in double or multiple sampling.

**Inspection lot:** A collection of similar units or a specific quantity of similar material offered for inspection and acceptance at one time.

**Inspection, normal:** Inspection used in accordance with a sampling plan under ordinary circumstances.

**Inspection, 100%:** Inspection of all the units in the lot or batch.

**Inspection, reduced:** Inspection in accordance with a sampling plan requiring smaller sample sizes than those used in normal inspection. Reduced inspection is used in some inspection systems as an economy measure when the level of submitted quality is sufficiently good and other stated conditions apply. Note: The criteria for determining when quality is “sufficiently good” must be defined in objective terms for any given inspection system.

**Inspection, tightened:** Inspection in accordance with a sampling plan that has stricter acceptance criteria than those used in normal inspection. Tightened inspection is used in some inspection systems as a protective measure when the level of submitted quality is sufficiently poor. The higher rate of rejections is expected to lead suppliers to improve the quality of submitted product. Note: The criteria for determining when quality is “sufficiently poor” must be defined in objective terms for any given inspection system.

**Instant pudding:** A term used to illustrate an obstacle to achieving quality or the supposition that quality and productivity improvement are achieved quickly through an affirmation of faith rather than through sufficient effort and education. W. Edwards Deming used this term, which was coined by James Bakken of Ford Motor Co., in his book *Out of the Crisis*.

**Inter-American Accreditation Cooperation (IAAC):** A cooperative organization of accreditation bodies.

**Intermediate customers:** Organizations or individuals who operate as distributors, brokers or dealers between the supplier and the consumer or end user.

**Internal customer:** The recipient (person or department) within an organization of another person’s or department’s output (product, service or information). Also see “external customer.”

**Internal failure:** A product failure that occurs before the product is delivered to external customers.

**Internal setup:** Die setup procedures that must be performed while a machine is stopped; also known as inner exchange of die. Also see “external setup.”

**International Accreditation Registry (IAR):** A not-for-profit organization that accredits training and certification program results to international standards and guidelines.

**International Aerospace Quality Group:** A cooperative organization of the global aerospace industry that is mainly involved in quality, cost reduction and process improvement efforts.

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**International Automotive Task Force (IATF):** A cooperative group of automotive manufacturers and others primarily responsible for the development and launch of International Organization for Standardization Technical Specification 16949.

**International Laboratory Accreditation Cooperation (ILAC):** A cooperative organization of laboratory accreditation bodies.

**International Organization for Standardization:** A network of national standards institutes from 157 countries working in partnership with international organizations, governments, industry, business and consumer representatives to develop and publish international standards; acts as a bridge between public and private sectors.

**Interrelationship diagram:** A management tool that depicts the relationship among factors in a complex situation; also called “relations diagram.”

**Intervention:** The action of a team facilitator when interrupting a discussion to state observations about group dynamics or the team process.

**Inventory:** In lean, the money invested to purchase things an organization intends to sell.

**Ishikawa diagram:** See “cause and effect diagram.”

**ISO 14000:** An environmental management standard related to what organizations do that affects their physical surroundings.

**ISO 26000:** International Organization for Standardization standard on social responsibility, under development.

**ISO 9000 series standards:** A set of international standards on quality management and quality assurance developed to help companies effectively document the quality system elements to be implemented to maintain an efficient quality system. The standards, initially published in 1987, are not specific to any particular industry, product or service. The standards were developed by the International Organization for Standardization (see listing). The standards underwent major revision in 2000 and now include ISO 9000:2000 (definitions), ISO 9001:2000 (requirements) and ISO 9004:2000 (continuous improvement).

**ISO/TS 16949:** International Organization for Standardization international technical specification for quality management systems, with particular requirements for the application of ISO 9001:2000 for automotive production and relevant service part organization; generally replaced the U.S. QS-9000 standard. Now in its second edition.

## J

**Jidohka:** Stopping a line automatically when a defective part is detected. Any necessary improvements can then be made by directing attention to the stopped equipment and the worker who stopped the operation. The jidohka system puts faith in the worker as a thinker and allows all workers the right to stop the line on which they are working. Also see “autonomation.”

**JIS Q 9100:** An international quality management standard for the aerospace industry. Also see AS9100.  
**Job instruction:** Quality system documentation that describes work conducted in one function in a company, such as setup, inspection, rework or operator.

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**Joint Commission:** A U.S. healthcare accreditation body; formerly known as Joint Commission for the Accreditation of Healthcare Organizations.

**Judgment inspection:** A form of inspection to determine nonconforming product. Also see “informative inspection.”

**Juran trilogy:** Three managerial processes identified by Joseph M. Juran for use in managing for quality: quality planning, quality control and quality improvement.

**Just-in-time (JIT) manufacturing:** An optimal material requirement planning system for a manufacturing process in which there is little or no manufacturing material inventory on hand at the manufacturing site and little or no incoming inspection.

**Just-in-time (JIT) training:** The provision of training only when it is needed to all but eliminate the loss of knowledge and skill caused by a lag between training and use.

## K

**Kaizen:** A Japanese term that means gradual unending improvement by doing little things better and setting and achieving increasingly higher standards. Masaaki Imai made the term famous in his book, Kaizen: The Key to Japan’s Competitive Success.

**Kanban:** A Japanese term for one of the primary tools of a just-in-time system. It maintains an orderly and efficient flow of materials throughout the entire manufacturing process. It is usually a printed card that contains specific information such as part name, description and quantity.

**Key performance indicator (KPI):** A statistical measure of how well an organization is doing in a particular area. A KPI could measure a company’s financial performance or how it is holding up against customer requirements.

**Key process:** A major system level process that supports the mission and satisfies major consumer requirements.

**Key product characteristic:** A product characteristic that can affect safety or compliance with regulations, fit, function, performance or subsequent processing of product.

**Key process characteristic:** A process parameter that can affect safety or compliance with regulations, fit, function, performance or subsequent processing of product.

**Key results area:** Customer requirements that are critical for the organization’s success.

**Kitting:** A process in which assemblers are supplied with kits—a box of parts, fittings and tools—for each task they perform. This eliminates time consuming trips from one parts bin, tool crib or supply center to another to get necessary materials.

**Kruskal-Wallis test:** A nonparametric test to compare three or more samples. It tests the null hypothesis that all populations have identical distribution functions against the alternative hypothesis that at least one of the samples differs only with respect to location (median), if at all. It is the analogue to the F-test used in analysis of variance. While analysis of variance tests depend on the assumption that all populations under comparison are normally distributed, the Kruskal-Wallis test places no such restriction on the comparison. It is a logical extension of the Wilcoxon Mann-Whitney Test (see listing).

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## L

**Laboratory:** A test facility that can include chemical, metallurgical, dimensional, physical, electrical and reliability testing or test validation.

**Laboratory scope:** A record containing the specific tests, evaluations and calibrations a laboratory has the ability and competency to perform, the list of equipment it uses, and a list of the methods and standards to which it adheres to each of these.

**Last off part comparison:** A comparison of the last part off a production run with a part off the next production run to verify that the quality level is equivalent.

**Layout inspection:** The complete measurement of all dimensions shown on a design record.

**Lead time:** The total time a customer must wait to receive a product after placing an order.

**Leadership:** An essential part of a quality improvement effort. Organization leaders must establish a vision, communicate that vision to those in the organization and provide the tools and knowledge necessary to accomplish the vision.

**Lean:** Producing the maximum sellable products or services at the lowest operational cost while optimizing inventory levels.

**Lean enterprise:** A manufacturing company organized to eliminate all unproductive effort and unnecessary investment, both on the shop floor and in office functions.

**Lean manufacturing/production:** An initiative focused on eliminating all waste in manufacturing processes. Principles of lean manufacturing include zero waiting time, zero inventory, scheduling (internal customer pull instead of push system), batch to flow (cut batch sizes), line balancing and cutting actual process times. The production systems are characterized by optimum automation, just-in-time supplier delivery disciplines, quick changeover times, high levels of quality and continuous improvement.

**Lean migration:** The journey from traditional manufacturing methods to one in which all forms of waste are systematically eliminated.

**Level loading:** A technique for balancing production throughput over time. Life cycle stages: Design, manufacturing, assembly, installation, operation and shutdown periods of product development

**Line balancing:** A process in which work elements are evenly distributed and staffing is balanced to meet takt time (see listing).

**Listening post:** An individual who, by virtue of his or her potential for having contact with customers, is designated to collect, document and transmit pertinent feedback to a central collection authority in the organization.

**Load-load:** A method of conducting single-piece flow in which the operator proceeds from machine to machine, taking the part from one machine and loading it into the next. The lines allow different parts of a production process to be completed by one operator, eliminating the need to move around large batches of work-in-progress inventory.

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**Lost customer analysis:** Analysis conducted to determine why a customer or a class of customers was lost.

**Lot:** A defined quantity of product accumulated under conditions considered uniform for sampling purposes.

**Lot, batch:** A definite quantity of some product manufactured under conditions of production that are considered uniform.

**Lot quality:** The value of percentage defective or of defects per hundred units in a lot.

**Lot size (also referred to as N):** The number of units in a lot.

**Lot tolerance percentage defective (LTPD):** Expressed in percentage defective, the poorest quality in an individual lot that should be accepted. Note: LTPD is used as a basis for some inspection systems and is commonly associated with a small consumer risk.

**Lower control limit (LCL):** Control limit for points below the central line in a control chart.

## M

**Maintainability:** The probability that a given maintenance action for an item under given usage conditions can be performed within a stated time interval when the maintenance is performed under stated conditions using stated procedures and resources.

**Maintainability has two categories:** serviceability (the ease of conducting scheduled inspections and servicing) and reparability (the ease of restoring service after a failure).

**Malcolm Baldrige National Quality Award (MBNQA):** An award established by the U.S. Congress in 1987 to raise awareness of quality management and recognize U.S. companies that have implemented successful quality management systems. Awards can be given annually in six categories: manufacturing, service, small business, education, healthcare and nonprofit. The award is named after the late Secretary of Commerce Malcolm Baldrige, a proponent of quality management. The U.S. Commerce Department's National Institute of Standards and Technology manages the award, and ASQ administers it.

**Management review:** A periodic management meeting to review the status and effectiveness of the organization's quality management system.

**Manager:** An individual charged with managing resources and processes.

**Manufacturing resource planning (MRP II):** Material requirements planning (see listing), plus capacity planning and finance, interface to translate operational planning into financial terms and into a simulation tool to assess alternative production plans.

**Mapping symbols or icons:** An easy, effective way to communicate the flow of materials and information through a plant. The symbol type doesn't matter, as long as the use is consistent from map to map. Mapping the flow helps identify constraints and potential improvement opportunities.

**Master Black Belt (MBB):** Six Sigma or quality expert responsible for strategic implementations in an organization. An MBB is qualified to teach other Six Sigma facilitators the methods, tools and applications in all functions and levels of the company and is a resource for using statistical process control in processes.

**Material handling:** Methods, equipment and systems for conveying materials to various machines and processing areas and for transferring finished parts to assembly, packaging and shipping areas.



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**Material requirements planning (MRP):** A computerized system typically used to determine the quantity and timing requirements for production and delivery of items to both customers and suppliers. Using MRP to schedule production at various processes will result in push production because any predetermined schedule is an estimate only of what the next process will actually need.

**Matrix:** A planning tool for displaying the relationships among various data sets.

**Mean:** A measure of central tendency; the arithmetic average of all measurements in a data set.

**Mean time between failures (MTBF):** The average time interval between failures for repairable product for a defined unit of measure; for example, operating hours, cycles and miles.

**Measure:** The criteria, metric or means to which a comparison is made with output.

**Measurement:** The act or process of quantitatively comparing results with requirements.

**Measurement system:** All operations, procedures, devices and other equipment or personnel used to assign a value to the characteristic being measured.

**Measurement uncertainty:** The result of random effects and imperfect correction of systemic effects in obtaining a measurement value that results in variation from the actual true value; also known as measurement error.

**Median:** The middle number or center value of a set of data in which all the data are arranged in sequence.

**Metric:** A standard for measurement.

**Metrology:** The science of weights and measures or of measurement; a system of weights and measures.

**MIL-Q-9858A:** A military standard that describes quality program requirements.

**MIL-STD-45662A:** A military standard that describes the requirements for creating and maintaining a calibration system for measurement and test equipment.

**MIL-STD-105E:** A military standard that describes the sampling procedures and tables for inspection by attributes.

**Mission:** An organization's purpose.

**Mistake proofing:** Use of production or design features to prevent the manufacture or passing downstream a nonconforming product; also known as "error proofing."

**Mode:** The value occurring most frequently in a data set.

**Monument:** Any design, scheduling or production technology with scale requirements that call for designs, orders and products to be brought to the machine to wait in line for processing. The opposite of a right sized (see listing) machine.

**Muda:** Japanese for waste; any activity that consumes resources but creates no value for the customer.

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**Multivariate control chart:** A control chart for evaluating the stability of a process in terms of the levels of two or more variables or characteristics.

**Mutual recognition agreement (MRA):** A formal agreement providing reciprocal recognition of the validity of other organizations' deliverables, typically found in voluntary standards and conformity assessment groups.

**Myers-Briggs type indicator (MBTI):** A method and instrument for identifying an individual's personality type based on Carl Jung's theory of personality preferences.

## N

**n:** The number of units in a sample.

**N:** The number of units in a population.

**Nagara system:** Smooth production flow, ideally one piece at a time, characterized by synchronization (balancing) of production processes and maximum use of available time; includes overlapping of operations where practical. A nagara production system is one in which seemingly unrelated tasks can be produced simultaneously by the same operator.

**National Institute of Standards and Technology (NIST):** An agency of the U.S. Department of Commerce that develops and promotes measurements, standards and technology, and manages the Malcolm Baldrige National Quality Award.

**Natural team:** A team of individuals drawn from a single work group; similar to a process improvement team except that it is not cross functional in composition and it is usually permanent.

**Next operation as customer:** The concept of internal customers in which every operation is both a receiver and a provider.

**Nominal group technique:** A technique, similar to brainstorming, to generate ideas on a particular subject. Team members are asked to silently write down as many ideas as possible. Each member is then asked to share one idea, which is recorded. After all the ideas are recorded, they are discussed and prioritized by the group.

**Nonconformity:** The nonfulfillment of a specified requirement. Also see "blemish," "defect" and "imperfection."

**Nondestructive testing and evaluation (NDT, NDE):** Testing and evaluation methods that do not damage or destroy the product being tested.

**Nonlinear parameter estimation:** A method whereby the arduous and labor intensive task of multiparameter model calibration can be carried out automatically under the control of a computer.

**Nonparametric tests:** All tests involving ranked data (data that can be put in order). Nonparametric tests are often used in place of their parametric counterparts when certain assumptions about the underlying population are questionable. For example, when comparing two independent samples, the Wilcoxon Mann-Whitney test (see listing) does not assume that the difference between the samples is normally distributed, whereas its parametric counterpart, the two-sample t-test, does. Nonparametric tests can be, and often are, more powerful in detecting population differences when certain assumptions are not satisfied.

# Glossary of Quality Terms

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**Nonvalue added:** A term that describes a process step or function that is not required for the direct achievement of process output. This step or function is identified and examined for potential elimination. Also see “value added.”

**Norm (behavioral):** Expectations of how a person or persons will behave in a given situation based on established protocols, rules of conduct or accepted social practices.

**Normal distribution (statistical):** The charting of a data set in which most of the data points are concentrated around the average (mean), thus forming a bell shaped curve.

**Number of affected units chart:** A control chart for evaluating the stability of a process in terms of the total number of units in a sample in which an event of a given classification occurs.

## O

**Objective:** A specific statement of a desired short-term condition or achievement; includes measurable end results to be accomplished by specific teams or individuals within time limits.

**One-piece flow:** The opposite of batch and queue; instead of building many products and then holding them in line for the next step in the process, products go through each step in the process one at a time, without interruption. Meant to improve quality and lower costs.

**One-touch exchange of dies:** The reduction of die setup to a single step. Also see “single-minute exchange of dies,” “internal setup” and “external setup.”

**Operating characteristic curve (OC curve):** A graph to determine the probability of accepting lots as a function of the lots’ or processes’ quality level when using various sampling plans. There are three types: type A curves, which give the probability of acceptance for an individual lot coming from finite production (will not continue in the future); type B curves, which give the probability of acceptance for lots coming from a continuous process; and type C curves, which (for a continuous sampling plan) give the long-run percentage of product accepted during the sampling phase.

**Operating expenses:** The money required for a system to convert inventory into throughput.

**Operations:** Work or steps to transform raw materials to finished product.

**Original equipment manufacturer (OEM):** A company that uses product components from one or more other companies to build a product that it sells under its own company name and brand. Sometimes mistakenly used to refer to the company that supplies the components.

**Overall equipment effectiveness (OEE):** The product of a machine’s operational availability, performance efficiency and first-pass yield.

**Out-of-control process:** A process in which the statistical measure being evaluated is not in a state of statistical control. In other words, the variations among the observed sampling results can be attributed to a constant system of chance causes. Also see “in-control process.”

**Out of spec:** A term that indicates a unit does not meet a given requirement or specification.

**Outputs:** Products, materials, services or information provided to customers (internal or external), from a process.

# Glossary of Quality Terms

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## P

**Painted floor:** A lean manufacturing technique to provide visual indications to determine stock levels. Similar to kanban.

**Parallel operation:** A technique to create economy of scale by having two operators work together to perform tasks on either side of a machine. Using this technique reduces the time it takes a single operator to move from one side to the other, making the overall process more efficient. An example of parallel operation is having two people work on a changeover, supplementing each other's work effort.

**Pareto chart:** A graphical tool for ranking causes from most significant to least significant. It is based on the Pareto principle, which was first defined by Joseph M. Juran in 1950. The principle, named after 19th century economist Vilfredo Pareto, suggests most effects come from relatively few causes; that is, 80% of the effects come from 20% of the possible causes. One of the "seven tools of quality" (see listing).

**Partnership/alliance:** Both a strategy and a formal relationship between a supplier and a customer that engenders cooperation for the benefit of both parties.

**Parts per million (PPM):** A method of stating the performance of a process in terms of actual nonconforming material, which can include rejected, returned or suspect material in the calculation.

**P chart:** See "percent chart."

**PDCA cycle:** See "plan-do-check-act cycle."

**Percent chart:** A control chart for evaluating the stability of a process in terms of the percentage of the total number of units in a sample in which an event of a given classification occurs. Also referred to as a proportion chart.

**Performance standard:** The metric against which a complete action is compared.

**Physical transformation task:** Taking a specific product from raw materials to a finished product delivered to the customer. Also see "value stream" and "information flow."

**Pitch:** The pace and flow of a product.

**Plan-do-check-act (PDCA) cycle:** A four-step process for quality improvement. In the first step (plan), a way to effect improvement is developed. In the second step (do), the plan is carried out, preferably on a small scale. In the third step (check), a study takes place between what was predicted and what was observed in the previous step. In the last step (act), action is taken on the causal system to effect the desired change. The plan-do-check-act cycle is sometimes referred to as the Shewhart cycle, because Walter A. Shewhart discussed the concept in his book *Statistical Method From the Viewpoint of Quality Control*, and as the Deming cycle, because W. Edwards Deming introduced the concept in Japan. The Japanese subsequently called it the Deming cycle. Also called the plan-do-study-act (PDSA) cycle.

**Point kaizen:** See "process kaizen."

**Point of use:** A technique that ensures people have exactly what they need to do their jobs—work instructions, parts, tools and equipment—where and when they need them.

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**Poisson distribution:** A discrete probability distribution that expresses the probability of a number of events occurring in a fixed time period if these events occur with a known average rate, and are independent of the time since the last event.

**Poka-yoke:** Japanese term that means mistake proofing. A pokayoke device is one that prevents incorrect parts from being made or assembled or easily identifies a flaw or error.

**Policy:** An overarching plan (direction) for achieving an organization's goals.

Policy deployment: The selection of goals and projects to achieve the goals, designation of people and resources for project completion and establishment of project metrics. Also see "hoshin kanri."

**Precision:** The aspect of measurement that addresses repeatability or consistency when an identical item is measured several times.

**Preventive action:** Action taken to remove or improve a process to prevent potential future occurrences of a nonconformance.

**Prevention cost:** The cost incurred by actions taken to prevent a nonconformance from occurring; one element of cost of quality or cost of poor quality.

**Prevention versus detection:** A term used to contrast two types of quality activities. Prevention refers to activities for preventing nonconformances in products and services. Detection refers to activities for detecting nonconformances already in products and services. Another phrase to describe this distinction is "designing in quality versus inspecting in quality."

**Probability (statistical):** The likelihood of occurrence of an event, action or item.

**Probability of rejection:** The probability that a lot will be rejected.

**Problem solving:** The act of defining a problem; determining the cause of the problem; identifying, prioritizing and selecting alternatives for a solution; and implementing a solution.

**Procedure:** The steps in a process and how these steps are to be performed for the process to fulfill a customer's requirements; usually documented.

**Process:** A set of interrelated work activities characterized by a set of specific inputs and value added tasks that make up a procedure for a set of specific outputs.

**Process average quality:** Expected or average value of process quality.

**Process capability:** A statistical measure of the inherent process variability of a given characteristic. The most widely accepted formula for process capability is 6 sigma.

**Process capability index:** The value of the tolerance specified for the characteristic divided by the process capability. The several types of process capability indexes include the widely used Cpk and Cp.

**Process control:** The method for keeping a process within boundaries; the act of minimizing the variation of a process.

**Process flow diagram:** A depiction of the flow of materials through a process, including any rework or repair operations; also called a process flow chart.

# Glossary of Quality Terms

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**Process improvement:** The application of the plan-do-check-act cycle (see listing) to processes to produce positive improvement and better meet the needs and expectations of customers.

**Process improvement team:** A structured group often made up of cross functional members who work together to improve a process or processes.

**Process kaizen:** Improvements made at an individual process or in a specific area. Sometimes called “point kaizen.”

**Process management:** The pertinent techniques and tools applied to a process to implement and improve process effectiveness, hold the gains and ensure process integrity in fulfilling customer requirements.

**Process map:** A type of flowchart depicting the steps in a process and identifying responsibility for each step and key measures.

**Process owner:** The person who coordinates the various functions and work activities at all levels of a process, has the authority or ability to make changes in the process as required and manages the entire process cycle to ensure performance effectiveness.

**Process performance management (PPM):** The overseeing of process instances to ensure their quality and timeliness; can also include proactive and reactive actions to ensure a good result.

**Process quality:** The value of percentage defective or of defects per hundred units in product from a given process. Note: The symbols “p” and “c” are commonly used to represent the true process average in fraction defective or defects per unit; and “100p” and “100c” the true process average in percentage defective or in defects per hundred units.

**Process re-engineering:** A strategy directed toward major rethinking and restructuring of a process; often referred to as the “clean sheet of paper” approach.

**Production (analysis) board:** A job site board on which hourly production targets are recorded, along with the actual production achieved. Details concerning problems and abnormal conditions are also recorded. Management checks the board hourly, takes steps to prevent recurrence of abnormalities and confirms the positive effects of the job site improvements that have been made. An example of visual management.

**Production part approval process (PPAP):** A Big Three automotive process that defines the generic requirements for approval of production parts, including production and bulk materials. Its purpose is to determine during an actual production run at the quoted production rates whether all customer engineering design record and specification requirements are properly understood by the supplier and that the process has the potential to produce product consistently meeting these requirements.

**Production smoothing:** Keeping total manufacturing volume as constant as possible. Also see “heijunka.”

**Product or service liability:** The obligation of an organization to make restitution for loss related to personal injury, property damage or other harm caused by its product or service.

**Product warranty:** An organization’s stated policy that it will replace, repair or reimburse a buyer for a product if a product defect occurs under certain conditions and within a stated period of time.

**Productivity:** A measurement of output for a given amount of input.

# Glossary of Quality Terms

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**Profound knowledge, system of:** Defined by W. Edwards Deming, a system that consists of an appreciation for systems, knowledge of variation, theory of knowledge and understanding of psychology.

**Project management:** The application of knowledge, skills, tools and techniques to a broad range of activities to meet the requirements of a particular project.

**Project team:** Manages the work of a project. The work typically involves balancing competing demands for project scope, time, cost, risk and quality, satisfying stakeholders with differing needs and expectations and meeting identified requirements.

**Proportion chart:** See "percent chart."

**Pull system:** An alternative to scheduling individual processes, in which the customer process withdraws the items it needs from a supermarket (see listing) and the supplying process produces to replenish what was withdrawn; used to avoid push. Also see "kanban."

## Q

**QEDS Standards Group:** The U.S. Standards Group on Quality, Environment, Dependability and Statistics consists of the members and leadership of organizations concerned with the development and effective use of generic and sector specific standards on quality control, assurance and management; environmental management systems and auditing, dependability and the application of statistical methods.

**Q9000 series:** Refers to ANSI/ISO/ASQ Q9000 series of standards, which is the verbatim American adoption of the 2000 edition of the ISO 9000 series standards.

**QS-9000:** Harmonized quality management system requirements developed by the Big Three automakers for the automotive sector. Replaced by Technical Specification 16949 effective Dec. 15, 2006. Also see "ISO/TS 16949."

**Qualitician:** Someone who functions as both a quality practitioner and a quality technician.

**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 bear on its ability to satisfy stated or implied needs; 2. a product or service free of deficiencies. According to Joseph Juran, quality means "fitness for use;" according to Philip Crosby, it means "conformance to requirements."

**Quality assurance/quality control (QA/QC):** Two terms that have many interpretations because of the multiple definitions for the words "assurance" and "control." For example, "assurance" can mean the act of giving confidence, the state of being certain or the act of making certain; "control" can mean an evaluation to indicate needed corrective responses, the act of guiding or the state of a process in which the variability is attributable to a constant system of chance causes. (For a detailed discussion on the multiple definitions, see ANSI/ISO/ASQ A3534-2, Statistics—Vocabulary and Symbols—Statistical Quality Control.) One definition of 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.

# Glossary of Quality Terms

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**Quality audit:** A systematic, independent examination and review to determine whether quality activities and related results comply with plans and whether these plans are implemented effectively and are suitable to achieve the objectives.

**Quality circle:** A quality improvement or self-improvement study group composed of a small number of employees (10 or fewer) and their supervisor. Quality circles originated in Japan, where they are called quality control circles.

**Quality control:** See “quality assurance/quality control.”

**Quality costs:** See “cost of poor quality.”

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

**Quality Excellence for Suppliers of Telecommunications (QuEST) Forum:** A partnership of telecommunications suppliers and service providers. The QuEST Forum developed TL 9000 (see listing).

**Quality function deployment (QFD):** A structured method in which customer requirements are translated into appropriate technical requirements for each stage of product development and production. The QFD process is often referred to as listening to the voice of the customer.

**Quality loss function:** A parabolic approximation of the quality loss that occurs when a quality characteristic deviates from its target value. The quality loss function is expressed in monetary units: the cost of deviating from the target increases quadratically the farther the quality characteristic moves from the target. The formula used to compute the quality loss function depends on the type of quality characteristic being used. The quality loss function was first introduced in this form by Genichi Taguchi.

**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 plan:** A document or set of documents that describe the standards, quality practices, resources and processes pertinent to a specific product, service or project.

**Quality policy:** An organization’s general statement of its beliefs about quality, how quality will come about and its expected result.

**Quality rate:** See “first pass yield.”

**Quality score chart:** A control chart for evaluating the stability of a process. The quality score is the weighted sum of the count of events of various classifications in which each classification is assigned a weight.

**Quality tool:** An instrument or technique to support and improve the activities of process quality management and improvement.



# Glossary of Quality Terms

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**Quality trilogy:** A three-pronged approach to managing for quality. The three legs are quality planning (developing the products and processes required to meet customer needs), quality control (meeting product and process goals) and quality improvement (achieving unprecedented levels of performance).

**Queue time:** The time a product spends in a line awaiting the next design, order processing or fabrication step.

**Quick changeover:** The ability to change tooling and fixtures rapidly (usually within minutes) so multiple products can be run on the same machine.

**Quincunx:** A tool that creates frequency distributions. Beads tumble over numerous horizontal rows of pins, which force the beads to the right or left. After a random journey, the beads are dropped into vertical slots. After many beads are dropped, a frequency distribution results. Quincunxes are often used in classrooms to simulate a manufacturing process. The quincunx was invented by English scientist Francis Galton in the 1890s.

## R

**RABQSA International:** Organization that designs, develops and delivers personnel and training certification sources.

**RAM:** Reliability/availability/maintainability (see individual entries).

**Random cause:** A cause of variation due to chance and not assignable to any factor.

**Random sampling:** A commonly used sampling technique in which sample units are selected so all combinations of n units under consideration have an equal chance of being selected as the sample.

**Range (statistical):** The measure of dispersion in a data set (the difference between the highest and lowest values).

**Range chart (R chart):** A control chart in which the subgroup range, R, evaluates the stability of the variability within a process.

**Red bead experiment:** An experiment developed by W. Edwards Deming to illustrate it is impossible to put employees in rank order of performance for the coming year based on their performance during the past year because performance differences must be attributed to the system, not to employees. Six people, 800 red beads and 3,200 white beads are needed for the experiment. The participants' goal is to produce white beads, because the customer will not accept red beads. One person begins by stirring the beads in a jar and then, blindfolded, selecting a sample of 50 beads. That person hands the jar to the next person, who repeats the process, and so on. When everyone has his or her sample, the number of red beads for each is counted. The limits of variation between employees that can be attributed to the system are calculated. Everyone will fall within the calculated limits of variation that could arise from the system. The calculations will show there is no evidence one person will be a better performer than another in the future. The experiment shows that it would be a waste of management's time to try to find out why, say, John produced four red beads and Jane produced 15; instead, management should improve the system, making it possible for everyone to produce more white beads.

**Reengineering:** A breakthrough approach for restructuring an entire organization and its processes.

**Registrar:** Generally accepted U.S. equivalent term for "certification body."

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**Registration:** The act of including an organization, product, service or process in a compilation of those having the same or similar attributes.

**Registration to standards:** A process in which an accredited, independent third-party organization conducts an on-site audit of a company's operations against the requirements of the standard to which the company wants to be registered. Upon successful completion of the audit, the company receives a certificate indicating it has met the standard requirements. In countries outside the United States, this generally known as certification.

**Regression analysis:** A statistical technique for determining the best mathematical expression describing the functional relationship between one response and one or more independent variables.

**Rejection number:** The smallest number of defectives (or defects) in the sample or samples under consideration that will require rejection of the lot.

**Relations diagram:** See interrelations diagram

**Reliability:** The probability of a product's performing its intended function under stated conditions without failure for a given period of time.

**Repeatability:** The variation in measurements obtained when one measurement device is used several times by the same person to measure the same characteristic on the same product.

**Reproducibility:** The variation in measurements made by different people using the same measuring device to measure the same characteristic on the same product.

**Requirements:** The ability of an item to perform a required function under stated conditions for a stated period of time.

**Resource utilization:** Using a resource in a way that increases throughput.

**Results:** The effects that an organization obtains at the conclusion of a time period.

**Right size:** Matching tooling and equipment to the job and space requirements of lean production. Right sizing is a process that challenges the complexity of equipment by examining how equipment fits into an overall vision for workflow through a factory. When possible, right sizing favors smaller, dedicated machines rather than large, multipurpose batch processing ones.

**Right the first time:** The concept that it is beneficial and more cost effective to take the necessary steps up front to ensure a product or service meets its requirements than to provide a product or service that will need rework or not meet customer needs. In other words, an organization should engage in defect prevention rather than defect detection.

**Risk management:** Using managerial resources to integrate risk identification, risk assessment, risk prioritization, development of risk handling strategies and mitigation of risk to acceptable levels.

**Robustness:** The condition of a product or process design that remains relatively stable, with a minimum of variation, even though factors that influence operations or usage, such as environment and wear, are constantly changing.

# Glossary of Quality Terms

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**Root cause:** A factor that caused a nonconformance and should be permanently eliminated through process improvement.

**Run chart:** A chart showing a line connecting numerous data points collected from a process running over time.

**Runner:** A person on the production floor who paces the entire value stream through the pickup and delivery of materials through kanban (see listing) usage.

## S

**SAE International:** Professional organization of individual engineers and related disciplines; formerly Society for Automotive Engineers.

**Sample:** In acceptance sampling, one or more units of product (or a quantity of material) drawn from a lot for purposes of inspection to reach a decision regarding acceptance of the lot.

**Sample size [n]:** The number of units in a sample.

**Sample standard deviation chart (S chart):** A control chart in which the subgroup standard deviation,  $s$ , is used to evaluate the stability of the variability within a process.

**Sampling at random:** As commonly used in acceptance sampling theory, the process of selecting sample units so all units under consideration have the same probability of being selected. Note: Equal probabilities are not necessary for random sampling; what is necessary is that the probability of selection be ascertainable. However, the stated properties of published sampling tables are based on the assumption of random sampling with equal probabilities. An acceptable method of random selection with equal probabilities is the use of a table of random numbers in a standard manner.

**Sampling, double:** Sampling inspection in which the inspection of the first sample leads to a decision to accept a lot, reject it or take a second sample; the inspection of a second sample, when required, then leads to a decision to accept or to reject the lot.

**Sampling, multiple:** Sampling inspection in which, after each sample is inspected, the decision is made to accept a lot, reject it or take another sample. But there is a prescribed maximum number of samples, after which a decision to accept or reject the lot must be reached. Note: Multiple sampling as defined here has sometimes been called "sequential  $n$  sampling" or "truncated sequential  $e$  sampling." The term "multiple sampling" is recommended.

**Sampling, single:** Sampling inspection in which the decision to accept or to reject a lot is based on the inspection of one sample.

**Sampling, unit:** Sequential sampling inspection in which, after each unit is inspected, the decision is made to accept a lot, reject it or to inspect another unit.

**Sanitizing:** English translation of seiso, one of the Japanese 5S's used for workplace organization. Sanitizing (also referred to as shining or sweeping) is the act of cleaning the work area. Dirt is often the root cause of premature equipment wear, safety problems and defects.

**Satisfier:** A term used to describe the quality level received by a customer when a product or service meets expectations.

# Glossary of Quality Terms

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**Scatter diagram:** A graphical technique to analyze the relationship between two variables. Two sets of data are plotted on a graph, with the y-axis being used for the variable to be predicted and the x-axis being used for the variable to make the prediction. The graph will show possible relationships (although two variables might appear to be related, they might not be; those who know most about the variables must make that evaluation). One of the “seven tools of quality” (see listing).

**Scientific management/approach:** A term referring to the intent to find and use the best way to perform tasks to improve quality, productivity and efficiency.

**Scorecard:** An evaluation device, usually in the form of a questionnaire, that specifies the criteria customers will use to rate your business’ performance in satisfying customer requirements.

**Seiban:** The name of a Japanese management practice taken from the words sei, which means manufacturing, and ban, which means number. A seiban number is assigned to all parts, materials and purchase orders associated with a particular customer job, project or anything else. This enables a manufacturer to track everything related to a particular product, project or customer, and facilitates setting aside inventory for specific projects or priorities. That makes it an effective practice for project and build-to-order manufacturing.

**Self-directed work team (SDWT):** A type of team structure in which much of the decision making regarding how to handle the team’s activities is controlled by the team members themselves.

**Sentinel event:** Healthcare term for any event not consistent with the desired, normal or usual operation of the organization; also known as an adverse event.

**Service level agreement:** A formal agreement between an internal provider and an internal receiver (customer).

**Seven tools of quality:** Tools that help organizations understand their processes to improve them. The tools are the cause and effect diagram, check sheet, control chart, flowchart, histogram, Pareto chart and scatter diagram (see individual entries).

**Seven wastes:** See “eight wastes.”

**Shadow board:** A visual management tool painted to indicate where tools belong and which tools are missing.

**Shewhart cycle:** See “plan-do-check-act cycle.”

**Sifting:** English translation of Japanese seiri, one of the 5S’s used for workplace organization. Sifting involves screening through unnecessary materials and simplifying the work environment. Sifting is separating the essential from the nonessential.

**Sigma:** One standard deviation in a normally distributed process.

**Signal to noise ratio (S/N ratio):** An equation that indicates the magnitude of an experimental effect above the effect of experimental error due to chance fluctuations.

**Simulation:** A 3-D technique to balance a line. It involves using cardboard, wood and plastic foam to create full-sized equipment mock-ups that can be easily moved to obtain an optimum layout.

# Glossary of Quality Terms

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**Single-minute exchange of dies:** A series of techniques pioneered by Shigeo Shingo for changeovers of production machinery in less than 10 minutes. The long-term objective is always zero setup, in which changeovers are instantaneous and do not interfere in any way with continuous flow. Setup in a single minute is not required, but used as a reference (see “one-touch exchange of dies,” “internal setup” and “external setup”).

**Single-piece flow:** A process in which products proceed, one complete product at a time, through various operations in design, order taking and production without interruptions, backflows or scrap.

**SIPOC diagram:** A tool used by Six Sigma process improvement teams to identify all relevant elements (suppliers, inputs, process, outputs, customers) of a process improvement project before work begins.

**Six Sigma:** A method that provides organizations tools to improve the capability of their business processes. This increase in performance and decrease in process variation lead to defect reduction and improvement in profits, employee morale and quality of products or services. Six Sigma quality is a term generally used to indicate a process is well controlled ( $\pm 6$  s from the centerline in a control chart).

**Six Sigma quality:** A term generally used to indicate process capability in terms of process spread measured by standard deviations in a normally distributed process.

**Software quality assurance (SQA):** A systematic approach to evaluating the quality of and adherence to software product standards, processes and procedures. SQA includes ensuring standards and procedures are established and are followed throughout the software acquisition life cycle.

**Sort:** English translation of the Japanese word seiri, one of the 5S's used for workplace organization. Sorting (also referred to as structuring or sifting) involves organizing essential materials. It helps the operator to find materials when needed.

**Special causes:** Causes of variation that arise because of special circumstances. They are not an inherent part of a process. Special causes are also referred to as assignable causes. Also see “common causes.”

**Special characteristic:** Automotive ISO TS 16949 term for key product or process characteristics.

**Specification:** A document that states the requirements to which a given product or service must conform.

**Sponsor:** The person who supports a team's plans, activities and outcomes.

**Stages of team growth:** Four stages that teams move through as they develop maturity: forming, storming, norming and performing.

**Stakeholder:** Any individual, group or organization that will have a significant impact on or will be significantly impacted by the quality of a specific product or service.

**Standard:** The metric, specification, gauge, statement, category, segment, grouping, behavior, event or physical product sample against which the outputs of a process are compared and declared acceptable or unacceptable.

**Standard deviation (statistical):** A computed measure of variability indicating the spread of the data set around the mean.

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**Standard in-process stock:** One of the three elements that make up standard work. It is the minimum quantity of parts always on hand for processing during and between subprocesses. It allows workers to do their jobs continuously in a set sequence, repeating the same operation over and over in the same order. Also see “standard work.”

**Standard work:** A precise description of each work activity, specifying cycle time, takt time, the work sequence of specific tasks and the minimum inventory of parts on hand needed to conduct the activity. All jobs are organized around human motion to create an efficient sequence without waste. Work organized in such a way is called standard(ized) work. The three elements that make up standard work are takt time, working sequence and standard in-process stock (see individual listings).

**Standard work instructions:** A lean manufacturing tool that enables operators to observe a production process with an understanding of how assembly tasks are to be performed. It ensures the quality level is understood and serves as an excellent training aid, enabling replacement or temporary individuals to easily adapt and perform the assembly operation.

**Standardization:** When policies and common procedures are used to manage processes throughout the system. Also, English translation of the Japanese word seiketsu, one of the Japanese 5S’s (see listing) used for workplace organization.

**Statistical process control (SPC):** The application of statistical techniques to control a process; often used interchangeably with the term “statistical quality control.”

**Statistical quality control (SQC):** The application of statistical techniques to control quality. Often used interchangeably with the term “statistical process control,” although statistical quality control includes acceptance sampling, which statistical process control does not.

**Statistics:** A field that involves tabulating, depicting and describing data sets; a formalized body of techniques characteristically involving attempts to infer the properties of a large collection of data from inspection of a sample of the collection.

**Stop the line authority:** Power given to workers to stop the process when abnormalities occur, allowing them to prevent the defect or variation from being passed along.

**Strategic planning:** The process an organization uses to envision its future and develop the appropriate strategies, goals, objectives and action plans.

**Strengths, weaknesses, opportunities, threats (SWOT) analysis:** A strategic technique used to assess what an organization is facing.

**Stretch goals:** A set of goals designed to position an organization to meet future requirements.

**Structural variation:** Variation caused by regular, systematic changes in output, such as seasonal patterns and long-term trends.

**Suboptimization:** A condition in which gains made in one activity are offset by losses in another activity or activities that are caused by the same actions that created gains in the first activity.

**Supermarket:** The storage locations of parts before they go on to the next operation. Supermarkets are managed by predetermined maximum and minimum inventory levels. Each item in the plant is at a designated location.

# Glossary of Quality Terms

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**Supplier:** A source of materials, service or information input provided to a process.

**Supplier quality assurance:** Confidence a supplier's product or service will fulfill its customers' needs. This confidence is achieved by creating a relationship between the customer and supplier that ensures the product will be fit for use with minimal corrective action and inspection. According to Joseph M. Juran, nine primary activities are needed: 1. define product and program quality requirements; 2. evaluate alternative suppliers; 3. select suppliers; 4. conduct joint quality planning; 5. cooperate with the supplier during the execution of the contract; 6. obtain proof of conformance to requirements; 7. certify qualified suppliers; 8. conduct quality improvement programs as required; 9. create and use supplier quality ratings.

**Supply chain:** The series of suppliers to a given process.

**Surveillance:** The continual monitoring of a process; a type of periodic assessment or audit conducted to determine whether a process continues to perform to a predetermined standard.

**Survey:** The act of examining a process or questioning a selected sample of individuals to obtain data about a process, product or service.

**Sustain:** The English translation of shitsuke, one of the 5S's (see listing) used for workplace organization. Sustaining (also referred to as self-disciplining) is the continuation of sorting, setting in order and sanitizing. It addresses the need to perform the 5S's on an ongoing and systematic basis.

**Symptom:** An observable phenomenon arising from and accompanying a defect.

**System:** A group of interdependent processes and people that together perform a common mission.

**System kaizen:** Improvement aimed at an entire value stream.

## T

**Taguchi Methods:** The American Supplier Institute's trademarked term for the quality engineering methodology developed by Genichi Taguchi. In this engineering approach to quality control, Taguchi calls for off-line quality control, on-line quality control and a system of experimental design to improve quality and reduce costs.

**Takt time:** The rate of customer demand, takt time is calculated by dividing production time by the quantity of product the customer requires in that time. Takt is the heartbeat of a lean manufacturing system. Also see "cycle time."

**Tampering:** Action taken to compensate for variation within the control limits of a stable system; tampering increases rather than decreases variation, as evidenced in the funnel experiment.

**Task:** A specific, definable activity to perform an assigned piece of work, often finished within a certain time.

**Team:** A group of individuals organized to work together to accomplish a specific objective.

**Technical report (TR):** A type of document in the International Organization for Standardization portfolio of deliverables.

# Glossary of Quality Terms

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**Technical specification (TS):** A type of document in the International Organization for Standardization portfolio of deliverables.

**Theory of constraints (TOC):** A lean management philosophy that stresses removal of constraints to increase throughput while decreasing inventory and operating expenses. TOC's set of tools examines the entire system for continuous improvement. The current reality tree, conflict resolution diagram, future reality tree, prerequisite tree and transition tree are the five tools used in TOC's ongoing improvement process. Also called constraints management.

**3P:** The production preparation process is a tool for designing lean manufacturing environments. It is a highly disciplined, standardized model that results in the development of an improved production process in which low waste levels are achieved at low capital cost.

**Throughput:** The rate the system generates money through sales, or the conversion rate of inventory into shipped product.

**TL 9000:** A quality management standard for the telecommunications industry based on ISO 9000. Its purpose is to define the requirements for the design, development, production, delivery, installation and maintenance of products and services. Included are cost and performance based measurements that measure reliability and quality performance of the products and services.]

**Tolerance:** The maximum and minimum limit values a product can have and still meet customer requirements.

**Top management commitment:** Participation of the highest level officials in their organization's quality improvement efforts. Their participation includes establishing and serving on a quality committee, establishing quality policies and goals, deploying those goals to lower levels of the organization, providing the resources and training lower levels need to achieve the goals, participating in quality improvement teams, reviewing progress organizationwide, recognizing those who have performed well and revising the current reward system to reflect the importance of achieving the quality goals.

**Total productive maintenance (TPM):** A series of methods, originally pioneered by Nippondenso (a member of the Toyota group), to ensure every machine in a production process is always able to perform its required tasks so production is never interrupted.

**Total quality:** A strategic integrated system for achieving customer satisfaction that involves all managers and employees and uses quantitative methods to continuously improve an organization's processes.

**Total quality control (TQC):** A system that integrates quality development, maintenance and improvement of the parts of an organization. It helps a company economically manufacture its product and deliver its services.

**Total quality management (TQM):** A term first used to describe a management approach to quality improvement. Since then, TQM has taken on many meanings. Simply put, it is a management approach to long-term success through customer satisfaction. TQM is based on all members of an organization participating in improving processes, products, services and the culture in which they work. The methods for implementing this approach are found in the teachings of such quality leaders as Philip B. Crosby, W. Edwards Deming, Armand V. Feigenbaum, Kaoru Ishikawa and Joseph M. Juran.

**Toyota production system (TPS):** The production system developed by Toyota Motor Corp. to provide best quality, lowest cost and shortest lead time through eliminating waste. TPS is based on two pillars: just-in-time and jidohka (see listings). TPS is maintained and improved through iterations of standardized work and kaizen (see listing.)



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**Transaction data:** The finite data pertaining to a given event occurring in a process. Examples are the data obtained when an individual checks out groceries (the grocery shopping process) and the data obtained from testing a machined component (the final product inspection step of the production process).

**Tree diagram:** A management tool that depicts the hierarchy of tasks and subtasks needed to complete an objective. The finished diagram bears a resemblance to a tree.

**Trend:** The graphical representation of a variable's tendency, over time, to increase, decrease or remain unchanged.

**Trend control chart:** A control chart in which the deviation of the subgroup average, X-bar, from an expected trend in the process level is used to evaluate the stability of a process.

**TRIZ:** A Russian acronym for a theory of innovative problem solving.

**T-test:** A method to assess whether the means of two groups are statistically different from each other.

**Type I error:** An incorrect decision to reject something (such as a statistical hypothesis or a lot of products) when it is acceptable.

**Type II error:** An incorrect decision to accept something when it is unacceptable.

## U

**U chart:** Count-per-unit chart.

**Unit:** An object for which a measurement or observation can be made; commonly used in the sense of a "unit of product," the entity of product inspected to determine whether it is defective or nondefective.

**Upper control limit (UCL):** Control limit for points above the central line in a control chart.

**Uptime:** See "equipment availability."

## V

**Validation:** The act of confirming a product or service meets the requirements for which it was intended.

**Validity:** The ability of a feedback instrument to measure what it was intended to measure; also, the degree to which inferences derived from measurements are meaningful.

**Value added:** A term used to describe activities that transform input into a customer (internal or external) usable output.

**Value analysis:** Analyzing the value stream to identify value added and nonvalue added activities.

**Value engineering:** Analyzing the components and process that create a product, with an emphasis on minimizing costs while maintaining standards required by the customer.

**Value stream:** All activities, both value added and nonvalue added, required to bring a product from raw material state into the hands of the customer, bring a customer requirement from order to delivery and bring a design from concept to launch. Also see "information flow" and "hoshin planning."

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**Value stream loops:** Segments of a value stream with boundaries broken into loops to divide future state implementation into manageable pieces.

**Value stream manager:** Person responsible for creating a future state map and leading door-to-door implementation of the future state for a particular product family. Makes change happen across departmental and functional boundaries.

**Value stream mapping:** A pencil and paper tool used in two stages. First, follow a product's production path from beginning to end and draw a visual representation of every process in the material and information flows. Second, draw a future state map of how value should flow. The most important map is the future state map.

**Values:** The fundamental beliefs that drive organizational behavior and decision making.

**Variable data:** Measurement information. Control charts based on variable data include average (X-bar) chart, range (R) chart, and sample standard deviation (s) chart (see individual listings).

**Variation:** A change in data, characteristic or function caused by one of four factors: special causes, common causes, tampering or structural variation (see individual entries).

**Verification:** The act of determining whether products and services conform to specific requirements.

**Virtual team:** Remotely situated individuals affiliated with a common organization, purpose or project, who conduct their joint effort via electronic communication.

**Vision:** An overarching statement of the way an organization wants to be; an ideal state of being at a future point.

**Visual controls:** Any devices that help operators quickly and accurately gauge production status at a glance. Progress indicators and problem indicators help assemblers see when production is ahead, behind or on schedule. They allow everyone to instantly see the group's performance and increase the sense of ownership in the area. Also see "andon board," "kanban," "production board," "painted floor" and "shadow board."

**Vital few, useful many:** A term Joseph M. Juran used to describe the Pareto principle, which he first defined in 1950. (The principle was used much earlier in economics and inventory control methods.) The principle suggests most effects come from relatively few causes; that is, 80% of the effects come from 20% of the possible causes. The 20% of the possible causes are referred to as the "vital few;" the remaining causes are referred to as the "useful many." When Juran first defined this principle, he referred to the remaining causes as the "trivial many," but realizing that no problems are trivial in quality assurance, he changed it to "useful many." Also see "eighty-twenty (80-20)."

**Voice of the customer:** The expressed requirements and expectations of customers relative to products or services, as documented and disseminated to the providing organization's members.

**Voluntary standard:** A standard that imposes no inherent obligation regarding its use.

## W

**Waste:** Any activity that consumes resources and produces no added value to the product or service a customer receives. Also known as muda.

# Glossary of Quality Terms

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**Weighed voting:** A way to prioritize a list of issues, ideas or attributes by assigning points to each item based on its relative importance.

**Wilcoxon Mann-Whitney test:** Used to test the null hypothesis that two populations have identical distribution functions against the alternative hypothesis that the two distribution functions differ only with respect to location (median), if at all. It does not require the assumption that the differences between the two samples are normally distributed. In many applications, it is used in place of the two sample t-test when the normality assumption is questionable. This test can also be applied when the observations in a sample of data are ranks, that is, ordinal data rather than direct measurements.

**Work in process:** Items between machines or equipment waiting to be processed.

**Work team:** See “natural team.”

**Working sequence:** One of three elements of standard work; refers to the sequence of operations in a single process that leads a floor worker to most efficiently produce quality goods.

**World-class quality:** A term used to indicate a standard of excellence: best of the best.

**X**

**X-bar chart:** Average chart.

**Y**

**Z**

**Zero defects:** A performance standard and method Philip B. Crosby developed; states that if people commit themselves to watching details and avoiding errors, they can move closer to the goal of zero defects.