

General Quality Assurance Glossary - By Bill Pflanz

(the elsmar cove) هذا القاموس حصلت عليه من موقع منتديات مجدى خطاب

1. Freequality.Org glossary by s. Thomas foster, jr., Phd from managing quality: an integrative approach (courtesy of prentice hall)
2. A quality lexicon compiled by ohio quality and productivity forum
3. Quality by donna c.S. Summers, prentice hall, 1997
4. Burge hughes walsh consulting, six sigma glossary
5. Smarter solutions, inc.

A

Acceptable quality level (aql) - the maximum percentage or proportion of nonconformities in a lot or batch that can be considered satisfactory as a process average.

Acceptance sampling - statistical quality control technique used in deciding to accept or reject a shipment of input or output.

Active data gathering - a method for gathering data that involves approaching respondents to get information.

Actively solicited customer feedback - proactive methods for obtaining customer feedback such as calling customers on the telephone or inviting customers to participate in focus groups.

Activity network diagram - also known as a pert diagram, an activity network diagram is a tool used in controlling projects.

Aesthetics - a dimension of quality that refers to subjective sensory characteristics such as taste, sound, look, and smell.

Affinity diagram - a tool that is used to help groups identify the common themes that are associated with a particular problem.

Alignment - term that refers to optimal coordination among disparate departments and divisions within a firm.

Andon - a Japanese term that refers to the warning lights on an assembly line that light up when a defect occurs. When the lights go on, the assembly line is usually stopped until the problem is diagnosed and corrected.

Annuity relationship - this occurs when a business receives many repeat purchases from a customer. The income is received steadily over time from a single customer.

Appraisal costs - expenses associated with the direct costs of measuring quality.

Assurance - a dimension of service quality that refers to the knowledge and courtesy of employees and their ability to inspire trust and confidence.

Attribute - a binomial state of being.

Abilene paradox - based on a story of a group of people that ended up agreeing to go to abilene, when in reality none of them wanted to go. A book by the same name [1974] describes the phenomenon in teams or task groups that causes people to say and do things in order to gain or keep approval of others in the group. This, and the tendency to focus on differences rather than points of agreement may cause a group to fail to recognize they are each after the same goals. The need to be accepted as part of the group may result in a "collective self-deception that leads to self-

Acceptable quality level (AQL) - the maximum percentage or proportion of nonconformities in a lot or batch that can be considered satisfactory as a process average.

Acceptance sampling - statistical quality control technique used in deciding to accept or reject a shipment of input or output.

Accountability - holding an individual or group subject to blame or penalty for the results of specified tasks, functions or results. The risk can be that the individual or group, while having responsibility to make a contribution to the task or result, cannot control all of the factors affecting the outcome and may be blamed (or credited) undeservedly for effects of other factors.

Accreditation - certification by a duly recognized body of the facilities, capability, objectivity, competence, and integrity of an agency, service or operational group or individual to provide the specific service(s) or operation(s) needed.

Accredited registrars - qualified organizations certified by a national body (e.G., The registrar accreditation board in the U. S.) To perform audits to the QS-9000 and to register the audited facility as meeting these requirements for a given commodity.

Accuracy - the degree of agreement of the results of a measurement process with an established standard (see "precision"). Assumes the measurement process is in statistical control.

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Actively solicited customer feedback - proactive methods for obtaining customer feedback such as calling customers on the telephone or inviting customers to participate in focus groups.

Activity network diagram - also known as a PERT diagram, an activity network diagram is a tool used in controlling projects.

Aesthetics - a dimension of quality that refers to subjective sensory characteristics such as taste, sound, look, and smell.

Affinity diagram - a tool that is used to help groups identify the common themes that are associated with a particular problem. A process to organize disparate language information by placing it on cards and grouping the cards that go together in a creative way. "Header" cards are then used to summarize each

group of cards.

Algorithm - a procedure for carrying out a task.

Alignment - term that refers to optimal coordination among disparate departments and divisions within a firm.

Alternative hypothesis - a null hypothesis (typically that there is no effect) is compared with an alternative hypothesis (typically that there is an effect, or that there is an effect of a particular sign).

Andon - a Japanese term that refers to the warning lights on an assembly line that light up when a defect occurs. When the lights go on, the assembly line is usually stopped until the problem is diagnosed and corrected.

Annuity - relationship this occurs when a business receives many repeat purchases from a customer. The income is received steadily over time from a single customer.

Anova analysis of variance - A statistical method for understanding the similarities and differences between different distributions.

Anova studies - similar to t tests, except that more statistical information is obtained about the components of product and process variation.

Appraisal costs (1) expenses associated with the direct costs of measuring quality.

Appraisal costs (2) costs incurred to determine the degree of conformance to quality requirements

Assignable cause (1) outside influences on the process's performance that change the nature and add variation to a process. One should look for assignable causes for points outside the control limits or points inside the limits with unnatural patterns.

Assignable cause (2) (also special cause) a source of variation that is not part of the inherent variation for which it is often possible to assign the reason for the variation.

Assurance - a dimension of service quality that refers to the knowledge and courtesy of employees and their ability to inspire trust and confidence.

Attribute - a characteristic that can take only one value..

Attributes data (1) (also discrete data) can be described as the number of times something happens or not and is therefore an integer quantity. Attribute data cannot be logically subdivided; you cannot have 0.4 of a 'defect'.

Attributes data (2) - data arising by classifying the individual outcomes of a process into two or more categories -or by counting the number of occurrences per unit of time, area or volume.

Attrition - the practice of not hiring new employees to replace older employees who either quit or retire.

Assessment - an evaluation process including a document review, an on-site audit

and an analysis and report.

Audit - an onsite verification activity used to determine the effective implementation of a supplier's documented quality system.

Audit - systematic, independent and documented process for obtaining audit evidence and evaluating it objectively to determine the extent to which audit criteria are fulfilled.

Auditee - client organization or person requesting an audit.

Audit conclusion - outcome of an audit provided by the audit team after consideration of the audit objectives and all audit findings.

Audit criteria - set of policies, procedures or requirements used as a reference (while conducting an audit).

Auditee - organization being audited.

Audit evidence - records, statements of fact or other information which are relevant to the audit criteria and verifiable.

Audit findings - results of the evaluation of the collected audit evidence against audit criteria.

Auditor - person with the competence to conduct an audit.

Audit program - set of one or more audits planned for a specific time frame and directed towards a specific purpose.

Audit team - one or more auditors conducting an audit.

Average outgoing quality (AQL): the expected average quality level of 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 in 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).

Award audits - site visits relating to award programs.

Axioms of probability - there are three axioms of probability: (1) chances are always at least zero. (2) The chance that something happens is 100%. (3) If two events cannot both occur at the same time (if they are disjoint or mutually exclusive), the chance that either one occurs is the sum of the chances that each occurs.

B

Balanced scorecard: a suggested tool to describe the relevant measures of a business, usually in the following categories:

financial, or return on investment and economic value-added;

customer, or satisfaction, retention, market and account share;

internal, or response time, cost, and new product introductions;

and learning and growth, or employee satisfaction and information system availability.

Baldrige award - a national award established in 1988 [named for malcolm baldrige, former secretary of commerce] for the purpose of recognizing and promoting outstanding corporate [for-profit companies] efforts to improve quality and productivity. The baldrige award guidelines are sometimes used as a checklist or framework for developing and implementing a plan for total quality or, for assessing organizational progress toward total quality. Some concerns and criticisms of the award include: a) it creates winners and losers by being limited to one company in each category, b) apparent emphasis on results over methods, c) insistence on "benchmarking" without accompanying instruction and cautionary information on the inherent risks in that practice.

Baldrige-lite - term used to depict states' quality award pro-grams using the same criteria as the malcolm baldrige national quality award but with a simplified process or application.

Baldrige-qualified - term used by firms that have been granted a site visit by the judges in the malcolm baldrige national quality award competition.

Basic events - term used in fault tree analysis. Basic events are initiating faults that do not require events below them to show how they occurred. The symbol used for a basic event is a circle.

Basic prototype - nonworking mock-up of a product that can be reviewed by customers prior to acceptance.

Bathtub-shaped hazard function - reliability model that shows that products are more likely to fail either very early in their useful life or very late in their useful life.

Bayes' rule - expresses the conditional probability of the event a given the event b in terms of the conditional probability of the event b given the event a:

$$p(a|b) = p(b|a) \cdot p(a) / (p(b|a) \cdot p(a) + p(b|ac) \cdot p(ac))$$

Benchmark - an organization that is recognized for its exemplary operational performance in one or more areas and is willing to allow others to view its operations and tour its facilities.

Benchmarking (1)the process of finding a company that is superior in a particular

area, studying what it does, and gathering ideas for improving your own operation in that area.

Benchmarking (2) identifying an organization that appears to do something well and copying or adapting its methods. Studying how well competitors are meeting customer needs or what other organizations appear to do well can be beneficial, providing management is aware that transferring a method from one set of circumstances to another will not necessarily produce the same results. It is important to have a theory as to why a method or system works and the conditions needed for its success.

Best-of-the-best - term used to refer to outstanding world benchmark firms.

Best-in-class - term used to refer to firms or organizations that are viewed as the best in an industry on some meaningful criterion.

Bias - a measurement procedure or estimator is said to be biased if, on the average, it gives an answer that differs from the truth. The bias is the average (expected) difference between the measurement and the truth.

Bimodal distribution - a distribution with two identifiable curves within it, indicating a mixing of two populations such as different shifts, machines, workers, etc.

Binomial distribution - a random variable has a binomial distribution (with parameters n and p) if it is the number of "successes" in a fixed number n of independent random trials, all of which have the same probability p of resulting in "success." Under these assumptions, the probability of k successes (and $n-k$ failures) is $\binom{n}{k} p^k (1-p)^{n-k}$, where $\binom{n}{k}$ is the number of combinations of n objects taken k at a time: $\binom{n}{k} = \frac{n!}{k!(n-k)!}$. The expected value of a random variable with the binomial distribution is n_p , and the standard error of a random variable with the binomial distribution is $(n_p(1-p))_{\frac{1}{2}}$.

Brainstorming - a method for getting ideas from a group of people in which ideas are offered and recorded without any judgment of the quality of the idea in order to stimulate one idea with another. After the group has run out of ideas, then some method such as "multi-voting" or "nominal group technique" is used to organize and prioritize the ideas collected.

By what method? - Goals set for any organization or system without an explicit method for achieving them are evidence of failure to understand the system of profound knowledge. "If you have a stable system, then there is no use to specify a goal. You will get whatever the system will deliver. A goal beyond the capability of the system cannot be reached. If you have not a stable system, then there is again no point in setting a goal. There is no way to know what the system will produce: it has no [predictable] capability." (Deming: chapter 2, out of the crisis) it is management's job to change and improve the system. Others would say that if the system is not capable of achieving the goal, the goal might be met temporarily, but only with unexpected damage in other dimensions of organizational performance, either in the short term or the long term.

C

c chart - a chart used to monitor the number of defects in a production process.

Calibration - 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 - likelihood a product will meet specification.

Capability analysis - a study to determine the extent of the actual variation against that required or specified. See process capability

Cartesian management - seeing events or causal factors as separate and independent and managing accordingly. System management, on the other hand, acknowledges the complex interrelationships among the various factors and the dynamics of cause and effect over time. This latter view is part of what deming refers to when he speaks of appreciation for a system.

Catchball - term used to describe the iterative nature of the hoshin planning process.

Categorizing - the act of placing strengths and weakness into categories in generic internal assessment.

Causation, causal relation two variables are causally related if changes in the value of one cause the other to change. Two variables can be associated without having any causal relation, and even if two variables have a causal relation, their correlation can be small or zero.

Cause and effect (or fishbone or ishikawa) diagram (1) a diagram designed to help workers focus on the causes of a problem rather than the symptoms.

Cause and effect diagram (2) tool for analyzing process dispersion.

Cause and effect matrix: a tool used to help quantify team consensus on relationships thought to exist between key input and key output variables. The results lead to other activities such as an fmea, creating multi-vari charts, doing an anova, regression analysis or doe.

Cedac - cause and effect diagram with the addition of cards. Developed by ryuji fukuda, author of managerial engineering, this variation of the "fishbone" diagram is modified as needed simply by moving the cards (or "post-its") containing the information.

Central limit theorem - states that the probability histograms of the sample mean and sample sum of n draws with replacement from a box of labeled tickets converge to a normal curve as the sample size n grows

Certificate of compliance - a document signed by an authorized party affirming that the supplier of a product or service has met the requirements of the relevant specifications, contract, or regulation.

Certificate of conformance (certificate of conformity) - a document signed by an authorized party affirming that a product or service has met the requirements of the relevant specifications, contract, or regulation.

Certification - the procedure and action by a duly authorized body of determining, verifying, and attesting in writing to the qualifications of personnel, processes, procedures, or items in accordance with applicable requirements.

Certification audits - audits relating to registration (e.G., Iso 9000 audits).

Chain of customers - a philosophy that espouses the idea that each worker's "customer" is the next worker in the chain of people that produce a finished product or service.

Chance variation, chance error - a random variable can be decomposed into a sum of its expected value and chance variation around its expected value. The expected value of the chance variation is zero; the standard error of the chance variation is the same as the standard error of the random variable---the size of a "typical" difference between the random variable and its expected value.

Change in the context of quality management, this means to move from one state of operation to another state of operation.

Chebychev's inequality - for every number $k > 0$, the fraction of elements in a list that are k sd's or further from the arithmetic mean of the list is at most $1/k^2$.

For random variables: for every number $k > 0$, the probability that a random variable x is k ses or further from its expected value is at most $1/k^2$.

Check sheets data-gathering tools that can be used in forming histograms. The check sheets can be either tabular or schematic.

Chi-square curve - a family of curves that depend on a parameter called degrees of freedom (d.F.). The chi-square curve is an approximation to the probability histogram of the chi-square statistic for multinomial model if the expected number of outcomes in each category is large.

The balance point of the curve is d.F., So the expected value of the corresponding random variable would equal d.F.. The standard error of the corresponding random variable would be $(2_d.F.)^{1/2}$. As d.F. Grows, the shape of the chi-square curve approaches the shape of the normal curve.

Chi-square statistic - used to measure the agreement between categorical data and a multinomial model that predicts the relative frequency of outcomes in each possible category. The chi-squared statistic summarizes the discrepancies between the expected number of times each outcome occurs (assuming that the model is true) and the observed number of times each outcome occurs, by summing the squares of the discrepancies, normalized by the expected numbers, over all the categories:

Chi-squared =

$(\text{observed}_1 - \text{expected}_1)^2 / \text{expected}_1 + (\text{observed}_2 - \text{expected}_2)^2 / \text{expected}_2 + \dots + (\text{Observed}_k - \text{expected}_k)^2 / \text{expected}_k$.

As the sample size n increases, if the model is correct, the sampling distribution of the chi-squared statistic is approximated increasingly well by the chi-squared curve with

$(\text{\#categories} - 1) = k - 1$

degrees of freedom (d.F.), In the sense that the chance that the chi-squared statistic is in any given range grows closer and closer to the area under the chi-squared curve over the same range.

Chi square tests use discrete, count data, arranged in a matrix of rows and

columns, to look for statistical differences among populations.

Closure - to bring to a completion, as in a meeting, when a topic or task is finished and the group is ready to move on or to end the meeting.

Collaborative - an agreement or a relationship in which two or more parties work together (co-labor) on a task of mutual interest.

Common cause (1) a source of variation that is acting on or common to all outcomes of a process. It is constantly present but its influence may vary over time.

Common cause (2) natural or random variation that is inherent in a process over time, affecting every outcome of the process. If a process is in control it has common cause variation only.

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.

Compensation - an organization's formal system of wages or salary and other benefits such as insurance, holidays, retirement, vacation, etc. [See also reward system].

Compensate (1) to pay or remunerate for some work; (2) to make up for some lack of ability or acuity.

Complaint-recovery process process associated with resolving complaints.

Complementary products - products that use similar technologies and can coexist in a family of products.

Compliance an affirmative - indication or judgment that the supplier of a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements.

Component - any raw material, substance, piece, part, software, firmware, labeling, or assembly which is intended to be included as part of the finished, packaged, and labeled device.

Component reliability - the propensity for a part to fail over a given time.

Components search - a approach to interchanging components in product in order to identify those that result in poor performance.

Computer-aided design (cad) - a system for digitally developing product designs.

Computer-aided inspection (cai) - a system for performing inspection through the use of technology. For example, some systems use infrared to detect defects.

Computer-aided testing (cat) - technology for taking tests or examinations.

Computer-based training - a form of training that uses specialized software, known as courseware, to address specific topics.

Concept design - the process of determining which technologies will be used in production and the product.

Concurrent engineering - the simultaneous performance of product design and process design. Typically, -concurrent engineering involves the formation of cross-functional teams. This allows engineers and managers of different disciplines to work together simultaneously in developing product and process designs.

Confidence interval - a random interval constructed from data in such a way that the probability that the interval contains the true value of the parameter can be specified before the data are collected.

Confidence interval - an interval computed from sample values. Intervals so constructed will straddle the estimated parameter a certain percentage of the time in repeated sampling.

Conformance (1) a dimension of quality that refers to the extent to which a product lies within an allowable range of deviation from its specification.

Conformance (2) an affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements.

Consensus - often used to describe a decision-making process in which formal rules or voting are not used. It usually means that everyone who wishes to, has spoken and has been heard, and while the "consensus decision" may not be everyone's first choice, they can agree to it and can support it.

Consultant audits - inspections that are performed by consultants to determine how an organization should be changed for improvement.

Consumer product safety commission (CPSC) - an independent federal regulatory agency that helps keep american families safe by reducing the risk of injury or death from consumer products.

Consumer's risk - the risk of receiving a shipment of poor quality product and believing that it is good quality.

Contact personnel - the people at the "front lines" who interact with the public in a service setting.

Contingency theory - a theory that presupposes that there is no theory or method for operating a business that can be applied in all instances.

Continuous data - data that uses some sort of measurement scale e.G. Length, time temperature. It can be broken down into smaller and smaller increments.

Continuous improvement - the ongoing improvement of products, services, or processes through incremental and breakthrough improvements.

Contract review - contract review involves the steps associated with contracting with suppliers. These steps involve acceptance of the contract or order, the tender of a contract, and review of the contract.

Contrition - forgiveness for error or mistake.

Control - three commonly-used versions of this word: (supervision)- to influence or manipulate an employee's behavior through the threat of consequences or the

promise of reward, whether these are explicit or implied; (engineering)- to influence or manipulate a process through feedback or feedforward; (statistical)- a description of behavior of the variation in the output of a process.

Control chart (1) a graphic comparison between the process's performance and computed limits known as control lines. This statistical method is used to decide when to take action and when to leave a process alone. The charts can identify when statistically unnatural patterns occur so their cause can be investigated. Tool for monitoring process variation.

Control chart (2) a plot of the process output against time or observation order. The variation observed is used to determine and plot the process average and the upper and lower control limits set at three standard deviation from the average. Observations outside the control limits and other patterns indicate the presence of special cause variation.

Control factors - variables in a taguchi experiment that are under the control of the operator. These can include things such as temperature or type of ingredient.

Control limits - calculated values representing the expected variation in the process.

Controlled experiment - an experiment that uses the method of comparison to evaluate the effect of a treatment by comparing treated subjects with a control group, who do not receive the treatment.

Control plans - ensure that problem solutions are permanently effective. Three questions are addressed: what has been done to prevent process problems; how is it known when problems occur; and what will be done when problems in fact do occur? Written descriptions of the systems for controlling parts and processes.

Control process - a process involving gathering process data, analyzing process data, and using this information to make adjustments to the process.

Conversion process - aligning the inputs of a process together to form a product or service.

Corporate culture - popularized in the early 1980's by a book of the same title, this term means the values, the assumptions, the organization's "legends" and heroes, the rituals and folklore that exist in most organizations and get passed along from one person to the next by example or word of mouth.

Corrective action - action to eliminate the cause of a detected nonconformity or other undesirable situation.

Correlation - a measure of linear association between two (ordered) lists. Two variables can be strongly correlated without having any causal relationship, and two variables can have a causal relationship and yet be uncorrelated.

Correlation coefficient r - a measure of how nearly a scatterplot falls on a straight line. The correlation coefficient is always between -1 and +1.

Cost benefit analysis - an assessment of the costs of a change against the projected benefits in order to quantify the timing and magnitude of the return on investment

Cost of quality {COQ} (1) often cited as "the cost of conformance (achieving

quality) plus the cost of non-conformance (waste)." This measure of organizational "effectiveness" fails to take into account the unknown and unknowable costs [e.G., The cost of a dissatisfied customer, or the loss to the individual and to society of poor education] and narrowly defines quality as conformance to specifications.

Cost of quality {COQ} (2) costs associated with providing poor quality products or service. There are four categories of costs: 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.

Crawford slip method - developed by e.C.Crawford of usc, this is a form of brainstorming which attempts to draw from a group of people their ideas on a particular subject. Participants write down each idea on a separate piece of paper, writing as many as they can in a limited period of time. All the different ideas are then compiled into one greater list.

Criticality - a term that refers to how often a failure will occur, how easy it is to diagnose, and whether it can be fixed.

Critical mass - dr.Deming uses this term to refer to that stage when an organization has "recruited" enough of its personnel to a new idea or philosophy that the transformation or change process will now be self-sustaining. Enough people will be behind the idea and will help convert others that the new idea will "take hold".

Critical value - the value of the test statistic beyond which we would reject the null hypothesis. The critical value is set so that the probability that the test statistic is beyond the critical value is at most equal to the significance level if the null hypothesis be true.

Cross-functional teams - teams with members from differing departments and vocations.

Cross-training - training an employee to do several different jobs.

Cumulative sum control chart - 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.

Customer (1) anyone who is the receiver of the goods or services that are produced.

Customer (2) this term is now used to described those persons who receive and use products and/or services, whether they be customers outside the organization (external customers) or co-workers within the same organization...Usually referred to as "internal customers". See also supplier.

Customer benefits package (cbp) - the package of tangibles and intangibles that make up a service.

Customer contact - a characteristic of services that notes that customers tend to be more involved in the production of services than they are in manufactured

goods.

Customer coproduction - the participation of a customer in the delivery of a service product. For example, in many restaurants it is not uncommon for customers to fill their own drinks.

Customer delight - the result of delivering a product or service that exceeds customer expectations.

Customer-driven quality - term that refers to a proactive approach to satisfying customer needs.

Customer expectations (1) what customers expect from a service provider; (2) a part of the servqual questionnaire.

Customer future needs - projection predicting the future needs of customers and designing products that satisfy those needs.

Customer perceptions (1) how customers view products or services; (2) the second part of the servqual survey.

Customer rationalization - the process of reaching an agreement between marketing and operations as to which customers add the greatest advantage and profits over time.

Customer-related ratios - ratios that include customer satisfaction, customer dissatisfaction, and comparisons of customer satisfaction relative to competitors.

Customer-relationship management - a view of the customer that asserts that the customer is a valued asset that should be managed.

Customer retention - the percentage of customers who return to a service provider or continue to purchase a manufactured product.

Customer satisfaction - customer's perception of the degree to which the customer's requirements have been fulfilled.

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

Customer service surveys - instruments that consists of a series of items (or questions) that are designed to elicit customer perceptions.

CQI - continuous quality improvement - a term now used by some organizations, (e.G., Hospitals) in place of tqm [see also tq, tqi, tqm, tqe].

D

Data - factual information used as a basis for reasoning, discussion, or calculation; often refers to quantitative information.

Dead messenger society - a movie title parody that prompts recognition that

organizations still tend to blame the messenger who happens to bring bad news (or call attention to the organization's problems, errors or flaws).

Deduction - an approach to theory development based on modeling.

Defect (1) a defect is any variation of a required characteristic which is far enough removed from its target so as to cause customer dissatisfaction.

Defect (2) 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; class 4 minor, is related to minor problems with respect to intended normal or reasonably foreseeable use.

Dependability - collective term used to describe the availability performance and its influencing factors: reliability performance, maintainability performance and maintenance support performance. [8]

Defect opportunity - any measurable event that provides the chance of not meeting a customer critical characteristic.

Delayed effects - an acknowledgment of the fact that the effects of actions or decisions will likely not be fully observed in the immediate time frame. Managers need to take this into account when determining or evaluating strategies, or drawing conclusions about the effectiveness of managerial methods or actions. One of the lessons in this is that in organizations in which managers are frequently moved, it is common to incorrectly attribute the carry-over effects of the previous manager or managers to the manager currently in place, leading to erroneous conclusions about both the current and the previous manager's performance and ability.

Deming cycle - see plan-do-study-act (pdsa) cycle

Deming prize - a Japanese quality award for individuals and groups that have contributed to the field of quality control.

Dependent variables - the variable, usually the process output (y) which is affected by the independent variables (x 's).

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. Dependability can be expressed as the ratio of time available/(time available + time required)

Design and Development - set of processes that transforms requirements into specified characteristics or into the specification of a product, process or system.

Design control - a set of steps focused on managing the design of a product.

Design for disassembly (DFA) - a method for developing products so that they can easily be taken apart.

Design for maintainability (DFM) - a concept that states that products should be designed in a way that makes them easy for consumers to maintain.

Design for manufacture (DFM) the principle of designing products so that they are cost effective and easy to make.

Design for manufacturability and assembly - a simultaneous engineering process designed to optimize the relationship between design function, manufacturability, and ease of assembly.

Design for remanufacture - a method for developing products so that the parts can be used in other products. Associated with green manufacturing.

Design for reuse - designing products so they can be used in later generations of products.

Design of experiments (DOE) (1) an approach to product design that involves identifying and testing alternative inputs to the production of a product to identify the best mix of inputs.

Design of experiments (DOE) (2) a statistical experimentation approach that enables understanding of how the variables (factors) in a process contribute and interact to affect the output (response) of that process.

Design input - the physical and performance requirements of a device that are used as a basis for device design. [4]

Design review (1) a formal, documented, comprehensive, and systematic examination of a design to evaluate the design requirements and the capability of the design to meet these requirements and to identify problems and propose solutions.

Design review (2) a documented, comprehensive, systematic examination of a design to evaluate the adequacy of the design requirements, to evaluate the capability of the design to meet these requirements, and to identify problems.

Design validation - testing to ensure that product conforms to defined user needs and/or requirements. Design validation follows successful design verification and is normally performed on the final product under defined operating conditions. Multiple validations may be performed if there are different intended uses.

Design validation - establishing by objective evidence that device specifications conform with user needs and intended use(s).

Design verification - testing to ensure that all design outputs meet design input requirements. Design verification may include activities such as:

- design review
- performing alternate calculations
- understanding tests and demonstrations
- review of design stage documents before release

Detection - the process of inspection or looking for defects after the output has been produced. Often compared to "prevention" in which the process is improved to avoid making the defect.

Development plan - a plan that identifies the skills that will be required for a particular employee to move up in an organization.

Deviation permit - written authorization, prior to production or provision of a service, to depart from specified requirements for a specified quantity or for a specified time.

Devil's advocate - reference to the role assumed by a person who takes the opposing side in a discussion in order to provide a good "test" of the prevailing argument (even though that person may not be personally opposed).

DFA - design for assembly

DFM - design for manufacturability. Design of product that considers the capability of the manufacturing process and the robustness of the product design to "forgive" (tolerate without affecting quality) process variation.

DFMEA - design failure mode and effects analysis

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

Discrete data - data that can only be described by levels, i.E. Pass/fail, colour. Discrete data cannot be logically subdivided.

Discrete variable - a quantitative variable whose set of possible values is countable. A random variable is discrete if and only if its cumulative probability distribution function is a stair-step function; i.E., If it is piecewise constant and only increases by jumps.

Distance learning - training that is conducted in one location and is observed in a distant location through telecommunications technology.

Distribution - the population (universe) from which observations are drawn, categorized into cells, and form identifiable patterns. It is based on the concept of variation that states that anything measured repeatedly will arrive at different results. These results will fall into statistically predictable patterns. A bell-shaped curve (normal distribution) is an example of a distribution in which the greatest number of observations occur in the center with fewer and fewer observations falling evenly on either side of the average.

Dodge-romig sampling plans plans for acceptance sampling involving four sets of tables: 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.

Dual sourcing - using only a few suppliers for a single -component.

Durability (1) a dimension of quality that refers to a product's ability to withstand stress or trauma.

Durability (2) the probability that an item will continue to function at customer expectation levels, at the useful life without requiring overhaul or rebuild due to wearout.

E

electronic data interchange (edi) - using computers to share data between customers and suppliers.

Empathy - a dimension of service quality that refers to the amount of caring and individualized attention exhibited by the service firm.

Empirical law of averages - states that if one repeats a random experiment over and over, independently and under "identical" conditions, the fraction of trials that result in a given outcome converges to a limit as the number of trials grows without bound.

Empirical method - relying upon or derived from observation or experiment (from latin and greek words meaning "experience")

Empowerment - a management initiative designed to move decision making to the lowest level in the -organization.

Empowerment - in the strict sense: authorization or permission. In a broader sense: taking action or creating conditions in which another person's full potential may be better realized, e.G., By providing proper tools, good training, clear direction, effective processes and systems and an environment in which the employee can take pride and find joy in his/her work. This broader definition is also referred to as "enablement" or enabling an employee.

End user - the ultimate user of a product or service.

Engineering analysis - the process of applying engineering concepts to the design of a product, including tests such as heat transfer analysis, stress analysis, or analysis of the dynamic behavior of the system being designed.

Enterprise capabilities - capabilities that make firms unique and attractive to customers.

Enterprise resource planning (erp) system - a system that integrates financial, planning, and control systems into a single architecture. Examples include the sap r/3 system and oracle.

Entropy - in common usage: the tendency of systems to deteriorate toward a disordered state.

Evaluation - assessment of how relevant resources and capabilities are to generic strategies in generic internal assessment.

Evaporating cloud - a term used to describe a methodology developed by goldratt (theory of constraints) to resolve conflicts in a "win-win" manner. Name relates to the idea that conflicts, like clouds, are often indistinct i.E., People are unable to articulate the real reasons for the conflict.

Exogenous factors - a term borrowed from biology: derived or developed from external causes. In this case referring to external factors influencing the process or system.

Experiential training techniques training that is hands-on and provides the recipients of training the opportunity to experience in some manner the concepts that are being taught.

Expert system - a term used to identify systems or software that are developed with "expertise" built in. Presented to users as "ready for use". Users should seek information by which to judge the underlying assumptions on which the system is designed, the quality of the data used, and whether all relevant factors were included in the design.

External customers - the ultimate consumers of the goods that an organization produces.

External events - a term used in fault tree analysis. An external event is an event that is normally expected to occur and thus is not considered a fault when it occurs by itself.

External failure costs (1) these are monetary losses associated with product failure after the customer has possession of the product. These may include warranty or field repair costs.

External failure costs (2) costs associated with defects found after the customer receives the product or service

external services - service that are provided by companies other than yours.

External validation - using benchmarking as a way to ensure that a firm's current practices are comparable to those being used by benchmark firms.

Extrinsic motivation - action taken because of external factors, such as pay, bonus, threatened consequences, coercion, etc.

F

Facilitate - a) in a group meeting, to serve as a supporter of the meeting process, helping the group move through its agenda to its desired outcome, but not getting personally involved in the meeting content. B) to "facilitate" efforts means to be help make things happen more readily or effectively.

Facilitation - helping a team or individual achieve a goal. Often used in meeting or with teams to help the teams achieve their objectives.

Facilitator - the person who performs facilitation. This person may be trained in group dynamics, teamwork, and meeting management methods.

Factorial experiments - structured techniques for building a model of how two or more input variables affect an output variable. This technique allows the discovery of interactions between input variables. The result of factorial experiment is a model that predicts how much each input, and all possible combinations of the inputs, influence the output.

Failure costs - two sets of costs — internal failure costs and external failure costs. Internal failure costs include those costs that are associated with failure during production, whereas external failure costs are associated with product failure after the production process.

Failure mode, effect, and criticality analysis (fmeca) - fmeca is an extensive but simple method for identifying ways in which an engineered system could fail. The primary goal of fmeca is to develop priorities for corrective action based on estimated risk.

Failure modes and effects analysis (fmea) - method for systematically considering each component of a -system by identifying, analyzing, and documenting the possible failure modes within a system and the effects of each failure on the system.

False discovery rate - the fraction of rejected null hypotheses that are rejected erroneously (the number of type i errors divided by the number of rejected null hypotheses), with the convention that if no hypothesis is rejected, the false discovery rate is zero.

Fault tree analysis - an analytical tool that graphically renders the combination of faults that lead to the failure of a system.

Features - a dimension of quality that refers to those attributes of a product that supplement the item's basic performance.

Final product definition - the process of articulating the final drawings and specifications for a product.

Financial benchmarking - a type of benchmarking that typically involves using cd rom databases such as lexis/nexis or compact disclosure to gather information about competing firms to perform financial analyses and compare results.

Financial ratios - numerical ratios of firm performance such as return on equity, return on assets, and earnings per share.

Fishbone diagram - also known as a cause and effect diagram or an ishikawa diagram, this is a tool for study of processes. It shows possible causes of an effect on the "bones" branching out from a line representing the process which produces the effect. Its primary limitation is that it has no means for adequately showing the possible inter-relationships of the various causes.

Fishing expedition - gathering data without any clear idea of what you are looking for, nor any plan for carefully investigating an issue.

Fitness for use - a term used to indicate that a product or service fits the customer's defined purpose for that product or service.

Fire-fighting - spending one's time solving endless daily problems without improving the process or system that created them.

Five S (5S) - a process for inducing discipline in an organi-zation.Five terms beginning with "s" utilized to create a workplace suited for visual control and lean production. Seiri (sort) means to separate needed tools, parts, and instructions from unneeded materials and to remove the latter. Seiton (set in order) means to neatly arrange and identify parts and tools for ease of use. Seiso (shine) means to conduct a cleanup campaign. Seiketsu (standardize) means to conduct seiri, seiton, and seiso at frequent, indeed daily, intervals to maintain a workplace in perfect condition. Shitsuke (sustain) means to form the habit of always following the first four ss.

Five whys - a technique for discovering the root causes of a problem and showing

the relationship of causes by repeatedly asking the question, "why?"

5W2h - who, what, when, where, why, how, and how much.

Flowchart - a pictorial representation of the progression of a particular process over time.

Flow chart - generally, a pictorial display of the sequence of actions taken in a process or in carrying out a task. There are several types of flow charts or flow diagrams: 1) top down - detailed steps are listed under headings describing major actions. 2) Logic flow - a symbolic display of the logical sequence of actions and decisions in a process. 3) Deployment flow - actions, decisions, meetings, etc., Are listed sequentially and in columns according to the individual, group or function responsible for, or participating in, the particular step. 4) Organization viewed as a system - a picture of an entire organization's components and its customers and suppliers as a system, beginning with customer research and ending with customers who use the output.

FMEA - failure modes effects analysis. A quality planning method that involves thinking about what might go wrong, what are the chances of it going wrong and what might be the consequences of it going wrong, leading to a plan for prevention and/or containment.

Focus group - a group of people who are brought together and are asked to share their opinions about a particular product or service.

Force field analysis - a commonly used method of examining the conditions or forces which tend to drive a particular action or change as well as the forces which tend to prevent that action or change from occurring or succeeding. Once listed, strategies can then be devised to either increase one or more of the driving forces or decrease one or more of the blocking forces or some combination of both in order to move closer to the desired goal.

Forming - the first stage of team development, where the team is formed and the objectives for the team are set.

Frequency distribution - a statistical table that presents a large volume of data in such a way that the central tendency (average/mean/median) and distribution are clearly displayed.

FTA - fault tree analysis

Full-baldrige approach - term used to depict states' quality award programs using the same criteria as the malcolm baldrige national quality award.

Functional benchmarking - a type of benchmarking that involves the sharing of information among firms that are interested in the same functional issues.

Fundamental rule of counting - if a sequence of experiments or trials $t_1, t_2, t_3, \dots, t_k$ could result, respectively, in $n_1, n_2, n_3, \dots, n_k$ possible outcomes, and the numbers $n_1, n_2, n_3, \dots, n_k$ do not depend on which outcomes actually occurred, the entire sequence of k experiments has $n_1 \times n_2 \times n_3 \times \dots \times n_k$ possible outcomes.

Funnel experiment - a term referring to the experiment deming describes to illustrate the futility and damage of adjusting a stable process in reaction to each outcome to try to affect subsequent results as desired. There are four rules of the

funnel, three of which amount to tampering and produce more variation than if the process were left alone [see chapter 11 in deming's out of the crisis]. See "tampering".

G

Gap - the difference between desired levels of performance and actual levels of performance.

Gap analysis - a term associated with the servqual survey instrument, gap analysis is a technique designed to assess the gap that can exist between a service that is offered and customer expectations.

Gap analysis - a formal study of the gaps between what exists and what needs, or ought, to exist.

Gauge r&r - gauge repeatability and reproducibility - a means of checking how much the measurement system itself is contributing to process variability.

Geometric mean - the geometric mean of n numbers $\{x_1, x_2, x_3, \dots, x_n\}$ is the n th root of their product:

$$(x_1 \cdot x_2 \cdot x_3 \cdot \dots \cdot x_n)^{1/n}.$$

Geometric modeling - a technique used to develop a -computer-based mathematical description of a part.

Globalization - an approach to international markets that requires a firm to make fundamental changes in the nature of its business by establishing production and marketing facilities in foreign markets.

Green manufacturing - a method for manufacturing that minimizes waste and pollution. These goals are often achieved through product and process design.

Group decision - support system a computer system that allows users to anonymously input comments in a focus group type of setting.

Group "memory" - a term used by meeting facilitators to describe any method for recording and displaying the pertinent points, questions, concerns, decisions, actions, plans, etc. Of a group of people working together on a common task. This is often done with "flipcharts" which allows each page to be torn off and placed either in sequence or in some other logical order in the room. This gives the whole group quick and easy reference to their work, and provides visible evidence of the group's progress.

Group technology - a component of cad that allows for the cataloging and standardization of parts and components for complex products.

H

Hack - a label for someone who knows just enough to teach the wrong things very well...And enough to be dangerous.

Hard data - measurements data such as height, weight, volume, or speed that can be measured on a continuous scale.

Hardware mock-ups physical representations of hardware that show designers, managers, and users how an eventual system will work.

Heijunka - the act of leveling the variety or volume of items produced at a process over a period of time. Used to avoid excessive batching of product types and volume fluctuations, especially at a pacemaker process.

Heterogeneous - a characteristic of services that means that for many companies, no two services are exactly the same. For example, an advertising company would not develop the same advertising campaign for two different clients.

Heteroscedasticity - a scatterplot or residual plot shows heteroscedasticity if the scatter in vertical slices through the plot depends on where you take the slice. Linear regression is not usually a good idea if the data are heteroscedastic.

Hidden factory - a term introduced by wickham skinner that refers to firm activities that have no effect on the customer.

Histogram - a representation of data in a bar chart format.

Histogram - vertical bar type display of a population distribution in terms of frequencies; a formal method of plotting a frequency distribution.

Homoscedasticity - a scatterplot or residual plot shows homoscedasticity if the scatter in vertical slices through the plot does not depend much on where you take the slice

horizontal deployment - a term that denotes that all of the departments of a firm are involved in the firm's quality efforts.

Hoshin - from the japanese term hoshin kanri, meaning policy deployment or management by policy. Used in this country to refer to a special focus of an organization. One organization refers to hoshin as a "planning system for implementing total quality management (tqm)"

Hoshin planning - process a policy deployment approach to strategic planning originated by japanese firms. Breakthrough planning. A 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 audits are then conducted to monitor progress.

House of quality - another name for quality function deployment.

Human resource measures - ratios that are used to measure the effectiveness of a firm's human resource practices.

Hypothesis - an assertion subject to verification or proof.

Hypothesis testing - statistical hypothesis testing is formalized as making a decision between rejecting or not rejecting a null hypothesis, on the basis of a set of observations. Used to determine whether the observed differences can be attributable to chance alone.

Hypothesis errors - two types of errors can result from any decision rule (test): rejecting the null hypothesis when it is true (a type i error), and failing to reject the null hypothesis when it is false (a type ii error). For any hypothesis, it is

possible to develop many different decision rules (tests). Typically, one specifies ahead of time the chance of a type i error one is willing to allow. That chance is called the significance level of the test or decision rule. For a given significance level, one way of deciding which decision rule is best is to pick the one that has the smallest chance of a type ii error when a given alternative hypothesis is true. The chance of correctly rejecting the null hypothesis when a given alternative hypothesis is true is called the power of the test against that alternative.

I

ibnr - sometimes used to make the point that some information or data may be "interesting, but not relevant". Management needs to know "what are we trying to learn from these data (what is the purpose of these data)?" "What do we know about how the data were obtained?" "What do the data tell us?" "What do the data not tell us that we need to know?" [See also fishing expedition]

Ideal quality - a reference point identified by taguchi for determining the quality level of a product or service.

Imagineering - a term used to describe creating a vision of a process or system as it would be in an ideal state.

Independent variable - variables (x's) that influence the response of the dependent (or output) variable.

Individual needs assessment - a method for determining training needs at the worker level prior to developing and implementing training programs. Often associated with company literacy programs.

Induction - an approach to theory development based on observation and description. Although the process of induction is useful, it is subject to observer bias and misperception.

Initiator firm - the firm that is interested in benchmarking and initiates contact with benchmark firms.

In-process inspection - the practice of inspecting work, by the workers themselves, at each stage of the production process.

Inspection - a) functional inspection: testing products in real or simulated conditions to see whether they work as intended. B) mass (100%) inspection: looking at all products to screen out those that may be defective. C) sampling inspection: looking at a fraction (a sample) of all the output to determine disposition of that output.

Instant pudding - a term used to illustrate an obstacle to achieving quality: the supposition that quality and productivity improvement is achieved quickly through an affirmation of faith rather than through sufficient effort and education. W. Edwards deming used this term in his book out of the crisis.

Intangible - a characteristic of services that means that services (unlike manufactured goods) cannot be inventoried or carried in stock over a long period of time.

Interference - checking a feasibility test for product designs to make sure that

wires, cabling, and tubing in products such as airplanes don't conflict with each other.

Internal assessment - the act of searching for strengths and areas for improvement in quality deployment.

Internal customers - individuals within the organization that receive the work that other individuals within the same organization do.

Internal failure costs (1) losses that occur while the product is in possession of the producer. These include rework and scrap costs.

Internal failure costs (2) costs associated with defects found before the customer receives the product or service

internal services - services that are provided by internal company personnel. For example, data processing personnel are often considered providers of internal services.

Internal validation - method of studying the quality system to find gaps in quality deployment.

Interrelationship digraph - a tool designed to help identify the causal relationships between the issues affecting a particular problem.

Intrinsic motivation - actions taken because of internal desires or needs for such things as satisfaction with doing a job well, engaging in meaningful work, feeling challenged, achieving a personal goal, growing in skill or gaining knowledge.

Investigation - ability to find sources of competitive advantage in generic internal assessment.

Involuntary services - a classification for services that are not sought by customers. These include hospitals, prisons, and the internal revenue service.

Iso-9000: consists of individual but related international standards on quality management and quality assurance. Developed to help companies effectively document the elements to be implemented in order to maintain an efficient quality system. It is a requirement often placed on manufacturing companies. The basic idea behind iso-9000 methodology is that you document what you do, then you do what you described in the documentation. During an iso-9000 certification process, the examining registrar will audit your company to confirm that you are following the standard. If you re, you can be certified. An updated version is iso-9000:2000, which requires that you demonstrate improvements are being made within your processes. Iso stands for organization for international standards.

J

Job analysis - the process of collecting detailed information about a particular job. This information includes tasks, skills, abilities, and knowledge re-quirements that relate to certain jobs.

JIT - a) "just-in-time"...Maintaining minimal inventory by arranging with suppliers to deliver the needed items daily or even hourly. Has major inventory cost-saving benefits, but can be accomplished only if high levels of quality are consistently available from suppliers. B) "just- in-time training" - providing training when it is

needed and when there is both the opportunity and support for applying that training.

Just-in-time (jit) (1) a method for optimizing processes that involves continual reduction of waste; (2) the toyota motor company production system; (3) an umbrella term that encompasses several japanese management techniques.

Just-in-time (jit) purchasing an approach to purchasing that requires long-term agreements with few suppliers.

K

kaizen - a japanese term meaning continual improvement involving everyone. Said by some, to be one of the most important concepts in "japanese management", it is working each and every day to make improvements in the processes of the organization. Such incremental, but continuous improvement may reap great gains over time. It is contrasted with the western world's pattern of relying on major "breakthrough" to gain needed improvement. The term was used by masakai imai.

Kaizen event (or kaizen blitz): a kaizen event occurs when an operation team works together to improve a specific operation. It typically involves a detailed description of the current state of the selected operation, developing the kaizen plan for improvement, implementing the plan, following-up to confirm that the plan was carried out fully and correctly, and reporting to management on the event and its accomplishments.

Kanban: pulling a product through the production process. This method of manufacturing process-flow-control only allows movement of material by pulling from a preceding process. Inventory is kept low. Then quality errors are detected, there is less product affected.

Key business factors (KBF) - those measures or indicators that are significantly related to the business success of a particular firm.

KPIV (key process input variable): factors within a process correlated to an output characteristic(s) important to the internal or external customer. Optimizing and controlling these is vital to the improvement of the kpov.

KPOV (key process output variable): characteristic(s) of output of a process that are important to the customer. Understanding what is important to the internal and external customer is essential to identifying kpovs.

Knowledge-growth systems - a compensation system that increases an employee's pay as he or she establishes competencies at different levels relating to job knowledge in a single job classification.

Knowledge work - jobs that consist primarily of working with information.

L

law of averages says that the average of independent observations of random variables that have the same probability distribution is increasingly likely to be close to the expected value of the random variables as the number of observations grows. More precisely, if x_1, x_2, x_3, \dots , Are independent random variables with the same probability distribution, and $e(x)$ is their common

expected value, then for every number $\epsilon > 0$,

$$p\{|(x_1 + x_2 + \dots + x_n)/n - e(x)| < \epsilon\}$$

converges to 100% as n grows. This is equivalent to saying that the sequence of sample means

$x_1, (x_1+x_2)/2, (x_1+x_2+x_3)/3, \dots$ Converges in probability to $e(x)$.

Law of diminishing marginal returns - a law that stipulates that there is a point at which investment in quality improvement will become uneconomical.

Leader behavior - a view of leadership stating that leadership potential is related to the behaviors an individual exhibits.

Leadership - the process by which a leader influences a group to move toward the attainment of a group of superordinate goals.

Leader skills - a view of leadership stating that leadership potential is related to the skills possessed by an individual.

Leading - the power relationship between two or more individuals where the power is distributed unevenly.

Lean: an approach to producing products or services focusing on reducing total cycle time and costs by reducing waste, improving flow, and striving for excellence.

Lean enterprise: focusing on the identification and reduction of waste throughout the entire organization and involving both suppliers and customers in the effort.

Lean manufacturing: a manufacturing process involving tools such as value-stream mapping and workflow diagrams without considering either supplier or customer processes. The methodology used to implement the lean production philosophy.

Learning curve effect - a theoretical concept that suggests that the more you do something, the better you become at doing it.

Learning organization - from Peter Senge's book *The Fifth Discipline*: the art and practice of the learning organization. Senge argues, that to excel in an increasingly complex and dynamic world, organizations will have to provide for and encourage individuals and teams in all levels of the organization to learn. He envisions "learning organizations...Where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning how to learn together."

Licensing - a method of reaching international markets that does not require the establishment of international supply chains or marketing arms.

Life testing - a facet of reliability engineering that concerns itself with determining whether a product will fail under controlled conditions during a specified life.

Linear regression - fits a line to a scatterplot in such a way as to minimize the sum of the squares of the residuals.

Line-stop authority - the approval authority to stop a production line whenever a problem is detected.

Logic flow - often used to refer to the logical sequence of steps in a process.

Loss to society - according to Taguchi, this occurs every time a dimension in a product varies from its target dimension. This is associated with taguchi's "ideal quality."

Lot - a defined quantity of product accumulated under conditions that are considered uniform for sampling purposes

Lot tolerance percent defective (LTPD) - the maximum level of percent defective acceptable in production lots.

M

Maintainability - the probability that a failed system can be made operable in a specified interval or downtime.

Malcolm Baldrige National Quality Award (mbnqa) - a U.S. National quality award sponsored by the U.S. Department of commerce and private industry. The award is named after former secretary of commerce Malcolm Baldrige.

Malpractice - the result of mistakes made by a professional service provider.

Management by fact a core value of the baldrige award that focuses on data-based decision making.

Manufacturing system design - the process of designing a manufacturing system.

Margin of error - a measure of the uncertainty in an estimate of a parameter;. The margin of error of an estimate is typically one or two times the estimated standard error of the estimate.

Market share data - a comparative measure that determines relative positions of firms in the marketplace.

Matrix diagram - a brainstorming tool that can be used in a group to show the relationships between ideas or issues.

MBO - management-by-objective. A term used to describe a method for achieving organizational objectives. Top management would set broad goals, then each subsequent layer below would identify how it would support and implement those goals, providing greater and greater degrees of detail. Dr. Deming notes that the result of mbo as practiced, will likely be suboptimization of the organization. Because there is a strong tendency to focus on the result (numbers), rather than on the systems and processes that produce those numbers, and because the typical reward system emphasizes the importance of those numbers, employees find ways to give management the numbers, often by taking actions that are not in the best interests of the organization.

Mean - the average of a collection of numbers, the mean of a population is represented by μ and represents the mean of a sample.

Mean squared error (mse) expected value of the square of the difference between

the estimator and the parameter. The mse measures how far the estimator is off from what it is trying to estimate, on the average in repeated experiments. It is a summary measure of the accuracy of the estimator. It combines any tendency of the estimator to overshoot or undershoot the truth (bias), and the variability of the estimator (se).

Measurement - a process for making an observation or evaluation. Like any process, measurement involves the interaction of people, methods, materials, and equipment in an environment to produce an output - in this case a number or evaluation. To extract meaning from measurements, the measurement process must be stable (in statistical control).

Measurement systems analysis: analysis of the complete process of obtaining measurements. This includes the collection of equipment, operations, procedures, software and personnel that affects the assignment of a number to a measurement characteristic. Includes, but is not limited to, gage r&r.

Median - the middle value in a set of a data.

Meeting management - a term that refers to the effective management of meeting in an organization.

Micro-management - focused on details and minutia to the point of failing to see the larger picture.

Milky way training - a term coined by dr.Deming to describe worker training worker (and thereby passing errors, personal bias, inconsistencies, etc. From one worker to the next), leading further and further away from the desired target, thereby "going off to the milky way"

MIL-Q-9858a - a military standard that describes quality program requirements

MIL-STD-105e - a military standard that describes the sampling procedures and tables for inspection by attributes

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

Mode - the value which occurs most frequently in a set of data.

Moment of truth - in a service context, the phrase "moment of truth" refers to the point in a service experience at which the customer expects something to happen.

Moment of truth - analysis a tool that helps identify and capture customer perceptions about a process.

Mr chart - a chart for plotting variables when samples are not possible.

Muda: a japanese term indicating efforts that do not add value (waste). Some categories of muda are defects, over production or excess inventory, idle time and poor layout.

Multilevel approach term used to depict state quality award programs that include two levels: a top level based on the full-baldrige criteria and a second level based on the baldrige-lite approach.

Multiple skills systems - a method for developing employees so that they can perform more than a single task.

Multi-user-cad systems - computer aided design systems that are networked so that multiple designers can work on a single design simultaneously.

Multi-vari chart: a chart that displays the variance within units, between units, between samples and between lots. It is useful in detecting variation sources within a process.

Multi-vari studies - methods to observe a process as it runs in its normal state. By noting the state of input variables, and the simultaneous state of output variables, basic correlation can be quantified. Sometimes a study such as this will reveal the sources of problems, while in other cases, the outputs of the study become the inputs to a factorial experiment.

N

Natural work groups - a term used to describe teams that are organized according to a common product, customer, or service.

Networking - developing relationships with other individuals for the purpose of sharing ideas, providing support and unifying efforts.

New philosophy - may have several meanings, but is usually a reference to the relatively recent emphasis on quality and the management principles that must accompany it. In some cases it is meant as a reference to deming's theory for management.

New seven (n7) tools (1) managerial tools that are used in quality improvement.

New seven tools (2) - in addition to the seven tools [see lexicon] there are "newer" tqm tools that are recommended for problem-solving or planning. Some of these are: affinity diagram, force field analysis, cross-impact matrix, ripple-effect diagram or wheel, planning tree diagram, five "whys?", The data-collection checklist, and the process-conformance checklist.

Nine dots - a reference to the puzzle in which nine dots (three rows of three, equally spaced) are to be connected by four straight lines. Solutions require that one go "outside" the imagined box delineated by the perimeter of the dots...A difficult task for most people because they are conditioned by their training and experience. The message intended by this reference is that it is often important to get "outside" our paradigms or our typical way of viewing a situation or a problem.

Nominal (value) - the stated "target" value for a characteristic of the outcome of a process...As distinguished from what the process is delivering.

Nominal group technique - a weighted ranking technique used by teams or small groups to narrow down a list of items.

Nonconforming unit - a unit which does not conform to stated requirements/specification.

Nonconformity - a condition within a unit which does not conform to some specific

specification/ requirement. Also commonly called a defect. Any given nonconforming unit can have the potential for more than one nonconformity.

Nonconformance - state that exists when a product, service, or material does not conform to the customer requirements or specifications.

Nonrandom variation - controllable variation.

Normal curve the familiar "bell curve". The mathematical expression for the normal curve is $y = \frac{1}{\sigma\sqrt{2\pi}} e^{-x^2/2\sigma^2}$. The normal curve is symmetric around the point $x=0$, and positive for every value of x . The area under the normal curve is unity, and the sd of the normal curve, suitably defined, is also unity.

Normal distribution - a pattern of variation of a continuous variable continuous variable characterized by a symmetric bell-shaped curve.

Normality - tests used to determine if a population has a statistically normal distribution, from measuring a sample from the population.

Norming - the third stage of team development, where the team becomes a cohesive unit, and interdependence, trust, and cooperation are built.

Np chart - a chart used to monitor the number of items -defective for a fixed sample size.

Null hypothesis - in hypothesis testing, the hypothesis we wish to falsify on the basis of the data. The null hypothesis is typically that something is not present, that there is no effect, or that there is no difference between treatment and control.

O

Off-line experimentation - a method for determining the best configurations of processes. Usually uses a design of experiments (DOE) format such as the taguchi method or plackett-burman experiments.

On-the-job training training that an employee receives at work during the normal work day.

Operating characteristic (oc) curve an assessment of the probability of accepting a shipment, given the existing level of quality of the shipment. There are three types: type a curves which give the probability of acceptance for an individual lot coming from finite production (will not continue into future); type b curves which give the probability of acceptance from lots coming from a continuous process; type c curves which for a continuous sampling plan, give the long run percentage of product accepted during the sampling phase.

Operating results - measures that are important to monitoring and tracking the effectiveness of a company's operations.

Operational auditing - modern auditing practices that -fo-cus on operational efficiencies.

Operational definition - "...Puts communicable meaning into a concept." "An operational definition is one that reasonable men can agree on." (Dr. Deming) example: customer and supplier agree to a defined method by which an item or

group of items can be determined to meet requirements or not.

Optimization - achievement of the aim of a system; when all processes and sub-systems within an organization or system work together to create results that are congruent with the system's or organization's aim [see also sub-optimization].

Orchestra director - deming uses the example of an orchestra to make the point that the individual components of any system must work together to accomplish the aim of the system...They cannot each be just doing their individual best. In any organization, it is the top person's job to be the "orchestra director"...To see that all the components work together toward the aim.

Ordinal data - ranked information.

Organizational design - the proces of defining the best structure to meet company objectives.

Organizational learning - the sum of the changes in knowledge among the employees of a firm.

Orthogonal arrays - experimental design tools that ensure independence between iterations of an experiment.

Outlier - an observation that is many standard deviations from the mean. It is sometimes tempting to discard outliers, but this is imprudent unless the cause of the outlier can be identified, and the outlier is determined to be spurious. Otherwise, discarding outliers can cause one to underestimate the true variability of the measurement process.

Over-the-wall syndrome difficulties that arise when different types of engineers work in totally different departments in the same firm.

P

p chart a chart used to monitor proportion defective.

Paper prototypes - a series of drawings that are developed by the designer on cad systems and are reviewed by decision makers prior to acceptance.

Paradigm - a model, or theory or conceptual system. In current use: a way of seeing or thinking which often serves to distort or limit our ability to receive or understand new information or learnings. Senge calls such models of thinking and perception "mental models" in his book the fifth discipline.

Parallel processing in focused teams - performing work simultaneously rather than sequentially.

Parameter design - designing control factors such as product specifications and measurements for optimal product function.

Pareto analysis - an economic concept identified by joseph juran that argues that the majority of quality problems are caused by relatively few causes. This economic concept is called pareto's law or the 80/20 rule. Juran dichotomized the population of causes of quality problems as the vital few and the trivial many.

Pareto chart - chart used to identify and prioritize problems to be solved.

Pareto diagram - focuses on efforts or the problems that have the greatest potential for improvement by showing relative frequency and/or size in a descending bar graph. Based on the proven pareto principle: 20% of the sources cause 80% of any problems.

Parking lot - a term used in meetings that refers to a flip-chart or whiteboard where topics that are off-the-subject are "parked" with the agreement that these topics will be candidates for the agenda in a future meeting.

Partnering - an approach to selling in foreign markets that involves the collaborative effort of two organizations.

Passive analysis: data collected and analyzed as the process is currently performing, without adjustments to the process, to determine kpivs.

Passive data - gathering this occurs when the customer initiates the data gathering for a firm such as filling out a customer complaint card or sending an e-mail. The firm provides the mechanism for feedback, the customer must initiate the use of the mechanism.

Passively solicited customer feedback - a method of soliciting customer feedback that is left to the customer to initiate, such as filling out a restaurant complaint card or calling a toll-free complaint line.

Pay-for-learning programs - programs that involve compensating employees for their knowledge and skills rather than singularly for the specific jobs they - perform.

PDSA - plan, do, study, act, [see shewhart cycle] a method for learning and for improvement. Also described as plan, try, observe, act (on observations). Popularized in japan as plan, do, check, act, or pdca. Deming prefers study rather than check in order to emphasize the importance of learning in improvement.

Perceived quality - a dimension of quality identified by david garvin that refers to a subjective assessment of a product's quality based on criteria defined by the observer.

Percent chart - a control chart for evaluating the stability of a process in terms of the percent of the total number of units in a sample in which an event of a given classification occurs. Also known as proportion chart.

Performance - a dimension of quality that refers to the efficiency in which a product performs its intended purpose.

Performance - systemic thinking recognizes that "performance" as observed or measured is the consequence of many factors and is rarely attributable just to the individual or group most closely associated with the process or event [see $x + (xy) = 8$ at the end of this lexicon].

Performance benchmarking - a type of benchmarking that allows initiator firms to compare themselves against benchmark firms on performance issues such as cost structures, various types of productivity performance, speed of concept to market, and quality measures.

Performing - the fourth stage of team development, where a mutually supportive, steady state is achieved.

Physical environment - the geographic area that is in the proximity of an organization.

Plan-do-check-act (PDCA) cycle a process for improvement pioneered by w. E. Deming.

Plan-do-study-act (PDSA) cycle a quality improvement process pioneered by walter shewhart and used by w.E. Deming. 1) A plan to effect improvement is developed. 2) The plan is carried out, preferably on a small scale. 3) The effects of the plan are observed 4) the results are studied to determine what was learned and what can be predicted.

Poka yoke - process or product mistake proofing

Population (1) all possible measurements on a part, or on a process throughout history, i.E. A whole set of data.

Population (2)- a statistical term referring to the collection of measurements of a characteristic that could be made on the items in a frame or list.

Post hoc ergo propter hoc "after this, therefore because of this." A fallacy of logic known since classical times: inferring a causal relation from correlation.

Precision - the amount of "scatter" in a collection of measurements. A quantitative measure of precision requires the measurement system be in statistical control. Note that "precision" does not mean that the measurements are at or near a desired target...Only how tightly grouped they are.

Presidential audits - annual audits where the president leads the quality audit.

Prevention - working to improve the process so it is likely that problems or defects will be avoided and will not have to be addressed by inspection (see detection) and rework.

Prevention costs (1)costs associated with preventing defects and imperfections from occurring.

Prevention costs (2) costs incurred to keep failure and appraisal costs to a minimum.

Preventive action - action to eliminate the cause of a potential nonconformity or other undesirable potential situation

Preventive maintenance - maintaining scheduled up-keep and improvement to equipment so equipment can actually improve with age.

Prioritization grid - a tool used to make decisions based on multiple criteria.

Probability - the chance of something happening. Calculated from the number of occurrences divided by number of times that occurrence could have occurred.

Probability density function - the chance that a continuous random variable is in any range of values can be calculated as the area under a curve over that range of values. The curve is the probability density function of the random variable. For example, the probability density function of a random variable with a standard normal distribution is the normal curve. Only continuous random

variables have probability density functions.

Probability sample - a sample drawn from a population using a random mechanism so that every element of the population has a known chance of ending up in the sample.

Problem solving - a process for responding to an unacceptable condition in order to make it acceptable. In many cases, this means returning conditions to their prior state. In such cases, problem solving can be distinguished from improvement because improvement's aim would be to change the conditions to a more desirable state, or to work on preventing or reducing the severity or frequency of the problem.

Process - the interaction of materials, machines/tools, methods and people together in an environment to produce a product or result.

Process benchmarking - a type of benchmarking that focuses on the observation of business processes including process flows, operating systems, process technologies, and the operation of target firms or departments.

Process capability (1) a statistical measure of the inherent process variability for a given characteristic.

Process capability (2) a measurement of the variability in a process to some specification criteria.

Process capability (3) the number of standard deviations that will fit between the target value and the specification limit, i.e. A process with 6 sigma capability can fit 6 standard deviations between the target and the upper or lower specification limit. A higher value indicates a more capable process.

Process capability index (cpk) (1) a measurement of process capability shown as a ratio of the distance between the specification limits and the process mean to the process variation. To have a capability of at least 1, a process must be in statistical control and on target.

Process capability index (2) the value of the tolerance specified for the characteristic divided by the process capability. Cpk and cp are common types of indices.

Process charts - tools for monitoring process stability.

Process decision program chart - a tool that is used to help brainstorm possible contingencies or problems associated with the implementation of some program or improvement.

Process improvement teams - teams that are involved in identifying opportunities for improving select processes in a firm.

Process mapping - illustrated description of how things get done, which enables participants to visualize an entire process and identify areas of strength and weaknesses. It helps reduce cycle time and defects while recognizing the value of individual contributions.

Process quality audit - an analysis of elements of a process and appraisal of completeness, correctness of conditions, and probable effectiveness.

Producer's risk - the risk associated with rejecting a lot of material that has acceptable quality.

Product - a tangible good that is produced for a customer. A result of a completed process. The product may be a physical item or the result of a group process such as a decision or a plan.

Product-based - the context of garvin's quality dimensions.

Product benchmarking - a type of benchmarking that firms employ when designing new products or upgrades to current products.

Product data management - a method for gathering and evaluating product-related data.

Product design and evaluation - activities that include the definition of the product architecture and the design, production, and testing of a system (including its subassemblies) for production.

Product design engineering - a form of engineering that involves activities associated with concept development, needs specification, final specification, and final design of a product.

Product idea generation - the process of generating product ideas from external and internal sources.

Product liability - the risk a manufacturer assumes when there is a chance that a consumer could be injured by the manufacturer's product.

Product marketing and distribution preparation - the process of developing the marketing-related activities associated with a product or service.

Product manufacture, delivery, and use stages of the supply chain.

Product traceability - the ability to trace a component part of a product back to its original manufacturer.

Product quality audit - a quantitative assessment of conformance to required product characteristics.

Productivity ratios - ratios that are used in measuring the extent to which a firm effectively uses its resources.

Profound knowledge - [see system of profound knowledge]

profound organizational learning - quality-based learning that occurs as people discover the causes of errors, defects, and poor customer service in a firm.

Project charter - a document showing the purposes, participants, goals, and authorizations for a project.

Proportion chart - see percent chart

protocol - an order or method for performing a particular task or function.

Prototyping - an iterative approach to design in which a series of mock-ups or models are developed until the customer and the designer come to agreement as

to the final design.

Pugh matrix - a method of concept selection used to identify conflicting requirements and to prioritize design tradeoff.

Pygmalion effect - recognition that our expectations of an individual can significantly influence that individual's behavior and perceived performance. From George Bernard Shaw's play Pygmalion: "the difference between a lady and a flower-girl is not how she behaves, but how she's treated. I shall always be a flower girl to Professor Higgins because he treats me as a flower girl and always will; but I know I can be a lady to you because you always treat me as a lady and always will."

Q

QS 9000 - a supplier development program developed by a consortium of Chrysler/Ford/General Motors supplier requirement task force. The purpose of QS 9000 is to provide a common standard and a set of procedures for the suppliers of the three companies.

QS-9000 quality system requirements for suppliers to Daimler Chrysler, Ford and General Motors

Quad of aims - a tool for ensuring aims are smart by consideration of purpose, customer and benefits, measures of success and deliverables

Quality - attempts to define this term are legion. Working definitions have progressed from "meeting customer specifications" to "satisfying the customer", to "meeting and exceeding customer expectations", but even this last definition puts an unnecessary boundary on quality, because it is limited to the customer's current information and perspective. Deming points out that many innovations have occurred because the creator of a product or service was able to develop a new idea that was not even imagined by the customer.

Quality assurance - those activities associated with assuring the quality of a product or service.

Quality assurance control charts - also known as product acceptance charts. QA charts are the application of statistical techniques to the finished product testing data. Depending on the sampling techniques, QA charts may or may not represent statistical control of the manufacturing process.

Quality at the source - a method of process control whereby each worker is responsible for his or her own work and performs needed inspections at each stage of the process.

Quality circles - brainstorming sessions involving employees of a firm whose goal is improving processes and process capability.

Quality circles - once thought by some to be the "method" by which quality could be achieved, programs like quality circles or employee involvement are now viewed, at best, as lacking a systems approach to quality and, at worst, as abdication by top management. Employee involvement is essential to quality and organizational success. However, such efforts must include participation by top management in order to have clear aim, redesign of products and process, innovation, and plans and actions that support the organization's strategies.

Quality control (1) the process relating to gathering process data and analyzing the data to determine whether the process exhibits nonrandom variation.

Quality control (2) broadest term used for the control of quality of a product by whatever methods are available. It includes instrument feedback loops, performance measurement and comparison to standards and responses based on that information and experience.

Quality dimensions - aspects of quality that help to better define what quality is. These include perceived quality, conformance, reliability, durability, and so on.

Quality function deployment (QFD) - qfd involves developing a matrix that includes customer preferences and product attributes. A qfd matrix allows a firm to quantitatively analyze the relationship between customer needs and design attributes.

Quality improvement system - the result of the interactions between the various components that defines the quality policy in a firm.

Quality loss function (qlf) - a function that determines economic penalties that the customer incurs as a result of purchasing a nonconforming product.

Quality management - the management processes that overarch and tie together quality control and quality assurance activities.

Quality manual - the chief document for standard operating procedures, processes and specifications that define a quality management system. The manual serves as a permanent reference guide for the implementation and maintenance of the quality management system described by the manual.

Quality maturity analysis (qma) - a study in which a firm's level of maturity relating to quality practices is -assessed.

Quality measures - ratios that are used to measure a firm's performance in the area of quality management.

Quality plan - integrates quality philosophies into an organization's environment. The plan will include specific continuous improvement strategies and actions. Plans are developed at all levels from company to plant. Lower level plans should support the company's strategic objectives. A quality plan emphasizes defect prevention through continuous improvement rather than defect detection.

Quality policy - the overall intentions and direction of an organization as regards quality as formally expressed by top management.

Quality records - written verification that a company's methods, systems, and processes were performed according to the quality system documentation such as inspection or test results, internal audit results and calibration data.

Quality system review - a formal evaluation by management of the status and adequacy of the quality system in relation to quality policy and/or new objectives resulting from changing circumstances.

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).

R

r chart - a variables chart that monitors the dispersion of a process.

Random and randomness - a condition in which any individual event in a set of events has the same mathematical probability of occurrence as all other events. Random individual events are not predictable but a large number of them will form a definite pattern or distribution.

Random sampling - sample units that are selected in such a manner that all combinations of n units under consideration have an equal chance of being selected as the sample.

Random variation - variation that is uncontrollable.

Range - a measure of the variation in a set of data. It is calculated by subtracting the lowest value in the data set from the highest value in that same set.

Reactive customer-driven quality (rcdq) a state that is characterized by a supplier "reacting" to the quality expectations of a customer rather than proactively anticipating customer needs and expectations.

Readiness - used in a leadership context, the term refers to the extent to which a follower has the ability and willingness to accomplish a specific task.

Ready-fire-aim - a method that focuses on getting new technology to market and then determining how to sell the products.

Reality tree - a cause-and-effect tree (current or future), construction of which is governed by rigorous rules of logic (one of the theory of constraints tools).

Recall procedures - steps for taking defective products from market. For example, tylenol and firestone wilderness at tires used these procedures to recall their products.

Red bead experiment - carried out at each of deming's 4-day seminars. Workers try to satisfy the customer by scooping out only white beads from a mixture of beads that is 80% white and 20% red . Each tries five times, all using the same tools and methods and under strict supervision (deming!). Regardless of how hard people try to do well, results vary from one try to the next and "rankings" among the workers change. Lessons learned include: a) there is inherent (common cause) variation in every process; b) in such stable processes results we often view as individual "performance" are mostly due to the process or system, rather than the individual; c) there is not much the workers can do about the variation produced - the problems must be corrected by management; d) ranking of individuals based on such performance measures is not only meaningless, but destructive to the individuals in the system. These are important and powerful lessons for anyone responsible for supervising or evaluating another person's performance.

Redundancy - a technique for avoiding failure by putting backup systems in place that can take over if a primary system fails. For example, many redundant systems are used on the space shuttle to protect the crew if a primary system fails.

Reengineering (1) a method for making rapid, radical changes to a company's organization and processes; (2) taking apart a competitor's products to see how they are designed and then designing similar -products.

Regression or regression analysis: a defined process for quantifying and modeling the output of a process relative to its input variables. It estimates the relationship between inputs and outputs of a process and produces mathematical model of that relationship. Its use can lead to a better understanding of the critical factors controlling the equality of the process output.

Relationship management - a method for developing long-term associations with customers.

Reliability - propensity for failure of a product or component. The probability that an item will continue to function at customer expectation levels at a measurement point, under specified environmental and duty cycle conditions. The ability of an item to perform a required function under stated conditions.

Reliability engineering - engineering function dealing with the principles and practices related to the design, specification, assessment, and achievement of product or system reliability requirements and involving aspects of prediction, evaluation, production, and demonstration

Replications - number of runs of an experiment.

Residual - the difference between a datum and the value predicted for it by a model. If linear regression is performed properly, the sum of the residuals from the regression line must be zero; otherwise, there is a computational error somewhere.

Residual error - experimental error

Response surface modeling - a process or product optimization technique, related to factorial experiments, that uses a "contour map" of the output variable as a function of two input variables. This map gives a way to discover and specify conditions of robust product and process performance.

Responsibility - a duty or obligation. In work, often those tasks, functions, processes or results which have been assigned to the individual which the individual is expected to do or to manage. In systems thinking, it is recognized that the "assignment of responsibility" does not mean that the "responsible" person or group of people actually has control over all the factors that affect the outcome. Too often, individuals or groups are blamed or credited undeservedly for the effects of the system [see also accountability].

Responsiveness - a dimension of service quality that refers to the willingness of the service provider to be helpful and prompt in providing service.

Reverse engineering - the process of dismantling a competitor's products to understand the strengths and weaknesses of the designs.

Reward system - in some cases this may refer only to such tangible elements as compensation and benefits, but typically this term also includes such intangible "rewards" as formal and informal recognition, praise or criticism, "perks", differential treatment by supervisors, being "included", access to information and many other considerations. Reward systems are powerful influences on organiz-

ational and employee behavior and need careful consideration and design to assure alignment with the aim and principles of the organization.

Rework - activity or effort required to convert an otherwise unacceptable outcome of a process into an acceptable outcome.

Robust - a product or service designed in such a way that it can be readily produced in the presence of variation without defects or costly process treatment and with little variation or, to be designed to function properly in the presence of environmental variation.

Robust design - designing such that an increase in variability will not result in defective products.

Robust process: a process with output variability that is not sensitive to the normal variation from its input variables.

Root cause - to prevent continuing recurrence of an undesirable outcome, problem-solvers need to "peel back the layers" to find the underlying or "root" causes. One technique for doing this is to ask "why did this happen?" And then to the reply to that question, ask "why?" Again. By the process of asking "why?" Several times in this fashion, one gets closer to the root cause. The early answers to the inquiries are more likely to be symptoms of more fundamental problems.

Root cause analysis - study of original reason for nonconformance with a process. When the root cause is removed or corrected, the nonconformance will be eliminated.

S

Sample - a subset of data which depicts the population.

Sampling plan - a determination of how data are to be gathered and evaluated.

Scatter diagram - a scatter plot used to examine the relationships between variables.

Scientific method - "the totality of principles and processes regarded as characteristic or necessary for scientific investigation, generally taken to include rules for concept formation, conduct of observations and experiments, and validation of hypotheses by observation or experiments." (New american heritage dictionary) similar to the shewhart cycle (pdsa).

Seiketsu - a term that refers to standardization.

Seiri - a term that refers to organizing and throwing away things you don't use.

Seiso - a term that suggests that a highly productive workplace should be clean.

Seiton - a term that refers to neatness in the workplace.

Selection - the process of evaluating and choosing the best qualified candidate for a particular job.

Self-directed work teams - work teams that have a considerable degree of autonomy.

Self-direction - a term that refers to providing autonomy to employees (or other recipients of training) in terms of facilitating their own training needs.

Sequential or departmental approach to design - an approach to design that requires product designers, marketers, process designers, and production managers to work through organizational lines of authority to perform work.

Service - a mix of intangibles and tangibles that are delivered to the customer.

Services blueprinting - a chart that depicts service processes and potential fail points in a process.

Service reliability - a dimension of service quality that refers to the ability of the service provider to perform the promised service dependably and accurately.

Serviceability - a dimension of quality that refers to a product's ease of repair.

Servqual - a survey instrument designed to assess service quality along five specific dimensions consisting of tangibles, reliability, responsiveness, assurance, and empathy.

Seven tools - sometimes referred to as the seven statistical tools, or seven traditional tools, these methods to organize or summarize data are an important part of any improvement methodology: histogram [or bar chart], pareto chart, run chart [or line chart], control chart, scatter diagram, flow diagram and cause & effect diagram. Some people list the pdsa cycle rather than the run chart as the seventh tool.

Seven (b7) tools of quality these are the fundamental methods for gathering and analyzing quality-related data. They are: fishbone diagrams, histograms, pareto analysis, flowcharts, scatter plots, run charts, and control charts.

Shewhart cycle - a cycle for learning and for improvement. Also called pdsa (plan,do,study,act) or the deming cycle:

Shitsuke - a term that refers to the discipline required to maintain the changes that have been made in a workplace.

Sigma - the term used in statistics to refer to the standard deviation, a measure of the spread or variation, in data. Represented by the greek letter σ .

Signal factors factors in a taguchi experiment that are not under control of the operator. Examples include small variations in ambient temperature and variability in material dimensions.

Simpson's paradox what is true for the parts is not necessarily true for the whole.

Sipoc - a diagrammatic technique for determining the suppliers, inputs, major steps, outputs and customers of a process.

Situational leadership model - a model of leadership proposed by hersey and blanchard that clarifies the interrelation between employee preparedness and effectiveness in leadership.

S.M.A.R.T: an acronym for guidelines in creating goals and strategies: s-specific, m-measurable, a- agreed upon and attainable, r- realistic and rewarded, t-

timely.

Societal environment - the portion of a firm's environment pertaining to cultural factors such as language, business customs, customer preferences, and patterns of communication.

Soft data - data that cannot be measured or specifically quantified, such as survey data that asks respondents to provide their "opinion" about something.

Sole-source - filters external validation measures of quality programs such as the Baldrige criteria and ISO 9000.

Sole sourcing - using only one supplier for a single component.

Special cause - a cause of variation which is localized, or acts at one period of time, or in one set of circumstances. A cause not common to all outcomes of a process.

Stable - a synonym for variation that is in a state of statistical control (or in statistical control). Variation due only to common causes.

Stable process - a process in which the variation is due to common causes only, i.e. is free of special (assignable) causes. It is said to be in statistical control.

Stability - the likelihood a process will be random.

Standard deviation (1) a statistic that reflects the degree of variation in a collection of results. Whereas the range reflects only the difference between the high and low values in the sample data, the standard deviation uses all numbers and therefore reports more information about the data. In small sets of numbers, the standard deviation and the range are similar as descriptions of variability.

Standard deviation, σ (2) a measure of variation in observed values.

Standard deviation, σ (3) a measurement that defines the spread of data around the average value or mean. The lower the value of standard deviation the better the process is running. Standard deviation of a population is denoted by sigma σ , and for a sample it is denoted by s .

Standardization - providing for uniformity of use of a method.

Statistical control - a stable process. i.e. is free of special causes.

Statistical process control (spc) (1) a technique that is concerned with monitoring process capability and process stability.

Statistical process control (2) the application of statistical techniques for measuring and analyzing the variation in processes. SPC generally refers to the use of various types of control charts that use historical data to calculate control limits. (Juran)

Statistical quality control - the application of statistical techniques for measuring and improving the quality of processes. SQC includes statistical process control, diagnostic tools (Pareto charts, flowcharts, fishbone etc.), Sampling plans, and other statistical techniques. (Juran)

Statistical thinking - Deming's concept relating to data-based decision making.

Storming - the second stage of team development, in which the team begins to get to know each other but agreements have not been made to facilitate smooth interaction among team members.

Strategic benchmarking - a type of benchmarking that involves observing how others compete. This type of benchmarking typically involves target firms that have been identified as "world class."

Strategic partnership - an association between two firms by which they agree to work together to achieve a strategic goal. This is often associated with long-term supplier-customer relationships.

Strategy (1) the art of planning military operations; (2) what a firm does; (3) a firm's long-term plan for attaining objectives.

Strategy (2) an approach to achieving a particular end, or plan as to how an end may be achieved.

Stratification - a technique for organizing data to better understand the process producing the data and to identify potential improvement opportunities. Stratification groups individual numbers into meaningful categories or classifications according to some criterion such as time, location, type, source, reason, etc.

Stratified sample - subsets of sampling units are selected separately from different strata, rather than from the frame as a whole.

Stretch target - a challenging goal or objective requiring significant effort to achieve.

Structural measures - measures that include objectives, policies, and procedures that are followed by a firm.

Student's t curve - a family of curves indexed by a parameter called the degrees of freedom, which can take the values 1, 2, . . . Student's t curve can be used to test hypotheses about the population mean and construct confidence intervals for the population mean, when the population distribution is known to be nearly normally distributed.

Suboptimization - when individual components of an organization attempt to maximize the performance or results of that component without regard for whether that is in the best interest of the whole organization. For example, goals such as increasing sales, reducing inventory or cycle times are usually thought of as desirable things for a business to do, but myopic pursuit of those goals may not be compatible with the organization's plan or supportive of its aim. "Optimization" is a process of orchestrating the components to move toward achievement of the organization's aim.

Superordinate goals - goals that transcend individual needs to reflect group objectives.

Superstitious learning - formation of beliefs about cause and effect based on observation without knowledge. Often happens when correlation is confused with cause and effect. Appears to be accompanied by a tendency to ignore variation, to interpret each result as if it came from a single cause and to ignore delays between actions and effects.

Supplier audit - the auditing portion of supplier development programs.

Supplier certification or qualification programs - programs designed to certify suppliers as acceptable for a particular customer.

Supplier development programs training and development - programs provided by firms to their suppliers.

Supplier evaluation - a tool used by many firms to differentiate and discriminate among suppliers. Supplier evaluations often involve report cards where potential suppliers are rated based on different criteria such as quality, technical capability, or ability to meet schedule demands.

Supplier partnering - a term used to characterize the relationship between suppliers and customers when a high degree of linkages and interdependencies exist.

Supply chain - a network of facilities that procures raw materials, transforms them into intermediate subassemblies and final products, and then delivers the products to customers through a distribution system.

Surveying - generating a list of strengths and weaknesses in a firm in generic internal assessment.

Synergy/synergism - a condition in which the combined results of a group of elements or people are greater or better than the individual elements could have produced separately. A list of ideas from an interactive group is likely to be more creative than adding together the lists produced by those same people working independently.

System - a collection of interdependent components that interact with one another. For example, an organization is a system; an automobile is a system; an office is a system, a family is a system. According to Deming, to be a system, all the components must have a common aim... "Without an aim, there is no system."

Systematic error - an error that affects all the measurements similarly. Systematic errors do not tend to average out.

System of profound knowledge - the foundation for Deming's theory of management is composed of four interdependent parts:

1. Appreciation for a system
2. Knowledge about variation
3. Theory of knowledge
4. Psychology

One of Deming's contributions is the synthesis of these components into a theory for management.

System reliability - the probability that components in a system will perform their intended function over a specified period of time.

Systems view - a management viewpoint that focuses on the interactions between the various components (i.e., People, policies, machines, processes, and products) that combine to produce a product or service. The systems view focuses management on the system as the cause of quality problems.

T

t test - an hypothesis test based on approximating the probability histogram of the test statistic by student's t curve. T tests usually are used to test hypotheses about the mean of a population when the sample size is intermediate and the distribution of the population is known to be nearly normal.

Taguchi loss function - g. Taguchi pointed out that both the manufacturer's and society's expected loss (or cost) is reduced when the results of a process are centered on the intended target value with little variation. The loss (cost) is ever increasing as those same product characteristics depart from their targets. The expected loss also depends on where the distribution is, relative to the target. The taguchi loss function is often shown as a parabolic curve, but in some situations the loss function is asymmetric with respect to the target, or desired value.

Taguchi method - an approach to quality management developed by dr. Genichi taguchi in 1980. The taguchi method provides: (1) a basis for determining the functional relationship between controllable product or service design factors and the outcomes of a process, (2) a method for adjusting the mean of a process by optimizing controllable variables, and (3) a procedure for examining the relationship between random noise in the process and product or service variability.

Tampering - adjusting a stable process in an attempt to improve the next result by compensating for or taking into account the deviation from the target of the previous result. Tampering, or overadjustment of a stable process, actually increases the variation of the results.

Tangibles - a dimension of service quality that refers to the physical appearance of the service facility, the equipment, the personnel, and the communications material.

Target - firm the firm that is being studied or benchmarked against.

Task environment - the portion of a firm's environment pertaining to structural issues such as the skill levels of employees, remuneration policies, technology, and the nature of government agencies.

Task needs - assessment the process of assessing the skills that are needed within a firm.

Tactic - a specific device or plan for carrying out a strategy.

Team - a group of individuals working to achieve a goal with activities requiring close coordination.

Team building - a term that describes the process of identifying roles for team members and helping the team members succeed in their roles.

Teamware - computer software that is used in making group decisions.

Technology feasibility statement - a feasibility statement used in the design process to assess a variety of issues such as necessary parameters for performance, manufacturing imperatives, limitations in the physics of materials, and conditions for quality testing the product.

Technology selection for product development - the process of selecting materials and technologies that provide the best performance for the customer at an acceptable cost.

Theory - "a system of assumptions, accepted principles, and rules of procedure devised to analyze, predict or otherwise explain the nature or behavior of a specified set of phenomena." (American heritage dictionary] "theory leads to prediction. Without prediction, experience and examples teach us nothing." "No number of examples establishes a theory, yet a single unexplained failure of a theory requires modification or even abandonment of the theory." [From deming's discussion of theory of knowledge].

Theory of constraints (toc): eliyahu goldratt describes this in his book, the goal, a model that challenges many traditional accounting and business practices. He makes the case that we often do not know what our true business goal is. One goal every business shares is the need to be profitable. A particular business will have other goals as well. These goals must be well thought out, clearly stated, and communicated to everyone in the organization. Goldratt's procedures focus on three metrics: throughput (the rate at which the system produces income), inventory (all the money the system invests in things to sell as well as all money tied up in the system), and operating expense (money spent turning inventory into throughput). The constraints that prevent achieving the goals are primarily system restraints. Therefore we must determine what to change, what to change to, and how to cause change. Goldratt describes five sequential steps to remove constraints and progress toward a goal:

1. Identify the system constraint.
2. Decide how to exploit the constraint.
3. Subordinate everything else.
4. Elevate the constraint.
5. Go back to step one.

Theory of equally likely outcomes - if an experiment has n possible outcomes, and (for example, by symmetry) there is no reason that any of the n possible outcomes should occur preferentially to any of the others, then the chance of each outcome is $100\%/n$. Each of these theories has its limitations, its proponents, and its detractors.

Theory of probability - a way of assigning meaning to probability statements that is, a theory of probability connects the mathematics of probability, which is the set of consequences of the axioms of probability, with the real world of observation and experiment

Frequency theory of probability, the probability of an event is the limit of the percentage of times that the event occurs in repeated, independent trials under essentially the same circumstances.

Subjective theory of probability, a probability is a number that measures how strongly we believe an event will occur. The number is on a scale of 0% to 100%, with 0% indicating that we are completely sure it won't occur, and 100% indicating that we are completely sure that it will occur.

30,000 Foot-level: a six sigma kpov, ctq, or y variable response that is used in s4/iee to describe a high level project or operation metric that has infrequent subgrouping/sampling such that short-term variations, which might be caused by kpivs, will result in charts that view these perturbations as common cause issues. A 30,000 foot-level xmr chart can reduce the amount of fire fighting in an organization when used to report operational metrics.

360-Degree evaluation a method for evaluating performance with input from supervisors, peers, and employees.

Three spheres of quality - quality management, assurance, and control.

Three ts - the task, treatment, and tangibles in service -design.

Tiger teams - teams with a specific defined goal and a short time frame to attain the goal.

Tolerance design - the act of determining the amount of allowable variability around parameters.

Total quality - used together, these words are usually meant to recognize that real quality requires all elements of the organization to work together toward achieving that end. It means to strive for excellence in everything an organization does. It refers to a concept whereas total quality management refers to a collection of practices.

TQC - total quality control... A term used to describe an approach in which an organization strives to achieve excellence in all aspects of its endeavors and activities. Frequent use of the term total quality control probably started with the book what is total quality control by kaoru ishikawa [1985] but the term originated with armand feigenbaum in his 1961 book by that name.

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

TQE - total quality in education tqm methods and practices applied to education.

TQHRM - total quality human resources management an approach to human resources management that involves many of the concepts of quality management. The primary purpose of this approach is to provide employees a supportive and empowered work environment.

TQI - total quality improvement - a term now used by some organizations (e.G., Hospitals) in place of tqm.

TQM - total quality management. A collection of methods and practices an organization uses in an attempt to achieve total quality. Often used loosely as a general statement of purpose, tqm does not represent a specific method or set of methods, nor does it appear to represent a theory for transformation of organizations.

Training needs - analysis the process of identifying organizational needs in terms of capabilities, task needs assessment in terms of skill sets that are needed within the firm, and individual needs analysis to determine how employee skills fit with company needs.

Training needs assessment - a process for gathering organizational data relative to finding areas where training is most needed.

Training program design - a term that describes the process of tailoring a course or set of courses to meet the needs of a company.

Trait dimension - a view of leadership that states that leadership potential is related to the "traits" of an individual, such as height.

Transcendent - a definition of quality that states that quality is something we all recognize but we cannot verbally define.

Tree diagram - a tool used to identify the steps needed to address a particular problem. Graphically shows any broad goal broken into different levels of detailed actions. It encourages team members to expand their thinking when creating solutions

Type I and type II errors - a type I error occurs when the null hypothesis is rejected erroneously when it is in fact true. A type II error occurs if the null hypothesis is not rejected when it is in fact false. See also significance level and power.

U

u chart - a chart used to monitor the number of defects in sequential production lots.

Undeveloped events - a term used in fault tree analysis. Undeveloped events are faults that do not have a significant consequence or are not expanded because there is not sufficient information available.

Unified theory for services management - a set of propositions relative to managing services.

Upstream - if the process by which something is accomplished or produced is thought of as a "flow" from one stage of the process to another, then "upstream" refers to the stages of the process that come before the stage that serves as the reference point. Improvements or innovations made upstream in a process (e.G., Design of product or process) often can have high-leverage impact on results downstream.

User-based - a definition of service or product quality that is customer centered.

User group - a voluntary and often informal association of individuals or organizations that are "using" a particular method, or theory and wish to share information, discuss common issues and/or pool resources to accomplish their respective goals. Aptly described as "a safe place to discuss ideas and problems". [Origin: users of specific computer hardware and/or software].

V

value - "worth in usefulness or importance to the possessor; utility or merit." (American heritage dictionary) "price without a measure of quality is meaningless" (deming) value is a combination of attributes, including quality. Some writers include price in the definition of value.

Value-added - a customer-based perspective on quality that is used by services, manufacturing, and public sector organizations. The concept of value-added involves a subjective assessment of the efficacy of every step in the process for the customer.

Value-based - a definition of quality relating to the social benefit from a product or service.

Value chain - a tool, developed by michael porter, that decomposes a firm into its core activities.

Value chain activities - Porter's chain of activities, including inbound logistics, production, and outbound -logistics.

Value system - a network of value chains.

Variable - a characteristic that may take on different values.

Variables data - data arising by obtaining a quantitative measure of a characteristic on an individual item or event. Often used to describe continuous data.

Variance - the mean of squared deviations of individual values from the average. Is a measure of spread.

Variation - any quantifiable difference between individual "items". In business variation is often concerned with the differences between actual outcomes and what is expected by the customer. All variation is caused which can be classified as being due to common causes (random) or special causes (assignable).

Variety - the range of product and service choices offered to customers.

Vertical deployment - a term denoting that all of the levels of the management of a firm are involved in the firm's quality efforts.

Virtual teams - teams that do not physically meet but are linked together through intranets and the internet.

Vision - picturing something as it ought to be or as you would want it to be in its ideal state.

Voice of the customer (1) a term that refers to the wants, opinions, perceptions, and desires of the customer.

Voice of the customer (2) - the needs and wants of the customer (or aggregate of customers) for a service or product that typically is expressed as a "target", but in the past was usually expressed as a set of tolerances (a "target" with

acceptable deviations in either direction). This information provides the basis for designing and managing the process. A process sometimes used to translate the customer voice into product and process planning is quality function deployment (qfd).

Voice of the process - whatever the process is producing (the outcomes). How this gets reported will depend on the sampling and measurement methods used. How the reported information gets translated will depend on the knowledge the interpreter has about that process, about variation and about systems.

W

Waste - anything that consumes the organization's resources without adding value to the final product or service. Uneconomic use of resources.

Whack-a-mole - a novel term that describes the process of solving a problem only to have another problem surface.

Willing worker - an employee who would like to do a good job, but is prevented from doing so because of the presence of barriers that only management can remedy (a deming term).

Working prototype - A functioning mock-up or model of a product.

X

x chart - a chart used to monitor the mean of a process for population values.

$X + (xy) = 8$ - equation used in various forms by dr. Deming to illustrate the point that the observed "performance" of an individual is actually a combination of the individual's effort and ability and the effect of the system. In the equation, 8 is an arbitrary number used to represent an observed result; x is the contribution of the individual to the result; xy is the effect of the system on the result. This equation with two unknowns cannot be solved uniquely for x. When performance of a collection of individuals is rank-ordered, the rank-ordering is not a ranking of the individual performances as is often thought, but rather is a ranking of the total outcomes of the individual's efforts and the interaction of the individual with the system. Values of xy are, almost certainly, different for each individual in that system. Thus, one cannot solve the equation, at one point in time, to evaluate individual effort and performance...Leading to the conclusion that performance reviews and merit systems are seriously flawed when they are designed to rate or rank individual performance.

Y

Yield the ratio of good to number of units produced by a process.

Z

z-score - the observed value of the z statistic

z statistic - a test statistic whose distribution under the null hypothesis has expected value zero and can be approximated well by the normal curve. Usually, z statistics are constructed by standardizing some other statistic. The z statistic is related to the original statistic by

z-test - an hypothesis test based on approximating the probability histogram of the z statistic under the null hypothesis by the normal curve

zero defects - the quality concept of zero tolerance for defects

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