

Six Sigma Glossary

Affinity diagram: An organization of individual pieces of information into groups of broader categories.

Analysis of Variance: A technique which subdivides the total variation of a set of data into meaningful component parts associated with specific sources of variation for the purpose of testing some hypothesis on the parameters of the model or estimating variance components.

ANOVA: A statistical test for identifying significant differences between process or system treatments or conditions, performed by comparing the variances around the means of the conditions being compared.

Attribute data: Data that has a set of discrete values such as pass or fail, yes or no.

Average: Also called the mean, it is the arithmetic average of all of the sample values. It is calculated by adding all of the sample values together and dividing by the number of elements (n) in the sample.

Bar chart: A graphical method depicting data grouped by category.

Breakthrough improvement: A rate of improvement at or near 70% over baseline performance of the as-is process characteristic.

Capability: A comparison of the required operation width of a process or system to its actual performance width. Expressed as a percentage (yield), a defect rate (DPM,DPMO), an index (Cp,Cpk,Pp,Ppk), or as a sigma score (Z).

Cause-and-effect diagram: See fishbone diagram.

Central tendency: A measure of the point about which a group of values is clustered; two measures of central tendency are the mean and the median.

Characteristic: A process input or output that can be measured or monitored.

Common cause of variation: Those sources of variability in a process that are truly random; that is, inherent in the process itself.

Complexity: The level of difficulty to build, solve, or understand something based on the number of inputs, interactions, and uncertainties involved.

Confidence limits: The end points of the interval about the sample statistic that is believed, with a specified confidence coefficient, to include the population parameter.

Consumer's risk (β): For a given sampling plan, the probability of acceptance of a lot, the quality of which has a designated numerical value representing a level which it is unlikely to be acceptable.

Control chart: The most powerful tool of statistical process control. It consists of a run chart, statistically determined upper and lower control limits, and a centreline.

Control limits: Upper and lower bounds in a control chart that are determined by the process itself. They can be used to detect special or common causes of variation. They are usually set at ± 3 standard deviations from the central tendency.

Correlation coefficient: A number between -1 and 1 that indicates the degree of linear relationship between two sets of numbers.

Cost of poor quality (COPQ): The costs associated with any activity that is not done “right first time”.

Cp: A capability measure defined as the ratio of the specification width to short-term process performance width.

Cpk: An adjusted short-term capability index that reduces the capability score in proportion to the offset of the process centre from the specification target.

Critical-to-quality (CTQ): Any characteristic that is critical to the perceived quality of the product, process, or system.

Critical X: An input to a process or system that has a significant influence on any one or all of the key outputs of a process.

Customer: Anyone who uses or consumes the output of a process, whether internal or external to the organisation.

Defect: An output of a process that fails to meet a defined specification or requirement, such as time, length, colour, finish, quantity, temperature, and so on.

Defective: A unit or product or service that contains *at least one defect*.

Deployment: The planning, launch, training, implementation, and management of a Six Sigma initiative within a company.

Design for Six Sigma (DFSS): The use of Six Sigma thinking tools, and methods applied to the design of products and services to improve manufacturability initial release performance, ongoing reliability, and life-cycle cost.

Design of experiments (DOE): An efficient, structured, and proven approach to investigating a process or system to understand and optimise its performance.

DMAIC: The acronym for the five core phases of the Six Sigma methodology: Define, Measure, Analyze, Improve, and Control; used to solve process and business problems through data and analytical methods.

DPMO (defects per million opportunities): The total number of defects observed divided by the total number of opportunities, expressed in events per million. Sometimes called Defects per Million (DPM).

DPU (defects per unit): The total number of defects detected in some number of units divided by the total number of those units.

Factor: An assignable cause which may affect the responses (test results) and of which different versions (levels) are included in the experiment.

Factorial experiments: Experiments in which all possible treatment combinations from two or more factors, each being studied at two or more versions (levels), are examined so that interactions as well as main effects can be estimated.

Failure Mode Effects Analysis (FMEA): A procedure used to identify, assess, and mitigate risks associated with potential failure modes in a product, system, or process.

Fishbone diagram: A pictorial diagram in the shape of a fishbone showing all possible variables that could affect a given process output measure. Can also be used to display potential solutions to problems.

Flowchart: A graphic model of the flow activities, material, and/or information that occurs during a process.

Gauge R & R: The quantitative assessment of how much variation (repeatability and reproducibility) is in a measurement system compared to the total variation of the process or system.

Hidden factor or operation: Corrective and non-value-added work applied to produce a unit of output generally not properly recognised as unnecessary and a form of waste of time, resources, materials and cost.

Histogram: A plot of the frequency distribution in the form of rectangles whose bases are equal to the cell interval and whose areas are proportional to the frequencies.

Hypothesis, alternative (Ha): The hypothesis that is accepted if the null hypothesis is disproved.

Hypothesis, null (Ho): The hypothesis tested in tests of significance is that there is no difference (null) between the population of the sample and specified population.

Input: A resource consumed, utilized, or added to a process or system. Often described as X, characteristic or input variable.

Ishikawa diagram: See fishbone diagram.

Kurtosis: A measure of the shape of a distribution. A positive value indicates that the distribution has longer tails than the normal distribution (platykurtosis); while a negative value indicates that the distribution has shorter tails (leptokurtosis). For the normal distribution, the kurtosis is 0.

Least squares: A method of curve-fitting that defines the best fit as the one that minimizes the sum of the squared deviations of the data points from the fitted curve.

Long-term variation: The observed variation of an input or output characteristic that has had the opportunity to experience the majority of the variation effects that influence it.

Lower control limit (LCL): For control charts: the limit above which the sub-group statistics must remain for the process to be in control; typically three standard deviations below the central line.

Lower specification limit (LSL): The lowest value of a characteristic that is acceptable.

Mean: A measure of the location of a distribution.

Measurement accuracy: For a repeated measurement, it is a comparison of the average of the measurements compared to some known standard.

Measurement precision: For a repeated measurement, it is the amount of variation that exists in the measured values.

Measurement Systems Analysis (MSA): The assessment of the accuracy and precision of a method for obtaining measurements.

Median: The middle value of a data set when the values are arranged in either ascending or descending order.

Metric: A measure that is considered to be a key indicator of performance. It should be linked to goals or objectives and carefully monitored.

Normal distribution: The distribution characterized by the smooth, bell-shaped curve; also called the Gaussian distribution.

Objective statement: A succinct statement of the goals, timing, and expectations of a Six Sigma improve project.

Opportunities: The number of characteristics, parameters, or features of a product or service that can be classified as acceptable or unacceptable in the eyes of the customer.

Out of control: A process is out of control if it exhibits variations larger than its control limits or shows a pattern of variation.

Output: A resource item, or characteristic that is the product of a process or system.

Parameter: A constant or coefficient that describes some characteristic of a population (e.g. standard deviation, average, regression coefficient).

Pareto chart: A bar chart for attribute data where the categories are presented in descending order of frequency.

Pareto Principle: The general principle originally proposed by Vilfredo Pareto (1848-1923) that the majority of influence on an outcome is exerted by a minority of input factors.

Poka-Yoke: A Japanese term meaning “to mistake proof”.

Population: the total number of items or units under consideration.

Probability: The likelihood of an event or circumstance occurring.

Problem statement: A succinct statement of a business situation used to bound and describe the problem that an improvement project is destined to solve.

Process: A set of activities, material and/or information flow that transforms a set of inputs into outputs for the purpose of producing a product, providing a service, performing a task.

Random sampling: The process of selecting units for a sample of size n in such a manner that all combinations of n units under consideration have an equal or ascertainable chance of being selected as the sample.

Range: A measure of the variability in a data set; the difference between the largest and smallest values in a data set.

Regression analysis: A statistical technique for determining the mathematical relation between a measured quantity and the variables upon which it depends, includes simple and multiple linear regression.

Repeatability: The extent to which repeated measurements of a particular object with a particular instrument produce the same value.

Replication: The repetition of the set of all the treatment combinations to be compared in an experiment. Each of the repetitions is called a *replicate*.

Reproducibility: the extent to which repeated measurements of a particular object with a particular individual produce the same value.

Rework: Activities required to correct defects produced by a process.

Risk priority number (RPN): In failure mode effects analysis, the aggregate score of a failure mode including its severity, frequency of occurrence, and ability to be detected.

Rolled throughput yield (RTY): The probability of a unit going through all steps or system characteristics with zero defects.

Run chart: A graphical tool for charting the performance of a characteristic over time.

Sample: A group of units or observations taken from a larger collection of units, or observations that provides information to be used as a basis for making decisions concerning the larger quantity.

Scatter plot: A chart in which one variable is plotted against another to observe or determine the relationship, if any between the two.

Screening experiment: A type of experiment used to identify the subset of significant factors from among a large group of potential factors.

Short-term variation: The amount of variation observed in a characteristic that has not had the opportunity to experience all the sources of variation from the inputs acting on it.

Sigma score: A commonly used measure of process capability that represents the number of short-term standard deviations between the centre of a process and the closest specification limit. Sometimes referred to as sigma level, or process Sigma. Also call the Z score.

Significant Y: The output of a process that exerts a significant influence on the success of the process or customer satisfaction.

SIPOC (Suppliers-Inputs-Process-Outputs-Customers): A visual representation of a process or system where inputs are represented by input arrows to a box (representing the process or system) and outputs are shown using arrows coming out of the box.

Skewness: A measure of the symmetry of a distribution. A positive value indicates that the distribution has a greater tendency to tail to the right (positively skewed or skewed to the right), and a negative value indicates a greater tendency of the distribution to tail to the left (negatively skewed or skewed to the left) Skewness is 0 for a normal distribution.

Special cause variation: Those non-random causes of variation that can be detected by the use of control charts and good process documentation.

Specification limits: The bounds of acceptable performance for a characteristic.

Stability: A process with no recognizable pattern of change and no special causes of variation.

Standard deviation:

1. σ population standard deviation. A measure of variability (dispersion) of observations that is the positive square root of the *population* variance.
2. s sample standard deviation. A measure of variability that is the positive square root of the *sample* variance.

Statistic: A quantity calculated from a sample of observations, most often to form an estimate of some population parameter.

Statistical process control (SPC): The use of basic graphical and statistical methods for measuring, analyzing, and controlling the variation of a process for the purpose of continuously improving the process. A process is said to be in a state of statistical control when it exhibits only random variation.

Supplier: An individual or entity that provides an input to a process in the form of resources or information.

Trend: A gradual systematic change over time (or some other variable)

Two-level design: An experiment where all factors are set at one or two levels, denoted as low and high (-1 and +1)

Upper control limit (UCL): The upper limit below which a process statistic must remain to be in control. Typically, this value is 3 standard deviations above the central tendency.

Upper specification limit (USL): The highest value of a characteristic that is acceptable.

Variability: The property of a characteristic, process, or system to take on different values when it is repeated.

Variables: Quantities that are subject to change or variability.

VOC (voice of the customer): The expressed and non-expressed needs, wants, and desires of a customer; usually expressed as specifications, requirements, or expectations.

VOP (voice of the process): The performance and capability of a process to achieve both business and customer needs; usually expressed in some form of an efficiency and/or effectiveness metric.

X: An input characteristic to a process or system. In Six Sigma, it is usually used in the expression of $Y=f(X)$, where the output Y is a function of the inputs (X)

Y: An output characteristic of a process. In Six Sigma, it is usually used in the expression of $Y=f(X)$, where the output Y is a function of the inputs (X)

Z score: See sigma score.