

# Lean Six Sigma Terminology

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**1-Sample Sign Test** – This is used to test the probability of a sample median being equal to hypothesized value.

**2-Sample t-Test** – Used for testing hypothesis about the location two sample means being equal.

**5 Why's** - The 5 why's typically refers to the practice of asking, five times, why the failure has occurred in order to get to the root cause/causes of the problem.

**5S plus Safety** - A process and method for creating and maintaining an organized, clean and high performance workplace. Sort, Straighten, Shine, Standardize, Sustain plus Safety.

**Accuracy** – The average difference observed between a gage under evaluation and a master gage when measuring the same parts over multiple readings.

**Affinity Diagram** – A tool used to organize and present large amounts of data (ideas, issues, solutions, problems) into logical categories based on user perceived relationships and conceptual frame working. Often used in the form of “sticky notes” sent up to the front of the room in brainstorming exercises, and then grouped by facilitator and workers. Final diagram shows relationship between the issue and the category. Then categories are ranked, and duplicate issues are combined to make a simpler overview.

**Alpha Risk** – The probability of accepting the alternate hypothesis

**Alternative Hypothesis** – A tentative explanation which indicates that an event does not follow a chance distribution; a contrast to the null hypothesis.

**Analysis of Variance (ANOVA)** – A statistical method for evaluating the effect that factors have on process mean and for evaluating the differences between the means of two or more normal distributions.

**Attribute Agreement Analysis** – A type of measurement systems analysis that evaluates repeatability, reproducibility, and overall accuracy of appraisers. This is done by using a master (known value) against the performance of two or more appraisers and comparing the results in a subjective test. The objective standard is necessary to measure the individual results, and then relate them to each other.

**Average** – Sum of all measurements divided by the total number of measurements. Statistic which is used to estimate the population mean. Same as MEAN.

**Baseline** – A snapshot of the state of inputs/outputs frozen at a point in time for a particular process. A baseline should be recorded to establish a starting point to measure the changes achieved with any process improvement.

**Batching** – Inefficient buildup or storing or holding; backlog

**Benchmarking** – An improvement process whereby a company measures its performance against that of best-in-class companies, determines how those companies achieved their performance levels, and uses the information to improve its own performance.

**Beta Risk** – The probability of accepting the null hypothesis when, in fact it is false.

**Bias** – Systematic error which leads to a difference between the average result of a population of measurements and the true accepted value of the quantity being measured.

**Bimodal Distribution** – Distribution is one in which 2 values occur more frequently in data set than rest of the values.

**Black Belt** – Full-time Six Sigma project leader who is certified following a four-month training and application program and successful completion of two Six Sigma Projects, the first under the guidance of a Master Black Belt, the second more autonomously.

**Blocking** – Blocking neutralizes background variables that cannot be eliminated by randomizing. It does so by spreading them across the experiment.

**Box Plot** – A box plot, also known as a box and whisker diagram, is a basic graphing tool that displays centering, spread, and distribution of a continuous data set. A box and whisker plot provides a 5 point summary of the data.

**Brainstorm** – Open, unhampered thinking. Idea generation

**Burning Platform** – An issue that is “critical” to the organization, the strategic plan, and the customer.

**Capability Indices** – A mathematical calculation used to compare the process variation to a specification. Examples are Cp, Cpk, Pp, PpK, Zst, and Zlt.

**Causality** – The principle that every change implies the operation of a cause.

**Cause and Effects Matrix** – A matrix used by teams to evaluate problems or possible solutions.

**Central Limit Theorem** - The central limit theorem states that given a distribution with a mean  $m$  and variance  $s^2$ , the sampling distribution of the mean approaches a normal distribution with a mean and variance  $/N$  as  $N$ , the sample size, increases. The central limit theorem explains why many distributions tend to be close to the normal distribution.

**Central Tendency** – An indication of the location or centrality of the data. The most common measures of central tendency are: mean (numerical average), median (the midpoint of an order data set such that half of the data points are above and half are below it) and the mode (the value that occurs most frequently)

**Champion** – An executive level business leader who facilitates the leadership, implementation, and deployment of Six Sigma philosophies.

**Change** – In Lean terms, a process improvement that will save time and better serve customers.

**Check Sheet** – Form used to capture real-time quantitative or qualitative data for a variety of purposes. The check sheet is designed, with operational definitions, so that data can be categorized on the check sheet as it is recorded. Check-sheet data often results in analysis in the form of a histogram, bar chart or Pareto chart.

**Chi-Square** – The test statistic used when testing the null hypothesis of independence in a contingency table or when testing a null hypothesis of a set of data following a prescribed distribution.

**Clean Sheet Redesign** – Redesign of process, removing waste, steps, handoffs, delays

**Common Cause Variation (Noise)** – Causes of variation that are inherent in a process over time. They affect every outcome of the process and everyone working in the process.

**Confidence Intervals** – Range within which a parameter of population (e.g. mean, standard deviation, etc.) may be expected to fall, on the basis of measurement, with some specified confidence level or confidence coefficient.

**Confidence Level** – The probability that a randomly distributed variable “x” lies within a defined interval of a normal curve.

**Confidence Limits** – The two values that define the confidence interval.

**Confounding** – Allowing two or more variables to vary together so that it is impossible to separate their unique effects.

**Continuous Data** – Data obtained from a measurement system which has an infinite number of possible outcomes.

**Continuous Improvement** – Adopting new activities and eliminating those which are found to add little or no value. The goal is to increase effectiveness by reducing inefficiencies, frustrations, and waste (rework, time, effort, material, etc.). The Japanese term is Kaizen, which is taken from the words “Kai” means change and “zen” means good.

**Control Chart** – also known as process - behavior charts, are tools used to determine whether a manufacturing or business process is in a state of statistical control. It shows the amount of variation in a process. Visually shows if the process is stable or not.

**Control Limits** – Apply to both range or standard deviation and subgroup average (X) portions of process control charts and are used to determine the state of statistical control. Control limits are derived statistically and are not related to engineering specification limits in any way.

**Control Plan** – A formal quality document that describes all of the elements required to control variations in a particular process or could apply to a complete product or family of products.

**Correlation** – The relationship between two sets of data such that when one changes, the other is likely to make a corresponding change. Also, a statistical tool for determining the relationship between two sets of data.

**Cost of Poor Quality** – Cost associated with providing poor quality products or (COPQ) services. Can be divided into four cost categories: Appraisal, Scrap, Rework, and Field Complaint (warranty costs).

**Cp** – A widely used capability index for process capability studies. It may range in value from zero to infinity with a larger value indicating a more capable process. Six Sigma represents Cp of 2.0.

**Cpk** – An index combining Cp and K (Difference between the process mean and the specification mean) to determine whether the process will produce units within tolerance. Cpk is always less than or equal to Cp. When the process is centered at nominal, Cpk is equal to Cp.

**Critical to Customer** – This is the input to the Quality Function Deployment activity, for the customer requirements side of the analysis. Not same as CTQ. CTQ's are the internal critical quality parameters that RELATE to these customer-critical parameters. QFD relates the two, and leads to the DFMEA efforts which quantify the severity and frequency of occurrence of failure to meet the CTQ's and thus the CTC's by relationship. Car door sound when closing might be a CTC, while the dimensional tolerances and cushioning that produce those conditions are CTQ's for the auto maker.

**Critical To Quality (CTQ)** – An element of a design or a characteristic of a part that is essential to quality in the eyes of the customer.

**CT Flowdown** – The cause and effect chain of critical factors related to any process or product. Customer - someone for whom work or a service is performed. Customers can be either internal or external to the organization.

**Dashboards** – Term for a series of key measures (e.g., the various gages on a car dashboard that must be monitored while driving).

**Data** – Factual information used as a basis for reasoning, discussion, or calculation; often refers to quantitative information.

**Data Collection Plan** – Data collection is any process of preparing and collecting data, for example, as part of a process improvement or similar project. The purpose of data collection is to obtain information to keep on record, to make decisions about important issues, or to pass information on to others.

**Defect** – Unacceptable to the customer. Waste

**Defective** – A unit of product containing one or more defects.

**Defects Per Million Opportunities (DPMO)** – The number of defects counted, divided by the actual number of opportunities to make a defect, and then multiplied by one million. A direct measure of sigma level.

**Defects Per Unit (DPU)** – The number of defects counted, divided by the number of products or characteristics produced. A process of counting and reducing defects as an initial step toward Six Sigma quality.

**Descriptive Statistics** – Descriptive statistics is a method of statistical analysis of numeric data, discrete or continuous, that provides information about centering, spread, and normality. Results of the analysis can be in tabular or graphic format.

**Design of Experiments (DOE)** – Statistical experimental designs to economically improve product and process quality. A major tool used during the “Improve Phase” of Six Sigma methodology.

**Discrete Data** – Data obtained from a measurement system which has a finite number of possible outcomes.

**Distributions** – Tendency of large numbers of observations to group themselves around some central value with a certain amount of variation or “scatter” on either side.

**DMAIC** – Define, Measure, Analyze, Improve, Control. Basic Lean method for process improvement

**Effect** – That which was produced by a cause.

**Experiment** – A test under defined conditions to determine an unknown effect; to illustrate or verify a known law; to test or establish a hypothesis.

**F Statistic** – A test statistic used to compare the variance from two normal populations.

**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 formed from two or more factors, each being studied at two or more versions (levels), are examined so that interactions (differential effects) as well as main effects can be estimated.

**Failure Mode Effects Analysis (FMEA)** – A process in which each potential failure mode in every sub-item of an item is analyzed to determine its effect on other sub-items and on the required function of the item.

**FIFO** – First In, First Out; “Take one, Make one” Produces at a steady rate or flow.

**FISH** – First In, Still Here; Representative of batching or accumulated backlog or inventory. May be work in process as well.

**Fishbone Diagram** – A schematic sketch, usually resembling a fishbone, which illustrates the main causes and sub-causes leading to an effect (symptom).

**Force Field analysis** – Identifies force and factors, both restraining and driving, effect the solution of an issue or problem so that the positives can be reinforced and/or negatives reduced or eliminated.

**Four Voices** – Voice of the Business, Voice of the Customer, Voice of the Employees, and Voice of the Process. Often used in project identification.

**Fractional Factorial Experiment** – A fractional factorial design of experiment (DOE) includes selected combinations of factors and levels. It is a carefully prescribed and representative subset of a full factorial design. A fractional factorial DOE is useful when the number of potential factors is relatively large because they reduce the total number of runs required. By reducing the number of runs, a fractional factorial DOE will not be able to evaluate the impact of some of the factors

independently. In general, higher-order interactions are confounded with main effects or lower-order interactions. Because higher order interactions are rare, usually you can assume that their effect is minimal and that the observed effect is caused by the main effect or lower-level interaction.

**Full Factorial** – A full factorial design of experiment (DOE) measures the response of every possible combination of factors and factor levels. These responses are analyzed to provide information about every main effect and every interaction effect. A full factorial DOE is practical when fewer than five factors are being investigated. Testing all combinations of factor levels becomes too expensive and time-consuming with five or more factors.

**Gage Repeatability & Reproducibility (Gage R&R)** – A measurement system evaluation to determine equipment variation and appraiser variation. This study is critical to ensure that the collected data is accurate.

**Gantt Chart** – A Gantt chart is a powerful and preferred visual reporting device used for conveying a project's schedule. A typical Gantt chart graphically displays the work breakdown, total duration needed to complete tasks, as well as %completion. The Gantt chart itself will not display level of effort, and is not an effective planning tool on its own. Today, Gantt Charts may be integrated with other spreadsheet-type reporting devices that convey additional information related to project planning. Furthermore, Gantt Charts are often enhanced with functionality that includes the identification of relationships between tasks, and the ability to dynamically change task attributes.

**General Linear Model** – General Linear Model (GLM) is a tool used to analyze the participation of each x's in creating defects for Project Y. This can be used to compliment the result of a Pareto Chart where the 80:20 ratio is analyzed and worked upon. Also in cases where none of the Potential x's could prove its significance as a part of the 'Analyze' phase, this tool can be used to enquire/attain information as to the contribution of each potential x's in creating a defect for your Project Y.

**Green Belt** – An employee of an organization who has been trained on the improvement methodology of Six Sigma and will lead a process improvement or quality improvement team as 'part' of their full time job. Their degree of knowledge and skills associated with Six Sigma is less than that of a Black Belt or Master Black Belt.

**GRPI Model** – GRPI stands for four critical and interrelated aspects of teamwork: goals, roles, processes, and interpersonal relationships, and it is a tool used to assess them.

**Hawthorn Effect** - Improved process data that results from process operators who know their process performance is being measured and exercise more care in the execution of the process than would normally be done.

**Histogram** – In statistics, a histogram is a graphical representation showing a visual impression of the distribution of data.

**Hypothesis** – When used as a statistical term, it is a theory proposed or postulated for comparing means and standard deviations of two or more data sets. A "null" hypothesis states that the data sets are from the same statistical population, while the "alternate" hypothesis states that the data sets are not from the same statistical population.

**Hypothesis Tests, Alternative** – The hypothesis that is accepted if the null hypothesis is disproved. The choice of alternative, hypothesis will determine whether "one-tail" or "two-tail" tests are appropriate.



**Hypothesis Tests, Null** – The hypothesis tested in tests of significance is that there is no difference (null) between the population of the sample and specified population (or between the populations associated with each sample). The null hypothesis can never be proved true. It can, however, be shown with specified risks of error, to be untrue; that is, a difference can be shown to exist between the populations. If it is not disproved, one may surmise that it is true. (It may be that there is insufficient power to prove the existence of a difference rather than that there is no difference; that is, the sample size may be too small. By specifying the minimum difference that one wants to detect and P, the risk of failing to detect a difference of this size, the actual sample size required, however, can be determined.)

**IMR Chart** – An I-MR chart, or individual and moving range chart, is a graphical tool that displays process variation over time. It signals when a process may be going out of control and shows where to look for sources of special cause variation.

**Includes/Excludes** – Includes/Excludes is a tool that can help your team define the boundaries of your project, facilitate discussion about issues related to your project scope, and challenge you to agree on what is included and excluded within the scope of your work.

**Independent Variable** – A controlled variable; a variable whose value is independent of the value of another variable.

**Intangible Benefits** – Intangible benefits, also called soft benefits, are the gains attributable to your improvement project that are not reportable for formal accounting purposes. These benefits are not included in the financial calculations because they are nonmonetary or are difficult to measure.

**Interaction** – When the effects of a factor A are not the same at all levels of another factor B.

**Interaction Plot** – A graphical display showing how two factors (input variables) interact if one factor's effect on the response is dependent upon the level of the other factor.

**Interval** – Numeric categories with equal units of measure but no absolute zero point, i.e., quality scale or index.

**Just-In-Time (JIT)** – A manufacturing practice pioneered by the Toyota Motor Company where each workstation acquires the required materials from upstream workstations precisely as needed.

**Kaizen** – Japanese for "improvement", or "change for the better" refers to philosophy or practices that focus upon continuous improvement of processes in manufacturing and business management

**Kaizen Event** – A five day intensive study, decomposition and re-engineering of an organizational process, typically targeting process steps, handoffs, and delays with a goal to improve by a minimum of 50%.

**Kamishibai Boards** – As part of the Toyota production system, kamishibai boards are used as a visual control for performing audits within a manufacturing process. A series of cards are placed on a board and selected at random or according to schedule by supervisors and managers of the area. This ensures safety and cleanliness of the workplace is maintained and that quality checks are being performed.

**Kanban** – Japanese work for signal. It is used in a pull system to signal when production is to start, an can take a number of forms (e.g., cards, boards, lights, bins, etc.).

**Kano model** – Kano analysis is a tool which can be used to classify and prioritize customer needs. This is useful because customer needs are not all of the same kind, not all have the same importance, and are different for different populations. The results can be used to prioritize your effort in satisfying different customers. Briefly, Kano (a Japanese researcher), stated that there are four types of customer needs, or reactions to product characteristics / attributes: Surprise or Delight, More is Better, Must Be things and Dis-satisfiers

**Key Performance Indicators (KPIs)** – Is a type of performance measurement. KPIs are commonly used by an organization to evaluate its success or the success of a particular activity in which it is engaged. Sometimes success is defined in terms of making progress toward strategic goals, but often success is simply the repeated achievement of some level of operational goal (for example, zero defects, 10/10 customer satisfaction, etc.).

**Kruskal-Wallis** – Performs a hypothesis test of the equality of population medians for a one-way design (two or more populations). This test is a generalization of the procedure used by the Mann-Whitney test and, like Mood's median test, offers a nonparametric alternative to the one-way analysis of variance. The Kruskal-Wallis test looks for differences among the populations medians.

**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 normal distribution, the kurtosis is 0.

**Lead Time** – The amount of time, defined by the supplier that is required to meet a customer request or demand. (Note: Lead Time is not the same as Cycle Time).

**Lean** – organizational process of finding and eliminating waste and speeding up processes.

**Lean Tools** – Tools and techniques taken from the Lean/Six Sigma discipline that can be applied over time to smaller or less critical issues (sometimes referred to as “bottom-up” projects). (DMAIC, SIPOC)

**Lower Control Limit** – A horizontal dotted line plotted on a control chart which represents the lower process limit capabilities of a process.

**Main Effects** – A main effect is a measurement of the average change in the output when a factor is changed from its low level to its high level.

**Mann-Whitney** – Performs a hypothesis test of the equality of two population medians and calculates the corresponding point estimate and confidence interval. Use this test as a nonparametric alternative to the two-sample t-test.

**Maslow's Hierarchy** – Motivation theory which suggests five interdependent levels of basic human needs (motivators) that must be satisfied in a strict sequence starting with the lowest level.

**Master Black Belt** – A person who is “expert” on Six Sigma techniques and on project implementation. Master Black Belts play a major role in training, coaching and in removing barriers to successful project execution in addition to overall promotion of the Six Sigma philosophy.

**Measurement System Analysis (MSA)** – Means of evaluating a continuous or discrete measurement system to quantify the amount of variation contributed by the measurement system.



**Median** – The mid value in a group of measurements when ordered from low to high.

**Metrics** – Things to measure to understand quality levels. Metric means measurement. Hence the word metric is often used in an organization to understand the metrics of the matrix (The tradeoff).

**Minitab** – Statistical software package that operates on Microsoft Windows with a spreadsheet format and has powerful statistical analysis ability.

**Mood's Median** – Mood's median test can be used to test the equality of medians from two or more populations and, like the Kruskal-Wallis Test, provides a nonparametric alternative to the one-way analysis of variance. Mood's median test is sometimes called a median tests.

**Muda** – The Japanese term for waste

**Multiple Regression** – Multiple regression is a method of determining the relationship between a continuous process output (Y) and several factors (Xs).

**Multi-vari** – Method used in the measure/analyze phase of Six Sigma to display in graphical terms the variation within parts, machines, or processes between machines or process parts, and over time.

**Multivariate Control Chart** – A control chart for evaluating the stability of a process in terms of the levels of two or more variables or characteristics n: sample size (the number of units in a sample).

**Mura** – Abnormality

**Muri** – Stress or strain

**Noise Variables** – Variables which are Hard or Expensive to control.

**Nominal Data** – The data related to gender, race, religious affiliation, political affiliation etc.; are the examples for Nominal data. In a more general form the data assigned with labels or names are considered as the data in Nominal scale. Since, each label or name indicates a separate category in the data; this data is also called as categorical data. The only comparison that can be made between two categorical variables is that they are equal or not, these variables cannot be compared with respect to the order of the labels.

**Nominal Group Technique** – A tool to bring a team in conflict to consensus on the relative importance of issues, problems, or solutions by completing individual importance ranking into a team's final priorities.

**Non-Parametric** – Set of tools that avoids assuming a particular distribution

**Non-Value Add** – Any activity that does not add form, feature or function to the product. Non-value activities include transportation, storage, inventory, handling, queues, machine repairs, etc.

**Non-Value Add but Necessary** – Does not add any form, feature or function to the product but is necessary by mandate, law or code

**Normal Distribution** – A continuous symmetrical density function characterized by a bell-shaped curve, e.g., distribution of sampling averages.

**Normality Test** – A normality test is a statistical process used to determine if a sample or any group of data fits a standard normal distribution. A normality test can be performed mathematically or graphically.

**Null Hypothesis** – An assertion to be proven by statistical analysis where two or more data sets are stated to be from the same population.

**One Piece Flow** – Refers to the concept of moving one work piece at a time between operations within a work cell

**One Tailed Test** – The value of a parameter which has an upper bound or a lower bound, but not both.

**Operational Definitions** – An exact description of how to derive a value for a characteristic you are measuring. It includes a precise definition of the characteristic and how, specifically, data collectors are to measure the characteristic. Used to remove ambiguity and ensure all data collectors have the same understanding. Reduces chances of disparate results between collectors after Measurement System Analysis.

**Ordinal** – Ordered categories (ranking) with no information about distance between each category, i.e., rank ordering of several measurements of an output parameter.

**Ordinal Data** – If the observations in a data are assigned with numbers which can be arranged in some order, the data is said to be in Ordinal scale. All the data sets consisting of ranks are examples for Ordinal data. These data can be compared with respect to their order.

**Out of Control** – Condition which applies to statistical process control chart where plot points fall outside of the control limits or fail an established run or trend criteria, all of which indicate that an assignable cause is present in the process.

**p-value** – It is equal to the significance level of the test for which we would only just reject the null hypothesis. The p-value is compared with the desired significance level of our test and, if it is smaller, the result is significant. That is, if the null hypothesis were to be rejected at the 5% significance level, this would be reported as " $p < 0.05$ ".

**Pareto Chart** – named after Vilfredo Pareto, a type of chart that contains bars, where individual values are represented in descending order by the bars.

**Pareto Principle** – 80% of the trouble comes from 20% of the problems (i.e. the vital few problems).

**Poisson Distribution** – A statistical distribution associated with attribute data (the number of non-continuities found in a unit) and can be used to predict first pass yield.

**Poka Yoke** – Any attempt at eliminating the root cause of defects prior to their occurrence. Also known as Defect Prevention or Mistake Proof.

**Population** – A group of similar items from which a sample is drawn. Often referred to as the universe. The entire set of items from which a sample is drawn.

**Power of an Experiment** – The probability of rejecting the null hypothesis when it is false and accepting the alternate hypothesis when it is true.

**Precision** – Lack of variation in your measurement. Can be measured in terms of the standard deviation of your measurement system. Has nothing to do with accuracy, which is lack of bias. A precise rifle will shoot small groups. An accurate rifle is properly sighted in.

**Probability** – The chance of something happening; the percent or number of occurrences over a large number of trials.

**Process** – A particular method of doing something, generally involving a number of steps or operations.

**Process Capability** – The relative ability of any process to produce consistent results centered on a desired target value when measured over time.

**Process Map** – Flow chart to analyze a process by breaking it down into its component steps, and then gaining a better understanding of the process, step-by-step. Pictorially representing a process, showing steps, decisions, inputs, etc.

**Project Approval Form** – A document or sheet that clearly scopes and identifies the purpose of an improvement project. Items specified include background case, purpose, team members, scope, and timeline.

**Project Champion (Sponsor)** – Business leaders and senior managers who ensure that resources are available for training and projects, and who are involved in project tollgate reviews.

**Project Scope** – Defined and specific project beginning and end points. The more specific the details what's in-scope and what's out of scope, the less a project may experience "scope creep".

**Project Scoping** – Preparation for Lean or Kaizen application. Summarizes project goals, measures, team members, out of scope issues and other issues that may impact a project.

**PUGH Matrix** – It is a scoring matrix used for concept selection, in which options are assigned scores relative to criteria. The selection is made based on the consolidated scores. Before you start your detailed design you must have many options so that you choose the best out of them.

**Pull** – Customer requested. The right thing at the right time. Produces a steady flow of production and delivery.

**Push** – Produced and delivered to customer. Not necessarily requested. Dumped into the system or process.

**Quality at the Source** – A concept in which each employee, department and/or other party must ensure the quality of every product.

**Quality Function Deployment (QFD)** – QFD is a disciplined matrix methodology used for documenting customer wants and needs – "the voice of the customer" – into operational "requirement" terms. It is an effective tool for determining critical-to-quality characteristics for transactional processes, services and products.

**Random** – Selecting a sample so each item in the population has an equal chance of being selected; lack of predictability; without pattern.

**Random Cause** – A source of variation which is random, usually associated with the “trivial many” process input variables, and which will not produce a highly predictable change in the process output response (dependent variable), e.g., a correlation does not exist; any individual source of variation results in a small amount of variation in the response; cannot be economically eliminated from a process; an inherent natural source of variation.

**Random Sample** – Selecting a sample such that each item in the population has an equal chance of being selected; lack of predictability; without pattern.

**Randomness** – A condition in which any individual event in a set of events has the same mathematical probability of occurrence as all other events within the specified set, i.e., individual events are not predictable even though they may collectively belong to a definable distribution.

**Range** – The difference between the highest and lowest values in a “subgroup” sample.

**Regression** – A statistical technique for determining the best mathematical expression that describes the functional relationship between one response and one or more independent variables.

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

**Repeatability** – A measure of the variation observed when a single operator uses a gage to measure a group of randomly ordered (but identifiable) parts on a repetitive basis.

**Replication** – Repeat observations made under identical test conditions.

**Report Out** – Preparation of summary slides and discussion points to present to senior leadership, colleagues and interested parties at the conclusion of a project event.

**Reproducibility** – A measure of average variation observed between operations when multiple operators use the same gage to measure a group of randomly ordered (but identifiable) parts on a repetitive basis.

**Residual** – The difference between an observed value and a predicted value

**Return on Investment (ROI)** – An indicator used to measure the financial savings/gain (or loss) of a project in relation to its cost. Typically, it is used in determining whether a project will yield positive financial benefits, and in turn giving approval to proceed. The formula for a Project ROI = (project's financial gain or loss – project's cost) / project's cost) X 100.

**R-Square** – A mathematical term describing how much variation is being explained by the X.

**Run Chart** – A run chart is a graph that displays observed data in a time sequence.

**Sample** – A portion of a population of data chosen to estimate some characteristic about the whole population. One or more observations drawn from a larger collection of observations or universe (population).

**Scatter Diagram** – A diagram that displays the relationships between two variables.

**Scorecard** – an on-going record to keep track of a process. Typically visual in nature.

**Sigma** – Standard deviation; an empirical measure based on the analysis of random variation in a standard distribution of values; a uniform distance from the mean or average value such that 68.26% of all values are within 1 sigma on either side of the mean, 95.44% are within 2 sigma, 99.73% are within 3 sigma, 99.9% are within 4 sigma and so forth.

**Sigma Level** – A statistical estimate of the number of defects that any process will produce equivalent to defects per million opportunities for that process.

**SigmaXL** – A graphical and statistical add-in tool for Microsoft Excel. (\$250) SigmaXL is a commonly used tool in Six Sigma training and implementation.

**Single Source Entry Point** – Efficient entry into a process; simplification

**SIPOC** – SIPOC stands for suppliers, inputs, process, output, and customers. You obtain inputs from suppliers, add value through your process, and provide an output that meets or exceeds your customer's requirements.

**SIPOC** – Suppliers, Inputs, Process, Outputs, Customers

**Six Sigma** – To improve the quality of process outputs by identifying and removing the causes of defects (errors) and minimizing variability in a business process. A Six Sigma process generates a maximum defect probability of 3.4 parts per million (PPM) when the amount of process shifts and drifts are controlled over the long term to less than +1.5 standard deviations.

**Six Sigma Quality** – A combination of verified customer requirements reflected in robust designs and matched to the capability of production processes that creates products with fewer than 3.4 defects per million opportunities to make a defect. World-class quality. A collection of tools and techniques for raising quality to worked-class levels.

**Skewed Distribution** – A non-symmetrical distribution having a tail in either a positive or negative direction.

**SMART** – Specific, Measurable, Achievable, Relevant and Time-bound.

**Smoothing** – Leveling the activities of a process. Removing spikes in process activities or work

**Spaghetti Map** – a pictorial representation of physical movement within a process

**Special Cause Variation (Signals)** – Unlike common cause variability, special cause variation is caused by known factors that result in a non-random distribution of output. Also referred to as “exceptional” or “assignable” variation. Example: Few X's with big impact.

**Specification Limits** – The bounds of acceptable values for a given product or process. They should be customer driven.

**Stable Process** – A process which is free of assignable causes, e.g., in statistical control.

**Stages of Group Development** – Forming, Storming, Norming, Performance and Adjourning

**Stakeholder** – People who will be affected by the project or can influence it but who are not directly involved with doing the project work. Examples are Managers affected by the project, Process

Owners, People who work with the process under study, internal departments that support the process, customers, suppliers, and financial department.

**Standard Deviation** – A statistical index of variability which describes the spread.

**Standard Operating Procedures** – Consists of all elements for a specific operation, including each step involved in the process and the approximate amount of time required for that process.

**Standard Work** – Detailed definition of the most efficient method to produce a product (or perform a service) at a balanced flow to achieve a desired output rate. It breaks down the work into elements, which are sequenced, organized and repeatedly followed.

**Standardization** – consistency or serving customers the same way each time.

**Statistical Control** – A quantitative condition which describes a process that is free of assignable/special causes of variation (both mean and standard deviation). Such a condition is most often evidenced on a control chart, i.e., a control chart which displays an absence of nonrandom variation.

**Statistical Process Control (SPC)** – Statistical process control is the application of statistical methods to identify and control the special cause of variation in a process.

**Stem and Leaf Plot** – Using the data set's numbers themselves to form a diagram, the stem and leaf plot (or simply, stem plot) is a histogram-style tabulation of data developed by John Tukey.

**Stratification** – A technique used to analyze/divide a universe of data into homogeneous groups (strata) often data collected about a problem or event represents multiple sources that need to be treated separately.

**Suppliers** – Companies who provide products to another company for use in the course of a producing a product or service

**Sustainability** – a process change that can be maintained. For the long term.

**Swim Lanes** – Individually defined rows within a process map

**Systems Thinking** – Each process has an effect on the next process.

**T Distribution** – A symmetric, bell shaped distribution that resembles that standardized normal (or Z) distribution, but it typically has more area in its tails than does the Z distribution, that is, it has greater variability than the Z distribution.

**T Test** – A hypothesis test of population means when small samples are involved

**Takt Time** – Derived from the German word Taktzeit which translates to cycle time. Lean Production uses Takt Time as the rate that a completed product needs to be finished in order to meet customer demand.

**Theory of Constraints** – Also called constraints management, it is a set of tools that examines the entire system for continuous improvement. The current reality tree, conflict resolution diagram, future reality tree, prerequisite tree and transition tree are the five tools used in its ongoing improvement process.



**TIM WOOD** – Acronym used to remember the seven wastes: Transportation, Inventory, Motion, Waiting, over production, over processing, defect(s)

**Toyota Production System** – Toyota’s continuous improvement practices are known as TPS; Toyota employs practices to eliminate waste.

**TRAIL Chart** – Chart used in the Define stage to help identify members of a project team. TRAIL stands for: team member, resource, approver, informer, and leader.

**Transformation** – significantly changed or re-engineered method(s) to better a process.

**Tree Diagram** – Breaks down or stratifies ideas in progressively greater detail. The objective is to partition a big idea or problem into its smaller components, making the idea easier to understand, or the problem easier to solve.

**Two Tailed Test** - The values of a parameter which designate both an upper and lower bound.

**Type 1 Error** – Error that concludes that someone is guilty, when in fact, they really are not. (Ho true, but I rejected it–concluded Ha), also known as ALPHA error and Producer’s risk.

**Type 2 Error** – Error that concludes that someone is not guilty, when in fact, they really are. (Ha true, but I concluded Ho). BETA

**Upper Control Limit** – A horizontal line on a control chart (usually dotted) which represents the upper limits of capability for a process operating with only random variation.

**Value Add** – Any activity that changes the form, fit, or function of a product to meet the needs of the customer.

**Value Stream Mapping** – Value stream mapping is a paper and pencil tool that helps you to see and understand the flow of material and information as a product or service makes its way through the value stream. Value stream mapping is typically used in Lean; it differs from the process mapping of Six Sigma in four ways: 1) it gathers and displays a far broader range of information than a typical process map. 2) It tends to be at a higher level (5-10 boxes) than many process maps. 3) It tends to be used at a broader level, i.e. from receiving of raw material to delivery of finished goods. 4) It tends to be used to identify where to focus future projects, subprojects, and/or kaizen events.

**Variable** – A characteristic that may take on different values.

**Variation** – Any quantifiable difference between individual measurements; such differences can be classified as being due to common causes (random) or special causes (assignable).

**Visual Controls** – Visual controls are a system of signs, information displays, layouts, material storage and handling tools, color-coding, and poka-yoke or mistake proofing devices. These controls fulfill the old fashioned adage: a place for everything and everything in its place. The visual control system makes product flow, operations standards, schedules and problems instantly identifiable to even the casual observer.

**VOB** – Voice of the Business - The “voice of the business” is the term used to describe the stated and unstated needs or requirements of the business/shareholders.

**VOC** – Voice of the Customer - The “voice of the customer” is the term used to describe the stated and unstated needs or requirements of the customer. The voice of the customer can be captured in a variety of ways: Direct discussion or interviews, surveys, focus groups, customer specifications, observation, warranty data, field reports, complaint logs, etc.

**VOE** – Voice of the Employees - The “voice of the employee” is the term used to describe the stated and unstated needs or requirements of the employees of your business.

**VOP** – Voice of the Process - Term used to describe what the process is telling you. What it is capable of achieving, whether it is under control and what significance to attach to individual measurements – are they part of natural variation or a signal that needs to be dealt with?

**Waste** – Unwanted, unnecessary to a process. Customer is not willing to pay for it. Inefficient use of resources.

**Work Flow** – Smooth and steady rate of processing that continuously meets the customer’s expectations

**X-bar and R Charts** – X-Bar and R Charts: This set of two charts is the most commonly used statistical process control procedure. Used to monitor process behavior and outcome overtime.

**Xs** – Designation in Six Sigma terminology for those variables which are independent, root causes; as opposed to “Ys” which are dependent outputs of a process. Six Sigma focuses on measuring and improving Xs, to see subsequent improvement in Ys.

**Ys** – Designation in Six Sigma terminology for those variables which are dependent outputs of a process, as opposed to “Xs” which are independent root causes.