# Six Sigma

## And Related
## Tools & Techniques

**By**

**Jay P. Patel, President and CEO**
**ASQ – Fellow, CSQE, CQA, CQE, CQIA, CQ Manager, HACCP**
**Auditor, Bio Med Auditor, Six sigma BB**
**RAB-QMSLA**
**Quality & Productivity Solutions, Inc.**
**One Sunny Hill, Oxford, MA 01540**
**Phone (508) 987-3800 Fax (508) 987-1464**
**E Mail: info@qpsinc.com**
**Website: www.qpsinc.com**

# Six Sigma and Related Tools

| Tools/Techniques | Description |
|---|---|
| Affinity Diagram | Grouping of ideas, collected through brainstorming sessions, into meaningful groupings. |
| Analysis of Variance | A technique that 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. |
| Attribute Sampling Plans | A plan that allows users to count the number of conforming or non-conforming parts and look for defects. The four types of attribute plans include single, double, multiple & sequential. |
| Bar Charts | A bar chart displays collected data on parallel horizontal bars for comparative analysis. Lengths are proportional to collected data. |
| Box Plot | A visual depiction of a dataset, including central tendency and dispersion. It can be used when analyzing the overall pattern of data, when comparing two sets of data, when there is not enough data for a histogram, or to summarize data. |
| Brainstorming | A technique used to generate a large number of ideas in a short period of time. It helps to generate creative, original ideas with participation of the entire group. |
| Brain Writing | A nonverbal form of brainstorming. Ideas are written on paper by team members then papers are exchanged and more ideas are written. |
| Cause and Effect Diagram | A diagram that relates causes and effects. It sorts ideas into useful categories for determining root cause of a problem. |
| Checksheet | A prepared form used for collecting and analyzing data. It can also be used to record that steps to a process have been completed. |
| Control Charts | A methodology for monitoring process & identifying when a process is operating "in control/out control" (within known statistical boundaries). The chart helps to monitor changes in process variability, stability, &/or central tendency over time. Chart is used to determine adjustment of process is required. Types of control charts include: <ul><li>X-Bar and R Chart</li><li>X-Bar and S Chart</li><li>Individuals Chart</li><li>1X-MR Chart</li><li>Median and Range Chart</li><li>Median and S Chart</li><li>Moving X and Moving Range Chart</li><li>Cusum Chart</li><li>EWMA Chart</li><li>Target Chart</li><li>Nominal Chart</li><li>X-Bar, R (within), and R (piece to piece)</li><li>P Chart</li><li>NP Chart</li><li>C Chart</li><li>U Chart</li></ul> |
| Correlation Studies/Coefficient | A study refers to the measure of the relationship between two sets of numbers or variables. **Correlation Coefficient** – describes the magnitude and direction of the relationship between two variables. |
| Cost of Quality | Cost of quality is the broad categories of internal & external failure costs, appraisal costs, & prevention costs. It is the sum of the costs associated with providing poor quality products & services. Also called 'cost of quality'. |

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| Cp | Capability Index is the ability to produce products conforming to a given specification regardless of mean location. It is a ratio of tolerance specified to process capability.<br>Cp = Tolerance /6s. |
| Cpk | Capability Index is the ability to produce products confirming to given specifications considering mean.<br>Cpk = min of (USL – mean) or (mean – LSL)/3s. |
| Critical to Quality | Requirements that are most important to customers. |
| CUMSUM Charts | A control chart based on CUMmulative SUMs. These charts can detect small process shifts faster than Shewhart control charts. |
| Defects per Million Opportunities | It gives additional insight into a process by including the number of opportunities for failure. |
| Descriptive Statistics | Used to describe data.  Examples of descriptive statistics include mean, median, mode, standard deviation, maximum, minimum, and percentiles. |
| Design of Experiments (DOE) | Systematic method of evaluating the effect of the input variables to response variable.  It is used to evaluate the effect of variation to the output, based on input variables. |
| EVOP Designs | A method of conducting designed experiments on an ongoing process without interrupting affecting its efficiency. |
| EWMA Charts | Exponentially Weighted Moving Average – a control charting methodology that utilizes historical data at an exponentially diminishing weighted value. |
| Fault Tree Analysis | An analysis that identifies possible failure modes and associated probabilities.  It is the opposite of FMEA. |
| Fishbone Diagram | See Cause and Effect Diagram |
| Force Field Analysis | An analytical tool that identifies opposing aspects of a change, the positive forces that support the change and negative forces that try to prevent it. |
| Full Factorial Design | Full Factorial experiment is the experimental design running all possible combinations of all levels of all factors. |
| Fractional Factorial Design | A designed experiment strategy that assesses several factors/variables simultaneously in one test, where a partial set of all possible combinations of factor levels are tested to more efficiently identify important factors. |
| Gage R&R (repeatability & reproducibility) Study | The evaluation of measuring and identifying inherent variations by using different gage operators at different times. Related concepts includes precision, accuracy, repeatability, reproducibility, bias, gage linearity, gage stability. |
| Histogram | A graphical representation of the sample frequency distribution that describes the occurrence of grouped items. It is a bar chart displaying the frequency of data in a column format. It is one of the SEVEN TOOLS OF QUALITY. |
| Hypothesis Testing | A statistical hypothesis is a statement or claim about an unrealized true state or nature. |
| Indices of Variability | Measures of Central Tendency, Mode, Median and Mean, and their corresponding measures of spread. |
| Interaction Plots | An interactions plot is a plot of means for each level of a factor with the level of a second factor held constant. Interactions plots are useful for judging the presence of interaction. |
| Main Effect Plots | Use Main Effects Plot to plot data means when you have multiple factors. The points in the plot are the means of the response variable at the various levels of each factor, with a reference line drawn at the grand mean of the response data. Use the main effects plot for |

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| | comparing magnitudes of main effects. |
| Matrix Diagram | A diagram that graphically shows the relationship between groups of information.  It can be used when identifying how one group of items relates to another, for example, when relating customer requirements to elements of a process. |
| Mixture Designs | Mixture experiments are a special class of response surface experiments in which the product under investigation is made up of several components or ingredients. In these situations, the response is a function of the proportions of the different ingredients in the mixture. |
| Monte Carlo Simulation | Randomly generates values for uncertain variables over and over to simulate a model. |
| MultiVari Charts | A chart that to graphically display sources of variability. It displays the variance within units, between units, between samples & between lots. |
| Multivoting | A technique used to narrow a large list of possibilities to a smaller list or a final selection. |
| Non-parametric Tests | Non-parametric tests are those that make no assumptions about the distribution of the data. They are therefore more robust when data do not have well-behaved distributions. They are generally used to investigate hypotheses about samples as a whole, rather than about properties such as means. |
| Normalized Yield | The geometric average throughput yield one would expect at any given step in the process. Analogous to the "typical" yield. For a $k$-step process, the normalized yield would be the $k$th root of the rolled throughput yield. A note of caution: This metric can be misleading if the throughput yields of the process steps vary a great deal. |
| Nominal Group Techniques | A method of group brainstorming that encourages contributions from everyone.  Each team member writes down their ideas and in turn, states one idea from their list. |
| Normal Probability Plot | A method for determining whether a set of data takes the form of a normal distribution. |
| Pareto Chart | A graphical tool for analyzing and ranking problem causes from most significant to least significant. It is a bar chart listing the identified causes of a problem in order of their frequency or importance to it. |
| Pareto Principle | Around 80% of the problems often seem to be produced by around 20% of all the contributing causes.  It suggests that most effects, around 80%, come from relatively few, around 20%, of the causes. |
| PDCA Cycle | The plan-do-check-act cycle for making improvements or changes.  The steps are: (1) develop the improvement plan, (2) do the plan on a small scale, (3) review and analyze the results, (4) take action based on what you learned. |
| Pp | Process Performance index is defined as the tolerance width divided by the process performance, irrespective of the process centering. |
| Ppk | Is the process performance index which accounts for process centering. |
| Probability Distributions | A probability distribution relates the values of a characteristic with their probability of occurrence.  Types of probability distributions include:<br>• Binomial<br>• B negative Binomial<br>• Exponential<br>• Geometric<br>• Hyper Geometric<br>• Normal<br>• Poisson<br>• Uniform – discrete |

| Tools/Techniques | Description |
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| | • Uniform – continuous |
| Process Capability | The capability of a process to make product that meet specification. |
| Process Mapping | A Flow chart is a visual representation of the process steps done showing tasks. Process Mapping provides additional information such as inputs, outputs, supplier, customer , matrix. . |
| Process FMEA | The Process FMEA (PFMEA) is a disciplined analysis of the part's processes with the intent to prevent the process-based failure modes *prior to* the first production run, before money is spent on machines, tooling, etc. The focus is to prevent, or at least detect, changes in the process variables, which could lead to a deviation from the design requirements. |
| Quality Function Deployment (QFD) | A structured method used to identify customer needs, translate them into a realizable product or service parameters, and guide the implementation process. |
| Relations Diagram | A diagram that shows cause and effect relationships. It helps a group analyze the links between different aspects of a complex problem. |
| Reliability | The probability that a product will perform its intended function under stated conditions for a given period of time. |
| Run Charts | Run charts are used to analyze processes according to time or order. Run charts are useful in discovering patterns that occur over time. |
| Regression | Regression is used to understand the relationship between two or more variables. Regression analysis makes it possible to predict one variable from the knowledge about the other. |
| Response Surface Designs | Empirical study of relationships between one or more responses and input variable factors. The technique is used to determine the 'best' set of input variables to optimize a response and or gain a better understanding of the overall system response |
| Rolled Throughput Yield | Rolled Throughput Yield (defect-based)--the probability of being able to pass a unit of product or service through the entire process defect-free. |
| Sampling Distributions | The distribution of the values of a quality characteristic in all possible units that can be sampled according to a specified sampling scheme. |
| Scatter Diagram | A diagram that helps to identify relationships between two variables. It is a two or three dimensional graph that plots coordinates and shows relationships between two or three variables. |
| Stem and Leaf Plot | Very similar to a histogram; the stem reflects the significant portion of the data and the leaf (bars of the chart) reflects remaining portion of the data. |
| Survey | A technique used to collect data about the knowledge and opinions of a targeted group of people. Types of surveys include written questionnaires, interviews, and focus groups. |
| Story Board | A visual display of thoughts. It makes all facets of a process, organization, plan, or concept visible at once. |
| Taguchi Designs | Robust parameter design technique, which is an engineering method for product/process design that minimizes variation and/or sensitivity to noise. |
| Tree Diagram | A diagram that identifies actions to solve a problem or implement a solution. It is also called a "How-How Diagram." |
| Why -Why Diagram | A diagram that is used to help identify the root causes of a problem. It can help determine both short term and long term solutions. |
| Z Tests | Calculation of how many sigmas fit between the process output average and the closest specification limit |