Quality Dictionary - Definitions, Terms and Acronyms

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1-Sample Sign Test

Test the probability of a sample median being equal to hypothesized value.

H0: m1=m2=m3=m4 (null hypothesis)
Ha: At least one is different (alternate hypothesis)

2-Sample t Test

2 - Sample t Test: The two sample t-Test is used for testing hypothesis about the location two sample means being equal.

1 - Sample t Test: The one sample t-Test is used for testing hypothesis about the location of the sample mean and a target mean being equal.

3P

A 3D model of TQM, having People, Product and Process as the 3 axis.
For Implementing TQM, all the 3 parameters should be improved.

1. People: Satisfaction of both Internal and External customer.

2. Product: Conforming to the requirements specified.

3. Process: Continuous Improvement of all the operations and activities is at the heart of
TQM.

5 Laws of Lean Six Sigma

5 Laws of Lean Six Sigma have been formulated to provide direction to improvement efforts. The laws are a conglomeration of Key Ideas of Six Sigma and Lean.

Law 0: The Law of the Market - Customer Critical to Quality defines quality and is the highest priority for improvement, followed by ROIC (Return On Invested Capital) and Net Present value. It is called the Zeroth law as it is the base on which others are built.

Law 1: The Law of Flexibility - The velocity of any process is proportional to the flexibility of the process.

Law 2: The Law of Focus - 20% of the activities in a process cause 80% of the delay. (Related to Pareto Principle)

Law 3:The Law of Velocity - The velocity of any process is inversely proportional to the amount of WIP. This is also called "Little's Law".

Law 4: The complexity of the service or product offering adds more non-value, costs and WIP than either poor quality (low Sigma) or slow speed (un-Lean) process problems

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. There can be more than one cause to a problem as well. In an organizational context, generally root cause analysis is carried out by a team of persons related to the problem. No special technique is required.

An example is in order:
You are on your way home from work and your car stops:

- why did your car stop? Because it ran out of gas.
- Why did it run out of gas? Because I didn't buy any gas on my way to work.
- Why didn't you buy any gas this morning? Because I didn't have any money.
- Why didn't you have any money? Because I lost it all last night in a poker game.

I hope you don't mind the silly example but it should illustrate the importance of digging down beneath the most proximate cause of the problem. Failure to determine the root cause assures that you will be treating the symptoms of the problem instead of its cause, in which case, the disease will return, that is, you will continue to have the same problems over and over again.

Also note that the actual numbers of why's is not important as long as you get to the root cause. One might well ask why did you lose all your money in the poker game last night?

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Here's another example. I learned the example using the Washington Monument used when demonstrating the use of the 5 Whys.

The Washington Monument was disintegrating
Why? Use of harsh chemicals
Why? To clean pigeon poop
Why so many pigeons? They eat spiders and there are a lot of spiders at monument
Why so many spiders? They eat gnats and lots of gnats at monument
Why so many gnats? They are attracted to the light at dusk.

Solution: Turn on the lights at a later time.

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Read the iSixSigma article on the
.5 Whys

5C

5C ia a 5 step technique very similar to 5S to stabilise, maintain and improve the safest, best working enviroment to support sustainable Qyality, Cost and Delivery.

What are the 5Cs?

Clear Out: Separate the essential from the non essential

Configure: A place for everything and everything in its place.

Clean and Check: Manualy clean to spot abnormal conditions.

Conformity: Ensures that the standard is maintained and improved.

Custom and Prctice: Everyone follows the rules, understands the benefits and contributes to the improvement.

5S

5S is the Japanese concept for House Keeping.

1.) Sort (Seiri)
2.) Straighten (Seiton)
3.) Shine (Seiso)
4.) Standardize (Seiketsu)
5.) Sustain (Shitsuke)

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I think the concept of 5S has been twisted and its real meaning and intention has been lost due to attempts to keep each element in English word to start with letter 'S', like the real Nippongo words (seiri, seiton, seiso, seiketsu, and shitsuke). Well, whoever deviced those equivalent English words did a good job,they're close, but the real interpretation is not exactly the correct one. For the benefit of the readers who would like to develop and establish their own understanding and applications, the following are the real meaning of each element in English:

Japanese - English Translations
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Seiri - Put things in order

(remove what is not needed and keep what is needed)
Seiton - Proper Arrangement
(Place things in such a way that they can be easily reached whenever they are needed)
Seiso - Clean
(Keep things clean and polished; no trash or dirt in the workplace)
Seiketsu - Purity
(Maintain cleanliness after cleaning - perpetual cleaning)
Shitsuke - Commitment (Actually this is not a part of '4S', but a typical teaching and attitude towards any undertaking to inspire pride and adherence to standards established for the four components)

Reference: The Improvement Book
By: Tomo Sugiyama
Productivity Press, Cambridge, MA / Norwalk, CT

FIRST S-SORTING(GOOD AND BAD, USEABLE AND NON USEABLE)
SECOND S- SYSTEMIC ARRANGEMENT(ONCE SORTED KEEP SYSTEMATICALLY TO HAVE TRACEABILITY)
THIRD S-SPIC AND SPAN(KEEP ARRANGED THINGS ALWAYS READY TO USE AND IN DIRT FREE AND TIDY STATUS)
FOURTH S-STANDARDIZE(MAKE A PROCESS FOR ABOVE THREE STAGES AND MAKE STANDARDS AND ALSO KEEP ON REVIEWING THESE.)
FIFTH S- SELF DISCIPLINE(INDIVIDUAL HAS TO COMMIT

5Z

This standard defines the procedure of “5Z Accreditation” which is the scheme to promote, evaluate, maintain and improve process control using the Genba Kanri principles.
“5Z” is a general term for the following five actions ending with “ZU”…meaning “Don’t” in Japanese.

-UKETORAZU (Don’t accept defects)
-TSUKURAZU (Don’t make defects)
-BARATSUKASAZU (Don’t create variation)
-KURIKAESAZU (Don’t repeat mistakes)
-NAGASAZU (Don’t supply defects

6 Ms

The traditional 6Ms are:

* Machines

* Methods

* Materials

* Measurements

* Mother Nature (Environment)

* Manpower (People)

Other definitions:

Machines
Methods
Materials
Measurements
Milieu (Mother Nature, surroundings, environment)
Manpower (People/mainly physical work)
Mindpower (Also people/mainly brain work)
Management (separate from Manpower/People because it considers Tampering)
Money
Miscellaneous
(the) Moon (so far unknown cause)

The Cause and Effect Diagram (a.k.a. Fishbone) You can read more about it in the article.

6 Serving Men of Creativity

Remember Rudyard Kipling's famous poem that reads as under?

"I have Six Stalwart Serving Men,
They taught me all I know,
Their Names are What and Where and When,
And Why and How and Who."

After ascertaining the methods etc. of a process, by using the 5 questions of What, Where, When, How and Who, then question each and every detail Why?... Why?... Why?...
This is the secret of creativity.

6W

Your project planning should answer following question:

WHAT : What will you make/do this?
WHY : Why will you make/do this?
WHERE : Where will you make/do this?
WHO : Who will make/do this?
WHEN : When will you start/stop this (time scheduling)?

WHICH : Which will you make/do this (process, tooling, material sources etc…)?

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7 QC Tools

Histograms
Cause and Effect Diagram
Check Sheets
Pareto Diagrams
Graphs
Control Charts
Scatter Diagrams

These are 7 QC tools also known as ISHIKAWAS 7QC tools which revolutionised the Japane & the World in Sixties & Seventies

7 Wastes Of Lean

The 7 wastes are at the root of all unprofitable activity within your organization.

The 7 wastes consist of:

1. Defects
2. Overproduction
3. Transportation
4. Waiting
5. Inventory
6. Motion
7. Processing

Use the acronym 'DOTWIMP' to remember the 7 Wastes of Lean.

The worst of all the 7 wastes is overproduction because it includes in essence all others and was the main driving force for the Toyota JIT system, they were smart enough to tackle this one to eliminate the rest.

8 D Process

The 8D Process is a problem solving method for product and process improvement. It is structured into 8 steps (the D's) and emphasizes team. This is often required in automotive industries. The 8 basic steps are: Define the problem and prepare for process improvement, establish a team, describe the problem, develop interim containment, define & verify root cause, choose

permanent corrective action, implement corrective action, prevent recurrence, recognize and reward the contributors.

Of course, different companies have their different twists on what they call the steps, etc...but that is the basics.

8 D is short for Eight Disciplines which oOriginated from the Ford TOPS (Team Oriented Problem Solving) program. (First published approximately 1987)
D#1 - Establish the Team
D#2 - Describe the problem.
D#3 - Develop an Interim Containment Action
D#4 - Define / Verify Root Cause
D#5 - Choose / Verify Permanent Corrective Action
D#6 - Implement / Validate Permanent Corrective Action
D#7 - Prevent Recurrence
D#8 - Recognize the Team

8 Wastes of Lean

An easy way I learned at a seminar to remember the wastes, they spell TIM WOODS

T - Transport - Moving people, products & information
I - Inventory - Storing parts, pieces, documentation ahead of requirements
M - Motion - Bending, turning, reaching, lifting

W - Waiting - For parts, information, instructions, equipment
O - Over production - Making more than is IMMEDIATELY required
O - Over processing - Tighter tolerances or higher grade materials than are necessary
D - Defects - Rework, scrap, incorrect documentation
S - Skills - Under utilizing capabilities, delegating tasks with inadequate training

Acceptable Quality Level - AQL

Acceptable Quality Level. Also referred to as Assured Quality Level. The largest quantity of defectives in a certain sample size that can make the lot definitely acceptable; Customer will definitely prefer the zero defect products or services and will ultimately establish the acceptable level of quality. Competition however, will 'educate' the customer and establish the customer's values. There is only one ideal acceptable quality level - zero defects - all others are compromises based upon acceptable business, financial and safety levels.

Acceptance Number

The highest number of nonconforming units or defects found in the sample that permits the acceptance of the lot.

Accessory Planning

The planned utilization of remnant material for value-added purposes

Accountability

Conditional personal or professional liability “after” the fact, determined by action or responsibility. Accountability to action assumes the willingness to be held accountable for adequate expertise and capability. (see responsibility

Accountable

A person holds themselves accountable for an item when they are willing to explain 1) how the item should be and 2) what they did to cause it to be the way it actually is.

Accuracy

1) Accuracy refers to clustering of data about a known target. It is the difference between a physical quantity's average measurements and that of a known standard, accepted 'truth,' vs. 'benchmark.' Envision a target with many arrows circling the bullseye, however, none of them are near each other.

2) Precision refers to the tightness of the cluster of data. Envision a target with a cluster of arrows all touching one another but located slightly up and to the right of the bullseye.

In practice it is easier to correct a process which has good precision than it is to correct a process which is accurate. This is due to the increased amount of variation associated with accurate but not precise process.

Active Data

Actively and purposefully make changes in our data to monitor the corresponding impact and results on the Xs and Ys.

Activity Based Costing (ABC)

A form of cost accounting that focuses on the costs of performing specific functions (processes, activities, tasks, etc.) rather than on the costs of organizational units. ABC generates more accurate cost and performance information related to specific products and
services than is available to managers through traditional cost accounting approaches.

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 frameworking.

Often used in form of "sticky notes" send up to front of room in brainstorming exercises, 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.

Alias

Lost interactions in a Design of Experiment. An alias indicates that you've changed two or more things at the same time in the same way. Aliasing is a critical feature of Plackett-Burman, Taguchi designs or standard fractional factorials.Lower the resolution higher is the aliasing issue. Aliasing is a confoundingsynonym for
.

Alpha Risk

Alpha risk is defined as the risk of rejecting the Null hypothesis when in fact it is true.

Synonymous with: Type I error, Producers Risk

In other words, stating a difference exists where actually there is none. Alpha risk is stated in terms of probability (such as 0.05 or 5%).

The value (1-alpha) corresponds to the confidence level of a statistical test, so a level of significance alpha = 0.05 corresponds to a 95% confidence level.

Alternative Hypothesis (Ha)

The alternate hypothesis (Ha) is a statement that the means, variance, etc. of the samples being tested are not equal. In software program which present a p value in lieu of F Test or T Test When the P value is less than or equal to your agreed upon decision point (typically 0.05) you accept the Ha as being true and reject the Null Ho. (Ho always assumes that they are equal)

Analysis Of Variance (ANOVA)

Analysis of variance is a statistical technique for analyzing data that tests for a difference between two or more means by comparing the variances *within* groups and variances *between* groups. See the tool 1-Way ANOVA.

Analytical Modeling

A software or other service component modelling technique using tools based on mathematical models.

Anderson-Darling Normality Test

After you have plotted data for Normality Test, Check for P-value.

P-value < 0.05 = not normal.

normal = P-value >= 0.05

Note: Similar comparison of P-Value is there in Hypothesis Testing.
If P-Value > 0.05, Fail to Reject the H0

The Anderson-Darling test is used to test if a sample of data came from a population with a specific distribution. It is a modification of the Kolmogorov-Smirnov (K-S) test and gives more weight to the tails than does the K-S test. The K-S test is distribution free in the sense that the critical values do not depend on the specific distribution being tested. The Anderson-Darling test makes use of the specific distribution in calculating critical values. This has the advantage of allowing a more sensitive test and the disadvantage that critical values must be calculated for each distribution.

Andon

In 'ancient' Japan, Andon was a paper lantern (a handy vertically collapsible paper lampshade with an open top and a candle placed at the central section of the closed bottom). To the ancient Japanese, Andon functioned as a flashlight, a signaling device in distance, or even a commercial sign.

Nowadays, Andon at many manufacturing facilities is an electronic device: audio and/or color-coded visual display. For example, suppose an Andon unit has three color zones (red, green, and orange) and when the orange zone flashes with a distinctive sound, it calls for an attention of and is signaling operator to replenish certain material.

A tool of visual management, originating from the Japanese for "Lamp". Lights placed on machines or on production lines to indicate operation status. Commonly color-coded are:

- Green: normal operations
- Yellow: changeover or planned maintenance
- Red: abnormal, machine down

Often combined an audible signal such as music or an alarm.

ANOVA

ANalysis Of VAriance (ANOVA), a calculation procedure to allocate the amount of variation in a process and determine if it is significant or is caused by random noise. A balanced ANOVA has equal numbers of measurements in each group/column. A stacked ANOVA: each factor has data in one column only and so does the response.

Appraisal Cost

Appraisal Cost is a component of 'Cost of Quality'

This is the cost incurred on Preventing the defects. e.g
Cost to establish Methods & Procedures
Cost to Plan for Quality
Cost incurred on Training.

APQP

Advanced Product Quality Planning

Phase 1 -
Plan & Define Programme - determining customer needs, requirements & expectations using tools such as QFD
review the entire quality planning process to enable the implementation of a quality programme how to define & set the inputs & the outputs.

Phase 2 -
Product Design & Development - review the inputs & execute the outputs, which include FMEA, DFMA, design verification, design reviews, material & engineering specifications.

Phase 3 -
Process Design & Development - addressing features for developing manufacturing systems & related control plans, these tasks are dependent on the successful completion of phases 1 & 2 execute the outputs.

Phase 4 -
Product & Process Validation - validation of the selected manufacturing process & its control mechanisms through production run evaluation outlining mandatory production conditions & requirements identifying the required outputs.

Phase 5 -
Launch, Feedback, Assessment & Corrective Action - focuses on reduced variation & continuous improvement identifying outputs & links to customer expectations & future product programmes.

Control Plan Methodology -
discusses use of control plan & relevant data required to construct & determine control plan parameters
stresses the importance of the control plan in the continuous improvement cycle.

Arrow Diagrams

A tool used for working out optimal schedules and controlling them effectively. It shows relationships among tasks needed to implement a plan using nodes for events and arrows for activities. Arrow diagrams are used in PERT (Program Evaluation and Review Technique) and CPM (Critical path method).

Artisan Process

Known for pioneering efforts to invent or create that which has never existed, it is one of a family of four work process types and is characterized as a temporary endeavor undertaken to create a unique product or result which is performed by people. (Artisan Process, Project Process, Operations Process, Automated Process)

A-square

A-squared is the test statistic for the Anderson-Darling Normality test. It is a measure of how closely a dataset follows the normal distribution. The null hypothesis for this test is that the data is normal. So if you get an A-squared that is fairly large, then you will get a small p-value and thus reject the null hypothesis. Small A-squared values imply large p-values, thus you cannot reject the null hypothesis.

Assignable Cause

See *Special Cause*.

Assurance

Providing an optimal degree of confidence to Internal and External Customers regarding establishing and maintaining in the organization, practices, processes, functions and systems for accomplishing organizational effectiveness.

Establishing and maintaining an optimal degree of confidence in the organizational practices, processes, functions and systems for accomplishing organizational effectiveness.

Alternate definition:
Establishing and maintaining the commitments made to Internal and External Customers.

Attribute Data

Attribute data is the lowest level of data. It is purely binary in nature. Good or Bad, Yes or No. No analysis can be performed on attribute data.

discrete Attribute data must be converted to a form of Variable data called in order to be counted or useful.data

It is commonly misnamed discrete data.

Attributes data are qualitative data that can be counted for recording and analysis.

Examples include the presence or absence of a required label, the installation of all required fasteners.

Attributes data are not acceptable for production part submissions unless variables data cannot be obtained.

The control charts based on attribute data are percent chart, number of affected units chart, count chart, count-per-unit chart, quality score chart, and demerit chart.

Attribution Theory

Attribution theory (B. Weiner) explains how individuals interpret events and how this relates to their thinking and behavior.

This theory has been used to explain the difference in motivation between high and low achievers. According to attribution theory, high achievers will invite rather than avoid tasks that could lead them to success because they believe success results from high ability and effort, and they are confident of their ability and effort. However, they believe failure is caused by bad luck or a poor exam, i.e. things that are beyong their range of control. Thus, failure doesn't affect their self-esteem but success builds pride and confidence.

On the other hand, low achievers avoid success-related actions because they tend to doubt their ability and/or assume success is related to luck or influence or to other factors beyond their control. Thus, even when successful, it isn't as rewarding to the low achiever because he/she doesn't feel responsible. Suceess does not increase his/her pride and confidence.

Audit

A timely process or system, inspection to ensure that specifications conform to documented quality standards. An Audit also brings out discrepencies between the documented standards and the standards followed and also might show how well or how badly the documented standards support the processes currently followed.

Corrective, Preventive & Improvement Actions should be undertaken to mitigate the gap(s) between what is said (documented), what is done and what is required to comply with the appropriate quality standard. Audit is not only be used in accounting or something that relates to mathematics but also used in Information Technology.

Authority

The granting or taking of power and liability to make decisions and influence action on the behalf of others.

Autocorrelation

Autocorrelation means that the observations are not independent. Each observation will tend to be close in value to the next. This can result in under estimating sigma. A little bit of autocorrelation will not ruin a control chart.

Automated Process

Known for eliminating labor costs, it is one of a family of four work processes characterized as an on-going endeavor undertaken to create a repetitive product or result which planned, executed and controlled. (Artisan Process, Project Process, Operations Process, Automated Process)

Availability

Availability is the state of able readiness, of a product, process, practicing person or organization to perform satisfactorily its specified purpose, under pre-specified environmental conditions, when called upon.

Average Incoming Quality

AIQ - Average Incoming Quality: This is the average quality level going into the inspection point.

Average Outgoing Quality

AOQ - Average Outgoing Quality: The average quality level leaving the inspection point after rejection and acceptance of a number of lots. If rejected lots are not checked 100% and defective units removed or replaced with good units, the AOQ will be the same as the AIQ.

B10 life

B10 Life is the time by which 10% of the product population will get failed

Back-Date

The start and due dates for each operation in the manufacturing process are calculated back from the ship date. (See also Ship Date).

Balanced Experiment

An experiment is balanced when all factor levels (or treatment groups) have the same number of experimental units (or items receiving a treatment). Unbalanced experiments add complexity to the analysis of the data but hopefully for good reason. For example, some levels are of less interest to the researcher than others. Some levels are expected to produce greater variation than others and so more units are assigned to those levels.

Balance is nonessential but desirable if equal accuracy, power, or confidence

interval width for treatment comparisons is important. Severe imbalance can induce factor confounding (correlated factors or non-independent treatment levels).

Balanced Scorecard

The balanced scorecard is a strategic management system used to drive performance and accountability throughout the organization.

The scorecard balances traditional performance measures with more forward-looking indicators in four key dimensions:
* Financial
* Integration/Operational Excellence
* Employees
* Customers

Benefits include:
* Alignment of individual and corporate objectives
* Accountability throughout the organization
* Culture driven by performance
* Support of shareholder value creation

Baldrige, Malcolm

See Malcolm Baldrige National Quality Award

Bar Chart

A bar chart is a graphical comparison of several quantities in which the lengths of the horizontal or vertical bars represent the relative magnitude of the values.

Bartlett Test

This test is used to determine if there is a difference in variance between 3 or more samples/groups. It is useful for testing the assumption of equal variances, which is required for one-way ANOVA.

Baseline

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

Baselining

Process by which the quality and cost effectiveness of a service is assessed, usually in advance of a change to the service. Baselining usually includes comparison of the service before and after the Change or analysis of trend information. The term Benchmarking is normally used if the comparison is made against other enterprises.

BAU

"Business As Usual" The old way of doing business, considering repetitive tasks with no critical sense of improvement

Benchmarking

The concept of discovering what is the best performance being achieved, whether in your company, by a competitor, or by an entirely different industry.

Benchmarking is an improvement tool whereby a company measures its performance or process against other companies' best practices, determines how those companies achieved their performance levels, and uses the information to improve its own performance.

Benchmarking is a continuous process whereby an enterprise measures and compares all its functions, systems and practices against strong competitors, identifying quality gaps in the organization, and striving to achieve competitive advantage locally and globally.

Best Practice

A way or method of accomplishing a business function or process that is considered to be superior to all other known methods.

A lesson learned from one area of a business that can be passed on to another area of the business or between businesses.

Beta Risk

Beta risk is defined as the risk of accepting the null hypothesis when, in fact, it is false.

Consumer Risk or Type II Risk.

Beta risk is defined as the risk of accepting the null hypothesis when, in fact, the alternate hypothesis is true. In other words, stating no difference exists when there is an actual difference. A statistical test should be capable of detecting differences that are important to you, and beta risk is the probability (such as 0.10 or 10%) that it will not. Beta risk is determined by an organization or individual and is based on the nature of the decision being made. Beta risk depends on the magnitude of the difference between sample means and is managed by increasing test sample size. In general, a beta risk of 10% is considered acceptable in decision making.

The value (1-beta) is known as the "power" of a statistical test. The power is defined as the probability of rejecting the null hypothesis, given that the null hypothesis is indeed false.

Actually, the term "risk" really means probability or chance of making an incorrect decision. The actual risks of making a wrong decision are unique to the decision being made and may be realized only if a wrong decision is made. For example, the probability of a false negative (type II error) on an a test for aids in a patient might be calculated as 0.001. The risk of concluding that a person does not have aids when in fact they do is quite a different concept - the "risk" is propagation of a deadly disease.

BIA - Business Impact Analysis

A formal analysis of the effect on the business if a specific process fails or loses efficiency. It will also identify the minimum performance level of a given process that an organization requires to continue operating.

Bias

Bias in a sample is the presence or influence of any factor that causes the population or process being sampled to appear different from what it actually is. Bias is introduced into a sample when data is collected without regard to key factors that may influence it. A one line description of bias might be: "It is the difference between the observed mean reading and reference value."

Big 'Q'

Distinguishing the professional and concepts of Quality from that of the word quality.

Bimodal Distribution

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

Preeti Singh Malik

Binomial Distribution

In a situation where there are exactly two mutually exclusive outcomes (Ex: Success or Failure) of a trial, to find the x success in N trials with p as the probability of success on a single trial.

Ex:
Team A has won 15 Cricket Matches out of 50 played. What is the probability of winning atmost 5 matches in the next 10 matches?

x = 5, N = 10 and p = 15/50 = 0.3
Mean = N * p = 10 * 0.3 = 3

Binomial Random Variable

A discrete random variable which represents the number of successes out of n (the sample size) identical and independent trials.

Black Belt

Six Sigma team leaders responsible for implementing process improvement) within the business -- to increase customer DFSS or DMAICprojects (satisfaction levels and business productivity. Black Belts are knowledgeable and skilled in the use of the Six Sigma methodology and tools.

Black Belts have typically completed four weeks of Six Sigma training, and have demonstrated mastery of the subject matter through the completion of project(s) and an exam.

Black Belts coach
.Master Black Belts and receive coaching and support from Green Belts

Black Noise

Sources of variation which are non-random (Special Cause

Blocking

Blocking neutralizes background variables that can not be eliminated by randomizing. It does so by spreading them across the experiment.

You can think of a block as an kind of uncontrolable factor that is added to the experiment. A block is ususally used when this uncontrolable factor cannot be avoided during the experiment, so it is incorporated into the experiment in a controlled way. The idea is to pull the variation due to the blocks out of the expermental error in order to reduce the experimental error and give the test more power.

Common examples of when blocking factors are used:

- When you don't have enough units from one lot and are forced to use another lot, AND you suspect (maybe know) that there are important differences between lots. You then use (in a controlled manner) half of the units from one lot and half of the units from the other lot.
- When you don't have enough test chambers for all the parts, AND you suspect (maybe know) that there are important differences in the effects between test chambers. You then assign (in a controlled manner) half of your units to one chamber and half to the other chamber.
- The original use of blocking involved agricultural experiments. Researchers needed to use multiple fields or fields that has important intra-field variation. They would the potential fertility of a field as a block factor. Similar blocking might have been needed due to differences between edge-effects and center effects on crops grown.

Box Cox Transformation

The Box-Cox transformation can be used for converting the data to a normal distribution, which then allows the process capability to be easily determined

Boxplot

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.
1) The box represents the middle 50% of the data.

2) The median is the point where 50% of the data is above it and 50% below it. (Or left and right depending on orientation).

3) The 25th quartile is where, at most, 25% of the data fall below it.

4) The 75th quartile is where, at most, 25% of the data is above it.

5) The whiskers cannot extend any further than 1.5 times the length of the inner quartiles. If you have data points outside this they will show up as outliers

BPMS

Business Process Management System (BPMS)- a nine step model enables companies to model, deploy and manage mission-critical business processes, that span multiple enterprise applications, corporate departments. BPMS is usually used for lesser mature processes to make them Repeatable & Reliable.

The nine step approach includes:

1. Create Process Mission
2. Document Process
3. Document Customer & Process requirements
4. Identify Output & Process Measures
5. Build process management system
6. Establish data collection plan
7. Process performance monitoring
8. Develop dashboards with spec limits & targets
9. Identify improvement opportunities

Brainstorming

A method to generate ideas. Groundrules such as -no idea is a bad idea- are typical. Benefit of brainstorming is the power of the group in building ideas of each others ideas.

A problem solving approach/technique whereby working members in a group are conducting a deductive methodology for identifying possible causes of any problem, in order to surmount poor performance in any process or activity pursued by the group members and facilitator

BRM

BRM---Business Risk Management. It is to evaluate the business risk involved for any change in the process

Buffer

The location between each operation in a production line that contains in-process parts. Typically a conveyor, roller-rack, or CML (continuously-moving-line).

The size of the buffer is governed by the average cycle times for each operation. A machine with a low cycle time feeding to a machine with a higher cycle time will typically have a large buffer in order to prevent blocking the first machine.

See also Level of Buffering and Lean Buffering.

Bug

Small insect. Also a problem in software.

The part of code that makes the program behave in an unwanted manner. The sooner a bug is detected in the Software Lifecycle, lesser would be the cost involved in fixing it

The term bug came from the fact that a moth flew into an early computer that ran on vacuum tubes.

Business Metric

A high level existing management performance indicator that champions care a lot about. Example: Profitability percentage, Customer satisfaction, Inventory levels, Time to market, Yield etc.

Business metrics are influenced by Multiple processes or many many outputs.

Business Process Quality Management

Also called Process Management or Reengineering. The concept of defining macro and micro processes , assigning ownership, and creating responsibilities of the owners.

Business Requirements

The critical activities of an enterprise that must be performed to meet the organizational objective and are solution independent.

Business Value added

A step or change made to the product which is necessary for future or subsequent steps but is not noticed by the final customer.

Calibration

Calibration is simply the comparison of instrument performance to a standard of known accuracy. It may simply involve this determination of deviation from nominal or include correction (adjustment) to minimize the errors. Properly calibrated equipment provides confidence that your products/services meet their specifications. Calibration:

increases production yields,
optimizes resources,
assures consistency and
ensures measurements (and perhaps products) are compatible with those made elsewhere.

CAP

Change Acceleration Process are a set of critical tools that helps orgnizations/groups towards a common goal for achieving path breaking improvements in the change initiatves.

The need for CAP can well be understood using simple law of mechanics, Vg=Ug(Initial Group velocity)+Ag(Group Acceleration)*Tg(Group Time).

The final velocity with which the organization or the group achieve their change initiatve objectives depends on their initial velocity or enthusiasm for change and the positive acceleration with which they move forward together.

CAP

CAP (Change Acceleration Process) is a change management framework with a set of tools...to gauge the political/strategic/cultural environment in the organization and plan for action which will eventually determine how much success a change initiative can bring in within the existing operating boundaries.
Some of the CAP tools are ARMI, GPRI , Includes/Excludes , Threat Vs Opportunity , In Frame / Out Frame , More of ..Less of exercise , Elevator Speech.

CAPA

Acronym for Corrective and Preventive Action.

Corrective action:
Action taken to eliminate the cause of the existing non-conformity to prevent its recurrence.

Preventive action:
Action taken to eliminate the cause of potential non-conformity.

Both of these are prevention oriented.

The quick fix type actions are called as corrections

Capability

The capability of a product, process, practicing person or organization is the ability to perform its specified purpose based on tested, qualified or historical performance, to achieve measurable results that satisfy established requirements or specifications.

Capability Analysis

Capability analysis is a graphical or statistical tool that visually or mathematically compares actual process performance to the performance standards established by the customer.

To analyze (plot or calculate) capability you need the mean and standard deviation associated with the required attribute in a sample of product (usually n=30), and customer requirements associated with that product.

See the tool Capability Analysis.

Capacity

The maximum amount of parts that may be processed in a given time period.

Is constrained by the bottleneck of the line--that is, the capacity of a production system depends on what is usually the slowest operation.

Capacity = 1 / Cycle Time

Typically the above formula is used when cycle time is expressed in shifts/part, thus measuring capacity as parts/shift.

CAR (Corrective Action Report)

Procedure used in response to a defect. This implies that you are reporting on a detected Non Conformance (NCR or NCMR) and have determined root cause to correct this from reoccuring.

Cause

A cause is anything that affects a result. But in root cause analysis we generally think of causes as bad. Therefore we need a different term to include both adverse influences and beneficial influences. Therefore, see "Factor."

Cause

A factor (X) that has an impact on a response variable (Y); a source of variation in a process or a product or a system.

Anything that adversely affects the nature, timing, or magnitude of an adverse effect

Cause and Effect Diagram

A cause and effect diagram is a visual tool used to logically organize possible causes for a specific problem or effect by graphically displaying them in increasing detail. It helps to identify root causes and ensures common understanding of the causes. It is also called an Ishikawa diagram.

CBR

Acronym for Critical Business Requirements.

CCR

Capacity Constraint Resource - Higher cycle time machine in a assembly line.

CCR

CCR----Critical Customer Requiremen

Center

The center of a process is the average value of its data. It is equivalent to the mean and is one measure of the central tendency

Center Points

A center point is a run performed with all factors set halfway between their low and high levels. Each factor must be continuous to have a logical halfway point. For example, there are no logical center points for the factors vendor, machine, or location

Central Limit Theorem

The central limit theorem states that given a distribution with a mean m and variance s2, the sampling distribution of the mean appraches 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.

Here's a great learning example website:
http://www.math.csusb.edu/faculty/stanton/m262/central_limit_theorem/clt.html

Addend:
If you are are averaging your measurements of a particular observable, your average's distribution may seem to tend toward a normal distribution. If the random variable that you are measuring is decomposable into a combination of several random variables your measurements may also seem to be normally distributed

YOU CAN STOP HERE IF YOU DO NOT WANT THE CALCULATIONS. However, I suggest just reading the words to keep yourself safe - the stuff between the dollar signs should suffice. I hope that my notation is clear for those venturing into the formulas.

Just to be on the safe side and preclude easy misinterpretations, here are some perspectives with three Central Limit Theorems. NO PROOFS! Immediately below you have one strong theorem and one weak one. At the very bottom is a theorem that is only referenced for completion and is for those who have fun proving limits of weighted sums of L2 integrals. Except for the third theorem, I trust that this will provide everyone with more light than heat!

$$$$$One Strong Central Limit Theorem states the following: The average of the sum of a large number of independent, identically distributed random variables with finite means and variances converges "in distribution" to a normal random variable. {Example: "independent" production runs for the manufacturing of a computer (or appliance) circuit component, or board; milling shafts, polishing 1000s of microscope or phased array telescope lenses (Hawaii, where are you?), software modules, etc.} One must be careful about the type of convergence, such as "convergence in measure (or almost everywhere)" vs. "mean-square convergence" vs. "convergence in distribution". {Please note: "convergence in distribution" is a much weaker than "convergence in measure", but it is also weaker than "mean-square convergence"}$$$$$$

$$$$$So, here we go: the average of the sum of a large number of independent, identically distributed random variables X1, X2, ..., Xn with finite means M(j) and finite variances Var(j) converges IN DISTRIBUTION to a normally distributed random variable X' with a finite mean M and a finite variance Var.$$$$$$ The formula follows (my apologies for my notation):

X1 + X2 + X3 + ...---> X' , where X' ~ N(M, Var), i.e., Normally Distributed with finite mean = M, and finite variance Var.

" -------> " denotes "converges toward"

If for each of the Xj, M(j) = 0 and Var(j) = 1, then X' ~ N(0,1)

$$$$$$A Weaker Central Limit Theorem: A sequence of jointly distributed random variables X1, X2, X3, ..., Xn with finite means and variances obeys the classical central limit theorem, IF the sequence Z1, Z2, Z3, ..., Zn converges IN DISTRIBUTION to a random variable Z ~ N(0,1) (WO! BACK UP! BE VERY CAREFUL HERE! THAT WAS AN IF!!!! THE TABLES HAVE BEEN TURNED!!!!)$$$$$$,

where

Zn = [Sn - E(Sn)]/[Std Dev(Sn)], and Sn = X1 + X2 + X3 + ... + Xn, Std Dev (Sn) = Square Root {Var(Sn)} is the standard deviation, and E(Sn) is the Expectation of Sn, the sum of the random variables Xj, 1<= j <= n.

" <= " denotes " less than or equal to"

The random variables Z1, Z2, ..., Zn are called the sequence of normalized consecutive sums of the sequence X1, X2, ..., Xn.

In terms of the characteristic functions (see Section **** below), the sequence {Xj} obeys the central limit theorem, IF for every real number a:

In the limit as n goes positively to infinity, the Characteristic Function (CF) of Zn(a) converges to exp(-a^2/2)

The limit CF(Zn(a)) --------> exp(-a^2/2), as n ------> infinity, where a^2 = "a squared", and exp( ) is the exponential function.

" ^ " denotes exponentiation

The gold nugget here is that the function exp(-a^2/2) is the Characteristic Function (CF) for a random variable that is distributed normally N(0,1)!

****[Characteristic Functions, i.e., the Fourier Transforms of the probability density functions of random variables (when they exist!). However, the spectral densities (the transforms of the Distribution Functions) always exist!)]

Two important concerns: the types of convergence, and what they mean. Two random variables with exactly the same distributions will often differ from one another to the vexation of the observer. However, they will tend to hop, skip, and jump around there central moments (i.e., means, variances, etc.) similarly.

Two important cases (Recommendation: Leave Case 2 for those who are most comfortable with probabilistic L2 calculus):

Case 1. Independent, identically distributed random variables X, and {Xj} with finite means M, and M(j) and variances Var, and Var(j).

Then for Zj = [(X1+....+Xj) - jE(X)]/[Sqrt(j)*Var(X)], j=1,.....n,..... The limit of the characteristic function for Zj will converge to a normal characteristic function.

" * " denotes multiplication

Case 2. Independent random variables with finite means and (2 + delta)th central moment {i.e. a little bit more exponentiation than the variance's square}. Delta is some very small number, and

the (2 + delta)th central moment for Xj = mu(2+delta; j) = E[|Xj - E(Xj)|^(2 + delta)]. Please recall E[g] is the expectation of g.

If the {Xj} are independent and the Zj are defined as in Case 1, the characteristic functions (CFs) will converge to the normal CF exp(-a^2/2), IF the Lyapunov Condition holds:

The Lyapunov Condition:

In the limit as j goes to infinity {1/Var(2+delta)[Sj]}*{Sum(mu(2+delta; j)|1<=j<=n)} = 0, where
Var(2+delta)[Sj] = E[|Sj - E(Sj)|^(2 + delta)]

Central Tendency

The numerical average (e.g. mean, median or mode) of a process distribution. Can also be displayed as the centerline of a process control chart.

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)

Chaku Chaku

Japanese for "load load", Chaku Chaku is an efficient style of production in which all the machines needed to make a part are situated in the correct sequence very close together.

The operator simply loads a part and moves on to the next operation. Each machine performs a different stage of production, such as turning, drilling, cleaning, testing or sandblasting.

Champion

Business leaders and senior managers who ensure that resources are available for training and projects, and who are involved in project tollgate

reviews.

directory for additional information.Sponsors and ChampionsSee the

Change Agent

A person who leads a change project or business-wide initiative by defining, researching, planning, building business support and carefully selecting volunteers to be part of a change team. Change Agents must have the conviction to state the facts based on data, even if the consquences are associated with unpleasentness.

Change Management

The Service Management process responsible for controlling and managing requests to effect changes (RFCs) to the business infrastructure or any aspect of business services to promote business benefit while minimizing the risk of disruption to services.

Change Management also controls and manages the implementation of the changes subsequently approved.

Characteristic

A characteristic is a definable or measurable feature of a process, product, or variable.

Charter

A document or sheet that clearly scopes and identifies the purpose of a Quality improvement project. Items specified include background case, purpose, team members, scope, timeline.

Chi Square Test

The Chi Square Test is a statistical test which consists of three different types of analysis 1) Goodness of fit, 2) Test for Homogeneity, 3) Test of Independence.

The Test for Goodness of fit determines if the sample under analysis was drawn from a population that follows some specified distribution.

The Test for Homogeneity answers the proposition that several populations are homogeneous with respect to some characteristic.

The Test for independence (one of the most frequent uses of Chi Square) is for testing the null hypothesis that two criteria of classification, when applied to a population of subjects are independent. If they are not independent then there is an association between them.

Chi Square is the most popular discrete data hypothesis testing method.

Circumstance

The sum of essential facts or events accompanying, conditioning, or determining the probability or improbability of an event.

C-Level

Typical term used to describe CEO, CFO, COO, CIO, and other senior executives within an organization

Cmk

Machine Capability index, should be 2.00 or higher. See also Cpk.

Calculated using continuous / Uninterupted samples. Also known as short term capability. Cmk > 1.67 is the preferable situation. Usually, The long term capability studies shall be done in a machine / Process after achieving the required Cmk value.

CMM

The Capability Maturity Model for Software (also known as the CMM and SW-CMM) has been a model used by many organizations to identify best practices useful in helping them increase the maturity of their processes.

Also: Co-ordinate Measuring Machine is a CNC measuring machine capable of performing Reverse engineering and Dimensional inspection of Critical components.

COC

See *Cost Of Conformance*

Certification of Conformity

Coefficient of Variation

Coefficient of variation is defined as the relative measure of dispersion it relates the mean and standard deviation by expressing the Std deviation as a % of mean. The benefit of standard deviation is a absolute measure which explains the dispersion in the same unit as original data.

Common Cause

A source of *Quality* failure that is always present as part of the random *Variation* inherent in the *Process* itself.

Its origin can usually be traced to an element of the process which only management can correct.

The less well-defined a process is, the more it is subject to random variation, resulting in a higher level of quality failures (bugs).

In general, and very approximately, Common Causes outweigh *Special Causes* as origins of quality failures by four to 1 (*Pareto* distribution).

Common Cause Variation

Common cause variation is fluctuation caused by unknown factors resulting in a steady but random distribution of output around the average of the data. It is a measure of the process potential, or how well the process can perform when special cause variation removed.

Common cause variability is a source of variation caused by unknown factors that result in a steady but random distribution of output around the average of the data. Common cause variation is a measure of the process's potential, or how well the process can perform when special cause variation is removed. Therefore, it is a measure of the process technology. Common cause variation is also called random variation, noise, noncontrollable variation, within-group variation, or inherent variation. Example: Many X's with a small impact.

Common cause variation is the remaining variation after removing the special causes (non-normal causes) due to one or more of the 5Ms and an "E" causes (Manpower, Material, Method, Measurement, Machine, and Environment), also known as 6Ms (Man power, Mother nature, Materials, Method, Measurements or Machine).

See also *Common Cause*, *Special Cause*, *Special Cause Variation*.

Communication

Communication is the process of delivering and sending messages through various channels.

Competitive Advantage

The ability of any organization or enterprise to dominate in the national and international markets, through offering quality products or services ,which are exceeding the requirements of the customers.

CONC

See *Cost Of Non-Conformance

Concept Engineering

Develop an understanding of customer's needs and environment, involve actual customer's to develop voice of customer (VOC), and operationally define requirements for downstream development

Concomitant Variable

In statistics: an incidental or subordinate variable

Condition

A restricting premise or provision upon which the fulfillment an occurrence or outcome of a cause and effect relationship depends.

Confidence Band (Or Interval)

Measurement of the certainty of the shape of the fitted regression line. A 95% confidence band implies a 95% chance that the true regression line fits within the confidence bands. Measurement of certainty

Confidence Interval

How "wide" you have to cast your "net" to be sure of capturing the true population parameter. If my estimate of defects is 10%, I might also say that my 95% Confidence Interval is plus or minus 2%, meaning that odds are 95 out of 100 hundred that the true population parameter is somewhere between 8 and 12%.

Confirmation

This is the last and also one of the most critical steps of a DOE. This is the phase of setting your process at the settings you have calculated to see if you really get what your equation says you should.

This should always be done before advertising results & implementing new factor settings, confirm the results.

If you are still unable to have a confirmation, there is likely a problem with the DOE. There may be an interaction involved and/or the DOE may have been botched.

Confounding

Factor or interaction effects are said to be confounded when the effect of one factor is combined with that of another. In other words, the effects of multiple factors on a response can not be separated. This occurs to some degree in all situations, and least frequently when the data is obtained from a carefully planned and executed experiment having a predefined objective.

Consequential Metrics

Consequential metrics can be both Business and process metric, which measures anything that goes wrong as a result of improving the primary metric.

Measures any negative consequences hence called as consequential metrics. Also called as a secondary metric.

There can be multiple consequential metrics in a project of improving one process or one primary metric.

Consumers Risk

Concluding something is good when it is actually bad (TYPE II Error)

See also Alpha Risk, Beta Risk, Error (Type I), Error (Type II), Null Hypothesis, Alternative Hypothesis and Hypothesis Testing

Containment

The systematic search and quarantine of potentially nonconforming product/material throughout the delivery chain and subsequent delivery of known conforming prouct/material.

(That's my first pass at defining this word used througout the automotive influenced manufacturing world. I was looking for a definition from you.)

Continuous

con·tin·u·ous (kn-tny-s)
adj.
Uninterrupted in time, sequence, substance, or extent

Continuous Data

Continuous data is information that can be measured on a continuum or scale. Continuous data can have almost any numeric value and can be meaningfully subdivided into finer and finer increments, depending upon the precision of the measurement system.

As opposed to discrete data like good or bad, off or on, etc., continuous data can be recorded at many different points (length, size, width, time, temperature, cost, etc.).

Continuous data is data that can be measured and broken down into smaller parts and still have meaning. Money, temperature and time are continous.Volume (like volume of water or air) and size are continuous data.

Let's say you are measuring the size of a marble. To be within specification,

the marble must be at least 25mm but no bigger than 27mm. If you measure and simply count the number of marbles that are out of spec (good vs bad) you are collecting attribute data. However, if you are actually measuring each marble and recording the size (i.e 25.2mm, 26.1mm, 27.5mm, etc) that's continuous data, and you actually get more information about what you're measuring from continuous data than from attribute data.

Data can be continuous in the geometry or continuous in the range of values. The range of values for a particular data item has a minimum and a maximum value. Continuous data can be any value in between.

It is the data that can be measured on a scale.

Continuous Improvement (CI)

Continuous Improvement (CI): 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

An "in statistical control" process is one that is free of assignable/special causes of variation. Such a condition is most often evidence on a control chart which displays an absence of nonrandom variation.

A technical function in nature and a continuous process by which the expected results are measured againist a predetermined criteria or standards. In the case of variances, a disciplinary action will be undertaken or improvement actions will be pursued.

Control Chart

A graphical tool for monitoring changes that occur within a process, by distinguishing variation that is inherent in the process(common cause) from variation that yield a change to the process(special cause). This change may be a single point or a series of points in time - each is a signal that something is different from what was previously observed and measured.

Control Limits

Control limits define the area three standard deviations on either side of the centerline, or mean, of data plotted on a control chart. Do not confuse control limits with specification limits. Control limits reflect the expected variation in the data. Bi latral specification/tolerances have two limits on both side of the tolerances which is not appreciated in the Unilatral tolerances.

Control Plan

The intent of a process control plan is to control the product characteristics

and the associated process variables to ensure capability (around the identified target or nominal) and stability of the product over time.

The process Failure Modes and Effects Analysis (FMEA) is a document to identify the risks associated with something potentially going wrong (creating a defect - out of specification) in the production of the product. The FMEA identifies what controls are placed in the production process to catch any defects at various stages on the processing.

Every completed Six Sigma project should have not only a control chart (if applicable), but a control plan. This ensures that the process doesn't revert to the way it previously operated.

Convert DPMO/Sigma To Cpk

Cpk = Z(short-term) which is sigma level / 3

However, if you are starting with DPMO, convert it to a decimal value(divide by 1,000,000), look this decimal value up in a standard normal curve(z table) and find the corresponding z. Minitab can do this as well. Anyway this is long term z. To convert to short term z which is sigma level:

z(short term) which is sigma level = Z(long term) + 1.5

then you can plug into the equation above to get Cpk

Copc

Customer Operations Performance Center

COPIS

Customer, Output, Process, Input, Supplier.
Similar to the more common SIPOC but COPIS is a term used for an outside-in approach. Used when completing a high level 'wing-to-wing' map of what a customer experiences. Gives you the steps in the process from a customers view point.

COPQ

COPQ stands for Cost of Poor Quality.
for definitionCost of Poor Quality

COQ

Cost of Quality. See Cost of Poor Quality.

See *Cost Of Quality*.

Correction

Action to eliminate the cause of a detected nonconformity

Correction versus Corrective Action

Correction is taken to rectify a known nonconformance; Corrective Action is taken to prevent recurrence of said nonconformance

Corrective Action

Action to eliminate the cause of a detected nonconformity. There can be more than one nonconformity. Corrective action is taken to prevent recurrence. Correction relates to containment whereas corrective action relates to the root .Preventive Actioncause. See

Corrective Action versus Preventive Action

Preventive Action is action to prevent the occurrence of a potential nonconformance; Corrective Action is taken to prevent recurrence of a known nonconformance. Examples of Preventive Action include (but are not limited to): Reviews (contracts, purchasing, processes, designs), Statistical Process Control (SPC) Analysis, Software Validation and Verification, Supplier Surveillance, Preventive Maintenance & Calibration Controls, Management Review of Quality Management System, Capability Studies, FMEA, Capability Maturity Model (CMM)/Capability Maturity Model Integration (CMMI) Processes, Employee Training Programs that train employees prior to commencing work, Suggestion Boxes, Disaster Recovery Planning, Trend Analysis, Benchmarking

Correlation

Correlation is a technique for investigating the relationship between two quantitative, continuous variables.

Correlation is the degree or extent of the relationship between two variables. If the value of one variable increases when the value of the other increases, they are said to be positively correlated. If the value of one variable decreases when the value other variable is increasing it is said to be negatively correlated. If one variable does not affect the other they are considered to not be correlated.

Correlation Coefficient (r)

The correlation coefficient quantifies the degree of linear association between two variables. It is typically denoted by r and will have a value ranging between negative 1 and positive 1.

Cost Model

In order to calculate the costs of providing service it is necessary to design and build a framework in which all costs can be recorded and allocated or apportioned to specific Customers or other activities. Such 'Cost Models' can be developed to show, for example, the cost of each service, the cost for each Customer or the cost for each location. The usual start point is to develop a Cost-by-Customer Cost Model.

Cost Of Conformance

(COC) A component of the *Cost Of Quality* for a work product. Cost of conformance is the total cost of ensuring that a product is of good *Quality*. It includes costs of *Quality Assurance* activities such as standards, training, and processes; and costs of *Quality Control* activities such as reviews, audits, inspections, and testing.

COC represents an organisation's investment in the quality of its products.

Contrast *Cost Of Non-Conformance

Cost Of Non-Conformance

(CONC.) The element of the *Cost Of Quality* representing the total cost to the organisation of failure to achieve a good *Quality* product.

CONC includes both in-process costs generated by quality failures, particularly the cost of *Rework*; and post-delivery costs including further *Rework*, re-performance of lost work (for products used internally), possible loss of business, possible legal redress, and other potential costs.

See also *Cost of Poor Quality - COPQ*

Cost of Poor Quality - COPQ

COPQ consists of those costs which are generated as a result of producing defective material.

This cost includes the cost involved in fulfilling the gap between the desired and actual product/service quality. It also includes the cost of lost opportunity due to the loss of resources used in rectifying the defect. This cost includes all the labor cost, rework cost, disposition costs, and material costs that have been added to the unit up to the point of rejection. COPQ does not include detection and prevention cost.

See also *Cost Of Non-Conformance*.

COPQ should contain the material and labor costs of producing and repairing

defective goods, you can include a portion of the appraisal cost if you have an inspection point, but never should you include prevention costs.

COPQ – Suppliers
Cost of Poor Quality from Suppliers

Suppliers can generally affect our cost due to:
a) Producing defective material.
b) Damaging material during delivery.

Our COPQ will generally cover the followings:
1) Cost of labor to fix the problem.
2) Cost of extra material used.
3) Cost of extra utilities .
4) Cost of lost opportunity
a) Loss of sales/revenue (profit margin)
b) Potential loss of market share
c) Lower service level to customers/consumers

Cost Of Quality

The cost associated with the quality of a work product.

As defined by Crosby ("Quality Is Free"), Cost Of Quality (COQ) has two main components: *Cost Of Conformance* and *Cost Of Non-Conformance* (see respective definitions).

Cost of quality is the amount of money a business loses because its product or service was not done right in the first place. From fixing a warped piece on the assembly line to having to deal with a lawsuit because of a malfunctioning machine or a badly performed service, businesses lose money every day due to poor quality. For most businesses, this can run from 15 to 30 percent of their total costs.

Cost Target

This value represents the maximum allowable expenditure for material, labor, outsourcing, overhead, and all other expenses associated with that project. (See also OCT: Operation Cost Target)

Covariate

Covariates are random variables you treat as concomitants (see Concomitant Variable) or as other influential variables that also affect the response. Covariates in DOE are uncontrolled variables that influence the response but do not interact with any of the other factors being tested at the time. Therefore, if they are present during the experiment then they would show as measurements of error.

Cp

Process Capability index: a measure of the ability of a process to produce consistent results - the ratio between the permissible spread and the actual spread of a process. Permissible spread is the difference between the upper and lower specific limits of acceptibility (a.k.a. total tolerance); actual spread is defined, arbitrarily, as the difference between upper and lower 3 x sigma deviations from the mean value (representing 99.7% of the normal distribution). As a formula, Cp = (USL-LSL)/(6 x sigma). Note this takes no account of how well the output is centered on the target (nominal) value. For that see Cpk.

You can think of the process capability index Cp in 3 ways:

1. Cp measures the capability of a process to meet its specification limits. It is the ratio between the required and actual variability.

2. More mathematically, the Cp is the ratio of the Spec difference (upper - lower) divided by 6-sigma, which is the spread of a normal curve. Minitab gives the following explanation: 'Capability statistics are basically a ratio between the allowable process spread (the width of the specification limits) and the actual process spread (6s)'

3. Graphically, think of positioning a normal curve centered between the specs. Now look at the tail areas that exceeds the specs. The smaller the area, the larger the Cp. In this sense it is equivalent to looking at the popular PPM measure (parts-per-million) which gives the area of the normal curve that exceeds the specs.

Cpk

Process Capability index ('equivalent') taking account of off-centredness: effectively the Cp for a centered process producing a similar level of defects - the ratio between permissible deviation, measured from the mean value to the nearest specific limit of acceptability, and the actual one-sided 3 x sigma spread of the process. As a formula, Cpk = either (USL-Mean)/(3 x sigma) or (Mean-LSL)/(3 x sigma) whichever is the smaller (i.e. depending on whether the shift is up or down). Note this ignores the vanishingly small probability of defects at the opposite end of the tolerance range. Cpk of at least 1.33 is desired.

Capability analysis indice.

Critical Element

A critical element is an X that does not necessarily have different levels of a specific scale but can be configured according to a variety of independent alternatives. For example, a critical element may be the routing path for an incoming call or an item.

Critical To Quality - CTQ

CTQs (Critical to Quality) are the key measurable characteristics of a product or process whose performance standards or specification limits must be met in order to satisfy the customer. They align improvement or design efforts with customer requirements.

CTQs represent the product or service characteristics that are defined by the customer (internal or external). They may include the upper and lower specification limits or any other factors related to the product or service. A CTQ usually must be interpreted from a qualitative customer statement to an actionable, quantitative business specification.

To put it in layman's terms, CTQs are what the customer expects of a product... the spoken needs of the customer. The customer may often express this in plain English, but it is up to us to convert them to measurable terms using tools such as DFMEA, etc.

CRM

Customer Relationship Management (CRM) is a philosophy that puts the customer at the design point, it is being customer-centric. It should be viewed as a strategy rather than a process. It is designed to understand and anticipate the needs of current and potential customers. There is a plethora of technology out there that helps capture customer data and external sources, and consolidate it in a central warehouse to add intelligence to the overall CRM strategy. "We are in business because of our customers. So it only makes sense to build and intimate relationship with the customer." Now that's CRM!

CSM

Characteristic Selection Matrix

CTC

CTC or 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 occurance 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.

Current Reality Tree

A CRT starts with the identification of Undesirable Effects (UDEs) present in

our reality.
Such UDEs are not only present, they hurt; they take away some, or much, of the joy that we take in our work.
They contribute to form the “prison” created by the way people interact. These UDEs cover a fairly large span; they originate from different sources and have different “weights.”

If we want to be effective we need to identify the minimum necessary things that need to change. To do this we should identify the few things causing the majority of the current problems. The fewer the elements we find that cause the problems the more powerful and focused our improvement process will be. We call problems 'UnDesirable Effects' to remind us that these are not things that exist in isolation but are the negative effects of some cause. They are symptoms and they result from a cause. Therefore to identify the few things that need to be changed we should rely on cause and effect relationships. We use a diagram called a 'Current Reality Tree' to show the relationships and links between the current UnDesirable Effects. The process used to identify how the UDE are linked together results in a Current Reality Tree (CRT).

Customer

Customer:
A person who receives the product or service of a process.

In a laymans language:
A customer is one who buys or rates our process/product (In terms of requirements), and gives the final verdict on the same. This in turn acts as a hidden feedback which can be implemented leading to improvement to all the parameters of the Process Management.

Customer Focus

The concept that the customer is the only person qualified to specify what Quality means. This leads to detailed analyses of who are the customers, what are their needs, what features (or new) are required of our products/services, how do customers rate our products/services versus our competitors and why, how can we keep our customers satisfied?

Customer Requirements

The wants or voice-of-customer in **Stated** or **Implied**Terms.

Most of the times the customer is enabled to state the requirements precisely. (Like please bring me a glass of luke warm water to drink). However customer may not always be able to precisely state or equipped to realize the basic attributes of his requirements. It is therefore the responsibility of the supplier to reconsider the attributes of desired/ supplied product in terms of the 'implied or real' requirements. For example the hygiene of the environment in which food is cooked in a restaurant

Cusum Chart

A cusum chart is a type of control chart (cumulative sum control chart). It is used to detect small changes between 0-0.5 sigma. For larger shifts (0.5-2.5), Shewart-type charts are just as good and easier to use. Cusum charts plot the cumulative sum of the deviations between each data point (a sample average) and a reference value, T. Unlike other control charts, one studying a cusum chart will be concerned with the slope of the plotted line, not just the distance between plotted points and the centerline. Critical limits for a cusum chart are not fixed or parallel. And a mask in the shape of a V is usually laid over the chart with the origin over the last plotted point. Previous points covered by the mask indicate the process has shifted.

So, who uses these types of charts? Typically chemical industries.

Cycle Time

Cycle time is the total time from the beginning to the end of your process, as defined by you and your customer. Cycle time includes process time, during which a unit is acted upon to bring it closer to an output, and delay time, during which a unit of work is spent waiting to take the next action.

In a nutshell - Cycle Time is the total elapsed time to move a unit of work from the beginning to the end of a physical process. (Note, Cycle Time is not the same as Lead Time).

Dashboard

A dashboard is a tool used for collecting and reporting information about vital customer requirements and/or your business' performance for key customers. Dashboards provide a quick summary of process and/or product performance.

Dashboard Examples

A tool that allows business leadership to monitor an organization's progress toward meeting strategic company objectives.
It is a concise visual indicator that displays:
clear, measureable and valid metrics for each objective,
targets for each metric, and
the status of each metric.
Example:
The car dashboard shows indicators that give the current measurable status of
engine speed, engine temperature, oil temperature, fuel levels and vehicle speed.
Business Example:
A business dashboard could show: percent gross margin by corporate region, pareto of returned units by product type, total sales by customer.

Data

Data are factual information used as a basis for reasoning, discussion, or calculation; often this term refers to quantitative information. It is plural in form. The singular is "datum."

Datsu Chaku

The Japanese word meaning Unload - Load. It is used in Manufacturing cycles for performing a task. This term is usually compared with Chaku Chaku

Datsu-Chaku

It is a Japanese term used to tell the traditional way of Component loading on a Machine/equipment. The term "Datsu" means Unloading ,and the term "Chaku" means loading. This terminology is used to compare with latest word "Chaku-Chaku".

Decision Rights Owner

This is a Subject Matter Expert with the vested authority to develop instructional rules for others to follow.

Defect

Any type of undesired result is a defect.

A failure to meet one of the acceptance criteria of your customers. A defective unit may have one or more defects.

'A defect is a failure to conform to requirements' (Crosby, 'Quality Is Free'), whether or not those requirements have been articulated or specified.

The non-conformance to intended usage requirement.

DefectiveRelated Term:

Defective

The word defective describes an entire unit that fails to meet acceptance criteria, regardless of the number of defects within the unit. A unit may be defective because of one or more defects.

Defects (%)

Once you have determined the operational definition of what constitues a defect:

The total number of defects counted on the population in question divided by the total population count.

.YieldCalculated as (1-Yield). See

Defects Per Million Opportunities - DPMO

Defects per million opportunities (DPMO) is the average number of defects per unit observed during an average production run divided by the number of opportunities to make a defect on the product under study during that run normalized to one million.

.PPMDefects Per Million Opportunities. Synonymous with

To convert DPU to DPMO, the calculation step is actually DPU/(opportunities/unit) * 1,000,000.

Defects Per Unit - DPU

DPU or Defects Per Unit is the average number of defects observed when sampling a population.
DPU = Total # of Defects / Total population

Consider 100 electronic assemblies going through a functional test. If 10 of these fail the first time around, we have a first pass yield of 90%. Let's say the 10 fails get reworked and re-tested and 5 pass the second time around; the 5 remaining fails pass on the third attempt. Feel free to work out how this would look as a rolling yield. (100 'passes'/115 tests).

DPU takes a fundamentally different approach to the traditional measurement of yield. It is simply a ratio of the number of defects over the number of units tested (don't worry about how many tests or how many opportunities for defects).

In the above example, the DPU is 15/100 or 0.15. There are 100 units which were found to have a cumulative total of 15 defects when tested.

One interesting feature of DPU is that if you have sequential test nodes, i.e. if the above 100 units had to go through 'Final Test' and threw up a DPU figure of 0.1 there, you simply add the DPU figures from both nodes to get the overall DPU of 0.25 (this is telling you that there were 25 defects in your 100 units). There are a few assumptions which must be realised for this statement to be wholly accurate, but there isn't really time to go there in a 'definition' space.

If out of the 100 loans applications there are 30 defects, the FTT yield is .70 or 70 percent. Further investigation finds that 10 of the 70 had to be reworked to achieve that yield so our Rolled Throughput Yield is 100-(30+10)/100 = .6 or 60 percent yield.

To consider the defects per unit in this process we divide the number of defects by the result of multiplying the sample by the number of opportunities

in each item.

No.of defects/(no. of units)*(no. of opportunities for a defect)= 30/100*3 = 30/300 = .1 or we would say that there is a 10 percent chance for a defect to occur in this process

Definition of Quality

Anticipate and honor the need of an intending user

Degree of Freedom

Degrees of freedom are the equivalent of currency in statistics - you earn a degree of freedom for every data point you collect, and you spend a degree of freedom for each parameter you estimate. Since you ususally need to spend 1 just to calculate the mean, you then are left with n-1 (total data points "n" - 1 spent on calculating the mean).

for more informationdiscussion forum threadSee this

Deming Cycle, PDCA

The Deming Cycle, or PDCA Cycle (also known as PDSA Cycle), is a continuous quality improvement model consisting out of a logical sequence of four repetitive steps for continuous improvement and learning: Plan, Do, Study (Check) and Act. The PDSA cycle (or PDCA) is also known as the Deming Cycle, the Deming wheel of continuous improvement spiral. Its origin can be traced back to the eminent statistics expert Mr. Walter A. Shewart, in the 1920's. He introduced the concept of PLAN, DO and SEE. The late Total Quality Management (TQM) guru and renowned statistician Edward W. Deming modified the SHEWART cycle as: PLAN, DO, STUDY, and ACT.

Along with the other well-known American quality guru-J.M. Juran, Deming went to Japan as part of the occupation forces of the allies after World War II. Deming taught a lot of Quality Improvement methods to the Japanese, including the usage of statistics and the PLAN, DO, STUDY, ACT cycle.

The Deming cycle, or PDSA cycle:

PLAN: plan ahead for change. Analyze and predict the results.
DO: execute the plan, taking small steps in controlled circumstances.
STUDY: check, study the results.
ACT: take action to standardize or improve the process.

Benefits of the PDSA cycle:

- Daily routine management-for the individual and/or the team
- Problem-solving process
- Project management
- Continuous development

- Vendor development
- Human resources development
- New product development
- Process trials

Dependent Variable

A variable that can change a desired output

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 For Manufacturing and Assembly (DFMA)

A methodology and tool set used to determine how to simpilify a current or future product design and/or manufacturing process to achieve cost savings. DFMA allows for improved supply chain cost management, product quality and manufacturing, and communication between Design, Manufacturing, Purchasing and Management

Design for Six Sigma - DFSS

Design for Six Sigma. Same as DMADV (below).

Design of Experiments - DOE

A Design of Experiment (DOE) is a structured, organized method for determining the relationship between factors (Xs) affecting a process and the output of that process (Y).

Other Definitions:
1 - Conducting and analyzing controlled tests to evaluate the factors that control the value of a parameter or group of parameters.

2- "Design of Experiments" (DoE) refers to experimental methods used to quantify indeterminate measurements of factors and interactions between factors statistically through observance of forced changes made methodically as directed by mathematically systematic tables.

for further information.DOESee

Design Risk Assessment

A design risk assessment is the act of determining potential risk in a design process, either in a concept design or a detailed design. It provides a broader evaluation of your design beyond just CTQs, and will enable you to eliminate possible failures and reduce the impact of potential failures. This ensures a

rigorous, systematic examination in the reliability of the design and allows you to capture system-level risk.

Additionally, a DFMEA would be a quantified estimate of the criticality of CTQ internal failures and CTC performance factors using the classic FMEA form but for design reviews and technology transfers. Performance to customer needs uses CTC's, design parameters to help meet those requirements and also the manufacturability requirements might be called CTQ's. Both would be appraised in the DFMEA document and then updated as the product moves into production, based on real failure frequencies and severities, becoming a living risk-management and design feedback document.

Detectable Effect Size

When you are deciding what factors and interactions you want to get information about, you also need to determine the smallest effect you will consider significant enough to improve your process. This minimum size is known as the detectable effect size, o

DF Degrees of freedom

The maximum numbers of quantities or directions, whose values are free to vary before the remainders of the quantities are determined,
Or an estimate of the number of independent categories in a particular statistical test or experiment.
Degrees of freedom (df) for a sample is defined as:
df = n – 1
Where ‘n’ is the number of scores in the samp

DFMEA

Design Failure Mode And Effect Analysis

Directive

Statements and priorities that serves to guide, and usually impel toward an action or goal; examples include:

Purpose: an original end objective intended to be attained through a course of action

Mission: a group sent to fulfill a promise or assignment of work

Vision: an objective conceived of the intuitive awareness of forethought

Discrete Data

Discrete data is information that can be categorized into a classification. Discrete data is based on counts. Only a finite number of values is possible, and the values cannot be subdivided meaningfully. For example, the number

of parts damaged in shipment.

Attribute data (aka Discrete data) is data that can't be broken down into a smaller unit and add additional meaning. It is typically things counted in whole numbers. There is no such thing as 'half a defect.' Population data is attribute because you are generally counting people and putting them into various catagories (i.e. you are counting their 'attributes'). I know, you were about to ask about the '2.4 kids' statistic when they talk about average house holds. But that actually illustrates my point. Who ever heard of .4 of a person. It doesn't really add addition 'meaning' to the description.

for alternative data type.See Continuous Data

Observations made by categorizing subjects so that there is a distinct interval between any two possible values. "Good or Bad" and "Tall or Short"

Dispersion

The degree to which the data set tends to spread about the mean. Dispersion has three common measures: Range, Variance and Standard Deviation

Distribution

Distribution refers to the behavior of a process described by plotting the number of times a variable displays a specific value or range of values rather than by plotting the value itself.

DMADV

Define, Measure, Analyze, Design, Verify. Design for Six Sigma or new .DMADV Methodologyproduct/service introduction. See

DMADV is a data-driven quality strategy for designing products and processes, and it is an integral part of a Six Sigma Quality Initiative. DMADV consists of five interconnected phases: Define, Measure, Analyze, Design, and Verify.

D-MAGICS

Problem solving methodology can be as Defining MAGICS, i.e.

M - Measure
A - Analyse
G - Grasp
I - Improvise
C - Control
S - Sustain

I have added G & S to original six-sigma D-MAIC, because ...

G - It is very dificult to accept the present situation (typically unfavorable), even though it is based on the facts. We always say "How it is possible, I have taken so much care not to create this situation. Something is wrong with the data." Hence before moving to improvise phase, let the team accept / grasp the situation.
S - For establishing link with ISO -9001 : 2000 continual improvement philosophy.

DMAIC

Define, Measure, Analyze, Improve, Control. Incremental process improvement using Six Sigma methodology. See DMAIC Methodology

Pronounced (Duh-May-Ick).

DMAIC refers to a data-driven quality strategy for improving processes, and is an integral part of the company's Six Sigma Quality Initiative. DMAIC is an acronym for five interconnected phases: Define, Measure, Analyze, Improve, and Control.

Each step in the cyclical DMAIC Process is required to ensure the best possible results. The process steps:

Define the Customer, their Critical to Quality (CTQ) issues, and the Core Business Process involved.
- Define who customers are, what their requirements are for products and services, and what their expectations are
- Define project boundaries the stop and start of the process
- Define the process to be improved by mapping the process flow

Measure the performance of the Core Business Process involved.
- Develop a data collection plan for the process
- Collect data from many sources to determine types of defects and metrics
- Compare to customer survey results to determine shortfall

Analyze the data collected and process map to determine root causes of defects and opportunities for improvement.
- Identify gaps between current performance and goal performance
- Prioritize opportunities to improve
- Identify sources of variation

Improve the target process by designing creative solutions to fix and prevent problems.
- Create innovate solutions using technology and discipline
- Develop and deploy implementation plan

Control the improvements to keep the process on the new course.

- Prevent reverting back to the "old way"
- Require the development, documentation and implementation of an ongoing monitoring plan
- Institutionalize the improvements through the modification of systems and structures (staffing, training, incentives

DMEDI

DMEDI----Define,Measure,Explore,Develop and Implement.It is equivalent to DFSS

Document

A document is a collection of information or instructions presented to perform some activity in a process / procedure.

A document is an output of manual or electronic documentation of data or information used for documenting events, processes, procedures or activities and utilized as a testimony to verify performance

DOE

for full definitionDesign of Experiments - DOESee

DPO

Defects per opportunity (DPO) represents total defects divided by total opportunities.

DPO is a preliminary calculation to help you calculate DPMO (defects per million opportunities). Multiply DPO by one million to calculate DPMO.

Example: If there are 34 defects out of 750 units having 10 oppurtunities per unit, then DPO=34/750*10=0.045/10=0.0045

DPU

Defects per unit (DPU) represents the number of defects divided by the number of products.

Example: If there are 34 defects in 750 units DPU will be 34 divided by 750 is equal to 0.045.

Drift

As components age and equipment undergoes changes in temperature or sustains mechanical stress, critical performance gradually degrades. This is called drift. When this happens your test results become unreliable and both design and production quality suffer. Whilst drift cannot be eliminated, it can be detected and contained through the process of calibration.

Dunnett's (1-way ANOVA)

Check to obtain a two-sided confidence interval for the difference between each treatment mean and a control mean. Specify a family error rate between 0.5 and 0.001. Values greater than or equal to 1.0 are interpreted as percentages.

DVP&PV

Design Verification, Production and Process Validation

ECO

Engineer Change Order...
Engineering changes in procedures that will be implemented in a new revision of a procedure

ECR

Engineering Change Request: A request or suggestion to Engineering for an improvement in a process or procedure.

Eficient Consumer Response: A term used to describe a way of doing business in the grocery industry that involves trading partners

Effect

An effect is that which is produced by a cause; the impact a factor (X) has on a response variable (Y).

Effectiveness

ef·fec·tive **Pronunciation Key** (ĭ-fĕk'tĭv)
adj.

1.
    a. Having an intended or expected effect.
    b. Producing a strong impression or response; striking: *gave an effective performance as Othello.*
2. Operative; in effect: *The law is effective immediately.*
3. Existing in fact; actual: *a decline in the effective demand.*
4. Prepared for use or action, especially in warfare.

Bridging the gap between the society's purposes and the organizational and workers objectives in the organization.

Process output satisfying customer CTQ.

Efficacy

The power or ability to cause an effect

Efficacy

The power or ability to cause desired effect

Efficiency

A term denoting to the relationship between outputs and inputs. It requires generating higher outputs as related to inputs. It means enhancing productivity, i.e less rework, less errors and optimal use of resources.

A term indicating the optimization of productivity (measured outputs over measured inputs)typically stated on a 0-100% scale. To improve efficiency, the productivity ratio must be improved (the input to output ratio must be decreased). See definition of productivity.

ELT

This acronym means to Extract Load Transfer. This tool is used mainly in the IT industry by the database engineers to extact information and load them or transfer them to other business units. This is helpful in retrieving information for data mining, data marts and other areas of datawarehouse. Information like this is helpful in making decisions based on the information that is already available and stored in a location.

Empirical Rule

For data sets having a normal, bell-shaped distribution, the following properties apply:

- About 68% of all values fall within 1 standard deviation of the mean
- About 95% of all values fall within 2 standard deviation of the mean
- About 99.7% of all values fall within 3 standard deviation of the mean

Empowerment

A series of actions designed to give employees greater control over their working lives. Businesses give employees empowerment to motivate them according to the theories of Abraham Maslow and Fredrick Herzberg.

To invest with power or give authority to complete. To empower employees.

Being allowed to make decisions and take actions on your own, apart from

management.

A contract that involves the delegation of authority and commitment to an individual to act or authorize actions to be taken, in exchange for the acceptance of responsibility and accountability to fulfill a defined objective. Used to increase an organizations responsiveness, effectiveness and efficiency without increasing the budget.

Encryption

Putting data into a code to prevent hackers taking data.

Enlistment

Making employees loyal and dedicated to the organization, external customer,and the society, this definition is more broader than partcipation or empowerment and involvement

Entitlement

As good as a process can get without capital investment. Alt. A perceived "right to demand." Opposite of a gift, in that it is without appreciation. A "you owe me" obligation for which, I owe nothing in return.

Entry Criteria

A predefined set of conditions used as a *Process Control* mechanism, to determine the cost-effectiveness of initiating a *Process* or sub-process.

Entry Criteria should be used to prevent the entry of "garbage" into a process, such as poor-*Quality* specifications or inadequate levels of prior work.

See also *Exit Criteria*.

ERP

Stands for Enterprise Resource Planning. ERP refers to software packages that attempt to consolidate all the information flowing through the company from finance to human resources. ERP allows companies to standardize their data, streamline their analysis process, and manage long term business planning with greater ease.

Erroneous

As defined by 'Harbour (2002)' an econometric technique that is purposely executed incorrectly to establish the consequences of poor technique. Or, it is simply an excuse for the statistician (econometrician) that makes a mistake, who could claim that he/she is simply looking to see what the consequences of erroneous behaviour is

Error

Error, also called residual error, refers to variation in observations made under identical test conditions, or the amount of variation that can not be attributed to the variables included in the experiment

Error (Type I)

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. Also known as Producer's risk

Error (Type II)

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

Accept an hypothesis or statement as true when it is false: Ho is false, but I conclude Ho is true. Error that concludes that someone is not guilty, when in fact, he or she really is. (accept Ho as true, beeing false, when Ha is true).

A failed alarm is a Type II error

BETA is the probabilty of error type II

Also known as consumer's risk.

Error Cause Removal

This is one of the steps in 14 steps advocated by Philip B crosby in his methodology of Quality Improvement

Error Mode Effects Analysis

Error Modes and Effects Analysis (EMEA)

A procedure in which each potential error made in every sub-process of a process is analyzed to determine its effect on other sub-processes and on the required accuracy of the process.

An EMEA is also used to prioritize & rank potential causes of process or human failures as well as create, launch and evaluate preventative actions.

ESER

Engineering Sample Evaluation Report

EWMA

Exponentially Weighted Moving Average

The exponentially weighted moving average (or EWMA) control chart is good for detecting small process shifts.

Exit Criteria

A predefined set of conditions used as a *Process Control* mechanism, to verify that a *Process* or sub-process has been completed and that its products are of acceptable *Quality*.

Exit Criteria prevent the delivery of "Garbage Out" to downstream users of the products.

See also *Entry Criteria*.

F test

F test - test of whether two samples are drawn from different populations have the same
standard deviation, with specified confidence level. Samples may be of different sizes.

Facilitate

To make easy or easier. Often referred to as a facilitator or one who makes meetings more efficient

Factor

A factor is an independent variable; an X

Factor (of a Consequence)

In root cause analysis we seek to construct an evidence based, logically complete, tightly linked tree of chains of factors affecting a specific consequence. (Most of the time we first select the most unacceptable consequence, be it actual, expected, or potential.)

{Consequence}<-- {Factors}
{Direct, Immediate, proximate Factors}<-- {Intermediate Factors}
{Intermediate Factors}<-- {Deeper Intermediate Factors}
{Deeper Intermediate Factors}<-- {Even Deeper Intermediate Factors}
Etc.
{Deepest Intermediate Factors}= {"Root" Factors}

Fagan Style Software Inspection

A variety of related manual defect detection activities go by names such as inspection, formal inspection, Fagan inspection, walkthrough, peer review, formal technical review, and so on. In the most general sense, these are all ways in which someone other than the creator of a software work product examines the product with the specific intent of finding errors in it.

Software Inspections were introduced in the 1970s at IBM, which pioneered their early adoption and later evolution. Michael Fagan helped develop the formal software inspection process at IBM, hence the term "Fagan inspection."

Reference: Fagan, M. "Design and Code Inspections to Reduce Errors in Program Development." IBM Systems Journal 15, 3 (1976): 182-211.

Failure Modes and Effects Analysis (FMEA)

A procedure and tools that help to identify every possible failure mode of a process or product, to determine its effect on other sub-items and on the required function of the product or process. The FMEA is also used to rank & prioritize the possible causes of failures as well as develop and implement preventative actions, with responsible persons assigned to carry out these actions.

Failure modes and effects analysis (FMEA) is a disciplined approach used to identify possible failures of a product or service and then determine the frequency and impact of the failure.

FAST

Function Analysis System Technique is a tool/diagram used in value analysis and value engineering projects

FCE

Frequently Committed Errors. The errors in process / operation that get repeated time and again. These are the common errors committed frequently. Eg: counting mistake by a Bank-Cashier

F-Chart

An F-Chart is a chart that carries a significant amount of misleading information, rendering it unfit for the intended analysis. A good example of an F-Chart can be found in the boxplots output of the 2-Sample t-test, and One Way ANOVA in Minitab release 14. The presence of a line connecting the means of each subgroup serves no apparant purpose, and could potentially mislead the reader into thinking that a steep gradient indicates a significant difference. The "F" comes from the latin 'fuccant'.

Fenwick-vanKoesveld Test

The Fenwick-vanKoesveld test typically refers to the practice of asking, three times, who caused the failure which has occurred in order to get to the originator of the problem. There can not be more than one originator to a problem as well. In an organizational context, generally Originator analysis is carried out by a team of persons not related to him/her (Internal Audit teams). No special technique is required.

An example is in order:

_____
Here's an example. I learned the example using the Washington Monument used when demonstrating the use of the Fenwick-vanKoesveld Test.

The Washington Monument was degrading
Who? stopped the use of harsh chemicals
Who? was assigned to clean pigeon poop
Who? controls the budget for the wildlife conservation.
Solution: Have correct ownership for the Budget Control.

FIFO

First In, First Out. A method of inventory rotation to ensure that the oldest inventory (first in) is used first (first out).

Financial Metrics

Used to measure the gains of a Project. Financial metrics convert the process improvements (measured through the primary process metric) in to Hard or soft dollars.

These metrics always include some kind of dollar impact.

First Time Yield - FTY

First Time Yield (FTY) is simply the number of good units produced divided by the number of total units going into the process. For example:

You have a process of that is divided into four sub-processes - A, B, C and D. Assume that you have 100 units entering process A. To calculate FTY you would:

1. Calculate the yield (number out of step/number into step) of each step. 2. Multiply these together.

For Example:

100 units enter A and 90 leave. The FTY for process A is 90/100 = .9

90 units go into B and 80 units leave. The FTY for process B is 80/90 = .89

80 units go into C and 75 leave. The FTY for C is 75/80 = .94

75 units got into D and 70 leave. The FTY for D is 70/75 = .93

The total process yield is equal to FTYofA * FTYofB * FTYofC * FTYofD or .9*.89*.94*.93 = .70.

You can also get the total process yield for the entire process by simply dividing the number of good units produced by the number going in to the start of the process. In this case, 70/100 = .70 or 70 percent yield.

First Time Yield Or First "Pass" Yield Is A Tool For Mearsuring The Amount Of Rework In A Given Process. It Is An Excellent Cost Of Quality Metric.

FISH

Inventory Control - instead of FIFO or LIFO - some organizations use FISH - first in still here!

Fishbone

A tool used to solve quality problems by brainstorming causes and logically organizing them by branches. Also called the Cause & Effect diagram and .fishbone sectionIshikawa diagram. For more information, view the

Fisher's (1-way ANOVA)

Check to obtain confidence intervals for all pairwise differences between level means using Fisher's LSD procedure. Specify an individual rate between 0.5 and 0.001. Values greater than or equal to 1.0 are interpreted as percentages.

Fits

Predicted values of "Y" calculated using the regression equation for each value of "X"

Fitted value

A fitted value is the Y output value that is predicted by a regression equation

Flowchart

A flowchart is a graphical representation of a process, depicting inputs, outputs and units of activity. It represents the entire process at a high or detailed (depending on your use) level of observation, allowing analysis and optimization of workflow.

A flowchart is a graphical representation of a process. It represents the entire process from start to finish, showing inputs, pathways and circuits, action or

decision points, and ultimately, completion. It can serve as an instruction manual or a tool for facilitating detailed analysis and optimization of workflow and service delivery.

FMEA

Failure Modes and Effects AnalysisSee

FMVSS

Federal Motor Vehicle Safety Standards

FOCUS - PDCA

The FOCUS-PDCA model was developed by W. Edwards Deming and provides a model for improving processes. The model's name is an acronym that describes the basic components of the improvement process. The steps include:
F ind a process to improve
O rganize an effort to work on improvement
C larify current knowledge of the process
U nderstand process variation and capability
S elect a strategy for continued improvement
PDCA is an acronym for Plan, Do, Check and Act. The PDCA cycle is a way of continuously checking progress in each step of the FOCUS process.

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

Form / Format

Form is a pre-defined template required to be used in a Process / instruction for information / data collection.

Fractional Factorial DOE

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.

Frequency Plot

A frequency plot is a graphical display of how often data values occur

Full factorial DOE

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

F-value (ANOVA)

Measurement of distance between individual distributions. As F goes up, P goes down (i.e., more confidence in there being a difference between two means). To calculate: (Mean Square of X / Mean Square of Error)

Gage R&R

Gage R&R, which stands for gage repeatability and reproducibility, is a statistical tool that measures the amount of variation in the measurement system arising from the measurement device and the people taking the measurement. See Gage R&R tools.

There's an excellent post on the discussion forum by Stephen Curtis describing Gage R&R:

"Gage R&R is intended to be a study to measure the measurement error in measurement systems."
http://www.isixsigma.com/forum/showmessage.asp?messageID=6070

Characterizing the Measurement Process
http://www.isixsigma.com/library/content/c020527a.asp

AIAG Automotive Industry Action Group publishes a booklet called Measurement Systems Analysis which answer your questions. Their website .http://www.aiag.orgis

When measuring the product of any process, there are two sources of variation: the variation of the process itself and the variation of the measurement system. The purpose of conducting the GR&R is to be able to distinguish the former from the latter, and to reduce the measurement system variation if it is excessive.

Typically, a gage R&R is performed prior to using it. We repeat the gage R&R anytime we have a new operator or inspector, it is part of our training and certification process. We also repeat it annually to make sure we aren't

experiencing any erosion of skills. It is used as part of the Six Sigma DMAIC process for any variation project.

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

Gap Analysis

Gap analysis is done to map the gap which exits between implied & specified customer requirements and existing process

Gating

Gating is the limitation of opportunities for deviation from the proven steps in the manufacturing process. The primary objective is to minimize human error

GCI

The Global Commerce Initiative (GCI) is a voluntary platform created in October 1999 to improve the performance of the international supply chain for consumer goods through the collaborative development and endorsement of recommended standards and key business processes

Gemba

Japanese term that means workplace where day to day activities are performed.

General Linear Model

General Linear Model(GLM)is a tool used to analyse 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 analysed and worked upon.
Also in cases where none of the Potential x's could prove it's significance as a part of the 'Analyse' 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.

Global definition of 'Quality'

Quality of any organisation is measured in terms of,

" Loss made to the society ".

This encompasses the whole gamut of quality metrics that are talked about, like,
Re-work, Delay - waste, customer dis-satisfaction, failures both within and outside the organisation, etc.,

Globalization

Social, economical, environmetal and technological perspectives to the many cultures that exist in the world.

Goal

1. A goal is a targeted value by a design team while building a quality process/product.

2. A goal can also be defined as a customer voice. What the customer is asking for or specifying.

The goal must be SMART: See S.M.A.R.T. in this dictionary.

A Goal is a targeted result of a process (design or currently running). In a service Industry, the goal can be satisfaction of the Customer. In layman language, the goal has to be achieved by doing an assignment, job, errand, etc. For example, achieving complimentry satisfaction from people eating food you have cooked. That is your goal.

Goodman-Kruskal Gamma

Term used to describe % variation explained by X.

GQTS

Global Quality Tracking System

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 Master or Black Beltand skills associated with Six Sigma is less than that of a . Extensive product knowledge in their company is a must in their Black Belt task of process improvement.
The green belt employee plays an important role in executing the Six Sigma process at an organization level.

GRPI

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. See the tool GRPI.

Gwilliam Motivational Model

A process whereby employees are motivated more by primal urges, than to any loyalty to their workplace

Hanedashi

Auto-eject devices that unload the part from the machine once the cycle is complete. This allows the operators to go from one machine to the next, picking up and loading. A key component of Chaku-Chaku lines.

Hard Savings

Six Sigma project benefits that allow you to do the same amount of business with less employees (cost savings) or handle more business without adding people (cost avoidance). These are referred to as hard savings. They are the soft savingsopposite of

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.

Hidden Factory, The

The notion that much of the endeavour of the company that is not quality minded is directed inadvertently to creating waste and performing wasteful tasks - examples of wasteful activities are the production of non-conforming products and the holding of excessive stock. The hidden factory is the extra useful, positive output that would theoretically be possible if the energy directed at creating waste were released and directed instead at making good quality items. In 1977, the quality guru Armand Feigenbaum estimated the endeavour within the hidden factory might be 15% to 40% of total company effort. The notion of the hidden factory is bound up with the metric COPQ (cost of poor quality). The COPQ may be estimated by multiplying the number of defects per period of time by the average unit cost to fix a defect (labour and materials). Such a calculation however omits such costs as loss of goodwill and loss of competitiveness, and such other matters as warranty costs and even legal damages.

Histogram

A bar graph of a frequency distribution in which the widths of the bars are proportional to the classes into which the variable has been divided and the heights of the bars are proportional to the class frequencies.

A histogram is a basic graphing tool that displays the relative frequency or occurrence of continuous data values showing which values occur most and least frequently. A histogram illustrates the shape, centering, and spread of data distribution and indicates whether there are any outliers.

A graphic way to summarize data. Size is shown on the horizontal axis (in cells) and the frequency of each size is shown on the vertical axis as a bar graph. The length of the bars is proportional to the relative frequencies of the data falling into each cell and the width is the
range of the cell. Data is variable measurements from a process.

Homegeneity of variance

Homogeneity of variance is a test used to determine if the variances of two or more samples are different. See the tool Homogeneity of Variance

Horizontalization

The philosophy of turning companies with traditional silo management systems into ones that are Process orientated

Hoshin Kanri

It is the annual planning process and deployment also known as Hoshin Planning or “Policy Deployment”.

What does Hoshin mean ?
* There are two Chinese characters: ‘Ho’ meaning method or form and ‘Shin’ meaning shiny needle or compass.
* Hoshin means ‘way of setting direction’.
* Kanri means ‘control or management’.
* It was first used in 1965 by Komatsu.
* Instead of Hoshin some companies use the term ‘policy deployment’.

Nichijo Kanri
* Nichijo means ‘Daily’. Hence ‘Nichijo Kanri’ means ‘Daily Management’.
* It is the complement to Hoshin Kanri, covering all the other things.
* It is usually covered by Business Fundamentals and Implementation Plans.

Many Organizations have used it. We have used it extensively in Hewlett-Packard

Hoshin Kanri

Hoshin Kanri is a step-by-step strategic planning process that assesses breakthrough strategic objectives against daily management tasks and activities. It provides a visual map at all levels of the organization provides clear strategic direction.

Hoshin's premise is that satisfying the customer and staying in business means listening to the Voice of the Customer, the environment and then and focusing on critical improvements - - hoshins.

Hoshin Kanri methodology ensures that everyone in the organization knows the strategic direction for the company. Creating a working communication system means everyone is working towards a common goal!

Another key component of Hoshin is the measurement and analysis that takes place in order to know base decisions on fact and not gut feelings. Measuring the system as a whole is critical to organizational effectiveness.

The term "Hoshin Kanri" was coined by Bridgestone Tires in Japan.

House of Quality

The House of Quality is the first matrix in a four-phase QFD (Quality Function Deployment) process. It's called the House of Quality because of the correlation matrix that is roof shaped and sits on top of the main body of the matrix. The correlation matrix evaluates how the defined product specifications optimize or sub-optimize each other.

for more information on House of Quality.QFD DefinitionSee

Hyper Micro Process map

The Hyper Micro Process Map is used when there is an important or doubtful process which requires detailed study for various sub-steps . The Hyper Micro Process map is limited to the exact process nder study and is generally created if a normal or a Micro Process Map is not able to distinguish the process step where defects are getting generated

Hypothesis Testing

Hypothesis testing refers to the process of using statistical analysis to determine if the observed differences between two or more samples are due to random chance (as stated in the null hypothesis) or to true differences in the samples (as stated in the alternate hypothesis). A null hypothesis (H0) is a stated assumption that there is no difference in parameters (mean, variance, DPMO) for two or more populations. The alternate hypothesis (Ha) is a statement that the observed difference or relationship between two populations is real and not the result of chance or an error in sampling. Hypothesis testing is the process of using a variety of statistical tools to analyze data and, ultimately, to fail to reject or reject the null hypothesis. From a practical point of view, finding statistical evidence that the null hypothesis is false allows you to reject the null hypothesis and accept the alternate hypothesis

ICT

Information Communication Technology

Ideation Brainstorming

Ideation Brainstorming

New brainstorming tools
New tools for brainstorming combine advantages of traditional brainstorming techniques of Osborn and of the I-TRIZ techniques. TRIZ is an acronym of Russian Theory of Inventive Problem Solving, which has been developed by Henrich Altschuller in 1940s-80s in Russia.
New tools are called Ideation Brainstorming, as they are based on the follow-up research of TRIZ specialists in Ideation, Inc. leaded by Boris Zlotin. Inventor and analyst B.Zlotin has been a student of H. Altschuller and has published several books together with him. The follow-up research studies are known as I-TRIZ -- an expanded, enhanced, and restructured version of the Theory of Inventive Problem Solving (TRIZ)

Ideation Brainstorming tools and methodology
Ideation Brainstorming software tools implement a simple well structured 4-step process for solving problems using I-TRIZ:
1. Define the problem-solving objectives
2. Form an "ideal" vision of a system
3. Develop solution concepts to bring the system closer to ideal
4. Evaluate solution concepts and tackle subsequent tasks
This easy-to-use software contains more than 100 "operators" -- proven innovation axioms with practical examples that have been successfully applied throughout the history of technology, as documented in patents and other descriptions of inventive achievement.
Ideation Brainstorming tools serve as a structured guide and knowledge-based facilitation support for any brainstorming session and for any application.
The Ideation Brainstorming operators particularly help to:
· Improve system performance, functionality, efficiency, etc.
· Eliminate, reduce, prevent or counteract undesired system effects and characteristics
· Find new applications for a system
· Resolve system contradictions without trade-off or compromise etc.

Who may use it
Anybody is able to use these tools after a short introductory workshop (2 hours) and a case study performed with the help of experienced facilitator (2 hours). The Ideation Brainstorming tools contain an e-Learning introductory book into I-TRIZ. Basic I-TRIZ e-Learning teaches the fundamentals of the I-TRIZ methodology (system approach, ideality, recognizing and resolving contradictions, utilization of resources, and more) in 4 hours or less.

Positive Impact
n-class and virtual يCurrent research and practical experiences in conducting brainstorming sessions for diverse problem solving targets show, that using Ideation Brainstorming
· Increases the productivity of idea generation 3-5 times in the first 15-20 min of brainstorming and 5-10 times during the rest of the session (which may last up to 2 hours) in comparison with traditional brainstorming techniques
· The quality of ideas (e.g. their impact on increasing sigma level and process capability) and their completeness are much higher comparing with traditional methods
· The risks to define problem in a wrong way, or forget critical opportunities, resources etc., miss efficient concepts and solutions are few orders lower
· Reduces or eliminates “rework” or follow-up brainstorming sessions with similar targets.
· Team members feel motivated and much more satisfied and excited after the session, especially due to the high tempo in ideas generation, proof of being smart, effectiveness and efficiency.
One need much less time and efforts to come with better ideas and solutions, and it will certainly make the Ideation Brainstorming tools to one of the most commonly used problem solving tools for diverse applications and audiences.

IDOV

IDOV: Identify, Design, Optimize, Validate. This is a methodology used in DfSS for design and product optimization. Some recipes used in each stage are:
Identify : VOC, CTQ, Technical requirements and quality targets
Design : Evaluate system concepts, CTQs,develop transfer functions, relate CTQs to design
Optimize : Robust design, DFM, Predict Reliability, Optimize 6 sigma, predict quality level.
Validate : Test and validate prototypes, assess performance and reliability, iterate design if necessary.

I-MR 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. See the tool I-MR Con

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. See

Incoming Goods Inspection

Incoming Goods Inspection (IGI)

A verification check if the product arrived in good condition at your warehouse before accepting them into your stock. In some cases additional measurements are required to verify if the product is according to the desired specification, but in general it means checking if the boxes are OK, the labels are there in the right place, the quantity is OK, etc., etc. The functionality is, or should be, guaranteed and proved with a measurement report from the vendor.

In-Control

An "In-Control" process is one that is free of assignable/special causes of variation. Stable, in-control, with random variation only, all mean the same thing which is, the process behaves equally over the time. Such a condition is most often evidence on a control chart which displays an absence of nonrandom variation.

In control refers to a process unaffected by special causes. A process that is in control is affected only by common causes. A process that is out of control is affected by special causes in addition to the common causes affecting the mean and/or variance.

.Stable ProcessAlso see

Independent Variable

An independent variable is an input or process variable (X) that can be set directly to achieve a desired output.

Indirect Cost

A cost incurred which cannot be directly allocated in full to a single product, service, customer, cost center or business activity; incurred on behalf of a number of cost units or centers to which the cost may be apportioned.

Inferential Statistics

Inferential statistics allow us to make inferences about a population on the basis of data collected.

Inspection

See *Fagan-style Inspection*, *Software Inspection*

Note: 'Inspection' outside of the software field may have a different -- and negative -- connotation equivalent to software 'testing'. It was the latter type of inspection that Deming condemned when he wrote, 'We must cease dependence on mass inspection' as a quality management technique

Inspection Plan

What is an inspection plan:
a. check machine tool for accuracy
b. select the critical and important dimensions to inspect
c. select the measuring insturments
d. construct SPC charts for all dimensions

This is part of NIMS certification for H.S. machine shop teachers and I could use some help! Thanks Jim
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The general purposes of a Plan are these: To identify the goal(s) to be achieved; to specify the best route (methods, processes ...) for arriving at the goal(s); to catalogue resources (tools, time ...) needed to pursue the chosen route; to assign responsibilities for controlling and consuming those resources; and to secure agreement by relevant stakeholders. (This is *not* an exclusive list!)

See further under Software Inspection Plan.

Instant Pudding

A term used to illustrate an obstacle to achieving quality or the supposition that quality and productivity improvement are achieved quickly through an affirmation of faith rather than through sufficient effort and education.

W. Edwards Deming used this term, which was initially coined by James Bakken of Ford Motor Co., in his book Out of the Crisis.

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.

eg, Non-reportable benefits such as, Increased level in service (in ways that cannot be measured) and customer satisfaction.

Interaction

An interaction occurs when the response achieved by one factor depends on the level of the other factor. On interaction plot, when lines are not parallel, there's an interaction

Interactional Data

Interactional data is the real-time capture of each procedural decision

complete with data and time stamp. Each interactional decision is also marked with the actual procedural version used at that moment of time

Interquartile Range

Difference between the 75th percentile and the 25th percentile

Interrelationship digraph

An interrelationship digraph is a visual display that maps out the cause and effect links among complex, multivariable problems or desired outcomes

I-P-O

Input-Process-Output is associated with a diagram that visually (usually best) represents the process (center box) with inputs shown on the left and outputs shown on the right. Assists in understanding proactive and reactive improvement. Strive for addressing the inputs to a process!

IQR

I ntraquartile range (from box plot) representing range between 25th and 75th quartile.

Ishikawa, Ichiro

Japanese Quality professional widely known for the Ishikawa diagram also known as the fishbone or cause and effect diagram. He is also known as Ishikawa, Kaoru

ISO 9000 Series of Standards

Series of standards established in the 1980s by countries of Western Europe as a basis for judging the adequacy of the quality control systems of companies.

ISO 9001:2000

ISO certification standard from the ISO 9000 series revised in year 2000. ISO 9001:2000 promotes a process based approach to increase the effectiveness of the QMS (Quality Management System) in translating customer requirements to customer satisfaction.

ITIL

Stands for IT (Information Technology) Infrastructure Library.

It is a British government service management standard/model that documents best practices for support and delivery of IT Services

I-TRIZ

I-TRIZ is a research-based enhancement of classical TRIZ science, methodology, tools and applications (Russian acronim for the Theory of Inventive Problem Solving).
Classical TRIZ was pioneered by Henrich Alshuller in 1946-85 as a science, way of thinking, basic set of tools and applications.
I-TRIZ followed up and
- expanded TRIZ methodology to non-technical areas (business, management,
scientific research etc.) and adopts it to the Western world, i.e. mental-, cultural-, language-, business-,teaching- models etc.,
- provides knowledge-based integration of classical and new TRIZ tools and lines of evolution for higher repeatability, reproducability and re-usability of innovation processes and results,
- expanded classical TRIZ way of thinking towards so-called Directed Evolution,
- provides advanced decision-support knowledge-based tools and (e-)training materials

Advanced I-TRIZ methods and tools can be used for enhancing Six Sigma methodology, both DMAIC and IMADV or DFSS, especially when Six Sigma methods and tools are by different reasons inefficient and/or insufficient.

It allows particularly to save time, find efficient low-cost improvement solutions already at the Define or Identify phase, efficiently screen measurements, avoid errors and reduce rework and consequently the Cost of Poor Quality of Six Sigma e.g. when determining the root causes of defects, designing for upgrade from 2-3-4 to higher sigma levels etc.

Jack in the Box

Jack in the Box is a variable or an "x" that appears at random intervals during a process due to non-apparent external factors. Although this will not be focussed upon while creating a FMEA, the uniqueness of this variable is its ability to be significant enough to affect the process capability when it appears.

Example: During the benchmarking of a Credit Cards process, the Jack in the Box was that employees of the bank randomly decided to apply for pre-approved cards for their family members. The number of cards issued were significantly large to affect the baselining. The cause could not be tracked because the applications happened across the entire bank for no apparent reason

Just In Time (JIT) Manufacturing

A planning system for manufacturing processes that optimizes availability of material inventories at the manufacturing site to only what, when & how much is necessary.

Typically a JIT Mfg. avoids the conventional Conveyor Systems. JIT is a pull system where the product is pulled along to its finish, rather than the conventional mass production which is a push system. It is possible using various tools like KANBAN, ANDON & CELL LAYOUT.
Others tools include: shojinka, smed, jidoka, poka-yoka, and kaizen

Kaikaku

Kaikaku is a rapid change event as opposed to Kaizen which is smaller incremental changes. Kaikaku is revolutionary while Kaizen is evolutionary

Kaizen

Japanese term that means continuous improvement, taken from words 'Kai' means continuous and 'zen' means improvement.

Some translate 'Kai' to mean change and 'zen' to mean good, or for the better.

The same japanese words Kaizen that pronounce as 'Gai San' in chinese mean:

Gai= The action to correct.

San= This word is more related to the Taoism or Buddhism Philosophy in which give the definition as the action that 'benefit' the society but not to one particular individual. The quality of benefit that involve here should be sustain forever, in other words the 'san' is and act that truely benefit the others.

Kaizen Blitz

Kaizen definition has been Americanized to mean "Continual Improvement." A closer definition of the Japanese meaning of Kaizen is "to take apart and put back together in a better way." According to Webster - blitz is short for blitzkrieg. And blitzkrieg is (b) -"Any sudden overpowering attack." Therefore, a Kaizen Blitz could be defined as 'a sudden overpowering effort to take something apart and put it back together in a better way." What is taken apart is usually a process, system, product, or service. Read "Goldratt", who wrote the book called "The Goal"

Kaizen Event

Any action whose output is intended to be an improvement to an existing process.

Kaizen Events are commonly refered to as a tool that:

1) Gathers operators, managers, and owners of a process in one place
2) Maps the existing process (using a deployment flowchart, in most cases)
3) Improves on the existing process

4) Solicits buy-in from all parties related to the process

Kaizen Events are an extremely efficient to quickly improve a process with a low Sigma score. Kaizen Events are also useful for convincing organizations new to Six Sigma of the methodology's value.

The true intent of a kaizen event is to hold small events attended by the owners and operators of a process to make improvements to that process which are within the scope of the process participants.

Kaizen Event

Could also be a one shot improvement in a process or place due to which there will long term benefits. For example, cleaning up and re-organizing the warehouse to have better account of materials in locations, remove all dead inventory, organize slow moving inventory etc.

The process improvement here would be - accurate material issue, accurate storage of material in specified locations easy traceability of material due to re organizing etc.

Kaizen events, whether big or small, would benefit immediately once event is completed

Kanban

Kanban: A Japanese term. The actual term means "signal". It is one of the primary tools of a Just in Time (JIT) manufacturing system. It signals a cycle of replenishment for production and materials. This can be considered as a “demand” for product from on step in the manufacturing or delivery process to the next. It maintains an orderly and efficient flow of materials throughout the entire manufacturing process with low inventory and work in process. It is usually a printed card that contains specific information such as part name, description, quantity, etc.

In a Kanban manufacturing environment, nothing is manufactured unless there is a “signal” to manufacture. This is in contrast to a push-manufacturing environment where production is continuous.

Kano Analysis

Kano analysis is a quality measurement tool used to prioritize customer requirements based on their impact to customer satisfaction.

Kano analysis is a quality measurement tool which is used to determine which requirements are important. All identified requirements may not be of equal importance to all customers. Kano analysis can help you rank requirements for different customers to determine which have the highest priority.

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.

Note that the Kano model can be used to help identify customer segments, based on the relative prioity of each segment's requirements. Once segments have been defined, using both needs analysis and more tradition criteria such as gender, company size, etc., the Kano model can be re-applied to each segment to further defined the segment's priorities.

Briefly, Kano (a Japanese researcher), stated that there are four types of customer needs, or reactions to product characteristics / attributes:

1. The 'Surprise & Delight' factors. These really make your product stand out from the others. Example, a passenger jet that could take off vertically.
2. The 'More is Better'. E.g. a jet airliner that uses a little less fuel than the competition.
3. The 'must be' things. Without this, you'll never sell the product. E.g. A jet airliner that cannot meet airport noise regulations.
4. Finally, there are the 'dissatisfiers', the things that cause your customers not to like your product. E.g. a jet airliner that is uncomfortable to ride in.

Kaplan-Meier

The Kaplan-Meier method is a nonparametric (actuarial) technique for estimating time-related events (the survivorship function). 1 Ordinarily it is used to analyze death as an outcome. It may be used effectively to analyze time to an endpoint, such as remission.

It is a univariate analysis and is an appropriate starting technique. It estimates the probability of the proportion of individuals in remission at a particular time, starting from the initiation of active date (time zero), is especially applicable when length of follow-up varies from customer to customer, and takes into account those customer lost to follow-up or not yet in remission at end of study (censored customers, assuming the censoring is non-informative). It is therefore the instrument of choice in evaluating remissions following loosing a customer. Since the estimated survival distribution for the cohort study has some degree of uncertainty, 95% confidence intervals may be calculated for each survival probability on the “estimated” curve.

A variety of tests (log-rank, Wilcoxan and Gehen) may be used to compare two or more Kaplan-Meier “curves” under certain well-defined circumstances. Median remission time (the time when 50% of the cohort has reached remission), as well as quantities such as three, five, and ten year probability of remission, can also be generated from the Kaplan-Meier analysis, provided there has been sufficient follow-up of customers.

The Kaplan-Meier technique is usually only useful as a method of preliminary

evaluation, since it is purely a descriptive method for the evaluation of one variable.

Kappa

The Kappa is the ratio of the proportion of times the appraisers (see Gage R&R) did agree to the proportion of times the appraisers could agree.

Kappa Statistics: If you have a known standard for each rating, you can assess the correctness of all appraisers' ratings compared to the known standard. If Kappa = 1, then there is perfect agreement. If Kappa = 0, then there is no agreement. The higher the value of Kappa, the stronger the agreement. Negative values occur when agreement is weaker than expected by chance, but this rarely happens. Depending on the application, Kappa less than 0.7 indicates that your measurement system needs improvement. Kappa values greater than 0.9 are considered excellent.

KBC

KBC----Knowledge Based Community.One of the Main objective of six sigma Deployment.

KBI and KBR

KBI----Key Business Issue
KBR----Key Business Requirement

Kirkpatricks 4 Levels of Evaluation

Kirkpatrick's Four Levels of Evaluation

In Kirkpatrick's four-level model, each successive evaluation level is built on information provided by the lower level.

ASSESSING TRAINING EFFECTIVENESS often entails using the four-level model developed by Donald Kirkpatrick (1994). According to this model, evaluation should always begin with level one, and then, as time and budget allows, should move sequentially through levels two, three, and four. Information from each prior level serves as a base for the next level's evaluation. Thus, each successive level represents a more precise measure of the effectiveness of the training program, but at the same time requires a more rigorous and time-consuming analysis.

Level 1 Evaluation - Reactions
Just as the word implies, evaluation at this level measures how participants in a training program react to it. It attempts to answer questions regarding the participants' perceptions - Did they like it? Was the material relevant to their work? This type of evaluation is often called a “smilesheet.” According to Kirkpatrick, every program should at least be evaluated at this level to provide for the improvement of a training program. In addition, the participants'

reactions have important consequences for learning (level two). Although a positive reaction does not guarantee learning, a negative reaction almost certainly reduces its possibility.

Level 2 Evaluation - Learning

To assess the amount of learning that has occurred due to a training program, level two evaluations often use tests conducted before training (pretest) and after training (post test).

Assessing at this level moves the evaluation beyond learner satisfaction and attempts to assess the extent students have advanced in skills, knowledge, or attitude. Measurement at this level is more difficult and laborious than level one. Methods range from formal to informal testing to team assessment and self-assessment. If possible, participants take the test or assessment before the training (pretest) and after training (post test) to determine the amount of learning that has occurred.

Level 3 Evaluation - Transfer

This level measures the transfer that has occurred in learners' behavior due to the training program. Evaluating at this level attempts to answer the question - Are the newly acquired skills, knowledge, or attitude being used in the everyday environment of the learner? For many trainers this level represents the truest assessment of a program's effectiveness. However, measuring at this level is difficult as it is often impossible to predict when the change in behavior will occur, and thus requires important decisions in terms of when to evaluate, how often to evaluate, and how to evaluate.

Level 4 Evaluation- Results

Level four evaluation attempts to assess training in terms of business results. In this case, sales transactions improved steadily after training for sales staff occurred in April 1997.

Frequently thought of as the bottom line, this level measures the success of the program in terms that managers and executives can understand - increased production, improved quality, decreased costs, reduced frequency of accidents, increased sales, and even higher profits or return on investment. From a business and organizational perspective, this is the overall reason for a training program, yet level four results are not typically addressed. Determining results in financial terms is difficult to measure, and is hard to link directly with training.

Methods for Long-Term Evaluation
Send post-training surveys
Offer ongoing, sequenced training and coaching over a period of time
Conduct follow-up needs assessment
Check metrics (e.g., scrap, re-work, errors, etc.) to measure if participants achieved training objectives
Interview trainees and their managers, or their customer groups (e.g., patients, other departmental staff)

Source: Encyclopedea of Educational Technology
as originally submitted to the Forum by K.sathya Narayanan

KISS

Keep It Simple and Specific.

The term is used for executive summary to To Management for their information and also for project leaders who might get lost in the complexities of the six sigma horizon.The term in itself suggests to apply common sense before selecting any complex tool and landing away from real world.

KJ

KJ is a method based on the work of a Japanese anthroploogist named Jiro Kawakita (hence KJ). It is a method of developing insight into themes and relationships amoung issues. It helps "drill" from high level issues at one level of context (usually abstract or vague) to a more detailed set of common, reuseable statements.

KJs are particularly useful in software because people have a tendency to state problems as abstract characteristics that they do not "like" as opposed to making data based statements about what they need. KJ is particularly useful in creating a flowdown of information leading to solid requirements at an appropriate level of context.

KPI

Key Performance Indicator (KPI) indicates any key performance that gives the actual data of that particular outcome.

Examples of quality KPI :

% of Rework.

Number of Customer Complaints.

KPIV

Key Process Input Variables

KPOV

Key Process Operating Variables

Key Process OUTPUT Variable

Kruskal-Wallis

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-Whitneytest 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

Kurtosis characterizes the relative peakedness or flatness of a distribution compared with the normal distribution. Positive kurtosis indicates a relatively peaked distribution. Negative kurtosis indicates a relatively flat distribution. [Microsoft Excel Help File, 2003.]

L1 Spreadsheet

An L1 spreadsheet calculates defects per million opportunities (DPMO) and a process Z value for discrete data.

L2 Spreadsheet

An L2 spreadsheet calculates the short-term and long-term Z values for continuous data sets.

LCL

Lower Control Limit (note different from LSL): similar to Upper Control Limit (q.v.) but representing a downwards 3 x sigma deviation from the mean value of a variable.

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 Level of Buffering (LLB)

The smallest buffer size needed to ensure the capacity of the line can meet

production demand.

See also Level of Buffering.

Lean Manufacturing

Initiative focused on eliminating all waste in manufacturing processes.

The Production System Design Laboratory (PSD), Massachusetts Institute of Technology (MIT) http://lean2.mit.edu/ states that 'Lean production is aimed at the elimination of waste in every area of production including customer relations, product design, supplier networks and factory management. Its goal is to incorporate less human effort, less inventory, less time to develop products, and less space to become highly responsive to customer demand while producing top quality products in the most efficient and economical manner possible.'

Principles of Lean Enterprise:
- Zero waiting time
- Zero Inventory
- Scheduling -- internal customer pull instead of push system
- Batch to Flow -- cut batch sizes
- Line Balancing
- Cut actual process times

Leptokurtic Distribution

A leptokurtic distribution is symmetrical in shape, similar to a normal distribution, but the center peak is much higher; that is, there is a higher frequency of values near the mean. In addition, a leptokurtic distribution has a higher frequency of data. If you move scores from shoulders of a distribution into the center and tails of a distribution, the result is a peaked distribution with thick tails.

Level of Buffering

A method of normalizing buffer capacity by applying the following formula:

LB = N / (c*Tdown)

Where LB: Level of buffering
N: Buffer capacity
c: Maximum cycle time of all machines in the line
Tdown: Maximum average of all machines in the line

Most often used in simulations and Lean Manufacturing Plants.

See also Lean Level of Buffering (LLB).

Levels

Levels are the different settings a factor can have. For example, if you are trying to determine how the response (speed of data transmittal) is affected by the factor (connection type), you would need to set the factor at different levels (modem and LAN)

LIFO

Last In, First Out. A method of inventory rotation to ensure that the newest inventory (last in) is used first (first out).

Likert Scale

A rating scale measuring the strength of agreement with a clear statement. Often administered in the form of a questionnaire used to gauge attitudes or reactions.

For example:
Question: "I found the software easy to use..."
1 Strongly disagree
2 Somewhat disagree
3 Undecided
4 Somewhat agree
5 Strongly agree

Linear Relationship

Linear Relationships are relationships between two variables that can be expressed as straight-line graphs.(eg; Scatterplot

Linearity

Linearity is the variation between a known standard, or "truth," across the low and high end of the gage. It is the difference between an individual's measurements and that of a known standard or truth over the full range of expected values.

Little's Law

Any Lean journey strives to minimize waste and increase speed. Increasing speed equates to reducing lead time to your customers. Minimizing waste includes an analysis of inventory on-hand and steps to reduce that inventory. Little's Law provides an equation for relating Lead Time, Work-in-Process (WIP) and Average Completion Rate (ACR) for any process. Named after the mathematician who proved the theory, Little's Law states:

Lead Time = WIP (units) / ACR (units per time period)

Knowing any two variables in the equation allows the calculation of the third.

Reducing WIP while maintaining the same ACR reduces lead time. Similarly, improving the process to increase ACR while maintaining the same WIP also reduces Lead Time. This applies to any process - manufacturing, transactional, service or design. If it is difficult to relate WIP to a given process, try using TIP instead (Things-in-Process).

Example: A quoting department can complete 4 quotes per day (ACR), and there are 20 quotes (TIP) in various stages in the department. Applying Little's Law:

Lead Time = TIP/ACR = 20 quotes/4 quotes/day = 5 days.

Therefore, without changing the process, inventory or priorities - or accounting for variation - any new quote coming into the department could reasonably be expected to be completed in 5 days.

Lot

A collection of individual pieces from a common source, possessing a common set of quality characteristics and submitted as a group for acceptance at one time. (Lot size = N).

Low Hanging Fruit

Low Hanging Fruit are basically those improvements & innovations that can be suggested and implemented during the Measure phase when they become apparent. It is not necessary to wait for the Improve phase for the implementation as it would be an opportunity loss. Low Hanging Fruit contribution should not be considered when Determining the Process Capability at the Control Phase.

LSL

A lower specification limit is a value above which performance of a product or process is acceptable. This is also known as a lower spec limit or LSL.

Lower Specific Limit: representing the minimum acceptable value of a variable (see also USL)

LTPD

LTPD - Lot Tolerance Percent Defective: the value of incoming quality where it is desirable to reject most lots. The quality level is unacceptable. This is the RQL expressed as a percent defective.

Lurking Variable

A lurking variable is an unknown, uncontrolled variable that influences the output of an experiment

Machine Capability Index

Often Known as Cmk. This is a short term machine capability index derived from the observations from uninterrupted production run. Even though the formulae are as same as Cp&Cpk calculation,the standard deviation used here is sample standard deviation (RMS). The preferred Cmk value is >1.67.Usually, The long term process capability to be planned and studied after achieving the targeted Cmk Value

Main Effect

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.

Malcolm Baldrige National Quality Award

The annual self-evaluation covers the following seven categories of criteria:

· Leadership
· Strategic Planning
· Customer and Market Focus
· Information and Analysis
· Human Resource Focus
· Process Management
· Business Results

The National Institute of Standards and Technology (NIST), a federal agency within the Department of Commerce, is responsible for managing the Malcolm Baldrige National Quality Award. The American Society for Quality (ASQ) administers the Malcolm Baldrige National Quality Award under a contract with NIST.

Mallows Statistic (C-p)

Statistic within Regression-->Best Fits which is used as a measure of bias (i.e., when predicted is different than truth).

Refer to a regression book for the exact definition.
Cp, Cpk, A2, D4, D2

Management

It is a rational social phenomenon based on planning, organizing, directing, coordinating, staffing, and control principles. Aiming to facilitate individuals and people to establish their organizations and projects for accomplishing their objectives and the organization's purposes efficiently and effectively, it could be a process or a system or a behavior. It can be applied to people, things, ideas, and on any activity or function.

Management by Knowledge

Employing data ,information, human knowledge;experiences ,human behavioural capabilities& intelligence,facts ,intellectual skills &psychomotor skills in improving organization total performance

Mann-Whitney

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.

Master Black Belt

Master Black Belts are Six Sigma Quality experts that are responsible for the strategic implementations within an organization. Master Black Belt main ; Green Belts and Black Beltsresponsibilities include training and mentoring of helping to prioritize, select and charter high-impact projects; maintaining the integrity of the Six Sigma measurements, improvements and tollgates; and developing, maintaining and revising Six Sigma training materials.

The Master Black Belt should be qualified to teach other Six Sigma facilitators the methodologies, tools, and applications in all functions and levels of the company, and should be a resource for utilizing statistical process control (typically just outside the Black Belt's knowledge base) within processes.

Matrix Diagram

A tool used for clarifying problems by “Thinking Multi-dimensionally”. It consists of a two-dimensional array to determine location and nature of problem. Tree diagram needs to be constructed before moving to Matrix diagram. The output (Means) of tree diagram are required to put in Y axis of Matrix and on X axis put Efficacy (Efficiency) and practicability, multiplication of Efficacy (Good, Satisfactory, not efficient) and practicability (Good, Satisfactory, not practical) will give the rank in 3rd Column. 4th column is responsibility (Various roles i.e. Doctor, Nurse, Ward boy etc), Put symbols for primary and secondary responsibility and 5th column could be remarks.

Mazume

Mazume is a Japanese word meaning "Gap Shrinking". This is used while doing a innovation in process lay out by shrinking the gap between equipment, thus saving the floor space and movement of operator / material

Mean

The mean is the average data point value within a data set. To calculate the mean, add all of the individual data points then divide that figure by the total number of data points.

Measure of Central Tendency and Dispersion

Step 1: Do you want to measure the disperison with in the data?

Yes: Calculate the range (Highest value - Lowest Value)

Step 2: Do you want to know more about other observations in the data sets by avoiding the extreme values?

Yes: Calculate the interquartile range (Q3-Q1)

Step 3: Do you want a better measure of the dispersion that takes every observation in to account:

Yes: Calculate the variance of the population (to calculate Population variance each item in the population by the total number of items in the population. By squaring each distance we are converting the -ve values to the positive values and at the same time assigning more weightage to to the large deviations).

Step 4: Do you want to a measure of dispersion with more convenient units?

Yes: Calculate the standard deviations where the standard deviation of the population is the square root of population variance.

Step 5: Do you want to know how many standard deviation a particular observation lies below or above the mean:

Yes: Calculate the standard score of the population

Step 6: Do you want to know a relative measure of magnitude of the standard deviation as compared to the magnitude of the mean for use in comparing two distributions?

Yes: Calculate the coefficient of variation

Measurement System Analysis - MSA

Measurement system analysis (MSA) is an experimental and mathematical method of determining how much the variation within the measurement process contributes to overall process variability.

There are five parameters to investigate in an MSA: bias, linearity, stability, repeatability and reproducibility.

According to AIAG (2002), a general rule of thumb for measurement system acceptability is:

- Under 10 percent error is acceptable.

- 10 percent to 30 percent error suggests that the system is acceptable depending on the importance of application, cost of measurement device, cost of repair, and other factors.

- Over 30 percent error is considered unacceptable, and you should improve the measurement system.

AIAG also states that the number of distinct categories the measurement systems divides a process into should be greater than or equal to 5.

In addition to percent error and the number of distinct categories, you should also review graphical analyses over time to decide on the acceptability of a measurement system.

Reference:
Automotive Industry Action Group (AIAG) (2002). Measurement Systems Analysis Reference Manual. Chrysler, Ford, General Motors Supplier Quality Requirements Task Force.

Measures Of Variation

Measures Of Variation

Median

Relating to or constituting the middle value in a distribution.

The median is the middle point of a data set; 50% of the values are below this point, and 50% are above this point.

Median is the middle value, when all possible values are listed in order.
Median is not the same as Average (or Mean).

MEDIC

Map+Measure, Explore+Evaluate, Define+Descibe, Implement+Improve, Control+Conform
Process Improvement Procedure, often used by Black Belts and Green Belts.

Metricationist

A person who uses or computes metrics.

(Note: Cannot use "Metrician" because it is a musical term.)

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 trade off

MGPP - Multi Generational Product Planning

MGPP - Multi Generational Product Planning is a Life cycle and generational planning of products, services and technology.

MGPP is used in Define phase of DMADV (Define-Measure-Analyze-Design-Verify) when we determine the Project Scope. The design or redesign of a new product or service begins with the identification of what you are going to design and why you are going to design it. There is often a competitive advantage to planning a series of product or service releases.

The Multi-Generational Product Plan (MGPP) is a critical tool used to define the scope of the current product or service to be designed as well as to plan the long-term direction of future product/service generations.

The main purpose of Multi-Generational Product Plan appears to be slightly "defensive" since it objective is to prepare for an unknown future. But this type of planning also has several "offensive" characteristics:

- MGPP focuses business and management on the long term.
- MGPP increases speed to market.
- MGPP reduces development risk.
- MGPP controls scope additions/changes to current design.
- MGPP prevents products/services/processes from stagnating while the market changes around them.
- In short, imagine it as a Leadership Strategy.

What is thought of during MGPP?

Generation I – Filling up the segments in the market that do not have this product.

Generation II – Capturing market needs and fill new target markets with your products.

Generation III – Delivering productivity breakthroughs to the end-user / customers. Gain competitive edge, technical leadership, etc.

Generation IV...(you decide).

Think of making a decision to do some world-changing event. Prior to starting your MGPP you want to come up with a long term goal. The MGPP is the most valuable when that goal is really hard.

Imagine your goal is putting a man on the moon. When JFK first suggested it, it sounded impossible. The first step in getting there is identifying the major milestones along the way. These are the generations. In the case of Apollo, they were putting a man in space, putting a man in orbit around the earth, putting a man in orbit around the moon, and finally putting a man on the moon's surface.

For each generation, you identify the capabilities you need to reach that goal. Now, you look at those capabilities. If the technology is already known, you can simply take something off the shelf and use it. However, maybe you sort of know, but you need to be a lot better at it. For those capabilities, you will spawn a DMAIC project to move the needle on those capabilities to where you need them. Finally, for the things where you really don't have anything like the capability, you execute a DFSS project to design out that capability.

Now, the neat thing is that you have a vision, a realistic path to that vision, and a bunch of clearly scoped projects. Each project can focus on it's needed capability without getting all worried about other issues. If a project finds out (as they often do) that some part of their scope is going to have a very unfavorable impact, they can look to the MGPP to see whether it might make sense to move that capability to a later generation. Similarly, if a project smells an opportunity, they can see what the total needed capability set is to determine whether pursuing that opportunity will move the organization toward the vision.

This is a really cool tool!

Mid Range

It is also termed as Mid Extreme.
It is nothing but the average of the least value and most value.
Steps involved are...
1. Arrange the numbers or readings in ascending order
2. Add the first number or reading with last number or reading.
3. Divide the sum by 2.

It gives the mid range of the readings.

Mid rank

If x1,x2,..xn are ‘n’ observations in a data set with frequencies f1,f2,...fn respectively. Lety1,y2,...,yn be the observed data arranged in the ascending order with respective ordered frequencies g(1),g(2),...g(n). Then mid-rank for yi is then calculated by
Ri=g(1)+g(2)+...+g(i-1)+(g(i)+1)/2;where i=1,2,...,n

Minford

meaning 'barmy economist'

MODAPTS

The MODAPTS (Modular Arrangements of Predetermined Time Standards) system was developed by G.C.Heyde as an instrument to improve ergonomics in the workplace. This system is used to analyse the way the work is performed and enables work teams to identify ways to make work easier through improved work and workplace design.

Once a team has been introduced to MODAPTS, a large number of improvement opportunities will be identified.

MODAPTS divides work into two basic elements:

1. Body part being used - alphabetical .

The following basic categories are defined:

-Movement : actions of the finger, hand or arm;
-Get: actions required to grasp an object;
-Put: actions required to place an object;
-Body: movements linked to the body (e.g. bend,walk).

2. Degree of effort involved - numerical (MOD=0.129 seconds)

The team analyses the way work is performed by adding the number of MODS involved.

The team then generates ideas to eliminate or reduce the elements with the highest scoring MODS.

Mode

The value or item occurring most frequently in a series of observations or statistical data.

The most often occurring value in the data set.

A data set may contain more than one mode, e.g., if there are exactly 2 values or items that appear in the data the same number of times, we say the data set is bi-modal.

Moods 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 an nonparametric alternative to the one-way analysis of variance. Mood’s median test is sometimes called a median tests

MPS

Master Production Schedule, The MPS is a time-phased plan of the items and the quantity of each that the orgranization intends to build.It is a commitment to meet marketing requirements and to use production capacity

MRP

Stands for Material Requirements Planning. MRP aims to increase manufacturing efficiency by managing the production schedule, reducing inventory, increasing cash flow, and delivering products in a timely manner. ERP is a technical subset of MRP.

MSA

Measurement System Analysis

MTBF

Mean time between failures.
An average time between machinery breakdowns. If the MTBF decreases, root cause analysis must be carried out to bring the MTBF # to a high, meaning long times between failures. PM, TQM, JIT, better controls are all tools to make MTBF higher.

MTTR

Mean time to repair.
This is the average time to repair a machine back to acceptable operating conditions. Also known as tool time, meaning once the machine breaksdown, the actual time spent on arranging spares, resources, planning and executing the tasks and then bringing it back to operating condition. This must be as low as possible.

Muda

The Japanese term for waste.

Multicolinearity

Multicolinearity is the degree of correlation between Xs. It is an important consideration when using multiple regression on data that has been collected without the aid of a design of experiment (DOE). A high degree of multicolinearity produces unacceptable uncertainty (large variance) in regression coefficient estimates. Specifically, the coefficients can change drastically depending on which terms are in or out of the model and also the order they are placed in the model.

Use Ridge Regression or Partial Least Squares (PLS) Regression to get around these problems if DoE is not an option.

Multiple Regression

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

Multi-Vari Chart

A multi-vari chart is a tool that graphically displays patterns of variation. It is used to identify possible Xs or families of variation, such as variation within a subgroup, between subgroups, or over time. See the tool Multi-Vari Chart.

MURA

The Japanese term for inconsistency

MURI

The Japanese term for strain

Natural Tolerances

Natural tolerances are the control limits placed at three times the standard deviation from the process average. These limits are some times refered to as Three Sigma Limits.

Noise

Process input that consistently causes variation in the output measurement that is random and expected and, therefore, not controlled is called noise. Noise also is referred to as white noise, random variation, common cause variation, noncontrollable variable.

Nominal

It refers to the value that you estimate in a design process that approximate your real CTQ (Y) target value based on the design element capacity. Nominals are usually referred to as point estimate and related to y-hat model.

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 can not 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-Conformity

A departure of a quality characteristic from its intended level or state that occurs with severity sufficient to cause an associated product or service not to meet a specification requirement

Non-Parametric

Set of tools that avoids assuming a particular distribution.

Non-parametric Test

A non-parametric test is used in place of its parametric conuterpart when certain assumptions about the underlying population are questionable (e.g. normality).

Normal Distribution

Normal distribution is the spread of information (such as product performance or demographics) where the most frequently occurring value is in the middle of the range and other probabilities tail off symmetrically in both directions. Normal distribution is graphically categorized by a bell-shaped curve, also known as a Gaussian distribution. For normally distributed data, the mean and median are very close and may be identical

Normal Probability

Used to check whether observations follow a normal distribution. P > 0.05 = data is normal

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. See the tool Normality Test.

Normsinv

NORMSINV is an Microsoft Excel function that delivers the inverse of the cummulative standarized normal distribution. You enter the "probability that a value Z is up to..." and it returns that value Z (in terms of "sigmas", because it is the standarized distribution with average 0 and sigma 1).

Example: NORMSINV(0.5)=0, NORMSINV(0.00135)=-3, NORMSINV(0.9772)=2. NORMSINV(0) and NORMSINV(1) will return error, because they correspond to - infinte sigmas and +infinte sigmas.

Null Hypothesis (Ho)

A null hypothesis (H0) is a stated assumption that there is no difference in parameters (mean, variance, DPMO) for two or more populations. According to the null hypothesis, any observed difference in samples is due to chance or sampling error.

The term that statisticians often use to indicate the statistical hypothesis being tested.

O.C.T. - Operation Cost Target

This value represents the maximum expenditure for material, labor, outsourcing, overhead, and all other costs associated with that project. This figure can then be divided between the various operations comprising the manufacturing process, in order to control costs at each step.

O.E.E.

O.E.E. means overall equipment effectiveness.It is a method to find out overall effectiveness of equipment. It is obtained by multiplication of three ratios.
1. Availability ratio - Time for which equipment was available for operation divided by total calender period for which O.E.E. is being calculated.
2. Quality Ratio - Quantity of "A" grade/Prime grade material produced divided by total production (Off grade+Prime grade)
3.Performance Ratio - Rate of production divided by Capacity of machine to produced.

Normaly O.E.E. is presented in terms of percentage.

O.E.M.

Original Equipment Manufacturer

Objective Evidence

Objective Evidence is physical evidence that someone, when reviewing an audit report, can inspect and evaluate for themselves. It provides compelling evidence that the review or audit was actually performed as indicated, and that the criteria for the audit/review was upheld.

O'Brien Effect

The O’Brien Effect, based upon the originator of the actual effect, is not knowing when to stop talking in front of the customer, thus creating non value added tasks which initially never were a customer requirement.

An effect is that which is produced by a cause, the effect in case of an "O'Brien Effect" is an activity unwished for or in other words an Undesirable

Effect (UDE) present in our reality. This specific UDE is not only present, it obstructs; they take away some, or much, of the joy and pride that we take in our work.

In case of an "O'Brien Effect" the UDE is caused by a specific team member who is actively participating in a direct dialogue with the customer (either internal or external) and making suggestions as to what the needs of the customer are, these needs are however unrelated to the customer requirements or needs.

This cause directly originates from the wish of the orginator of the "O'Brien Effect" to have greater control over their working lives, this empowerment motivates them according to the theories of Abraham Maslow and Fredrick Herzberg.

One of the causes for this effect is motivation more by primal urges, thus resulting in Speaking Without Thinking of the Consequences (SWTC)or the so called "Speaking Bollocks".

Originators need to work in strictly controlled environments.

OCAP

Out of Control Action Plan

OEE

OEE = Availbility * Performance Rate * Quality rate

where

Availbilty =(Calender Hours - Planned losses -Unplanned lossed)/ Calender hours

Performance rate = Operatig Efficiency * Rate Efficiency

where ,
Operating Efficiency=(Available hours -Losses beyond equipment/plant's control
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Available hours
Rate Efficiency = Actual output/design output

Quality Rate = OK product tonnage/Total input material

One Piece Flow

Refers to the concept of moving one workpiece at a time between operations within a workcell.

Operational Cost

Sometimes referred to as Revenue or Running Costs, these are the costs resulting from day-to-day running of an operation, e.g. staff costs, hardware maintenance and electricity.

The value of the item purchased will diminish as it is used up e.g. consultancy. Sometime operational costs are a variable cost (paper, consultancy assistance) and sometimes fixed (salaries). For practical purposes in IT Accounting, operational costs can be considered as those charged to a single financial year, with no depreciation element.

Operational Definition

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.

Operations Process

Known for leveraging economies of scale and narrowly defined tasks, it is one of a family of four work processes characterized as an on-going endeavor undertaken to create a repetitive product or result which is performed by people, planned, executed and controlled. (Artisan Process, Project Process, Operations Process, Automated Process)

Opportunity

Any area within a product, process, service, or other system where a defect could be produced or where you fail to achieve the ideal product in the eyes of the customer. In a product, the areas where defects could be produced are the parts or connection of parts within the product. In a process, the areas are the value added process steps. If the process step is not value added, such as an inspection step, then it is not considered an opportunity.

Opportunities are the things which must go right to satisfy the customer. It is not the number of things we can imagine that can go wrong .

.DefectSee

:]discussion forum[From the

"Some folks think we measure opportunities by counting how many ways something can go wrong. That is a bad approach, because it inflates the

denominator. Motorola had a fairly simple approach: count number of parts plus number of connections. Period. In another discussion thread I read that Allied-Signal used a formula of multiplying bill of material part counts by three. Both approaches are straigthforward and repeatable.

"If your process is adminsitartive, it probably will be very difficult to be as simple or as repeatable. Don't sweat it. You can use defects per unit as easily as defects per opportunity. The idea is to measure the right things, and to understand how the process varies over time, so that it can be improved."

Opportunities from a customer's standpoint really do not make any sense. When you hand something off to a customer the opportunity is once - just like you recieving supplied material. They either sent you the correct thing or not, and if it isn't perfect then it is defective. At the customer level you need to treat it as one.

You use opportunity counts to account for complexity differences internally (or benchmarking something externally). If you make jet engines, light bulbs and loans the opportunity count will level the playing feild. If they are all 1 defect per unit they are not equivalent operations. If I calculate rolled throughput yield from defects per unit it still says they are equivalent. If I put in the opportunity count I can differentiate betweent them.

Opportunity Creation

Opportunity creation is the projection of present problems into future solutions.

At one level both problem solving and opportunity creation addresses a current problem or defect. The esential difference is opportunity creators see a scope for betterment where problem solvers see perfection. For opportunity creators quality is not the manufacturer's definition of meeting the standards or the absence of defects, rather it is the endowment of the delivered product or service with a distinguishing trait of excellence.

Optimization

Adjusting the system or process inputs to produce the best possible average response with minimum variability

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.

Ordinal Data Type

Data that has been placed in order but there isn't an attempt to make the intervals equal in terms of some rule.

OSHA

Occupational Safety and Health Administration

Outlier

An outlier is a data point that is located far from the rest of the data. Given a mean and standard deviation, a statistical distribution expects data points to fall within a specific range. Those that do not are called outliers and should be investigated

Output

The result of a process. The deliverables of the process; such as products, services, processes, plans, and resources.

Ownership

The recognized possession of rights and liability created or passed to an individual person who, through integrity and competent ability, is recognized and empowered to decide and act; willingly accepting responsibility as well as accountability

P Value

The probability value (p-value) of a statistical hypothesis test is the probability of getting a value of the test statistic as extreme as or more extreme than that observed by chance alone, if the null hypothesis Ho, is true.

It is the probability of wrongly rejecting the null hypothesis if it is in fact true.

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".

Small p-values suggest that the null hypothesis is unlikely to be true. The smaller it is, the more convincing the evidence is that null hypothesis is false. It indicates the strength of evidence for say, rejecting the null hypothesis H0, rather than simply concluding "Reject Ho" or "Do not reject Ho".

" Forum Message:P-Value Of 0.05, 95% ConfidenceFrom "
The p-value is basically the percentage of times you would see the value of the second mean IF the two samples are the same (ie from the same population). The comparison then is in the risk you are willing to take in making a type I error and declaring the population parameters are different. If

the p-value is less than the risk you are willing to take (ie <0.05) then you reject the null and state that with a 95% level of confidence that the two parameters are not the same. If on the other hand, the p-value is greater than the risk you are assuming, you can only tell that there isn't enough difference within the samples to conclude a difference. Where you set your risk level (alpha) then determines what p-value is significant.

See P-Value

Paired T Test

The two-sample t-test is used to determine if two population means are equal. The data may either be paired or not paired.

For paired t test, the data is dependent, i.e. there is a one-to-one correspondence between the values in the two samples.
For example, same subject measured before & after a process change, or same subject measured at different times.

For unpaired t test, the sample sizes for the two samples may or may not be equal.

Pareto

The Pareto principle states that 80% of the impact of the problem will show up in 20% of the causes. (Originally stated: 80% of the wealth is owned by 20% of the people.) A bar chart that displays by frequency, in descending order, the most important defects. Proper use of this chart will have the cumulative percentage on a second y-axis (to the right of the chart). This chart-type is used to identify if the Pareto principle is evident in the data. If the Pareto principle is evident, about 20% of the categories on the far left will have about 80% of the impact on the problem.

Passion for Action - PFA

Passion for Action is the outward expression of Highly Motivated Professionals Dedicated to the Improvement of Quality in All Aspects of Service and Manufacturing Companies. PFA is a characteristic of highly Successful Companies as it permeates all activities at all levels of the business culture. An organization containing PFA will develop an Enterprise-Wide Current that continuously pulls the organization to its next performance level. The concept was coined by Organizational Change Agent Consultant Rick Carangelo.

Passive Data

Passive Data is the data collected from a process where the Xs and Ys are allowed to fluctuate in their normal range, normal manner.

Passive data represents long term variability.

Passive Data is usually used during Hypothesis tests in the Analyze phase.

Paynter Chart

A graphical tool started at Ford Motor Company that combines the concepts of a run chart with a Pareto chart. The run chart is typically used at the top and a list of defects/deficiencies are listed below the x axis to indicate what items make up the count for each reporting period.

PDPC

Process Decision Program Charts - For producing the desired result from many possible outcomes. Can be used to plan various contingencies, get activities back on track, steer events in the required direction and find counter measures

PDSA

.Deming Cycle, PDCASee

Pearson's Correlation

Pearson's correlation reflects the degree of linear relationship between two variables.

Pearson's correlation coefficient (r) for continuous (interval level) data ranges from -1 to +1:

Positive correlation indicates that both variables increase or decrease together, whereas negative correlation indicates that as one variable increases, so the other decreases, and vice versa.

Percent of tolerance

Percent of tolerance is calculated by taking the measurement error of interest, such as repeatability and/or reproducibility, dividing by the total tolerance range, then multiplying the result by 100 to express the result as a percentage.

PFMEA

Process Failure Modes Effects Analysis.
Is a systemized group of activities intended to: (a) recognize and evaluate the potential failure of a product/process and its effect, (b) identify actions which could eliminate or reduce the occurance, (c) document the process.(d)Track changes to process-incorporated to avoid potential failures.

Is a living document. Is better to take actions addressed to eliminate or reduce the potential causes than implement controls in process. Is a process which

before hand tells you the potential failure modes and their effects.

In safety terminology in chemical industry, PFMEA can directly be related to HAZOP Analysis. HAZOP is an acronym for Hazard and Operability. It is a process to find out the potential failures of equipment, piping, pumps and utilities and their effects on plant and human safety. This study helps in introducing extra safety features beforehand on equipment and piping to avoid the potential failures and consequent disasters

Pi

Pi (TM) Perpetual Improvement is the Manufacturing Management System, designed by David Wilkerson, in which each team member continuously seeks to improve every system, process, and procedure, as well as her/his performance in the manufacturing unit. Step-by-step instructions facilitate this process.

Platykurtic Distribution

A platykurtic distribution is one in which most of the values share about the same frequency of occurrence. As a result, the curve is very flat, or plateau-like. Uniform distributions are platykurtic.

PMP

Project Management Professional - PMI certified project manager
PMP - Educated project manager adhering to the stipulations of the PMI and certified by PMI so.

PMTS

Predetermined Motion Time System

Poisson Distribution

The Poisson Distribution is a discrete distribution which takes on the values X = 0, 1, 2, 3,... It is often used as a model for the number of events (such as the number of telephone calls at a business or the number of accidents at an intersection) in a specific time period. It is also useful in ecological studies, e.g., to model the number of prairie dogs found in a square mile of prairie.

The Poisson distribution is determined by one parameter, lambda. The distribution function for the Poisson distribution is f(x) = exp(-1*lambda) lambda^x / x!

Poka Yoke

Japanese term which means mistake proofing.
A poka yoke device is one that prevents incorrect parts from being made or assembled, or easily identifies a flaw or error.

poka-yoke - 'mistake-proofing', a means of providing a visual or other signal to indicate a characteristic state. Often referred to as 'error-proofing', poke-yoke is actually the first step in truly error-proofing a system. Error-proofing is a manufacturing technique of preventing errors by designing the manufacturing process, equipment, and tools so that an operation literally cannot be performed incorrectly.

To avoid (yokeru) inadvertent errors (poka).

Pooled Standard Deviation

Pooled standard deviation is the standard deviation remaining after removing the effect of special cause variation-such as geographic location or time of year. It is the average variation of your subgroups.

Pooled Standard Deviation combines two such deviations to then compare their statistical difference.

s = sqrt[((n1-1)s1^2 + (n2-1)s2^2)/(n1+n2-2)]

Population

The entire collection of items that is the focus of concern

Population Defect Rate

The true proportion of defects in the population. This is usually estimated by a sample, rather than getting true population data. Since estimates are less than perfect, it is common to indicate how imperfect they are.

Positive Correlation

Positive correlation indicates that both variables increase or decrease together, whereas negative correlation indicates that as one variable increases, so the other decreases, and vice versa.

PPAP

Production Part Approval Process:
The Production Part Approval Process (PPAP) outlines the methods used for approval of production and service commodities, including bulk materials, up to and including part submission warrant in the Advanced Quality Planning process. The purpose of the PPAP process is to ensure that suppliers of components comply with the design specification and can run consistently without affecting the customer line and improving the quality systems. PPAP ensures that you will achieve the first time quality and will lower down the cost of quality.

Ppk

Ppk represents the long-term capability of the process

PPM

Parts Per Million. Typically used in the context of defect Parts Per Million .DPMOopportunities. Synonymous with

PPS

Production Preparation Schedule

Practice

The development of knowledge, skills and experiences for the purpose of the proficient execution of duties or activities associated with a discipline of creating or providing value.

One of three "P" areas of focus for measuring and improving quality (Product, Process and Practice).

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.

Prediction Band (or Prediction Interval)

Measurement of the certainty of the scatter about a certain regression line. A 95% prediction band indicates that, in general, 95% of the points will be contained within the bands

Prevention cost

Prevention cost
Money required to prevent defects
Money spent in establishing methods & procedures
Money spent in training
Money spent in planning quality
Spent before the product is actually built

Preventive Action

. Long term cost / risk weighted action taken to prevent Corrective ActionSee a problem from occurring, based on an understanding of the product or process.

Preventive action will address inadequate "conditions" which may produce nonconformances.

Primary Metrics

Primary metrics are also called as Process metrics. This is the metric the Six Sigma practitioners care about and can influence.

Primary metrics are almost the direct output characteristic of a process.

It is a measure of a process and not a measure of a high-level business objective.

Primary Process metrics are usually Process Defects, Process cycle time and Process consumption.

Probability

Probability refers to the chance of something happening, or the fraction of occurrences over a large number of trials. Probability can range from 0 (no chance) to 1 (full certainty).

Probability of Defect

Probability of defect is the statistical chance that a product or process will not meet performance specifications or lie within the defined upper and lower specification limits. It is the ratio of expected defects to the total output and is expressed as

Procedures

Procedures are the largest volume of instructional content representing practical knowledge; they include all types of human decisioning such as guides, help text, methods, instructions, policies, regulations, standards and technical practices. A procedure is a set of conditional instructions that affects the human interactions involving customers, information workers and service suppliers. These instructions involve a sequence of nano-decisions (minuscule decisions) with each decisioning path leading to an outcome. These sets of instructions are the procedural components and these components may be linked together. A Decision Rights Owner is responsible for a repository of procedural components and the links to other related procedural components belonging to other Decision Rights Owners.

Process

A series of steps or actions that lead to a desired result or output.

A set of common tasks that creates a product, service, process, or plan that will satisfy a customer or group of customers.

A sequential series of steps leading to a desired outcome.

Processes are largely affected by one or more of the following factors:

a) personnel who operate the processes;
b) materials which are used as inputs (including information);
c) machines or equipment being used in the process (in process execution or monitoring/measurement;
d) methods (including criteria and various documentations used along the process);
e) work environment

Understanding how these factors interact and affect processes is a key consideration in process studes.

See *Process Control*.

Process Acceptance Certificate

A certificate or other document that is completed immediately prior to a new or modified process being accepted into the live environment for business use. It provides a degree of confidence that all required activities have been undertaken to ensure that the service is capable of being delivered to the process owner's satisfaction.

Incomplete tasks should be recorded here as should the degree of risk to which these shortcomings are now exposing the business. Based upon that information, the decision can be taken as to whether the new or changed process should be released into the live environment.

Process Capability

Process capability refers to the ability of a process to produce a defect-free product or service in a controlled manner of production or service environment. Various indicators are used-some address overall performance, some address potential performance.

Process Capability Index

Process Capability Index is used to find out how well the process is centered within the specification limits.It is denoted by Cpk.

Cpk = Cp(1-K)

Where,

Cp = Process Capability

K = 2(Design Target - Process Average) / (USL - LSL)

Design target is the actual specification targetted without +/- allowance.

Process Control

1. The features or mechanisms that control the execution of a *Process*, including process initiation, selection of process steps, selection of alternative steps, iteration of steps within a loop, and process termination.

2. Controlling mechanisms that ensure that a *Process* is conducted to maximum cost-effectiveness, including *Entry Criteria*, formal procedure specifications, and *Exit Criteria*.

In development or manufacturing processes, the rate of *Variations* that reveal themselves as work product *Defects* is in general inversely proportional to the degree in which the process is formalised and followed. Or, poor processes produce bugs ...

See *Common Cause*, *Special Cause*.

Process Control Plan

The Process Control Plan assures that the good improvements established by your project will not deteriorate once the improved process is returned to the process owners

Process Control Versus Process Capability

To say "a process is in control" you compare the process against itself. If its behavior is consistent over the time then it is in control. You don't even need specifications to see if it is in control or not.

When you compare the process output against a specification, then you are talking about process capability or process performance.

Even when a good capability is needed, typically stability (another way to say "in control") is needed first. If the process is stable, you can compare its performance against the required performance and take corrective actions if needed. But if it is not stable, you can hardly even compare the process against something, because a thing such as "the process" does not even exist from a statistical point of view, as its behavior is changing over the time so you don't have one distribution to model the process.

For example, if the process is stable but not capable you can predict that you will have let's say 20% scrap. This can be not acceptable but you know what you will get, where you are and where you need to steer to. If the process is not stable, then you don't know what you will get, where you are, and where to

steer to, except that you need to stabilize the process first.

Also see:
In-Control
Capability
Process_Capability

Process Cycle Efficiency (PCE)

Value-Added Time/Total Lead Time

A lean process is one in which the value-added time in the process is more than 25% of the total lead time of that process.

Process Design Requirements

What the organization needs and expects of the process to meet customer requirements

Process Entitlement

It is the best short-term performance of an output characteristic when the input variables are running in a constrained fashion.

Process entitlement helps us set realistic goals.

Process Indicator

See also Process Measurables.

These are indicators which directly measure the performance of key processes that affect customer expectations. Specific actions can be taken to improve the performance of these indicators, which in turn should improve the performance of the result measurables.

Originally Posted By: "Mark" defined as Process Measurables.

Process Instance

An instance of a process (e.g. the production of a specific purchase order is one instance of the purchasing process

Process Management

Also called Business Process Quality Management or Reengineering. The concept of defining macro and micro processes, assigning ownership, and creating responsibilities of the owners.

Modifying, altering, reshaping, redesigning any business/production process, work method or management style to deliver greater value.

The art of reshaping, an organization and belonging processes to attain optimal result, through continuous improvements within the organizational.

Process Map

It is a hierarchical method for displaying processes that illustrates how a product or transaction is processed. It is a visual representation of the work-flow either within a process - or an image of the whole operation. Process Mapping comprises a stream of activities that transforms a well defined input or set of inputs into a pre-defined set of outputs.

The High Level Process Map; "30,000 feet overviews", "Medium image" is differentiated from the Detailed Process Map; "homing in", "zooming in", "Micro Map". The High Level Process Map is utilized in scoping a Six Sigma project and establishing boundaries, while a detailed process map will be used by the GB/BB to Analyze (identify potential causes) and Improve (optimize) the process.

A good Process Map should:
1)allow people unfamiliar with the process to understand the interaction of causes during the work-flow.
2)contain additional information relating to the Six Sigma project i.e. information per critical step about input and output variables, time, cost, DPU value.

Software programs utilized to create Process Maps include Microsoft Visio, SigmaFlow and iGrafx. For those individuals who may not have access to these packages, Process Mapping may be performed in Excel or Power Point.

Process Maturity

An indication of how close a developing process is to being complete, and capable of continuous improvement through quantitative measure and feedback.

Process Measurables

These are indicators which directly measure the performance of key processes that affect customer expectations. Specific actions can be taken to improve the performance of these indicators, which in turn should improve the performance of the result measurables.

Process Owner

The individual(s) responsible for process design and performance. The process owner is accountable for sustaining the gain and identifying future improvement opportunities on the process.

Process Performance Management

The overseeing of process instances to ensure their quality and timeliness. Can also include proactive and reactive actions to ensure a good result.

For effective Performance Management, strategic decisions have to be taken by the senior management, with involvement from the key executives. This should address day-to-day decision making process across all levels. The most important aspect is clearly defined goals which are relevant, reliable, and timely. The process should be able to track the progress to reach that objective.

Performnace management should be:

Formal: A clearly defined process that everyone understands and accepts
Frequent: Consistent information dissemination.
Relevant: Information relevant to the departments and decisions.
Reliable: Everyone believes in the information.
Timely.
Tied to outcomes: Everyone is held accountable for their performance and are given the right tools to achieve the goals.
Feedback.
Leadership: People from different departments can collaborate on changing processes and procedures and making day-to-day operational decisions

Process Stability

Process stability is the ability of the process to perform in a predictable manner over time. A Run Chart gives a good picture of stability.

Producers Risk

Concluding something is bad when it is actually good (TYPE I Error)

See also Alpha Risk, Beta Risk, Error (Type I), Error (Type II), Null Hypothesis, Alternative Hypothesis and Hypothesis Testing

Product

A product is an outcome of a process or activity which could be a defined object or service.

Productivity

The ratio of measured outputs over measured inputs (i.e. - widgets produced per man-hour).

Productivity Target

Each operation in the manufacturing process is assigned a Productivity Target

value. This value represents the minimum number of conformant products (value-added entities) per designated period. (See also Value-Added)

Project Nomination

iDMAIC)
A Black Belt, MBB, Sponsor, or General Manager associated with a project nominates the project for Innovation Transfer, using the e-Six Sigma project tool. The nominator evaluates the project and tabulates a "score" based on the following guidelines:

- Financial benefits significant and applicable in similar properties?

- A clearly defined process, which is shown to be effective, functional and cost effective.

- Includes documented Voice of the Customer data from a representative sample.

- Entire project is well documented & meets minimum documentation guidelines.

- Has been in Control phase for a minimum of 90 days showing improved results.

- Must be piloted - arranged by divisional Six Sigma Council

Project Process

Known for leveraging cross functional teams and specifically defined activities, it is one of a family of four work process types characterized as a temporary endeavor undertaken to create a unique product or result which is performed by people, planned, executed and controlled. (Artisan Process, Project Process, Operations Process, Automated Process)

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 Selection

(iDMAIC)

During quarterly review meetings, each Division Council reviews all projects that have been nominated as Best Practices. Associates working on the projects are invited to provide expertise and insight from the property. The Council selects projects that meet the criteria for a Best Practice and have the highest potential value for the Division. Best Practices that are recommended

for an entire brand must be approved by the Global or multiple divisions SIXSIGMA Council

PSO

Process Sign Off

Review of supplier's manufactoring process at the quoted peak daily rate. The PSO (Audit) will is performed at the supplier's manufacturing plant.

PSW

Part Submission Warrant. A procedure by which the supplier of a part or subsystem gives evidence to the customer that he is able to satisfy the requirements of Delivery date, Quality, Process Capability and Production Rate.

PTC

Pass Through Characteristic

Pugh Matrix

Refers to a matrix that helps determine which items or potential solutions are more important or 'better' than others. It is necessarily to be done after you capture VOC and before design which means after product planning QFD.

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.

This tool is also known as 'Criteria Based Matrix'

The Pugh matrix is a tool used to facilitate a disciplined, team-based process for concept generation and selection . Several concepts are evaluated according to their strengths and weaknesses against a reference concept called the datum (base concept). The datum is the best current concept at each iteration of the matrix.
The Pugh matrix allows you to

1. Compare different concepts
2. Create strong alternative concepts from weaker concepts
3. Arrive at an optimum concept that may be a hybrid or variant of the best of other concepts

The Pugh matrix encourages comparison of several different concepts against a base concept,creating stronger concepts and eliminating weaker ones until an optimal concept finally is reached. Also, the Pugh matrix is useful because it does not require a great amount of quantitative data on the design concepts, which generally is not available at this point in the process.

Pull System

The flow of resources in a production process by replacing only what has been consumed.

P-Value

Each statistical test has an associated null hypothesis, the p-value is the probability that your sample could have been drawn from the population(s) being tested (or that a more improbable sample could be drawn) given the assumption that the null hypothesis is true. A p-value of .05, for example, indicates that you would have only a 5% chance of drawing the sample being tested if the null hypothesis was actually true.

Null Hypothesis are typically statements of no difference or effect. A p-value close to zero signals that your null hypothesis is false, and typically that a difference is very likely to exist. Large p-values closer to 1 imply that there is no detectable difference for the sample size used. A p-value of 0.05 is a typical threshhold used in industry to evaluate the null hypothesis. In more critical industries (healthcare, etc.) a more stringent, lower p-value may be applied.

More specifically, the p-value of a statistical significance test represents the probability of obtaining values of the test statistic that are equal to or greater in magnitude than the observed test statistic. To calculate a p-value, collect sample data and calculate the appropriate test statistic for the test you are performing. For example, t-statistic for testing means, Chi-Square or F statistic for testing variances etc. Using the theoretical distribution of the test statistic, find the area under the curve (for continuous variables) in the direction(s) of the alternative hypothesis using a look up table or integral calculus. In the case of discrete variables, simply add up the probabilities of events occurring in the direction(s) of the alternative hypothesis that occur at and beyond the observed test statistic val

Q1

25th percentile (from box plot)

Ford Definition of "Quality is Job 1

Q3

75th percentile (from box plot)

QAS

Quality Assurance Schedule
This is a layout of a timetable format for items/activities, responsibile

department or person(s) and the beginning and ending of the Plan/act. This part of the report is usually found in the QAS/TPR Status Report. Revisiona

QCM

Quality Control Manager
QCM in Engineering organisation is responsible to get the work output by following standard practices and using standard -materials, tools and machines. Work output may be the normal production or standard corrective actions which must be planned by QCM when descrepancies arises.

Whereas

Quality Assurance manager will ensure or evaluates all the engineering activities as regards to adequacy of existing standard-procedures,materials,tools and machines etc.He also evaluates perfectness and adequacy of planned and/or corrective actions taken when descrepancies arised.

QFD

Quality Function Deployment

Quality Function Deployment (QFD) is a systematic process for motivating a business to focus on its customers. It is used by cross-functional teams to identify and resolve issues involved in providing products, processes, services and strategies which will more than satisfy their customers. A prerequisite to QFD is Market Research. This is the process of understanding what the customer wants, how important these benefits are, and how well different providers of products that address these benefits are perceived to perform. This is a prerequisite to QFD because it is impossible to consistently provide products which will attract customers unless you have a very good understanding of what they want.

When completed it resembles a house structure and is often referred to as House of Quality. The House is divided into several rooms. Typically you have customer requirements, design considerations and design alternatives in a 3 dimensional matrix to which you can assign weighted scores based on market research information collected.

Quality Function Deployment (QFD) is a methodology for taking the Voice of the Customer and using that information to drive aspects of product development.

Cross functional teams participate in the process that consists of matrices that analyze data sets accoring to the objective of the QFD process. A typical QFD process involves a four phase approach. This approach has been made popular by the American Supplies Institute.

QFD is not just the House of Quality--matrix 1. It involves much more and

matrices that are connected together using priority ratings from the previous matrix.

_____

Quality Function Deployment (QFD) is a structured approach to defining customer needs or requirements and translating them into specific plans to produce products to meet those needs. The "voice of the customer" is the term to describe these stated and unstated customer needs or requirements. The voice of the customer is captured in a variety of ways: direct discussion or interviews, surveys, focus groups, customer specifications, observation, warranty data, field reports, etc. This understanding of the customer needs is then summarized in a product planning matrix or "house of quality". These matrices are used to translate higher level "whats" or needs into lower level "hows" - product requirements or technical characteristics to satisfy these needs.

QOS

A Quality Operating System is a systematic, disciplined approach that uses standardized tools and practices to manage business and achieve ever increasing levels of customer satisfaction

QPR

Quality Problem Report

QS-9000

QS-9000 is a quality system standard that focuses on helping automotive suppliers ensure that they are meeting/exceeding automotive customer requirements. As mentioned before, it uses ISO 9000 as a core (document control, corrective action, auditing, etc.), but adds quite a few additional requirements.

QS-9000 is now being replaced by a newer related standard called ISO/TS 16949. TS 16949 contains all of ISO 9000, QS-9000, and many European standards.

TS is much more process-oriented than QS or ISO. It defines the business as a set of processes with inputs and outputs that need to be defined, controlled, improved/optimized, etc. In my view TS looks like someone who knew QS took Six Sigma/BB training and incorporated many of the SS/BB ideas.

Qualitative Data

.discrete dataAlso known as

Quality

Quality is difficult to define, it's an abstract term, it requires continuous and

dynamic adaptation of products and services to fulfill or exceed the requirements or expectations of all parties in the organization and the community as a whole.

'Quality means conformance to requirements' (Philip Crosby, 'Quality Is Free'). It does not matter whether or not the requirements are articulated or specified; if a product does not fully satisfy, it lacks quality in some respect. ('Quality is binary -- you've either got it, or you haven't' -- ibid. Note that both these quotes are 'top-of-the-head' and therefore approximate.)

The starting-point for a 'quality product', therefore, is precise determination of the requirements of its users. This may not be possible in practice, but should still be attempted as best possible (see *Acceptable Quality Level*).

Note that the 'quality' of a product is the sum of multiple separate *Quality Attributes*.

Quality

A refined process in which products are assessed, improved, ensured, and confirmed.

Quality

Achieving excellence in a product/service by meeting/exceeding the requirements of the customer.

Quality

Quality is a function of loss. The better the quality, the lesser is the loss it causes to society. – Taguchi

Quality

The essential and distinguishing trait why product X may not be replaced by a similar product Y

QUALITY - DEFINITION

Reduction of variation around the "Mean

Quality Assurance

A planned and systematic set of activities to ensure that variances in processes are clearly identified, assessed and improving defined processes for fullfilling the requirements of customers and product or service makers.

A planned and systematic pattern of all actions necessary to provide

adequate confidence that the product optimally fulfils customer's expectations.

A planned and systematic set of activities to ensure that requirements are clearly established and the defined process complies to these requirements.

"Work done to ensure that Quality is built into work products, rather than Defects." This is by (a) identifying what "quality" means in context; (b) specifying methods by which its presence can be ensured; and (c) specifying ways in which it can be measured to ensure conformance (see *Quality Control*, also *Quality*).

Quality Attribute

A property of a work product or goods by which its *Quality* will be judged by some *Stakeholder* or stakeholders. (Also "Quality Factor" or [Gilb] "Quality".) Quality attributes are and should be quantifiable in specifications by the definition of some appropriate and practical scale of measure.

Quality Control

Also called statistical quality control. The managerial process during which actual process performance is evaluated and actions are taken on unusual performance.
It is a process to ensure whether a product meets predefined standards and requisite action taken if the standards are not met.

Quality Control measures both products and processes for conformance to quality requirements (including both the specific requirements prescribed by the product specification, and the more general requirements prescribed by *Quality Assurance*); identifies acceptable limits for significant *Quality Attributes*; identifies whether products and processes fall within those limits (conform to requirements) or fall outside them (exhibit defects); and reports accordingly. Correction of product failures generally lies outside the ambit of Quality Control; correction of process failures may or may not be included.

Quality Dictionary

Dictionary of quality terms. You are reading a quality dictionary

Quality Function Deployment

Quality function deployment (QFD) is a structured methodology and mathematical tool used to identify and quantify customers' requirements and translate them into key critical parameters. In Six Sigma, QFD helps you to prioritize actions to improve your process or product to meet customers' expectations.

Quality Gap

It is the difference between the approved standards, criteria or expectations in any process or activity and the real results in such process or activity in accordance with the adopted national and or international standards by any country.

Quality Improvement

A systematic and continuous activity to improve all processes and systems in the organization to achieve optimal level of performance.

The organized creation of beneficial changes in process performance levels.

Quality Management

A systematic set of activities to ensure that processes create products with maximum *Quality* at minimum *Cost of Quality*. The activities include *Quality Assurance*, *Quality Control*, and *Quality Improvement*.

Quality Procrastination

Postponing quality improvement decisions and programs to the last moment, putting the organization under time pressure.

Quality Record

Quality record indicates that a control has been made or an observation has been been done.

Quality Target

Each operation in the manufacturing process, which has an effect on the conformance of the end product to the customer's specifications, is assigned a Quality Target value. This value represents the maximum allowable discrepancies per 1,000 opportunities. (See also Opportunity)

Quantifiers

Quantifiers are the means by which the performance of measurables is tracked. The values of the quantifiers are typically plotted over time in trend charts. Quantifiers associated with result measurables are called result quantifiers and quantifiers associated with process measurables are called process quantifiers.

Quantitative data

Continuous data.

Quantitative data will be different depending on the types of questions you ask and the data you gather.

Quantitative Variable

A variable that consists of a count or numerical measurement of the characteristics of objects, people or events.

variable that measures a numerical characteristic; also called a measurement variable For example, since the response to how many brothers and/or sisters a person has is a number, this variable is a quantitative variable.

count variable - a type of quantitative variable; answers the question, "How many?"

Queuing Theory

A modeling technique based upon the allocation of requirement to resources. It will indicate whether the resources will meet with the anticipated level and distribution of demand. Invariably delivered as a computer simulation it provides a prediction of resource requirements, generally mapped against time and business process cycles.

Quorum

The minimal number of officers and members of a committee or organization, usually a majority, who must be present for valid transaction of business.

R

R is the measure of the strength of the linear association in a correlation analysis

R is the correlation co-efficient

Rabbit Chase

A work procedure where each of the 2/3 workpersons goes through all the steps of the multi step process, performing the same tasks(start from the beginning to end). This is applicable within an assembly line or for part supply tasks.

Radar Chart

A radar chart is a graphical display of the differences between actual and ideal performance. It is useful for defining performance and identifying strengths and weaknesses

Radian

Unit of angular measurement. There are 2 pi radians in the circumference of a

circle, where pi is the constant ratio of the circumference to the diameter (pi = 3.14159...).

Random Sample

A data point taken at random from the universe or population of your process. Is There Bias In Your Random SampleSee

Random Variation

The tendency for the estimated magnitude of a parameter (eg, based upon the average of a sample of observations of a treatment effect) to deviate randomly from the true magnitude of that parameter. Random variation is independent of the effects of systematic biases. In general, the larger the sample size is, the lower the random variation is of the estimate of a parameter. As random variation decreases, precision increases

Randomization

Running experiments in a random order, not the standard order in the test layout. Helps to eliminate effect of "lurking variables", uncontrolled factors which might vary over the length of the experiment.

Range

The difference or interval between the smallest (or lowest) and largest (or highest) values in a frequency distribution.

Rational Subgroup

A rational subgroup is a subset of data defined by a specific factor such as a stratifying factor or a time period. Rational subgrouping identifies and separates special cause variation (variation between subgroups caused by specific, identifiable factors

RBI

Risk Based Inspection

RBM

Risk Based Maintanence

RCFA

Root Cause & Failure Analysis

Red X

Data indicating characteristics which show a change between good and bad. .XAlso known as a critical X. See definition of

Reengineering

Also called Business Process Quality Management or Process Management. The concept of defining macro and micro processes, assigning ownership, and creating responsibilities of the owners.

Reengineering is about achieving dramatic, breakthrough improvements often by the application of new technologies. It is the opposite of Kaizen (many gradual improvements) and reflected a return to Western 'Macho' management ideas. The approach was developed by Hammer and Champy.

Regression

The relationship between the mean value of a random variable and the corresponding values of one or more independent variables.

A model for predicting one variable from another.

A statistical analysis assessing the association between two variables.

Regression analysis is a method of analysis that enables you to quantify the relationship between two or more variables (X) and (Y) by fitting a line or plane through all the points such that they are evenly distributed about the line or plane.

REL

It means relationship chart which is used for arrangement of departments based on their closeness required with other departments. It is very much useful when designing and modifying the plant layout. This chart is constructed based on the letters of AEIOUX. Each letter having their own weightage. Based on the total value arrived, the departments can be rearranged/relocated/established.

Reliability

The reliability of an item is the probability that it will adequately perform its specified purpose for a specified period of time under specified environmental conditions.

Dr. Lawrence M. Leemis, Department of Mathematics, College of William and Mary, from his text book titled: Reliability: Probabilistic Models and Statistical Methods.

Repeatability

Repeatability is the variation in measurements obtained when one person measures the same unit with the same measuring equipment.

Repeatability is the variation in measurements obtained when one person takes multiple measurements using the same instrument and techniques on the same parts or items.

Replicates

Number of times you ran each corner. Ex. 2 replicates means you ran one corner twice.

Replicate is the number of applications applied to a treatment level.

Replication

Replication occurs when an experimental treatment is set up and conducted more than once. If you collect two data points at each treatment, you have two replications. In general, plan on making between two and five replications for each treatment.

Replication is a repeat of the experimental run such that the repeated run only occurs after a full breakdown of 'SET UP' and 'SET POINTS'. This requires an additional 'SET UP' and the establishment of'SET POINTS' even if the prior experimental run was with these exact 'SET POINTS'.

On the contrary Repetition is making a repeat of the experimental run and taking an immediate additional sample without breaking down the 'SET UP' or changing the 'SET POINT'

Replication is done to reduce the impact of the inherent variation in the process, whereas repetition reflects the uncontrolled variability in the measurements.

In other words Repetition is equivalent to Repeatability, whereas Replication is equivalent to Reproducibility

Reproducibility

Reproducibility is the variation in average measurements obtained when two or more people measure the same parts or items using the same measuring technique.

Residual

A residual is the difference between the actual Y output value and the Y output value predicted by the regression equation. The residuals in a regression model can be analyzed to reveal inadequacies in the model. Also called "errors"

Resolution

Resolution is a measure of the degree of confounding among effects. Roman numerals are used to denote resolution. The resolution of your design defines the amount of information that can be provided by the design of experiment. As with a computer screen,
The above is an explanation of resolution in the context of DOE.

For Gage R & R, 'Number of distinct categories' measures the ability of the measurement system to resolve the data in to a number of catogories - hence a measurement of resolution - the greater, the better.

Response

A reaction, as that of an organism or a mechanism, to a specific stimulus.

Responsibility

Defined or assumed conditional liability “before” the fact, limited to overt practices. Capacity to be responsible assumes the use of adequate expertise and capability.

Result Measurables

These are indicators which are tied directly to customer expectations. There is usually little direct control over result measurables

Rework

"Work done to correct defects" (Crosby, "Quality Is Free").

See *Defect*.

Robust

Insensitivity of a process output to the variation of the process inputs.

Robust Process

A robust process is one that is operating at 6 sigma and is therefore resistant to defects. Robust processes exhibit very good short-term process capability (high short-term Z values) and a small Z shift value. In a robust process, the critical elements u

Robustness

The characteristic of the process output or response to be insensitive to the variation of the inputs. Setting the process targets using the process interactions increases the likelyhood of the process exhibiting robustness.

Rolled Throughput Yield - RTY

Rolled Throughput Yield (RTY) is the probability that a single unit can pass through a series of process steps free of defects.

Next we will turn our attention to a Rolled Throughput Yield example. If you will remember, the First Time Yield calculation we did (FTY) considered only what went into a process step and what went out. Rolled Throughput Yield adds the consideration of rework. Using the previous example:

Process A = 100 units in and 90 out Process B = 90 in and 80 out Process C = 80 in and 75 out Process D = 75 in and 70 out.

If in order to get the yield out of each step we had to do some rework (which we probably did) then it really looks more like this:

Process A = 100 units, 10 scrapped and 5 reworked to get the 90. The calculation becomes [100-(10+5)]/100 = 85/100 = .85 This is the true yield when you consider rework and scrap.

Process B = 90 units in, 10 scrapped and 7 reworked to get the 80. [90-(10+7)]/90 = .81

Process C = 80 units in, 5 scrapped and 3 reworked to get the 75. [80-(5+3)]/80 = .9

Process D = 75 units in, 5 scrapped and 10 reworked to get the 70. [75-(5+10)]/75 = .8

Now to get the true Rolled Throughput Yield (Considering BOTH scrap and the rework necessary to attain what we thought was first time throughput yield) we find that the true yield has gone down significantly:

.85*.81*.9*.8 = .49572 or Rounded to the nearest digit, 50% yield. A substantially worse and substantially truer measurement of the process capability. An Assumption is made in the preceeding example that there are no spilled opportunities after each process step.

RONA

Return on Net Assets
RONA is one bottom-line measurement showing performance relative to strategic goals and objectives. More and more successful companies are utilizing RONA measurement. It provides an apples-to-apples comparison of performance that is understood by non-financial professionals.

Calculated as: RONA = Net Income /(Fixed Assets + Net Working Capital)

Interpretation: The higher the return, the better the profit performance for the company.

Root Cause

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

The most basic reason, which if eliminated, would prevent recurrence.

The source or origin of an event.

A root cause of a consequence is any basic underlying cause that was not in turn caused by more important underlying causes. (If the cause being considered was caused by more important underlying causes, those are candidates for being root causes.)

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.

RPN

Risk Priority Number

RQL

RQL - Rejectable Quality Level: generic term for the incoming quality level for which there is a low probability of accepting the lot. The quality level is substandard.

R-Square

A mathematical term describing how much variation is being explained by the X.

Rsq = 1 - SS(regression)/SS(total), Assuming "SS" = Sum Squared error, and that "SS(total)" means the variance in the data. This should be obvious, as R-squared approaches unity as a regression approaches a perfect fit.(i.e., Rsq = 1 - sum((data - regression)^2))/sum((data - datamean).^2))

The R-squared value is the fraction of the variance (not 'variation') in the data that is explained by a regression

R-Square Adjusted

Unlike R-square, R-square adjusted takes into account the number of X's and the number of data points. FORMULA: R-sq (adj) = 1 - [(SS(error)/DF(error)) / (SS(total)/DF(total))]

Takes into account the number of Xs and the number of data points...also answers: how much of total variation is explained by X.

Run Chart

A performance measure of a process over a specified period of time used to identify trends or patterns.

Runs Test

Use Runs Test to see if a data order is random. Runs Test is a nonparametric test because no assumption is made about population distribution parameters. Use this test when you want to determine if the order of responses above or below a specified value is random. A run is a set of consecutive observations that are all either less than or greater than a specified value.

Suppose an interviewer selects 30 people at random and asks them each a question for which there are four possible answers. Their responses are coded 0, 1, 2, 3. You wish to perform a runs test in order to check the randomness of answers. Answers that are not in random order may indicate that a gradual bias exists in the phrasing of the questions or that subjects are not being selected at random.

S.M.A.R.T.

Alternatives:
Specific, Measurable, Achievable, Relevant and Time-bound.
Specific, Measurable, Attainable, Relevant and Time-bound.
Specific, Measurable, Acceptable, Realistic and Time-bound.

It can also be referenced (although less correctly) as:
S Simple, specific with a stretch, sensible, significant.
M Meaningful, motivating.
A Acceptable, achievable, action-oriented, accountable, as-if-now, agreed, agreed-upon, actionable, assignable.
R Realistic, reviewable, relative, rewarding, reasonable, results-oriented, relevant to a mission.
T Timelines, time-frame, time-stamped, tangible, timely, time-based, time-specific, time-sensitive, timed, time-scaled, time-constrained, time-phased, time-limited, time-driven, time-related, time-line, timed and toward what you want, truthful

S.M.A.R.T.E.R

S.M.A.R.T. See the specific definition SPECIFIC, MEASURABLE, ACCEPTABLE, REALISTIC and TIMEBOUND
then add:
E = Evaluated

R = Reviewed
because nothing is constant.

Sample

A Sample is a portion of the whole collection of items (population).

An estimate of a larger group of people or items; also called a subgroup.

A portion or subset of units taken from the population whose characteristics that would be used for analysis are considered to be identical with a notion that any unit can represent the population.

Sample Size Calc.

The sample size calculator is a spreadsheet tool used to determine the number of data points, or sample size, needed to estimate the properties of a population. See the tool Sample Size Calculator.

Sampling

Sampling is the practice of gathering a subset of the total data available from a process or a population

Saturated Design

Resolution III designs are sometimes referred to as saturated designs because all or most of the orthogonal columns are assigned factors. If 2-way interactions are of interest, unsaturated designs of Resolution V or greater are suggested.

Taken from Understanding Industrial Designed Experiments by Stephen Schmidt and Robert Launsby

SCAMPER

SCAMPER is an Idea Generation and synthesis technique developed by Michael Michalko. It is a sort of checklist and is an acronym made of the first letters of the following:

Substitute
Combine
Adapt / Adopt
Modify / Magnify / Minify
Put to other Uses
Eliminate
Reverse / Rearrange

In order to generate ideas, these questions are asked.

Scatter Plot

A scatter plot, also called a scatter diagram or a scattergram, is a basic graphic tool that illustrates the relationship between two variables. The dots on the scatter plot represent data points. See the tool Scatter Plot.

Scatter plots are used with variable data to study possible relationships between two different variables. Even though a scatter plot depicts a relationship between variables, it does not indicate a cause and effect relationship. Use Scatter plots to determine what happens to one variable when another variable changes value. It is a tool used to visually determine whether a potential relationship exists between an input and an outcome.

Scatterplot

A graph of the points representing a collection of data, is one of the most useful techniques for gaining insight into the relationship between two variables.

Scope

Generally, the extent to which a process or procedure applies. The scope of Configuration Management may not, for example, extend to Customer information (other than on an 'as informed' basis) and the scope of a Change Management procedure may not apply to 'Urgent Changes'. Also a key concept in outsourcing, defining which activities are covered by the base contract and which are separately chargeable.

Scorecard

A scorecard is an evaluation device, usually in the form of a questionnaire, that specifies the criteria your customers will use to rate your business's performance in satisfying their requirements

SCOT analysis

SWOT analysis is renamed as SCOT analysis.W---Weakness is replaced by C---challenge

Screening

An inspection step in the process, designed to distinguish between good and bad products. It utilizes an attribute measuring method.

Screening DOE

A screening design of experiment (DOE) is a specific type of a fractional factorial DOE. A screening design is a resolution III design, which minimizes the number of runs required in an experiment. A screening DOE is practical

when you can assume that all factors are known, and are included, as appropriate, in the experimental design.

Segmentation

Segmentation is a process used to divide a large group into smaller, logical categories for analysis. Some commonly segmented entities are customers, data sets, or markets. For example, you may collect the cause of defects of a process and place the data into a pareto chart. The pareto chart then displays the segmentation...type A defects are 50%, type B defects are 30% and type C defects are 10%. These are possible ways to segment the data.

Sensitivity

The ratio of change in the output to the change in the value of the measure.

S-hat Model

It describes the relationship between output variance and input nominals

Ship Date

Ship Date is the latest date an order can depart the manufacturing facility.

Short-Run SPC

Statistical Process Control charting techniques for small production runs from which sufficient data is not available for Xbar & R or Individuals and Moving Range charts.

Sigma

The Greek letter s (sigma) refers to the standard deviation of a population. Sigma, or standard deviation, is used as a scaling factor to convert upper and lower specification limits to Z. Therefore, a process with three standard deviations between its mean and a spec limit would have a Z value of 3 and commonly would be referred to as a 3 sigma process.

Sigma Level

Determining sigma levels of processes (one sigma, six sigma, etc.) allows process performance to be compared throughout an entire organization, because it is independent of the process. It is merely a determination of opportunities and defects, however the terms are appropriately defined for that specific process.

Sigma is a statistical term that measures how much a process varies from perfection, based on the number of defects per million units.

One Sigma = 690,000 per million units

Two Sigma = 308,000 per million units
Three Sigma = 66,800 per million units
Four Sigma = 6,210 per million units
Five Sigma = 230 per million units
Six Sigma = 3.4 per million units

In formulae for control limits and process capabilities, sigma is the symbol for Standard Deviation, calculated from the squares of the deviations of measured samples from the mean value (or sometimes by other methods using 'magic' numbers). For a normally distributed output, 99.7% would be expected to fall between +/-(3 x sigma) levels.

Simple Linear Regression

Simple linear regression is a method that enables you to determine the relationship between a continuous process output (Y) and one factor (X). The relationship is typically expressed in terms of a mathematical equation such as Y = b + mX

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.

Supplier-Input-Process-Output-Customer: Method that helps you not to forget something when mapping processes.

.SIPOC articleSee

Six Sigma

The goal of Six Sigma is to increase profits by eliminating variability, defects and waste that undermine customer loyalty.

Six Sigma can be understood/perceived at three levels:

1. **Metric**: 3.4 Defects Per Million Opportunities. DPMO allows you to take complexity of product/process into account. Rule of thumb is to consider at least three opportunities for a physical part/component - one for form, one for fit and one for function, in absence of better considerations. Also you want to be Six Sigma in the Critical to Quality characteristics and not the whole unit/characteristics.
2. **Methodology**: DMAIC/DFSS structured problem solving roadmap and tools.
3. **Philosophy**: Reduce variation in your business and take customer-focused, data driven decisions.

Six Sigma is a methodology that provides businesses with the tools to improve the capability of their business processes. This increase in

performance and decrease in process variation leads to defect reduction and vast improvement in profits, employee morale and quality of product.

What is Six Sigma?Here's an article with more detail on defining Six Sigma:

Six Sigma is a rigorous and a systematic methodology that utilizes information (management by facts) and statistical analysis to measure and improve a company's operational performance, practices and systems by identifying and preventing 'defects' in manufacturing and service-related processes in order to anticipate and exceed expectations of all stakeholders to accomplish effectiveness.

Six Sigma Strategy

Strategy of improvements through Six Sigma can be summed up as any one or combination of the following 3 S.

SHIFT: If the central tendency of the process is outside the specification limits and spread is well within these limits, we need to Shift the process within these limits.

SHRINK: If the central tendency of the process is within the limits but the spread of the process is beyond the limits, Shrink the process within the limits

Stabilise: If both central tendency and spread are as desired, stabilise the process by monitoring, standardizing and documenting the process.

Skewness

Most often, the median is used as a measure of central tendency when data sets are skewed. The metric that indicates the degree of asymmetry is called, simply, skewness. Skewness often results in situations when a natural boundary is present. Normal distributions will have a skewness value of approximately zero. Right-skewed distributions will have a positive skewness value; left-skewed distributions will have a negative skewness value. Typically, the skewness value will range from negative 3 to positive 3. Two examples of skewed data sets are salaries within an organization and monthly prices of homes for sale in a particular area.

SMED

Single Minute Exchange of Die.
One of Lean tools that reduces the changeover time. It has a set of procedures to be followed for a successful implementation.

Some Advantages:
Setup reduction and fast, predictable setups enable Lean Manufacturing.
Setup reduction reduces setup cost, allows small lot production, smoothes flow, and improves kanban

Soft Savings

Six Sigma project benefits such as reduced time to market, cost avoidance, lost profit avoidance, improved employee morale, enhanced image for the organization and other intangibles may result in additional savings to your organization, but are harder to quantify. These are referred to as soft savings. .hard savingsThey are different from

Software Inspection

A form of document *Quality Control* in which a team of colleagues assists an author in assessing the *Quality* of a documentary work-product against pre-defined quality criteria.

Inspection is distinguished from reviews and walkthroughs by its formal approach to five aspects:

1. A documented process of six to eight tasks;
2. Specialist roles within the process, with a written job specification for each role;
3. Process control by quantitative entry and exit criteria for the process, and sometimes for each task;
4. "Oracles" (such as source and related documents, and "best-practice" checklists) to assist in the identification of defects; and
5. Collection and analysis of both product and process data to determine cost-effectiveness.

Additionally, while reviews and walkthroughs concentrate solely on "defect detection" within the document being dealt with, inspection provides explicit formal mechanisms for "defect prevention" via improvement of processes and of personal skills.

Note that there are around twenty variants of what may properly be called "Inspection", of which *Fagan Style Software Inspection* is one. Differences between the varieties are mostly of emphasis and terminology.

See *Software Inspection Plan*.

References:
Fagan, M. "Design and Code Inspections to Reduce Errors in Program Development." IBM Systems Journal 15, 3 (1976): 182-211;

Gilb, T., & Graham, D. "Software Inspection", Addison-Wesley, 1993;

Radice, R., "High-Quality Low-Cost Software Inspections", Paradoxicon, 2002.

Software Inspection Plan

In Gilb-Graham *Software Inspection* (see also *Fagan Style Software Inspection*), the Inspection Plan is created by the Inspection Leader (aka Facilitator or Moderator) and reviewed and amended by the inspection team members. The principal purpose of the plan is for the document being inspected to exit from inspection, at a pre-defined quality level, on its first pass. Other goals (such as training) may also be planned for.

The Plan has six sections:

1. The Header identifies the document being inspected, the *Entry Criteria* that have governed entry to the inspection, and the *Exit Criteria* to be achieved for success.

2. The Meetings section plans dates, times, and locations of working meetings.

3. The Documents section specifies which part(s) of the document will be inspected, and what other documents ("oracles") will be used to check its quality and accuracy.

4. The Participants section identifies the inspection team members and their specific roles in the inspection.

5. The Standard Rates And Estimates section identifies the work-rates currently mandated for each task of the inspection, and individualises this to the amount of work (hours) required for each inspector.

6. The Data Collection section provides space for the individual inspector to record costs (time spent) and benefits (work done, issues recorded).

Span

Defined as P_{95}-P_5. Unlike the Range (R) which is the maximum value minus the minimum value of process data, the Span removes the extreme outliers of your process by looking only at the difference between the 95th and 5th percentiles (the "P"s in the above formula).

for more information.GE's Six Sigma Focus On SpanSee

Special Cause

A source of *Quality* failure that lies outside the *Process*, and so is intermittent, unpredictable, unstable; sometimes called an *Assignable Cause*.

See also *Special Cause Variation*, *Common Cause*, *Common Cause Variation*.

Special Cause Variation

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.

Special cause variation is a shift in output caused by a specific factor such as environmental conditions or process input parameters. It can be accounted for directly and potentially removed and is a measure of process control.

Specification

Customer's expectation for product or service deliverable/output.

Parameters by which an output can be verified.

Spread

The spread of a process represents how far data points are distributed away from the mean, or center. Standard deviation is a measure of spread.

SREA

Supplier Request for Engineering Approval

SS Process Report

The Six Sigma process report is a Minitab™ tool that calculates process capability and provides visuals of process performance. See the tool Six Sigma Process Report.

SS Product Report

The Six Sigma product report is a Minitab™ tool that calculates the DPMO and short-term capability of your process. See the tool Six Sigma Product Report.

SSBOK

SSBOK: Six Sigma Body of Knowledge.

Alternative: Six Sigma Book of Knowledge

Stability

Stability represents variation due to elapsed time. It is the difference between an individual's measurements taken of the same parts after an extended period of time using the same techniques.

Also, PROCESS STABILITY INDEX is often used in SPC where many charts are ranked by the %OOC (instability) due to application of control limits and alarm rules. Stability is not the same as Capability. Stability is based on

statistical control limits, while Capability is based on customer specification limits. Often shown as %OOC and Cpk. But of course a Stable process has LOW %OOC near zero, but never zero long term if limits are set correctly due to false alarm rate with good limits and rules.

Stationary (lack of drift) is opposite of Dynamic. Not the same as Stability. Engineers and statisticians argue about these terms.

Stable Process

A process that does not contain any special cause variation -- it only contains common cause variation. Common cause variation is that which is normal to the process and doesn't change over time.

.In-ControlAlso see

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.

Alternative definition:
People who are (or might be) affected by any action taken by an organization. Examples are: Customers, owners, employees, associates, partners, contractors, suppliers, related people or located near by.

Alternative definition:
Any group or individual who can affect or who is affected by achievement of a firm's objectives

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Standard Deviation

A statistic used to measure the variation in a distribution. Sample standard deviation is equal to the square root of (the sum of the squared deviations of the mean divided by the sample size minus 1). Where the whole population is known, the minus 1 "fudge factor" should be omitted.

Standard deviation is a measure of the spread of data in relation to the mean. It is the most common measure of the variability of a set of data. If the standard deviation is based on a sampling, it is referred to as 's.'

In formulae it is often represented by the letters SD or the symbol (Greek letter) sigma.
Although it is closely related to, and used in calculations for, the Sigma level of a process you need to be careful to distinguish the two meanings.

Standard Deviation

A statistic used to measure the variation in a distribution. Sample standard deviation is equal to the square root of (the sum of the squared deviations of the mean divided by the sample size minus 1). Where the whole population is known, the minus 1 "fudge factor" should be omitted. This "fudge factor" is degrees of freedom. Therefore, as the size of the population increases, the impact of the minus 1 "fudge factor" decreases. For a very small sample size, this minus 1 "fudge factor" can be significant.

Standard deviation can be thought of as "the average distance each data point is from the average of the entire data set". That is, add the squared distance each point is from the average value and divide by the number of points in the population, or 1 minus the number of data points for a sample, then take the square root of the answer. The distances are squared to eliminate any negative values. It is the most common measure of the variability of a set of data. If the standard deviation is based on a sampling, it is referred to as 's.' When it is describing the population, the lower case Greek letter "sigma" is used.

Although it is closely related to, and used in calculations for, the Sigma level of a process you need to be careful to distinguish the two meanings

Standard Operating Sheet (SOS)

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.

Can be divided into Manual and Robot times if operator deals with a machine.

Used in lean manufacturing for standardization and continuous improvement.

Typically contains a diagram of the workstation and is signed by the Supervisor and/or Team Leader.

Standard Order

Design of experiment (DOE) treatments often are presented in a standard order. In a standard order, the first factor alternates between the low and high setting for each treatment. The second factor alternates between low and high settings every two treat

Statistic

A numerical value, such as standard deviation or mean, that characterizes the sample or population from which it was derived. Any number calculated from sample data, describes a sample characteristic.

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.

Statistical Process Control (SPC) is the equivalent of a histogram plotted on it's side over time. Every new point is statistically compared with previous points as well as with the distribution as a whole in order to assess likely considerations of process control (i.e. control, shifts, and trends). Forms with zones and rules are created and used to simplify plotting, monitoring, and decision making at the operator level. SPC separates special cause from common cause variation in a process at the confidence level built into the rules being followed (typically 99.73% or 3 sigma).

Statistical Thinking

The process of using wide ranging and interacting data to understand processes, problems, and solutions. The opposite of one factor at a time (OFAT), where ones natural born tendency is to change one factor and “see” what happens. Statistical thinking is the tendency to want to understand complete situational understanding over a wide range of data where several control factors may be interacting at once to produce and outcome. Common cause variation becomes your friend and special cause variation your enemy. Attribute judgements of good and bad are replaced with estimates of significance with given confidence.

Statistics

The mathematics of the collection, organization, and interpretation of numerical data, especially the analysis of population characteristics by inference from sampling.

Stem and Leaf Plot

Stem and Leaf Plot

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

Consider the following data set, sorted in ascending order: 8, 13, 16, 25, 26, 29, 30, 32, 37, 38, 40, 41, 44, 47, 49, 51, 54, 55, 58, 61, 63, 67, 75, 78, 82, 86, 95

A stem and leaf plot of this data can be constructed by writing the first digits in the first column, then writing the second digits of all the numbers in that range to the right.

Stem and Leaf Plot

0|8
1|3 6
2|5 6 9
3|0 2 7 8
4|0 1 4 7 9
5|1 4 5 8
6|1 3 7
7|5 8
8|2 6
9|5

The result is a histogram turned on its side, constructed from the digits of the data. The term "stem and leaf" is used to describe the diagram since it resembles the right half of a leaf, with the stem at the left and the outline of the edge of the leaf on the right. Alternatively, some people consider the rows to be stems and their digits to be leaves.

If a larger number of bins is desired, the stem may be 2 digits for larger numbers, or there may be two stems for each first digit - one for 2nd digits of 0 to 4 and the other for 2nd digits of 5 to 9.

Stem and Leaf Plot Advantages

The stem and leaf plot essentially provides the same information as a histogram, with the following added benefits:

- The plot can be constructed quickly using pencil and paper.
- The values of each individual data point can be recovered from the plot.
- The data is arranged compactly since the stem is not repeated in multiple data points.
- The stem and leaf plot offers information similar to that conveyed by a histogram, and easily can be constructed without a computer.

Strategic Planning

Strategic planning is a disciplined effort to produce fundamental decisions and actions that shape and guide what an organization is, what it does, and why it does it, with a focus on the future.

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 treated separately.

It involves looking at process data, splitting it into distinct layers (almost like rock is stratified) and doing analysis to possibly see a different process.

For instance, you may process loans at your company. Once you stratify by loan size (e.g. less than 10 million, greater than 10 million), you may see that the central tendency metrics are completely different which would indicate that you have two entirely different processes...maybe only one of the processes is broken.

Stratification is related to, but different from, Segmentation.

A stratifying factor, also referred to as stratification or a stratifier, is a factor that can be used to separate data into subgroups. This is done to investigate whether that factor is a significant special cause factor.

Sub-Group

A distinct group within a group; a subdivision or subset of a group.

Subgrouping

Measurement of where you can get

Subject Matter

A topic under discussion during the research phase of a documentation project.

Subject Matter Expert - SME

The Subject Matter Expert is that individual who exhibits the highest level of expertise in performing a specialized job, task, or skill within the organization.

An SME might be a software engineer, a helpdesk support operative, an accounts manager, a scientific researcher: in short, anybody with in-depth knowledge of the subject you are attempting to document. You need to talk to SMEs in the research phase of a documentation project (to get your facts straight) and you need to involve them in the technical validation of your drafts (to make sure that your interpretation of information matches theirs).

Subjective Rating and Ranking

This is a very commonly and easy to use matrix where the possible causes generated through brainstorming or other group activities are rated by a team of experts first individually.For convenience and clarity , the rating is done as 0(No Significance), 1(Little Significance) , 3 (May be significant) and 9 (Highly significant). Once the entire team has rated the possible causes , they are grouped and ranked (normally by using median)and higher ranked reasons are worked on priority. This serves a good tool if the team consists of members having very good knowledge of the subject.

Sufficiency

Accomplishing defined or required objectives, according to the required or defined conditions, conforming with the right time, place, quantity, quality and costs.

Supply Chain Management

Managing the movement of goods from raw materials to the finished product delivered to customers. Supply Chain Management aims to reduce operating costs, lead times, and inventory and increase the speed of delivery, product availability, and customer satisfaction.

SWOT Analysis

A scan of the internal and external environment is an important part of the strategic planning process. Environmental factors internal to the firm usually can be classified as strength (S) or weaknesses (W), and that external to the firm can be classified as opportunity (O) or threats (T). Such an analysis of the strategic environment is referred to as a SWOT analysis.

The SWOT analysis provides information that is helpful in matching the firm's resources and a capability to the competitive environment in which it operates. As such, it is instrumental in strategy formulation and selection.

System Audit

System Audit - Also called Process Audit: can be conducted for any activity. Usually made against a specific document such as operating procedure, work instruction, training manual, etc.

System of Profound Knowledge - SoPK

Deming advanced the System of Profound Knowledge (SoPK) which he said consisted of four main subheadings:

1. Knowledge of Variation, that is, a knowledge of common cause and special variation.

2. Knowledge of Systems, that is, understanding that all the parts of a business are related in such a way that if you focus on optimizing one part, other parts may suffer.

3. Knowledge of Psychology, that is, what motivates people.

4. Theory of Knowledge, that is, how we learn things.

Systems Engineering

An interdisciplinary collaborative approach to derive, evolve, and verify a life cycle balanced system solution which satisfies customer expectations and meets public acceptability

Systems Thinking

Any process of estimating how local policies and actions influence the state of the neighboring universe. Everyone is a Systems Thinker – some more neighborly than others.

The development of a Systems Thinking Model and intervention involves five phases:
1) problem structuring
2) causal loop modeling
3) dynamic modeling
4) scenario planning and modeling
5) implementation and organizational learning

t Statistic

The t statistic is used to determine whether two means are statistically different. The formula uses the means of the two samples, their standard deviation and sample size. The t value is then evaluated against your alpha to determine if your null hypothesis can be rejected or not.

for more information and a discussion.this forum postSee

t Test

The t test employs the statistic (t), with n-1 degrees of freedom, to test a given statistical hypothesis about a population parameter. Usually used with small sample sizes (<30). It is used when population standard deviation is unknown.

Taguchi Method

A technique for designing and performing experiments to investigate processes where the output depends on many factors (variables; inputs) without having to tediously and uneconomically run the process using all possible combinations of values of those variables. By systematically choosing certain combinations of variables it is possible to separate their

individual effects.

A special variant of Design of Experiments (DOE) that distinguishes itself from classic DOE in the focus on optimizing design parameters to minimize variation BEFORE optimizing design to hit mean target values for output parameters.

Takt Time

What is Takt Time?
"Takt" is the German word for the baton that an orchestra conductor uses to regulate the speed, beat or timing at which musicians play. So Takt Time is "Beat Time"? "Rate Time" or “Heart Beat" Lean Production uses Takt Time as the rate or time that a completed product is finished. If you have a Takt Time of two minutes that means every two minutes a complete product, assembly or machine is produced off the line. Every two hours, two days or two weeks, whatever your sell rate is your Takt Time.

How is Takt Time established?
The customers buying rate establishes Takt Time. It's the rate at which the customer buys your product. So this means that over the course of a day, week, month, or year the customers you sell to are buying at a rate of one every two minutes.

What happens if the customers buy fewer products?
You can't predict when and how much a customer will buy. But if customer demand falls for an extended period of time then the Takt time should change. This means that if your producing at a Takt Time of one every two minutes and the customers demand fall to a rate of one every 3 minutes. Then your takt Time should increase or become more. Your Takt Time should increase to 3 minutes and production staffing should be set accordingly.

What happens if the customers buy more?
Then your Takt Time will decrease. You would lower your Takt Time to make more products in a shorter amount of time. This means if your customer buy more than your 2 minute Takt Time. Then you would lower your Takt Time to match the sell rate and increase staffing accordingly.

Producing to Takt Time with optimal staffing is where you wan t to be. Where you have the right amount of people to produce your product within your established Takt Time. The Operators cycle times are loaded to Takt Time.

Imbalances in Takt Time, especially in older facilities, drive security inventories and buffer space. If you manage such a facility, one step on "the Lean Journey" is to monitor Summed Takt in order to move toward preventive (rather than reactive) quality measures. That is, if you can detect, contain, and correct a problem within Takt + Buffer Time (Summed Takt) then you have taken a step toward Error Proofing. This is no substitute for continuously improving a balanced Takt Time (thereby eliminating security inventory /

buffering) but, rather, it is a first step which you can institute quickly and economically and which will help the people begin to "see" Lean.

TAT

Turn Around Time (TAT)

TEAM

TEAM is defined as an unit which
Totally (effectively) and
Efficiently
Achieves the
Milestones.
I have tried to capture essence of effectiveness and efficiency (from TS-16949 standard) and linked the definition to the desired results / milestones.

Team Capacity

Available manpower with the desired skill set and the available number of hours in a day to deliver a certain amuont of output.

Team Leader

Each work cell is supervised by a Team Leader, who is responsible for maintaining optimal quality and productivity. Generally, this is a top-level technician who also is a natural leader. (See also Work Cell).

It is a person who gives orders and plans to technician and operator in a manufacturing company.

Telecosm

n. the entire network of communication; sattelite; radio; telephone; television; internet; etc: "This discovery will be spread throughout the entire telecosm

Theory of constraints (TOC)

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.

Thought Process Map - TMAP

A visual representation of a person's or team's thoughts that act as a roadmap to progress through DMAIC; additionally, it is a living document that will change throughout the project and has no set format.

Throughput

Output or production, as of a computer program, over a period of time.

THULLA

Thulla is the term defined for the resource waste time during the processing due to the motivational reasons.

Example :- Workers taking extra processing time, or break time for their due course of action because of the motivational reasons. This term is a management concern

Time Value Map

A Time Value Map is generated by tracking a work item through the process and tracking where it spends its time. Only work that is seen as Value added by the customer is plotted above the middle line; everything else is waste in their eyes.

The concept of a Time Value Map is simple: We can track any work item into one of the 3 categories. 1) Value added work 2) Waste that is unavoidable due to business reasons (the work or functions for which the customer does not pay for e.g., payroll, legal, regulatory) and 3) delays/waste.

Then a time line is drawn and the time segments is marked off for each category. The idle queuing time is represented by the blank space.

Tolerance Range

Tolerance range is the difference between the upper specification limit and the lower specification limit

Total Observed Variation

Total observed variation is the combined variation from all sources, including the process and the measurement system

Total Prob of Defect

The total probability of defect is equal to the sum of the probability of defect above the upper spec limit-p(d), upper-and the probability of defect below the lower spec limit-p(d), lower

Total Quality

Holistic sufficiency, efficiency, efficacy and effectiveness in all organization functions to accomplish continuous excellence in business outcomes

Total Quality Management

A short label for the list of prerequisites for achieving world-class quality. Use began in the last half of the twentieth century. Although there is no agreement on what were the essential elements of TQM, many use the criteria of the Malcolm Baldrige National Quality Award.

A conceptual and a philosophical context which requires management and human resources commitment to adopt a perpetual improvement philosophy, through succinct management of all processes, practices and systems throughout the organization to achieve effectiveness in the organizational performance and fulfilling or exceeding the community expectations.

TPM

Japanese management philosphy. Stands for Total Productive Maintenanace. Used to increase time between failure (MTBF) or life of machinery.

TQM

Total Quality Management

Transfer Function Y=f(X)

A transfer function describes the relationship between lower level requirements and higher level requirements. If it describes the relationship between the nominal values, then it is called a y-hat model. If it describes the relationship between the variations, then it is called an s-hat model.

is the dependent output variable of a process. It is used to monitor a Y process to see if it is out of control, or if symptoms are developing within a s that contribute to the process. Once Xprocess. It is a function of the , a transfer function Y=f(X) can be Design of Experimentquantified through developed to define the relationship of elements and help control a process.

Y is the output measure, such as process cycle time or customer satisfaction. f is the transfer function, which explains the transformation of the inputs into the output. X is any process input process step that is involved in producing the output.

For example, if you call your major department store to ask a question, the ability to have your question answered (Y) is a function (f) of the wait time, the number of people answering the phones, the time it takes to talk with the representative, the representative's knowledge, etc. All of these X's can be defined, measured and improved.

Transformations

Used to make non-normal data look more normal

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.

Trend Analysis

The process of analysing data to identify underlying longer-term trends e.g. failure patterns. Used in Incident and Problem Management, it is also employed as a method of modelling in Capacity Management.

Process Control Charts are key tools in completing this type of analysis.

Trend Charts

Trend charts allow a company to engage in visual management. They typically display the value of a quantifier through time, together with a goal line.

Tribal Knowledge

Tribal knowledge is any unwritten information that is not commonly known by others within a company. This term is used most when referencing information that may need to be known by others in order to produce quality product or service. The information may be key to quality performance but it may also be totally incorrect. Unlike similar forms of artisan intelligence, tribal knowledge can be converted into company property. It is often a good source of test factors during improvement efforts.

Example 1: A measurement system was out of control and the inspectors began fighting over what they believed to be the accurate gages. Gage R&R showed that 92% of the variation came from how the inspectors used the gage, not the gage itself.

Example 2: A product line was re-started after being down for two years but the original operators had to be re-hired in order to produce product that worked.

Trimmed Mean

Compromise between the mean and median. Trimmed mean is defined as the mean calculated by trimming 5% data sets from the top and bottom of data sets. This helps to alleviate the distortion caused by extreme values from which the ordinary arithmetic mean suffers.

Trivial many

The trivial many refers to the variables that are least likely responsible for variation in a process, product, or service

TRIZ

TRIZ (pronounced "TREEZ", the Russian acronym for the Theory of Inventive Problem Solving) is an established science, methodology, tools and knowledge- and model-based technology for stimulating and generating innovative ideas and solutions for problem solving. It is short for Teoriya Resheniya Izobreatatelskikh Zadatch.

Historically it has been widely spread in Eastern Europe, particularly in the countries of the former USSR and is a part of many university-, college-, school-education programmes.

TRIZ science expands system engineering approaches and provides powerful systemic methods and tools for problem formulation, system- and failure analysis, both as-is and could be, i.e. system patterns of evolution.

Original TRIZ was mostly applicable for analysis and innovative problem solving for manufacturing processes, e.g. process/product/performance improvement, failure correction etc.

TRIZ basic postulates, methods and tools, including training methodologies invented by H.Altshuller are now further developed and significantly enhanced by his followers, researchers and trainers, particularly known as I-TRIZ.

I-TRIZ also adopts the methodology and tools for new applications, like transactional processes(e.g., innovative service design and engineering, business development etc.).

Advanced I-TRIZ methods and tools can be used for enhancing Six Sigma methodology, both DMAIC and IMADV or DFSS, especially when Six Sigma methods and tools are by different reasons inefficient and/or insufficient.

It allows particularly to save time, find efficient low-cost improvement solutions already at the Define or Identify phase, efficiently screen measurements, avoid errors and reduce rework and consequently the Cost of Poor Quality of Six Sigma e.g. when determining the root causes of defects, designing for upgrade from 2-3-4 to higher sigma levels etc.

T-test

A t-test is a statistical tool used to determine whether a significant difference exists between the means of two distributions or the mean of one distribution .t-testand a target value. See

Tukey's (1-way ANOVA)

Check to obtain confidence intervals for all pairwise differences between level means using Tukey's method (also called Tukey's HSD or Tukey-Kramer method). Specify a family error rate between 0.5 and 0.001.

TVM

Total Value Management

Type I Error

In hypothesis testing, rejecting the null hypothesis (no difference) when it is in fact true (e.g. convicting an innocent person.)

TYPE 1 errors are those where scientists assumed a relationship where none existed. The Producers risk: Rejecting a good part.

When a point falls out of the boundary limit and the SPC system gives signal that the process is out of control or produced product is bad in Quality but actually nothing have gone wrong (i.e., the process is in control).

Type II Error

In hypotheis testing: failing to reject a false null hypothesis (e.g., failing to convict a guilty person).

TYPE 2 errors are those where scientists assumed no relationship exists when in fact it does.

Consumers Risk - Accepting and shipping bad parts.

U Chart

A chart displaying the counts per unit.

UCL

Upper Control Limit (note, different from USL): representing a 3 x sigma upwards deviation from the mean value of a variable (see also LCL). For normally distributed output, 99.7% should fall between UCL and LCL.

When used on control charts, the "3sigma" level can be calculated from sample-to-sample values or batch-to-batch averages using a "magic number", and is used to flag-up unexpected deviations.

Unbiased Statistic

A statistic is an unbiased estimate of a given parameter when the mean of the sampling distribution of that statistic can be shown to be equal to the parameter being estimated.

Unexplained Variation (S)

Regression statistical output that shows the unexplained variation in the data.
Se = sqrt((sum(yi-y_bar)^2)/(n-1))

Unit

A unit is any item that is produced or processed which is liable for measurement or evaluation against predetermined criteria or standards.

Univariate

A random variable with a numerical value that is defined on a given sample space.

USL

An upper specification limit, also known as an upper spec limit, or USL, is a value below which performance of a product or process is acceptable.

Upper Specific Limit: representing the maximum acceptable value of a variable (see also LSL).

Value

Value=Function/cost
Value is the exchange for which customer pays.

Value can also equate to quality over Cost, ie the higher the quality the lower should be the cost in the real context.It can also construed being tha higher the quality is the higher the cost of implementing it, but this is not the kind we talk about.No doubt that some times it takes higher cost to improve quality but in the long term cost like hidden, opportunity cost will be reduced perpertually.

Value Stream

A value stream is all the steps (both value added and non-value added) in a process that the customer is willing to pay for in order to bring a product or service through the main flows essential to producing that product or service.

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.

A value stream map (AKA end-to-end system map) takes into account not only the activity of the product, but the management and information systems that support the basic process. This is especially helpful when working to reduce cycle time, because you gain insight into the decision making flow in addition to the process flow. It is actually a Lean tool.

The basic idea is to first map your process, then above it map the information flow that enables the process to occur.

Value-Added

To be a value added action the action must meet all three of the following criteria:

1) The customer is willing to pay for this activity.

2) It must be done right the first time.

3) The action must somehow change the product or service in some manner.

You will need to look for the "7 elements of waste" and when categorizing need to break out your % split into:
% True Value Added,
% True Non Value Added, and
% Necessary Waste (i.e legal requirement).

If your processes are typical then the %VA will be less than 5%.

Variable

A quantity that may assume any one of a set of values. Usually represented in algebraic notation by the use of a letter. In the equation.

A quantity able to assume different numerical values.

Variable Data

Variable data is what you would call Quantitative. There are two types (Discrete) count data and (Continuous) data.

Attribute data is always binary and unuseable for the purpose of quantification. Good Bad, Yes No -- once you convert it to discrete data by counting the number of good or bad -- it becomes discrete variables data.

Variance

The sum of the squared deviations of n measurements from their mean divided by (n-1).
The deviation from what was expected.

Deviation from process mean ie, away from the target which often results in extra cost to revert back on target/mean.

Variance Inflation Factor

Variance inflation factor (VIF) measures
the impact of collinearity among the X's in a regression model on the precision of estimation. It expresses the degree to which collinearity among the predictors degrades the precision of an estimate. This can be used with Minitab. Typically a VIF value greater than 10 is of concern.

Variation

Variation is the fluctuation in process output. It is quantified by standard deviation, a measure of the average spread of the data around the mean. Variation is sometimes called noise. Variance is squared standard deviation

Variation (Common Cause)

Common cause variation is fluctuation caused by unknown factors resulting in a steady but random distribution of output around the average of the data. It is a measure of the process potential, or how well the process can perform when special cause variation removed.

Common cause variability is a source of variation caused by unknown factors that result in a steady but random distribution of output around the average of the data. Common cause variation is a measure of the process's potential, or how well the process can perform when special cause variation is removed. Therefore, it is a measure of the process technology. Common cause variation is also called random variation, noise, noncontrollable variation, within-group variation, or inherent variation. Example: Many X's with a small impact.

Variation (Special Cause)

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.

Special cause variation is a shift in output caused by a specific factor such as environmental conditions or process input parameters. It can be accounted for directly and potentially removed and is a measure of process control.

VEISA

V.VERIFY APROCESS TO IMPROVE

E.ESTABLISH OBJECTIVES/MEASURES & A PLAN FOR PROCESS IMPROVEMENT
I.IMPLEMENT THE PLAN
S.STUDY RESULTS/MEASURE TO IDENTIFY CHANGES FOR CONTIUOUS IMPROVEMENT
A.APPLY THE REQUIRED CHANGES FOR CONTINOUS IMPROVEMENT OF PERFORMANCE

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.

Vital Few

Derived from the pareto chart, the term indicates that many defects come from relatively few causes (the 80/20 rule).

For example, 20% of the people in the country make up 80% of the wealth of the country.

Vital Few: These are the few (20%) independent variables (X's) which contribute to maximum (80%) of the total variation. These are identified through Pareto Charts and Design of Experiments.

Voice Of the Business (VOB)

The "voice of the business" is the term used to describe the stated and unstated needs or requirements of the business/shareholders.

Voice Of the Customer (VOC)

The "voice of the customer" is a process used to capture the requirements/feedback from the customer (internal or external) to provide the customers with the best in class service/product quality. This process is all about being proactive and constantly innovative to capture the changing requirements of the customers with time.

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.

This data is used to identify the quality attributes needed for a supplied component or material to incorporate in the process or product.

Voice Of the Employee (VOE)

The "voice of the employee" is the term used to describe the stated and unstated needs or requirements of the employees of your business.

Voice Of The Process (VOP)

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?
The best way to discover the VOP is to plot it on a control chart - time sequenced events across the bottom (x-axis) and the individual results up the side (y-Axis). Calculate the normal variation ranges and plot these as lines above and below the average the process is giving you.
Any points within the lines are part of the normal variation and any points above and below the lines have 'special causes' which are the only ones worthy of investigation and action. MINITAB or WINCHART software does all this plotting for you.

VQD

Visual Quality Document

Warning Limits

In a control chart, if control limits are placed at two times the standard deviation from the process average then the limits are said to be Warning Limits or Two Sigma Limits.

Waste

Waste in a process is any activity that does not result in moving the process closer to the final output or adding value to the final output.

The main wastes are seven (7W):

W1 - Overproduction;
W2 - Iventory;
W3 - Waiting;
W4 - Transportation;
W5 - Motion;
W6 - Process (useless steps in a process);
W7 - Defects.

WBT

A learning mode thru web based technology

Web Chart(tm)

Graphical Visual Management Tool that Diplays Multiple Measurables in a Spider "Web" like Chart Allowing Quick Analysis Among and Comparisons Between Data Streams. A Highly Effective World Class Manufacturing Visual Control Tool used in Environments such as Lean Manufacturing, Kaizen, and others. Published in the American Society for Quality in the early Nineties

Whisker

From box plot...displays minimum and maximum observations within 1.5 IQR (75th-25th percentile span) from either 25th or 75th percentile. Outlier are those that fall outside of the 1.5 range.

White Noise

A uniform distribution of frequency components spanning a wide spectrum of frequencies (cycles / sec.)

Sources of variation which are random or 'natural' - a change in the source will not produce a predictable change in the response.

Wilcoxon Rank Sum Test

A test used in nonparametric statistics used to compare the locations of two populations, to determine if one population is shifted with respect to another. The method employed is a sum of ranks comparison.

Work Cell

A logical and productive grouping of machinery, tooling, and personnel which produces a family of similar products. Each cell has a leader who manages the work flow, and is responsible for maintaining optimal quality and productivity. A key element in the Pi (TM) Perpetual Improvement system.

World-Class Quality

A term used to indicate a standard of excellence: best of the best

X

Xs are the independent inputs to a process that cause or control a problem to Design of) of a process. Once quantified through Yoccur in the output (, a transfer function Y=f(X) can be developed to define the Experiment relationship of elements and help control a process.

equation definitionY=f(x)See

X Bar

Also known as the sample mean. See Mean.

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.

X-Bar and R charts draw a control chart for subgroup means and a control chart for subgroup ranges in one graphic. Interpreting both charts together allows you to track both process center and process variation and detect the presence of special causes. Generally, a user focuses on the range portion of the chart first, confirming that the process is in control. Finally, the user focuses on the average chart, looking for special cause there.

X-Matrix

X-matrix is the tool available for successfully implementing Policy Deployment in a meaningful and simple way as part of a Lean conversion. It addresses a few critical aspects of Policy Deployment i.e. Business objectives, Selected projects, Goals and Project impact in $ (or any currency

Y

Y is the dependent output variable of a process. It is used to monitor a process to see if it is out of control, or if symptoms are developing within a s that contribute to the process. Once Xprocess. It is a function of the , a transfer function Y=f(X) can be Design of Experimentquantified through developed to define the relationship of elements and help control a process.

equation definition.Y=f(x)See

Y=f(X)

In this equation X represents the input of the process and Y the output of the procees and f the function of the variable X.

is the dependent output variable of a process. It is used to monitor a Y process to see if it is out of control, or if symptoms are developing within a s that contribute to the process. Once Xprocess. It is a function of the , a transfer function Y=f(X) can be Design of Experimentquantified through developed to define the relationship of elements and help control a process.

Y is the output measure, such as process cycle time or customer satisfaction. f is the letter representing "function" (what the value(s) of X(s) does/do for Y (the output). X(s) is/are any process input(s) (variables) having assigned or inherent values(s) that is/are involved in producing the output.

For example, if you call your major department store to ask a question, the ability to have your question answered (Y) is a function (f) of the wait time, the number of people answering the phones, the time it takes to talk with the representative, the representative's knowledge, etc. All of these X's can be defined, measured and improved.

Yellow Belt - YB

Sometimes referred to as Green Belts (GB) -- varies from business to business. A Yellow Belt typically has a basic knowledge of Six Sigma, but does not lead projects on their own, as does a Green Belt or Black Belt. Is often responsible for the development of process maps to support Six Sigma projects. A Yellow Belt participates as a core team member or subject matter expert (SME) on a project or projects. In addition, Yellow Belts may often be responsible for running smaller process improvement projects using the PDCA (Plan, Do, Check, Act) methodology. PDCA, often referred to as the Deming Wheel, enables Yellow Belts to identify processes that could benefit from improvement. These smaller Yellow Belt projects often get escalated to the Green Belt or Black Belt level where a DMAIC methodolgy is used to maximize cost savings using Statistical Process Control.

ield

Yield is the percentage of a process that is free of defects.

OR

Yield is defined as a percentage of met commitments (total of defect free events) over the total number of opportunities.

First Time Yield - FTY
Rolled Throughput Yield – RTY

Z

A Z value is a data point's position between the mean and another location as measured by the number of standard deviations. Z is a universal measurement because it can be applied to any unit of measure. Z is a measure of process capability and corresponds to the process sigma value that is reported by the businesses. For example, a 3 sigma process means that three standard deviations lie between the mean and the nearest specification limit. Three is the Z value.

Z bench

Z bench is the Z value that corresponds to the total probability of a defect.

Z lt

Z long term (ZLT) is the Z bench calculated from the overall standard deviation and the average output of the current process. Used with continuous data, ZLT represents the overall process capability and can be used to determine the probability of making out-of-spec parts within the current process.

Z Score

A measure of the distance in standard deviations of a sample from the mean. Calculated as (X - X bar) / sigma

Z Shift

Z shift is the difference between ZST and ZLT. The larger the Z shift, the more you are able to improve the control of the special factors identified in the subgroups.

Z shift is usually assumed to be 1.5 (ZST = ZLT+1.5). However it can be computed precisely for any given process by calculating its "Between sub-group variation" using Process Capability Analysis.

Z st

ZST represents the process capability when special factors are removed and the process is properly centered. ZST is the metric by which processes are compared.

Zadj

The probability of a defect when defects are correlated. For example, when linewidths are printed too wide the process can cause thousands of 'bridging' defects, so although the number of defects is extremely high, there is only one opportunity. Unless of course there are say four sensitive areas on the circuit so that a slight 'under exposure' condition would only cause say four sensitive areas to bridge, in which case Zadj would then have four opportunties.

Zero Defects

A practice that aims to reduce defects as a way to directly increase profits. The concept of zero defects lead to the development of Six Sigma in the 1980s.