LEAN SIX SIGMA GREEN BELT
CHEAT SHEET

GreyCampus

Includes formulas: what they are, when to use them, references

CONTENTS

LEAN CONCEPTS

VSM Value Stream Mapping

- Value Stream Mapping is a tool used to understand a process and how much value-added and non-value added time is spent on and between each activity.
- The VSM will include a data box of key statistics, such as:

Data Box	Current State	Future State	% Improvement
Value Add Time			
Non Value Add Time			
Lead Time			
People			
Systems			
System Touches			
Inventory			

TAKT Time

- Often referred to as the rate of customer demand.
- It is how often a product needs to be completed to meet customer demand.
- Formula = Effective Working Time / Average Customer Demand (for that time period)

Batch Size

- To keep this explanation lean I'll just write that moving to batch sizes of one generally reduces cycle time and improves throughput.

SMED Singe Minute Exchange of Die

- SMED stands for Single Minute Exchange of Die, and covers the techniques for obtaining a changeover time of less than 10 minutes (a single digit number of minutes).
- Basically, the SMED methodology consists of 6 steps:
  - ◇ observe the current changeover process
  - ◇ identify internal and external activities
  - ◇ convert activities from internal to external setup
  - ◇ increase efficiency of the remaining internal activities
  - ◇ optimize the Startup time
  - ◇ increase efficiency of external activities

Theory of Constraints

- The underlying assumption of Theory of Constraints is that organizations can be measured and controlled by variations on three measures: Throughput, Operating Expense, and Inventory.

- Throughput is money (or goal units) generated through sales. Operating Expense is money that goes into the system to ensure its operation on an ongoing basis. Inventory is money the system invests in order to sell its goods and services.
- Theory of Constraints is based on the premise that the rate of goal achievement is limited by at least one constraining process. Only by increasing flow through the constraint can overall throughput be increased. Assuming the goal of the organization has been articulated (e.g.,"Make money now and in the future") the steps are:

  1. IDENTIFY the constraint (the resource/policy that prevents the organization from obtaining more of the goal)
  2. Decide how to EXPLOIT the constraint (make sure the constraint's time is not wasted doing things that it should not do)
  3. SUBORDINATE all other processes to above decision (align the whole system/organization to support the decision made above)
  4. ELEVATE the constraint (if required/possible, permanently increase capacity of the constraint; "buy more")
  5. If, as a result of these steps, the constraint has moved, return to Step 1. Don't let inertia become the constraint.

TPM Total Productive Maintenance

- TPM is a program for planning and achieving minimal machine downtime
- Equipment and tools are literally put on "proactive" maintenance schedules to keep them running efficiently and with greatly reduced downtime
- Machine operators take far greater responsibility for their machine upkeep
- Maintenance technicians are liberated from mundane, routine maintenance, enabling them to focus on urgent repairs and proactive maintenance activities
- A solid TPM program allows you to plan your downtime and keep breakdowns to a minimum
- Without a strong TPM program, becoming truly Lean would be difficult or impossible in an environment heavily dependent on machinery
- Buy-in at the shop floor level is generally quite high as TPM is an exciting undertaking
- A robust TPM system consists of:

  ◇ Autonomous Maintenance
  ◇ Focused Improvement
  ◇ Education and Training
  ◇ Planned Maintenance
  ◇ Quality Maintenance
  ◇ Early Management and Initial Flow Control
  ◇ Safety, Hygiene and Pollution Control
  ◇ Administrative and Office TPM

- The metric used in Total Productive Maintenance environments is called **OEE** or **Overall Equipment Effectiveness**
    - ◇ OOE is measured as a percentage
    - ◇ OOE = Availability * Performance * Quality
        - Availability = % of scheduled production equipment is available for production
        - Performance = % number of parts produced out of best known production rate
        - Quality = % of good sellable parts out of total parts produced

SAMPLING

Sample Size Calculator

- To determine how large a sample you need to come to a conclusion about a population at a given confidence level.
- Formula for creating a sample size to test a proportion:
    - ◇ $n_o = \{Z^2\, pq\}/\{e^2\}$
        - n_o = required sample size
        - Z = value from the Z table (found on-line or in stats books) for confidence level desired
        - p = estimated proportion of population that has the attribute we are testing for
        - q = 1-p
        - e = precision {ie: if we want our proportion to be known within 10% then set 'e' at .05 and if we set the confidence interval at 95% and the sample gives a proportion of 43%, the true value at 95% confidence is between 38% and 48%}
- Formula for creating a sample size to test a mean:

        - no = required sample size
        - Z = value from the Z table (found on-line or in stats books) for confidence level desired
        - σ = variance of the attribute in the population
        - e = precision in the same unit of measure as the variance

Single lot Sampling

- Single lot sampling is when your sample comes from a single lot. It is often used in manufacturing when output from a single lot is sampled for testing.
- This may be used as a **Lot Acceptance Sampling Plan (LASP)** to determine whether or not to accept the lot:

◇ Single sampling plans: One sample of items is selected at random from a lot and the disposition of the lot is determined from the resulting information. These plans are usually denoted as (n,c) plans for a sample size n, where the lot is rejected if there are more than c defectives. These are the most common (and easiest) plans to use although not the most efficient in terms `of average number of samples needed.

Dual lot Sampling

- Dual lot sampling is when your sample comes from 2 different but similar lots. It is often used as part of an MSA or as part of hypothesis testing to determine if there are differences in the lots.

Continuous Sampling

- Continuous sampling is used for the inspection of products that are not in batches. The inspection is done on the production line itself, and each inspected item is tagged conforming or non-conforming. This procedure can also be employed to a sequence of batches, rather than to a sequence of items (known as Skip Lot Sampling).

Stratified Sampling

- Stratified Sampling is when the population is dived into non-overlapping subgroups or strata and a random sample is taken from each subgroup. It is often used in hypothesis testing to determine differences in subgroups.

Random Sampling

- Random sampling is a sampling technique where we select a group of subjects (a sample) for study from a larger group (a population). Each individual is chosen entirely by chance and each member of the population has a known, but possibly non-equal, chance of being included in the sample.

MSA

MSA Measurement System Analysis

- A Measurement System Analysis, abbreviated MSA, is a specially designed experimentthat seeks to identify the components of variation in the measurement.
- Since analysis of data is key to lean six sigma ensuring your data is accurate is critical. That's what MSA does – it tests the measurements used to collect your data.
- Common tools and techniques of Measurement Systems Analysis include: calibration studies, fixed effect ANOVA, components of variance, Attribute Gage Study, Gage R&R, ANOVA Gage R&R, Destructive Testing Analysis and others. The tool selected is usually determined by characteristics of the measurement system itself.

    ◇ Gage R & R
        - ANOVA Gauge R&R measures the amount of variability induced in measurements that comes from the measurement

system itself and compares it to the total variability observed to determine the viability of the measurement system.

- There are two important aspects on a Gauge R&R:

  ◊ **Repeatability**, Repeatability is the variation in measurements taken by a single person or instrument on the same item and under the same conditions.

  ◊ **Reproducibility**, the variability induced by the operators. It is the variation induced when different operators (or different laboratories) measure the same part.

- Formulas (this is best done using a tool such as Minitab or JMP):

  ◊ $y_{ijk} = \mu + \alpha_i + \beta_j + \alpha\beta_{ij} + \varepsilon_{ijk}$

    ◊ Y_{ijk} = observation k with part i & operator j
    ◊ μ = population mean
    ◊ α_i = adjustment for part i
    ◊ β_j = adjustment for operator j
    ◊ $\alpha\beta_{ij}$ = adjustment for part i operator j interaction
    ◊ ε_{ijk} = observation random 'error'

  ◊ $\sigma^2_y = \sigma^2_i + \sigma^2_j + \sigma^2_{ij} + \sigma^2_{error}$

    ◊ σ^2_y = Variance of observation y
    ◊ σ^2_i = Variance due to part i
    ◊ σ^2_j = Variance due to operator j
    ◊ σ^2_{ij} = Variance due to part I operator j interaction
    ◊ σ^2_{error} = Variance of that observation due to random 'error'

- These formulas are used in the ANOVA Gage R &R to determine repeatability & reproducibility.

Kappa MSA

- MSA analysis for discrete or attribute data.

  ◊ Kappa (K) is defined as the proportion of agreement between raters after agreement by chance has been removed.

  ◊ $K = \{P_{observed} - P_{chance}\}/\{1 - P_{chance}\}$

    - $P_{observed}$ = proportion of units classified in which the raters agreed
    - P_{chance} = proportion of units for which one would expect agreement bychance

  ◊ Generally a K < .7 indicates measurement system needs improvement
  ◊ K > .9 are considered excellent

DATA ANALYSIS

Statistics Error Types

- Type 1, Alpha or α errors
  - Type I error, also known as an "error of the first kind", an α error, or a "falsepositive": the error of rejecting a null hypothesis when it is actually true. Plainly speaking, it occurs when we are observing a difference when in truth there is none. An example of this would be if a test shows that a woman is pregnant when in reality she is not. Type I error can be viewed as the error of excessive credulity.
- Type 2, Beta or β errors
  - Type II error, also known as an "error of the second kind", a β error, or a "false negative": the error of failing to reject a null hypothesis when it is in fact not true. In other words, this is the error of failing to observe a difference when in truth there is one. An example of this would be if a test shows that a woman is not pregnant when in reality she is. Type II error can be viewed as the error of excessive skepticism.

Hypothesis Testing

- When to use what test: (The Six Sigma Memory Jogger II p 144)
  - If comparing a group to a specific value use a 1-sample t-test (The Lean Six Sigma Pocket Toolbook p 162)
    - ◇ Tells us if a statistical parameter (average, standard deviation, etc.) is different from a value of interest.
    - ◇ Hypothesis takes the form Ho: μ = a target or known value
    - ◇ This is best calculated using a template or software package. If needed the formula can be found in the reference.
  - If comparing 2 independent group averages use a 2-sample t-test (The Lean Six Sigma Pocket Toolbook p 163)
    - ◇ Used to determine if the means of 2 samples are the same.
    - ◇ Hypothesis takes the form Ho: $\mu 1 = \mu 2$
  - If comparing 2 group averages with matched data use **Paired t-test**
    - ◇ The number of points in each data set must be the same, and they must be organized in pairs, in which there is a definite relationship between each pair of data points
    - ◇ If the data were taken as random samples, you must use the independent test even if the number of data points in each set is the same
    - ◇ Even if data are related in pairs, sometimes the paired t is still inappropriate
    - ◇ Here's a simple rule to determine if the paired t must not be used - if a given data point in group one could be paired with any data point in group two, you cannot use a paired t test

- If comparing multiple groups use ANOVA (The Lean Six Sigma Pocket Toolbook p 173)
  - ◇ Hypothesis takes the form Ho: μ1 = μ2 = μ3 = …

The smaller the p-value the more likely the groups are different.

Pearson Correlation Co-efficient

- In statistics, the Pearson product-moment correlation coefficient (sometimes referred to as the PMCC, and typically denoted by r) is a measure of the correlation (linear dependence) between two variables X and Y, giving a value between +1 and −1 inclusive. It is widely used in the sciences as a measure of the strength of linear dependence between two variables.
  - ◇ Remember Pearson measures correlation not causation.

- A value of 1 implies that a linear equation describes the relationship between X and Y perfectly, with all data points lying on a line for which Y increases as X increases. A value of −1 implies that all data points lie on a line for which Y decreases as X increases. A value of 0 implies that there is no linear relationship between the variables.

- The statistic is defined as the sum of the products of the standard scores of the two measures divided by the degrees of freedom Based on a sample of paired data (Xi, Yi), the sample Pearson correlation coefficient can be calculated as:
  - ◇ $r = \{1/(n-1)\}\Sigma\ [(X_i - X(avg))/(S_x)][(Y_i-Y(avg))/(S_y)]$
  - ◇ where
    - n = sample size
    - X_i = the value of observation I in the X plane
    - X(avg) = the average X value
    - S_x = the standard deviation of X
    - Y_i = the value of observation i in the Y plane
    - Y(avg) = the average Y value
    - S_y = the standard deviation of Y

Central Limit Theorem

- In probability theory, the central limit theorem (CLT) states conditions under which the sum of a sufficiently large number of independent random variables, each with finite mean and variance, will be approximately normally distributed.
  - Let X1, X2, X3, ..., Xn be a sequence of n independent and identically distributed(i.i.d) random variables each having finite values of expectation μ and variance $\sigma^2 > 0$.

- The central limit theorem states that as the sample size n increases, the-distribution of the sample average of these random variables approaches the normal distribution with a mean μ and variance σ^2 / n irrespective of the shape of the original distribution.

- By using the central limit theorem we can apply tools that require a normal distribution even when the distribution of the population is non-normal. However, be careful when interpretingresults if you use the CLT to analyze averages rather than samples from the direct population. Remember your analysis is based on averages which can be dangerous. In many cases it's safer to find a tool that doesn't require normally distributed data when analyzing non-normal data.

- • Applying CLT to data analysis:
    - ◇ Take 10 data points from the distribution & average them. Then take 29 other samples of 10 data points averaged. Then use these 30 data averaged data points to do your analysis. This converts your data from its original distribution to a normal distribution.
    - ◇ As long as n (sample size) is large enough, the sampling distribution will be normal and the mean will be representative of the population mean μ.
    - ◇ **No matter what the parent looks like the child will look reasonably normal by 30!**
    - ◇ **Formulas:**
        - Sampling distribution for the mean has SD = $\sigma / \sqrt{n}$
        - For variables data, applying the 95% rule we expect μ to lie in the interval:
            - 95% Confidence Interval for the Population Mean =
            - Sample size: h (maximum error allowed) =
            - Attribute data:
                - 95% Confidence Interval for the Population Proportion =
                - Sample size: ( )

FMEA Failure Mode and Effects Analysis

- This tool helps determine where to focus improvement efforts by analyzing severity offailures, probability of occurrence of an error, and likelihood of detection of an error.

- An RPN (Risk Priority Number) is computed by multiplying these factors together.Processes/Steps with the highest RPN should be addressed first.

PROCESS CONTROL

Attribute vs. Variable Data

- Different Tools are best able to handle different types of date (for example control charts).

- For six sigma data analysis Discrete or Attribute data is considered the same thing. Discrete data is any data not quantified on an infinitely divisible numerical scale. Discrete data has boundaries and includes any number that must be an integer. Discrete examples include day of the week; hour of the day; age in years; counts; income; an non-numeric translated to a numeric value (i.e.: good/bad, on-time/not on-time, pass/fail, primary colors, eye color, grade, method).

- Variable or Continuous data is any data on a continuous scale. Examples include length,diameter, temperature, weight, time.

Control Charts

- A Control Chart is simply a run chart with statistically based limits.

- Within the subject of control charts Voice of the Customer (VOC) is the customer requiredspecifications or the Upper Spec Limit (USL) and Lower Spec Limit (LSL).

- The Voice of the Process is the Upper Control Limit (UCL), and Lower Control Limit (LCL). It is 3 standard deviations from the process mean and is what the process will deliver (99.7% of the time).

- When to use what chart:

  ◇ Variable Individual data: use **XmR** or **I** or **mR** (use moving range to measure control)

    - **XmR** or **I**

      ◇ Called XmR since we use the Moving Range relative to X

      ◇ Also called I since it is based on Individual data

      ◇ This chart will work for virtually any situation

      ◇ K = # of subgroups

      ◇ Avg(X) = $\Sigma X/k$

      ◇ Rm = | (Xi+1 – Xi) |

      ◇ Avg (Rm) = $\Sigma R/(k-1)$

      ◇ E2 is based on sample size & is in a table in the reference

      ◇ UCL = avg(X) +E2 * Avg (Rm)

      ◇ LCL = avg(X) +E2 * Avg (Rm)

- **mR**
  - ◇ K = # of subgroups
  - ◇ Avg(X) = ΣX/k
  - ◇ Rm = | (Xi+1 − Xi) |
  - ◇ Avg (Rm) = ΣR/(k-1)
  - ◇ D3 & D4 are based on sample size & is in a table in the reference
  - ◇ UCL = D4 * Avg (Rm)
  - ◇ LCL = D3 * Avg (Rm)
- ◇ Variable data of group sizes 2-10: use Xbar & R (use range to measure control)
  - **Xbar**
    - ◇ K = # of subgroups
    - ◇ Avg(X) = Avg of X for subgroup k
    - ◇ Avg(Avg(X)) = ΣAvg(X)/k
    - ◇ Avg (R) = ΣR/k
    - ◇ A2 is based on sample size & is in a table in the reference
    - ◇ UCL = Avg(Avg(X)) + A2 * Avg(R)
    - ◇ LCL = Avg(Avg(X)) − A2 * Avg(R)
  - **R**
    - ◇ K = # of subgroups
    - ◇ Avg (R) = ΣR/k
    - ◇ D4 & D3 are based on sample size & is in a table in the reference
    - ◇ UCL = D4 * Avg (R)
    - ◇ LCL = D3 * Avg (R)
- ◇ Variable data of group sizes 10 or more: use Xbar & S (use standard deviation to measure control)
  - ◇ **Xbar**
    - ◇ K = # of subgroups
    - ◇ Avg(X) = Avg of X for subgroup k
    - ◇ Avg(Avg(X)) = ΣAvg(X)/k
    - ◇ Avg (s) = Σs/k
    - ◇ A3 is based on sample size & is in a table in the reference
    - ◇ UCL = Avg(Avg(X)) + A3 * Avg(s)
    - ◇ LCL = Avg(Avg(X)) − A3 * Avg(s)

- ◇ **S**
    - ◇ K = # of subgroups
    - ◇ Avg (s) = Σs/k
    - ◇ B3 & B4 are based on sample size & is in a table in the refernce
    - ◇ UCL = B4 * Avg(s)
    - ◇ LCL = B3 * Avg(s)
- Note: Defect data is a failure to meet one of the acceptance criteria; Defective data is when an entire unit fails to meet acceptance criteria. A defective unit may have multiple defects.
- Attribute Defect Data Constant sample size: use **C**
    - ◇ **C**
        - ◇ c = number of defects for each subgroup
        - ◇ k = # of subgroups
        - ◇ avg (c) = Σc/k
        - ◇ UCL = avg (c) + 3√avg (c)
        - ◇ LCL = avg (c) - 3√avg (c)
- Attribute Defect Data Variable sample size : use **U**
    - • **U**
        - • u = c/n for each subgroup
        - • avg (u) = Σc/Σn
        - • UCL = avg (u) + 3√(avg (u)/n)
        - • LCL = avg (u) + 3√(avg (u)/n)
- Attribute Defective Data Constant sample size: use **nP** for number defective
    - • **nP**
        - ◇ most reliable when sample size greater than 50
        - ◇ np = # defective units for each subgroup
        - ◇ k = # of subgroups
        - ◇ avg (np) = Σnp/k
        - ◇ UCL = avg (np) + 3√[avg(np) * {1- avg(p)}]
        - ◇ LCL = avg (np) - 3√[avg(np) * {1- avg(p)}]
- ◇ Attribute Defective Data Variable sample size: use **p** for fraction defective
    - • **P**
        - ◇ most reliable when sample size greater than 50
        - ◇ p = np/n = % defective units for each subgroup

- ◇ § avg(p) = Σnp/Σn
- ◇ UCL = avg (p) + 3√([avg(np) * {1- avg(p)}]/n)
- ◇ LCL = avg (p) - 3√([avg(np) * {1- avg(p)}]/n)
- ◇ Process is known to be in control & want to examine small shifts: use **CUSUM** or **EWMA**
  - • **CUSUM (CUmulative SUM chart)**
    - ◇ The Cusum chart can detect process shifts more rapidly than the XmR or XbarR. If a trend develops, it's evidence that the process has shifted.
    - ◇ To compute:
      - • n = number of data points
      - • Avg(x) = ΣX/n
      - • S(i) = Cumulative Sum of the difference between the current value and the average.
      - • The cumulative sum is not the cumulative sum of the values. Instead it is the cumulative sum of differences between the values and the average. Because the average is subtracted from each value, the cumulative sum also ends at zero.
      - • If S(i) is positive or negative for more than a few points in a row it is an indication there may be a change in the process.
  - • **EWMA (Exponentially Weighted Moving Average)**
    - ◇ The Exponentially Weighted Moving Average (EWMA) is a statistic for monitoring the process that averages the data in a way that gives less and less weight to data as they are further removed in time.
    - ◇ $EWMA_t = \lambda Y_t + (1-\lambda) EWMA_{t-1}$ for t = 1, 2, ..., n.
      - • $EWMA_0$ is the mean of historical data (target)
      - • Y_t is the observation at time t
      - • n is the number of observations to be monitored including $EWMA_0$
      - • $0 < \lambda < 1$ is a constant that determines the depth of memory of the EWMA.
      - • The parameter λ determines the rate at which 'older' data enter into the calculation of the EWMA statistic. A value of $\lambda = 1$ implies that only the most recent measurement influences the EWMA (degrades to Shewhart chart). Thus, a large value of $\lambda = 1$ gives more weight to recent data and less weight to older data; a small value of λ gives more weight to older data. The value of is usually set between 0.2 and 0.3 (Hunter) although this choice is somewhat arbitrary.

- s^2 ewma = $(\lambda/(2-))s^2$
- The center line for the control chart is the target value or $EWMA_0$. The control limits are:
  - ◇ UCL = $EWMA_0 + ks_{ewma}$
- • LCL = $EWMA_0 - ks_{ewma}$
- where the factor k is either set equal 3 or chosen using the Lucas and Saccucci (1990) tables. The data are assumed to be independent and these tables also assume a normal population.

- Out of Control Conditions:
  - ◇ If 1 or more points falls outside of the UCL (Upper Control Limit) or LCL (Lower Control Limit). (i.e.: any point more than 3 standard deviation from the mean).
  - ◇ If 2 of 3 successive points fall beyond 2 standard deviations from the mean.
  - ◇ If 4 of 5 successive points fall beyond 1 standard deviations from the mean.
  - ◇ If there is a run of 6 or more points that are either successively higher or successively lower.
  - ◇ If 8 or more successive points fall on either side of the mean.
  - ◇ If 15 points in a row fall within 1 standard deviation from the mean.(Examine to determine if the process has become better controlled).

VOC Voice Of the Customer

- Every lean Six Sigma project needs to understand the Voice of the Customer. You can not truly exit define phase without an understanding of what's important to the customer.
- In Lean only process that add value to the customer are value-add processes. You need to understand the customer (i.e.: what would the end-customer pay for) to understand if a step is technically a value-added step in a Lean analysis.
- In control charts the VOC is translated to Upper Spec Limit (USL) & Lower Spec Limit (LSL) (see control charts above).

Control Limits

- See control charts above. Control Limits are the 'voice of the process' and based on the
- standard deviation and variability of the process.

Process Capability (The Black Belt Memory Jogger p 95)

- Measures the capability of a process to meet customer specifications.
- The higher the Cp, Cpk, Pp, or Ppk, the better, the less variance there is in the process.

- Short-Term Capability indices:
  - ◇ Used if long-term data is not available or if process has changed recently.
  - ◇ Uses short term process variation to determine process capability
  - ◇ C_p tells you if the process is capable: If $C_p > 1$ then the process is capable (the process spread fits within tolerance). While C_{pk} also tells you if the process is centered; if $C_{pk} < 1$ while $C_p > 1$ then the process is not centered and should first be centered.
  - ◇ C_p
    - The ratio of customer-specified tolerance to 6 standard deviations of the short-term process variation.
    - Gives an indication of what the process could perform to if the mean of the data was centred between the specification limits.
    - Sometimes referred to as process potential
    - Formula: C_p = USL - LSL / $6s_{MR}$
  - ◇ Cpk
    - The ratio of the distance between the process average and the closest specification limit to 3 standard deviations of short term process variation.
    - More realistic measure of process than C_p because it uses data mean.
    - Formula: Cpk = min{USL- x/$3s_{MR}$, x- LSL/$3s_{MR}$}
- Long Term Capability indices:
  - ◇ Used if long-term data available & representative of the current process.
  - ◇ Uses long-term process standard variation
  - ◇ Pp
    - The ratio of customer-specified tolerance to 6 standard deviations of the long-term process variation.
    - Gives an indication of what the process could perform to if the mean of the data was centred between the specification limits.
    - Sometimes referred to as process potential
    - Formula: Pp = USL - LSL / 6s
  - ◇ Ppk
    - The ratio of the distance between the process average and the closest specification limit to 3 standard deviations of long term process variation.
    - More realistic measure of process than Pp because it uses data mean.
    - Formula: Ppk = min { USL - x /3s, x - LSL/3s }

Process Capability (The Black Belt Memory Jogger p 95)

- The control plan is the plan used to control the process. Within six sigma it is used in the control phase & after project closure to ensure project improvements are sustained.

- There a various control plan templates, but what needs to be captured is what is being measured; how it is used, what sampling method is used, who owns the control chart, where it is located, and what conditions constitute loss of control or improvement that require corrective action.

- Usually C_p, C_{pk}, P_p, and P_{pk} (see process capability above) are measured as part of the control plan, and often process control charts (see control charts above) are the key control chart used.

ABOUT GREYCAMPUS

GreyCampus is a leading provider of on-demand training that address the unique learning needs of professionals, delivered as online self-learning, live online training or in-person classroom training. Our aim is to provide quality training enabling professionals to achieve their certification and career enhancement goals. We offer training for certifications in areas of *Big Data & Hadoop, Project Management, IT Service Management, Quality Management, Python Programming, Agile Training Coaching & Certification and Workplace Tools.*

TRAINED OVER 30,000 PROFESSIONALS

REACH ACROSS 50+ COUNTRIES

EXAM PASS RATE OF OVER 97 %

COURSES ACCREDITED BY LEADING GLOBAL BODIES

ACCREDITATIONS & ASSOCIATIONS

Project Management Institute
Registered Education Provider
Provider ID : 3871

ITIL® TRAINING ORGANIZATION
ACCREDITED BY PEOPLECERT

AXELOS CERTIFIED PARTNER

PRINCE2® TRAINING ORGANIZATION
ACCREDITED BY PEOPLECERT

IASSC Accredited

DISCLAIMER