Unit 5

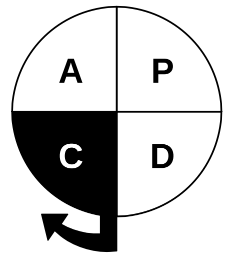
Steps 4 & 5

Table of Contents

Step 4: Improve (Continued)

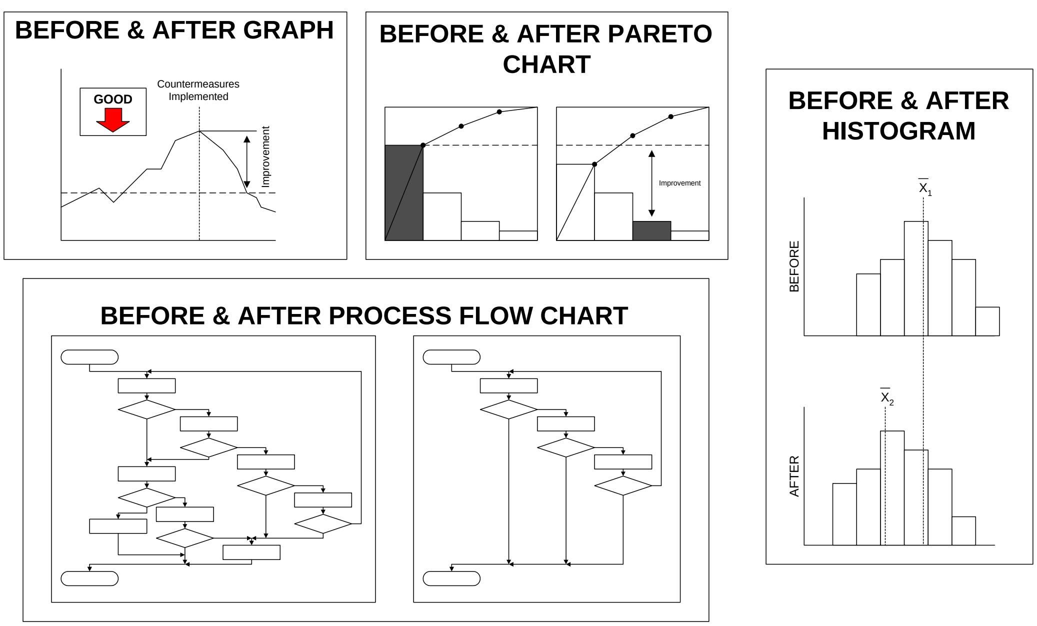
Objective:

Confirm that the Improvements taken have impacted the root causes and problem; and that the target has been met.



Description:

Demonstrate the effects that selected countermeasures had on the stakeholders' need. An effective way to demonstrate the **effects** is through a series of **before** and **after** indicators. First, a comparison is made to the indicator and target, in STEP 1, that represent **Define**. Next, in the series are comparisons to the **stratified data** in STEP 2 and 3. Causes of significant **variation** from the target should be understood and addressed.



17 ✓

A similar (and comparable) "before" and "after" time period was chosen to display results.

Care should be taken to select comparable data sets from time periods "before" the countermeasures were implemented and "after" the countermeasures were fully implemented. Without similar opportunities for experiencing the problem (or absence of problem), bias could be introduced into results, which could confuse the effect the countermeasures actually have had on the root causes and problem.

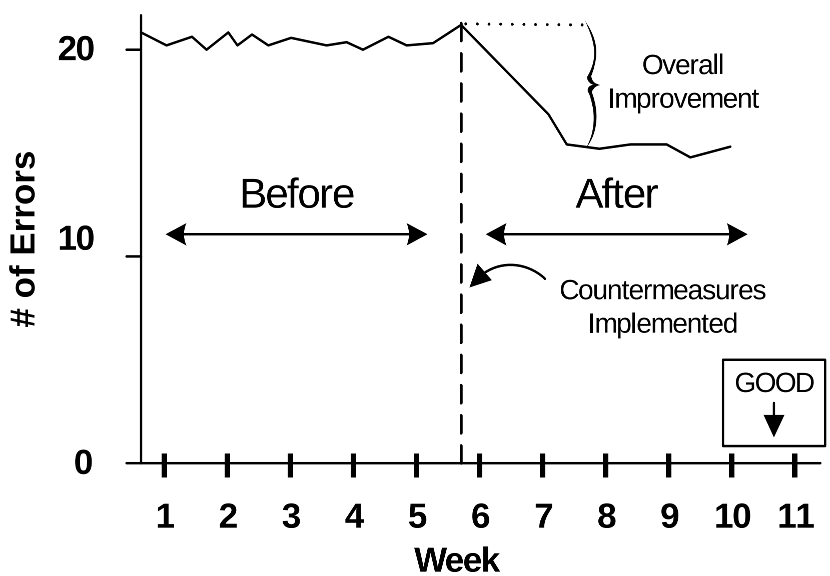
18 ✓

The effect of countermeasures on the line graph outcome indicator in Step 1 was demonstrated.

In STEP 1, an indicator was used to represent the stakeholder's need. The team should now show the effect of their countermeasures on that need.

Example:

Number of Report Errors Found Per Week (As Identified in Step 1)



- This procedure "closes the loop" on the team's improvement efforts and demonstrates its contribution to the stakeholder's need.

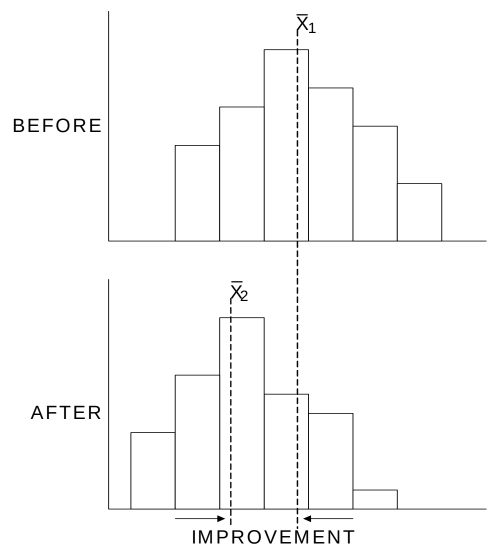
- If there is a significant difference between the target and the achievement, the team should understand and explain why those effects have occurred.

Checkpoints:

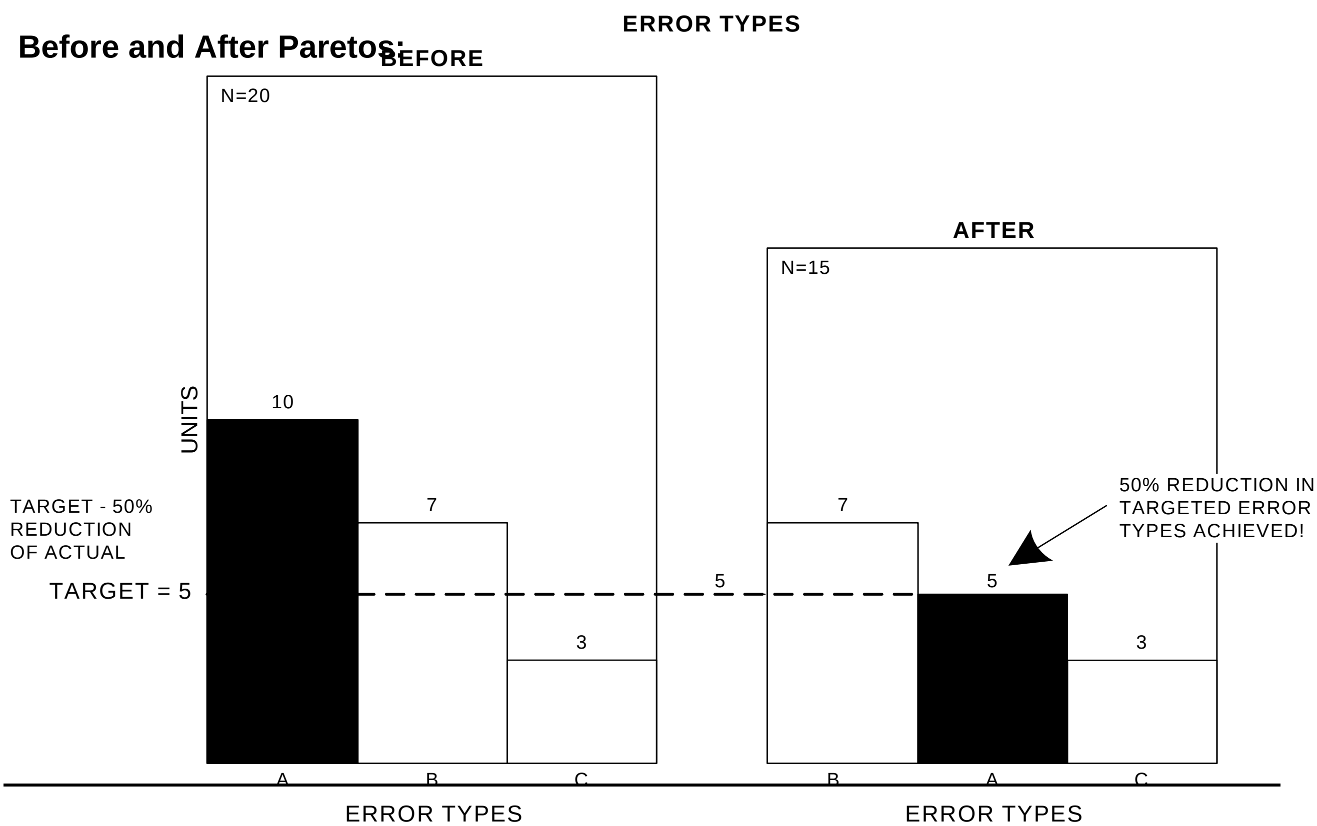
19 ✓ The effect of countermeasures on the root causes was demonstrated.

Appropriate use of statistical tools is an effective way to show the impact of countermeasures on stratified data (linked to root causes) identified in STEP 2. This type of **before** and **after** comparison using statistical tools leaves little doubt as to the effectiveness of the countermeasures and resources expended. If root causes have been reduced for reasons other than the countermeasures, this should be explained.

Before & After Histograms



Before and After Paretos:



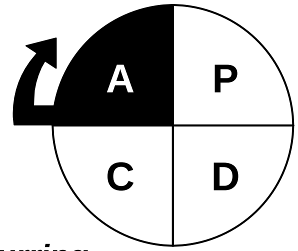
20 ✓ **The improvement target was achieved and causes of significant variation were addressed.**

Recommended Tools and Techniques:

Tools commonly used include:

- Checksheet
- Control Chart
- Histogram
- Pareto Chart
- Graphs
  - Bar Graph
  - Line Graph
  - Pie Chart

Step 5: Control



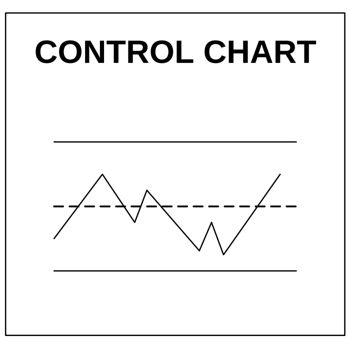
Objective:

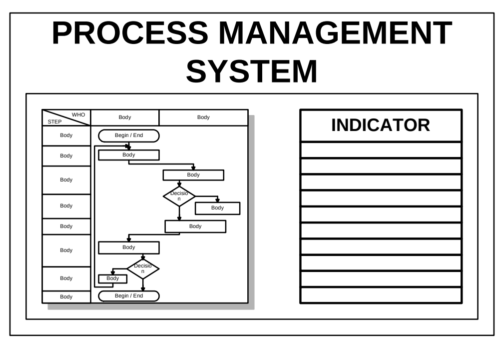
Prevent the problem and its root causes from recurring. Maintain and share the gains.

Description:

In STEP 5, the successful countermeasures should be **documented and integrated** into the appropriate process, procedure or standard. Those changes must be **communicated** and the necessary **education** and **training** must occur. In addition, a system of **responsibility** should be established to ensure that the revised process or procedure is observed. If the above steps are not taken, the countermeasures taken may not take hold and employees may revert back to the old methods resulting in the problem returning. Without a documented revised process or new standards, the problem can also return when new people become involved in the work. By considering these specific areas for **standardization**, the organization can leverage scarce resources and minimize duplication of effort.

Typical Tools:





Checkpoints:

21 ✓ **A method was established to document, permanently change, and communicate the revised process or standard.**

When revising the process or standard, the five "W's" and one "H" should be answered and communicated (what, when, where, who, why and how). The method of executing the job can be well understood without the "why", but the "why" is vital to the person doing the job. Without the "why", the revised process may never be followed, or later improved. In addition, training and education is necessary to make the revisions take hold and become part of the daily routine.

22 ✓ **Responsibility was assigned and periodic checks scheduled to ensure compliance with the revised process or standard.**

As with anything that is important in business, someone must be accountable and responsible for compliance. Regular reviews or monitoring must occur for consistent results.

23 ✓ **Specific areas for replication were identified.**

The team members are responsible for identifying potential standardization areas for management to consider. Replication, which is the imitation of the standard in other areas to prevent root causes, is a resource leveraging process that can multiply the benefits of the **DMAIC Story** process. Replication of countermeasures in other areas can prevent duplication of efforts across areas and minimize costs overall. **Management** must promote replication; it won't happen automatically.

Recommended Tools and Techniques:

Tools commonly used with STEP 5 may include:

- Control Chart
- Graphs
  - Bar Graph
  - Line Graph
  - Pie Chart

Techniques that may be helpful include:

- Action Plan
- Process Flow Chart

Future Plans

Objective:

Evaluate the team's effectiveness and plan future activities.

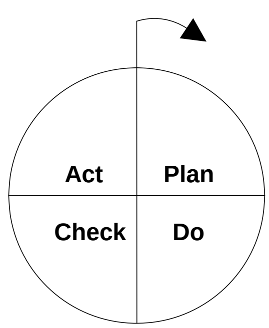
Description:

Once the **DMAIC Story** is completed, an assessment must be made as to how thoroughly the **theme indicator** has been improved and whether or not it would be effective to continue working on the theme through another **DMAIC Story**. In addition to assessing additional work on the theme, some time should be spent discussing and documenting the **lessons** the team members learned and the team members' collective personal **growth**. Finally, specific **plans for continuous improvement**, or **P-D-C-A**, should be made.

Checkpoints:

24 ✓ **Any remaining issues connected to the problem were addressed.**

Determine, by using the (AFTER) Pareto Chart of the problem, the recent improvement of the theme indicator, or a cost-benefit analysis, whether it is desirable to further address the theme through additional **DMAIC Story**® applications.



25 ✓ **Lessons learned, P-D-C-A of the DMAIC Story process, and team growth were assessed and documented.**

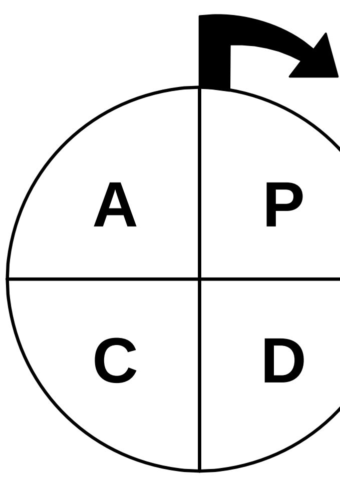
Some reflective thoughts should be given to the team's actual problem solving activities. Consider what went well and what could be done differently next time. This should aid in the solving of future problems (P-D-C-A). The team may wish to document and display team growth.

Recommended Tools and Techniques:

- Pareto Chart
- Histogram
- Bar Graph
- Pie Graph

Techniques that may be helpful include:

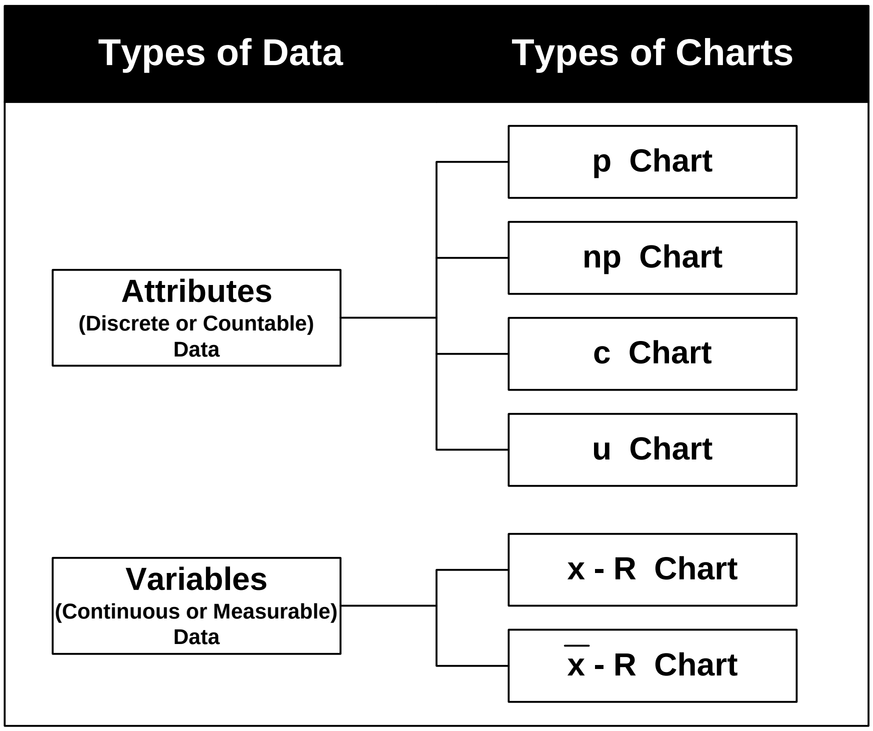
- Action Plan
- Process Flow Chart
- Radar Chart (or Spider Diagram)



Continuous performance improvement comes with each "turn of the wheel." Each turn begins at a higher performance level than the previous turn.

Control Charts (Tool)

Control Charts can be classified into main applications groups depending on the type of data being measured for the indicator or process output. The table below summarizes the types of data and applicable Control Charts that will be discussed on the following pages.



Tip

Here is a simple rule of thumb to help you distinguish between the two types of data:

- *Attributes Data is **countable** and always whole numbers (for example, number of defects, on or off, yes or no, etc.).*
- *Variables Data is **measurable** and can be fractional values (for example, temperature, thickness, time, dollars, weight, etc.).*

Attributes Data Control Charts

There are four types of attributes data control charts:

- **p Chart:** This is a one-part control chart used to chart a process that generates attribute data. It is applicable to problems that deal with the **percentage or proportion** not conforming to specifications from a sample or population of varying size.
  Example: Percentage of invoices reworked per month, or the percentage of services delivered late to customers.

- **np Chart:** This is a special type of **p chart** where the **number** instead of percentage of non-conformances is tracked from a fixed sample size at each observation point.
  Example: Number of errors found in an inspection for food stamp eligibility with equal sample size at each inspection.

- **c Chart:** This chart counts the number of defects (non-conformances) in each sample with a constant sample size.
  Example: Number of omissions found on the District offices' weekly situation reports (with the number of District offices remaining constant).

- **u Chart:** This chart counts the number of defects (non-conformances) per unit with a varying sample size.
  Example: Number of omissions found per new account application (as found from a sample of 10% of all applications received each week).

Variables Data Control Charts

There are two types of variables data control charts:

- **x-R Chart**: This chart is a two-part control chart and the number of items observed at each subgroup is equal to 1. In other words, the x-R Chart tracks how each process data point varies from another.

  The x chart tracks the actual measured data point for the process. The R (or Range) Chart tracks the difference between the current data point and the previous data point. Because of this, the R Chart cannot display a data point until the second measured x is known.

  <u>Example</u>: The total overtime hours reported per month for a department.

- **$\bar{x}$-R (X-bar R) Chart:** This is a two-part control chart used to monitor processes with variables data. The number of items observed at each subgroup should be at least two or at most ten.

  $$2 \leq n \leq 10$$

  (n = number of items)

  The $\bar{x}$ chart tracks how the process average varies from one point to another. In the example, this will be how the average drive time varies from week to week. The R (or Range) chart tracks the variation that occurs within each subgroup (the time difference between the longest and shortest drive time per subgroup n).

  <u>Example</u>: Average time it takes to drive to work daily, where the $\bar{x}$ is computed and displayed weekly. Consider a workweek of five days as a subgroup.

Why Are Control Charts Useful?

Control Charts are helpful tools to monitor the performance of an ongoing process in determining whether or not the process output is in control.

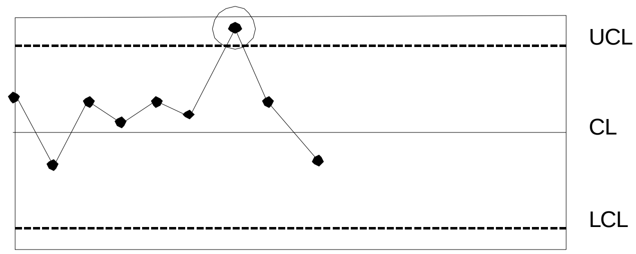
How To Create A Control Chart

1. **Collect** data.
2. **Calculate** the average, or mean.
3. **Calculate** the range, when appropriate.
4. **Draw** a "mean" or "central" line (CL) that represents the statistically calculated average value of the process.
5. **Draw** the horizontal and vertical axes and enter an appropriate scale.
6. **Draw** an upper control limit (UCL) at a calculated distance above the central line representing the maximum variation that could be expected if only normal/common causes of variation are present. (Note: Actual formula calculations are not included. Formulas can be found in any Process Management Manual.)
7. **Draw** a lower control limit (LCL) at a calculated distance below the central line representing the minimum variation that could be expected if only normal/common causes of variation are present. (Note: Actual formula calculations are not included. Formulas can be found in any Process Management Manual.)
8. **Enter** data by drawing a point at the measured position over the proper scaled data group in the exact sequence as it was gathered, otherwise it is meaningless.
9. **Draw** lines connecting the points.
10. **Analyze** data looking for non-random trends.

How To Interpret Control Charts

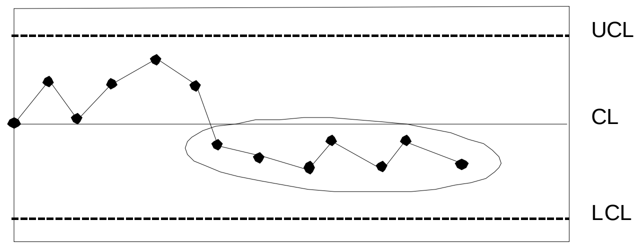
1. **Point Outside Of Limit:**

   Control limits are calculated to measure the natural variability of a process. Any point on or outside the limit is considered abnormal, or special, and requires investigation.



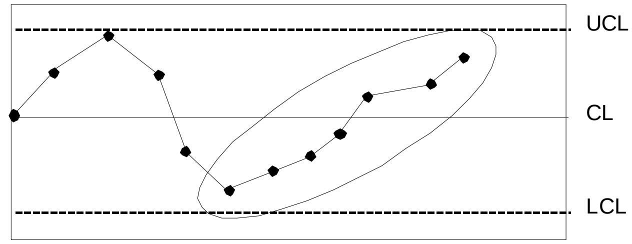
2. **Run:**

   A "run" of seven points on one side of the centerline is considered abnormal. Also considered abnormal; 10 out of 11, 12 out of 14, 16 out of 20 points on one side of the centerline. Each of these situations requires investigation.



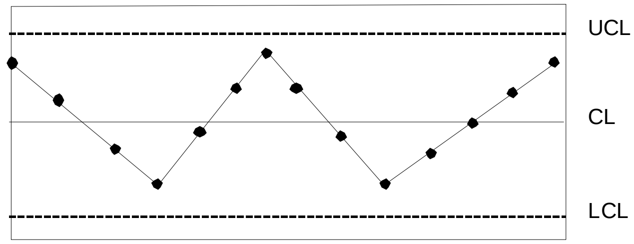
3. **Trending:**

   Seven points in a continuous upward or downward direction requires investigation.



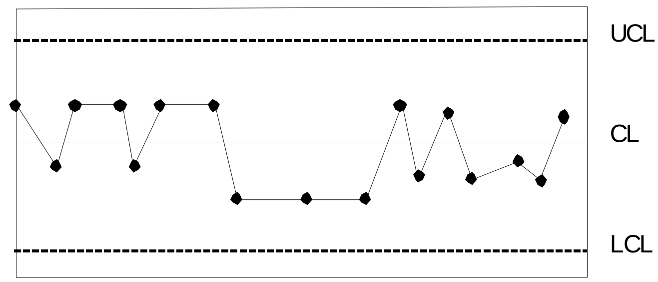
4. **Cycling (Periodicity):**

   Any repeated up and down trend is abnormal and requires investigation.



5. **Hugging (Approaching The Center Line)**:

When most points lie close to the centerline an uncontrolled state is indicated. This usually means there is a mixing of data from different populations. This makes the control limits too wide and stratification of data is usually necessary.



Tip

Specification limits *may be established (not calculated with historical data as are Control Limits) that reflect customer or product requirements. If the upper and lower specification limits are within the boundaries of the upper and lower control limits, the process is not capable of meeting the requirements. The process must be improved to meet the requirements.*