TOOL 15

Control chart

Overview

Improvement takes place over time, and you must observe patterns in your data over time to determine if your initiative has actually achieved long-term improvement. Run charts and control charts can help us do this.

Control charts, also known as Shewhart charts or statistical process control charts, are used to determine if a process is stable (in a state of statistical control). A process is considered stable when there is a random distribution of the plotted points within established limits.

We can use control charts to:

- learn how much variation exists in a process.
- assess stability and determine improvement strategy (common cause or special cause strategy).
- monitor performance and correct as needed.
- find and evaluate causes of variation.
- tell if our changes yielded improvements.
- see if improvements are 'sticking'.

Control charts are more sensitive than run charts. They allow us to predict process behaviour, future performance, and process capability more accurately than run charts. Like a run chart, a control chart is used to display data over time (or sequential order), with time on the horizontal axis and the measured value of the process characteristic on the vertical axis.

However, there are two key differences:

1. Data is plotted against a mean central line (instead of a median).
2. Control charts have control limits. The upper control limit (UCL) and lower control limit (LCL) are derived from statistical analysis of the process data. These are based on the level of variation that is tolerated within the system you are monitoring.

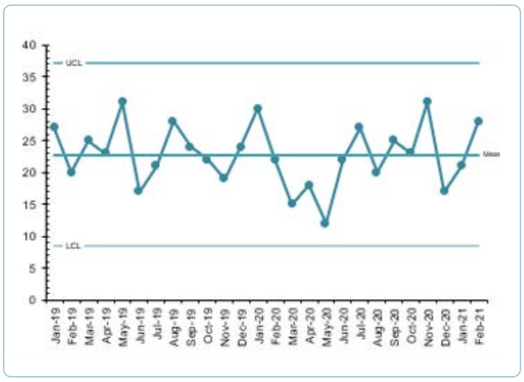


Figure 1: Example of a Control Chart

Making a control chart

1. Begin plotting your data on a run chart.
2. When enough data becomes available (minimum 30 data points), a centre line (mean) and upper and lower limits can be calculated.
3. The type of data you are collecting will determine which type of control chart is most appropriate.

There are many different types of control charts, and you are encouraged to seek training/advice to create the right chart. There are also many different types of software readily available that can complete the calculations required to display the charts visually.

When should I use a control chart?

- **Statistical analysis:** control charts are based on statistical principles and should be used when a more rigorous analysis of process performance is required than a run chart can provide.
- **Process variability:** if your goal is to improve or monitor the stability of a process and detect deviations from expected performance a control chart should be used.
- **Control:** control charts provide statistical control limits that help in distinguishing between common cause and special cause variations.
- **Large data sets:** if you have over 30 data points, then you should use a control chart instead of a run chart.

Responding to variation

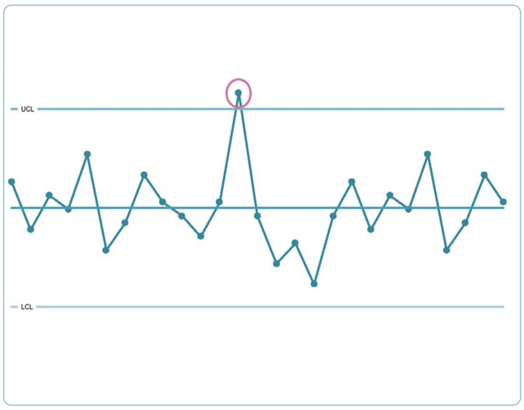
The improvement approach differs depending on whether you have found a common or special cause in the system.

Common Causes: causes that are inherent in the system (process or product) over time, affect everyone working in the system and all outcomes of the system. For common cause, the process is performing as well as possible and requires process redesign to improve. The improvement approach will involve identifying aspects to change, testing, and implementing these through Plan-Do-Study-Act (PDSA) cycles.

Special Causes: causes that are not part of the system (process or product) all the time or do not affect everyone but arise because of specific circumstances (such as unusual events, process instability or changes made in improvement efforts). Special causes mean that something that is not part of the process design is affecting the process. There are five rules for identifying special cause variation in control charts (see next page).

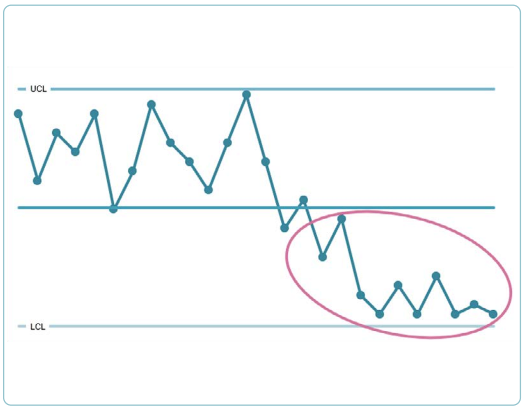
The improvement approach is to identify when the special cause occurred and why (frontline staff are the experts here), learn, and act. If the special cause is undesirable, we should remove it and make it difficult to recur. Where the special cause is desirable, we should try and make it a permanent part of the process. This may require tests of change using PDSA cycles in different parts of the system.

Rules for identifying special cause variation in a control chart



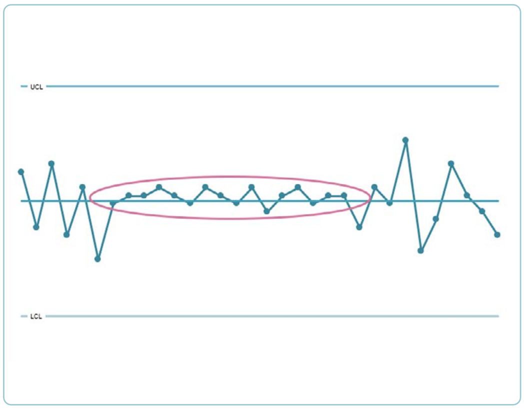
Any point outside the control limits.

A point exactly on a limit is not considered outside the limit.

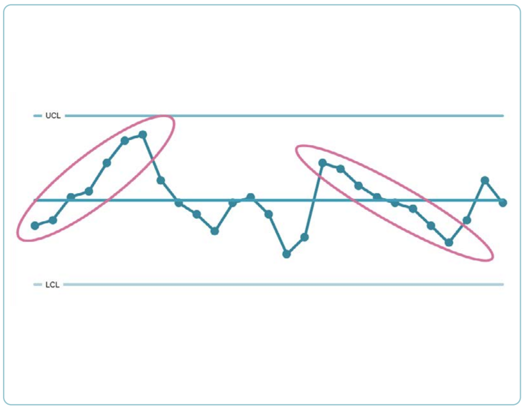


Shift: 8 or more consecutive points above or below the centre line.

A point exactly on the centre line does not cancel or count towards a shift.

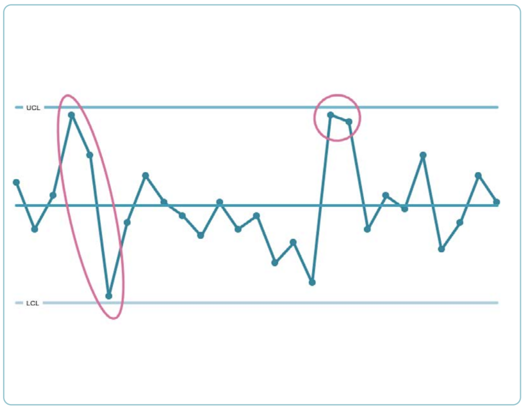


15 consecutive points 'hugging' the centre line (inner one-third).



Trend: 6 consecutive points increasing (trend up) or decreasing (trend down)

Ties between consecutive points do not break or add to a trend.



2 out of 3 consecutive points near a control limit (outer one-third).

Additional resources

To learn more about Quality Improvement you can access the following resources:

- SCV Quality Improvement Toolkit
- Institute for Healthcare Improvement website
- NSW Clinical Excellence Commission Quality Improvement Tools

Video Resources

- IHI Control Chart – Part 1 (~5 mins)
- IHI Control Chart – Part 2 (~8 mins)
- IHI Using Run and Control Charts to Understand Variation by Robert Lloyd (~56 mins)

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