Introduction to Statistical Process Control

What is SPC?

- SPC stands for Statistical Process Control
- SPC does not refer to a particular technique, algorithm or procedure
- SPC is an optimisation philosophy concerned with continuous process improvements, using a collection of (statistical) tools for:
  - data and process analysis
  - making inferences about process behaviour
  - decision making
- SPC is a key component of Total Quality initiatives
- Ultimately, SPC seeks to maximise profit by:
  - improving product quality
  - improving productivity
  - streamlining process
  - reducing wastage
  - reducing emissions
  - improving customer service, etc.

SPC is a method for achieving quality control in manufacturing processes. It is a set of methods using statistical tools such as mean, variance and others, to detect whether the process observed is under control. By using statistical tools, the operator of the production line can discover that a significant change has been made to the production line, by wear and tear or other means, and correct the problem - or even stop production - before producing product outside specifications. An example of such a statistical tool would be the control chart.

Control chart

The control chart is a statistical tool intended to assess the nature of variation in a process and to facilitate forecasting and management.

Every process in one way from another varies. To illustrate this reality, write your name ten different times. If you compared your handwriting collectively no two signatures will be exactly alike. The random variation would normally be common and expected however there is also a type of variation called special cause variation that is totally unexpected within the process. This can be shown for example by when somebody bumps into your elbow while you write your name on one of the ten trials. This also may alter the way your signature looks significantly. Special causes are crucial to catch since if hypothetically this were a process repeated ten different times in diamond cutting. The seemingly harmless bump to the elbow can be substituted for some other variation factor related to diamond cutting for example, in which case it would become quite an expensive special variation.

A control chart is a run chart of a sequence of quantitative data with three horizontal lines drawn on the chart:

- A centre line, drawn at the process mean;
- An upper control-limit (also called an upper natural process-limit drawn three standard deviations above the centre line; and

- A lower control-limit (also called a lower natural process-limit drawn three standard deviations below the centre line.

Common cause variation plots as an irregular pattern, mostly within the control limits. Any observations outside the limits, or patterns within, suggest (signal) a special-cause. The run chart provides a context in which to interpret signals and can be beneficially annotated with events in the business.

Types

Variable and attribute charts are the two different types of control charts. Variable charts assess quantitative features like height, weight, volume, and etc. An airplane's speed is an example of this measure of data. Attribute charts, however, are usually denoted by a letter such as p charts, c charts, u charts, and etc. P charts show the percentage of defectives in a set. C charts show the number of defectives per unit in a set. U charts show the average number of defects in a set. Attribute charts make up only a part of the whole from the all-encompassing influence of control charts. Attribute charts have become the dominant trait when one thinks about control charts in general. The many different varieties of control charts can be applied to different kinds of data that need to be processed.

Trends

There are some characteristics to lookout for in how to use and fully utilize the powerful tool of control charts. The point of making control charts to begin with is to look at variation, seeking special causes and keeping track of random causes. Special causes can be recognized and discovered by some simple tests. First of all, if one data point (outlier) falls outside of the control limits set then that is most likely a special cause. Another important observation is if six or more points are in a steady row of increasing or decreasing in the chart. Also, if eight or more points lie in a row on either side of the mathematical mean or centreline then that could be due to special variation. Lastly, but most obscurely if fourteen points alternate up and down then that may be something to responsible for in special cause. A good idea when implementing control charts is to pair two control charts together and compare inconsistencies to help further maximize control chart effectiveness.

Conclusion

A control chart is a tremendous graphical and analytical tool used by quality technicians to control, analyse and document the processes involved in production and other quality-relevant areas. As quoted by Deming, "There is no such thing as constancy in real life. There is, however, such a thing as a constant-cause system. The control chart will tell you whether your process is in statistical control". In a business, control charts contribute to process analysis that can improve productivity, quality, and efficiency by establishing what needs to be altered within an operation. If control charts are implemented correctly, they can become a commanding advantage in the greater philosophy of total quality management in an organization.