PathStone Group

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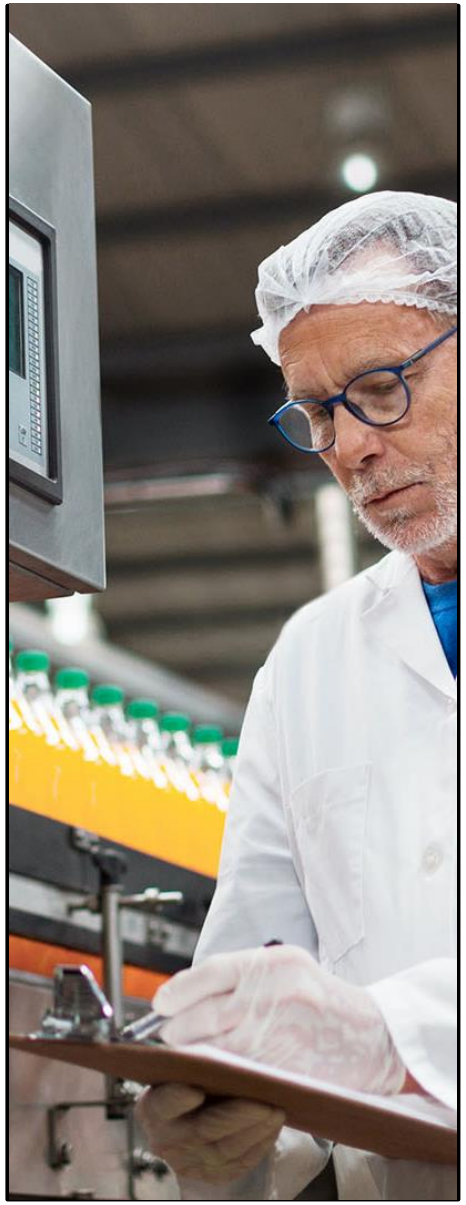
STATISTICAL PROCESS CONTROL

Agenda

1. SPC: What is it ?
2. SPC purpose and benefits
3. Control Chart
4. SPC Analysis
5. Types of Data
6. Takeaways



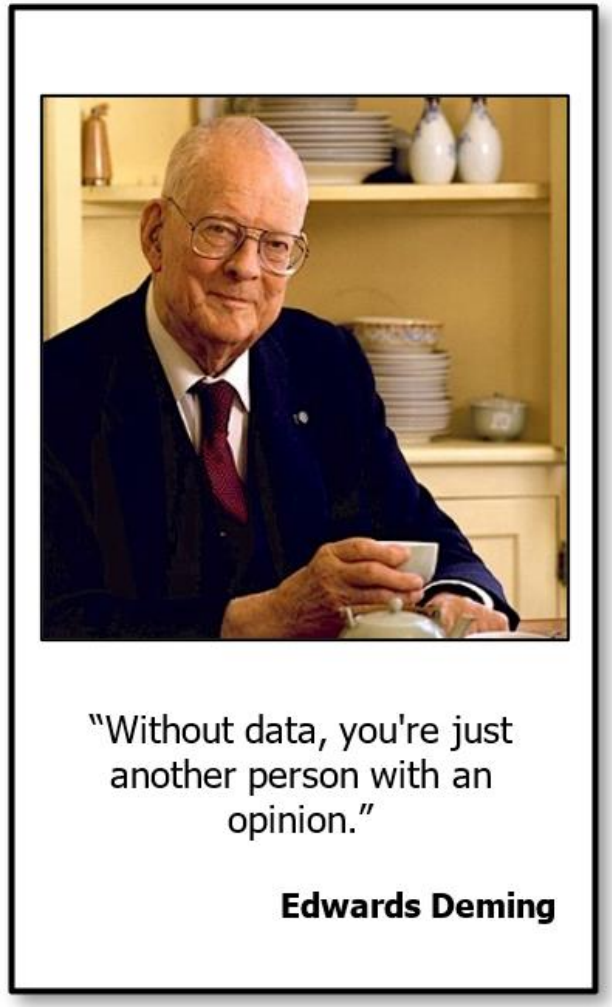
Introduction

What is it ?

Statistical Process Control (SPC) is a method of measuring and **controlling** quality by **monitoring** the manufacturing process.

SPC refers to a scientific, **data-driven method** for quality **analysis** and **improvement** that allows us to prevent problems from occurring.

The **process data** that is collected in **Control Charts** and is used to evaluate, monitor and control it.



Introduction

Purpose and Benefits

One of he advantages of SPC is the ability to use it for **analysis through control charts**.

SPC is an effective method to drive **continuous improvement**.

SPC can **predict** processes performance, help to take **better decisions**, find **correlations** with process variables and implement solid **quality management**.

Control Chart

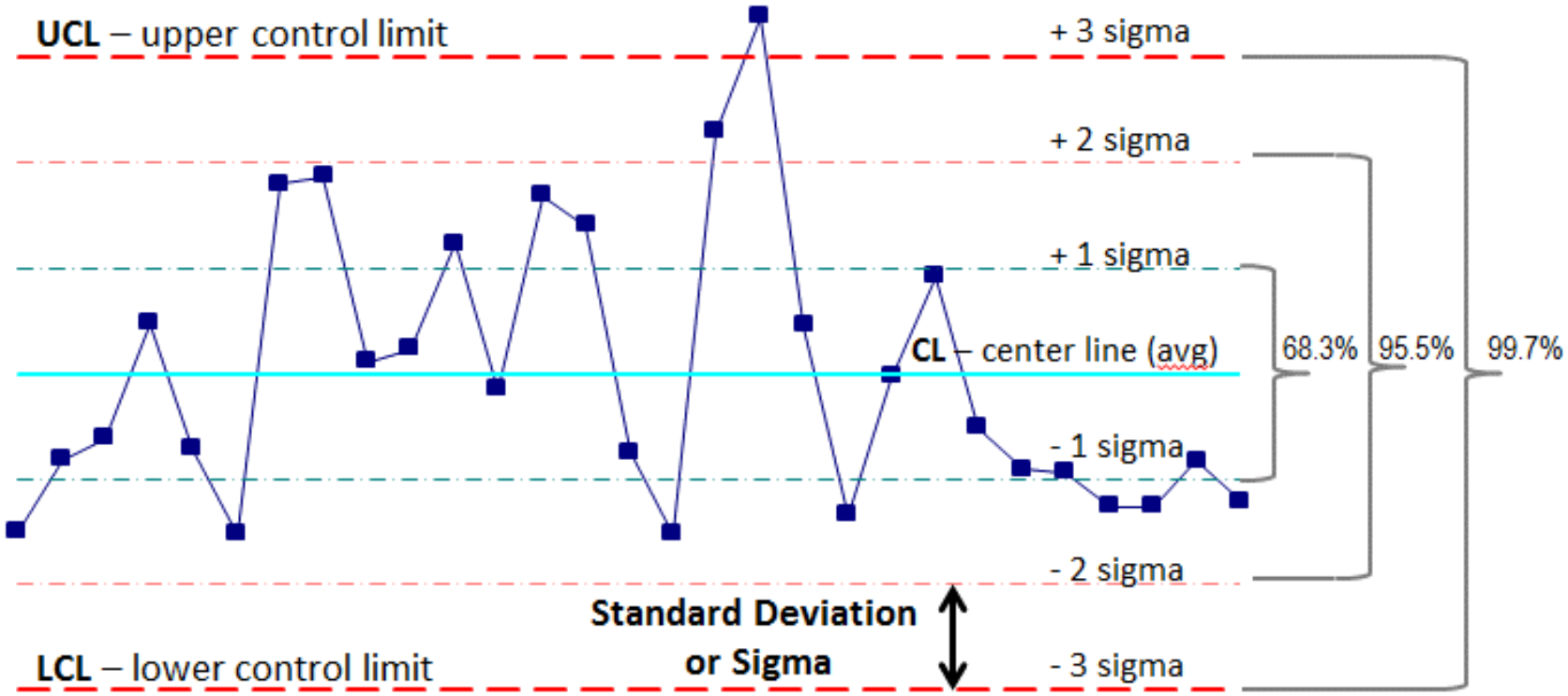
A **control chart** is a smart line graph. It performs calculations on the data and displays the average or median as a center line and the amount of variation in data using **control limit lines**.

As data moves through the zones created by these control limits, a control chart highlights data points or trends that should be investigated:

- An **Upper Control Limit** (UCL) line calculated at 3 sigma above the Center Line.
- A line chart of data measuring the process over time.
- A **Center Line** calculated as the average or median of the data.
- A **Lower Control Limit** (LCL) line calculated at 3 sigma below the Center Line.

SPC

Control Chart



Control Chart

The **average** (**mean**) is used for the centerline (instead of the median, used on a run chart). **Control limits** are added, representing the range of expected variation. The control limits are approximately ± 3 standard deviations off the average (99.7% of the points in a set of normally distributed data will fall between the limits).

Control limits **are not specification** limits. Control limits are based on data and tell us how a process is performing. Spec limits are based on customer requirements and tell us how we want a process to perform.

SPC Analysis

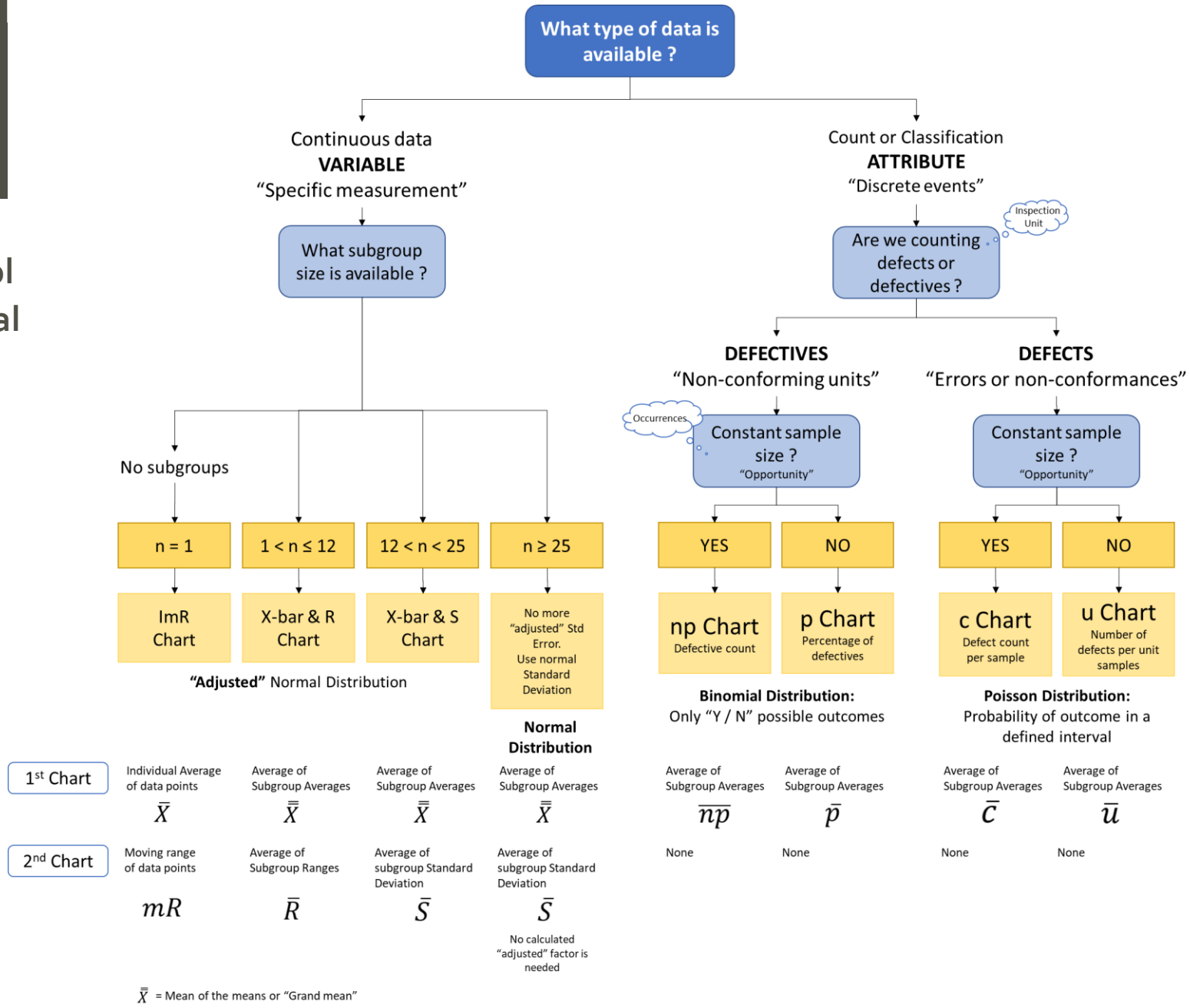
We use quality and process control procedures in production and service processes to ensure that the products or services **continue to meet the specifications**.

With a control chart **will be clear to see** where the two changes were made in the process, each of which resulted in a reduction of the variation in the process.

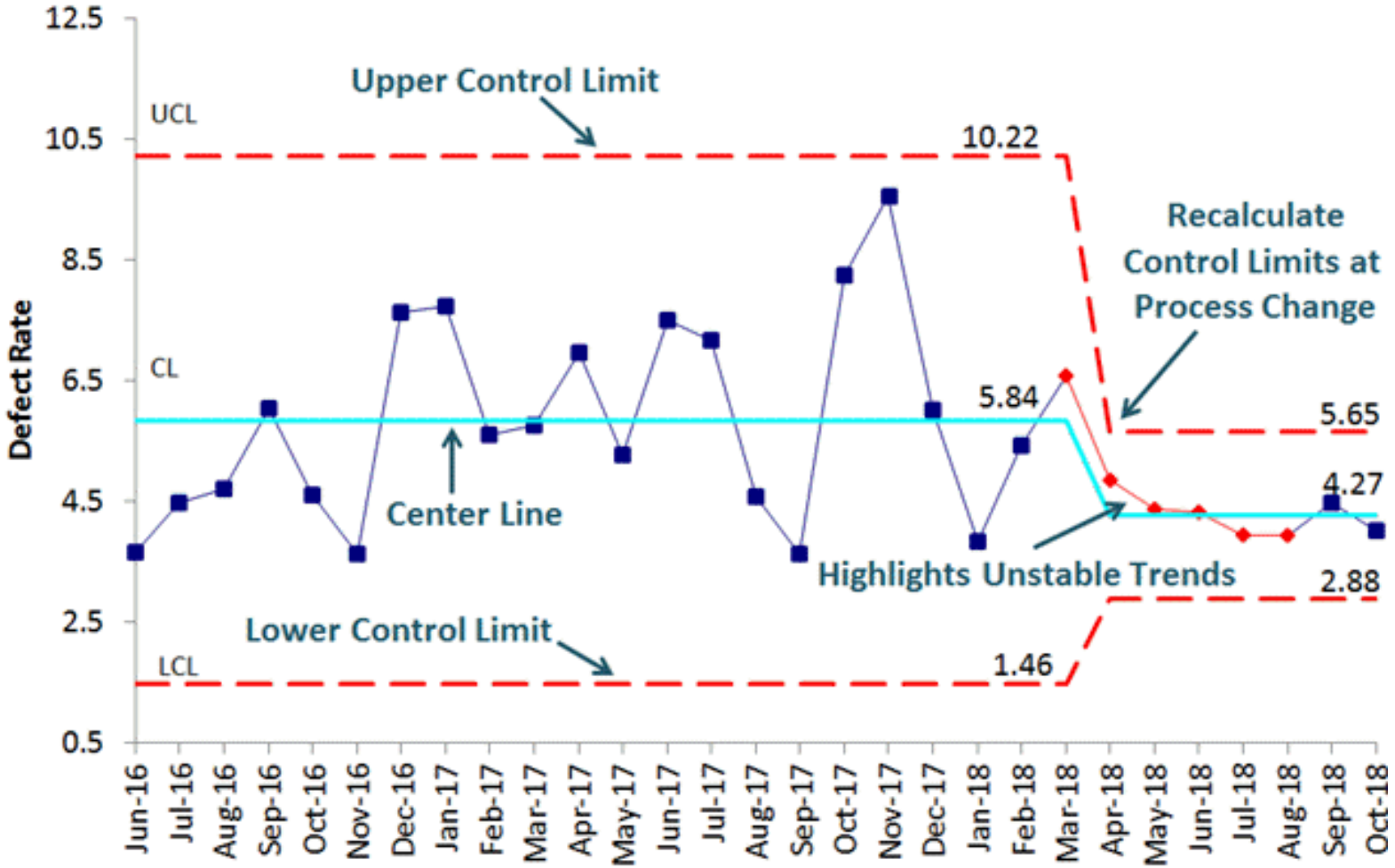
When the operator or team leader in the process uses this type of graph, it can be **deduced whether the process is still stable**. When a value moves within the limits, the process is under control.

SPC

The 7 types of Control Charts and the Normal Distribution Chart.



SPC


Defect Rate
12.5
10.5
8.5
6.5
4.5
2.5
0.5
UCL
CL
LCL
Upper Control Limit
Lower Control Limit
Center Line
Recalculate
Control Limits at
Process Change
Highlights Unstable Trends
10.22
5.84
1.46
5.65
4.27
2.88
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
Jan-17
Feb-17
Mar-17
Apr-17
May-17
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Oct-18

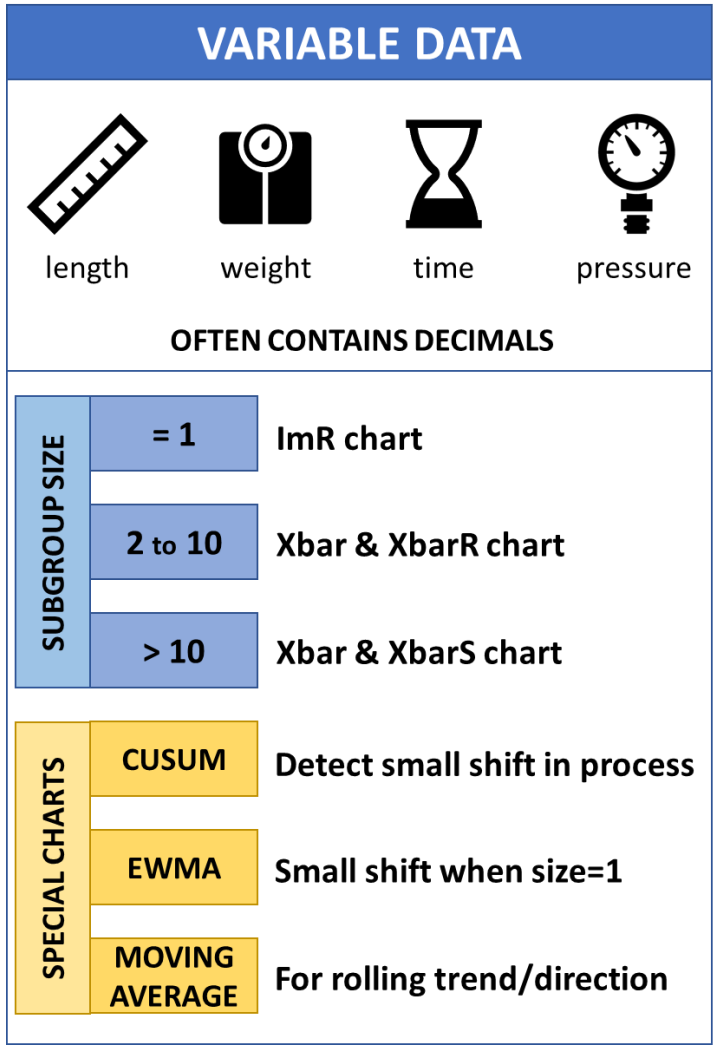
Types of data

Continuous

Any variable measured on a continuum or scale that can be infinitely divided. There are more powerful statistical tools for interpreting continuous data, so it is preferred over discrete/attribute data.

Example:

Lead time, cost or price, duration of call, and any physical dimensions or characteristics (height, weight, density, temperature).



Types of data

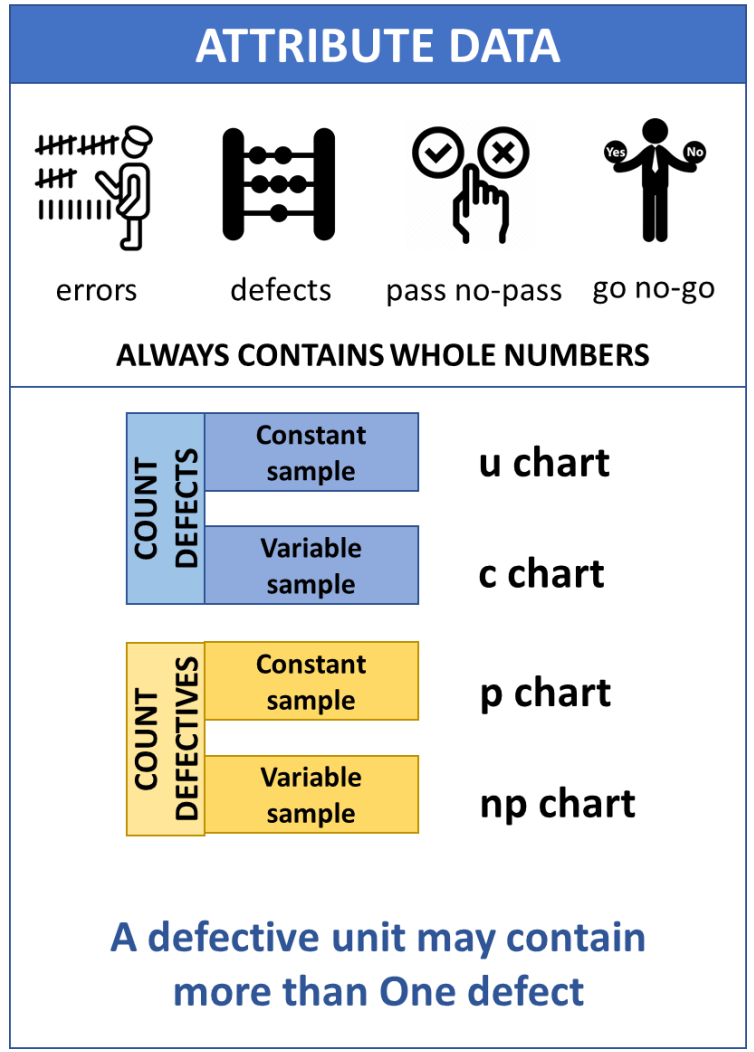
Discrete (also called Attribute)

Count: Example, counts of errors.

Binary data: Data that can have only one of two values.

Example:

On-time delivery (yes/no); Acceptable product (pass/fail).



Types of data

Discrete (also called Attribute)

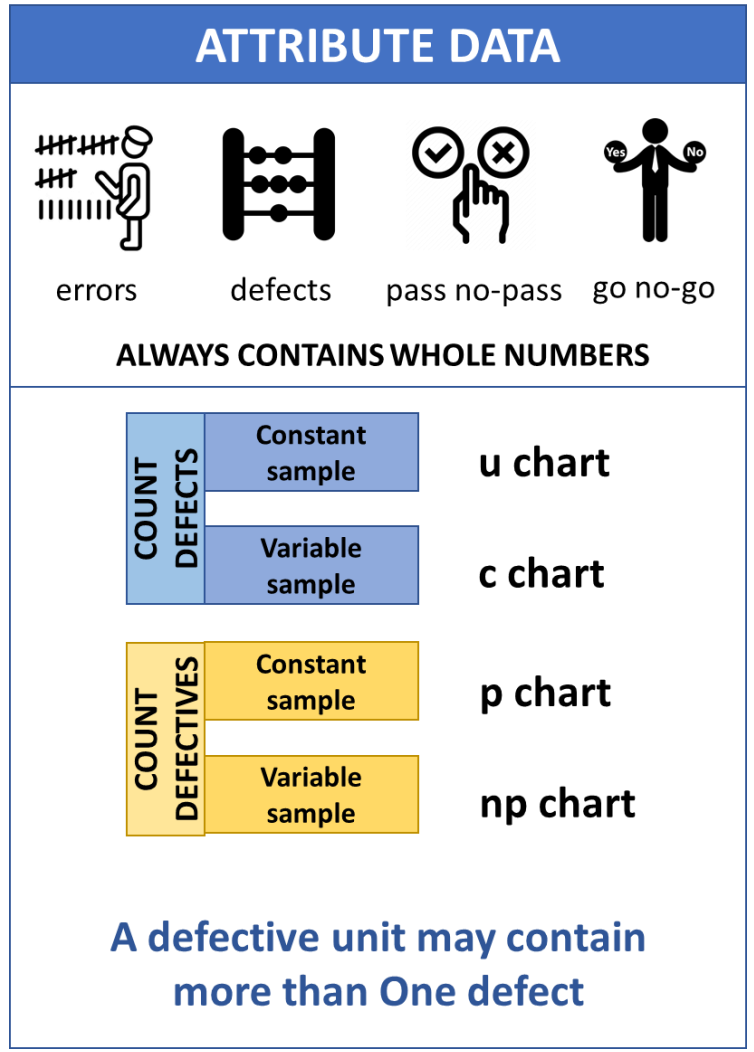
Attribute–Nominal: The "data" are names or labels. There is no intrinsic reason to arrange in any order or make a statement about any quantitative differences between them.

Example:

In a company: Dept A, Dept B, Dept C

In a shop: Machine 1, Machine 2, Machine 3

Types of transport: boat, train, plane



Types of data

Discrete (also called Attribute)

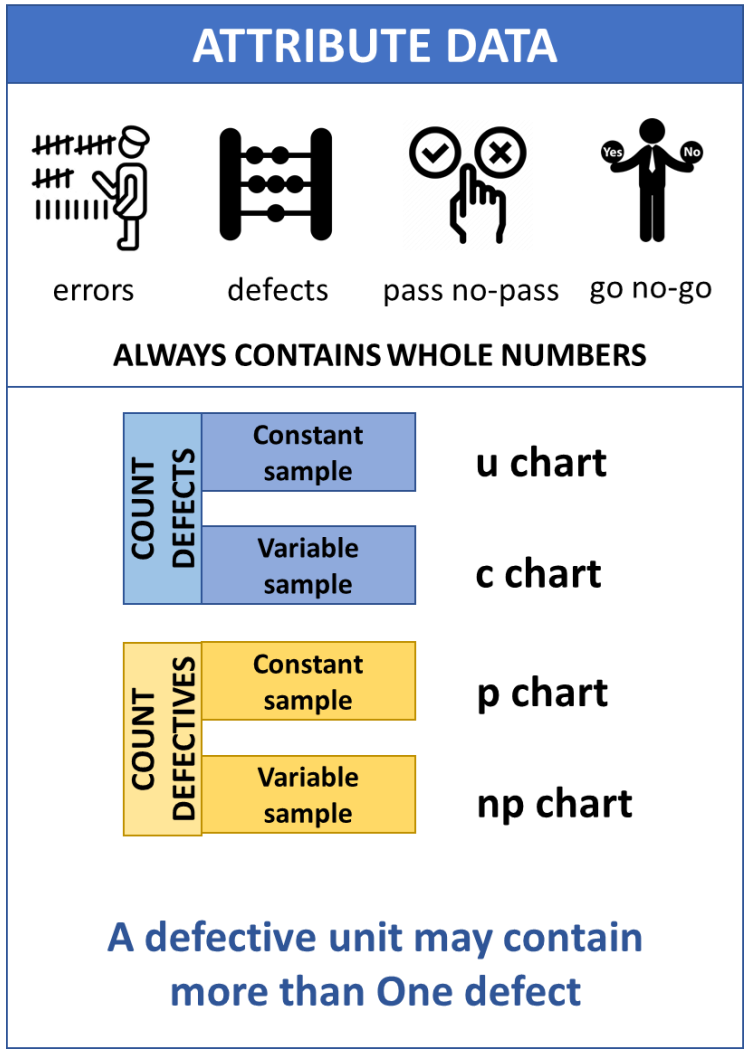
Attribute–Ordinal: The names or labels represent some value inherent in the object or item (so there is an obvious order to the labels).

Example:

On product performance: excellent, very good, good, fair, poor

Salsa taste test: mild, hot, very hot, makes me suffer

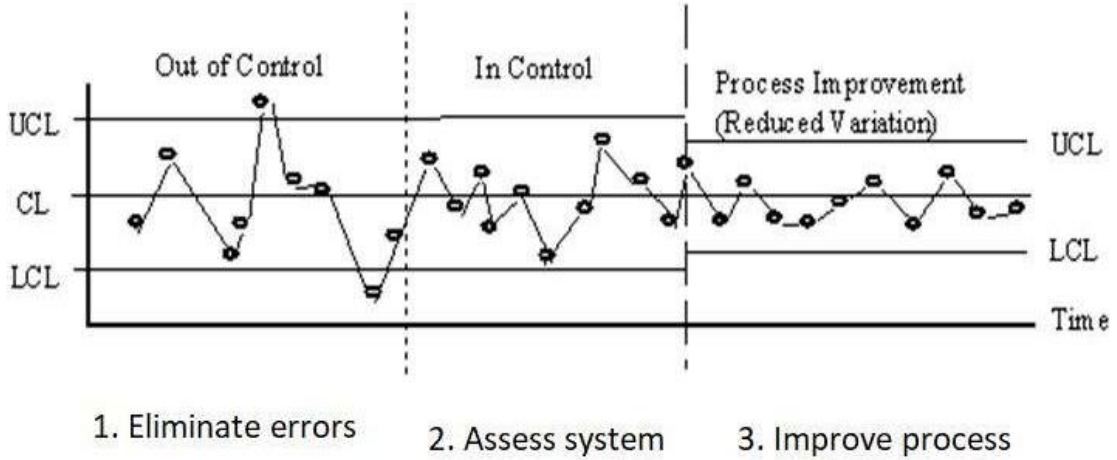
Customer survey: strongly agree, agree, disagree, strongly disagree



Types of data

The data points recorded on a control chart should fall between the control limits, provided that only **common causes** and no special causes have been identified.

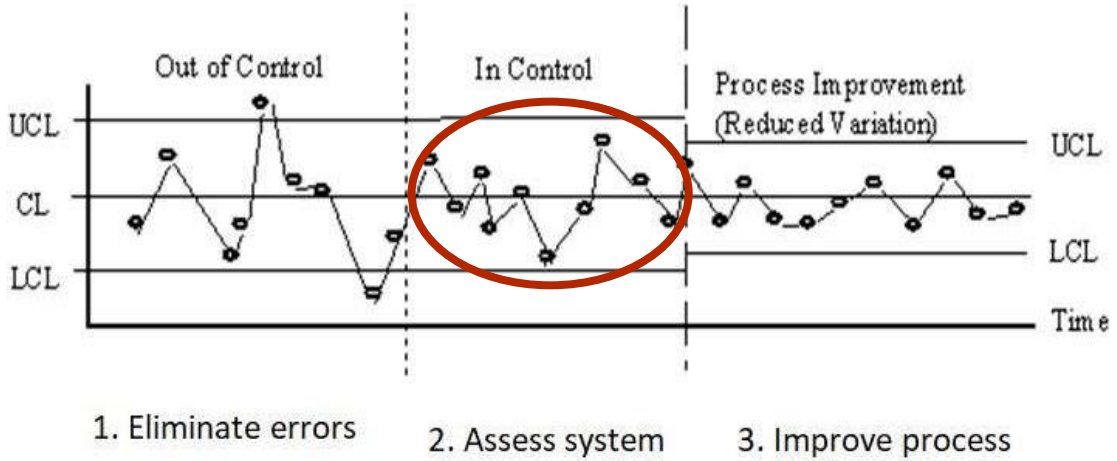
Common causes will fall between the control limits, whereas **special causes** are **outliers** or are outside of the control limits.



Types of data

Some examples of **common cause** variation are:

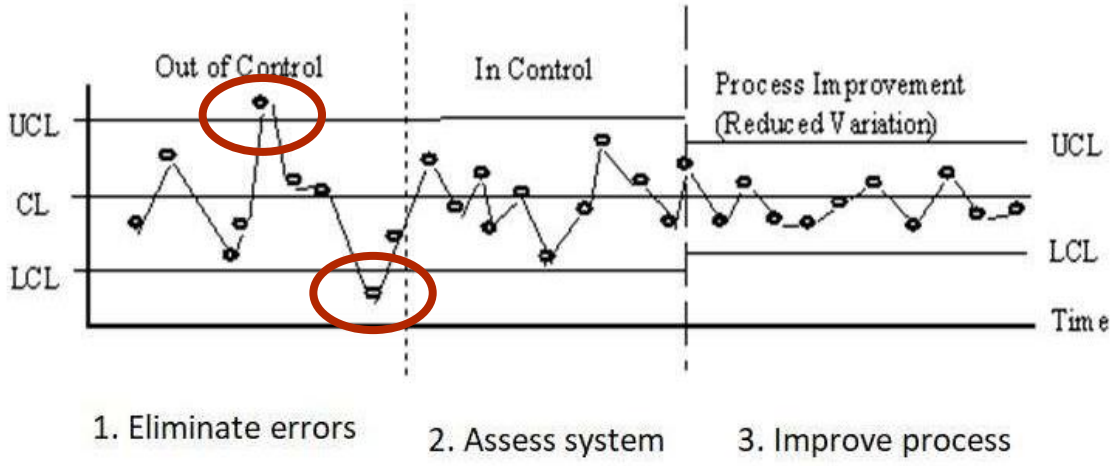
- Variation in material properties within specification.
- Seasonal changes in ambient temperature or humidity.
- Normal machine or tooling wear.
- Variability in operator-controlled settings.
- Normal measurement variation.



Types of data

Some examples of **special cause** variation are below:

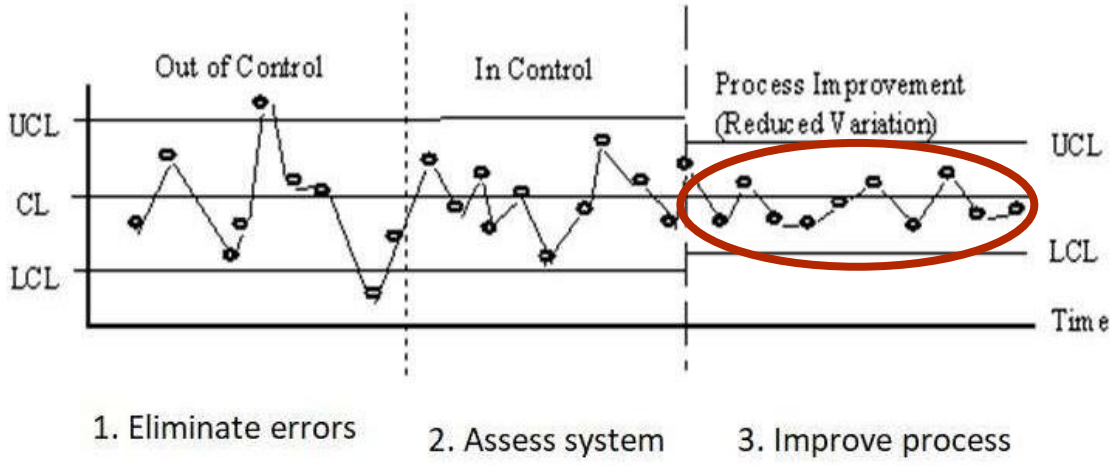
- Failed controllers.
- Improper equipment adjustments.
- A change in the measurement system.
- A process shift.
- Machine malfunction.
- Raw material properties out of design specifications.
- Broken tool, punch, bit, etc.
- Inexperienced operator not familiar with process.



Types of data

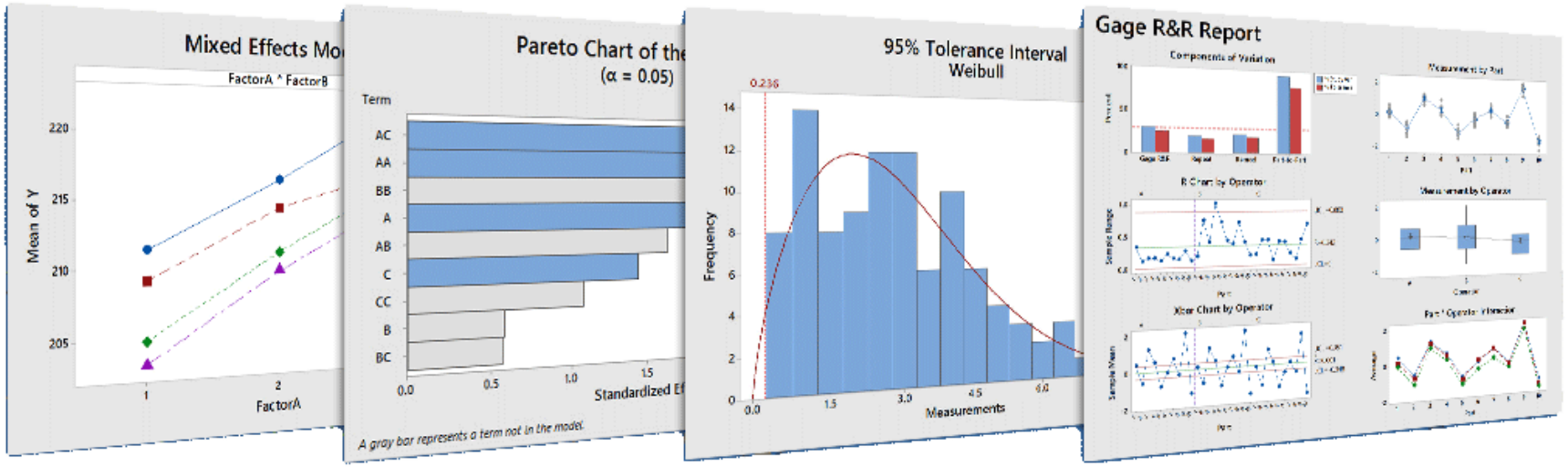
By addressing any **special causes**, trends or shifts in the process, we can assure we are producing parts that **meet the customer's requirements**.

The control limits should **always fall between the spec limits determined** by the process experts and / or the customer.



SPC

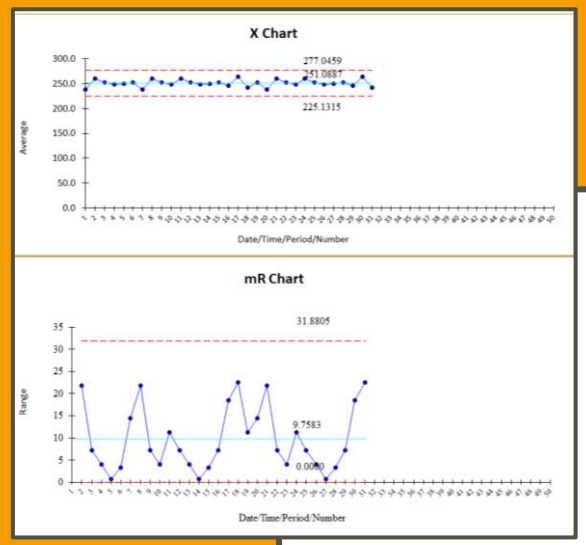
With current computer technology, there are several affordable software and MS Excel® add-ins to calculate and graph control charts without the need to learn complex formulas. Using templates is more practical in real-life operations.

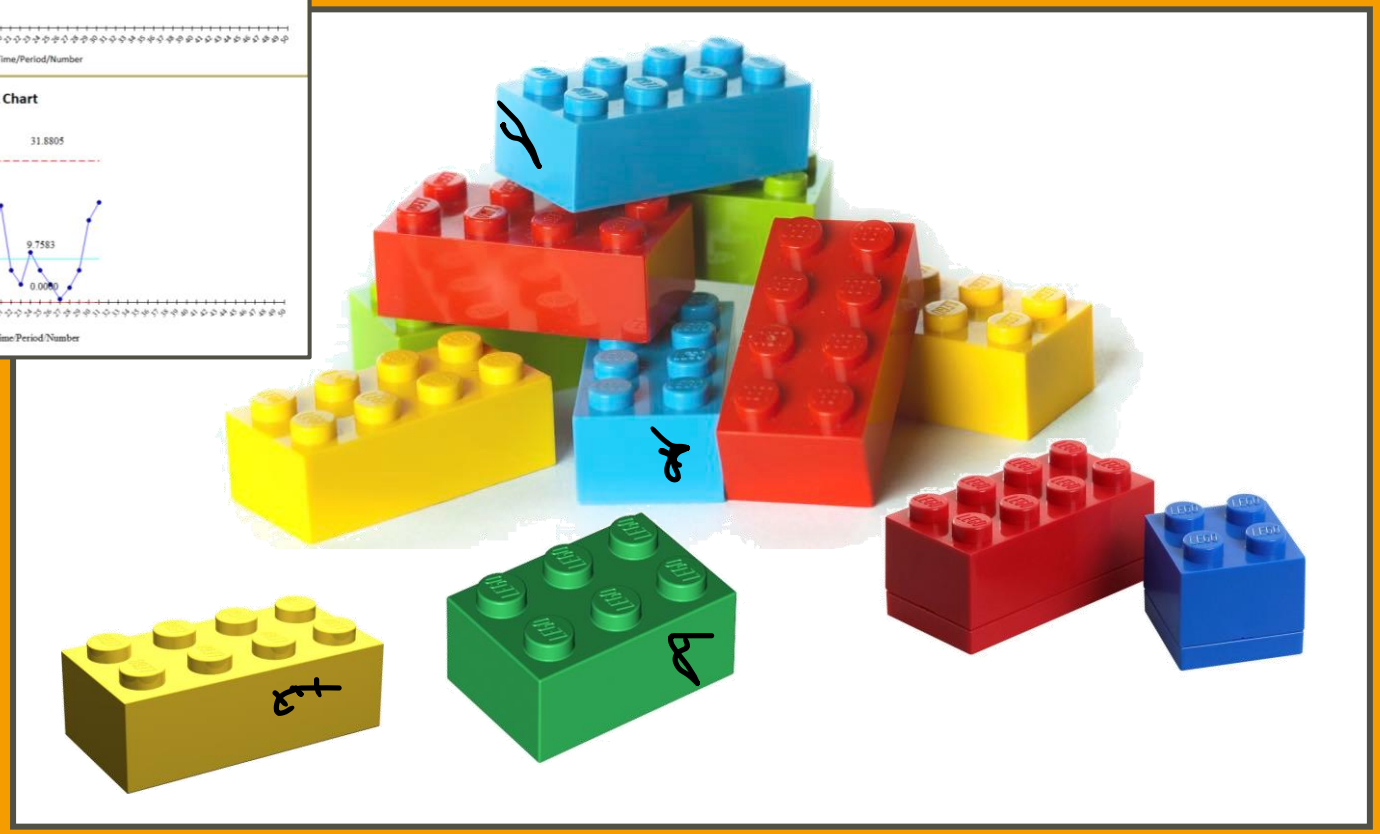


LEGO Defect Process Control

LEARNING HUB

Lego Defect Process Control





TOOLBOX

Control Chart Template

Control Chart Template

Takeaways

- Remember that without data, all we have is **opinions and "gut-feelings",** and they won't help us to solve most complex problems.

- **Reduce special cause variation** by tracking down and eliminating the specific, assignable root cause(s), looking for "what is different" in the process when the special cause variation appears.

- **Understand well the SPC foundations** and let a **SPC software** application do the heavy lifting. There are many affordable software out there, many as MS Excel add-ons.

Thank You

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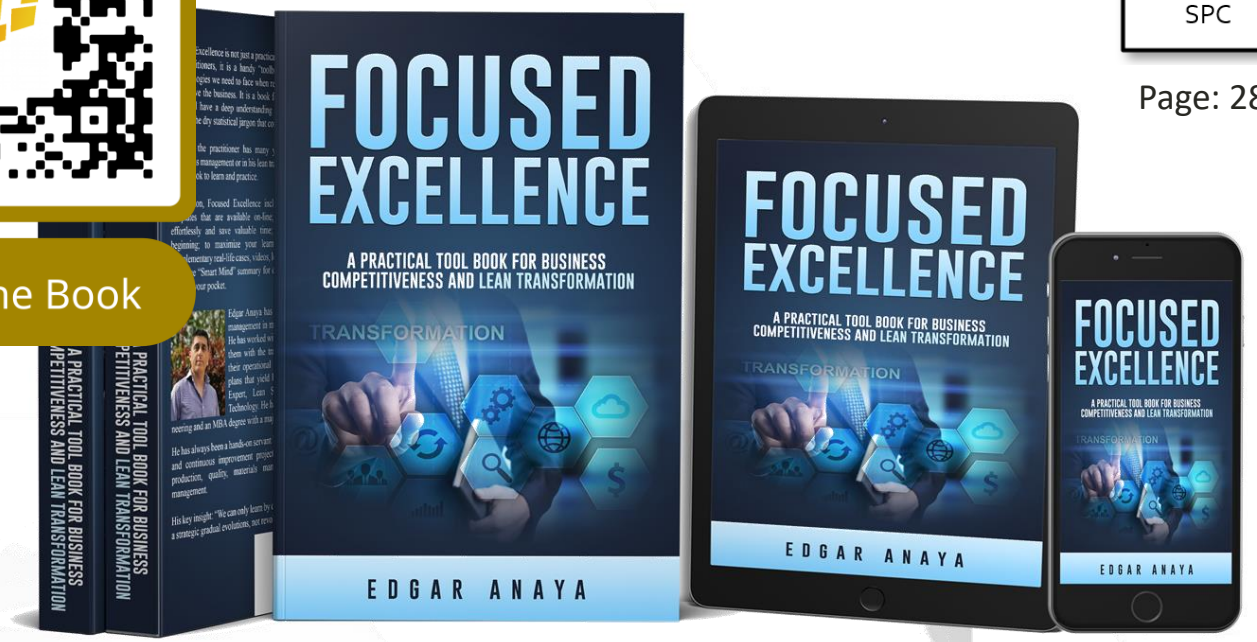
Get the Book



TOPIC

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Reference: Focused Excellence
by Edgar Anaya

A Practical Tool Book for
Business Competitiveness and
Lean Transformation