Chapter 15

Six Sigma Management

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15.1 Definition

Six Sigma is a short-cut for saying six standard deviations (6σ) from the mean, which specifies a tolerable range.

A major target of statistical quality control (SQC) is the reduction in variation in specification. This variation is measured in terms of Standard Deviation (σ).

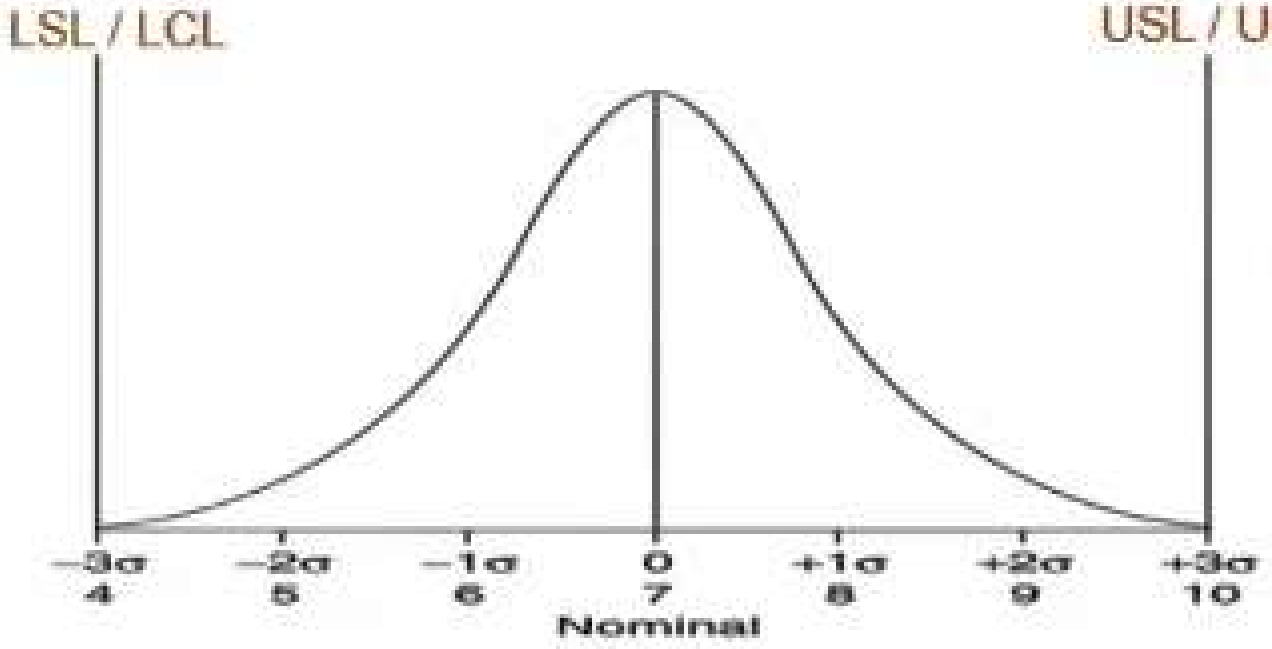
- When **Motorola** began its effort, the rate it chose was a 10-fold reduction in defects in two years, along with a 50% reduction in cycle time.

  For example, a bank takes an average of 60 days to process a loan with a 10% rework rate in 2004.

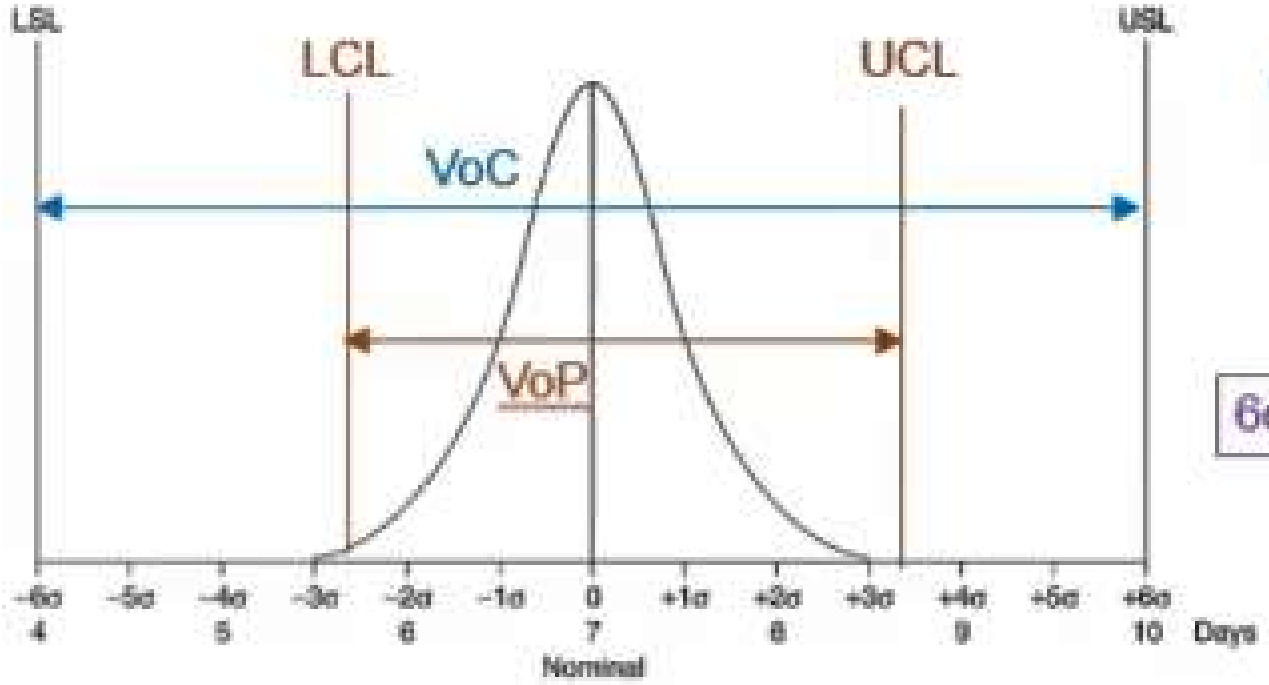
  In a Six Sigma organization, the bank should take no longer than an average of 30 days to process a loan with a 1% error rate in 2006, and

  no more than an average of 15 days to process a loan with a 0.10% error rate by 2008. Clearly, this requires a dramatically improved/innovated loan process.

- In 1988, Motorola Corp. became one of the first companies to receive the Malcolm Baldrige National Quality Award (MBNQA) for its Six Sigma Program.



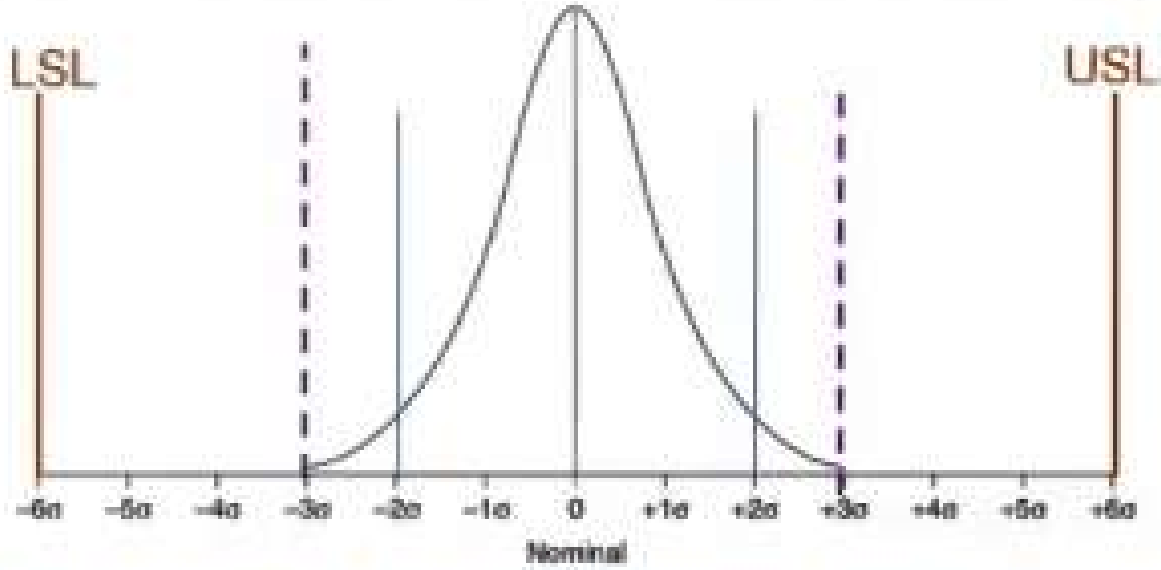
3σ quality control



In case of Six Sigma quality control, *the process is twice as good as a customer demands* *(page 243)*

6σ quality control

15.2 Normal Distribution Assumption



1 million = 10^6
1 billion = 10^9

Empirical rule:
for **±1σ**, 68% data fall in the Acceptance range

In case of **±2σ** quality control program, about 95.44% data or products fall in the acceptance range, i.e. defect rate (non-conformance) is only 4.56% (or, 0.0456), or 45,600 units per million products.

In case of **±3σ** quality control, about 99.73% data or products fall in the acceptance range, i.e. defect rate is only 0.27% (or, 0.0027), or 2700 products per million products.

In case of **Six Sigma (±6σ)** quality control, 99.9999998% data or products fall in the acceptance range, i.e. defect rate is only 0.0000002% (or, 0.000000002) 2 products per billion products produced.

However, "official" Six Sigma literature is that it states that a process operating at Six Sigma levels will produce 3.4 parts-per-million products, because the process mean may shift by 1.5σ in either direction.

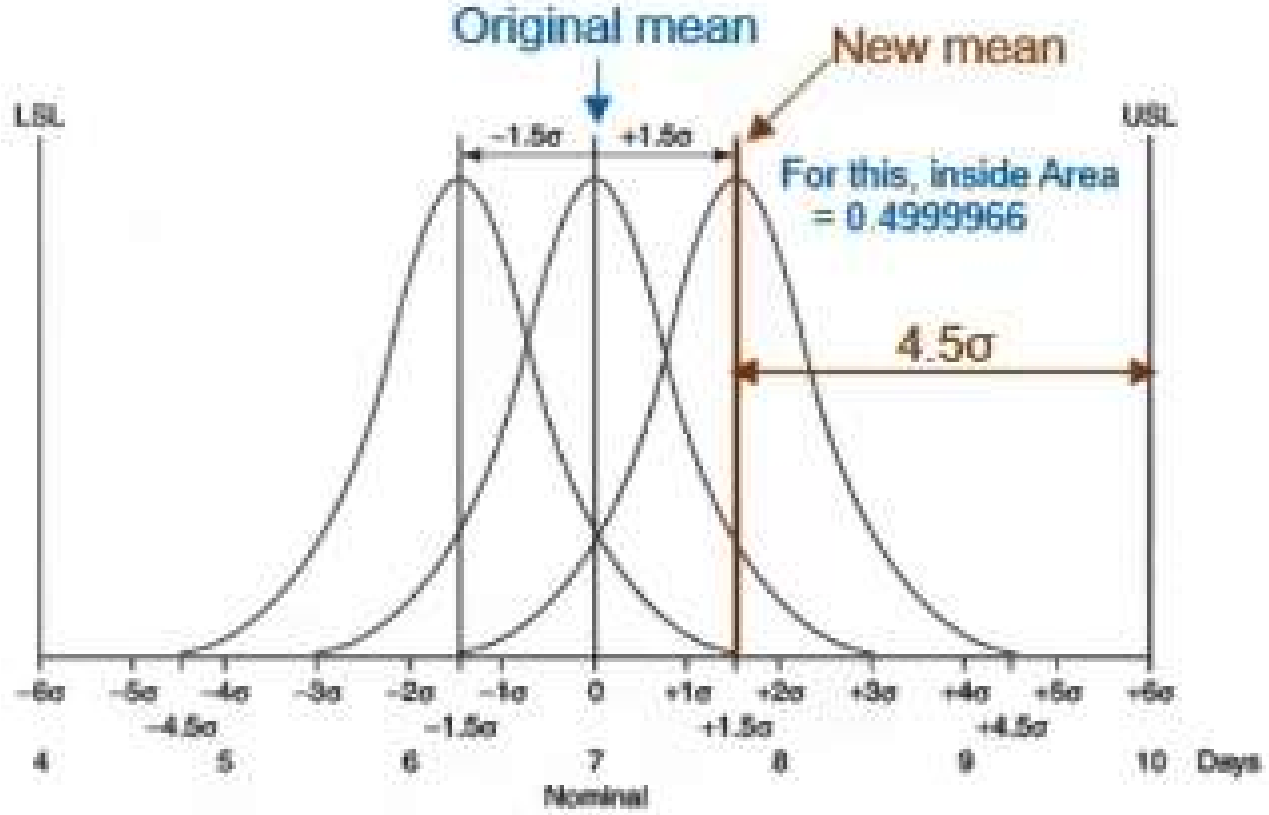


Figure 15.5: Six Sigma process, with 1.5σ shift in process mean

Outside area (i.e. outside of USL) = 0.5 − 0.4999966 = 0.0000034

So, non-conformance = 0.0000034 defects per unit = 0.0000034 × 1,000,000 defects per million
= 3.4 defects per million

Thus, for six sigma control:

a) If the process mean does not shift, then defect rate = 2 defects per billion products
b) If the process mean shifts up to 1.5σ , then defect rate = 3.4 defects per million

15.4 1.5-Sigma shift in the mean

Six Sigma concept was created at Motorola by Bill Smith.

Motorola had a very strong emphasis on two things:

1. Defect rate reduction – a typical quality control issue
2. Cycle time reduction – a typical operations management issue

At a glance, they are not related. But Bill Smith had a different view.

The more time you spend in a production process (i.e. higher cycle time), the more chance of unforeseen events, or defects.

It is indeed a new concept for establishing a linkage of quality to productivity.

These two targets can be accomplished by

- streamlining the process,
- removing non-value added activities
- Eliminating waste

These above three things have close relevance with Toyota Production System (TPS) concepts, Just-In-Time (JIT) philosophy, and "*Lean Manufacturing*."

15.6 The DMAIC Model for Improvement

DMAIC (a 6σ program) ➡ Define, Measure, Analyze, Improve, and Control.

Define Phase: This step identifies the quality characteristics that are critical to quality (called CTQs) using SIPOC analysis

SIPOC ➡ Supplier, Input, Process, Output, and Customer.

Measure Phase : Measure and collect data for the CTQs.

Analyze Phase:

- Identify Major Noise Variables (MNVs) that affect performance of the process
- Analyze process variables using TQM and statistical tools.

Improve Phase: Take actions to improve performance.

Control Phase: Control the implementation of optimal values for process control.

15.8 Certification schemes on Six Sigma

Different certifications for different levels of application of Six Sigma.

This certification has become popular in the USA.

Motorola and many big US companies follow this.

This certification system can be classified as the following, indicating from lower level of scope and knowledge to higher levels of scope and knowledge required –

1. Green belt
2. Black belt
3. Master black belt

Green Belt

Preliminary level to intermediate level of success is achieved through training.

A structured problem-solving methodology for addressing business improvement projects, using DMAIC model.

After completing the training program, Green Belt candidates are required to pass a test and demonstrate results on an improvement project in order to be formally certified.

Black Belt

This is more comprehensive than a green belt program.

The company has to show exceptional leadership of business improvement projects.

After completing the training program, Black Belt candidates are required to pass a test and demonstrate results on two improvement projects in order to be formally certified.

Master Black Belt

This is the most advanced level of certification, demonstrating that the candidates are the true champions of Six Sigma program.