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Introduction to Variation and Waste

Key Learning Points

1. Recognize Lean and Six Sigma as a means to improve.
2. Explain how the equation Y=f(x) defines what you are trying to improve.
3. Describe the difference between value and waste.
4. Explain how variation is related to Six Sigma performance.

DMAIC: A Means to Improve

DMAIC; Define, Measure, Analyze, Improve, Control are:

- Disciplined and Rigorous Process
- Uses Projects
- Involves Multi-Functional Teams
- Begins by Understanding the Problem
- Uses Systematic Planning, Control, and Understanding

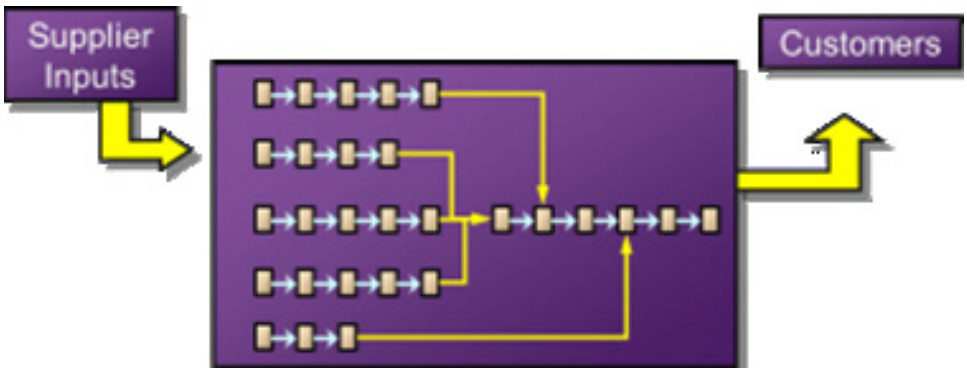
Six Sigma is about improving what is important or "critical to the customer and quality (CTQ)." Y is the measurement of the CTQ that needs to be improved to meet customer needs.

Once you understand what the Ys are, (those things critical to customers and quality), measure them and compare them to the targets. Understand the process characteristics that may cause variation and then reduce this variation by

controlling the process variables.

These process variables are called the Xs. There may be many Xs that can affect the Y. This simple equation is used to help communicate what a project is trying to accomplish. If Y is a function of X, then identify the Xs with enough precision to first improve the Xs and then control the Xs. Once Xs are maintained, the Y will be met.

A Process is a Value Stream



A value stream includes all activities which are required to bring goods or services from conception to commercialization. It can include detailed design, order taking, scheduling, processing, and delivery. Understanding a value stream allows one to see value added steps, non-value added steps, and non-value added but necessary steps.

Value streams are often discussed in conjunction with Lean Six Sigma projects since these projects are started by selecting a problem or value stream to improve. The improvement that can be implemented follows the Six Sigma DMAIC methodology, the Lean DMAIC methodology, or frequently a combination of both.

While Six Sigma is used to improve process effectiveness, and to make breakthrough improvements, Lean, or Value Stream Management focuses on improving efficiency by reducing lead time, increasing process throughput, and eliminating waste. Lean provides more value to customers, and can create greater profitability through improving delivery time.

Y=f(x)

- Your role is to identify the Xs that cause variation and improve on them.
- Outputs can be good products and services that meet customer and business needs.
- Outputs can be ineffective and inefficient due to waste and too much variation.

Understanding Business Waste vs. Waste

- Value Added: Lean & Six Sigma begin by defining value in terms of

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products and processes that provide the customer with what they need, at the right time, as well as at an appropriate price and speed of delivery. This is an activity that transforms or shapes material or information to meet customer requirements.

- Non-Value Added: Those activities that require time or resources, but do not add value to the customer's requirement (but may meet company requirements).

The Eight Wastes

The Eight Wastes are:

Defects

Errors, scrap, rework, non-conformance.

- Any defect is waste.
- Use Pareto Analysis to identify key defect reasons.
- You need to understand the causes of errors. Use a cause-effect diagram.
- Look to eliminate all causes of defects through mistake proofing.

Overproduction

Making or doing more than is required or earlier than needed.

- What is the minimum quantity the customer needs?
- When do they need it?
- What is the minimum order quantity or lot size?

Waiting

Waiting for information, materials, people, maintenance, etc.

- Any wait time is waste.
- Look to eliminate or minimize by ensuring that items arrive only when they are truly needed.

Non-Utilization of Talent

Transport

Moving people or goods around or between sites.

- Although some is necessary, this is also pure waste.
- Calculate the amount of travel distance and number of times items, materials, and WIP are moved per day (use a spaghetti diagram).
- Look to minimize the distance or the number of daily moves.

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Inventory

Work in progress, papers, electronic files, etc.

- Calculate days of supply for all goods.
- Understand how long it takes to replenish each item (more frequent supplies means less inventory).
- Develop a strategy for the amount of supply to keep.
- Monitor and measure.

Motion

Inefficient layouts at workstations; poor ergonomics in offices.

- Motion requires detailed analysis of movements.

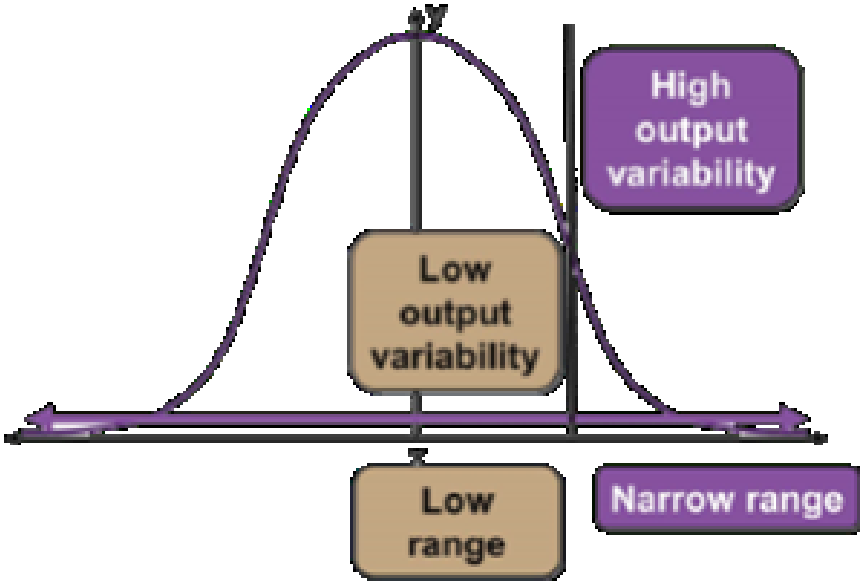
Poor Process Design

Too many or too few steps, non-standardization, inspection rather than prevention, etc.

- This is attacked through VA/NVA analysis.
- U-Shaped cells and moving areas in close proximity.
- Standardize on a size (i.e. using the same screw for all assemblies).
- Design to eliminate inspection.

Variation

It's the Range



Organizations are forced to improve the quality of their services and products in

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order to maintain their competitiveness. These services and products, which were created to respond to customer needs, may no longer be good enough for today's challenging competition. Customers have multiple sources available to fulfill most of their needs and will switch suppliers when their needs are no longer being met, or when another supplier offers superior products or services for less cost.

Too much variation in your processes creates deficiencies in the goods and services you deliver. It erodes financial margins and reduces customer loyalty. Reducing variation can lead to superior performance.

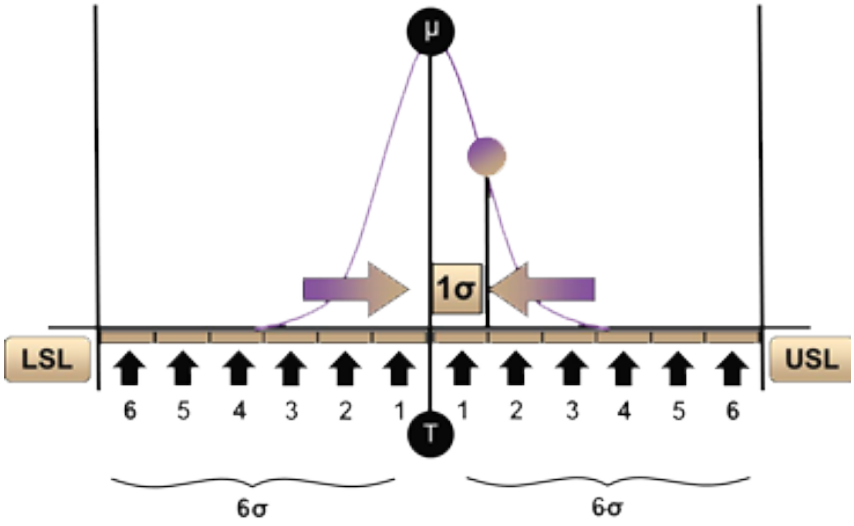
Merely improving average performance is not enough. Customers, costs, and profits are also adversely affected by the range. Lean Six Sigma focuses on identifying variation in your processes and products, and identifying the causes for that variation by reducing the average and the range.

Sources

All products and services are designed with good intentions but without knowing what variables will cause the product or service to not meet customer needs over time. Over time excess variation from these root causes must be reduced.

- Poor Design
- Changing Needs
- Measurement System
- Insufficient Process Capability
- Skills and Behaviors

Standard Deviation and Sigma



Sigma is a measure of standard deviation, denoted by the Greek letter, (σ). The standard deviation of the output of a process tells you how much variation occurs with the product.

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A process with normally distributed variation (or a bell-shaped curve) is symmetrical and has most (99.7%) of its outcomes within three standard deviations on each side of the mean (center).

The performance of a process with respect to meeting specification limits can be measured in terms of "sigma level."

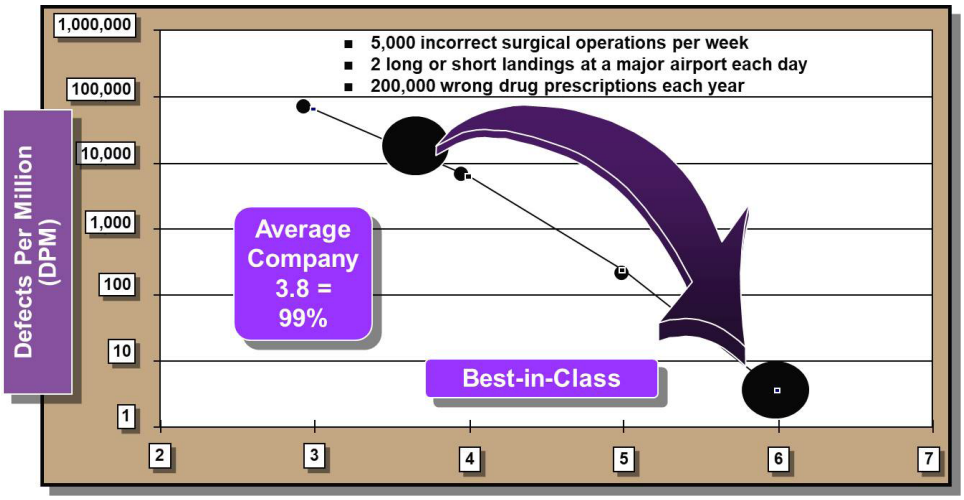
Sigma level is the distance between the mean and the nearest specification limit; measured in terms of the number of standard deviations, or sigmas.

This distance in terms of the number of sigmas determines the sigma level.

A "six sigma" process is one that was designed such that the specification limits are 6 standard deviations (or sigmas) away from the mean when the process performs as designed. Such a process in actual operation typically results in 3.4 or fewer defective parts per million (or defects per million opportunities [DPMO]).

Unfortunately, many processes are only performing at 2 to 3 sigma levels.

Sigma is a Metric



Six Sigma Scale of Measure:

- 1.7 incorrect surgical operations per week
- 1 short landing at a major airport in 5 years
- 68 wrong prescriptions per year

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Metrics of Performance

Sigma	Yield	DPM (Defects per 1,0000,000)
1σ	31.0%	690,000
2σ	69.2%	308,000
3σ	93.3%	66,800
4σ	99.4%	6,210
5σ	99.97%	230
6σ	99.99966%	3.4

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