

Introduction to Six Sigma

Lecture X [Chapter 3 in textbook]

History of Six Sigma

CEO of Motorola in early 1980's posed the challenge to achieve a tenfold reduction in product failure levels in three years.

History of Six Sigma

Focus on statistical analysis, team problem solving, continuous improvement

"implementation of a measurement-based strategy that focuses on process improvement and variation reduction of 6-sigma projects"

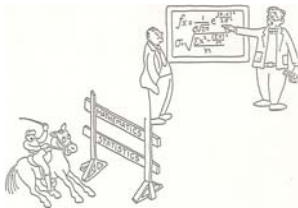
Six Sigma

Not all quality characteristics are equally important

goal is to define the "controlling critical factors"

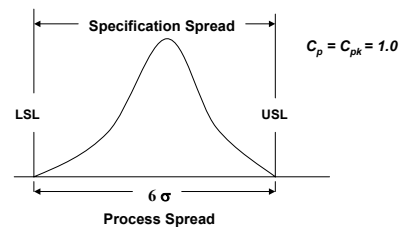
Six Sigma

"Statistical Intimidation"



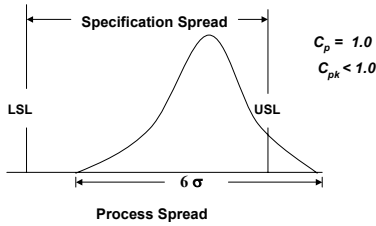
Conceptual Formulation of 6-sigma

Process capability (centered process)



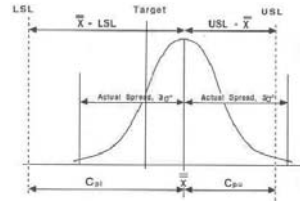
Conceptual Formulation of 6-sigma

Process capability (non-centered process)



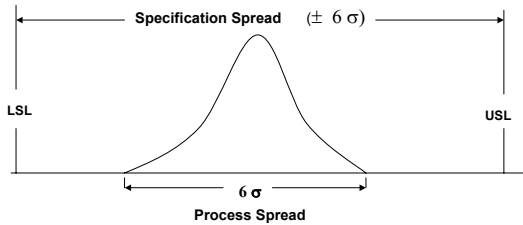
Conceptual Formulation of 6-sigma

Process capability (non-centered process)



Conceptual Formulation of 6-sigma

Process capability (6 sigma)



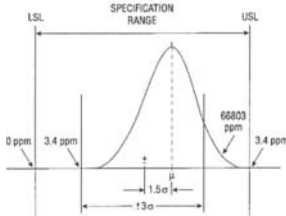
Conceptual Formulation of 6-sigma

Specification Limit	Percent Conformance	Nonconformance Rate (ppm)	Process Capability (C _p)
$\pm 1 \sigma$	68.7	317300	0.33
$\pm 2 \sigma$	95.45	485500	0.67
$\pm 3 \sigma$	99.73	2700	1.00
$\pm 4 \sigma$	99.9937	63	1.33
$\pm 5 \sigma$	99.999943	0.57	1.67
$\pm 6 \sigma$	99.9999998	0.002	2.00

Assumes normal distribution in tails – “unlikely”

Conceptual Formulation of 6-sigma

Process capability



Conceptual Formulation of 6-sigma

Definition of “defect” in six-sigma is very broad

“any product, service or process variation which prevents meeting the needs of the customer and/or which adds cost, whether or not it is detected.”

DMAIC Model

D - Define

*benchmark
voice of the customer
voice of the business
quality function deployment
process flow mapping*

DMAIC Model

M - Measure

*basic statistics
cause/effect matrix
process capability
failure mode/effects analysis*

DMAIC Model

A - Analyze

*cause-effect diagrams
failure mode/effects analysis
statistical inference
control charts
capability analysis*

DMAIC Model

I - Improve

*design of experiments
modeling
tolerancing
robust design*

DMAIC Model

C - Control

*control charts
procedural adherence
performance management
preventive activities*

Phases of six-sigma

1st Phase – Management Commitment

*training on principles and tools to senior
management*

development of a management infrastructure

Phases of six-sigma

2nd Phase – Information Gathering

intensive communications with customers, suppliers and employees

Phases of six-sigma

3rd Phase – training

green belt – black belt

Phases of six-sigma

4th Phase – DMS

developing monitoring systems

Phases of six-sigma

5th Phase – Business Improvement

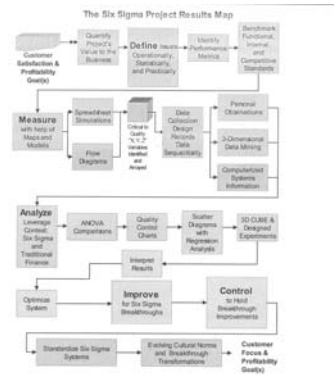
the current key processes are mapped and problems identifies

Phases of six-sigma

6th Phase – Conducting 6-sigma Projects

improve the processes and validate them by simulations and statistical methods

determine proper documentation systems



Design for Six-Sigma

Quality function deployment

- QFD matrix

Robust design

Failure mode and effects analysis (FEMA)

Limitations to 6-sigma

"Mind limitations"

fear

time pressure

resistance to change

lack of trust

poor communication

Limitations to 6-sigma

Knowledge limitations

lack of knowledge among team members

lack of statistical knowledge

Limitations to 6-sigma

Management limitations

lack of leadership

lack of management support

lack of hands-on involvement

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