Lecture X
[Chapter 3 in textbook]

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

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”

Not all quality characteristics are equally important

goal is to define the “controlling critical factors”

“Statistical Intimidation”

Process capability (centered process)
Conceptual Formulation of 6-sigma

**Process capability (non-centered process)**

![Diagram showing process capability with LSL, USL, and 6σ spread]

- \( C_p = 1.0 \)
- \( C_{pk} < 1.0 \)

Conceptual Formulation of 6-sigma

**Process capability (6 sigma)**

![Diagram showing process capability with LSL, USL, and ±6σ spread]

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

M - Measure
basic statistics
cause/effect matrix
process capability
failure mode/effects analysis

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

I - Improve
design of experiments
modeling
tolerancing
robust design

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

3rd Phase – Training

Green belt – Black belt

4th Phase – DMS

Developing monitoring systems

5th Phase – Business Improvement

The current key processes are mapped and problems identified

6th Phase – Conducting Six-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