CHAPTER 2

SIX SIGMA

Expected Outcomes

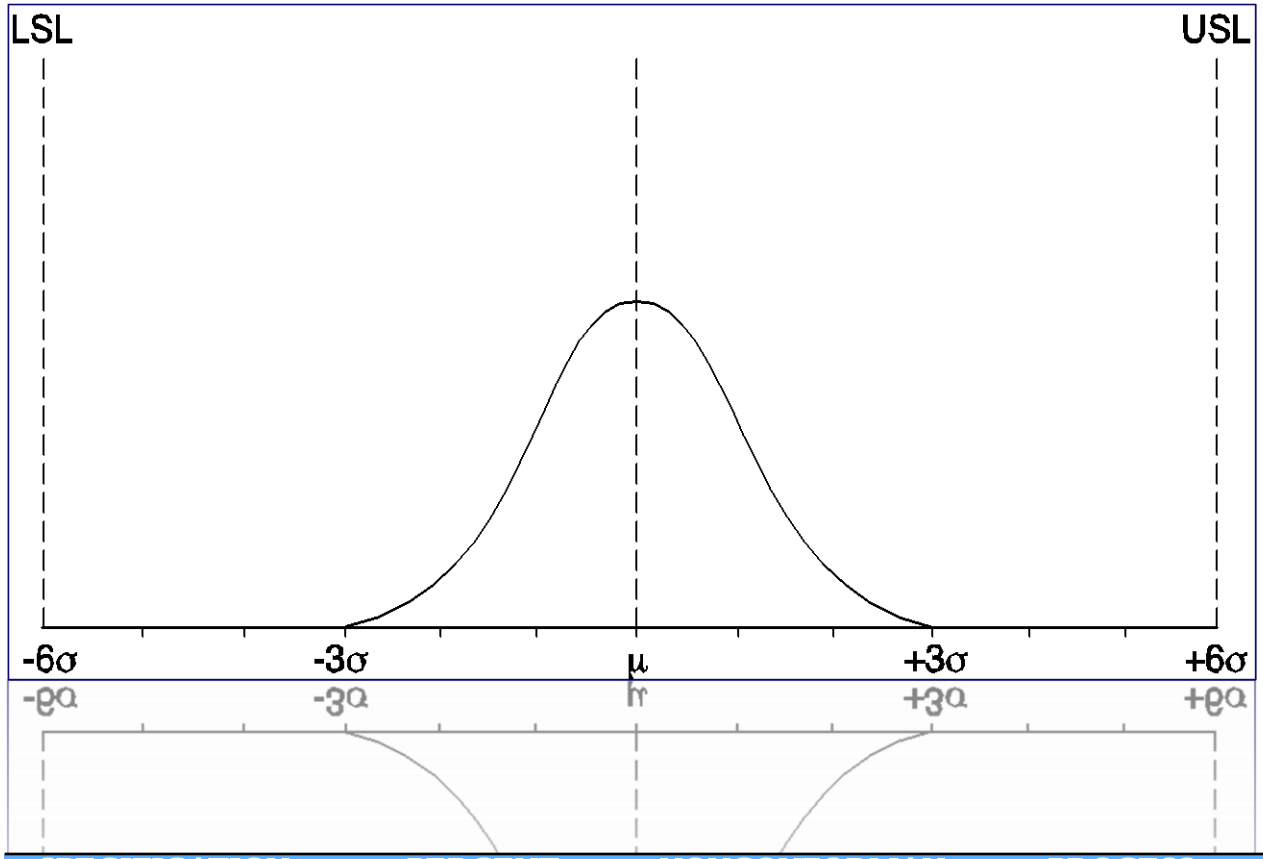
Understand the concept of six sigma statistics.
Able to describe DMAIC project methodology.
Know the advantages of the methodology.

Historical Review

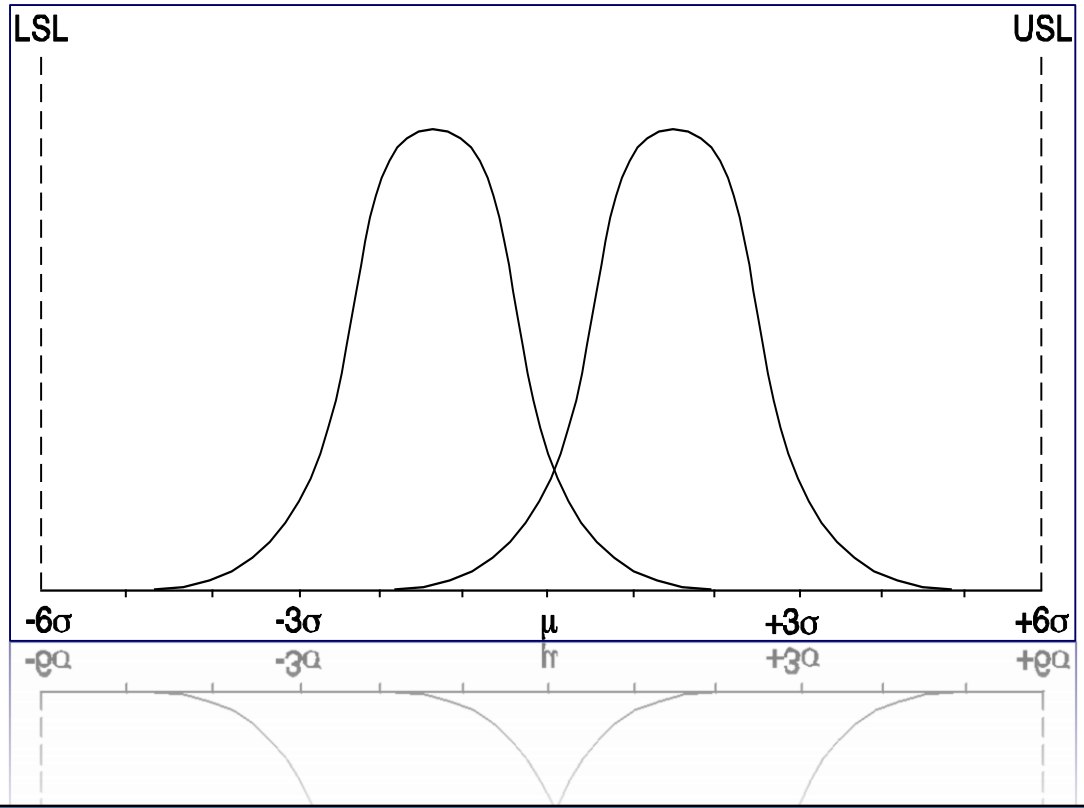
- 1980's at Motorola, which won the Baldrige National Quality Award in 1988
- Significant improvement in quality.
- Mid 1990's other companies such as General Electric and Allied Signal obtained similar results.
- Six Sigma is both a quality management philosophy and a methodology that focuses on reducing variation, measuring defects, and improving quality of products, processes and services.

Statistical Aspects

- Sigma, σ, is the Greek symbol for population standard deviation, which is the best measure of variation. If we can reduce variation to the point that the specifications are at ±6σ, then 99.9999998% of the items are satisfactory. The nonconformance rate is .002 ppm.



SPECIFICATION LIMIT	PERCENT CONFORMANCE	NONCONFORMANCE RATE	PROCESS CAPABILITY
±1σ	68.7	317,300	0.33
±2σ	95.45	485,500	0.67
±3σ	99.73	2,700	1.00
±4σ	99.9937	63	1.33
±5σ	99.999943	0.57	1.67
±6σ	99.9999998	0.002	2.00



SPECIFICATION LIMIT	PERCENT CONFORMANCE	NONCONFORMANCE RATE (PPM)	PROCESS CAPABILITY (C_{PK})
±1σ	30.23	697,700	–0.167
±2σ	69.13	308,700	0.167
±3σ	93.32	66,810	0.500
±4σ	99.3790	6,210	0.834
±5σ	99.97670	2,330	1.167
±6σ	99.9996600	3.4	1.500

Statistical Aspects (Continued)

- Actually the nonconformance rate is much closer to .002 ppm, because:
- Process shift of 1.5 was envisioned in 1990.
- Shift will not always be at 1.5. It will move back and forth.
- Control charts will correct, so shift will only be at 1.5 about 5% of the time.
- Use of improved technology will keep the process centered.

Improvement Methodology

- DMAIC stand for Define, Measure, Analyze, Improve, Control.
- Not a new concept, but no other methodology included tools and techniques.
- Each phase requires a progress report to management.
- Motorola developed MAIC and GE added the D

Measure

- Measure consists of understand the process, validate the data accuracy, and determine the process capability.
- This information is used to review the define phase, establish a baseline, and obtain a better knowledge of the process.

Analyze

- Phase consists of process analysis, cause investigation, charter updating.
- Pinpoint and verify causes affecting problem.
- **Process Analysis**
- Review VSM, calculate takt time, identify non-value added, determine bottlenecks.
- Review measure phase data.

Improve

- This phase selects optimal solution, tests a pilot, and implements solution.
- Objective – improved process to meet goals

Optimal Solution

- Team uses brainstorming to be creative and innovative in selecting possible solution.
- Three types of creativity: create new process – highest type; combine processes; modify existing process.
- Select optimal solution

Control

- This phase consists of evaluating the process, standardizing the procedures, and final actions.
- It's objective is to evaluate the effectiveness of the improvement.

Evaluating the Process

- Team should meet periodically to evaluate the improvement. May need to repeat some phases.
- Tools--SPC, capability, & combination map

Additional Comments

- Modifications to DMAIC
  - Recognize at beginning
  - Standardize and Integrate at the end
  - Replicate for multiple facilities
- Six Sigma works because it gives bottom line results; trains leaders; reduces variation, improves quality, increases customer satisfaction, and uses statistical techniques.

REFERENCES

1) BESTERFIELD, QUALITY IMPROVEMENT, 9TH EDITION, PEARSON

2) THOMAS PYZDEK, QUALITY ENGINEERING HANDBOOK