



Six Sigma

Breakthrough Strategy
or
Your Worse Nightmare?

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Agenda

- What is Six Sigma?
- What are the challenges?
- What are the rewards?
- Summary and Questions

Six Sigma has many meanings

- A Symbol σ
- A Measure
- A Benchmark or Goal
- A Method

Six Sigma: A Symbol

- σ is a Statistical Symbol for Standard Deviation
- Standard Deviation is a Measure of Variability

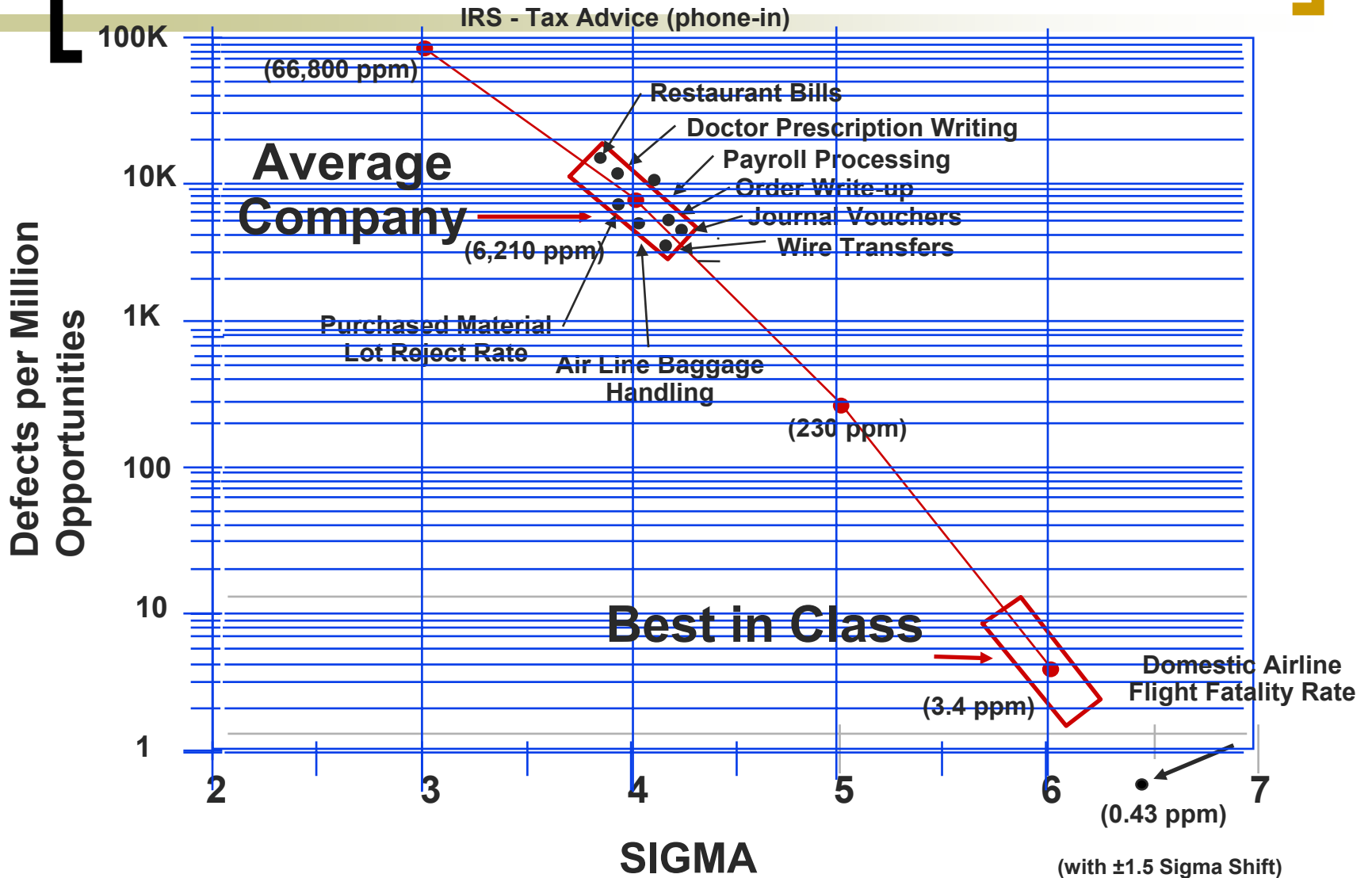
Six Sigma: A Measure

- The “Sigma Level” of a process can be used to express its capability
 - How well it performs with respect to customer requirements.
- Defects per million opportunities

Doing the math

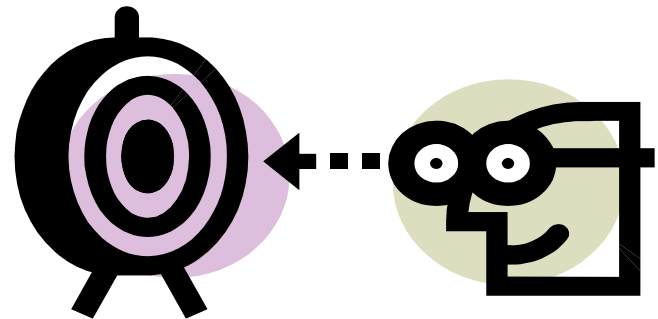
6 Sigma = 3.4 defects per million
5 Sigma = 230 defects per million
4 Sigma = 6,210 defects per million
3 Sigma = 66,800 defects per million
2 Sigma = 308,000 defects per million
1 Sigma = 690,000 defects per million

Some Examples to Illustrate Typical Defect Rates



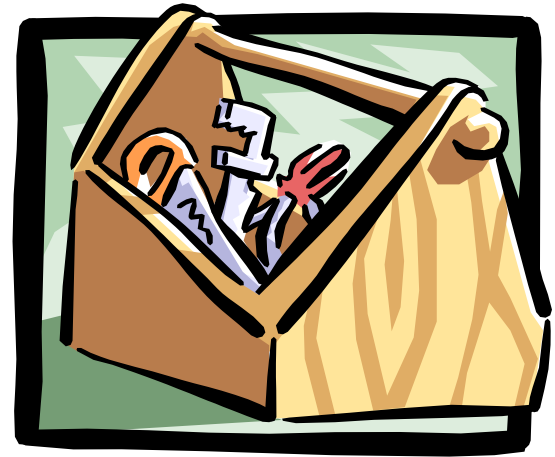
Six Sigma: A Benchmark or Goal

- The specific value of 6 Sigma (as opposed to 4 or 5 Sigma) is a benchmark for process excellence.
- Adopted by leading organizations as a goal for process capability.
- Delivering nearly defect-free products and services
- Focus on variation reduction

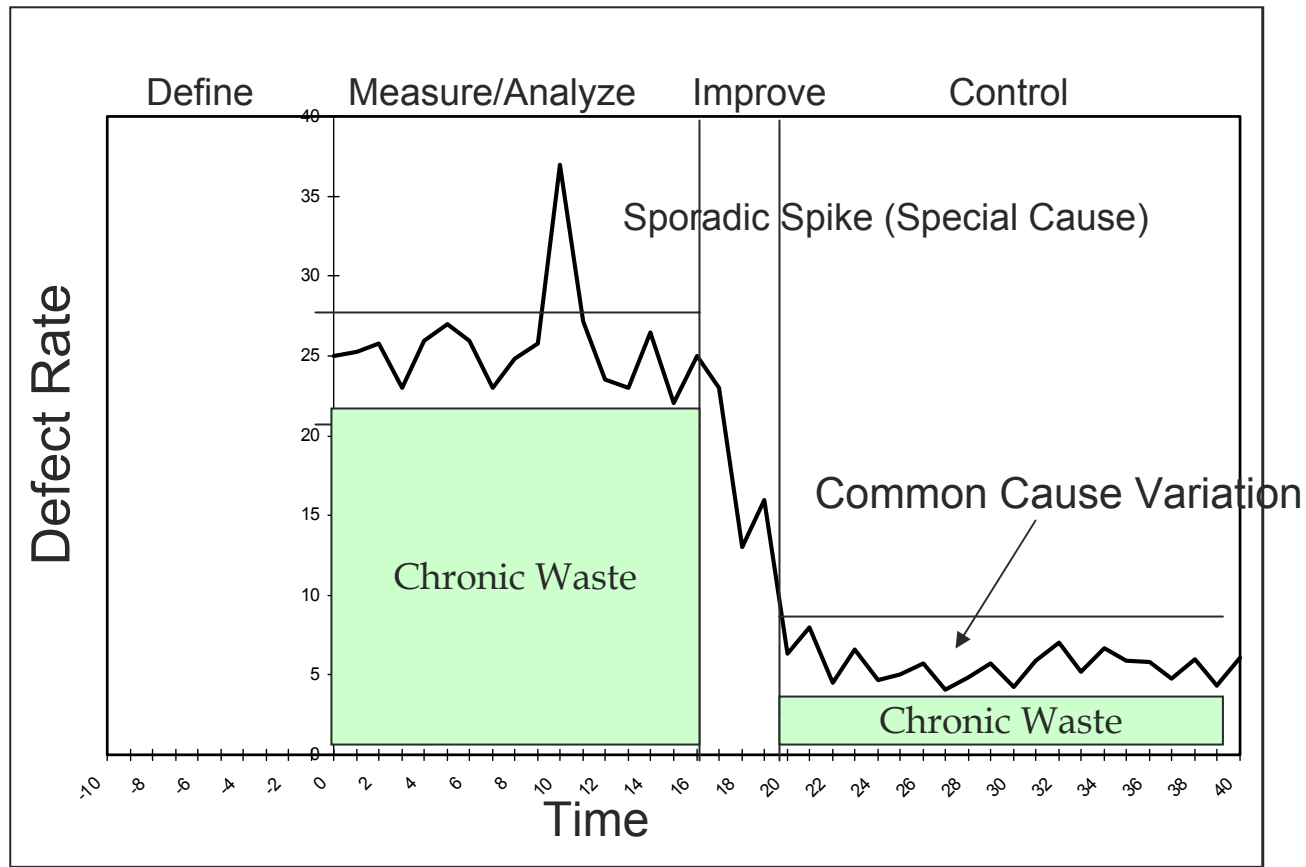


Six Sigma: A Method

- A well defined process and toolkit used for:
 - Product/Service Design
 - Product & Process Improvement



DMAIC Approach



DMAIC Approach

Define



Select customer-focused problem, document business impact, determine project deliverables, complete project charter, form multidisciplinary team

Measure



Develop factual understanding of current process, locate current problem sources, establish “as-is” process baseline, measure baseline process capability

Analyze



Identify potential defect root causes and sources of variation, investigate using experiments and statistics, verify root causes

Improve



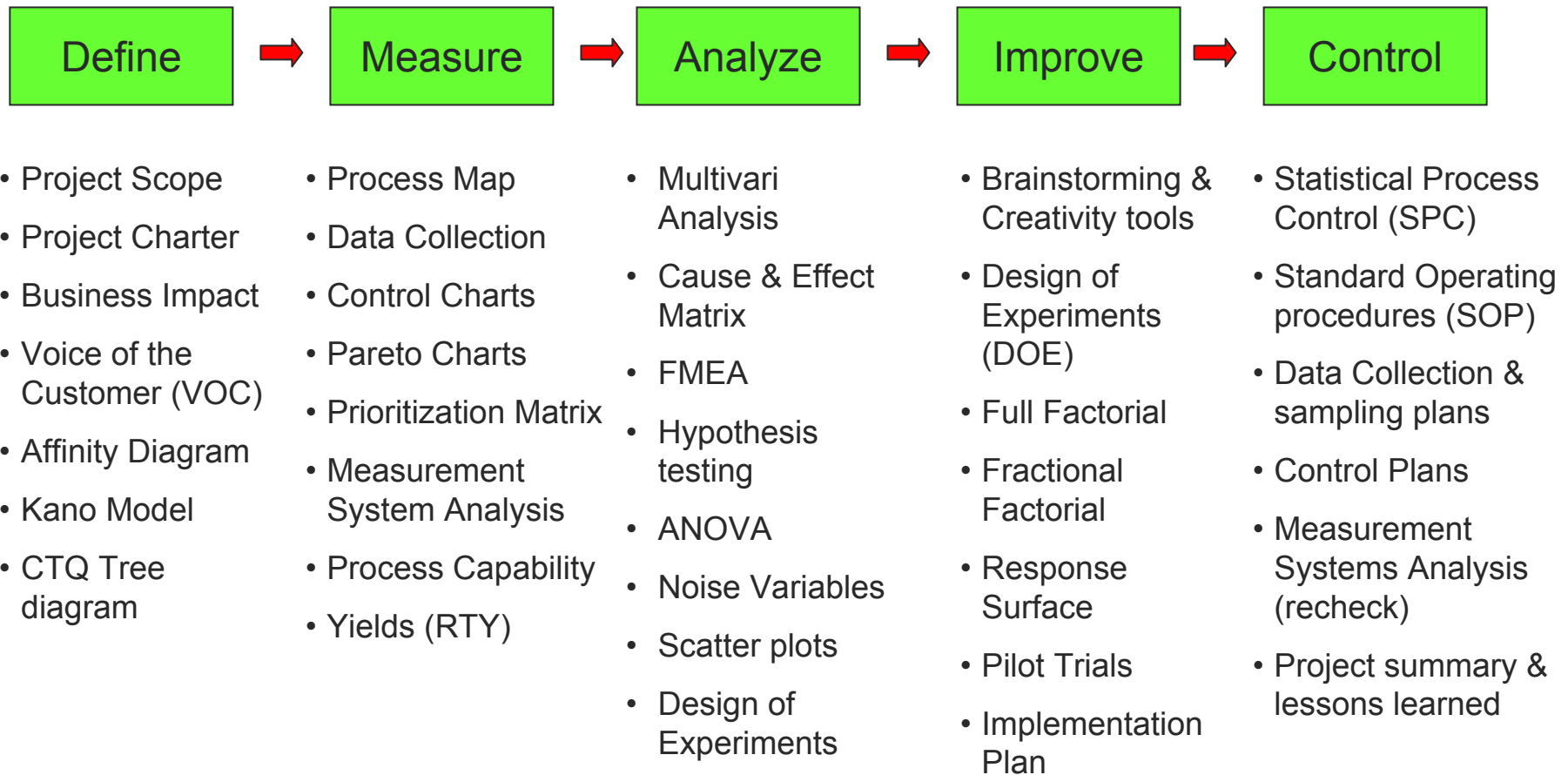
Use design of experiments to develop solutions. Eliminate the verified root cause(s), or reduce sources of variation, demonstrate with data

Control

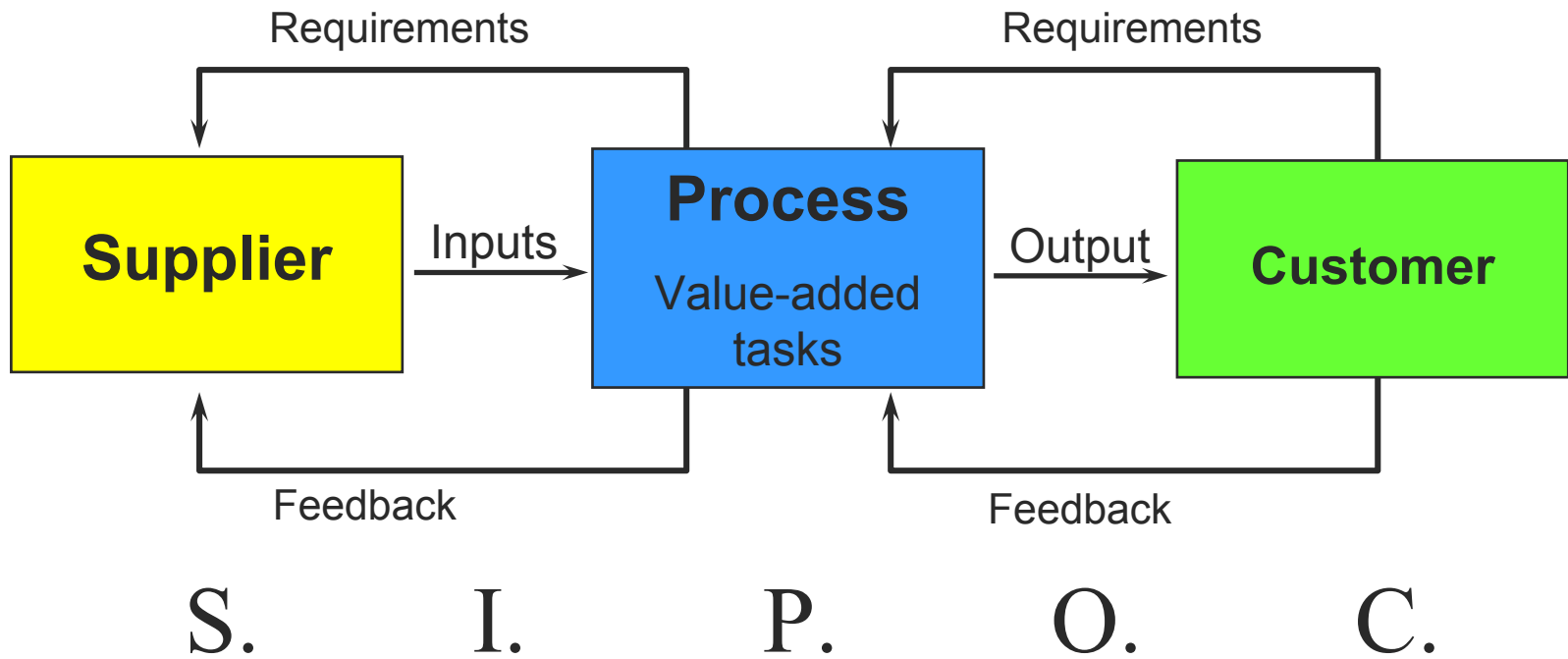


Implement methods to hold the gains such as SOP's and statistical process controls (SPC).

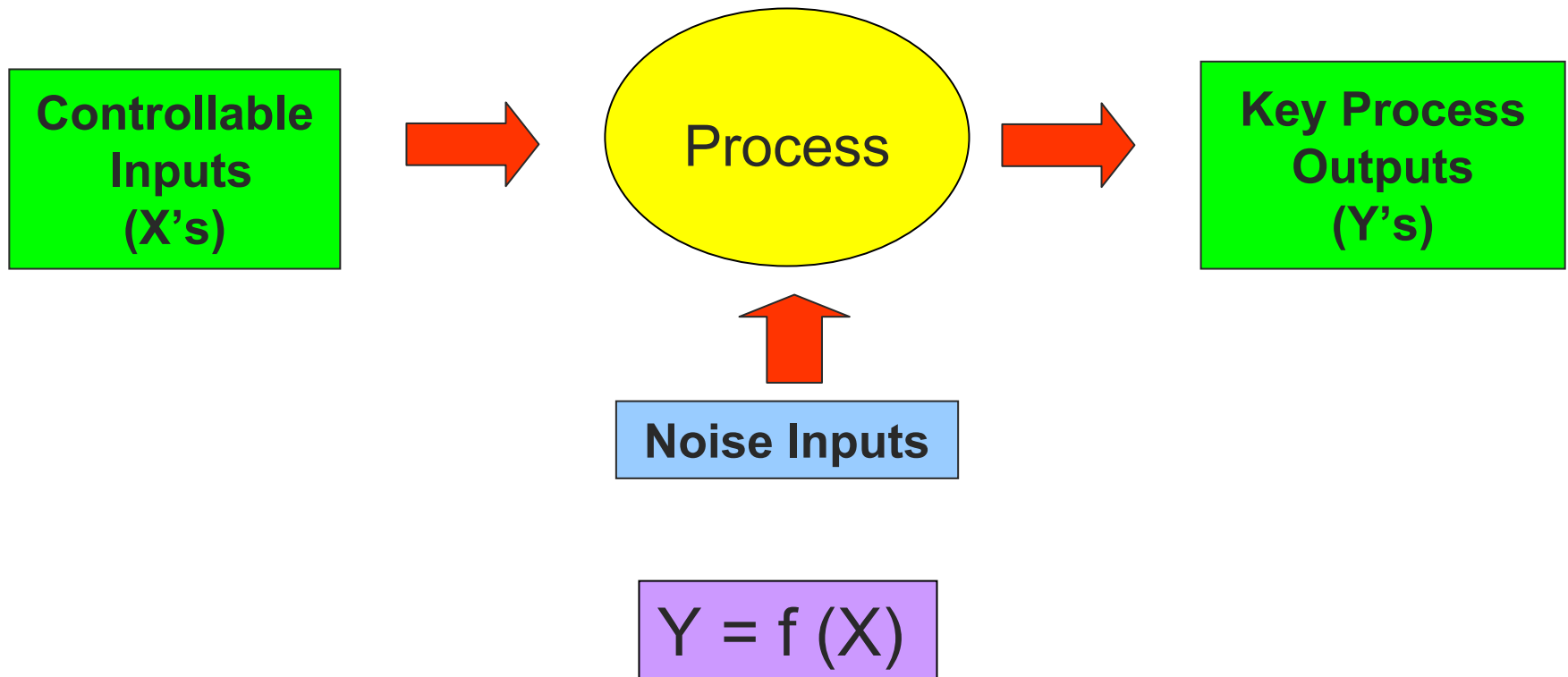
Six Sigma DMAIC Tools



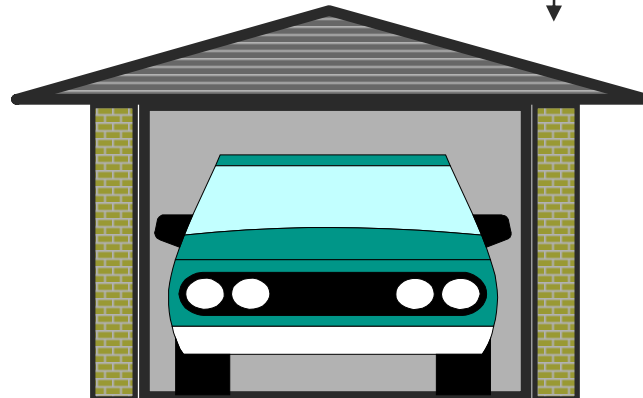
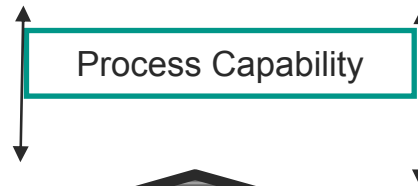
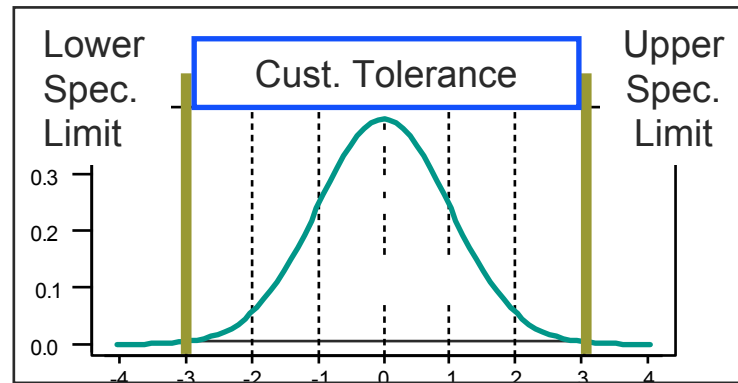
All Work is a Process



What is a process?

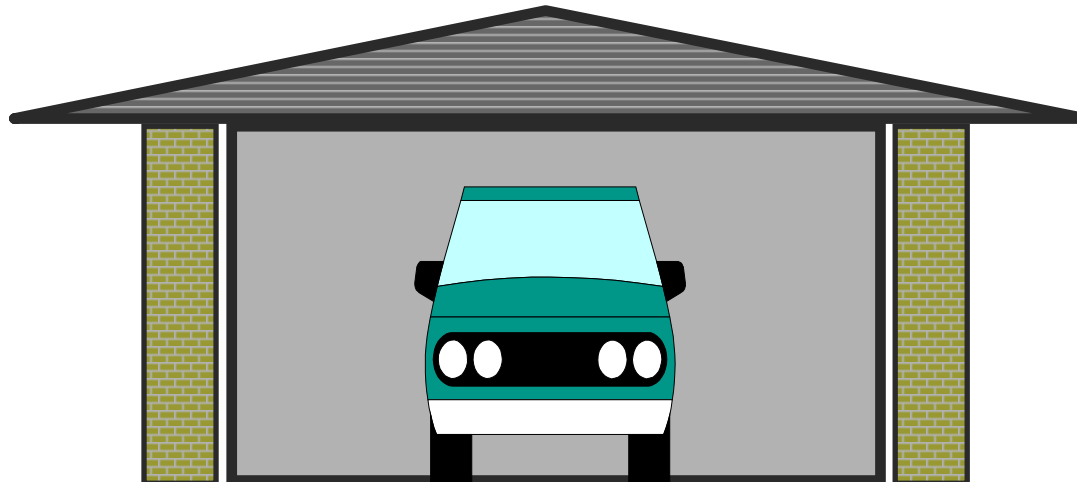
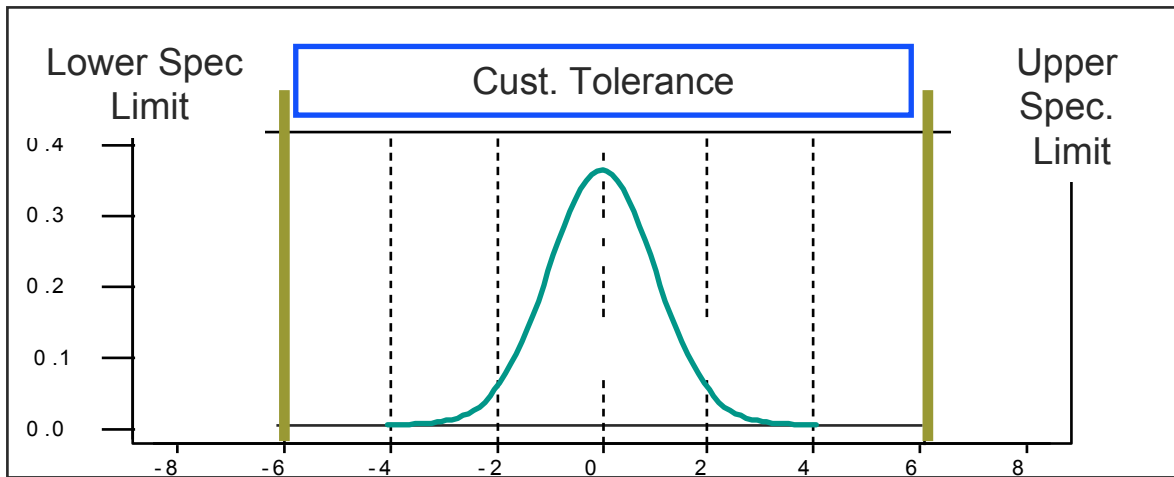


Visualizing Process Capability



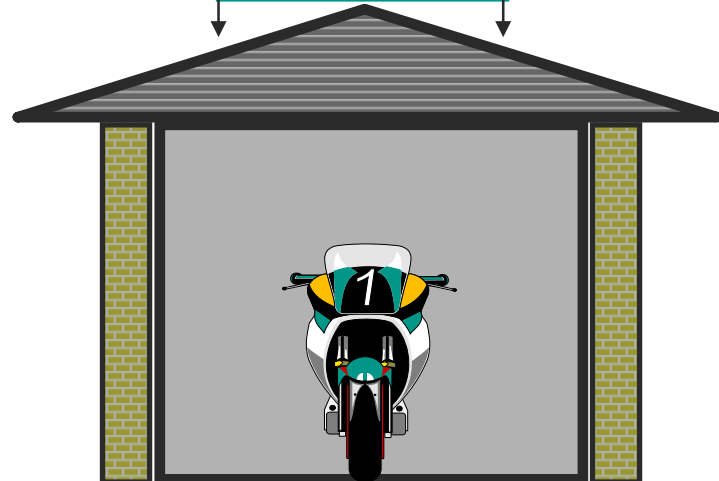
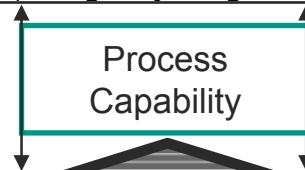
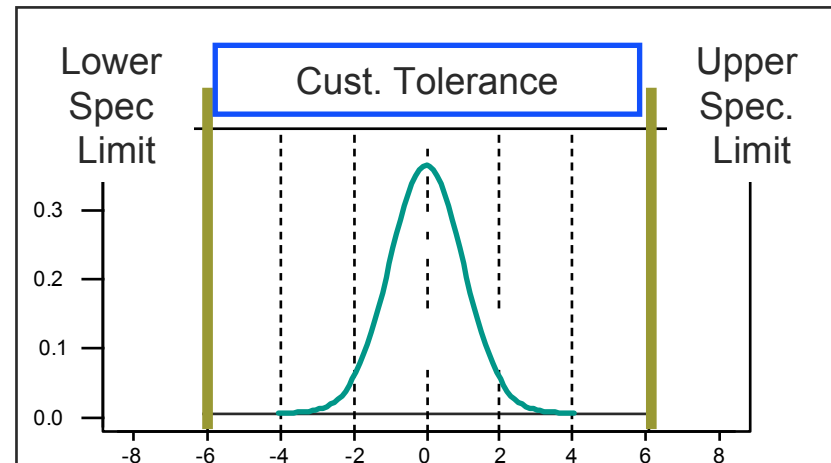
$$C_p = 1$$

Visualizing Process Capability



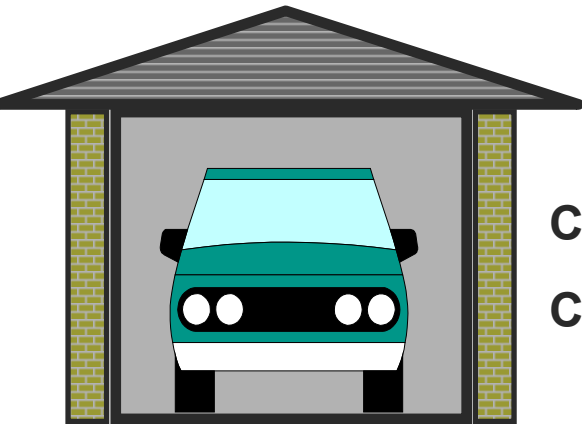
$$C_p = 2$$

Visualizing Process Capability



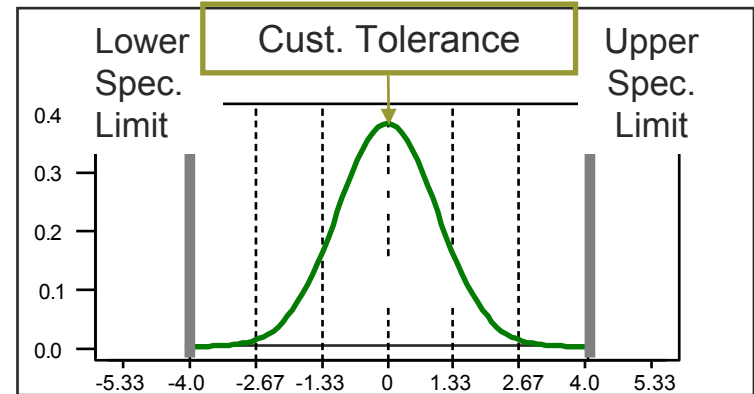
Change the process to fit in the original specification window

Process Drift



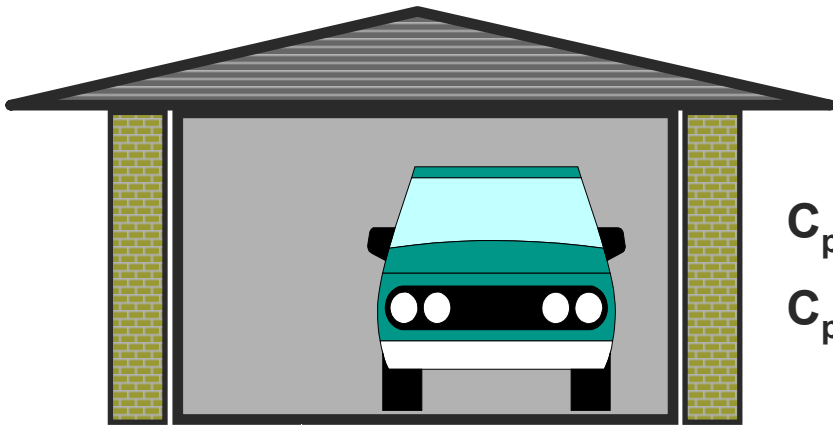
$$C_p = 1.33$$

$$C_{pk} = 1.33$$



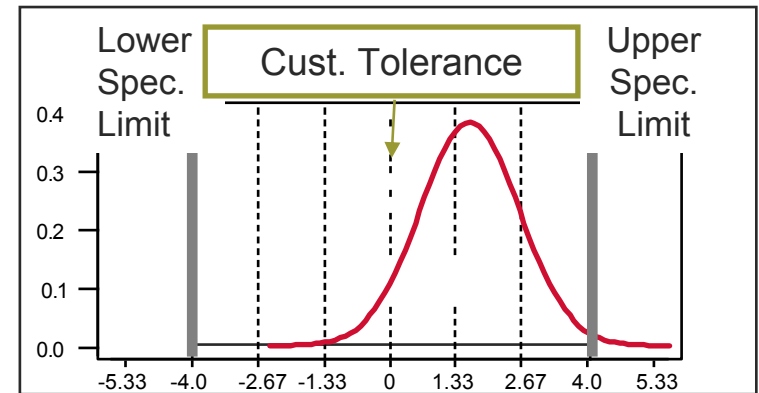
Process is Centered Between the Specification Limits

Process Drift



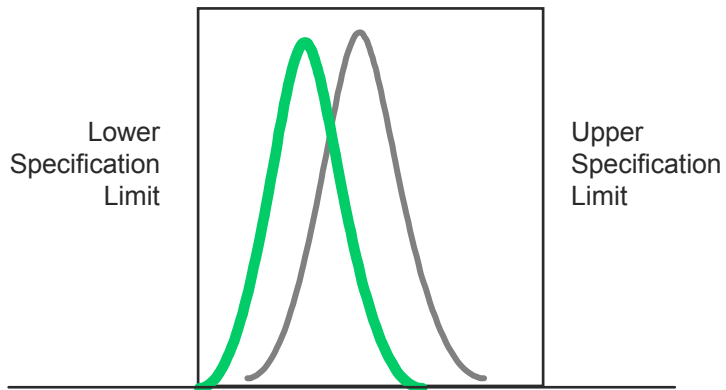
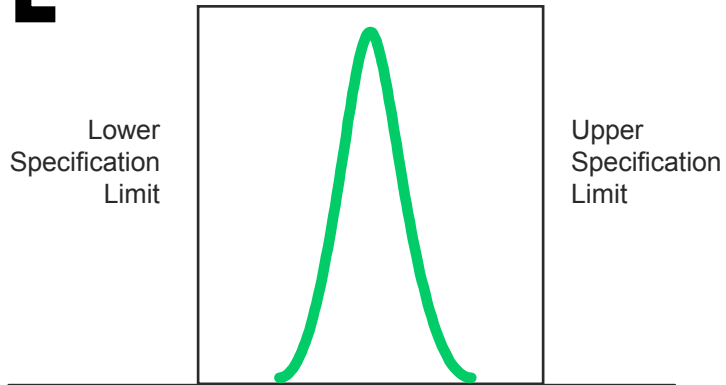
$$C_p = 1.33$$

$$C_{pk} = 0.83$$

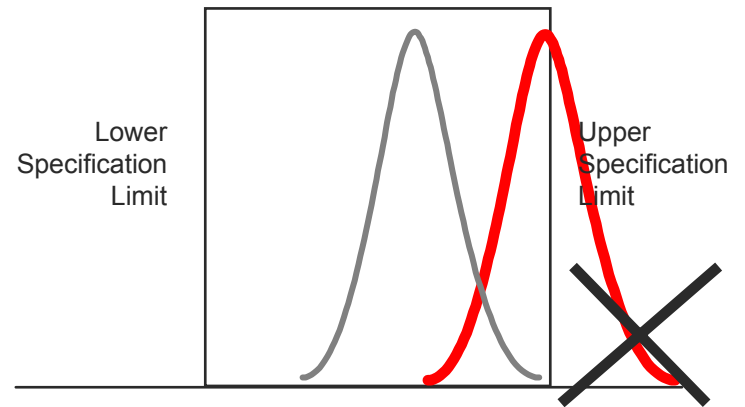
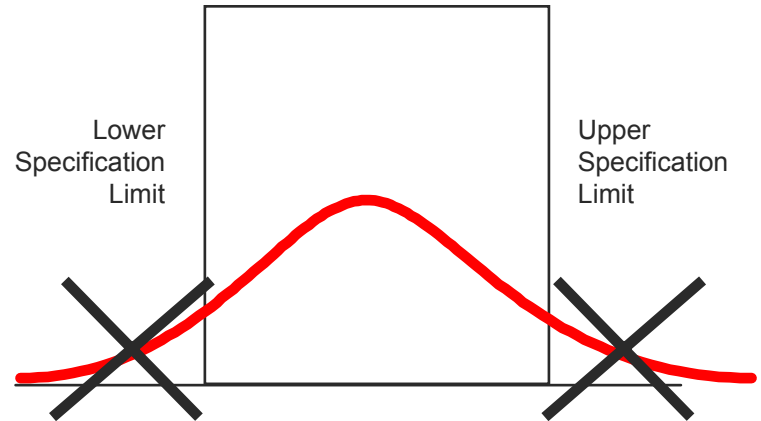


Process has Drifted Between the Specification Limits

Process Capability Summary



Capable Process

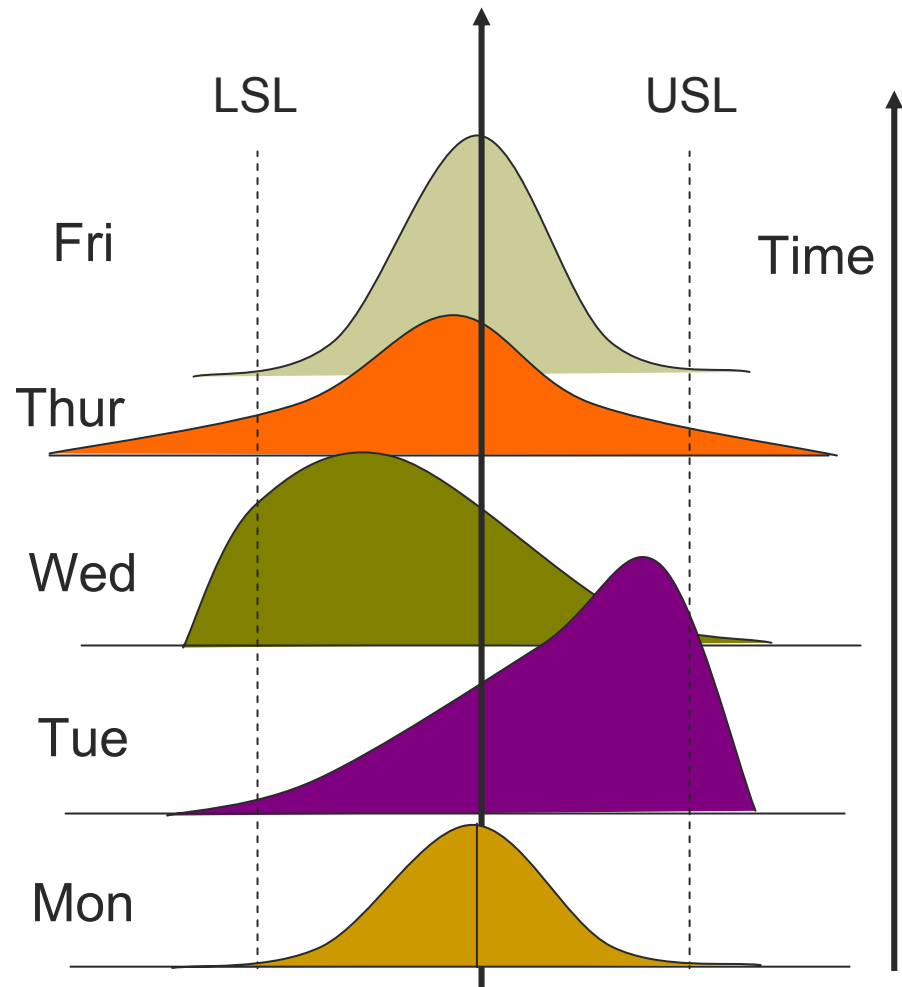


This process is not capable

Unstable Process

Unstable Process

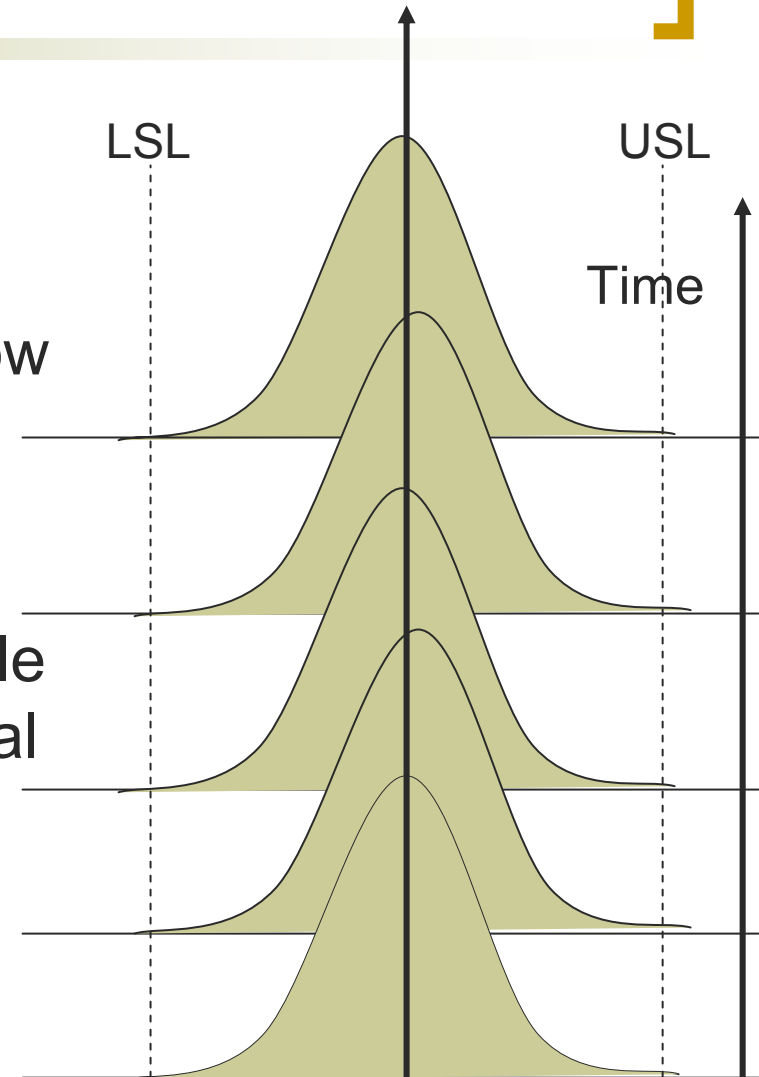
- Mean shifts present
- Excess variation (σ changes)
- Special causes of variation are present,
- Process output is not stable over time and is not predictable



Stable Process

Stable process:

- Variation reduced (lower σ)
- Process is centered in spec window
- Mean shifts reduced
- Only common cause variation is present
- Process output is stable/predictable
- The process is termed “in statistical control.”



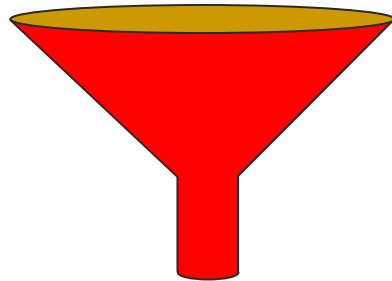
History of Six Sigma

- Originated at Motorola in the early 80's
- Doesn't use "Quality" in the name
- Uses a modification of the Deming Plan-Do-Check-Act (PDCA) cycle
- Adopted widely in the 90's by major corporations including AlliedSignal (now Honeywell), GE, Kodak, and a growing list of small, medium, and large companies.

Training for Six Sigma

- Executives
 - 8 hour Six Sigma overview and implementation roadmap development.
- Champion
 - 30 hour course, overview of DMAIC, Tools overview
 - Focus on developing project selection skills
- Black Belt
 - 160 hours of classroom, total of four months to train
 - Required to have a project
- Green Belt
 - 30-80 hours depending on training philosophy
 - May or may not have to complete a project

Identifying Six Sigma Projects



Easy to Fix?

yes →

Quick Hit

no ↓

Solution Available?

yes →

Other Initiative

no ↓

Six Sigma Project

Basic Project Criteria

- Problem in key business activity
- Large financial impact
- Can measure and quantify performance

- Process focus
- Analyze $Y = f(x)$
- Reduce variation & defects
- Complex relationships

Project Focus

- Projects are chartered by Champions and business leaders
- Led by Black Belts
- Assisted by Green Belts
- Each experienced Black Belt can typically handle between 4-6 projects per year
- Typical financial impact is approximately \$175,000 per project
- Experienced Black Belt can generate about \$1M in savings per year

Why adopt Six Sigma?

- Concept has been around for 16 years, proven track record at big companies.
- Has shown the most endurance and return on investment of any improvement initiative.
- Starting to be implemented in small and medium-sized corporations.
- Provides a comprehensive set of philosophies, tools, methods, and fundamental concepts leading to quantifiable business results.
- Involves the entire organization; from CEO, CFO, Champions, Black Belts, Green Belts, and workers.

What are the Challenges?

- Takes careful preparation and a commitment to fundamental change efforts required.
- Training – key for all levels in the organization
- It is not a quick fix nor a “one-size-fits-all” approach.
- Statistical analysis is not generally part of the engineering discipline in most companies.
- Tendency to work on too many projects at once. Resource limitations are real!
- Need to manage expectations on payback time, typically takes 9-12 months from roll-out to start seeing quantifiable financial gains.



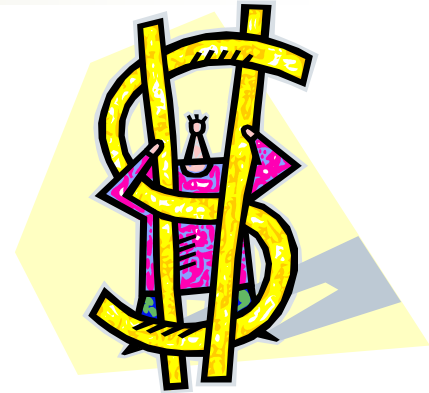
What are the Rewards

- Increased value to the customers and shareholders.
- Improved reliability and predictability of products and services.
- Significant reduction in defects.
- Institutionalization of a “process” mindset.
- Increased competitive advantage.



Some Results...

- Motorola – 10 years; \$11 Billion Savings
- AlliedSignal - \$1.5 Billion estimated savings
- General Electric – started efforts in 1995
 - 1998: \$1.2 Billion less \$450 Million in costs... net benefits = \$750 Million
 - 1999 Annual Report: more than \$2 Billion net benefits
 - 2001: 6,000 projects completed; \$3 Billion in savings



Six Sigma Summary

- Disciplined & Systematic Approach
 - Process orientation, drive for variation reduction
 - Focus on quantitative methods and tools
 - Focus on control to hold the gains
 - Uses a new metric for defects (sigma, DPMO, ppm)
- Results oriented management leadership, using data-driven decision making
- Significant training & organizational learning

Six Sigma Summary

- Success happens “one project at a time”
- Good project selection leads to large financial impact
- Implementation is hard work, not magic. Expect bumps in the road, stay the course, results will happen
- Six Sigma is “A journey not a destination”

Questions?

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