UNIVERSITAS KOMPUTER INDONESIA

[TAR] Chap 15

Chapter 7a: USE OF SIX SIGMA IN OPERATIONAL RISK

Dr. Ir. Yeffry Handoko Putra, M.T

What is Six Sigma

- managerial concept combining Lean and Six Sigma that results in the elimination of the seven kinds of wastes / muda (classified as Transportation, Inventory, Motion, Waiting, Overproduction, Over-Processing, and Defects) and provision of goods and service at a rate of 3.4 defects per million opportunities (DPMO). A mnemonic for the wastes is "TIMWOOD".

- In real-world terms, this means that 99 percent good (a traditional standard in business) is no longer good enough

HOW GOOD?

99% Good (3.8 Sigma)	99.99996% Good (Six Sigma)
20,000 lost articles of mail per hour	Seven articles of lost mail per hour
Unsafe drinking water for almost 15 minutes per day	One unsafe minute of drinking water every seven months
5,000 incorrect surgical operations per week	1.7 incorrect surgical operations per week
Two short or long landings at major airports every day	One short or long landing at major airports every five years
200,000 incorrect drug prescriptions each year	68 incorrect drug prescriptions each year
No electricity for almost seven hours each month	One hour without electricity every 34 years
11.8 million shares incorrectly traded on the NYSE every day	4,021 shares incorrectly traded on the NYSE every day
Three warranty claims for every new automobile	One warranty claim for every 980 new automobiles
48,000 to 96,000 deaths attributed to hospital errors each year	17 to 34 deaths attributed to hospital errors each year

Six Sigma is

- is a *management philosophy and culture that passionately embraces* defect-free process performance across the business;
- is a *disciplined, fact-based problem-solving methodology that focuses on* producing reliable and consistent results that meet customer and stockholder expectations; and
- is a *stretch goal. Six sigma companies strive to deliver services, products,* and profitable results, consistently within expectations—*every time.*

Drivers

- What do you believe is necessary to manage your business?
- How do you measure success?
- What do you look at?

Our motto:

If you cant Measure it…

You can't Manage it.

Some Tools used to measure and change….

SIXSIGMA SOLUTIONS, Inc.

Tools

- Reengineering
- PDCA
- Best Practices
- Change Management Initiatives
- Lean processing
- Six Sigma Initiatives
- Lean Six Sigma Initiatives
- Etc.

Focus on improving processes through measurement and evaluation

Lean Six Sigma Drivers

- What comes to mind when you hear “Lean Six Sigma”?
- What think of when you hear “Change Management”?
- Is anyone here a Six Sigma Black/Green Belt or higher?

Processes For Improvement

Lean Six Sigma provides a process based approach to improvement. It can be used to improve any business process.

What is Lean Six Sigma?

- Comprehensive Process tool for:
  - Achieving
  - Sustaining and
  - Maximizing business success.
- Six Sigma is uniquely driven by:
  - Understanding customer needs
  - Disciplined use of facts and data
  - Statistical evaluation of “issues”
  - Attention to managing, improving and reinventing business process.

Where did it originate and how is it different?

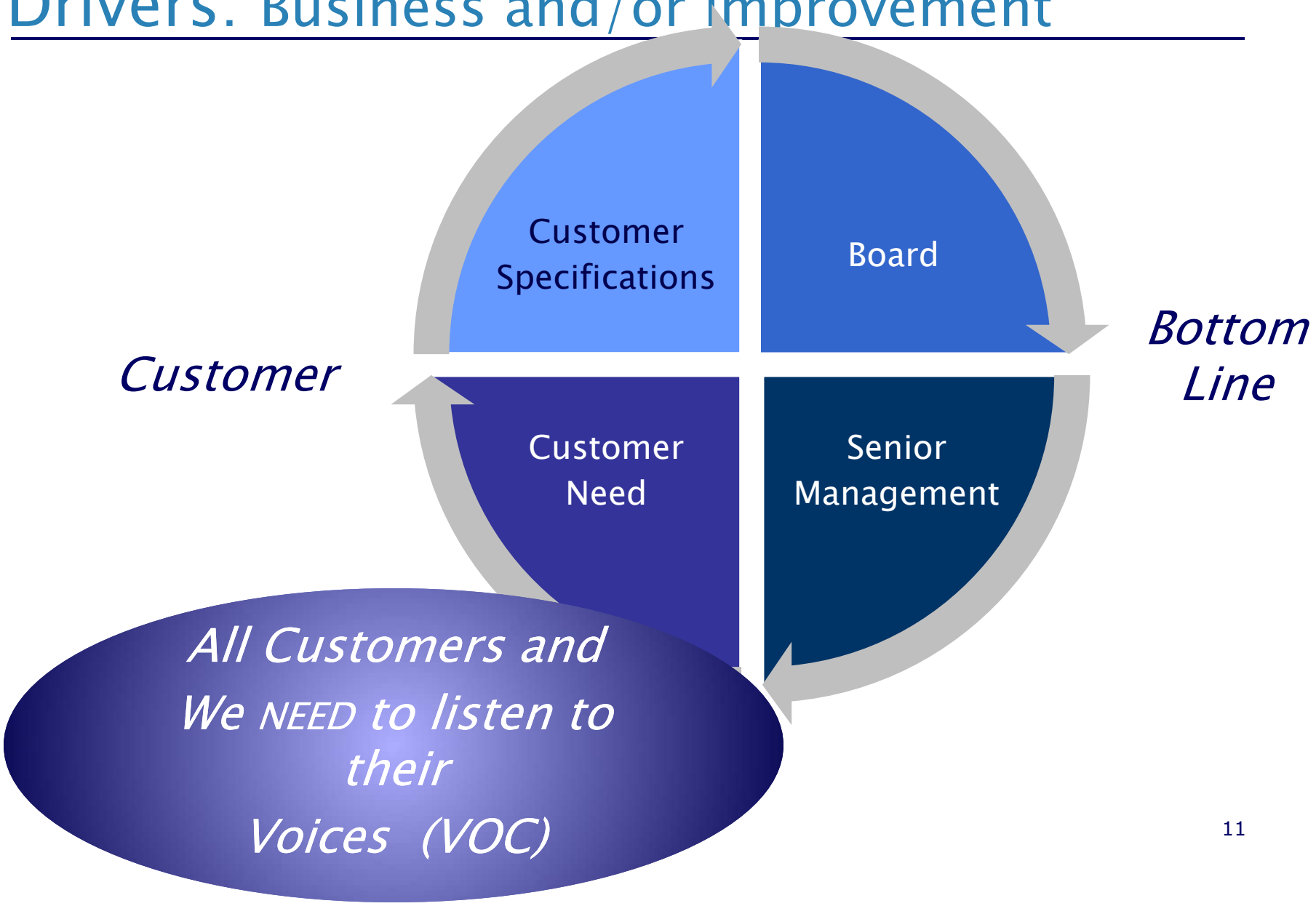
SIXSIGMA SOLUTIONS, Inc.

History of Change

- Ford's Assembly Line
- GE Western – Hawthorne –'(20s –'30s)
- PDCA cycle originally conceived – Shewart (Western Electric –'30s –'40s)
- PDCA Made famous by his assistant – Demming (The "Demming Wheel") – became CQI model (40–50s)
- Ohno / Toyoda's – Toyota Processing System (TPS) was already taking shape ('40s–'50s)
- Harry / Shroeder start the Six Sigma process initiative at Motorola (80s)
- Womack's "The Machine That Changed the World" Described *Lean* a.k.a. TPS ('90s)

What might be next?

Drivers: Business and/or Improvement



Lean Six Sigma

- Customer focused
- Data Driven
- Accurate
- Creates a “Common Language”
- Reduces waste
- Reduces variation
- Improves contribution

Distinguishes between
“the feel and the real”

Example

Roller Bearing Manufacturing

Diameter is a CTQ

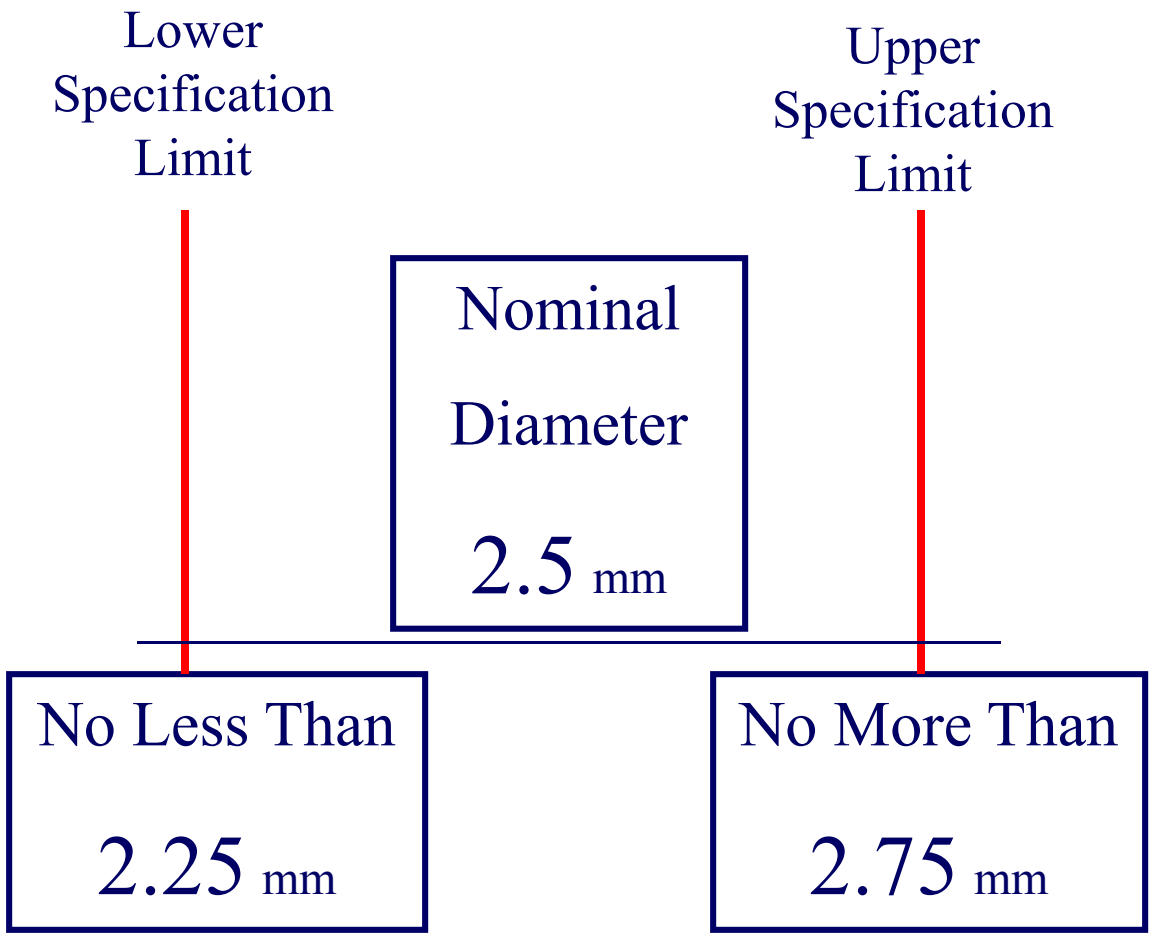
(Critical To Quality Parameter)

Nominal diameter = 2.5mm

Minimum Spec = 2.25mm

Maximum Spec = 2.75mm

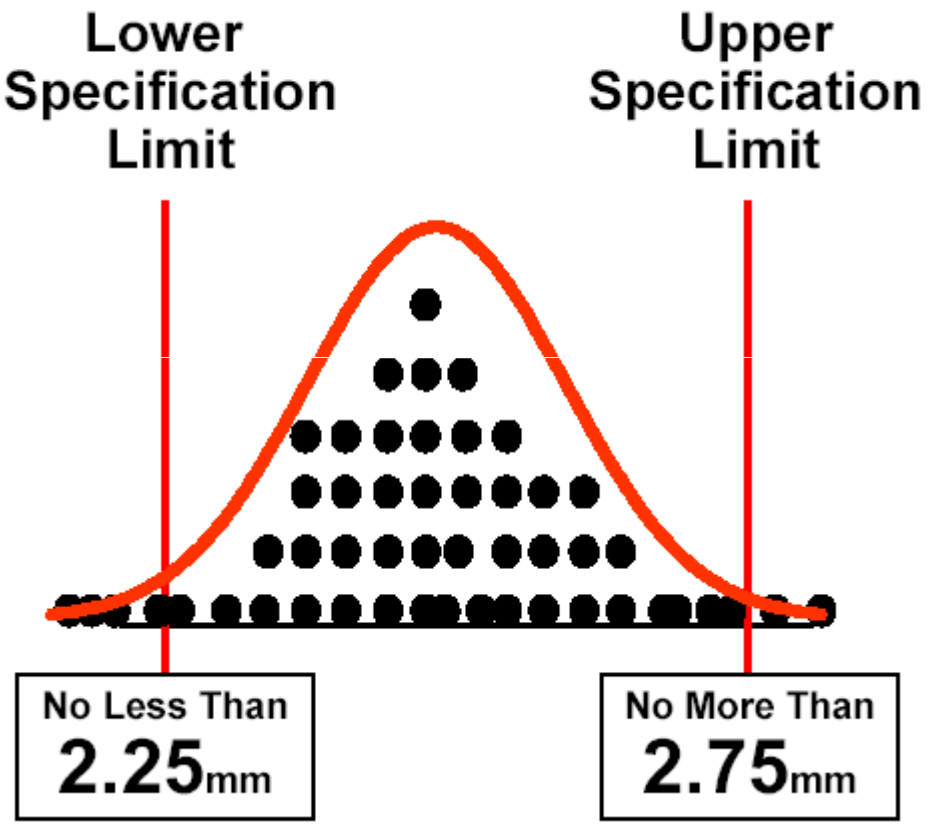
Example (Cont.)



Customer is expecting 2.5 mm

But will allow some variation within the Spec range.

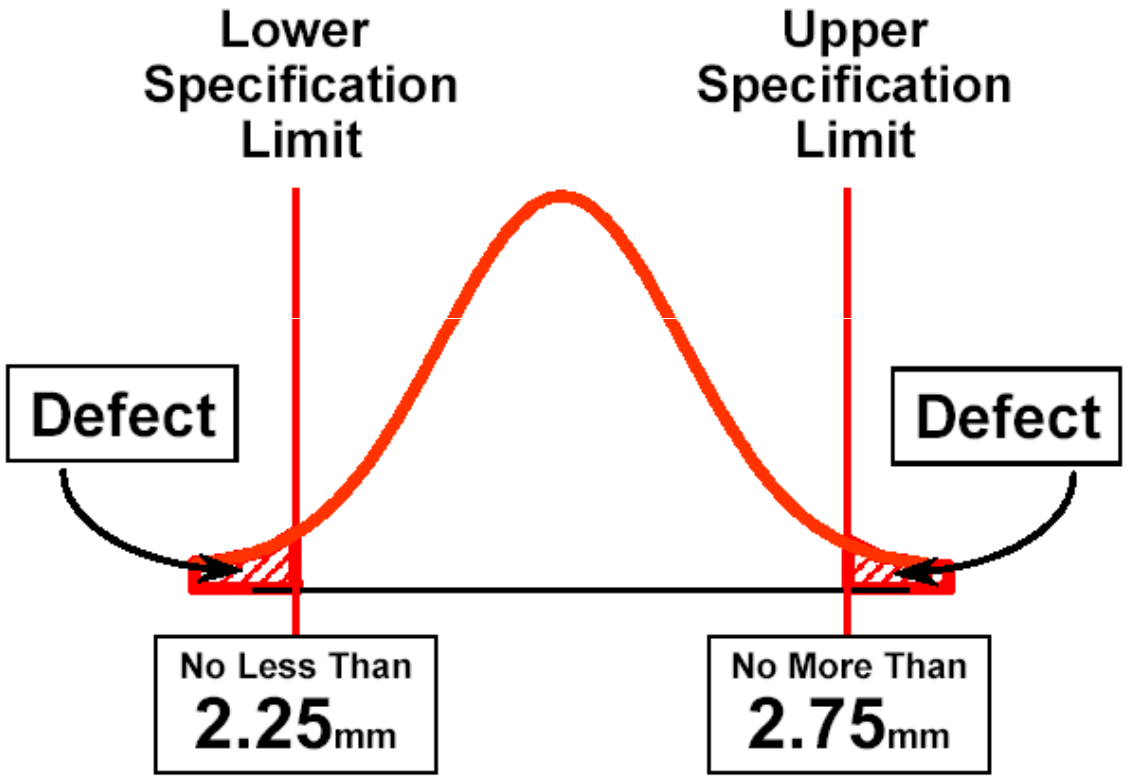
Example (Cont.)



Manufactured Roller Bearing Diameter

Actual Micrometer Measurements

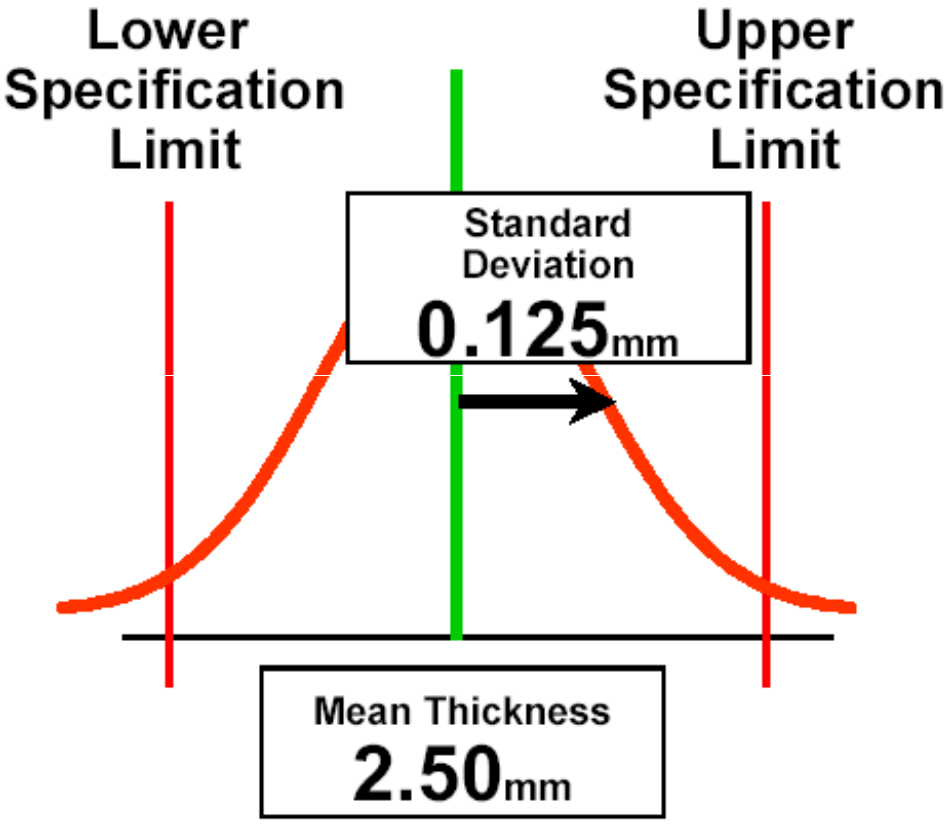
Example (Cont.)



Manufactured Roller Bearing Diameter

Variation ending up as a defect

Example (Cont.)



Let's Look at Some Basic Statistics

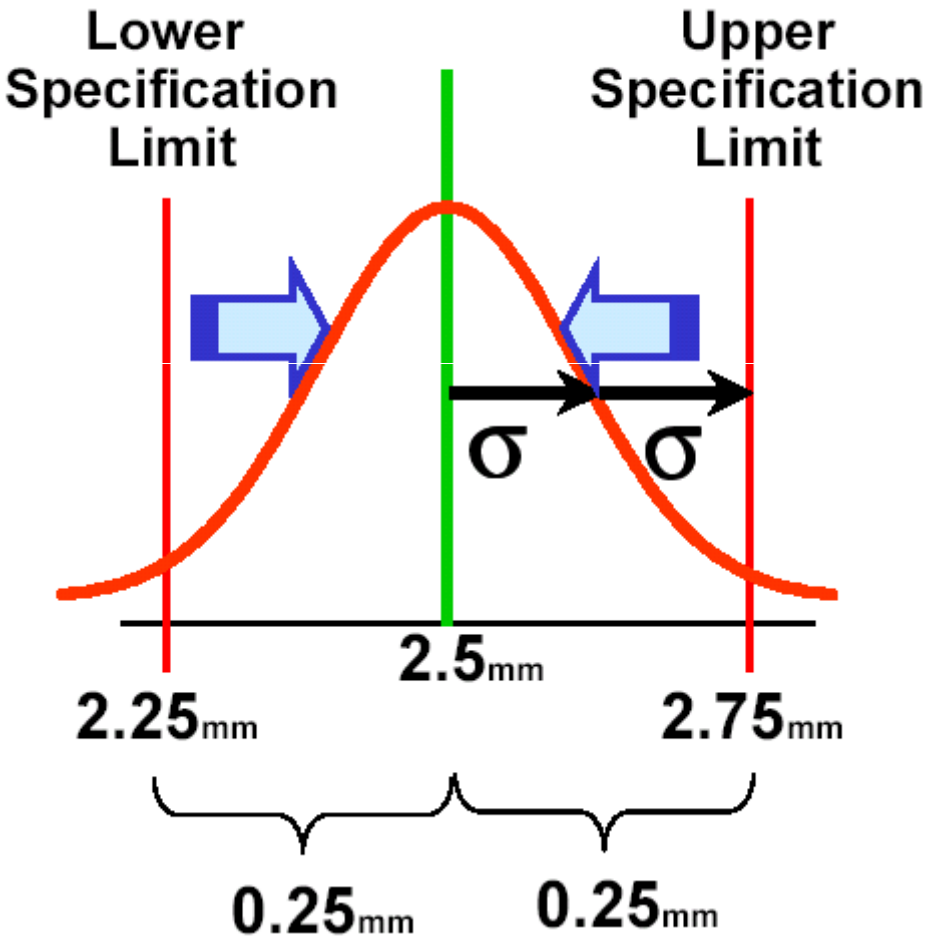
Mean diameter = 2.50 mm

Standard Deviation = 0.125 mm

On Average it's OK

It's a Variation issue

Example (Cont.)



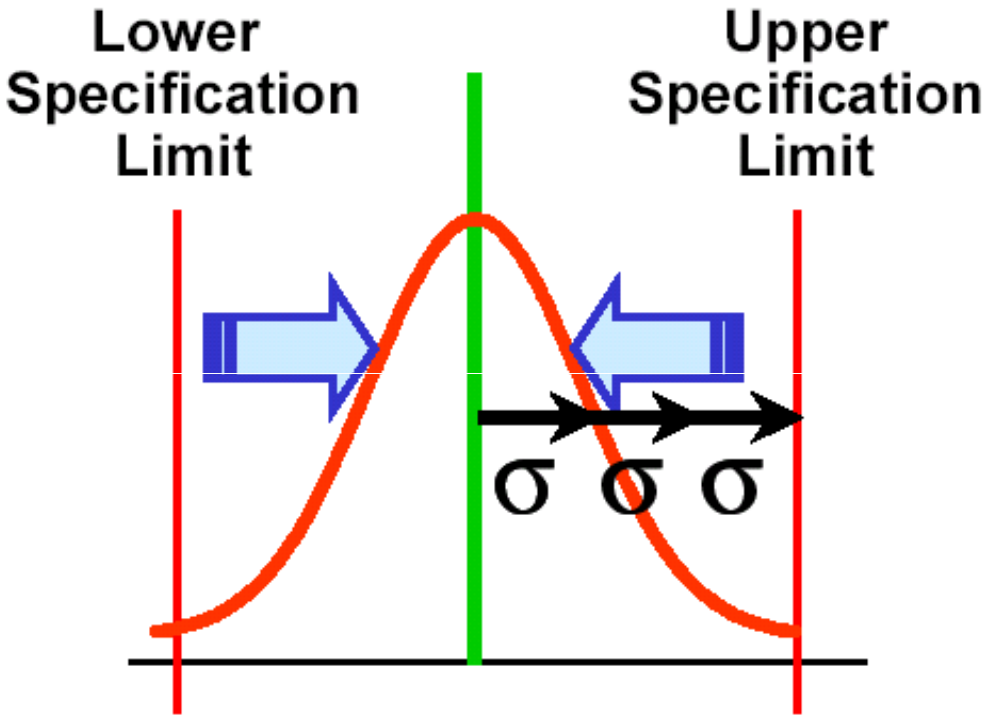
Reducing Variation is Clearly the Key to Improving Process Capability

Spec Width
0.5 mm

Std Dev
0.125 mm

2σ

Example (Cont.)



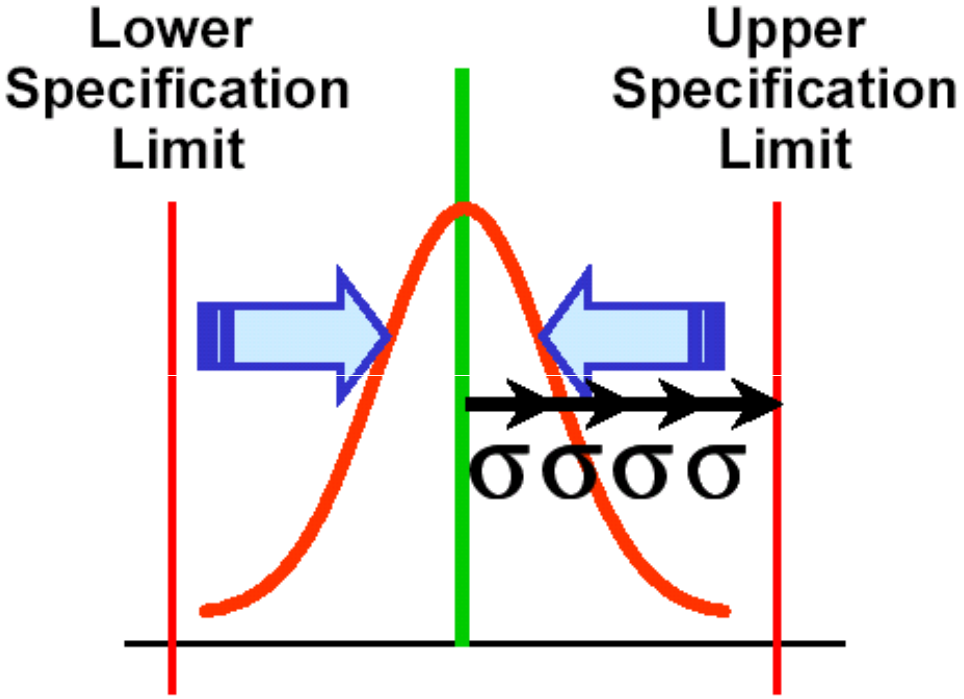
Reducing Variation is Clearly the Key to Improving Process Capability

Spec Width
0.5 mm

Std Dev
0.083 mm

3σ

Example (Cont.)



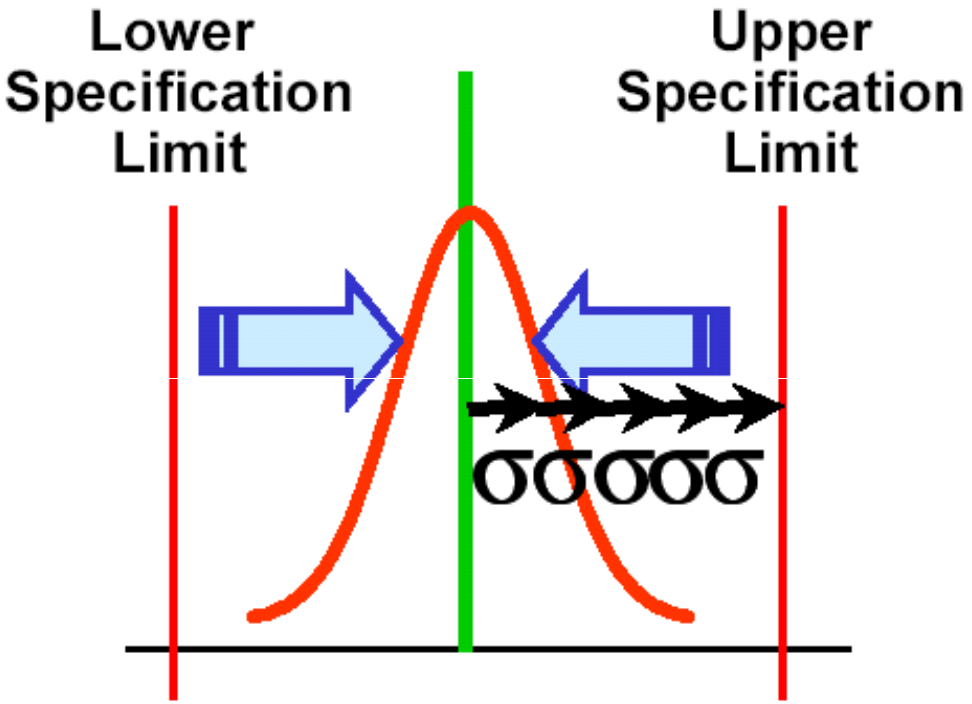
Reducing Variation is Clearly the Key to Improving Process Capability

Spec Width
0.5 mm

Std Dev
0.062 mm

4σ

Example (Cont.)



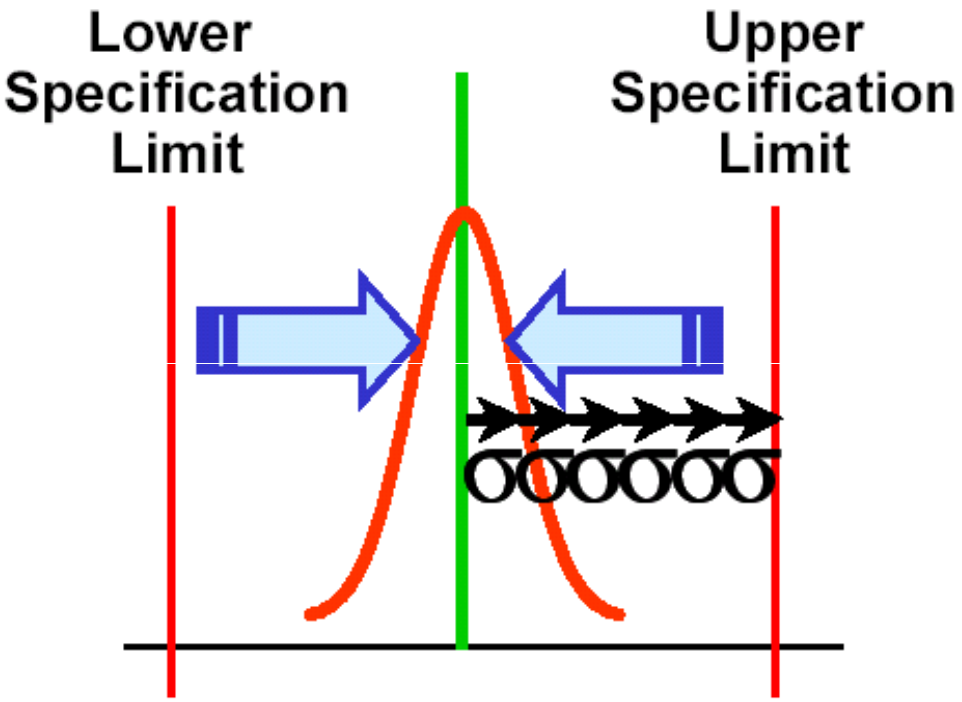
Reducing Variation is Clearly the Key to Improving Process Capability

Spec Width
0.5 mm

Std Dev
0.05 mm

5σ

Example (Cont.)



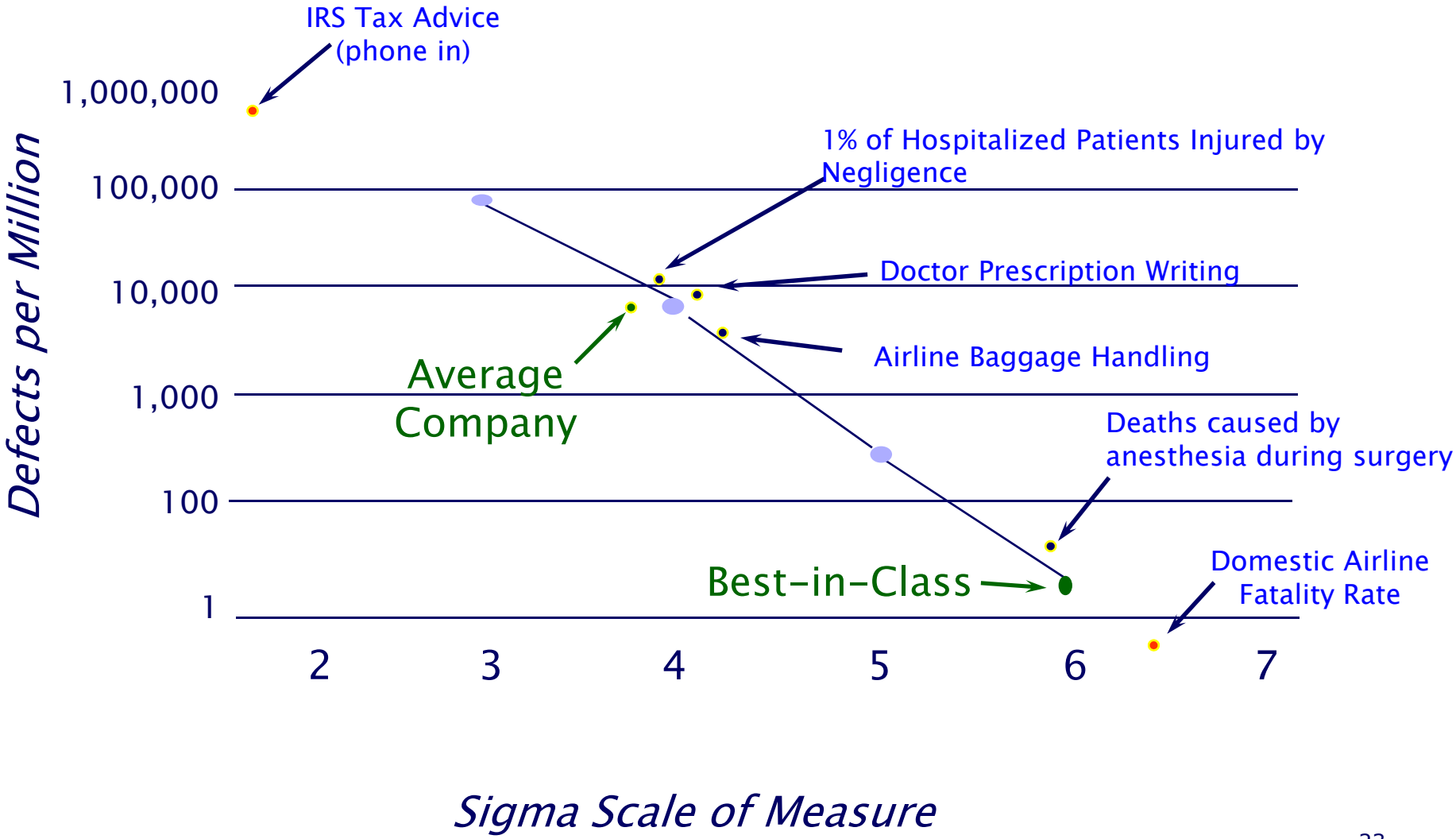
Reducing Variation is Clearly the Key to Improving Process Capability

Spec Width
0.5 mm

Std Dev
0.041 mm

6σ

How do Others Perform?



Understanding Six Sigma

STATISTICALLY

Six Sigma refers to a process that produces only 3.4 defects per million opportunities.

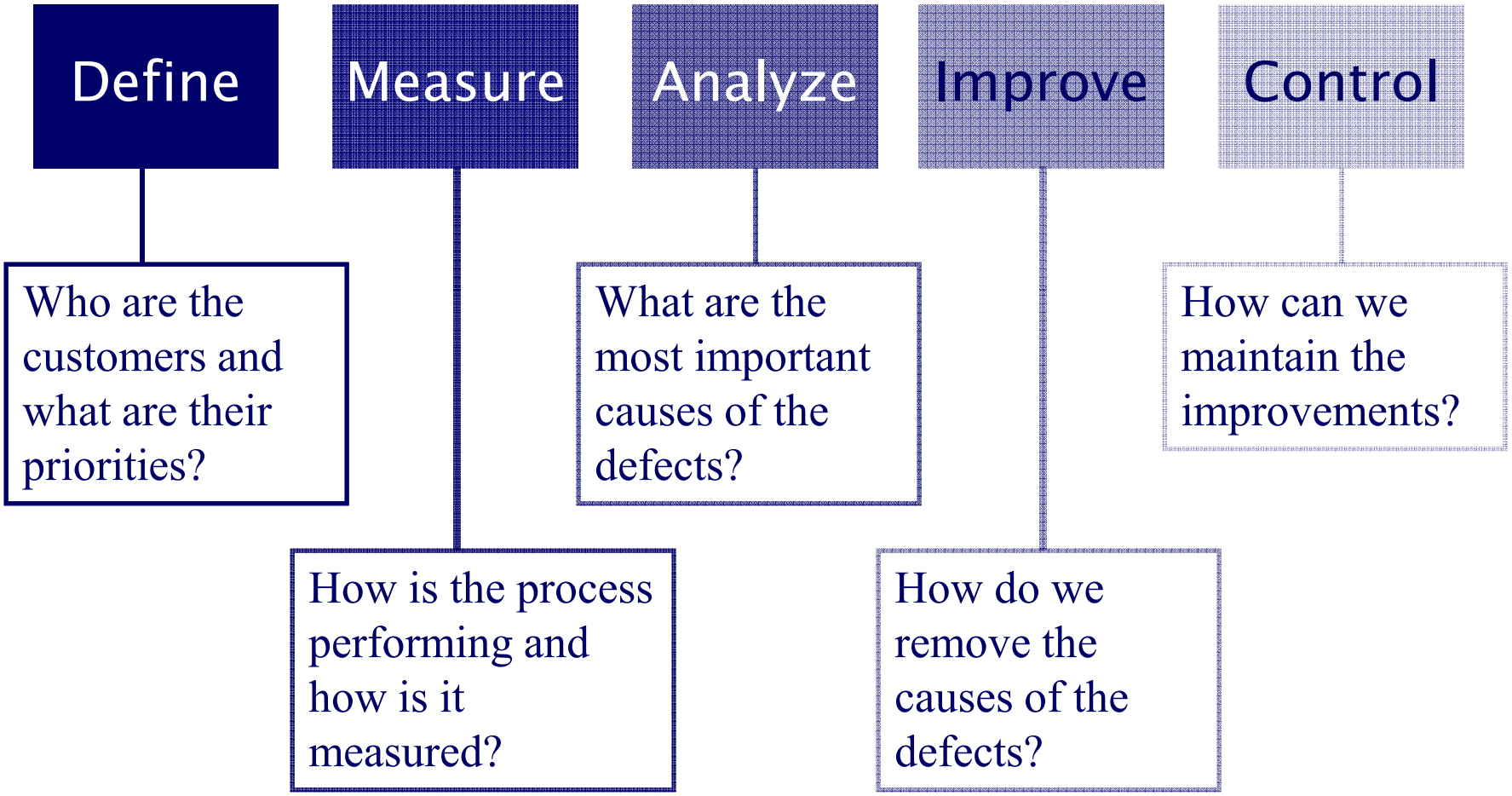
Sigma	DPMO	
2	308,537	
3	66,807	← Most US Businesses
4	6,210	
5	233	
6	3.4	← Goal

Business Strategy — An overall strategy that encompasses your organization's quality philosophy. It sets the vision for achieving Six Sigma levels in key processes.

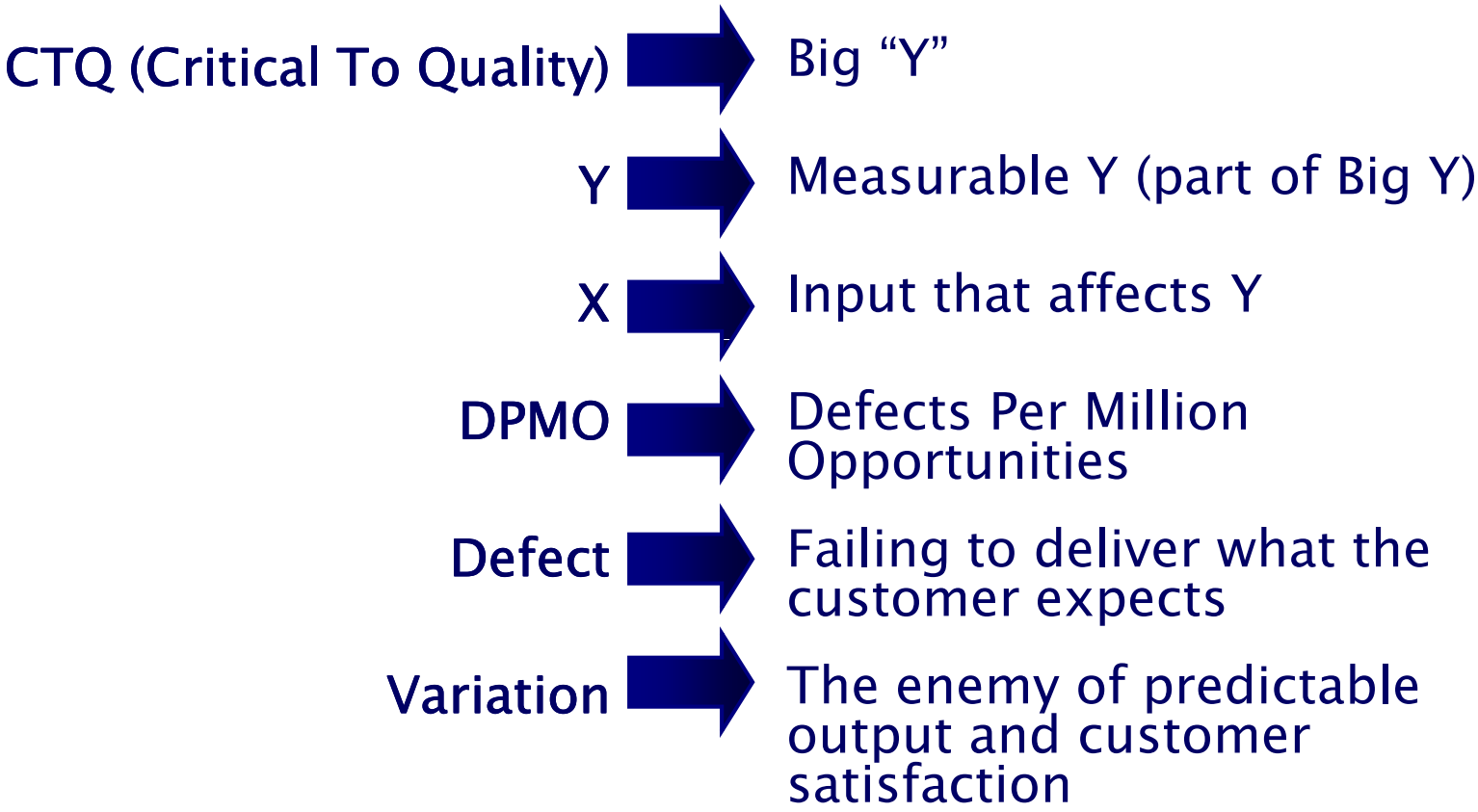
Tools And Tactics — A set of statistical tools and a disciplined methodology used by specially trained individuals to improve processes by reducing variation and defects.

Six Sigma Method

DMAIC: To improve any existing product or process



The Language Of Six Sigma



Customer Needs vs. Customer CTQ's

- Customer needs are the data collected from customers that gives information about what they need or want from your process. Customer needs are often high level, vague, and non-specific

  "I need a quick response!"

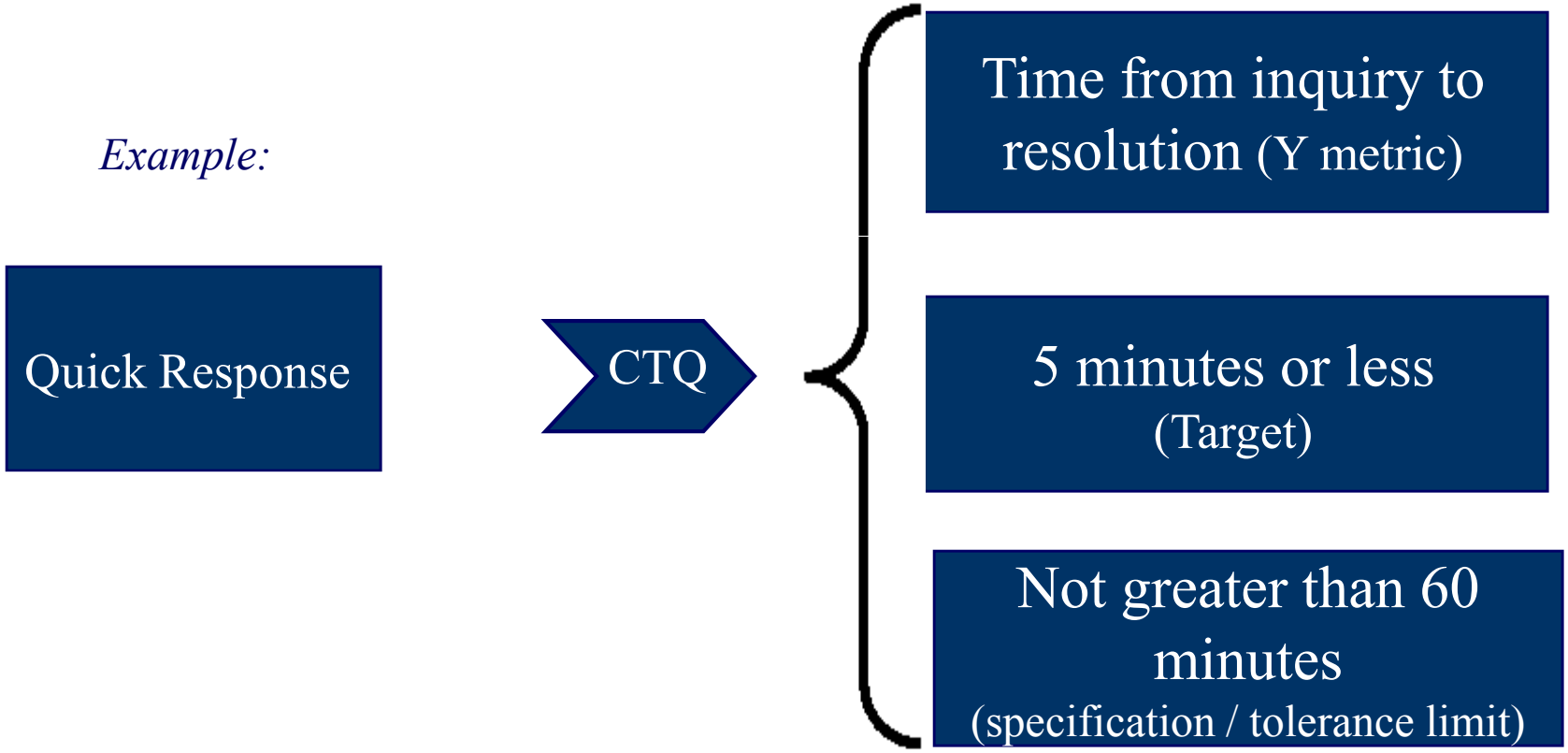
  "I need accurate information!"

- CTQ's are customer needs translated into critical process requirements that are specific and measurable. A fully developed CTQ has three elements: Y metric, target, specification/tolerance limits

Getting to the CTQ's

Translating a customer need into a fully developed CTQ

Example:



Measure Overview

What is the Measure phase?

The Measure phase defines the defects, establishes improvement goals, determines that the system of measuring defects is repeatable and reproducible and gathers data about the process.

Why is the Measure phase important?

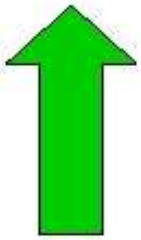
The Measure phase ensures that you specifically define the defects you are going to measure and that your measurement system is accurate before you begin to actually measure the process.

Alternatives to Measuring…

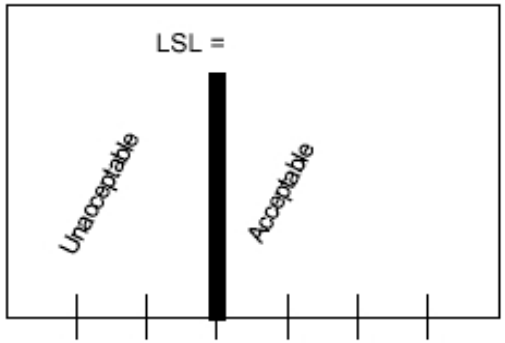
"It's an interesting concept, but we normally don't hire muses here at Techno Industries."

Specifications

More is Better

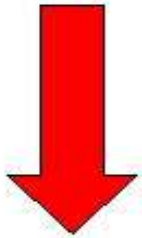


One-sided - lower specification limit

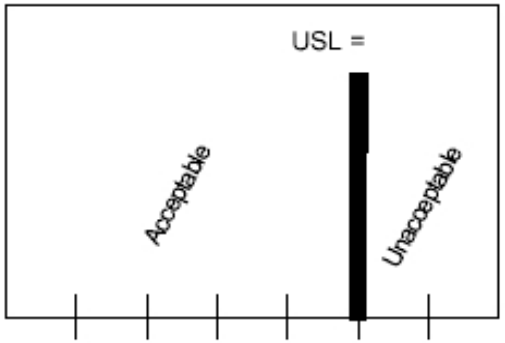


- **Throughput**
- Mean Time Between Failures

Less is Better



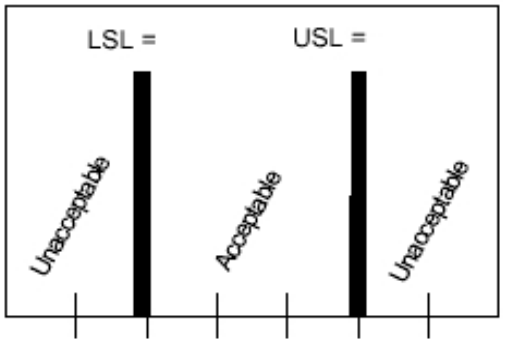
One-sided - upper specification limit



- **Cycle Time**
- **AR days**
- % Defects

The Bull's Eye

Two-sided specifications



- **Delivery Date**
- **Stock Level**
- **Medication Time**

SIXSIGMA SOLUTIONS, Inc.

Analyze Phase

Purpose:

Identify the key sources of variation (vital X's) by analyzing data and the process

Steps:

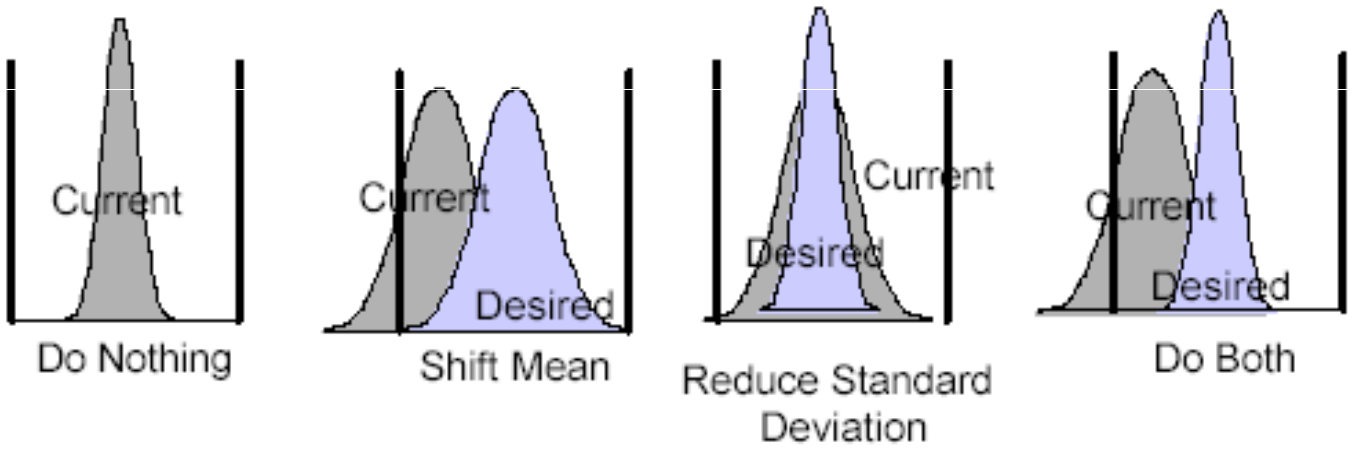
- Define Performance Objectives
- Identify Variation Sources
  - Graphical Tools
  - Hypothesis Testing
  - Regression Analysis

Primary Goal: Determine the vital few X's

Analyze

Define Performance Objectives

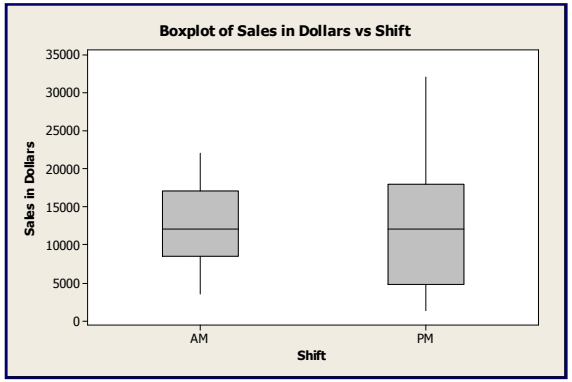
State the improvement goal in statistical terms

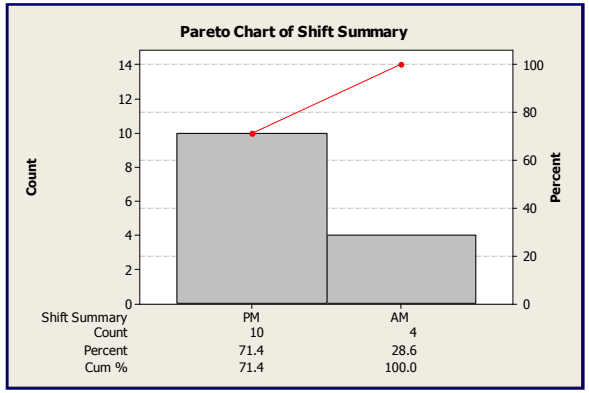


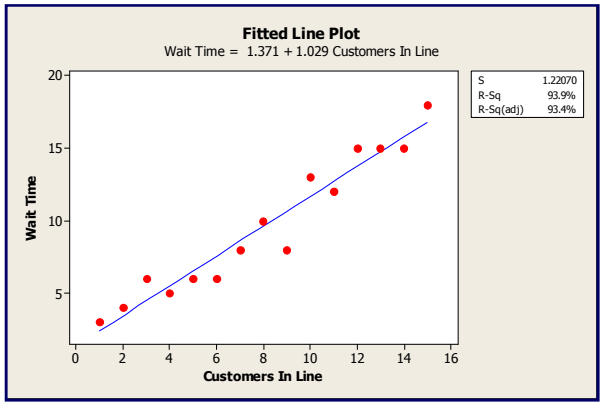
Analyze: Graphical Tools

Find potential X's using data analysis techniques on the data collected in Measure.

Examples of some of the data analysis tools are shown here:



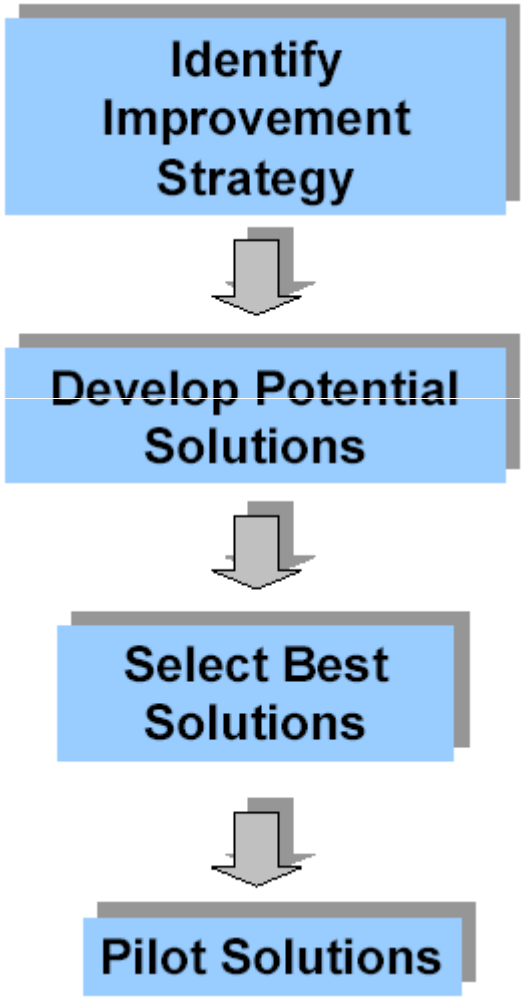




Improve Phase

- **Purpose:**
  - To confirm that the proposed solution(s) will meet or exceed the quality improvement goals of the project
  - To identify the resources required for successful full-scale implementation of that solution
- **Steps:**
  - Screen potential causes
  - Discover variable relationships
  - Process improvement techniques

Improve General Approach



- Select improvement strategy

Critical Elements:

- Process Improvement
- Standard Operating Procedures
- Best Practices
- Brainstorming
- Mistake Proofing

- Cost / Benefit Analysis

- Plan for Pilot
- Run Pilot
- Collect & Analyze Data

Piloting the Solution

Plan and Prepare Pilot

Execute Pilot

Analyze Pilot

Document and Transition

Pilot: small scale, localized, high level of control, high level of scrutiny

Scale-up: gradual, highly monitored

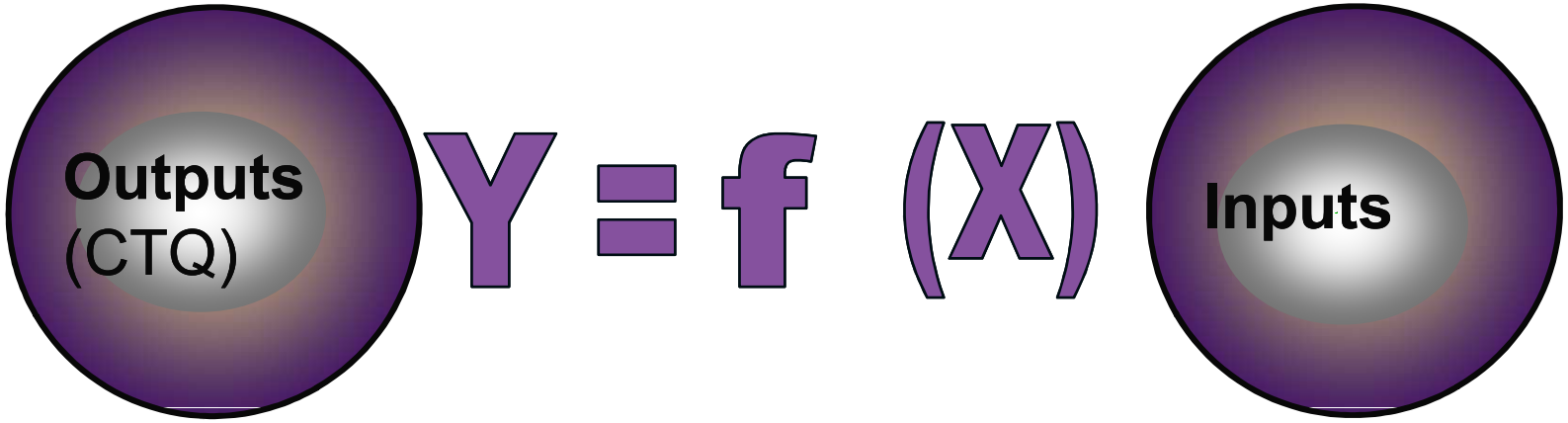
Full-scale implementation: everyday hospital environment, monitoring plan

Pilot solution on a small scale or for a specific period of time in a real business environment. Verifies that process meets CTQ's

THE SIX SIGMA METHODOLOGY

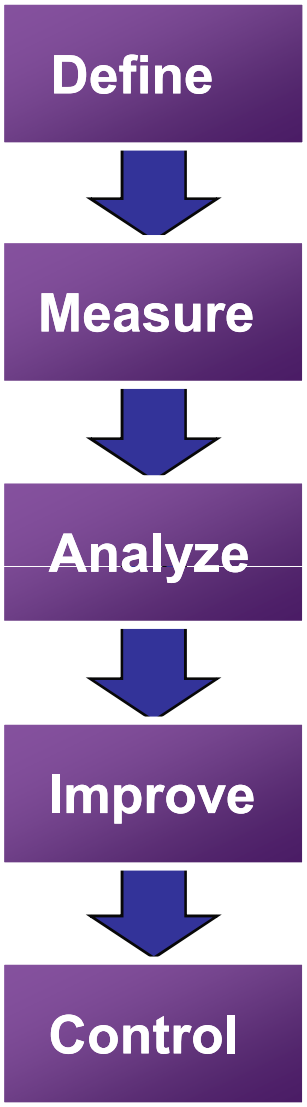
- *Process owner.* This individual is responsible for a process
- *Champion. This individual could be the process owner*
- *Six sigma green belt. This person is a part-time employee who has undergone* one to two weeks of training in the six sigma methodology
- *Six sigma black belt . This person is a full-time employee who is essentially* the project manager in a six sigma project
- *Master six sigma black belt . This individual is a full-time employee who* has the responsibility to manage the education, training, and promotion of the program.

Six Sigma Basic Premise



Do you know what is important to customers?
Do you know what "Xs" are important to meet customer needs?
How do the "Xs" drive outcomes, revenue, and cost?

Six Sigma DMAIC Methodology



Develop Project Charter
Determine Customers & CTQs
Map High-Level Process

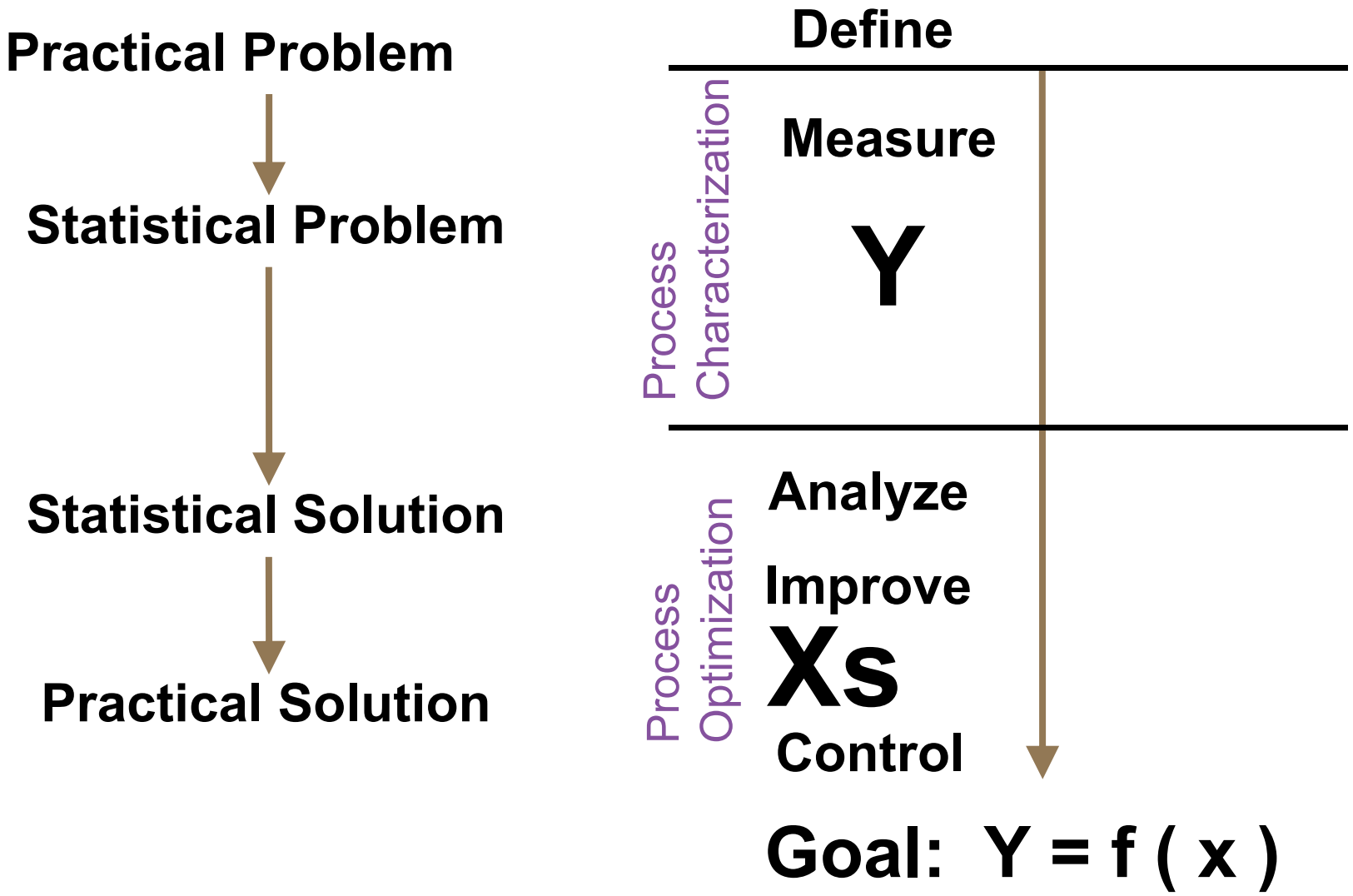
Establish and Measure Ys
Plan for Data Collection
Validate Measurement System
Measure Baseline Sigma
Identify Possible Xs

Test Hypotheses
List Vital Few Xs

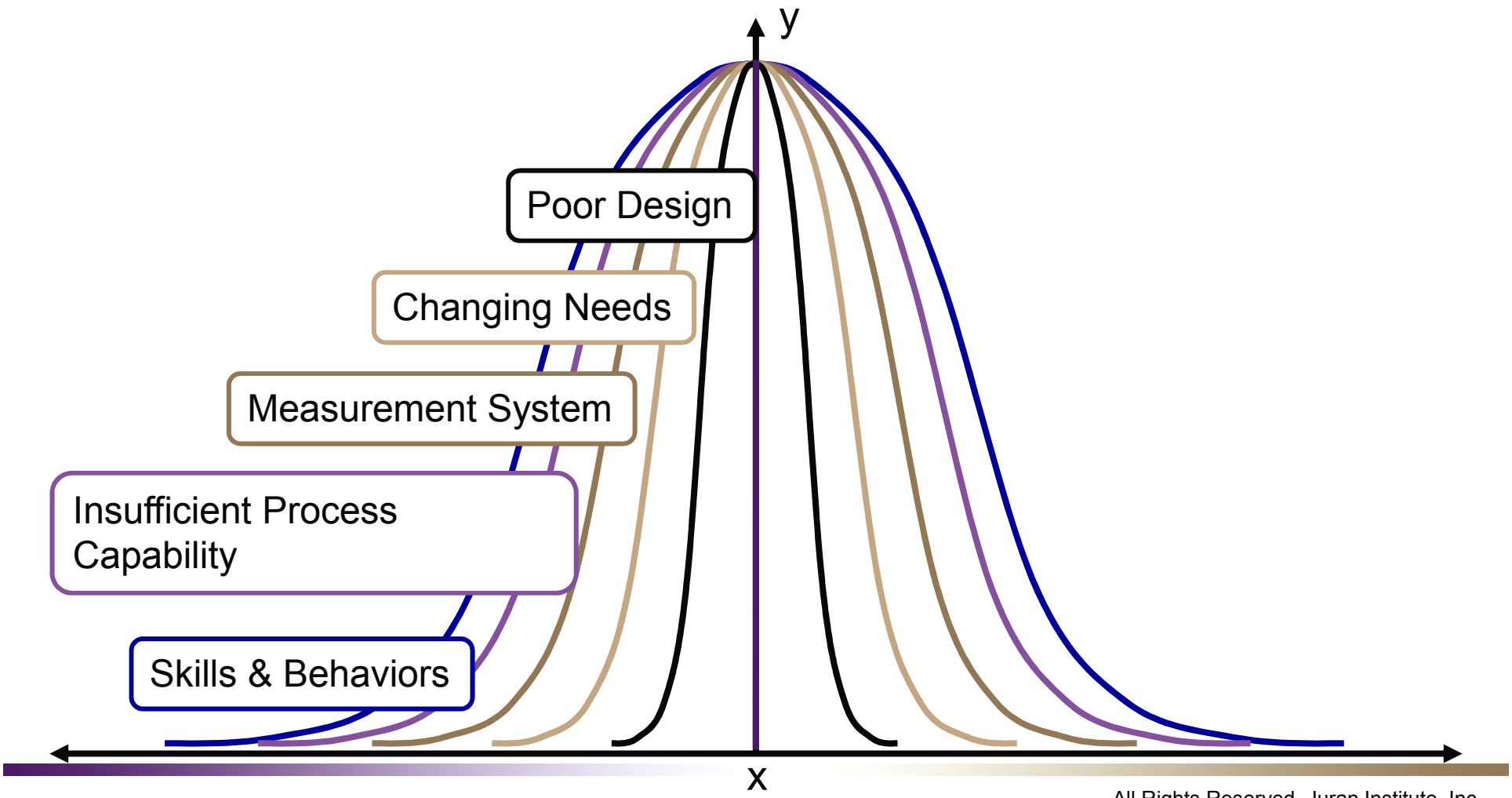
Select the Solution
Design Solution, Controls, and Design for Culture
Prove Effectiveness

Identify Control Subjects
Develop Feedback Loops
Develop Process Control Plan to Hold the Gains
Implement, Replicate

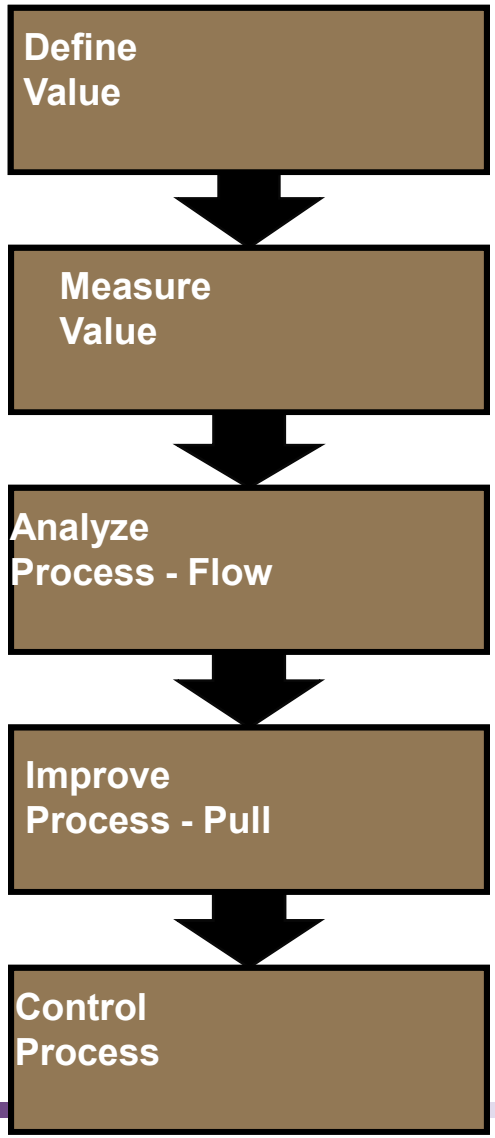
Six Sigma Methodology



Sources of Variation



Lean Methodology



Define Stakeholder Value and CTQs
Define Customer Demand
Map High-level Process
Assess for 6S Implementation

Measure Customer Demand
Plan for Data Collection
Validate Measurement System
Create a Value Stream Attribute Map
Determine Pace, Takt-time and Manpower
Identify Replenishment and Capacity Constraints
Implement S1-S3

Analyze the Value Stream Attribute Map
Analyze the Process Load and Capacity
Perform VA/NA Decomposition Analysis
Apply Lean Problem Solving to Solve for Special Causes

Conduct the Rapid Improvement Event
Design the Process Changes and Flow
Feed, Balance, Load the Process
Standardize Work Tasks
Implement New Processes

Stabilize and Refine Value Stream
Complete Process and Visual Controls
Identify Mistake-proofing Opportunities
Implement S4-S6
Control Plan, Monitor Results, and Closeout Project

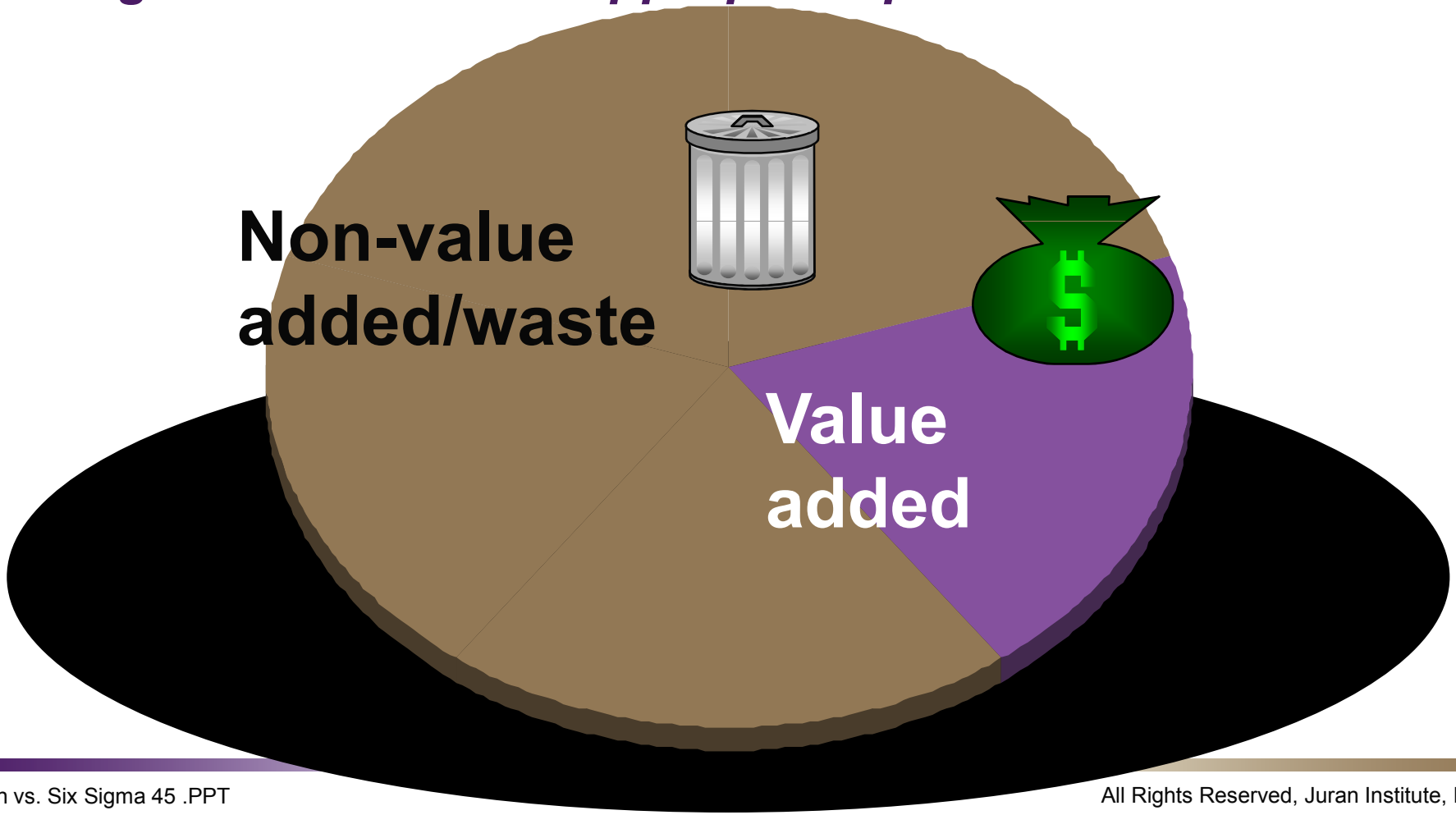
Why Define a Process as a Value Stream?

A Value Stream

- Focuses attention on what is important for the customer.
- Identifies all the necessary components to bring a product or service from conception to commercialization.
- Identifies waste inherent in processes and works to remove it.
- Reduces defects in products and deficiencies in processes.
- Focuses on improving specs and cost.

What Is Typically Found

Lean Value Stream Management starts with defining value in terms of products and process capabilities to provide the customer with what they need at the right time and at an appropriate price.

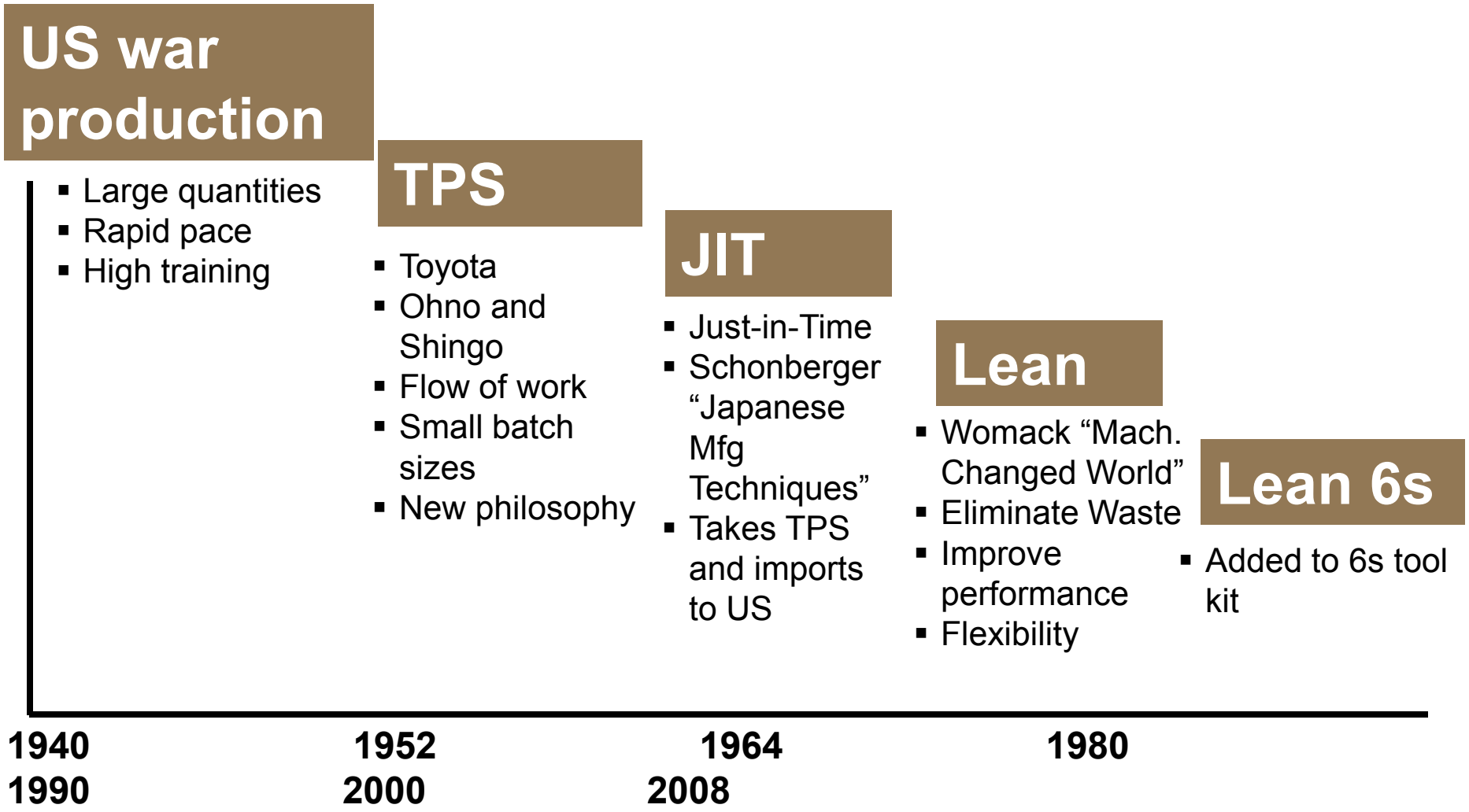


The Eight Wastes

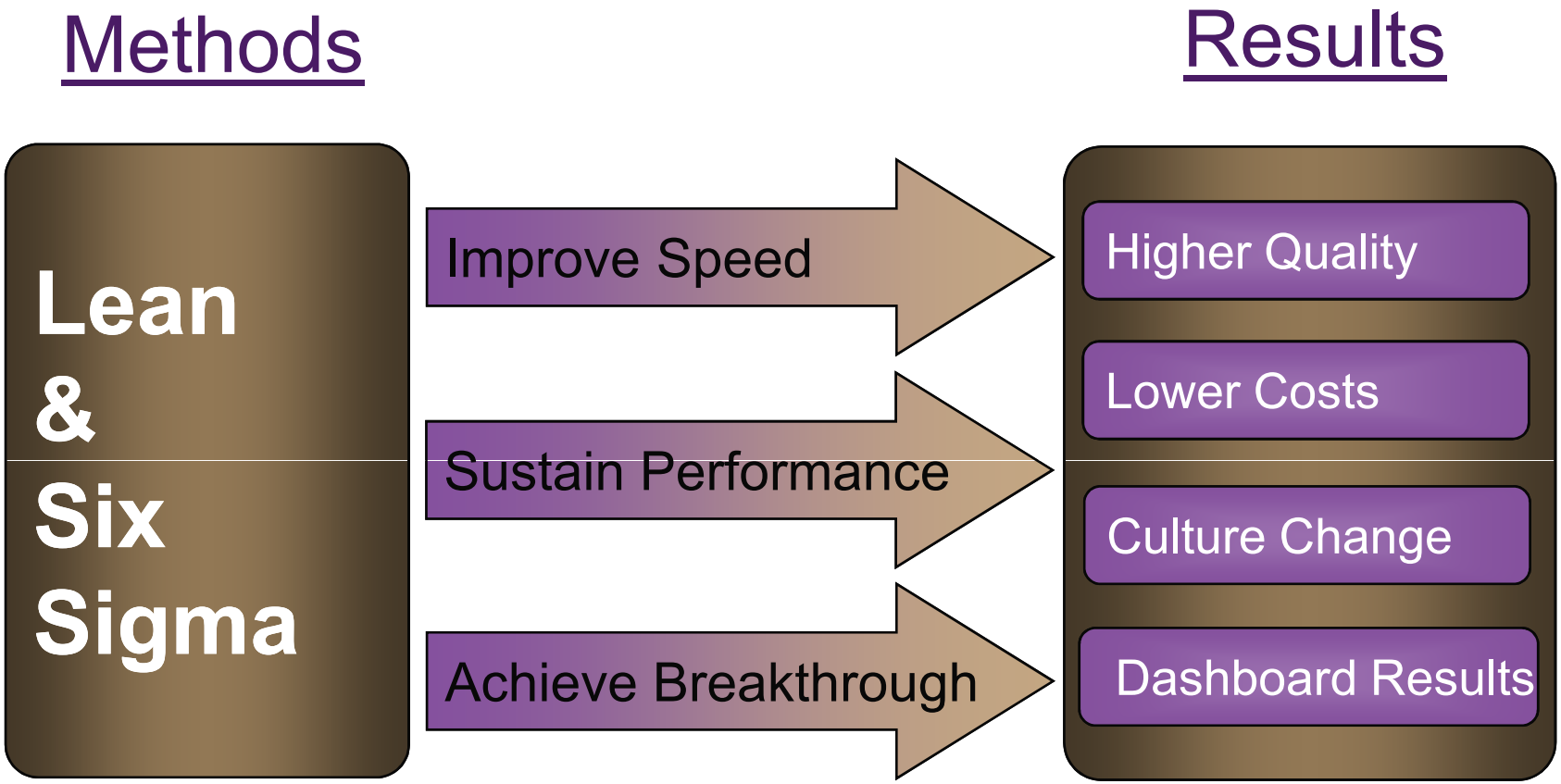
adapted from Taiichi Ohno

1. ***Overproduction***—making or doing more than is required or earlier than needed.
2. ***Waiting***—for information, materials, people, maintenance, etc.
3. ***Transport***—moving people or goods around or between sites.
4. ***Poor process design***—too many/too few steps, non-standardization, inspection rather than prevention, etc.
5. ***Inventory***—raw materials, work-in-progress, finished goods, papers, electronic files, etc.
6. ***Motion***—inefficient layouts or poor ergonomics at work-stations or in offices.
7. ***Defects***—errors, scrap, rework, non-conformance.
8. ***Underutilized personnel resources and creativity***—ideas that are not listened to, skills that are not utilized.

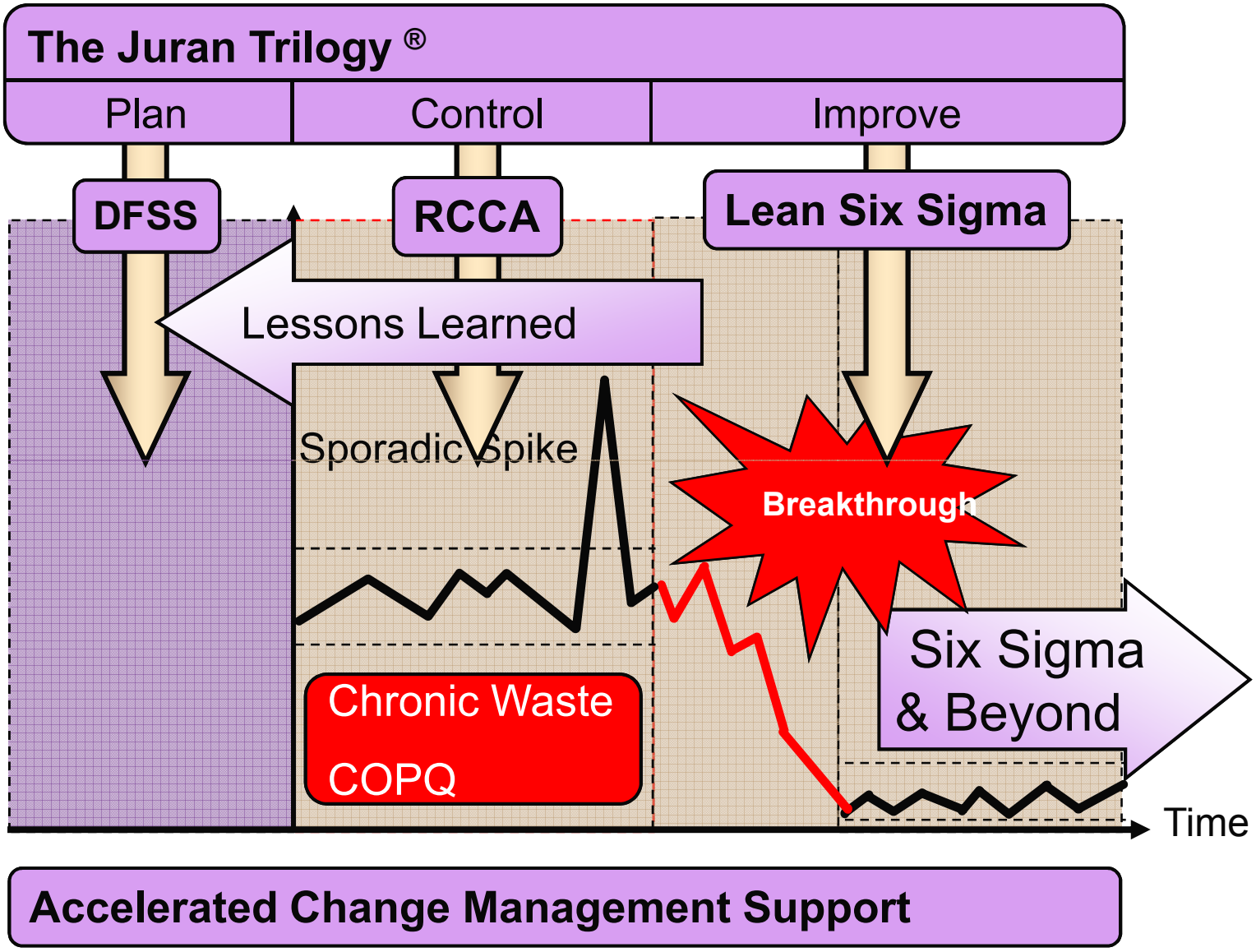
History of Lean



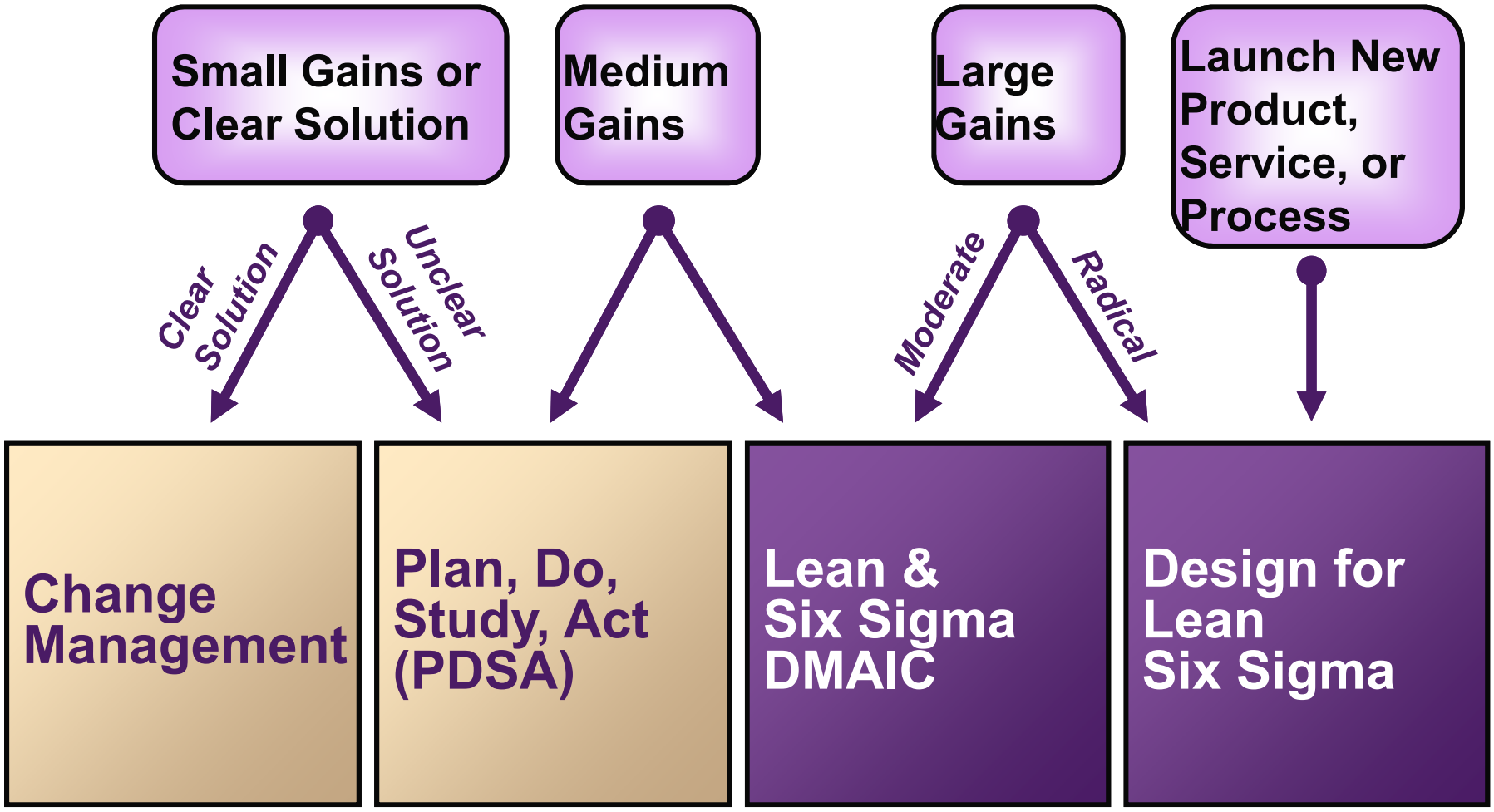
The Methods



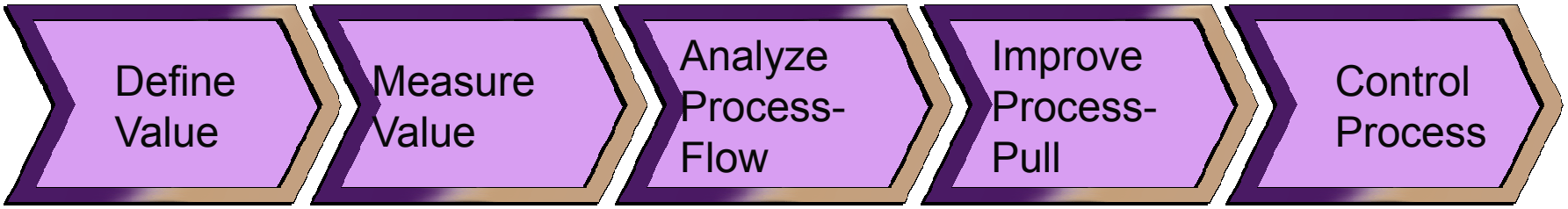
How to Think About Improvement



Matching Improvement Process to Need



Lean and Six Sigma



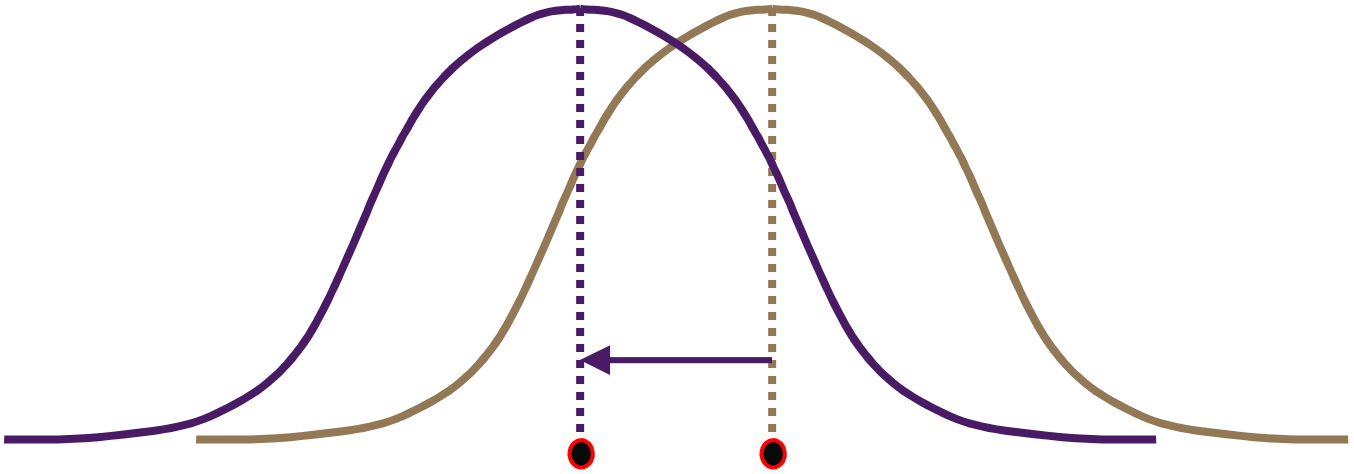
LEAN = Improvement principles focused on dramatically improving process speed and eliminating the eight deadly wastes.

SIX SIGMA = Breakthrough Process, Design, or Improvement Teams focused on eliminating chronic problems and reducing variation in processes.

Lean Project Attributes

Simply stated: “Lean is about moving the Mean.” It focuses on efficiency.

- Lean reduces average cycle time.
- Lean reduces excess inventory.
- Lean improves average response time.

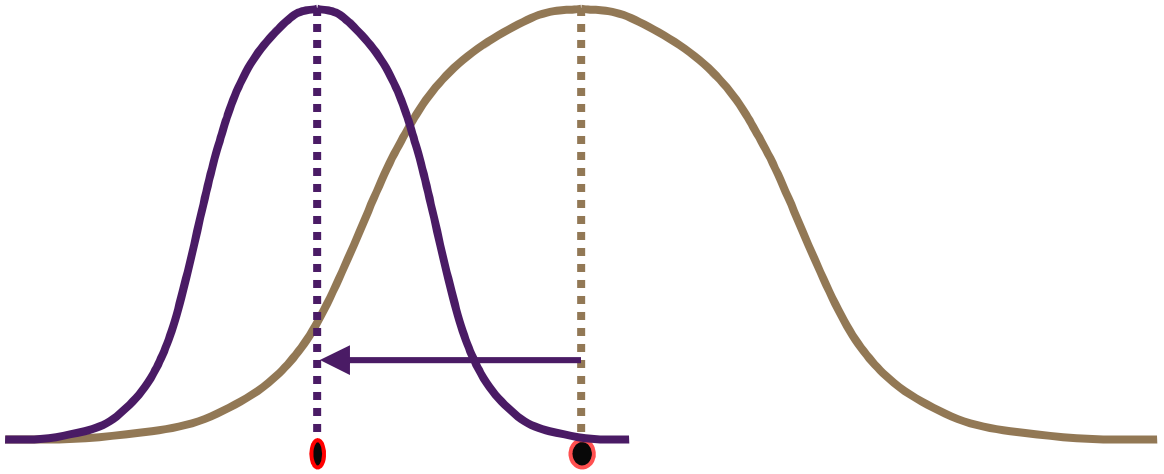


Improvement

Six Sigma Attributes

Simply stated: “Six Sigma is about Reducing Variation.” It focuses on Effectiveness. The mean will most likely also be improved.

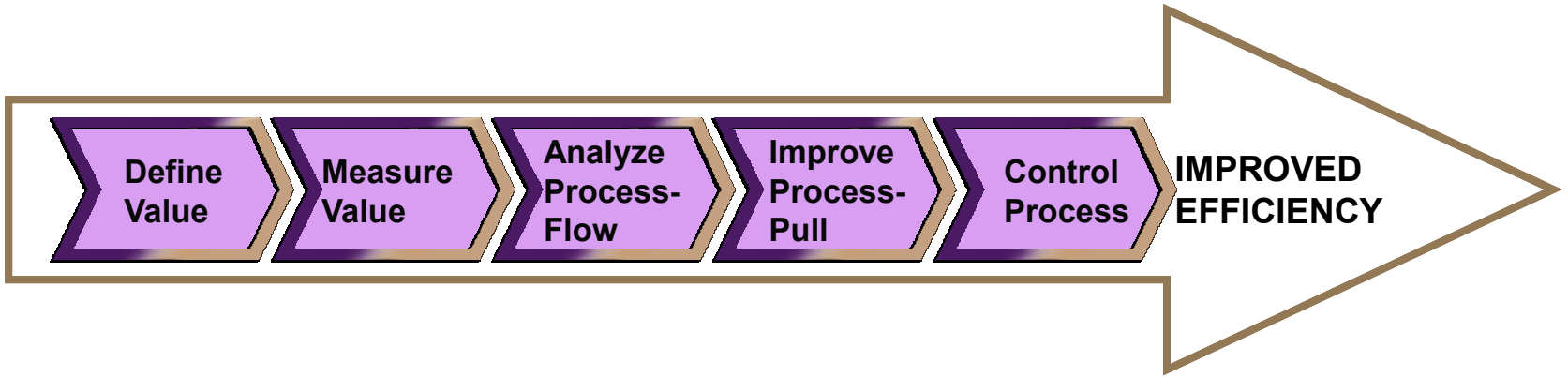
- Decrease defect rate
- Increase Process Yield



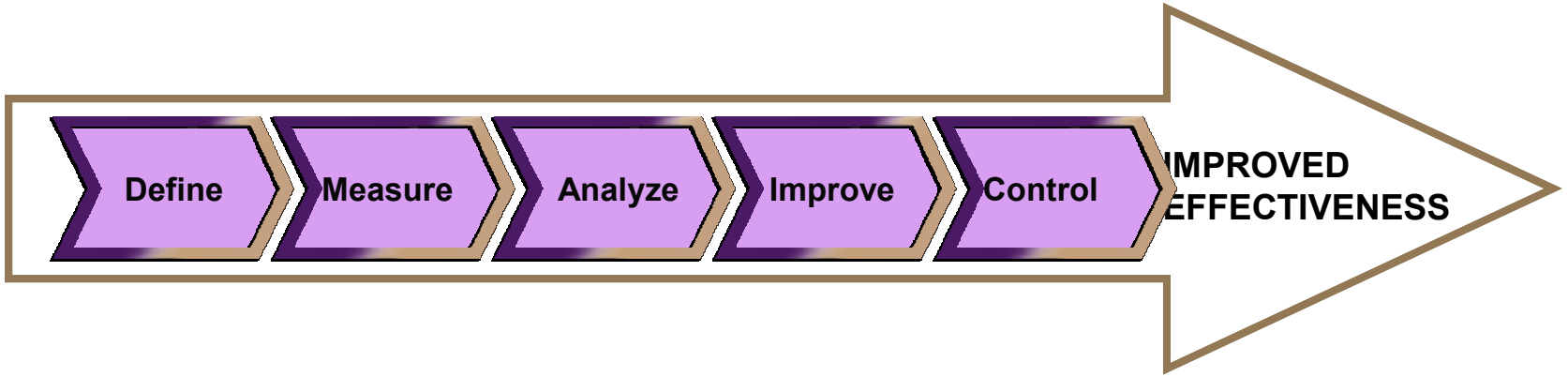
Improvement

Lean and Six Sigma

Lean = Rapid Improvement Teams focused on dramatically improving process speed, and the elimination of the eight deadly wastes.

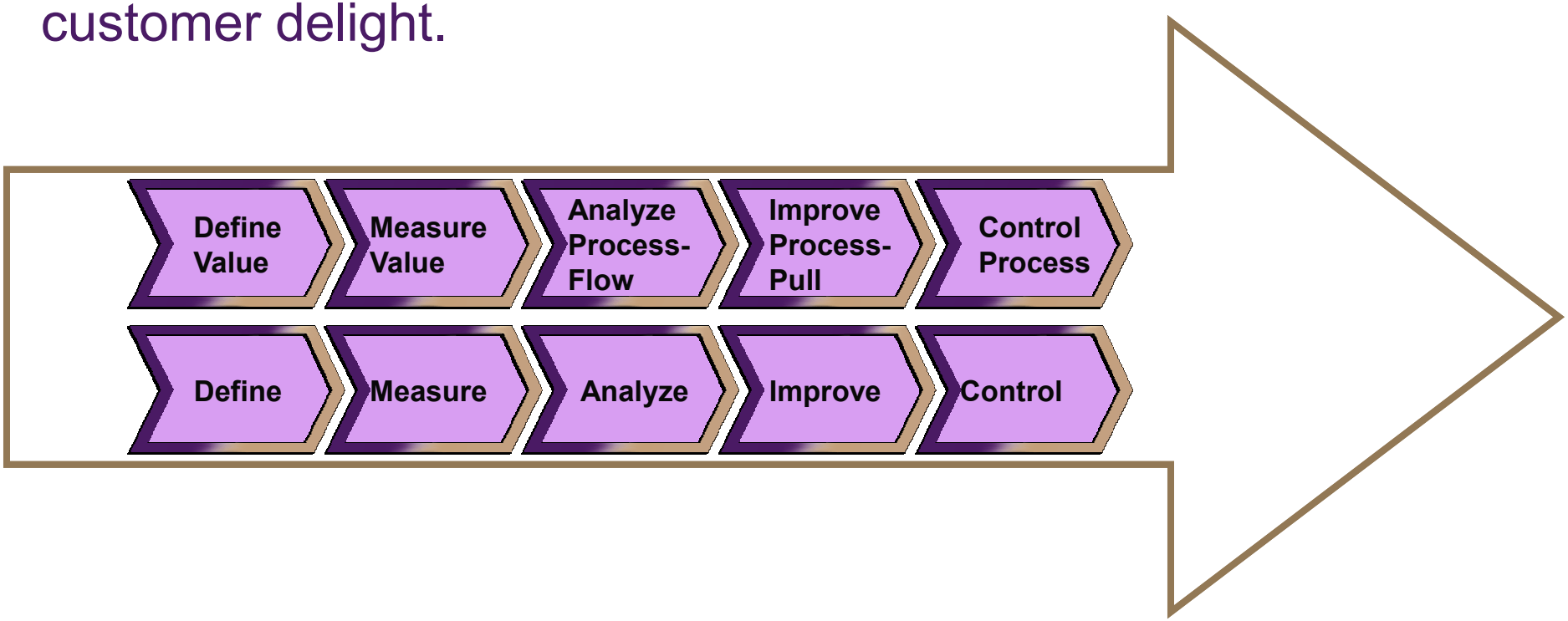


Six Sigma = Breakthrough Process Improvement Teams focused on eliminating chronic problems and reducing variation in processes.



Lean Six Sigma

Lean Six Sigma is an approach to integrating the power of Six Sigma Tools and Lean Enterprise Tools which can be applied within an organization to create the fastest rate of improvement, maximize shareholder value, and increase customer delight.



Which Technique to Begin With?

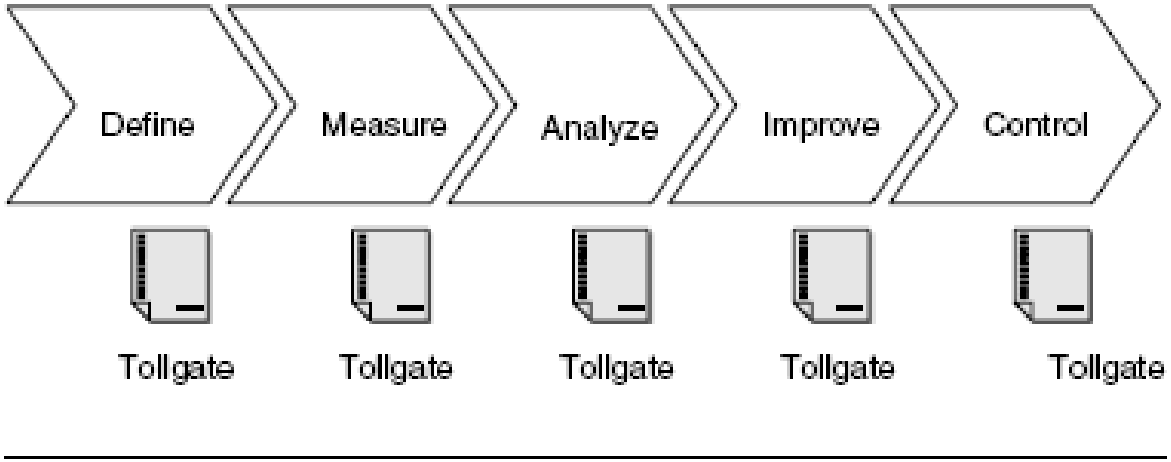
- It is often advantageous to begin with Lean projects.
  - These are easier to understand and implement.
- Begin with streamlining processes and Rapid Improvement Events.
  - This gets the operation in good order.
  - Chronic problems are now easier to deal with.
  - "Low Hanging Fruit" is eaten.
- Next, select Six Sigma projects

Other Reasons to Begin Lean?

FIVE STEPS IN SIX SIGMA (DMAIC)

1. **Define**
2. **Measure**
3. **Analyze**
4. **Improve**
5. **Control**

Example Tolgate DMAIC



FIVE STEPS IN SIX SIGMA (DMADV)

1. **Define**
2. **Measure**
3. **Analyze**
4. **Design**
5. **Validate**

- A key point to remember when doing a six sigma project is that the DMAIC project should last only 12 to 16 weeks (which requires a small, well-defined project), whereas a DMADV or redesign might take years.

Tools in Six Sigma

- Normal Curve
- Descriptive statistics
- Histograms
- Pareto charts
- Line and run charts
- Scatter plots
- Control charts

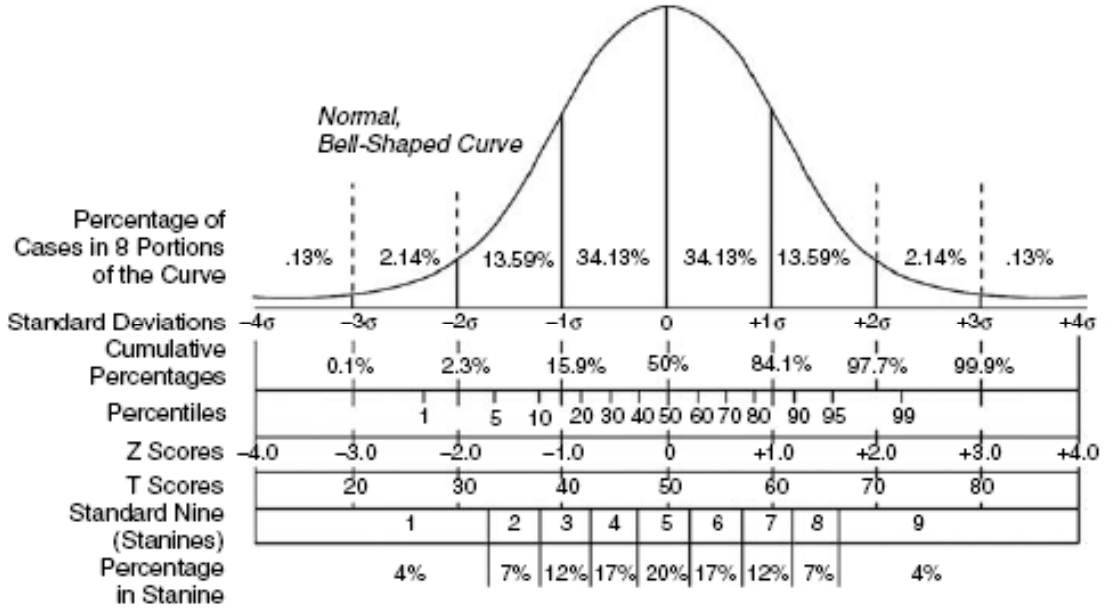


EXHIBIT 15.3 THE NORMAL CURVE

Mean	7
Standard Deviation	2.44949
Variance	6
N	36
Minimum	2
1st Quartile	5
Median	7
3rd Quartile	9
Maximum	12

EXHIBIT 15.5 DESCRIPTIVE STATISTICS

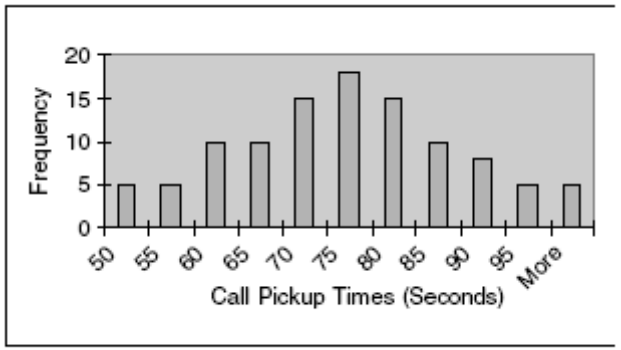


EXHIBIT 15.6 HISTOGRAM OF CALL PICKUP TIMES

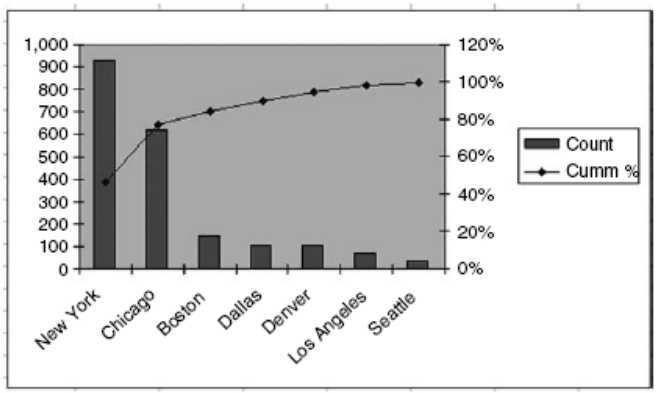


EXHIBIT 15.7 PARETO CHART

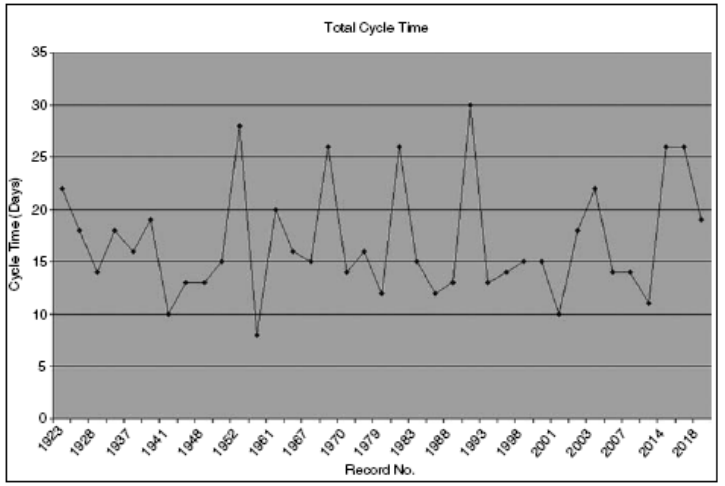


EXHIBIT 15.8 LINE AND RUN CHART

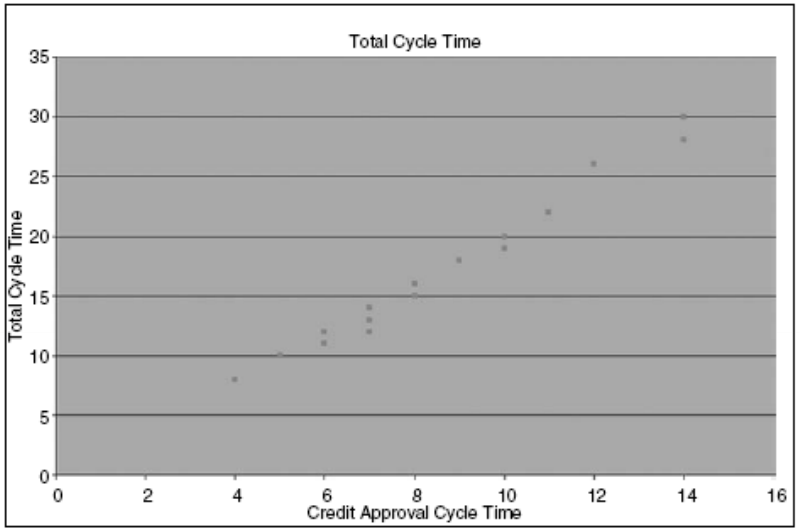


EXHIBIT 15.9 SCATTER PLOT

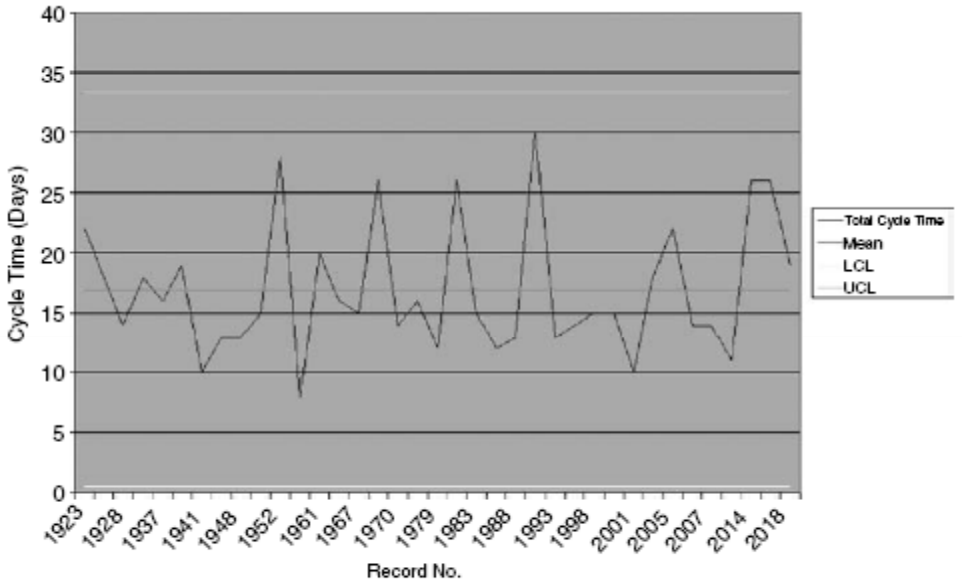


EXHIBIT 15.10 CONTROL CHART WITH UPPER AND LOWER CONTROL LIMITS

ORGANIZATION APPROACH

Traditional Model	Six Sigma Goals
• Intuition-based decision making • Reliance on trial and error • Dependence on rework • Fixing • Accepting firefighting behavior • Point or one-off solutions • Minimal tracking of post-implementation results	• Metric-driven organization • Structured methodology • Defect-free processes • Preventing • Challenging status quo • Integrated solutions based on customer and business needs • Ongoing monitoring with corrective actions