



# An Introduction to Six Sigma

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# Agenda

- What is Six Sigma?
- Why would a company adopt Six Sigma?
- What are the challenges?
- What are the rewards?
- How is Six Sigma implemented?
- Summary and Questions

# Six Sigma has many meanings

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

# Six Sigma: A Symbol

- $\sigma$  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.
- Percent Defects,  $C_p$ ,  $C_{pk}$ , ppm

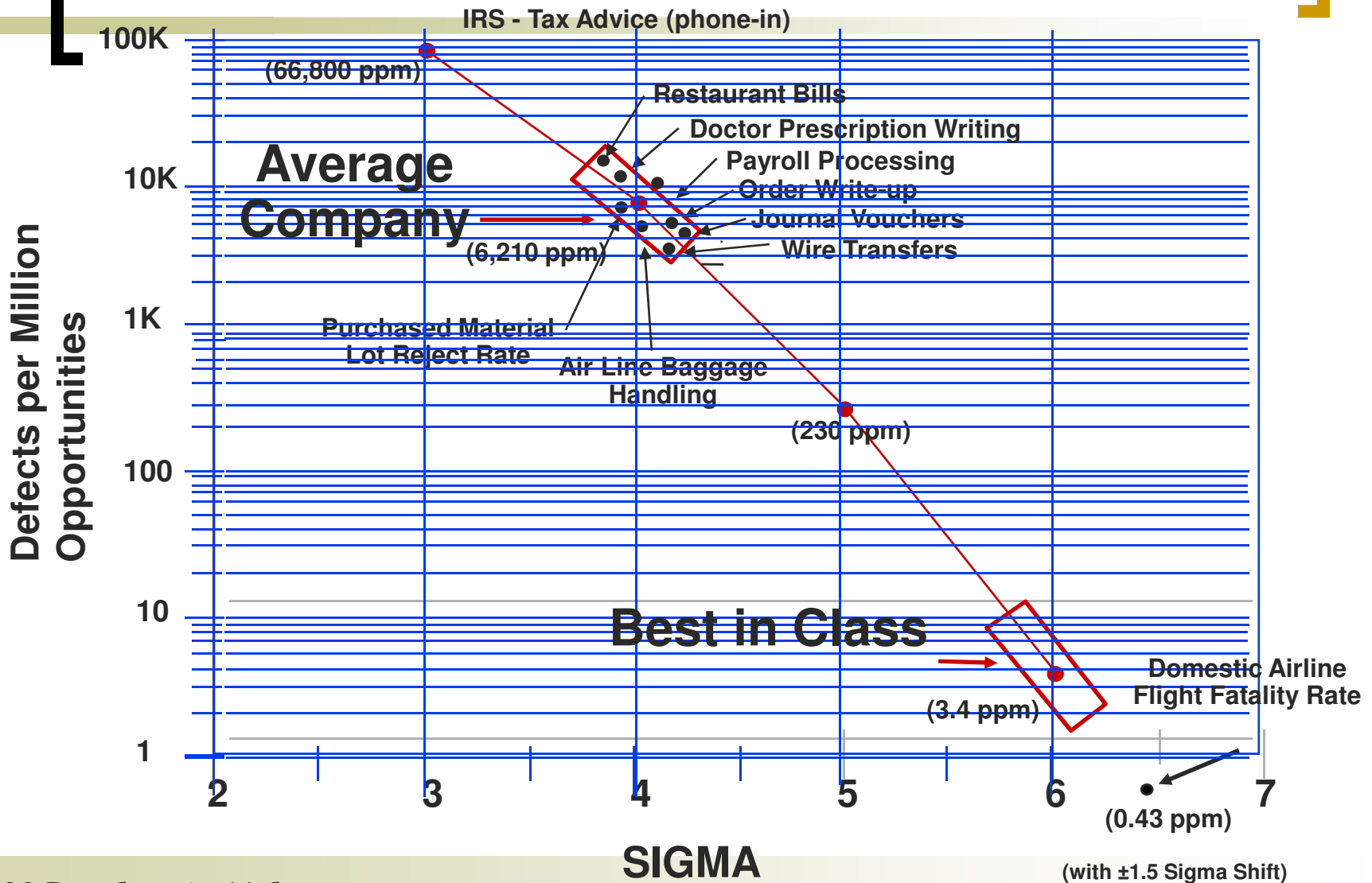
# Doing the math

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

## 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.

# Some Examples to Illustrate Typical Defect Rates





# Six Sigma: A Philosophy

- A vision of process performance
- Delivering nearly defect-free products and services
- Focus on variation reduction
- A Guiding Management Principle

# Six Sigma: A Method

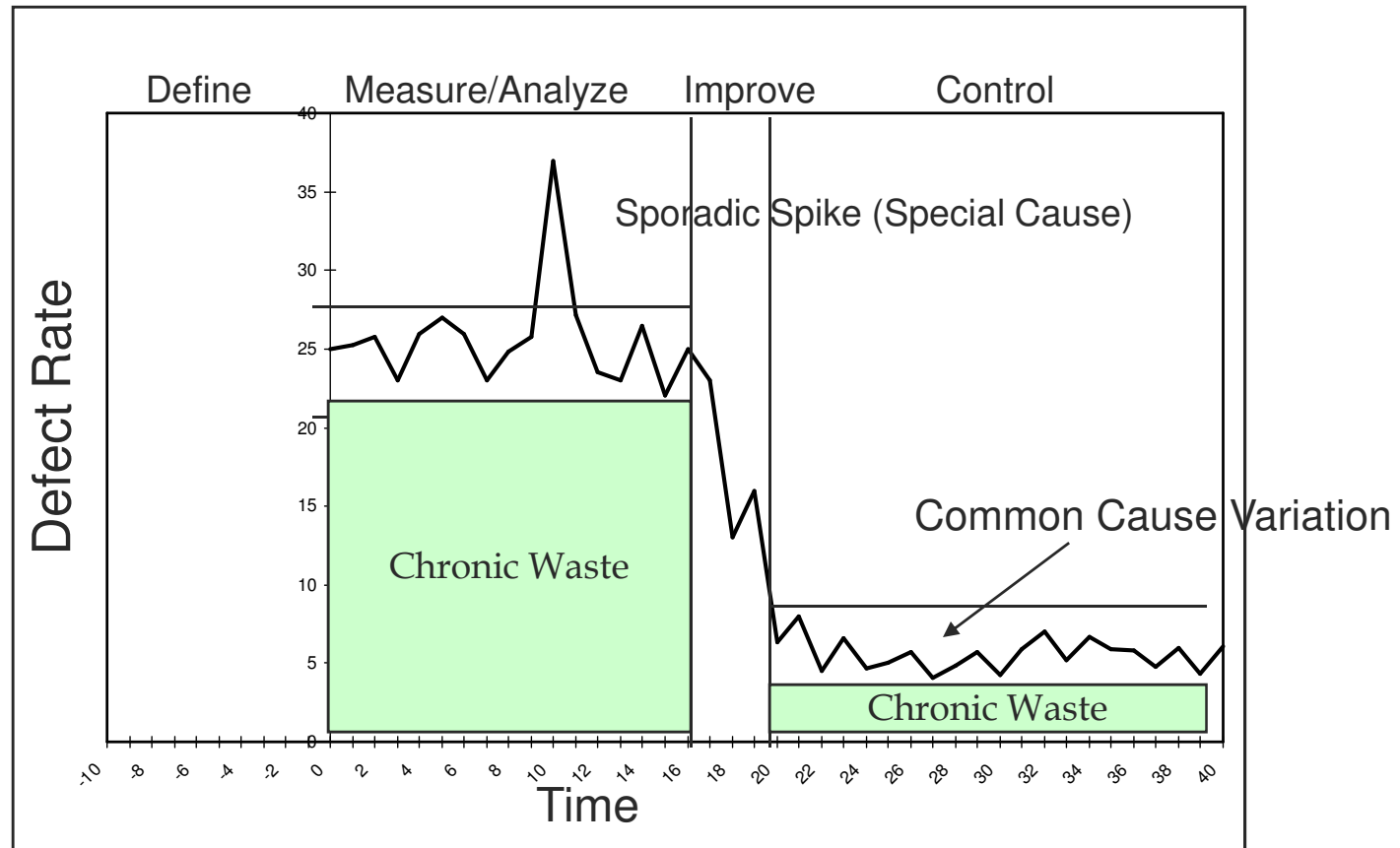
- A well defined process and toolkit used for:
  - Product/Service Design
  - Quality Control
  - Quality Improvement
  - Strategic Planning

# Six Essential Themes

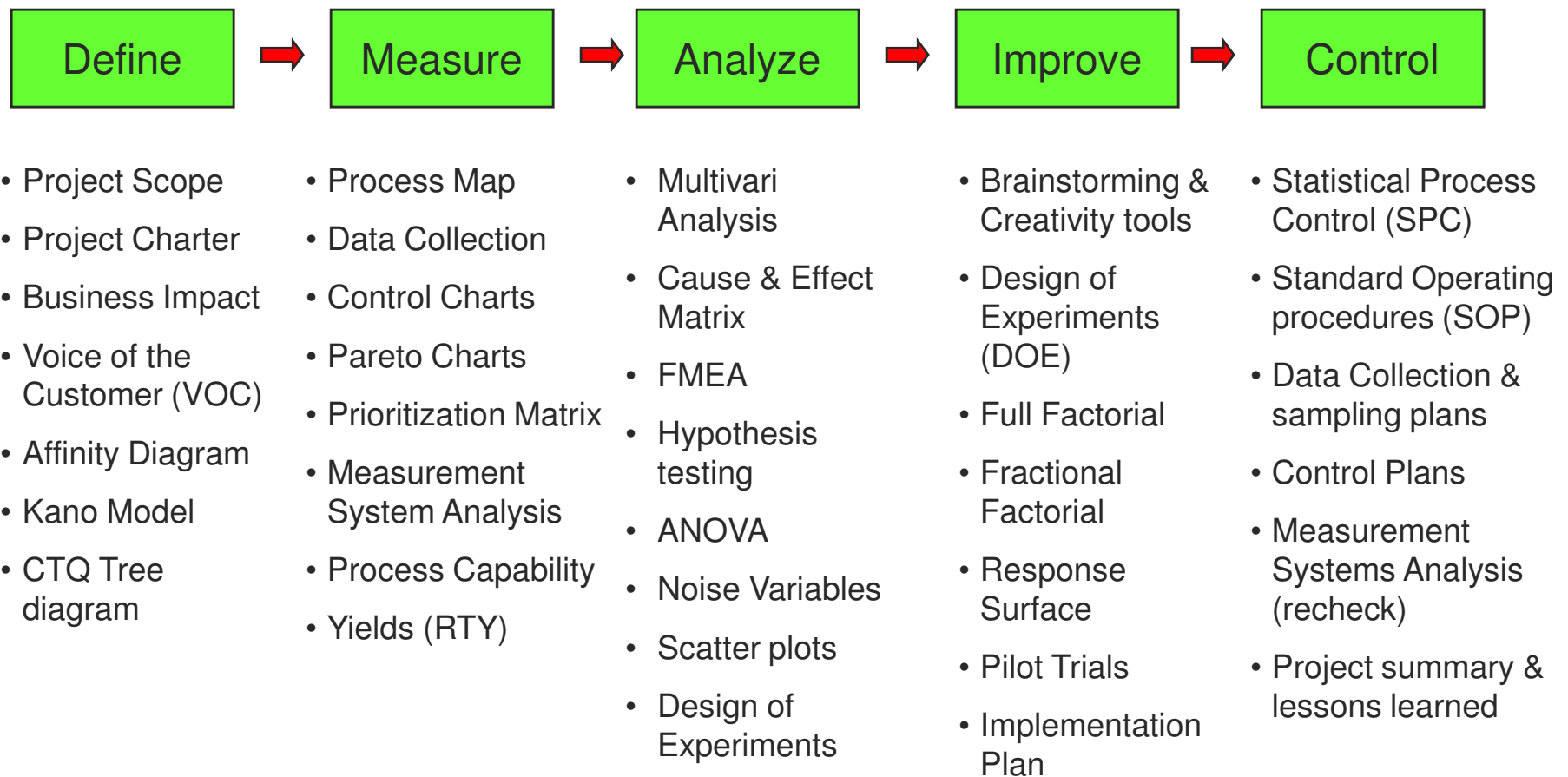
- A genuine focus on the customer
- Data and fact-driven management (using effective measurement systems)
- Process focus [ $Y = f(x)$ ]
- Proactive management drives improvement efforts
- Boundaryless\* collaboration (including customers, suppliers, and supply chain partners)
- A drive for perfection with a tolerance for failure (freedom to take risks, learning from mistakes, drive to try new approaches)

\* Termed by Jack Welch, CEO of GE

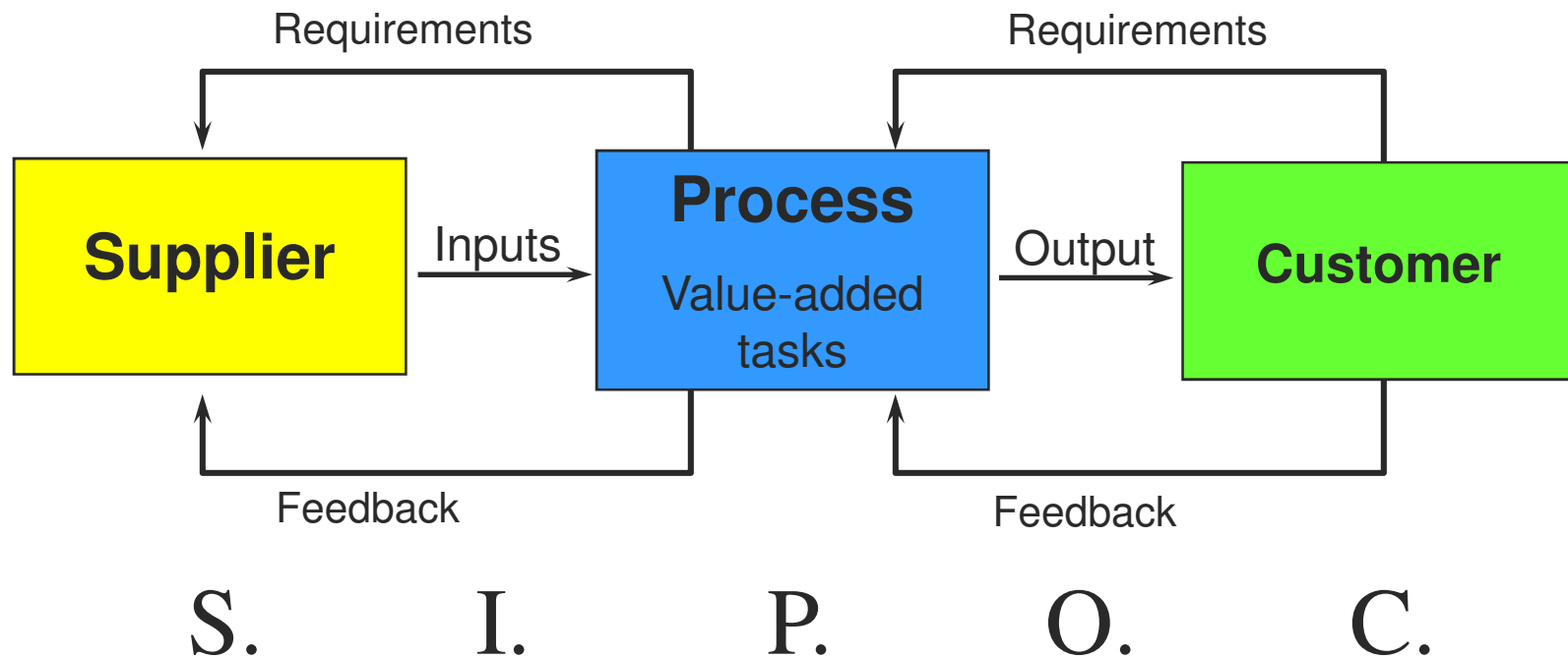
# DMAIC Approach



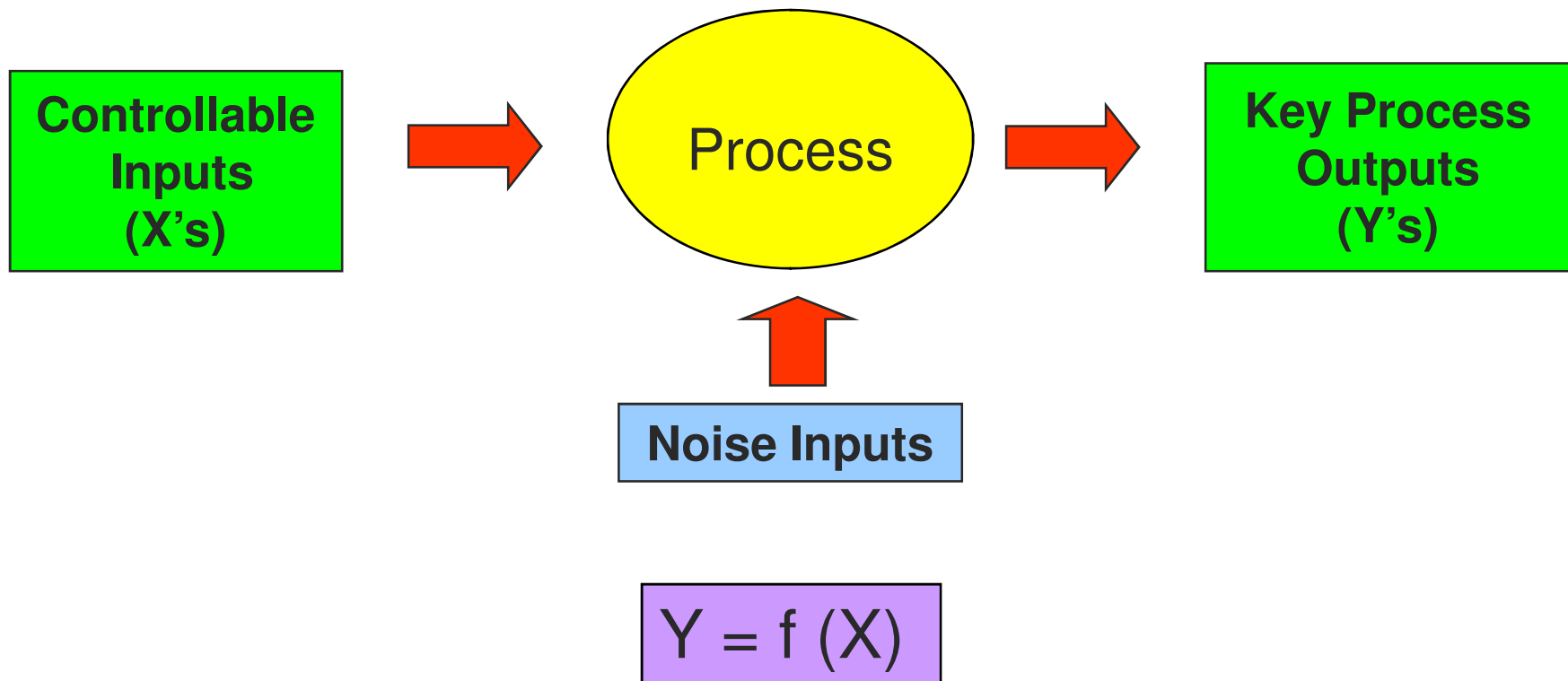
# Six Sigma DMAIC Process



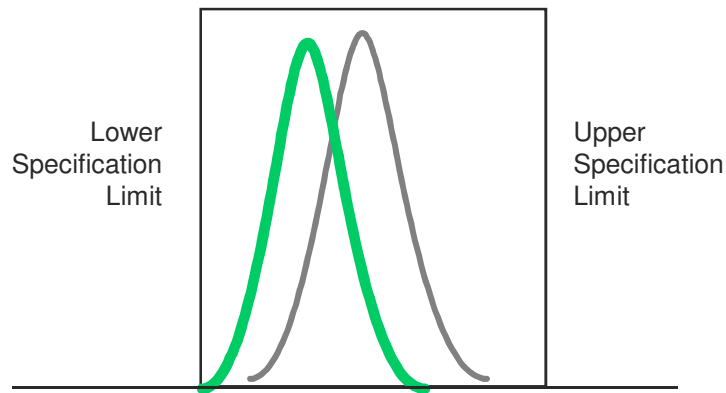
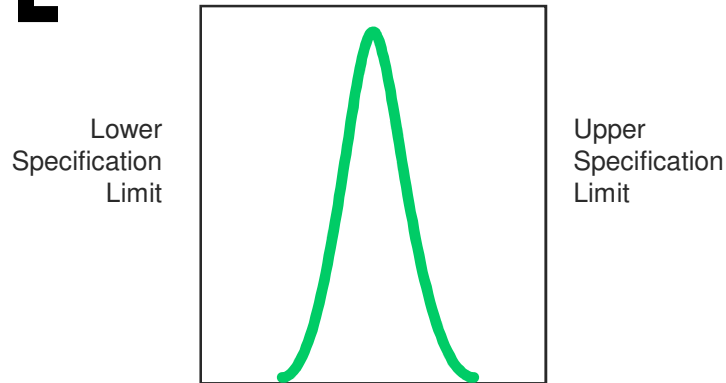
# All Work is a Process



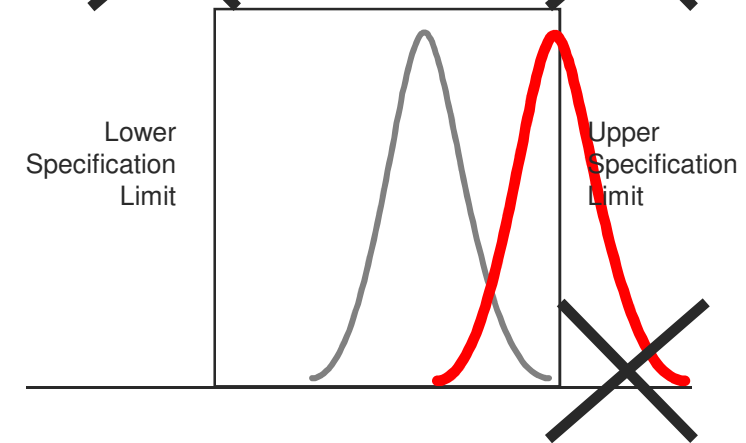
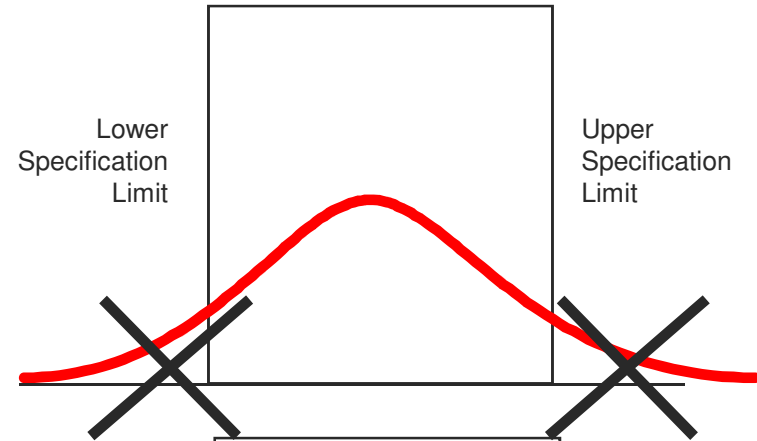
# What is a process?



# Process Capability



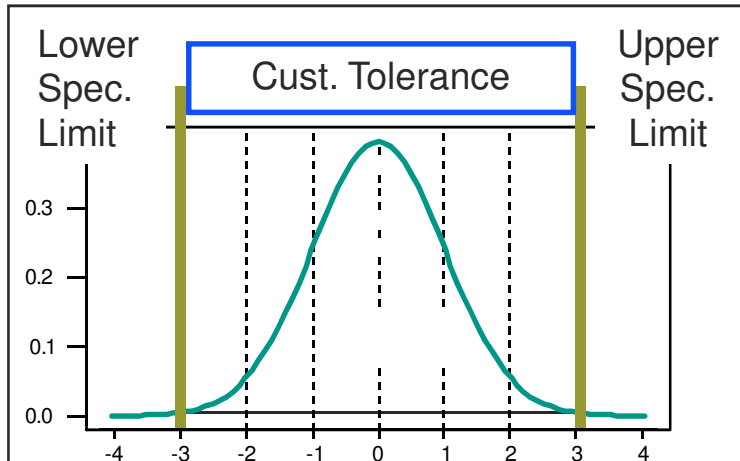
Capable Process



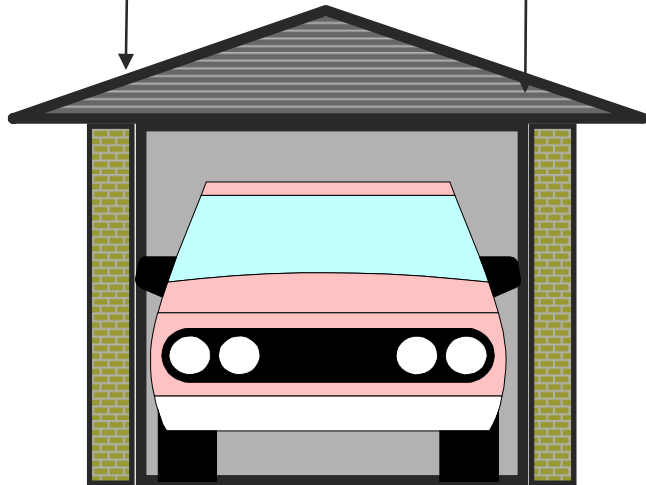
This process is not capable



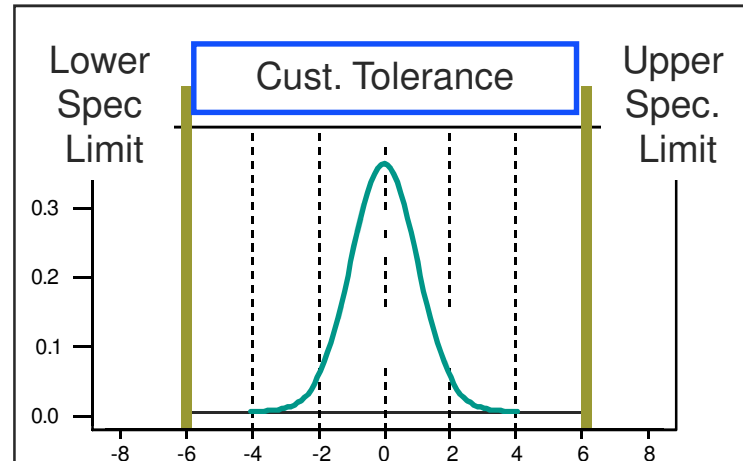
# Visualizing Process Capability



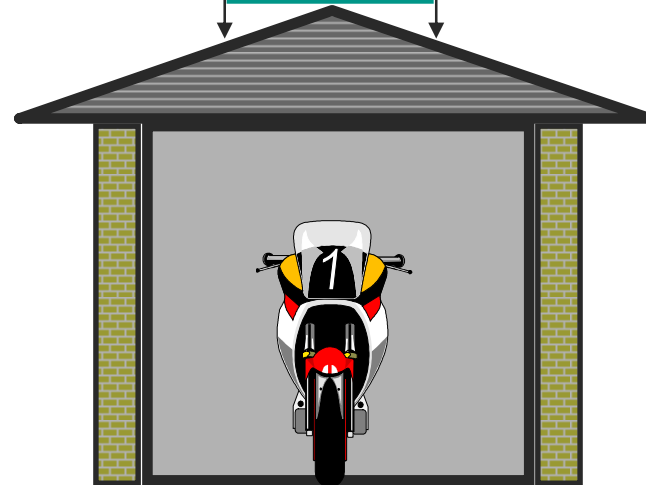
Process Capability



$C_p=1$

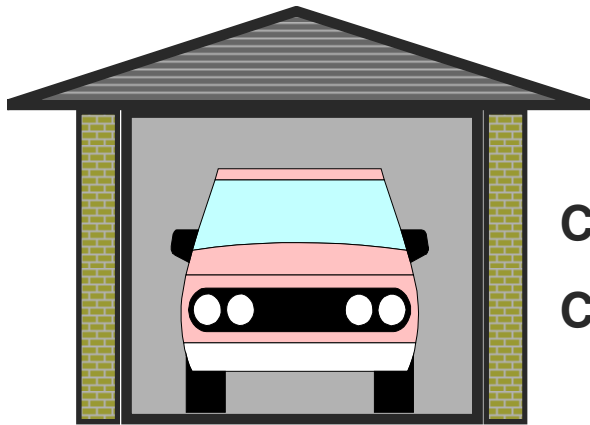


Process Capability

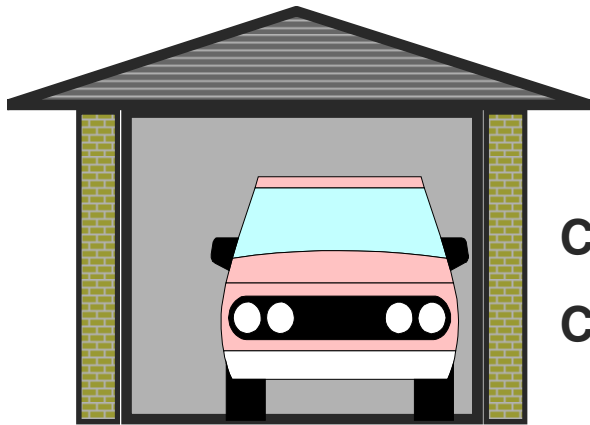
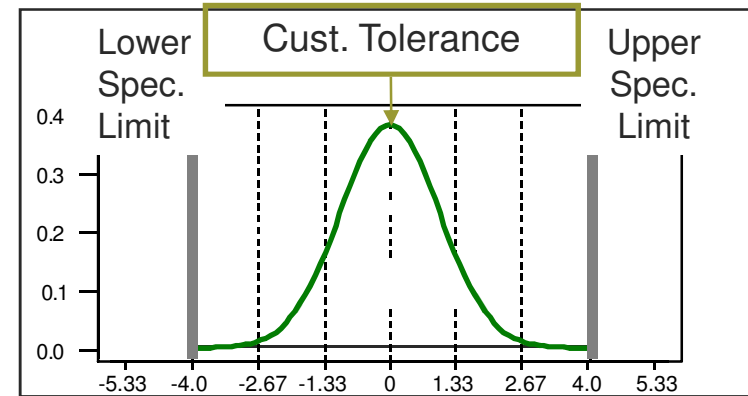


$C_p=2$

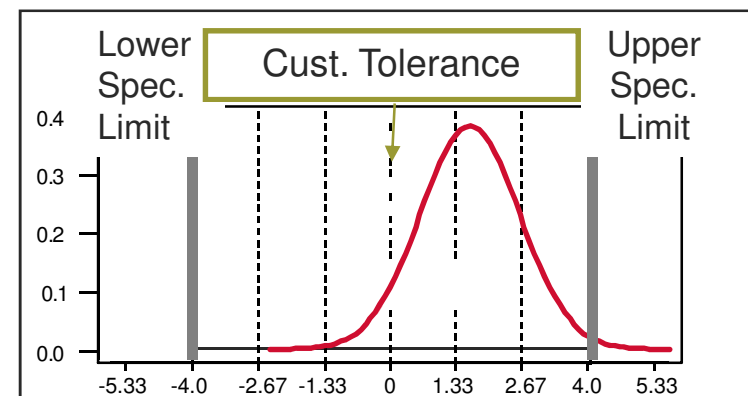
# Process Drift



$$C_p = 1.33$$
$$C_{pk} = 1.33$$



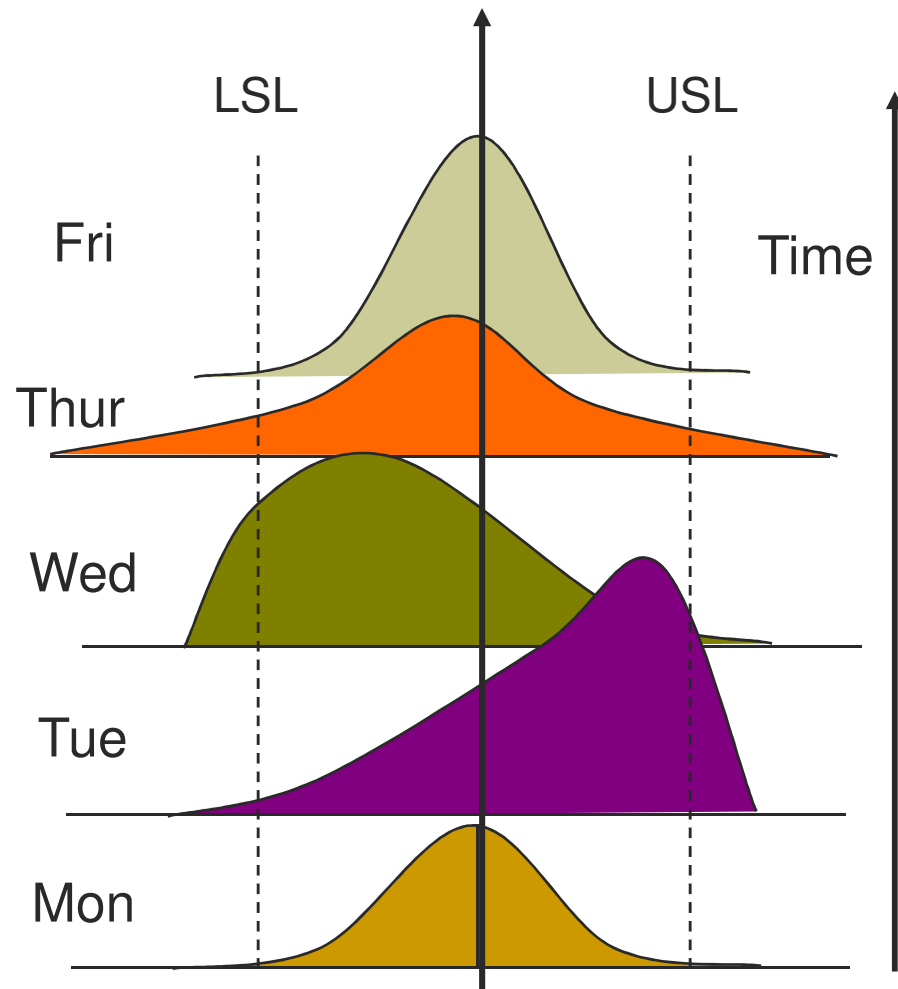
$$C_p = 1.33$$
$$C_{pk} = 0.83$$



# Unstable Process

## Unstable Process

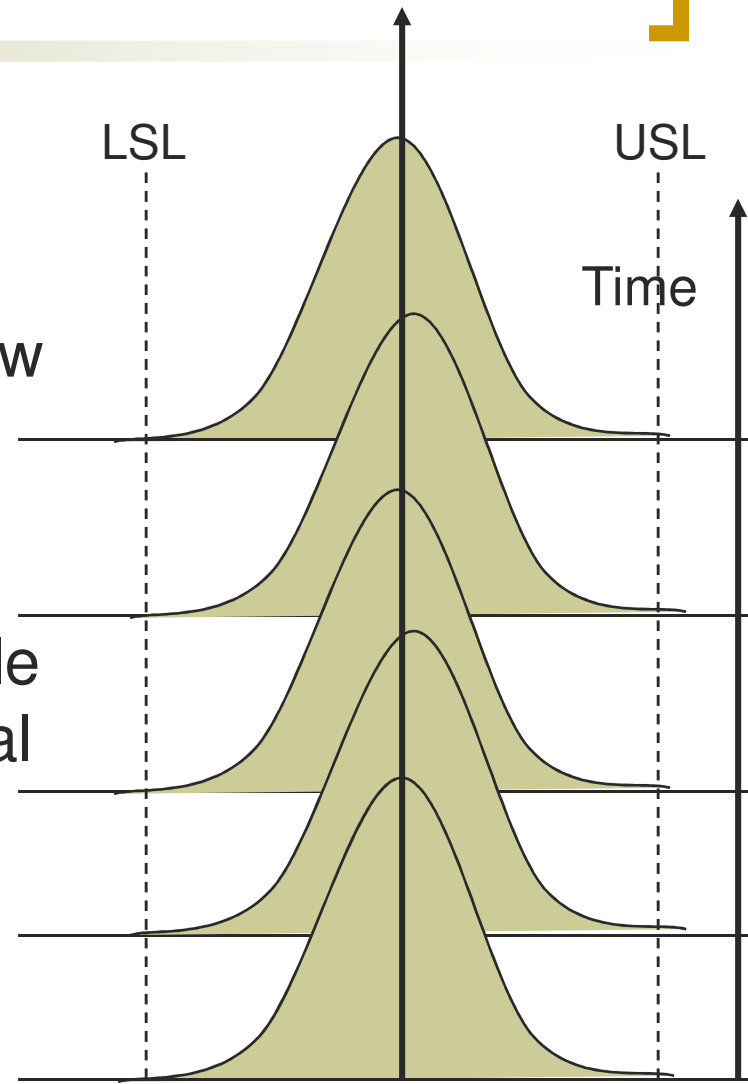
- Mean shifts present
- Excess variation ( $\sigma$  changes)
- Special causes of variation are present,
- Process output is not stable over time and is not predictable



# Stable Process

## Stable process:

- Variation reduced (lower  $\sigma$ )
- 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.

# Six Sigma Strategy

- Implementation is top-down. CEO driven with executive management and Champions (process owners) leading the initiative.
- Improvement projects must be integrated with the goals of the organization.
- Six Sigma uses a “divide and conquer” approach. Find and work on the most important key customer related projects.
- Uses several levels of competency in Six Sigma implementation:
  - Champions
  - Master Black Belt
  - Black Belt
  - Green Belt

# Roles & Responsibilities

- Executive Team:
  - Provide continuous support to drive for results. Sets strategic direction, identify core business process issues, prioritize
- Champion:
  - Identifies high impact projects by combining the strategic vision of the executive team & the key customer and process needs of the business.
  - Facilitates successful project completion, coaches teams
- Master Black Belt:
  - Highly skilled & experienced in all aspects of Six Sigma
  - Coach and mentor to Black Belts, works with Champion on project selection

# Roles & Responsibilities

- Black Belt:
  - Project Leader
  - Highly trained in Six Sigma methods and tools
  - Influencer, team facilitator, project manager
- Green Belt:
  - Project team member
  - Trained in Six Sigma methods and tools



# 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
  - Required to have a project
  - Class for 1 week (40 hours) and project work for 3-4 weeks
  - Total of 4 months to train
- Green Belt
  - 30-80 hours depending on training philosophy
  - May or may not have to complete a project

# Projects Drive Six Sigma Success

## Types of Six Sigma Projects

- Manufacturing Quality Improvement (origin of Six Sigma initiatives)
- Design for Six Sigma (DFSS) for product development
- Business process improvement (transactional Six Sigma)

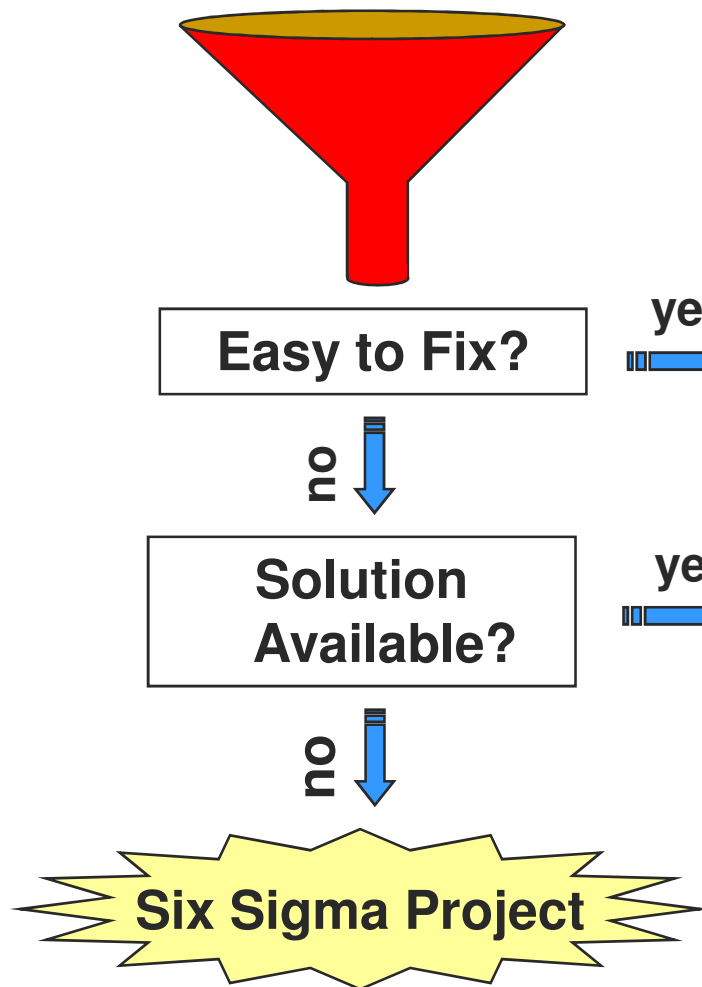
Some companies find much larger impact in transactional type projects:

- One company:
  - \$150-250K for manufacturing improvement projects
  - > \$500K for transactional projects

Process management methods rarely used for business process improvements

Transactional Six Sigma is a Huge Opportunity

# Identifying Six Sigma Projects



## 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.
- Implementation tends to be uneven and lapses occur frequently.
- 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 Challenges

- Not everything has to be Six Sigma; this was the downfall of reengineering efforts! Choose your projects carefully.
- Statistical analysis is not generally part of the engineering discipline in most companies.
- Determine the role of DFSS and transactional Six Sigma in your organization
- Needs to focus on people issues and change management
- People must not fear giving “bad news” and continually require data-driven decision making.

# 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

# The Road to Six Sigma



**Usually has many twists and turns!**

# Six Sigma Implementation



- Appoint an implementation team leader
- Use a multifunctional team to lead roll-out
- Work with Execs & Champions to develop a Six Sigma Roadmap
- Establish quantifiable goals
- Formulate an implementation plan
- Develop a mechanism to coach black belts & teams
- Implement project review and metrics tracking mechanism

# Six Sigma Roadmap

- Identify core processes & key customers
- Define key customer drivers
  - Voice of the Customer (VOC)
  - Critical to Quality (CTQ's)
- Measure and baseline current performance
- Prioritize, analyze, charter and kick-off key improvement projects
- Develop a diversified project portfolio (short and long term projects)
- Expand and integrate the Six Sigma system across the enterprise as experience grows

# Costs to Implement

- Direct payroll (individuals dedicated full-time to Six Sigma)
- Indirect payroll (executives, champions, process owners, etc.)
- Training and consulting costs (Champion, black and green belt, implementation and project reviews)
- Improvement implementation costs (cost to implement solutions found in BB projects)

# Where Do You Start?

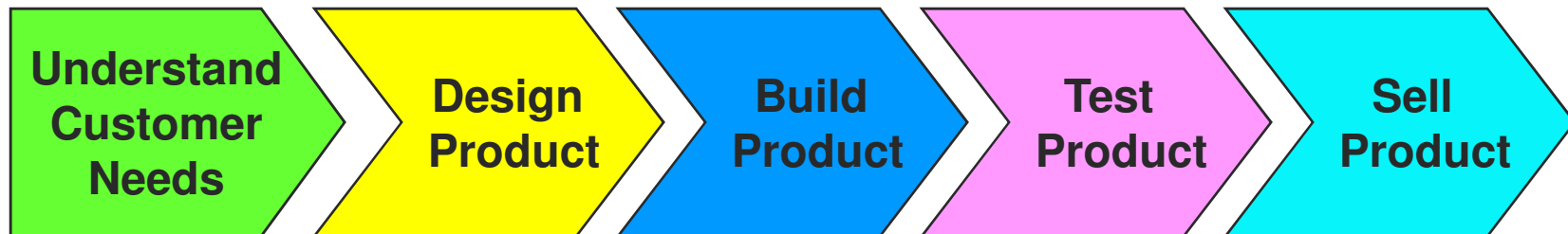
- Business Transformation
  - Full scale change initiative
- Strategic Improvement
  - Address a strategic weakness
  - Used to build a core competency that is missing (such as VOC, or measurement systems)
- Problem Solving
  - Most popular starting point
  - Focus on key short-term and long-term improvement projects to get maximum impact

# What are your core processes?

- Product Development Process
- Order fulfillment process
- Customer service process
- Support Processes
  - Finance
  - Administration (HR, legal, etc.)
  - Information technology

# Customer centric core process

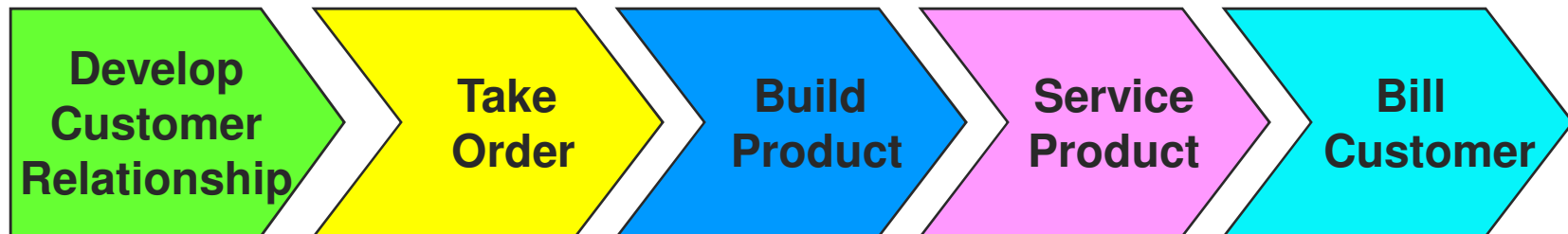
## Product Development Process





# Customer centric core process

## Order Fulfillment Process



# 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”

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