



# Lean Six Sigma Green Belt Training

## Module 0.3

Lean Six Sigma History

*The Roots of Six Sigma*

# A History of Manufacturing

## Craft

- Made to customer specifications
- Each product unique
- Pride in workmanship
- Little inventory
- Relatively High Cost

## Mass Production

- Whitney's interchangeable parts
- Taylor's division of labor
- Ford's assembly line
- Ford's limited variety
- Worker/management division

*History shows customer value quality and variety, manufacturers desire efficiencies and workers desire job satisfaction*

## Mass Customization

- High variety
- Small volume per product
- Near perfect quality
- Engaged workforce

1875

1900

1925

1950

1975

2000

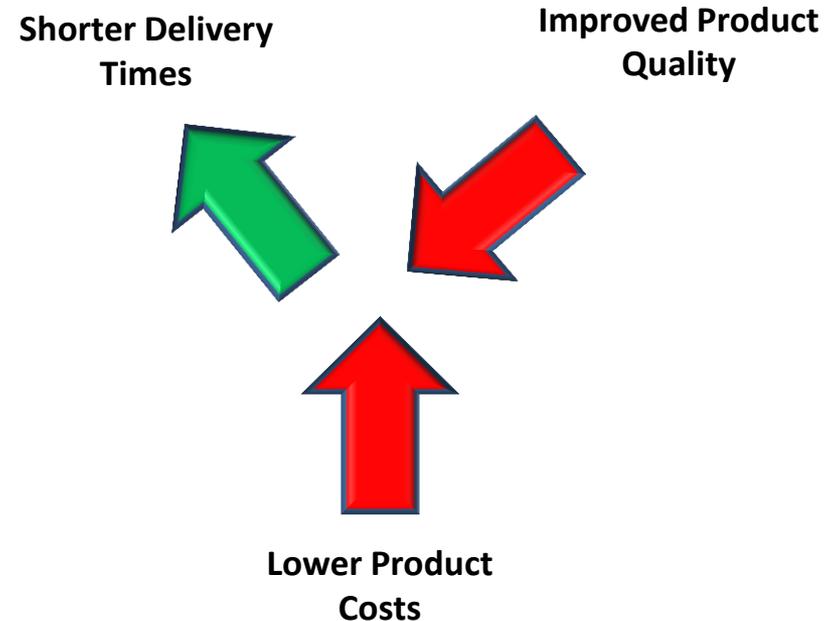
# Learning Objectives

- 🔗 Understanding the market and workplace forces driving the need for Lean Six Sigma
- 🔗 Understand the background and primary focus of Lean
- 🔗 Understand the background and primary focus of Six Sigma
- 🔗 Learn the tremendous benefits to be reaped by combining Lean and Six Sigma together

# Traditional Performance Paradigm

In the past, companies believed a gain in one performance area required a trade off in one or more of the other dimensions

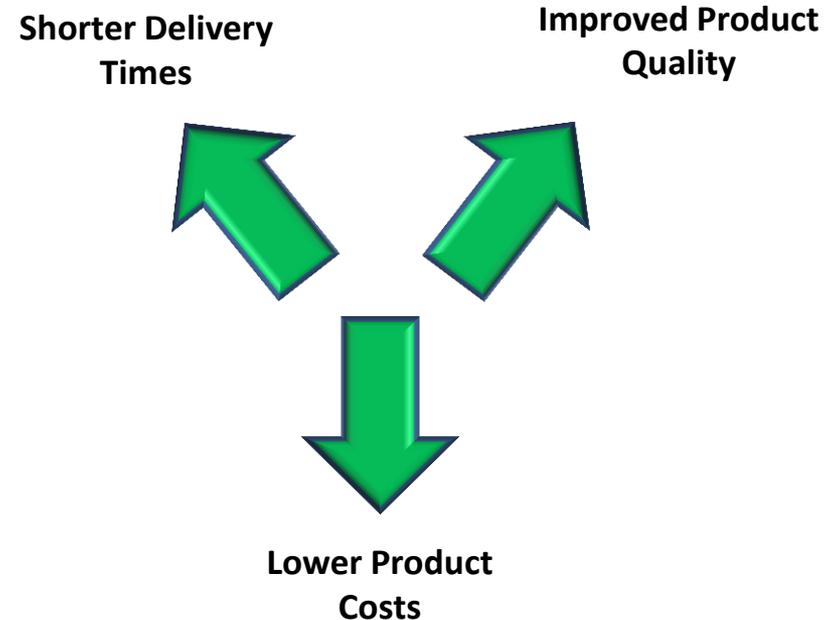
For example, to decrease delivery time firms hired more expeditors, which drove up costs, while product quality suffered in the rush to get product out of the door.



# New Performance Paradigm

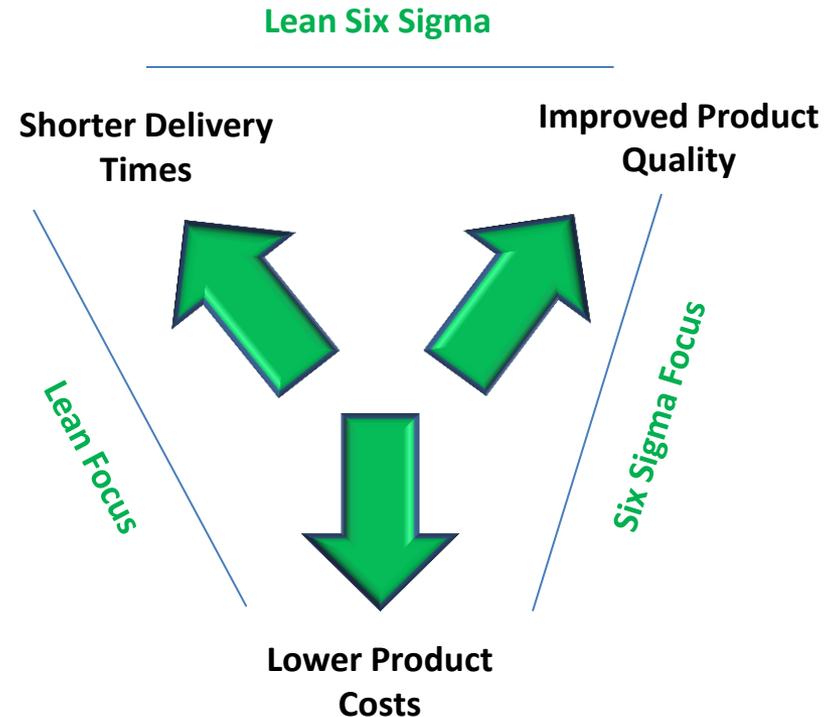
The new paradigm says a performance gain in one area requires or will result in performance gains in other dimensions.

For example, achieving a sustainable decrease in delivery time requires that rework, scrap and other inefficiencies be eliminated in production process, resulting in higher product quality and lower production costs.



# The Lean Six Sigma Strategy

- 🔗 To implement the new paradigm, companies turned to two major process improvement strategies – Lean and Six Sigma
- 🔗 Lean focuses on reduced lead time and reduced costs
- 🔗 Six Sigma focuses on improved quality and reduced costs
- 🔗 Lean Six Sigma combines the benefits and power of **both** strategies



# What Is Every Firm Driven to Both Quality and Lead Reductions?

- 🔗 Customer loyalty and retention
- 🔗 Shorter customer lead time demands
- 🔗 Increased customer demand for small lots sizes and flexibility
- 🔗 Increased demand for capacity
- 🔗 Need for lower invested capital; higher financial returns
- 🔗 Downward price pressure; need to lower costs.

# Why Do These Goals Require Both Lean and Six Sigma?

- 🔗 Inconsistent product delivery and quality reduces sales.
- 🔗 In a value stream, material spends 95% time waiting.
- 🔗 Poor quality increases manufacturing lead time  
10% scrap can increase lead time by 40% and reduces available capacity
- 🔗 Slow lead times reduce the rate of quality improvements
- 🔗 Capacity problems are masked by Slower lead times
- 🔗 Lean tools accelerate lead time reduction.....and Six Sigma brings process is control.

# Lean Production History

- 🔗 Concept pioneered by Toyota
- 🔗 Adopted by other Japanese manufacturers
- 🔗 Discovered much later by Western Manufacturers
- 🔗 Know by many names
  - Toyota Production System
  - Just in Time
  - Lean Production
- 🔗 Originally focused on reducing waste in manufacturing
- 🔗 Now huge gains are being achieved by applying Lean to transactional and service environments.

# Lean Focuses on Elimination of the Seven Deadly Wastes (TIMWOOD)

- 🔗 Waste in **Transportation**
- 🔗 Waste in **Inventory** (Excess Stock in Hand)
- 🔗 Waste in **Movement** (Excess Worker Motion)
- 🔗 Waste if **Waiting** (Idle Time)
- 🔗 Waste of **Overproduction** (Currently Unneeded Stock)
- 🔗 Waste of **Over Processing** (Misused Capacity)
- 🔗 Waste of **Defective Products**



The Seven Deadly Wastes are inherent in EVERY process – Lean provides the methodology, tools and techniques to reduce and eliminate them!

# Lean Tools and Terminology

🔗 Value Stream Mapping

🔗 Time Trap Analysis

🔗 Generic Pull Systems

🔗 Replenishment Pull

🔗 Analytical Batch Sizing

🔗 Stocking Strategy

🔗 5S

🔗 Setup Time Reduction

🔗 Total Productive Maintenance

🔗 Process Balancing

🔗 Process Flow Improvement

🔗 Mistake Proofing

🔗 Visual Control Tools

🔗 Sales Operations Planning

**GOAL:**

- 1. Highest Quality**
- 2. Lowest Cost**
- 3. Shortest Lead Time**

# Six Sigma History

- 🔗 Motorola was the first advocate in the 80s; gathered momentum in late 80s/early 90s
- 🔗 Six Sigma involves use of statistical tools and structured problem-solving approach to attach highest payback projects
- 🔗 Project implementers are called “Black Belts”
- 🔗 Implementers expected to deliver annual financial benefits through 3-6 projects per year
- 🔗 Companies embracing Six Sigma include GE, Allied Signals, Sony, ITT, Caterpillar, Bombardier and many more.

# Six Sigma Terminology

## Sigma ( $\sigma$ ) = Standard Deviation

- Key measure of variability
- Emphasizes need to control both the average and variability of a process

## Six Sigma Quality

- Sigma Quality Level (SQL) measure used to indicate how often defects are likely to occur
- Realization that 99% yield is not good enough
  - Unsafe drinking water almost 15 minutes each day
  - 2 short or long landings at most major airports each day
  - No electricity for almost 7 hours per month
- Six Sigma Quality = 3.4 Defects per Million Opportunities (DPMO)

# Six Sigma Results

- 🔗 GE annual report states that Six Sigma delivered
  - \$300 million to its operating income in 1997
  - \$750 million to its bottom line in 1998
- 🔗 Additional annual report examples
  - 10 fold increase in life of CT scanner x-ray tubes
  - Improved yields of super-abrasive – worth a full decade of increased capacity despite growing demands
  - 62% reduction in turn-around time or railcar leasing repairs
  - Plastic business added 300 million pounds of new capacity
    - equivalent to “one free plant”

# Six Sigma 1.0 – Improving Process Performance

Six Sigma defined as a method to eliminate variation to customer requirements

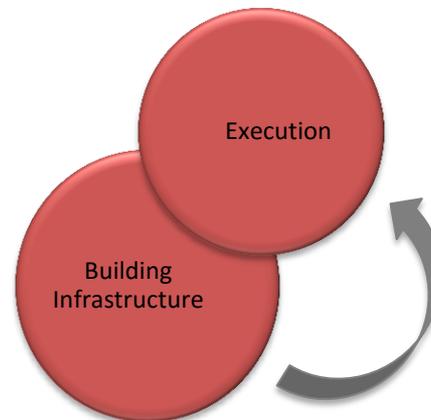
- 5 step Define; Measure; Analyze; Improve; Control **(DMAIC)** methodology
- Concept of  $Y = f(x_1, x_2, \dots, x_n)$  introduced to drive focus on improving critical process **inputs** rather than just outputs (sales profits, etc.)
- Supported by a suite of quality/statistical analysis **tools**



# Six Sigma 2.0 – Management Infrastructure

Six Sigma effectiveness enhanced by strengthening the management infrastructure needed to execute business strategy: Define; Measure; Analyze; Improve; Control (DMAIC)

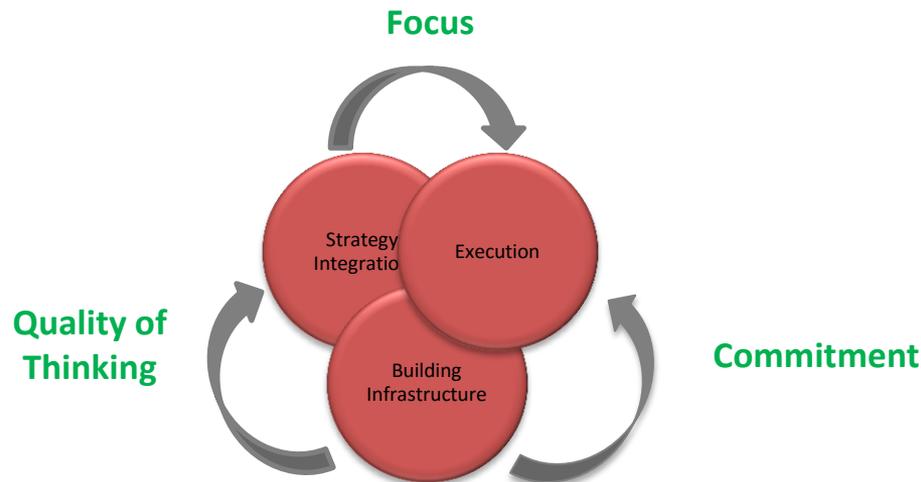
- Business Leaders trained and actively engaged in the process
- Projects selected specifically to support business objectives
- Defined organization and set roles (Black Belts; Champions; Sponsors; Green Belts etc.) creates accountability
- Critical mass of resources deployed (Set % of employee population)



# Six Sigma 3.0 – Value Based Lean Six Sigma

Six Sigma strategic focus sharpened and Lean added to specifically focus on ROC and to enable process speed

- “Define” phase added to enhance project selection and team launch processes resulting in DMAIC
- Value Based Project Selection process and rigorous system of project-in-process management
- Integration of Lean Tools with Six Sigma to remove waste from non-value added processes and drive speed



# The Lean Six Sigma Concept

Combining the strategy and solution sets inherent in **Lean** with cultural, organizational process and analytical tools of **Six Sigma**

With the result that we....

***Respond to our customers better, faster with less waste***



# Six Sigma and Lean Contributions

## 🔗 Six Sigma is the “Unifying Framework”

- Six Sigma provides the over-riding methodology (DMAIC)
- Six Sigma provides the improvement infrastructure
- Six Sigma provides the burning platform for improvement

## 🔗 Lean provides:

- Key measure and analyze tools to visualize problems and pinpoint where to improve
- Powerful improvement tools to “turbo-charge” improvement efforts by reducing waste and increasing process speed.

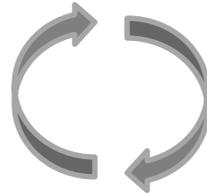
# Lean and Six Sigma are Essential for the Success of Your Company

## LEAN

Speed + ~~Waste~~ +  
Implicit Infrastructure

- Goal – Reduce waste and increase process speed
- Focus – Bias for action/Implementing Toyota tools
- Method – Kaizen events, VSM

Lean Speed Enables  
Six Sigma Quality  
(Faster Cycles of  
Experimentation/Learning)



## SIX SIGMA

Quality, Cost +  
Explicit Infrastructure

- Goal – Improve performance on Customer CTQs
- Focus – Use DMAIC to eliminate variation
- Method – Management engagement, 1% dedicated as Champion and Black Belts

Six Sigma Quality  
Enables Lean Speed  
(Fewer Defects Means Less Time  
Spent on Rework)

# Six Sigma and Lean

## **Are not mutually exclusive**

Not only are they mutually exclusive, they....

## **Are compatible**

Not only are they compatible, they....

## **Are complementary**

Not only are they complementary, they....

## **Are enablers of each other**

Not only are they enablers of each other, they....

## **Are in many cases necessary condition of each other**

# Lean Six Sigma can be Applied in All Processes, Not Just Manufacturing

## **Customer Facing Processes**

- Pricing/Quotation
- Order Management
- Customer Service
- Accounts Receivable

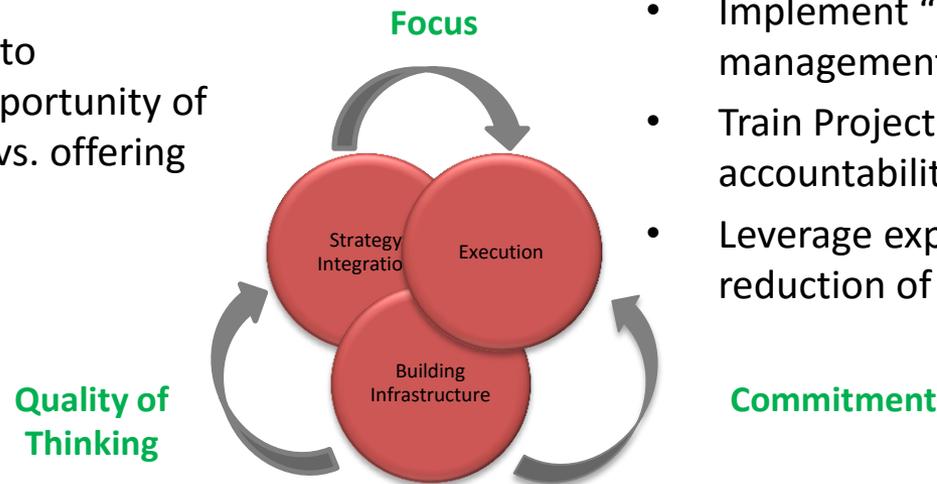
## **Internal Business Processes**

- Engineering Change Notice Cycle
- Production Scheduling Cycle

 All that **Can** and **Should** be attacked using Lean Six Sigma Quality and Time Tools

# Lean Six Sigma Employs the Evolved Deployment Model of Success

- Train Business Leaders to use a rigorous Value Based Project Selection Process
- Analyze each business to understand relative opportunity of process improvement vs. offering complexity reduction



- Train Black Belts and Green Belts in Lean Six Sigma DMAIC and Team Leadership
- Implement “Project in Process” management style and stage gating
- Train Project Sponsors to ensure accountability and long term results
- Leverage experts to support reduction of offering complexity

- Rapidly deploy the best people as Black Belts in critical mass
- Create an effective organization of improvement resources in line organizations
- Implement a rigorous process of measurement and tracking of project financial results
- Integrate Lean Six Sigma into daily management practices of the business.

# Six Sigma 4.0 - Conquering Complexity

Lean Six Sigma currently being extended to quantify and attack the cost driven by complexity of the product/service offerings

- Our latest research indicates that Product/Service Complexity is often the creator of Non Value Add waste and quality problems
- Product/Service complexity comes in Three Forms
  - Offering which earn adequate ROC
  - Offerings which do not earn adequate ROC:
    - Improvement
    - Rationalization
- Offerings may have complexity that is transparent to the customer
  - Often due to historical design evolution
  - Standardization is required

Conquering Complexity –  
The next Lean Six Sigma Frontier