Introduction to Lean Six Sigma: Confessions of a Master Black Belt

Arnold Pachtman (pachtman@alum.mit.edu)

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Learning Objectives

- Lean Six Sigma (LSS) Historical Perspective
- Business Transformation Process and Tools
  - DMAIC Process: Define, Measure, Analyze, Improve, Control/Validate
  - Tools to help identify and eliminate non-value added activities and waste
- Lean Six Sigma Project Roles
- Continuous Performance Improvement (CPI) and LSS Reporting and Metrics
- Lean Six Sigma Project Selection
- Six Sigma and Lean Bodies of Knowledge (BOK)
1. Lean Six Sigma
   Historical Perspective
"Lean Six Sigma is a knowledge-based process for transforming organizational culture to maximize customer value and business growth."

-- Dan Burnham, Raytheon CEO, 1998 - 2004
Lean Six Sigma Behavioral Model

“It’s easier to act your way to new thinking, than to think your way to new action.”
-- John Shook (*Managing to Learn*, LEI 2008)

> Culture is embedded in work

“Doing the task and doing the task better become one and the same thing”
-- John Shook (*Fast Company*, Dec/Jan 2007)

“Quality is everybody’s job, but it can become nobody’s job without the proper leadership and organization.”
-- Armand Feigenbaum, General Electric
Lean and Six Sigma Work Best Together: Faster, Better, AND Cheaper!

- 1924 Shewhart developed SQC and SPC at Bell Labs, beginnings of Six Sigma
- 1930 Ford River Rouge Plant: 81,000 employees, 7 million square feet, 8,000 cars per day, over 15M Model Ts sold
- 1943 SPC critical to US war effort
- 1950 Eiji Ohno developed Lean at Toyota as a competitive answer to Detroit’s mega-factories overflowing with Inventory and Work-In-Process (WIP)
- 1960 Nissan won the Deming Prize for implementing TQC
- 1965 Toyota won the Deming prize for integrating Lean and TQC, beginnings of Lean Six Sigma
- 1979 Ford acquired 24% stake in Mazda, learned about Lean (but didn’t get it)
- 1980 Motorola adopted Six Sigma in manufacturing ops
- 1989 GE, Allied Signal re-married Lean and Six Sigma
Originally developed in manufacturing, Lean Six Sigma has found wide application in defense, healthcare, government, and service organizations.

Modern Era Lean Six Sigma Adoption by Industry

- **Manufacturing**
- **Finance & Healthcare**
- **Civil Govt**
- **Defense**

Government and Service sectors leverage lessons learned in manufacturing.
Lean Metrics: Function, Quality, Cost, Speed

- Outputs from corporate processes:
  - RFPs, SOWs, Contracts, Mods, Task Orders
  - Risk Analysis, Assessment, Mitigation
  - Budgets, Expenditures
  - Briefings
  - Purchasing and Acquisition Documents
  - Manuals, Support, Training
  - Responses to emerging needs (External and Internal)
  - Results – Products, Services, Materiel, Equipment, Capabilities, Profit

As Knowledge Workers, We Create, Modify, Improve, Review, Approve, Move, Deliver, Track, and Monitor … THERE ARE PROCESSES FOR ALL OF THESE ACTIVITIES
Lean Six Sigma Program success depends on having visible, sustained Leadership support, and the right people and resources.

<table>
<thead>
<tr>
<th>LSS Role</th>
<th>Responsibilities</th>
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<tr>
<td>Deployment Director</td>
<td>Develops the strategy, policies, objectives, plans, and procedures to integrate LSS into the command’s operations. Reports directly to the Organization or Division President.</td>
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<tr>
<td>Master Black Belt</td>
<td>Leads LSS Enterprise Transformation, supports Deployment Director, serves as LSS technical expert, coach, mentor.</td>
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<td>Project Sponsor</td>
<td>Process Owner. Defines LSS project Problem or Opportunity and Goal via the Project Charter. Key Project Team Member.</td>
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<td>Project Resource Manager</td>
<td>Responsible for Project Benefit calculation and validation. Key Project Team Member.</td>
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<td>Black Belt</td>
<td>A full-time resource who leads large, cross-functional performance improvement projects and conducts training and mentoring of Black and Green Belts. Key Project Team Member.</td>
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<td>Green Belt</td>
<td>A part-time resource that applies Lean Six Sigma concepts and methods to an improvement project in his/her work area.</td>
</tr>
<tr>
<td>Yellow Belt</td>
<td>A part-time resource that applies basic Lean Six Sigma tools to an improvement project in his/her work area.</td>
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2. Lean Manufacturing + Six Sigma: The Best of Both Worlds
What is Lean Six Sigma?

The combination of Lean and Six Sigma provides a powerful methodology for performance improvement.

**Product and Process Quality**

- Six Sigma is a *business performance improvement system* that uses facts and data to produce measurable bottom-line results through reduction of product and process variation.

- Six Sigma provides a *standardized measurement system* that provides organizations with a world-class measure of process quality. Processes that achieve a Six Sigma level of performance have 3.4 Defects Per Million Opportunities (DPMO).

- Six Sigma is also a *management philosophy* that continually strives for perfection in products and processes.

**Core Six Sigma Methodologies**

- DMAIC: Process Improvement
- DMADOV: Design for Six Sigma

**Process Speed & Efficiency**

- Lean is a *time and value based process improvement methodology* designed to achieve one-piece continuous flow and eliminate waste in all of its forms.

- For typical processes, less than 1/3 of activities add value, 1/3 are non-value-added but essential, and 1/3 are just non-value-added (waste).

- Lean focuses on achieving fast, uninterrupted flow of value as defined by the customer, with minimum waste, just in time to meet customer demand.

**Efficiency Gains**

- >66% Waste Reduction
- DOTWIMP+U: Defects, Overproduction, Transport, Waiting, Inventory, Motion, Processing, Underutilization

**Fast, Flexible, Flow of Value**

- Perfection
- Pull/JIT
- Flow
- Value Stream
- Value is defined by the Customer
What is a Sigma and why should I care?

What is a Sigma?
Sigma is a measure of variation:
- Variation is waste
- We measure process variation in
  - Flow Time
  - Cycle Time
  - Defect Rate or “Sigma Level”
  - Cost

Why should I care?
4.5 vs. 6 Sigma in the USA would mean:
- 5,400 babies taken home by the wrong parents each year vs. 14 (4M babies/year)
- 94,000 surgical errors per year vs. 238 (70M surgeries/year; actual is 6.4 Sigma (2002))
- 27,000 bad circuits in a computer vs. 68 (20M circuits in a PC CPU)
Lean Manufacturing (TPS)

- Lean strives to maximize value and minimize waste and cost throughout the value stream using five principles:
  1. Help the Customer precisely define Value
  2. Map the Value Stream and eliminate waste
  3. Balance the flow of Value through the system
  4. Let the Customer pull Value through the system
  5. Continually strive for perfection

*Faster flow means less waste, less Work-in-Process (WIP), lower cost, higher quality, less complexity, lower stress, and happier Customers, Employees, and Shareholders.*
What is Value?

- Value is defined by the Customer
  - Value is what the Customer is willing to pay for
- Value is ...
  - The exact product or service the Customer requires
  - In the right quantity
  - At the right time
  - With zero defects (perfect quality as defined by the Customer)
  - At a price the Customer will pay

Value is measured by Function, Quality, Cost, and Speed as defined by the Customer
Who is the Customer?

- A matter of perspective – End User, Payer, or Sponsor

- End User and Sponsor:
  - Wants the product to work as required
  - Wants the product to be reliable and available all the time, especially when needed

- Payer (End User, Shareholder, Taxpayer):
  - Wants the product to be inexpensive to purchase and maintain
What is Lean, actually?

- Lean is:
  - A set of rules and principles with the goal of satisfying customer needs with the required quality at the lowest cost in the shortest time, while developing the talent and skills of the workforce through rigorous improvement techniques and problem solving disciplines.
  - The systematic elimination of waste from all aspects of an operation, where waste is defined as any use or loss of resources that does not contribute directly to creating the product a customer wants the first time, when they want it.
  - A never-ending journey seeking perfection in product and process

CAUTION: PERFORM LEAN PROJECTS ONLY UNDER SUPERVISION OF A TRAINED PROFESSIONAL!
Process Mapping

Process Maps help visualize process flows:

- What are the Suppliers, Inputs, Processes, Outputs, and Customers at each step?
- Where is the Waste?
- Where is the Bottleneck?
- What is causing variation in Cycle Time, Cost, and Quality???
Value Stream Maps help identify waste in the process, material, and information flows.

- **Award Initiator**
- **Civilian Awards Processing**
  - Lead Time: 8.75
  - Cycle Time: 1.8
  - Fail Thruput Ytd: 46%
  - Average Tmr Rate: 8%
- **Award Package Prepared**
  - Lead Time (Days): 4
  - Cycle Time (Hrs): 1.8
  - Error Rate: 5%
- **Award Routing for Approval**
  - Lead Time (Days): 2
  - Cycle Time (Hrs): 0.36
  - Error Rate: 5%
- **Delivery & Funding**
  - Lead Time (Days): 0.75
  - Cycle Time (Hrs): 0.28
  - Error Rate: 17%
- **DCPDS Processing**
  - Lead Time (Days): 0.5
  - Cycle Time (Hrs): 0.25
  - Error Rate: 0%
- **CPOC Processing**
  - Lead Time (Days): 15
  - Cycle Time (Hrs): 0.03
  - Error Rate: 15%

8.75 Lead Time (Days)
3. Strategic Lean Six Sigma Project Selection
Selecting a LSS Project

Enterprise and Department Strategic Goals

Candidate LSS Projects (CPI Plan)

Customer Complaints

Broken Processes

Scrap, Errors, Rework

Headaches

Takes Too Long

Select Team, Write Charter

Select Project

Review, Approve Charter

Project Sponsor

Launch Project
LSS Project Portfolio Design

1. DMAIC and Value Stream Analysis (VSA) Projects

- Used when root cause, constraint, source of variation, or source of waste is not known or easily identified
- Rigorous measurement and analysis are performed
- Project Duration is six months or less

2. Kaizen Blitz / Rapid Improvement Event (RIE) Projects

- Low hanging fruit
- Medium effort, Solution known
- Medium to High Benefit
- Project Duration is one month or less

3. Just Do It! (JDI) Projects

- Low Effort
- Low Benefit
- Project Duration is one week or less

Prioritize and start Projects to match available resources with a focus on rapid COMPLETION and RESULTS.
CPI Portfolio Management and Strategic Project Alignment

Kaizen/Rapid Improvement Events
- Best for low complexity projects where known solution can be implemented
- High bias for action and implementation
- Typical 1 month project duration

DMAIC or VSA Projects
- Best for complex projects where root cause of problem is not understood
- Thorough measurement and analysis prior to solution implementation
- Typical 2 to 6 month project duration

Strategic Projects
- Enterprise-level business issues (e.g., wrong offerings for target market, losing market share)
- Historical performance issues
- Slow innovation resulting from costly, ineffective product development processes
- Typical 6 - 12 month project duration

Little's Law: Process Flow Time = \( \frac{\text{Work In Process}}{\text{Completion Rate}} \)

Economic Value

Effort

Before Project Selection Process

After Project Selection Process
The Focusing Effect of Lean Six Sigma Extracts the Critical Few Factors From the Trivial Many

Inputs \{X\} \rightarrow Process Y=f(x) \rightarrow Outputs \{Y\}

Define
- Project Charter, Voice of Customer, SIPOC
  - Review<

Measure
- VSM, Constraint ID, Sampling
  - Review<

Analyze
- Value Added, Cause/Effect, DOE
  - Review<

Improve
- Cell Layout, Process Flow
  - Review<

Control
- Control Plan, Standard Operating Procedure
  - Review<

DMAIC Project Methodology

All Possible Data (Xs)
Lean Six Sigma Project Tracking in the Power Steering Knowledge Base

- Continuous Performance Improvement (CPI) activities are tracked and reported in the Power Steering database
- Project Office CPI/LSS project performance metrics are tracked in Power Steering
- LSS Belts are certified using projects documented in Power Steering
- If your project is not in Power Steering, it doesn’t exist, Project Offices don’t get credit, and you can’t get certified!
- Make sure your project data is maintained and updated in Power Steering.
4. Six Sigma and Lean Bodies of Knowledge (BOK)
A. General Principles
   I. Enterprise-Wide Deployment (History, Values, Deployment Model)
   II. Organizational Process Management and Measures (Benchmarking, CTx, Business Metrics, Financial Metrics)
   III. Team Management (Types, Roles, Dynamics, Leadership)

B. DMAIC Process
   IV. Define (VoC, Project Charter, Project Management)
   V. Measure (Measurement Systems, Statistics, Probability, Capability)
   VI. Analyze (Modeling, Hypothesis Testing, FMECA, Root Cause)
   VII. Improve (Design of Experiments, Waste and Cycle Time Reduction, Theory of Constraints, Risk Management)
   VIII. Control/Validate (SPC, SOP, TPM, Training, Visual Factory)

C. (IX) Design for Six Sigma (DFSS, DFx, Robust Design, TRIZ, Strategic Planning)
1. Cultural Enablers (Respect, Humility, Empowerment, OJT, Leadership, Mentoring, Teamwork, Communication)
3. Consistent Lean Enterprise Culture (Systems Thinking, Constancy of Purpose, Enterprise Perspective, Strategy Deployment, Social Responsibility)
4. Business Results (Measurement Systems, Key Lean Metrics: Quality, Delivery, Cost, Financial, Competitive)
5. Stories
Lean Six Sigma Project Examples

1. **Customer**: U.S. Navy  
   **Title**: Gun Weapon System Customer Survey  
   **Objective**: Improve Reliability and Availability of a Major Caliber GWS  
   **Methodology**: Survey of 47 Gunners’ Mates on 16 ships, Survey Design and Data Analysis, Technical Documentation Review and Analysis  
   **Result**: 16 detailed Action Plans, Navy Commendation Medal

2. **Customer**: U.S. Intelligence Agency  
   **Title**: Geospatial Intelligence Database Process Improvement  
   **Objective**: Deploy new GEOINT database  
   **Methodology**: Kaizen Blitz, VTP, Critical Chain Project Mgt. (CCPM)  
   **Result**: Increased Contractor Award Fee to 95% from 69%, profit $0.8M/y

3. **Customer**: Top Five Global Defense Contractor  
   **Title**: Cleared Resource Staffing Process Improvement Project  
   **Objective**: Maximize utilization and availability of cleared, qualified staff  
   **Methodology**: Interrelational Digraph, TOC, Queuing Theory  
   **Result**: More than doubled hiring rate, increased sales by $0.9M/year