Lean Six Sigma Overview
Bill Smith

Six Sigma Was Born on 15 January 1987
Discovery of bill smith
Realization at Motorola

• To reduce field failures, much higher level of internal quality is required.

• Done right, improving quality will reduce cost.

• Cost of correcting poor quality ranged $800-$900 million per year.
Desire of Bob Galvin

4 years

100 times
Results of Six Sigma at Motorola

• Five fold growth in sales
• Annual increase of profit 20%
• Cumulative saving $14 Billion
• Annual stock price gain 21.3 %
Philosophy of Six Sigma

Make customer extremely happy
And
Improve Bottom Line
What is Six Sigma ($6\sigma$)?

- Six Sigma is a philosophy for managing process improvement.
- Six Sigma is a way to integrate quality into day-to-day activities.
- Six Sigma is a means of continuously improving to meet customer needs.
- Six Sigma is a measurement of defects and variation.
Basic Definitions

Sigma

• A mathematical term used to designate the distribution or spread of any process around the average (mean) as expressed in “standard deviations”.

• For a business or a manufacturing process, the sigma value is a metric used to indicate how well the process is performing.
Six Sigma Is...

...an initiative

- Improvement
- Breakthrough
- Right Projects
  - Linked to Business Goals
- Right People
  - Selected & Trained
- Project Management
  - Management Reviews
- Right Results
  - Process & Financial ($$)
- Sustaining Gains

...a methodology

- Process Thinking
- Process Variation
- Facts, Figures, Data
- Define, Measure, Analyze Improve, Control (DMAIC)
- Statistical Tools
- Critical Few Variables

...a measurement

- Quantifies our Process Capability
Six Sigma Is…

…a simple, unique, proven and lasting approach for improving our business performance based on:

• Alignment of the customer, strategy, processes and people

• Big, measurable business results

• Selective but broad deployment of advanced quality and statistical tools
Six Sigma is emerging into all aspects of business.
DMAIC Approach

• Once Projects are identified, the Six Sigma Methodology is applied to provide a structure to problem solving.

The Methodology:

• Define the Process / Problem
• Measure the Process / Problem
• Analyze the Process / Problem
• Improve the Process / Problem
• Control the Process / Problem
Another View: The Roadmap

Define
- Initiate the Project
- Define the Process
- Determine Customer Requirements
- Define Key Process Output Variables

Measure
- Understand the Process
- Evaluate Risks on Process Inputs
- Develop and Evaluate Measurement Systems
- Measure Current Process Performance

Analyze
- Analyze Data to Prioritize Key Input Variables
- Identify Waste

Improve
- Verify Critical Inputs Using Planned Experiments
- Design Improvements
- Pilot New Process

Control
- Finalize the Control System
- Verify Long Term Capability
DMAIC Is A Filter Process

Define

30+ Inputs

Measure

All X’s

10 - 15

1st “Hit List”

Analyze

8 - 10

Screened List

Improve

4 - 8

Found Critical X’s

Critical Input Variables

Control

3 - 6

Controlling Critical X’s

Critical Input Variables
# Level of Competition

<table>
<thead>
<tr>
<th>Sigma</th>
<th>DPMO</th>
<th>Cost of poor quality (% of sales)</th>
<th>% OK</th>
<th>Competitive level</th>
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<tbody>
<tr>
<td>6</td>
<td>3.4</td>
<td>&lt;10</td>
<td>99.999%</td>
<td>World class</td>
</tr>
<tr>
<td>5</td>
<td>233</td>
<td>10 – 15</td>
<td>99.97%</td>
<td>Industry average</td>
</tr>
<tr>
<td>4</td>
<td>6,210</td>
<td>15 – 20</td>
<td>99%</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>66,807</td>
<td>20 – 30</td>
<td>93%</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>308,537</td>
<td>30 – 40</td>
<td>63%</td>
<td>Non competitive</td>
</tr>
<tr>
<td>1</td>
<td>690,000</td>
<td>&gt; 40</td>
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Why is 99% not good enough?
What Does $6\sigma$ Mean In Your Daily Life?

![Graph showing PPM vs. Sigma Level]

- **Tax Advice**: 1 PPM
- **Prescription Writing**: 2 PPM
- **Restaurant Bills**: 3 PPM
- **Payroll Processing**: 4 PPM
- **Baggage Handling**: 5 PPM
- **Airline Safety Rate**: 6 PPM

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Benefits

• Financial
  ✓ GE – $2 Billion to bottom line. (1999)
  ✓ Honey Well – $1.4 Billion (1996)
  ✓ DuPont – $1.6 Billion (1998)
  ✓ VSNL – $16.6 Million (2005)

• Customers

• Employees

• Quality
Lean Six Sigma

What is LEAN SIX SIGMA?

LEAN
Reduce waste by reorganizing a process

SIX SIGMA
Reduces defects by solving problems

LEAN SIX SIGMA
LEAN improves SIX SIGMA: Reducing waste and solving problems to be faster and more efficient
Recognize Problem

Is process Management Exists

Is Solution Known?

Is it Cycle Time Related?

Just Do It

Are Solution Obvious?

Is new Production / Process?

DFSS DMADV

Work Out

Lean

Process Management

Y

Y

N

Y

N

N

Y

N

N

Y

N

N

Y

N

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Harvesting the Fruits of Six Sigma

Sweet Fruit
Design for Six Sigma (DMADV)

Bulk of Fruit
Process Characterization & Optimization (DMAIC)

Low Hanging Fruit
Seven Basic Tools

Ground Fruit
Logic and Intuition
Quick hits - KAIZEN
When Do You Call A Company A Six Sigma Company?

- 20-30% of Bottom line coming from Six Sigma Projects
- 5-10% of the Population are BB & MBB
- 40-50% of the Population are GB
- All the HOD are Champions
- A Stream of Projects are in pipe line
- HR Policies are aligned with Six Sigma deployment
- The Six Sigma Performance is reported to all the stake holders
- Six Sigma efforts self sustaining without external help
- It has the expertise to spread 6 Sigma culture to its Suppliers and Customers and insist on them being 6 Sigma Companies
Ways to select the projects

Key Business Plan / Operating Plan

Top-Down approach

Opportunities to reach the goals

Potential Projects

Bottom-Up approach

Issues needing attention

Problems, Errors, Dissatisfied Customers, Inefficiency
Objectives Of Six Sigma Project

- Reduce Variability
- Reduce Defects
- Improve Customer Satisfaction
- Reduce Cost.
- Reduce Lead Time
- Improve First Pass Yield.

- Improve Rolled Throughput Yield.
- Shorten Lead Time
- Optimize Process Performance
- Optimize Supply Chain.
Six Sigma Project Identification

• Usually, Six Sigma projects are undertaken at the process level. However, all such projects should tie to the strategic business level goals.
• Key Performance Indicators (KPI) are metrics that reflect strategic value drivers, specify organizational goals and are key to organizational success.

Each project should address at least one KPI at the business level.
Linking Projects to the Big Ys – The Decision Tree

- Show how each project rolls up to the Big Ys
- Indicate the amount of impact of each project.
  - \( \% \)
  - \$ 
  - Number (e.g. days)
- Indicate the direction of impact if applicable
  - Increase
  - Decrease
Six Sigma - Define
DEFINE : What is the Problem?

• Goals
  – Define Project Purpose
  – Determine Scope And Goals
  – Identify Voice Of The Customer And Define Value
  – Create The Project Charter And Plan

• Deliverables
  – Approved Project Charter
  – Timeline chart
  – Critical To Quality (CTQ) Characteristics
  – VOC (Voice of Customer)
  – Kano Model
  – Define phase toll gate review

DMAIC

DEFINE:
Define the problem/reason for the project, and map the value stream steps

MEASURE:
Populate the value stream map with data, measure and baseline current state performance

ANALYZE:
Identify and confirm root causes

IMPROVE:
Generate and implement solutions and evaluate results

CONTROL:
Maintain the gains
Six Sigma – Measure
MEASURE : What is the Problem?

• Goals
  – Gather relevant data
  – Determine magnitude of problem
  – Understand waste, cycle time, defects, and variation within the process

• Deliverables
  – Baseline data and control charts, Sigma Level, Process Capability (yield, trends, etc.)
  – Focused problem statement.

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Six Sigma – Analyse
Analyze : What is Causing the Problem?

• Goals
  – Identify Potential Root Causes
  – Conduct Data Analysis
  – Validate Critical Root Causes

• Deliverables
  – List of Root Causes (Critical X’s) and how they were validated
  – Determination of how much of the Problem is accounted for by the Critical x’s

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Analyze: Common Tools

- Data and Graphical Analysis from Measure,
  - Control Chart
  - Histogram
  - Boxplot
  - Graphical Summary
  - Pareto Chart
- Successive Pareto
  - Can the 80/20 rule help narrow the focus on the key drivers by diving deeper into the big bars?
Analyze : Common Tools, cont.

- **Brainstorming**
  - What factors might be causing the problem?

- **5 Whys**
  - What are the deeper causes of problems?
  - Can you peel away the layers of symptoms to identify the root cause?
Analyze : Common Tools

- **Cause-and-Effect Diagram**
  - What are all the potential causes?
  - What are the relationships between identified causes?
  - Which are the deeper causes?
  - What other data should we collect to validate what the root causes are?

- **Scatter Plot**
  - Does the suspected cause have a correlation to the problem?
  - Could there be another factor contributing to the correlation?
- **Linear Regression**
  - Does the suspected cause have a correlation to the problem?
  - If so, what is the mathematical model describing the correlation?
  - If the x changes, how does it affect your y?

- **Advanced Statistical Tools**
  - What other ways can we verify the root causes?
Six Sigma – Improve
Improve : Making the Problem GO Away

**Goals**
- Generate, evaluate and select solutions
- Quantify financial impact
- Conduct a pilot
- Plan implementation

**Deliverables**
- Recommended solution(s)
- Cost-benefit analysis
- Evaluated pilots / simulations / experiments
- Full-scale implementation

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**DMAIC**

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**IMPROVE:**
Generate and implement solutions and evaluate results

**CONTROL:**
Maintain the gains
Improve: Common Tools

• Brainstorming
  – What are the possible specific solutions?

• Solution Implementation plan (Piloting and Full Scale)
  – Implement the identified solutions on a pilot basis
  – Do validation of the solution effectiveness
  – Make a full scale implementation plan
**Improve : Common Tools**

- **Before and After Metrics**
  - How much improvement was made?
  - Total Cycle Time = 35 - 140 business days
  - Yield = 14%
  - Total Cycle Time = 2 - 20 business days
  - Yield = 67%

- **Before and After Chart**
  - How effective was the pilot?
  - What went right?
  - What went wrong?
  - What needs to change before full implementation?
Six Sigma – Control
Control: Making the Problem STAY Away!

• Goals
  – Determine process controls and monitoring system
  – Update standardized process documentation
  – Establish clear, ongoing process ownership
  – Effectively transition from a improvement project to ongoing process management
  – Translate/replicate where appropriate

• Deliverables
  – Process control system
  – Updated process documentation
  – Replication opportunities
  – Final tollgate review

DMAIC

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Control : Common Tools

• Monitoring Plan
  – How will we monitor the process in the future?
  – How will we monitor and control the x’s in order to prevent problems with the y’s?

• Control Chart
  – How will we make sure the process stays in control and continues to meet customer requirements?
  – How will we identity future improvement opportunities?
Control : Common tools

• Standard Work Document / Procedure
  – How will we train staff and standardize the new way of working?

• Final Tollgate Storyboard
  – What is the executive level view of the complete story of the project?
  – What is the more complete story of the project meant for specific audiences?
  – How did the logic flow from DEFINE to CONTROL?
  – What were the lessons learned?
Thank You!!!