Comparing Lean Six Sigma to DFSS

Presentation Objectives

- **Who We Are**
  - ✓ M&T Bank Overview & Vision

- **Explore Comparisons Between Lean Six Sigma (LSS) and DFSS (Design for Six Sigma)**
  - ✓ Make distinctions between LSS vs. DFSS business principles & objectives
  - ✓ Examine LSS DMAIC Problem Solving Process vs. DFSS (IDDOV, DMADV, DMADOV, etc.) Problem Prevention Process Frameworks
  - ✓ Define what you are improving – business “process” vs. “design”
  - ✓ Define your internal/external customers and metrics to quantify how well customer expectations are met or exceeded
  - ✓ Compare LSS vs. DFSS Tool/Methodology Comparisons

- **Discuss practical tool application analogies, synergies & differences**

- **Enable innovative solutions to improving business processes & product designs**

- **Share lessons learned from “problem solving to prevention” cultural experiences**

- **Q & A**
Who We Are @ M&T Bank

M&T Bank Corporate Vision

M&T Bank strives to be the best place our employees ever work, the best bank our customers ever do business with and the best investment our shareholders ever make.

The main reasons for our success are our employees, our customer focus, and our community involvement. The bank’s vision statements guides how we operate and what we strive to achieve every day. Our employees help make that vision a reality.

At M&T, our vision focuses on being the best. We are all part of a team working to achieve one common objective: excelling in the eyes of our customers. Whether our customers are the banking public or our own fellow employees, our goal is to consistently exceed their expectations.

Accomplishing our vision

We make our vision a reality by focusing on M&T’s strengths:

- Understanding what's important
- Exceptionally talented employees
- Accomplishing objectives by working as a team
- A customer-driven organization
- A strong commitment to our communities
Comparing Lean Six Sigma to DFSS

Who We Are @ M&T Bank (cont’d)

The M&T community banking philosophy is more than just a way of doing business—it reflects the way banking should be.

M&T Bank has a rich history of community banking and an established track record of commitment to serving our customers and communities for more than 150 years. With more than 700 branches and 1,500 ATMs across seven states, M&T actively lends in the markets where its customers live and work. This commitment to community is engrained in the culture of the bank and has helped M&T remain profitable for 150 consecutive quarters—37 straight years.

M&T’s Chairman and CEO Robert G. Wilmer often says, “The well-being of the bank is dependent upon the well-being of the communities we serve.”

M&T continually invests in its communities.
- The bank contributed $22 million to more than 3,300 not-for-profit organizations in 2013 through the M&T Charitable Foundation.
- M&T Bank employees report spending thousands of hours per year in volunteer service.
- M&T has earned the highest Community Reinvestment Act rating since 1982.

For more than 150 years, M&T Bank has been known as one of the strongest regional banks in the nation.

M&T’s primary strength is helping businesses grow.
- M&T made more than 10,000 new loans to small businesses in 2013.
- Fifth-largest Small Business Administration (SBA) lender in the nation, despite primarily operating in the northeast U.S.
- The bank is the number one SBA lender in most of its markets, including: Buffalo, Rochester, Syracuse and Binghamton, N.Y.; Philadelphia, Pa.; Baltimore, Md.; Wilmington, Del.; and Washington, D.C.

Key Statistics*
- Total Assets: $85.1 billion
- Total Deposits: $66.5 billion
- Total Loans: $64.1 billion
- Employees: Nearly 16,000
- Customers: More than 2 million retail customers and 220,000 businesses
- 2013 Charitable Contributions: $22 million

Banking Resources
- Checking & savings accounts
- Debit & credit cards
- Home equity loans & other lending options
- Small business & commercial banking
- Wealth management through Wilmington Trust
- Online & mobile banking available

M&T Bank
Understanding what's important*

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Comparing Lean Six Sigma to DFSS

DFSS vs. “Lean Six Sigma”
Evolving From Problem “Solving” to “Prevention”

Cost to Correct Quality and Reliability

$\text{Defects hard to see, Easy to prevent}$

$\text{Defects easy to see, Costly to fix}$

Product Design/Development Cycle Time

Most LSS quality improvement efforts are here...

Marketing/Research  Design  Prototype  Production  Customer
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Where is Your Company on the Six Sigma Path?

Six Sigma Benchmarking
Company X First Time Quality (FTQ)

- World Class Six Sigma
  - Domestic Airline Fatality Rate
  - APQP Minimum (based on Cpk = 1.33)
    (32ppm, 6.6 Sigma)

- Need to close gap by designing-in Robustness and Quality.

- Company X Total
  - 25,565 ppm
  - 3.45 Sigma

- IRS Phone Advice Errors (25%)
**Comparing Lean Six Sigma to DFSS**

**What does Six Sigma mean to Customers?**

Think 99% good is good enough? Think again....

<table>
<thead>
<tr>
<th>99% Good Means (3.8 Sigma)</th>
<th>99.9997% Good Means (6 Sigma)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.2 hours of server wait time per month</td>
<td>9 seconds of server wait time per month</td>
</tr>
<tr>
<td>20,000 lost articles of mail per hour</td>
<td>7 lost articles of mail per hour</td>
</tr>
<tr>
<td>5,000 incorrect surgical operations per week</td>
<td>1.7 incorrect surgical operations per week</td>
</tr>
<tr>
<td>2 short or long landings at most major airports each day</td>
<td>1 short or long landing every 5 years</td>
</tr>
<tr>
<td>150,000 wrong drug prescriptions each year</td>
<td>68 wrong drug prescriptions each year</td>
</tr>
</tbody>
</table>

**As a statistical measure, 6 Sigma represents 3.4 defects per million opportunities, or 99.9997% quality.**

**Lean Six Sigma delivers products and services that are both superior and consistent**
Innovation and Continuous Improvement Business Strategies

- **M&T Goal is Cultural Integration** –
  - Centralized Bankwide Transformation organization founded in 2008 and Continuous Improvement Program (CIP) founded in 2012
  - Goal is that all M&T employees are trained in common problem solving/prevention processes

- **Continuous Improvement** – Foundation for **problem solving**
  - Lean (PDCA) and Six Sigma (DMAIC) Methods deployed independently
  - Integrated Lean Six Sigma tools directly into DMAIC Roadmap (2014)

- **Innovation** – Foundation for **problem prevention**
  - DFSS is a Future Business Strategy
  - DFSS becomes the common framework, aligned with design/development processes
  - Recognize DFSS, Applied Creativity & other core competencies for Innovation

- **Core Competency Tools**
  - LSS/DFSS Awareness & Practitioner Training
  - LSS/DFSS Tool Workshops planned to reinforce, refresh & sustain core foundation
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Alphabet Soup for LSS/DFSS Process Framework

- IDDONV (DFSS)
- DMEDI
- CDOV
- IDOV
- DCCD
- MAIC
- DCOV
- DMCAD
- DMAIC (Lean Six Sigma)
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DMAIC vs. IDDOV Process Frameworks

Breakthrough business results rely on a rigorous, structured methodology ...

Lean Six Sigma Breakthrough Roadmap

1. Define
2. Measure
   - Capability OK?
     - Yes
     - No → Analyze
3. Analyze
   - Change Required?
     - Yes → Improve
     - No
4. Improve
   - Capability OK?
     - Yes → Control
     - No → Redesign Loop

DFSS Framework

1. Identify & Initiate
2. Define Requirements
3. Develop Concepts
   - Concept Selected
     - No → Optimize Design
     - Yes → Verify & Control
   - Requirements Met
     - No
     - Yes → CELEBRATE
Lean Six Sigma DMAIC Roadmap For Problem Solving

**DEFINE**
- Define Customers and Requirements (SIPOC)
  - Identify Critical to Quality (CTQs) That Impact Customer and Business Needs
  - Develop High Level Process Map (IPO Diagram and/or P-Map)
- Develop Problem Statement, Goals/Benefits (Charter) and Project Scope
  - Identify Champion, Process Owner and Cross-Functional Project Team
  - Evaluate Key Organizational Support
- Problem Solving Strategy
  - Develop Project Plan and Milestones (T-Map)

**MEASURE**
- Define Defect, Opportunity, Defects, Metrics, Assess Current Baseline
  - Detailed Process Map (P-Map) and/or Value Stream Map (VSM)
- Analyze potential failure modes (FMEA)
- Develop/Execute Data Collection & Evaluate Measurement Systems
  - Identify Data Types (Attribute vs. Variable)
  - Identify & Characterize Sources of Variation in Current State
  - Determine Appropriate Control Charting for Current Process Performance
  - Determine Current Process Capability & Baseline Sigma Level
- Begin Developing Y=f(x) Relationship (Formulate Hypotheses)

**ANALYZE**
- Evaluate the Measurement System Analysis (MSA)
- Data Torturing & Interpretation using multiple Analyses (PGA Approach)
  - Sub-grouping To Compare “Within” vs. “Between” Variation (Control Charts)
- Identify Value/Non-Value Added Process Steps To Improve Workflow
- Investigate, Analyze & Verify Root Cause Hypotheses
- Narrow Focus to Critical Few X’s to characterize Y=f(x) Relationship
  - Perform Regression and/or Correlation Analyses
  - Perform Screening and/or Characterization Design of Experiments

**IMPROVE**
- Optimize & Verify Critical Few X's to Refine Y=f(x) Relationship
  - Perform Regression and/or Optimization DOEs (Predictive Equation)
- Improve The Process Work Flow (Update Future State P-Maps/VSMs)
- Develop Evaluate & Select Potential Best Fit Solutions
  - Assess Failure Modes of Potential Solutions & Mistake-Proof the Process
- Validate Potential Improvement by Pilot Studies of Best Solution
  - Correct/Re-Evaluate Potential Solution
  - Perform Cost/Benefit Analysis & Verify Improvement Level Metrics

**CONTROL**
- Define/Validate Process Monitoring and Control System
  - Verify New State Process Capability & Assess Improved Sigma Level
  - Implement Statistical Process Control (SPC)
  - Institutionalize the Improvements Through Business Systems Modifications
- Develop/Implement Control & Transition, Handoff to Process Owner
- Develop Standard Work Procedures & Continue to Monitor/Audit Process
- Close Project, Finalize Documentation in Project Knowledge Notebooks
  - Verify Business Impact Benefits, Cost Savings/Avoidance, Profit Growth
- Communicate Lessons Learned to Business Organization
- CELEBRATE SUCCESS!
DFSS IDDOV Framework For Problem Prevention

<table>
<thead>
<tr>
<th>DFSS Framework</th>
<th>Process Steps</th>
<th>DFSS Tollgates</th>
<th>Deliverables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify &amp; Initiate</td>
<td>Form Team</td>
<td>Develop Communication &amp; Reporting/Review Plan</td>
<td>- Assess Business Case/Risk</td>
</tr>
<tr>
<td>Define Requirements</td>
<td>Define Overall Project &amp; Develop Plan</td>
<td>Define DFSS Project Scope</td>
<td>- Develop Initial Charter</td>
</tr>
<tr>
<td>Develop Concepts</td>
<td>Gather VOC &amp; Other Voices</td>
<td>Translate VOC into CTQ’s</td>
<td>- Organizational Plan</td>
</tr>
<tr>
<td>Optimize Design</td>
<td>Define DFSS Project Scope</td>
<td>Translate CTQ into Functions</td>
<td>- Prioritized Customer Needs</td>
</tr>
<tr>
<td>Verify &amp; Control</td>
<td>Generate Concepts to Meet CTQ’s</td>
<td>Develop Transfer Function</td>
<td>- Initial QFD HOQ #1 (VOC)</td>
</tr>
<tr>
<td>Concept Selected</td>
<td>Estimate Reliability</td>
<td>Update DFSS QFD Scorecard Throughout Project</td>
<td>- Final Project Charter</td>
</tr>
<tr>
<td>Yes</td>
<td>Assess Design Risk</td>
<td>- Prioritized Customer CTQ’s</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>Concept Selection</td>
<td>- Initial DFSS QFD Scorecard</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>Optimize Design for Robustness</td>
<td>- Functional Analysis</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>Evaluate Manufacturability</td>
<td>- Final QFD HOQ #1</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>Allocate Tolerances</td>
<td>- Initial Transfer Function(s)</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>Predict Capability</td>
<td>- Generate Multiple Concepts</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>Test &amp; Final Verification and Validation as Appropriate</td>
<td>- Reliability Assessment</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>- Design Risk Assessment</td>
<td></td>
</tr>
<tr>
<td>OK</td>
<td>OK</td>
<td>- Physical Design Characteristics</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>- Final QFD HOQ #2</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>No</td>
<td>- Selected Concepts</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>Establish Controls</td>
<td>- Optimized Design/Process</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td></td>
<td>- Prioritized Key Control Characteristics</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>Update Corporate Memory</td>
<td>- Final Tolerance Design</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td></td>
<td>- Final QFD HOQ #3</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>Update DFSS QFD Scorecard</td>
<td>- Capability Estimates For Optimized Design</td>
<td></td>
</tr>
</tbody>
</table>

- Assessment of Conformance To Requirements
- Establish Implementation Strategy
- Control & Transition Plan
- Final SOPs/STMs, Product/Process Design Guidelines
- Final QFD HOQ #4
- Final DFSS QFD Scorecard

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Comparing Lean Six Sigma to DFSS

<table>
<thead>
<tr>
<th>Business Strategy</th>
<th>Lean Six Sigma</th>
<th>DFSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>View of Waste</td>
<td>Lean: Non-value add is waste</td>
<td>VOC/VOB Dissatisfiers, Lack of Standard Work (Design), Reactionary Design Changes</td>
</tr>
<tr>
<td></td>
<td>SS: Variation, Defects/Errors &amp; Rework are wastes</td>
<td></td>
</tr>
<tr>
<td>Process Framework</td>
<td>1. Identify Value</td>
<td>1. Identify Design Opportunity</td>
</tr>
<tr>
<td></td>
<td>2. Define Value Stream</td>
<td>2. Define Requirements</td>
</tr>
<tr>
<td></td>
<td>3. Determine Flow</td>
<td>3. Develop Concepts</td>
</tr>
<tr>
<td></td>
<td>4. Define Pull</td>
<td>4. Optimize Design</td>
</tr>
<tr>
<td></td>
<td>5. Improve Process</td>
<td>5. Verify &amp; Control</td>
</tr>
<tr>
<td>Tools</td>
<td>Lean: Visualization</td>
<td>Critical-to-Quality (CTQ)</td>
</tr>
<tr>
<td></td>
<td>SS: Data-Driven Decisions</td>
<td>Customer Driven Requirements for Design Functions &amp; Features</td>
</tr>
<tr>
<td></td>
<td>Statistical/Graphical Analysis</td>
<td></td>
</tr>
<tr>
<td>Focus</td>
<td>Problem Solving</td>
<td>Problem Prevention</td>
</tr>
<tr>
<td></td>
<td>Focused Process Flow, Variation Reduction</td>
<td>Focused Design Optimization</td>
</tr>
</tbody>
</table>

Combining Lean Tools with the Six Sigma discipline will reduce waste and defects, lowering cost while raising efficiency and effectiveness.
Comparing Lean Six Sigma to DFSS

Design for Six Sigma (DFSS) Definition

- Design for Six Sigma (DFSS) is a highly disciplined approach to embedding the principles of Six Sigma as early as possible in the design and development process.¹
  - A customer-driven process
  - Creates robust designs that have Six Sigma Quality “Designed In” and meets customer defined critical-to-quality (CTQ) requirements
  - Change vision to move from reactive design to predictive design

- DFSS is used for:
  - Designing and developing a new design with predictable functional performance
  - Major changes to an existing design when variation associated with Continuous Improvement efforts have reached a point of diminishing returns and a redesign effort is required
    - Indicated by system-wide changes
    - To reduce common cause variation
    - To achieve quantum “breakthrough” improvements

Comparing Lean Six Sigma to DFSS

What is a Design?

Definition of “Design”: to devise for a specific function or purpose held in view by an individual or group

Types of “Designs” can include:

• **A Product**: a marketing-mix element that is designed with features and benefits that are desired by a customer or market
  - **Physical**: Computer, cell phone, coffee maker, automobile, medical device, lawn/gardening equipment, IT computer technology/networks/systems
  - **Virtual**: Checking or savings account, bank loan, mortgage, cell phone “app”, IT computer networks/systems (software), electronic data warehouse

• **A Process**: a systematic series of activities that transforms a set of inputs into a specific set of outputs
  - **Manufacturing**: Computer Assembly Process, Food Manufacturing Process, Tooling or Equipment Fabrication Process, Automotive Assembly Process
  - **Transactional Business Process**: complete bank checking account application, procurement process, part number assignment process, design process for a product/math model, developing customer quote for products/services
  - **Service Related Process**: Retail and/or Commercial Banking services, hospital admittance, performing a medical surgical procedure, 1 hour photo processing, repairing a vehicle or household appliance, customer invoicing
Comparing Lean Six Sigma to DFSS

What are the objectives of Lean Six Sigma vs. DFSS?

Lean and Six Sigma aim to improve the business by eliminating wasteful activities, reducing variation, and improving process performance.

**Lean**

- Speed in the Value Chain
- Waste Elimination
- Value System Redesign

**Six Sigma**

- Variation Reduction
- Problem Solving methodology
- Continuous Improvement

**DFSS**

- Design for Six Sigma (DFSS) aims to create product/system/process designs that have Six Sigma Quality “Designed In”

- Customer Driven Design Optimization
- Problem Prevention methodology
- Innovation

All can work together to provide insight into problem solving/prevention efforts.
Comparing Lean Six Sigma to DFSS

Both Six Sigma & DFSS Focus on Variation Reduction

Given a distribution function which approximates the histogram of a process which displays a reasonable degree of statistical control:

- The parameter which will be used to characterize “process location” is called the mean ($\mu$) of $f(x)$.
- The parameter which will be used to characterize “process dispersion” is called the standard deviation ($\sigma$) of $f(x)$.

\[ Y = f(X_1, \ldots, X_N) \]

\[ Y = f(X) \]

The focus of $6\sigma$
Comparing Lean Six Sigma to DFSS

DFSS and Lean Six Sigma Tools/Processes Overlap

**METHODS:**
- **DFSS (IDDOV Process):**
  - Function Analysis
    - Functional P-Maps, FAST
  - Design Improvement Tools
  - Robust Design Engineering
  - DFSS QFD Scorecard
  - Design for “X” Innovation Tools
  - Design Focus/Behavior
    - DOE (Design of Experiments)
    - VOC QFD HOQ#1, 2, KANO
    - Data Analysis, Monte Carlo Sim.
  - IDDOV Problem Prevention Process

- **Lean Six Sigma (DMAIC Process):**
  - SIPOC
  - Applied Creativity
    - Brainstorming
  - Process Mapping (P-Maps)
  - Thought Process Maps (T-Maps)
  - Constraint Mitigation
  - Risk Management: FMEA, C&E Diagrams
  - Data Collection Plan
  - Control Charts
  - Y = F (X)
  - Hypothesis Testing
  - Standard Work
  - Error Proofing
  - Statistical/Graphical Analysis
  - Measurement System Analysis (MSA)

**OBJECTIVES:**
- **DFSS (IDDOV Process):**
  - Design/Development Time Reduction
  - Functional Performance
  - Physical Design Characteristics
  - Design Capability
  - Design Variability/Optimization
  - Cost Avoidance

- **Lean Six Sigma (DMAIC Process):**
  - Variation Management
  - Cost Reduction/Avoidance
  - Customer Satisfaction
  - Quality Improvement
  - Control Plans

**Lean Six Sigma & DFSS Tools integrated into DMAIC & IDDOV process frameworks respectively help drive problem solving/prevention activities**
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DFSS - Optimizing Product Design/Development Processes

- **Need a Robust New Product Development Process**
  - “Robustness” traditionally relates to a product/manufg. process that consistently produces its intended and desired output in the presence of uncontrollable noise conditions like production and usage/application
  - Need similar philosophy in the design/development process used to design new products, processes (both Mfg./Transactional) and systems

- **Assessment of Taguchi Robust Optimization Approach**
  - A tried & proven Robust Engineering philosophy originated for manufacturing products
  - Test applicability of moving this philosophy up stream to the Design Engineering Factory design and development process

- **Achieve Robustness in the Design/Development Process through a Two-Step Optimization Approach**
  - Step (1): Reduce Variation in the Design Engineering Factory
  - Step (2): Adjust Performance
Step 1: Reduce Variation

Define Noise Factors

- Identify the Key **Noise** Variables Driving Variation in the Design Engineering Factory

- **Absence of Standard Work:** Variation by design, development and manufacturing engineers/developers in the performance of work in the process used for developing new products.

- **Work Environment Variation:** Variation in global cultural work environments.
  - Includes personal characteristics, variation in how people think through problems and tasks, variation in local rules and regulations, and variation in leadership and management styles.

- **Competency Level Variation:** Variation in regional/global skill levels, available subject matter experts, and years (generations) of experience and expertise.
Step 1: Reduce Variation
Define What DFSS Is For Your Organization

DFSS is a systematic methodology utilizing tools, training and measurements to enable us to design products and processes that meet or exceed customer and business expectations, and can be produced at appropriate Sigma quality levels.
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Step 1: Reduce Variation
Introduce Standard Work (Common Systems & Processes)

- **Continuous Improvement Strategy:** Lean Six Sigma (LSS)
  - Establish Common training, tools, and problem solving / prevention processes
  - Foundation for Problem Solving with a goal of Cultural Change
  - Start with plant floor Continuous Improvement and Problem Solving

- **Innovation Business Strategy:** Design for Six Sigma (DFSS)
  - Foundation for Problem Prevention strategy becomes primary focus
  - DFSS (IDDOV) becomes the common, global Framework and language of Design

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![DFSS Diagram](image-url)
Comparing Lean Six Sigma to DFSS

Step 1: Reduce Variation  Implement a Common DFSS Framework

DFSS projects that follow an IDDOV framework typically spend 75% of the time in “Get the Right Design” which is highly focused on defining functions to meet the Customer Needs.

**IDD  Get the Right Design**
- Identify High Value Projects
- Deeply Understand Customer Needs
- Generate Best Design To Meet CTQs
  - Form Follows Function
- Select Best Solution

**OV  Get the Design Right**
- Optimize Design for Robustness
- Achieve Design Margin
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Step 2: Adjust Performance

Technology and Product Design/Development Processes

DFSS Framework (Methods and Tools)

“What” + “How” = Flawless Designs and Flawless Launch

“What” to do  “How” to do it
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Step 2: Adjust Performance
How: Key Tools in DFSS Program

Tools selected to optimize development **Time, Cost and Quality**

- Quality Function Deployment (QFD)
  - Keep it simple, basic 4 houses – Talk to your customer
- DFSS QFD Scorecard
  - Linkages from QFD through production
- Functional Analysis
  - Form follows Function
- Design for Reliability (DFR)
  - Engage Reliability Engineering and Prevent Problems
  - Change Point and DRBFM Analysis
- Systems Engineering
  - Requirements Flow-down
- Robust Engineering
  - Use of Taguchi Robust Design and Traditional approaches
- Monte Carlo Analysis
  - Reduced design/development time and cost modeling
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- Share lessons learned from “problem solving to prevention” cultural experiences

- Q & A
Comparing Lean Six Sigma to DFSS

How Do Customers’ View Your Company’s Problem Solving / Problem Prevention Competencies

- How is your company viewed by your customers?
  - Reactionary, not preventative
  - Adequately responsive to customer requests
  - Problems not permanently solved
  - Chronic problems not solved
  - Inconsistent
  - Flawed startups

- How does your company want to be viewed by your customers?
  - Proactive
  - Quick, agile
  - Leaders
  - Systems experts
  - Flawless startups
  - On-Time Delivery
  - Enterprise-wide problem solving/prevention culture

Your Customers’ Best Supplier
Comparing Lean Six Sigma to DFSS

DFSS Transitions Reactive to Predictive Design Quality

From:
1. Removes defects once in production
2. Evolving design requirements
   ✓ Emphasizes normal product performance
3. Hardware based design
   ✓ Product performance assessed by “Build and Test” prototyping
4. Performance and producibility problems fixed AFTER product is in use
5. Quality and reliability “tested in”

To:
1. Predicts/avoids defects in design process
2. Disciplined CTQ customer requirements flow-down using systems engineering
   ✓ Product System level architecture view
   ✓ Analyzes full range using variation of subsystems and components
3. Math based design
   ✓ Predicted Functional System performance modeled/simulated with optimized prototypes
4. Designed for robust performance producibility (process capability flow-up)
5. Quality and reliability “designed in”

Create products that have 6-sigma quality “Designed In”

Comparing Lean Six Sigma to DFSS

Leadership Roles in Evolving from Problem Solving to Prevention

Optimized New Product/Technology Design/Development Process

1) Leading Change
   2) Creating A Shared Need
   3) Shaping A Vision
   4) Mobilizing Commitment
   5) Making Change Last
   6) Monitoring Progress
   7) Changing Systems & Structures

Current State  Transition State  Improved State

Goal
Culture Change: Problem Prevention

Adapted from Norman Kuchar, GE CRD
1) Leading Change

- Lead by example: attend training, set high expectations, hold people accountable to follow the new direction and apply new tools
- Establish and support Competency Owners to grow and govern the competency
- Oversee creation of common language and processes administered by global managers
- Executive Champions & Project Sponsors breakdown roadblocks and foster supportive work environment for employees

Inverted Pyramid Model

User Community
Global Enterprise Organization

First-line Supervision
Global Managers

Competency Owner Masters (SMEs)

Exec. Leaders

Smallest organizational group - largest support role
2) Creating A Shared Need Within the Organization

Business Impact On Using DFSS Early On In Design/Development

Casting the Biggest Shadow

Decisions made in the design phase can influence 70% or more of the total cost. So how would that relate to FTQ?

Traditional Cost Accounting

Design 5%  Material 50%  Labor 15%  Burden 30%

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### 3) Shaping a Vision
Evolving from Problem Solving to Prevention

<table>
<thead>
<tr>
<th>Fire Fighting</th>
<th>Problem Solving</th>
<th>Problem Prevention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crisis Management</td>
<td>Know how to solve problems</td>
<td>Anticipate and Design out problems</td>
</tr>
<tr>
<td>No Understanding of Variation</td>
<td>Know how to measure variation</td>
<td>Knowledgeable of variation and capabilities</td>
</tr>
<tr>
<td>Don’t understand customer requirements</td>
<td>Understand and meet customer requirements</td>
<td>Anticipate customer needs, exceed expectations</td>
</tr>
<tr>
<td>Rely on peoples’ judgment &amp; experiences</td>
<td>Have problem solving experts</td>
<td>Have problem prevention and problem solving culture</td>
</tr>
</tbody>
</table>

**Knowledge-Based**

![Image of Fire Fighter](1980's)

**1980’s**

![Image of Mechanic](1990's)

**1990’s**

![Image of Inspecting Engineer](2000's)

**2000’s**
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4) Mobilizing Commitment

Executive Leadership
Sets Strategic Goals, Review and Approve Results, Approve Certification, and Actively Supports Organization

Business Process Improvement Steering Committee
Oversees LSS Implementation
Monitors Metrics

Competency Owner
Manages LSS Competency

Trainer (BB/Master BB)
Develops Competency

LSS Project Leader
Leads Project
LSS GB/BB Candidates

Project Team
Assists in Problem Prevention or Problem Solving Effort
Cross Functional Support

Coach (BB/Master BB)
Competency Application Expert

Project Champion/Sponsor
Problem Owner
Manager/Process Owner
5) Making Change Last - Sustainability

Executive Leadership

1. Hardest element in implementing change: Leaders must breakdown barriers and support teams in closing their projects.

2. Ensure Golden Triangle is implemented and executed.

3. Ask the right questions throughout the entire Quality and/or Design improvement processes.


Visual Controls
- Is this condition Normal or Abnormal?
- Are all procedures being followed?
- How do I know this process is producing good parts?

Standard Work
- Expectations clearly understood by everyone.
- Realistic Standards Strictly Enforced.

Standard Management
- Supervisor Standard Work
- Immediate Reaction-If it’s not important to the Leadership it will not be important to the people.
- Escalation Process
6) Monitoring Progress

- Easy: Hard Numbers (generic example)

  - Percent Improvement In Enterprise-wide DFSS Integration 2004-2006
    - Savings: 85%
    - Project Closure: 33%
    - Certifications: 180%
    - DfSS Trained: 33%

- Difficult: Soft-side Culture Issues, the REAL impact
  - Observations of employees using new tools
  - Employees driving co-workers and suppliers to do things differently
  - Native Language differences on a Global basis
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7) Change Systems and Structures

Common Competency Footprint
At Regional/Global Technical Centers

Design/Process Improvement Manager
• LSS / DFSS Masters
• BPI Program/Project Leads
• Certification/Competency Trackers

Training and Certification at all levels:
Leadership, SMEs and GBs/BBs

Project Tracker based on Sponsor
Standard Work to Foster Gate Reviews

Company's proactive and reactive activity management, tracking and lessons learned system. Stay on course by PREVENTING problems before they occur and PREVENTING problems from recurring.
Where is your organization on this Journey?
Evolving From Problem “Solving” to “Prevention”

Ask your organization what is the current estimated cost of poor quality (COPQ)?

What's the value of DFSS in making a 1 sigma improvement on COPQ?
Design Engineering influences 70% of final product/technology costs

DFSS Breakthrough
"Barrier removed. Diminishing returns now dependent on technology and business opportunities."

Opportunities open up when Continuous Improvement is joined with Prevention for an overall attack on variation!

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**Lean Six Sigma / DFSS** Vision for **Innovation** and **Continuous Improvement** Processes

- **Innovation** - Foundation for Problem Prevention Cultural Integration
  - DFSS (IDDOV) becomes language of Design
  - Customers desire a thorough and consistent design process
  - Predict functional performance up front
  - Good initial design/process quality
  - Good long term performance & reliability
  - Robust Engineering, Design for “X”, Applied Creativity and other tools
  - Designing to Nominal is not good enough

- **Continuous Improvement** - Foundation for Problem Solving Cultural Integration
  - Lean Six Sigma (DMAIC) & basic problem solving tools well established
  - Tune our eyes to look for improvement
  - Drive success by demonstrating results
  - Point out new CI opportunities
  - Expose some limitations & lessons learned

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**Build Problem solving foundation and transition to Problem Prevention foundation for Cultural Integration**

**Cultural Integration**

- **Common Problem Solving/Prevention Processes**
- **Innovation**
  - Concept Creation and Selection
  - Design and Development
  - Test and Validation
- **Continuous Improvement**
  - Product/Process Designs
  - Mfg./Business Processes
  - Changing Problem Causes

**Core Analytical Skills**

- Design for Six Sigma
  - Requirements Definition
- Design for “X”
  - Innovation and Selection
- Lean Six Sigma
  - Continuous Improvement
- Basic Problem Solving
- Applied Creativity
- Robust Engineering

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Benefits of Proactive Business Strategies

Focus of DFSS

Classical Six Sigma Start Point

- DFSS is a strategy to reduce the area under the curve
  - Break the endless test-fix-test cycle
  - Focused analytical and experimental methods will reduce total product development costs
- Resultant “Plateau of stability” to dedicate resources upfront to execute flawless launch

Need to Define the Right Metrics

- **Current**
  - # Certifications
  - # Projects
- **Future**
  - Overall design sigma
  - FTQ data
  - Cost of Poor Quality (COPQ)
  - Development time & cost
  - Improved performance
  - New sales revenue
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Summary

- To evolve from a Problem Solving to a Problem Prevention Culture requires:
  - Build Long Strong Foundation of Problem Solving Competency
  - Long Term Vision of Business Process & Design Improvement Strategies

- To optimize the Product Development Process through Design for Six Sigma requires:
  - Reduced Variation
    - A Cornerstone Focus: Standard Work
  - Adjust Performance
    - A Framework of Proven Methods and Tools: DMAIC for LSS, IDDOV for DFSS
  - Leadership that
    - Leads Change
    - Creates a Shared Need
    - Shapes Vision
    - Mobilizes Commitment
    - Makes Change Last
    - Monitors Progress
    - Establishes Support Systems and Structures

- Result will exceed customer expectations with flawless product/process designs and flawless launches.