

Lean Six Sigma Graduate Workshop

One Week

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Implementing Six Sigma: Smarter Solutions using Statistical Methods, Forrest W. Breyfogle III,
John Wiley and Sons, New York, NY, 2003

Note

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Monday

1. Opening and Introductions
2. Business Improvement Strategy
 - Business Improvement Methodology
 - Business: Value Chain Analysis
 - Case Study: Project Execution and Tracking
 - Formula for Success
3. Process Improvement Strategies
 - Six Sigma
 - Lean
 - Theory of Constraints (TOC)
 - S⁴/IEE
4. Traditional Performance Measures
 - Traditional Performance Measures: Tabular
 - Traditional Performance Measures: Bar Charts
 - Traditional Performance Measures: Balanced Scorecard
 - Process Tracking and Process Capability
5. Reduce Fire-fighting
 - Example: Reacting to Data
 - Variation and Process performance
 - Determining the Capability of an In-control Process
 - S⁴/IEE Methodology
 - Case Study: Improving Telephone Wait Time
6. Smarter Six Sigma Solutions (S⁴)/Integrated Enterprise Excellence (IEE)
 - Traditional Performance Measures: Accounting
 - Business Goals and Measures : Traditional Approaches
 - Process Tracking and Process Capability
 - Six Sigma Strategy
 - Project Selection Alternatives
 - What is S⁴/IEE?
 - Why S⁴/IEE?
 - S⁴/IEE Alternative
 - S⁴/IEE Business Goals and Measures
 - S⁴/IEE Business Strategy
 - S⁴/IEE High-level Metrics
 - Exercise: Satellite-level Metric Creation
 - S⁴/IEE Value Chain and Enterprise Functional Handoff Metrics (EFHM)
 - S⁴/IEE Enterprise Measurements, Analyses, and Improvements
 - S⁴/IEE Satellite-level Metrics
 - S⁴/IEE 30,000-Foot-Level Metrics

Lunch

S⁴/IEE Continued

- Exercise: S⁴/IEE Value Chain and EFHM Initiation
- S⁴/IEE High-level Metrics for Process Outputs
- S⁴/IEE Low-level Metrics for Process Inputs
- S⁴/IEE Project Selection: EFHM and EIP
- S⁴/IEE Project Selection: Lean Enterprise
- S⁴/IEE Illustration: Enterprise Improvement
- IEE Enterprise Improvement Process (EIP)
- Example: IEE Enterprise Improvement Process (EIP)
- Exercise: EIP Project Selection Initiation

- 30,000-Foot-Level Operational Metrics pull for the most appropriate Six Sigma/Lean Tools
 - S⁴/IEE Improvement Methodology
 - Case Study: 30,000-foot-level metrics – Continuous Response
 - Case Study: 30,000-foot-level metrics – Attribute Response
 - How S⁴/IEE Compares to Other Improvement Initiatives
 - Benefits of S⁴/IEE
7. **Enterprise: Define Phase**
- S⁴/IEE integration
 - Identify key stakeholders
 - Voice of the customer at the enterprise level
 - VOC inputs
 - Customer satisfaction and loyalty
 - QFD application
 - Enterprise Supplier-Input-Process-Output-Customer (SIPOC)
 - Enterprise value chain creation
 - S⁴/IEE satellite-level metrics alternatives
8. **Enterprise: Measure Phase**
- S⁴/IEE integration
 - S⁴/IEE value chain and functional handoff metrics (EFHM)
 - Satellite-level and 30,000-foot-level metric examples
 - Data collection and sources
 - Data integrity and measurement error
9. Probability Plotting: Distribution Fit and Capability/Performance Assessment - 2nd Edition Chapter 8
- S⁴/IEE Implementation
 - Description
 - Example: Probability Plot
10. Control Charts: 30,000-foot-level Measurement Alternatives - 2nd Edition Chapter 10
- Application
 - S⁴/IEE Implementation
 - Overview and Monitoring Processes
 - Rational Sampling and Subgrouping
 - Interpretation of Control Chart Patterns
 - Defect versus Defective
 - Traditional control chart options
 - Control chart options
 - Individual Measurements
 - Example: Individual Measurements
 - Exercise: Individual Measurement
 - Multiple Samples within Subgroups
 - Example: Multiple Samples within Subgroups
 - Exercise: Multiple Samples within Subgroups
 - Example: Non-normal Distributed Data
 - Attribute Control Charts
 - Example: Alternatives to p, np, c, and u charts
 - Exercise: Attribute Analysis
 - Charts for Rare Events
 - Example: Charts for Rare Events
 - Exercise: Charts for Rare Events
 - Exercise: DSO control chart plan
 - S⁴/IEE Assessment

Tuesday

11. Process Capability/Process Performance Metrics for Normally Distributed and Attribute Data - 2nd Edition Chapter 11

- Importance of process capability/performance metrics
- S⁴/IEE Implementation
- Confusion: Short-term versus Long-term variability
- Calculating Standard Deviation
- Example: Process Capability/Performance Metric
- Exercise: Process Capability/Performance Metric Multiple Subgroup Samples
- Exercise: Process Capability/Performance Metric Single Subgroup Sample
- A Process Capability/Performance Metric when No Specification Exists
- Example: Process Capability/Performance Metric when No Specification Exists
- Exercise: Process Capability/Performance Metric when No Specification Exists
- Exercise: Process Capability for Non-normal data
- Process Capability for Attribute Data
- Exercise: Process Capability/Performance Metric for Attribute Data
- Exercise: Process Capability/Performance Metric for Infrequent Failures
- Exercise: DSO capability/performance metric

12. Enterprise: Analyze Phase

- S⁴/IEE integration
- Analysis and improvement strategy
- Enterprise improvement process (EIP) drill down for projects
- Capturing enterprise improvement opportunities using a cause and effect diagram
- Compiling data
- Data analysis (hypothesis testing and visualization of data)
- Application exercise (Part a): Tool selection when analyzing data
- Tool selection when analyzing hierarchical data (variance components)
- Application exercise (Part b): Tool selection when analyzing data
- Tool selection when analyzing continuous output data with discrete input data
- Application exercise (Part c): Tool selection when analyzing data
- Tool selection when analyzing continuous output data with discrete input data
- Application exercise (Part d): Tool selection when analyzing data
- Tool selection when analyzing attribute output data with discrete input data
- Application exercise: Sources for data and test hypotheses
- Product/process development business case

13. Cost of doing nothing differently (CODND) versus cost of poor quality (COPQ)

- Calculating COPQ/CODND
- Project hard and soft savings
- Example; Reducing the total cycle time of a process
- Project costing categories
- Exercise: Benefit calculations

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14. Theory of Constraints and project selection - 2nd Edition Chapter 45

- Answering the right question
- System constraints
- Five focusing steps of TOC
- TOC measures
- TOC and project selection
- S⁴/IEE considerations

15. Value Stream Mapping Current State – 2nd edition Chapter 44
 - Why value stream mapping?
 - Value stream manager and systems thinking
 - Lean enterprise: value stream
 - Value stream mapping process
 - Current state VSM creation process
 - VSM observation worksheet
16. Value Stream Mapping Future State– 2nd edition Chapter 44
 - Voice of the customer
 - Overproduction
 - Steps to create a lean value stream
 - Drawing a future state map
 - Value stream plan
17. **Enterprise: Improve Phase**
 - S⁴/IEE integration
 - Three S⁴/IEE approaches for improvement (DMAIC, DFSS, and BPIE [business process improvement event])
 - 30,000-foot-level operational metrics pulling for most appropriate Six Sigma/lean tools
 - Project selection through EIP drill down with prioritization matrix
 - Problem and opportunity statements
 - Exercise: Compare your organization enterprise improvement strategy to an IEE strategy
18. **DMAIC Project: Define Phase**
 - S⁴/IEE integration and project execution roadmap
 - S⁴/IEE phase deliverables and tools
 - Role of champion within phase
 - Phase checklist
19. Crafting Insightful Metrics - 2nd edition Chapters 9 & 11
 - S⁴/IEE project execution roadmap
 - S⁴/IEE defects per million opportunities (dpmo) application
 - S⁴/IEE alternatives to traditional dpmo reporting
20. **DMAIC Project: Plan Project and Metrics within Measure Phase**
 - S⁴/IEE integration and project execution roadmap
 - S⁴/IEE phase deliverables and tools
 - Project flexibility matrix
 - Work breakdown structure
 - Role of champion within phase
 - Phase checklist
21. **DMAIC Project: Baseline Project within Measure Phase**
 - S⁴/IEE integration and project execution roadmap
 - S⁴/IEE phase deliverables and tools
 - S⁴/IEE value chain with enterprise functional handoff metrics
 - Data collection and sources
 - Data integrity and measurement error
 - Role of champion within phase
 - Phase checklist
 - Exercise: Compare your organization Six Sigma metrics to an IEE strategy

Wednesday

22. **DMAIC Project: Lean Assessment within Measure Phase**
 - S⁴/IEE integration and project execution roadmap
 - S⁴/IEE phase deliverables and tools
 - Lean principles
 - Lean manufacturing and metrics
 - Integrating lean with six sigma
 - Logic flow diagram
 - Time value diagram
 - Case study: Inside sales quote
 - Role of champion within phase
 - Phase checklist
23. Lean Thinking – 2nd edition Chapter 44
 - Lean enterprise: Value, waste, flow, value stream
 - Lean metrics
 - Six Sigma vs. lean
 - Overview
 - Value added, non-value added, and waste
 - Inventory problems
24. Lean Principles – 2nd edition Chapter 44
 - Lean workplace principles
 - Standardized work chart
 - Lean people principles
 - Lean system principles
 - Lean focus assessment matrix
 - Exercise: Lean focus assessment matrix
25. Work flow analysis – 2nd edition Chapter 44
 - Standardized work chart
 - Combination work table for work element timing
 - Logic flow map
 - Physical process flow or spaghetti diagram
 - Time value diagram
26. **DMAIC Project: Measurement Systems Analysis within Measure Phase**
 - S⁴/IEE phase objectives
 - S⁴/IEE project execution roadmap
 - Quantifying Gage R&R, confusion and resolution
 - Attribute Gage R&R
 - Destructive testing
 - Example: Gage study of destructive testing
 - Example Five Step Method for MSA (Overview)
 - Exercise: Call center application
27. **DMAIC Project: Wisdom of the Organization within Measure Phase**
 - S⁴/IEE integration and project execution roadmap
 - S⁴/IEE phase deliverables and tools
 - Role of champion within phase
 - Phase checklist

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28. **DMAIC Project: Analyze Phase**
 - S⁴/IEE integration and project execution roadmap
 - S⁴/IEE phase deliverables and tools
 - Roadmap visualization drill down applications

- Roadmap hypothesis drill down applications
 - Role of champion within phase
 - Phase checklist
29. **DMAIC Project: Improve Phase**
- S⁴/IEE integration and project execution roadmap
 - S⁴/IEE phase deliverables and tools
 - Descriptive proactive testing phase
 - DOE overview
 - RSM review
 - Role of champion within phase
 - Phase checklist
30. Understanding the Creation of Full & Fractional Factorial 2^K DOE'S - Second edition Chapter 28
- Overview
 - Two-level Full Factorial Experiments and Two-factor Interactions
 - Saturated Two-Level DOE
 - Example: Applying DOE techniques to a transactional process
 - DOE: Fractional Factorial Designs
31. Planning 2^k DOE's - Second edition Chapter 29
- Overview
 - Planning a successful DOE
 - Initial thoughts when setting up a DOE
 - Experiment design considerations
 - Sample size considerations for a continuous response output DOE
 - Experiment design considerations: Choosing factors and levels
 - Exercise: DOE, thruput
 - Experiment design considerations: Factor significance
 - Experiment design considerations: Experiment resolution
 - Blocking and randomization
 - Curvature check
 - S⁴/IEE assessment

Thursday

32. Design and Analysis of 2^K DOE's - Second edition Chapter 30
 - Overview
 - Two-Level DOE design alternatives
 - Example: Stepper Motor DOE (Design and Analysis)
 - Exercise: DOE hypothesis statements
 - DOE Design Alternatives
 - Exercise: Creating 5-factor 16-trial DOE design
 - Exercise: Creating 14-factor, 16-trial DOE design with interaction assessment
 - Orthogonal Design
 - Exercise: DOE analysis
 - Example: A DOE development test (DFSS application)
 - Exercise: DOE analysis of hard drive case temperature
 - Exercise: Two-factor interaction assessment from a resolution IV design
 - DOE step-by-step summary
 - Response optimization
33. Variability Reduction through DOE and Taguchi Considerations - Second edition Chapter 32
 - Process robustness
 - DOE variability analysis
 - Analyzing 2K residuals for sources of variability reduction
 - Example: Analyzing 2K residuals for sources of variability reduction
 - Taguchi Application
 - Test strategies
 - Loss function
 - Standard deviation as a response
 - Exercise: DOE, Airflow robustness
 - Exercise: Inner and outer array
 - Exercise: Testing strategy for gas mileage
34. Other DOE Fractional Factorial Considerations - Second edition Chapter 31
 - Evolutionary Operations
 - Steepest Ascent
 - DOE Experiment: Reliability Evaluations
 - Example: Analysis of a resolution III experiment with two-factor interaction assessment
 - DOE experiment: Attribute response
 - Example: DOE with attribute response
 - Exercise: Tin debris analysis
 - Example: A system DOE stress to fail test
 - Exercise: DOE within development

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35. Lean Improvement Strategy: 5S
 - 5S Methodology
 - Sort
 - Straighten
 - Shine
 - Standardize
 - Sustain
 - How 5S fits into Six Sigma/Lean integration
36. Leveling Production
 - Inventory problems
 - Leveling production/Heijunka
 - Just in time production

- Example: Heijunka box
 - Heijunka box calculation
37. Continuous Flow
- Traditional batch production
 - Small lot production
 - U-shaped cell
 - Examples 1-3: Work cell flow
38. Lean Improvement Strategy: Kaizen
- Kaizen principles
 - Improvement types and Kaizen
 - Kaizen execution process
39. Demonstrating and Quantifying Improvements
- Example: 30,000-foot-level for cont data without a spec and there is one sample per subgroup
 - Example: 30,000-foot-level for cont data with a spec and there are multiple samples per subgroup
 - Example: 30,000-foot-level for attribute data
40. Lean Implementation Examples within S⁴/IEE
- Case study: Inside sales quote turn-around time
 - Example: Sales quoting process
 - Example: Flow for cell phone assembly
41. **DMAIC Project: Control Phase**
- S⁴/IEE integration and project execution roadmap
 - S⁴/IEE phase deliverables and tools
 - Control plan
 - Final validation and project close
 - Role of champion within phase
 - Phase checklist
42. EWMA/EPC (Overview) - Second edition Chapter 36
- Application
 - Description
 - Summary of EWMA and EPC process steps
 - Exercise (call center application): EWMA and EPC
43. Pre-control Charts - Second edition Chapter 37
- Description
 - Application Considerations
 - Exercise (call center application): Pre control charts
44. Pass/Fail Functional Testing (Overview) - Second edition Chapter 42
- Types of Responses
 - Example: Hardware/software system functional test
 - Exercise (call center application): Pass-fail functional testing

Friday

45. Reliability Testing/Assessment: Overview - Second edition Chapter 39
 - Application
 - Systems Reliability Models
 - Example: System reliability
 - Product life cycle
 - Repairable Versus Non-Repairable Testing
 - Exercise: Types of failures
46. Reliability Testing/Assessment - Non-repairable Devices (Applying Weibull distribution) - Second edition Chapter 41
 - Application
 - Weibull Distribution
 - Example: Weibull distribution
 - Exercise: Weibull distribution
 - Log-Normal Distribution
 - Weibull probability plotting
 - Example: Weibull probability plot for failure data
 - Example: Component failures
 - Censored data
 - Example: Weibull probability plot for failure data with censored data
 - Exercise: Weibull probability plot for failure data with censored data
 - Nonlinear data plots
 - Log-normal distribution
 - Example: Log-normal probability plot analysis
47. **Enterprise: Control Phase**
 - S⁴/IEE integration and project execution roadmap
 - S⁴/IEE phase deliverables and tools
 - Role of champion within phase
 - Phase checklist
48. Application Examples - Second edition Chapter 43
 - Example 43.2: A QFD Evaluation with DOE
 - Example 43.3: A Reliability and Functional Test of an Assembly
 - Example 43.4: A Development Strategy for a Chemical Product
 - Example 43.5: Tracking On-Going Product Compliance from a Process Point of View
 - Example 43.6: Tracking and Improving Times for Change Orders
 - Example 43.7: Improving the Effectiveness of Employee Opinion Surveys
 - Example 43.8: Tracking and Reducing the Time of Customer Payment
49. Example Project Report Outs
 - Project execution checklist
 - Example 1 - Project Report Out: Reduce the hold time duration for callers to a call center
 - Example 2 - Project Report Out: Reducing the number problem calls experienced within a call center
50. Summary
 - Performance Measures
 - Process Tracking and Process Capability
 - S⁴/IEE Methodology
 - Enterprise Improvement Process
 - 30,00-foot-level Metrics Pull for Most Appropriate Six Sigma/Lean Tools
 - Business Goals and Measures
 - Organization Example
 - Implementation plan overview
51. Wrap-up

- Exercise: Next step
- Take aways