



MSQPC—The Quality Center

A program of The Memphis Regional Chamber and
Southwest Tennessee Community College

S⁴/IEE Black Belt Training

Six Sigma Black Belt Training: Four 5-day Training Sessions

Lean Six Sigma Black Belt

Agenda

**In partnership with
Smarter Solutions, Inc.
Austin, TX**

www.smartersolutions.com

Referenced chapters, examples, and exercises are from
Implementing Six Sigma: Smarter Solutions using Statistical Methods, 2nd ed. Forrest W. Breyfogle III,
John Wiley and Sons, New York, NY, 2003

Note

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Week One

Define and Measure Phase

Lean Integration

Week 1 - Monday

1. Introductions and S⁴ Workshop Projects Definition - 2nd Edition Chapter 1
 - Slides and Handout Material
 - Code of Conduct
 - Introductions
 - Exercise: Statistical Knowledge Baseline
 - Exercise: Project Definitions
2. Overview of Traditional Six Sigma - 2nd Edition Chapter 1
 - Background
 - Strategy
 - Metrics
 - Opinions about Six Sigma
3. Benefits of an S⁴/IEE Implementation - 2nd Edition Chapter 1
 - Performance measures
 - Balanced scorecard
 - Process tracking and process capability
 - Six Sigma strategy
 - Business goals and measures
 - What is S⁴/IEE?
 - Why S⁴/IEE?
 - S⁴/IEE business strategy
 - S⁴/IEE alternative
 - S⁴/IEE high-level metrics
 - S⁴/IEE high-level metrics and enterprise functional hand-off metrics (EFHM)
 - S⁴/IEE Enterprise Measurements, Analyses, and Improvements
 - S⁴/IEE Satellite-level Metrics
 - S⁴/IEE 30,000-Foot-Level Metrics
 - Project Selection Alternatives
 - S⁴/IEE Project Selection: EFHM and Enterprise improvement process (EIP)
 - S⁴/IEE Project Selection: Lean Enterprise
 - S⁴/IEE Enterprise Improvement Process (EIP)
 - 30,000-Foot-Level Operational Metrics pull for the most appropriate Six Sigma/Lean Tools
 - S⁴/IEE Project Execution: Roadmap
 - S⁴/IEE Methodology
 - Project Execution DMAIC Roadmap
 - S⁴/IEE Approach: Six Sigma Metrics
 - How S⁴/IEE Compares to other Improvement Initiatives
 - Exercise: Alignment of Past/Current Management Initiatives and Strategies with S⁴/IEE
4. S⁴/IEE infrastructure - 2nd Edition Chapter 1 (REFERENCE)
 - Six Sigma infrastructure
 - Roles and responsibilities
 - Culture change
 - Exercise: Drivers and Restraints for Six Sigma Culture
 - Communication plans
 - Infrastructure metrics

- Organizational relationships
- The successful infrastructure

LUNCH: Goal Video

5. 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

6. S⁴/IEE Project Execution and Integration with Lean - 2nd Edition Chapter 44

- Exercise: Catapult
- Business metrics
- What is SIPOC and its integration with S⁴/IEE?
- SIPOC within an organization
- Catapult exercise discussion: S⁴/IEE project execution roadmap

7. Project COPQ/CODND analysis and project selection 2nd Edition Chapters 1 & 52

- Calculating COPQ/CODND
- Project costing: Hard savings
- Project costing: Soft savings
- Example 5.2 Reducing the total cycle time of a process
- Project costing categories
- Six Sigma financial benefits
- Working capital benefits
- Exercise: Benefit calculations
- Project selection matrix

8. Define Phase Deliverables - 2nd Edition Chapter 1

- Define phase objectives
- S⁴/IEE project execution roadmap: Define Phase
- Problem statement
- Successful project requirements
- Project charter

9. Team Effectiveness - 2nd Edition Chapter 53

- Evolution of a team: Forming from Orming model
- Personality styles
- Ingredients for a successful team
- Reacting to common team problems
- First team meeting
- Ground rules
- Meeting roles
- Example: Project charter creation

10. Project Application Homework Assignment

Week 1 - Tuesday

Project Application Homework

Homework problems

11. Voice of Customer - 2nd Edition Chapters 2, 13

- Voice of the Customer Perspectives
- VOC at the business level
- SIPOC Diagram: VOC
- Collecting VOC
- Customer Satisfaction

Value is from Customer

- Customer loyalty
 - Project execution roadmap: VOC
 - Exercise: Define your customer
 - Exercise: Define Customers for days sales outstanding (DSO) project
 - Obtaining customer needs, wants and desires: Kano Model
 - Example: Customer needs, wants and desires buying a computer
 - Customer needs: Quality function deployment (QFD)
 - Exercise: Sources of information for DSO project
 - Are you satisfying the customer
 - Exercise Voice of the customer
12. Measurements to Reduce Firefighting - 2nd Edition Chapter 3
- Example: Reacting to Data
 - Variation and process performance
 - Process Control Charting
 - Determining the capability of an in-control process
 - Pulling to improve a process
13. Sources of Variation and Sampling Variation – 2nd Edition Chapter 3
- Variability and Process Improvements
 - Exercise: Variability
 - Sampling
14. Introduction to Minitab and measurements - 2nd Edition Chapter 3
- Minitab introduction
 - Histogram
 - Example: Histogram and Dot Plot
 - Exercise: Histogram and Dot Plot

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- Sample Statistics
 - Degrees of freedom
 - Descriptive Statistics
 - Attribute versus Continuous Data
 - Visual Inspections
 - Exercise: Visual Inspection
 - Some Sampling Considerations
 - S⁴ Assessment
15. Process Flowcharting - 2nd Edition Chapter 4
- S⁴/IEE Implementation
 - Catapult Exercise 4.1 (part a) [Catapult process execution]
 - Process Flowcharting
 - An Alternative “High Level” Process Map
 - Defining the process
 - Flow charting software
 - Exercise (part b) [Catapult process documentation and improvement]
 - COPQ/CODND
 - Exercise Catapult COPQ/CODND
16. Project Application Homework Assignment

Start of value stream development

Week 1 - Wednesday

Catapult Exercise Team Report-outs (Process range calculation, process flow chart, process range calculation after change)
 Project Application Homework
 Homework problems

17. Basic Tools for Working with Numbers - 2nd Edition Chapter 5

- S⁴/IEE Implementation
- Exercise: Descriptive statistics
- Run Chart (Time Series Plot)
- Exercise: Run Chart
- Exercise: Catapult descriptive statistics and plots
- Check Sheets
- Pareto Chart
- Example: Improving a Process that has Defects
- Exercise: M&M's -- Pareto

18. Normal Distribution and Six Sigma Metrics - 2nd Edition Chapter 7

- Overview
- Normal Distribution
- Example: Normal Distribution - Using Z distribution to determine percent beyond spec
- Exercise: Normal Distribution - Using Z distribution to determine percent beyond spec
- Exercise: Catapult data analysis to determine percent beyond spec
- Exercise: M&M's data analysis of brown color

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19. Probability Plotting: Distribution Fit and Capability/Performance Assessment - 2nd Edition Chapter 8

- S⁴/IEE Implementation
- Description
- Example: Probability Plot
- Exercise: Catapult Data Analysis - Probability Plotting

20. Control Charts: 30,000-foot-level Measurement Alternatives - 2nd Edition Chapter 10

- Application
- S⁴/IEE Implementation
- Overview
- Monitoring Processes
- Rational Sampling and Subgrouping
- Statistical Process Control Charts
- Interpretation of Control Chart Patterns
- Traditional control chart options
- X-bar and R and X-bar
- Example: X-bar and R chart
- Exercise: X-bar and R chart
- Exercise: Catapult Data Analysis -- x-bar and R Chart

Week 1 - Thursday

Catapult Exercise Team Report-outs (Run chart, beyond specification analysis, probability plot, x-bar and R chart)

Homework problems

20. (Con't). Control Charts: 30,000-foot-level Measurement Alternatives - 2nd Edition Chapter 10

- XmR charts: Individual Measurements
- Example: XmR Chart
- Exercise: XmR Chart
- Exercise XmR versus X-bar and R chart
- Exercise: Subgroup size of 20
- Attribute Control Charts
- P chart
- Example: p-chart
- np chart
- c chart

- u chart
- Creating p, np, c, and u charts
- Exercise: M&M Data Analysis
- Exercise: DSO control chart plan
- S⁴ Assessment

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

- Importance of process capability/performance metrics
- S⁴/IEE Implementation
- Overview
- Definitions
- Misunderstandings
- Confusion: Short-term versus Long-term variability
- Calculating Standard Deviation
- Example: Process Capability Indices
- Exercise: Subgroup of 20
- Exercise: Process capability/performance assessment of individual readings
- Process Capability for Attribute Data
- A Process Capability/Performance Metric when No Specification Exists
- Example: A Process Capability/Performance Metric when No Specification Exists
- Exercise: Catapult Exercise Data Analysis
- Exercise: DSO capability/performance metric

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22. 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

23. 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
- Kanban
- Kanban card and calculations
- Focus points of Lean Six Sigma
- 5 Whys

24. 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

25 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: Product families

- Value stream mapping process
 - Value stream map (VSM) icons
 - VSM process data
 - Current state VSM creation process
 - VSM observation worksheet
 - Exercise (Part 1) “LEAN” process simulation
- 26 Value Stream Mapping Future State– 2nd edition Chapter 44
- Voice of the customer
 - Overproduction
 - Steps to create a lean value stream
 - Exercise (Part 2) “LEAN” process simulation
 - Drawing a future state map
 - Exercise (Part 3) “LEAN” process simulation
 - Value stream plan
27. Project Application Homework Exercise

Week 1 - Friday

Catapult Exercise Team Report-out from week

Project Application Homework

Homework problems

28. Crafting Insightful Metrics - 2nd edition Chapters 9 & 11

- Right metric
- Six Sigma Metrics
- S⁴/IEE Implementation
- Defects per million
- Defects per million opportunities (dpmo)
- Example: PPM Continuous numeric
- Example: Process Capability
- Rolled Through-put Yield
- Exercise: Golf RTY
- 30,000 foot-level metrics
- Process capability indices
- Process capability indices: issues
- Capability Issues: Short vs long term standard deviation calculation
- COPQ/CODND
- Sigma quality level

29. Project Management (PM) - 2nd edition Chapter 52

- Benefits
- Definitions
- Keys to successful project
- Three pillars
- Project plan
- Work breakdown structure
- Exercise: Project management work breakdown structure
- PM resources required
- Exercise: PM resources required
- Scheduling
- Exercise: Scheduling
- Scheduling: Arrow network
- Scheduling: Network diagrams
- Controlling
- Monitor and track team progress

- Project reviews
30. Effective Presentations (Part 1)
- Overview
 - Earnest and Conviction
 - Speaking with Confidence
 - Delivering Talk
31. Example Project Report Out
- Project final report
 - 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
32. Wrap-up
- Key points
 - Business goals and measures
 - Enterprise measurements
 - S⁴/IEE business strategy
 - Project selection
 - EBPM
 - ECMM
 - S⁴/IEE pull for project creation

Week Two

Measure (Con't) and Analyze Phase

Week 2 - Monday

Homework problems

1. Week 2 Kickoff (Review and Discussion)
 - Exercise: Roadmap utilization and book referencing
 - Example: Reacting to Data
 - Six Sigma and lean
 - Business goals and measures
 - S⁴/IEE project selection
 - S⁴/IEE Enterprise improvement process (EIP)
 - S⁴/IEE Enterprise functional hand-off metrics (EFHM)
 - S⁴/IEE project execution roadmap
 - Exercise: define phase deliverables
 - Six Sigma Benefits and Deployment
 - Exercise: Control charting and COPQ/CODND
 - Exercise: Sales force automation
 - Exercise: Parts usage
 - Exercise: Accounts receivable
 - Exercise: Measure phase deliverables
 - Catapult discussion: S⁴/IEE implementation
 - S⁴ Project Execution
2. Control Charts: Alternatives and rare events - Second edition Chapter 10 (Part 2)
 - Comparing x-bar and R chart with XmR chart
 - Basic control chart options
 - Attribute control charts

- Discussion p-chart example
- Example: Alternatives to p, np, c and u charts
- Charts for rare events
- Example: Chart for rare events
- Sampling strategies
- Exercise: Building a plan to track measurements within an organization

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3. Process Capability/Performance Metric: Non-normal data - Second edition Chapter 11 (Part 2)

- Process predictability and capability
- Traditional process capability/performance indices
- Application of metrics
- Inconsistencies in calculating capability indices
- Process capability/performance for attribute data
- A process capability/performance metric when no specification exists
- Process capability confidence interval
- Process capability for non-normal distribution
- Example: Process capability for non-normal distribution
- Exercise: Process capability for non-normal distribution
- Exercise: Cpk conversion to percent failure?

4. Basic Tools for Working with Ideas - 2nd edition Chapter 5

- S⁴/IEE application
- Benchmarking
- Brainstorming
- Nominal group technique (NGT)
- Cause-and-effect diagram
- Force field analysis
- Affinity Diagram
- Interrelation Digraph
- Tree diagram
- Why-why diagram
- Matrix diagram and prioritization matrix
- Process decision program charts (PDPC)
- Activity network diagrams or arrow diagram
- Example: Improving a service process
- Catapult Data Exercise: 5.2: cause-and-effect diagram

Use in Lean Efforts

5. Cause and Effect Matrix - Second edition Chapter 13

- Description
- Selection input variables
- Summaries and action plans
- Exercise: Catapult cause-and-effect matrix

Week 2 - Tuesday **Project reviews: 4:00-5:00 PM**

Catapult Exercise Team Report-outs (C&E diagram and Matrix)

Homework problems

6. Sampling Distributions - Second edition Chapter 7 (Part 2)

- Overview
- Chi-Square Distribution
- t Distribution
- F Distribution
- Degrees of freedom

7. Hypothesis testing - Second edition Chapter 16 (Part 1)

- Statistical inference
 - Overview
 - Exercise: Central limit theorem
 - Sample statistics can deceive
 - Hypothesis testing
 - Example: Hypothesis testing
 - Forming null and alternative hypothesis
8. Confidence intervals - Second edition Chapter 16 (Part 2)
- Statistical inference
 - Confidence interval estimation
 - Confidence interval statements
 - Exercise: Determining confidence intervals
 - Degrees of freedom
 - Exercise: Confidence intervals - sample size needs
 - Sample considerations
 - Confidence interval statements

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9. Measurement Systems Analysis (MSA): Gage R&R continuous data - Second ed. Chapter 12 (Part1)
- Accuracy and precision
 - Measurement component of variance
 - Sources of variability
 - Three Uses of Measurements
 - Terminology
 - Quantifying the capability of a measurement system
 - Gage R&R relationships
 - Example: Gage R&R study
 - Exercise 1: Gage R&R study
 - Exercise 2: Gage R&R study
 - Exercise: Machine screw exercise
10. Failure Mode and Effects Analysis (FMEA) - Second edition Chapter 14
- Benefits
 - Types
 - Implementation
 - Process FMEA
 - Example: Initiating an FMEA
 - Conducting a process FMEA
 - Exercise: Catapult FMEA
11. Project Application Homework Assignment

Week 2 - Wednesday
Project reviews: 4:00-5:00 PM

Catapult Exercise Team Report-outs (FMEA)
 Project Application Homework
 Homework problems

12. Probability - Second edition Chapter 6
- Application
 - Multiple events
 - Multiple event relationships
 - Exercise: Probability of two events occurring
 - Exercise: Probability - three step process
 - Exercise: Probability may not be intuitive
13. Non-normal and Attribute Distributions - Second edition Chapter 7 (Part 3)

- Applications
 - Types of distributions
 - Population and sampling distributions
 - Characterization
 - Normal Distribution
 - Binomial Distribution
 - Example: Binomial distribution
 - Hypergeometric distribution
 - Poisson distribution
 - Example: Poisson distribution
 - Exercise: Poisson distribution
 - Exponential Distribution
 - Example: Exponential distribution
 - Exercise: Reliability determination
 - Weibull Distribution
 - Example: Weibull distribution
 - Exercise: Weibull distribution
 - Log-normal distribution
 - Applications of distributions
 - Exercise: Distribution application
14. Facilitating Effective Teams: Storming - Second edition Chapter 53 (Part 2)
- Evolution of a Team: Storming
 - The Process of Holding Effective Meetings
 - Process for Dealing with Conflict
 - Multi-voting
 - Exercise: How would you facilitate?

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15. Visualization of Data using Multi-vari chart, Box Plot and Marginal Plot - Second edition Chapter 15
- Application
 - Multi-Vari Charts
 - Example: Multi-vari chart
 - Exercise: Multi-vari chart
 - Box Plot
 - Example: Box plot
 - Exercise: Box plot
 - Exercise: Catapult data analysis
16. Inferences: Continuous Response - Second edition Chapter 17
- Applications
 - Sample Size: Hypothesis test of a mean criterion
 - Example: Sample size determination
 - Exercise: Sample size determination
 - Exercise: Beta risk
 - Confidence intervals on the mean
 - Example: Confidence intervals on the mean
 - Standard Deviation Confidence Interval
 - Example: Standard deviation confidence interval
 - Percentage of population assessments
 - Example: Percentage of population statements
 - Exercise: Catapult data analysis
 - Tolerance Analysis

Week 2 - Thursday

Project reviews: 4:00-5:00 PM

Catapult Exercise Team Report-outs (Data analyses)

Homework problems

17. Inferences: Attribute (pass/fail) response - Second edition Chapter 18

- Application
- Sample size: Hypothesis test of an attribute criterion
- Example: Sample size determination
- Exercise: Sample size determination
- Confidence intervals for pass/fail evaluations
- Example: confidence intervals for pass/fail evaluations
- Exercise: Confidence intervals for pass/fail evaluations
- Alternative sample size considerations
- Exercise: population assessment
- Exercise: Population assessment
- Exercise: Confidence interval for Acceptable quality level (AQL) plan
- Exercise: M&M data analysis
- Exercise: Catapult data analysis

18. Comparison Tests: Continuous response - Second edition Chapter 19

- Applications
- Comparing two means
- Example: Comparing the means of two samples
- Comparing variances of two samples
- Example: Comparing variances of two samples
- Exercise: Comparing two data sets
- Comparing populations using a probability plot
- Example: Comparing responses using a probability plot
- Comparing more than two samples
- Example: Comparison test of attendance
- Exercise: Distribution determination
- Exercise: Catapult data analysis
- Paired comparison testing
- Example: Paired comparison testing

LUNCH (Creativity Video: Shifting Perspectives)

19. Creativity: Shifting Perspectives - second edition Chapter 54

- Key concepts
- Exercise: Project assessment
- Exercise: Applying creativity concepts

20. Tapping Creativity - Second edition Chapter 54

- Defining Creativity
- Exercise: Triangles
- The Process of Creative Problem Solving
- Tools for Creative Thinking
- Exercise: Barriers to Creative Thinking
- Overcoming barriers
- Exercise: Problem solving self assessment

21. Comparison Tests: Attribute (pass/fail) Response - Second edition Chapter 20

- Applications
- Sample Size: Comparing Proportions
- Comparing Proportions
- Example: Comparing proportions
- Comparing the Non-Conformance Rate of a Proportion

- Example: Comparing the non-conformance rate of a proportion
- Example: Difference in proportions
- Exercise: M&M candy analysis
- Exercise: Comparing attribute to a continuous response analysis
- Exercise: Catapult data analysis
- Exercise: Reporting failure rates
- Example: Attribute process Capability/performance metric assessment
- Example: Attribute improvement assessment
- Exercise: Golf data analysis
- Comparing Attribute Response to a Continuous Response

Week 2 - Friday

Catapult Exercise Team Report-outs (Data analyses)

Homework problems

22. Workshop Project Application

23. Data collection

- Data collection, types, and sources
- Data collection tools
- Tool review: Check sheets
- Tool review: automated systems
- Sampling
- Tool review: Surveys
- Infrequent sampling/sub grouping
- Sources of error in sampling
- Sample size trade-offs

24. Effective Presentations: Vocal Variety

- Overview
- Using Your Voice
- A Good Speaking Voice
- Exercise: Try Your Voice
- Rehearsing Your Presentation
- Your Presentation

25. Example Report Out (Part 2)

- Checklist reporting for project execution
- 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

26. Wrap-up

- Statistical assessments
- Exercise: Passive analysis strategy
- Project report out
- Before next class

Week Three

Analyze (Con't) and Improve Phase

Week 3 - Monday

Project reviews: 4:15-5:00 PM

Homework exercise discussion

1. Week 3 Kickoff (Review and Discussion)

- Project selection
- Exercise: Project metrics baseline
- Sources of process variability
- Project execution: Wisdom of the organization
- Exercise: Passive analysis roadmap steps
- Project Executive: Passive analysis
- Exercise: Baseline and passive measurements

2. MSA for Attribute Data and Destructive Tests - Second edition Chap 12 (Part 2)

- Application
- Terminology
- Attribute gage study
- Example: Attribute gage study
- Exercise: M&M's attribute MSA
- Exercise: Visual inspection attribute MSA
- Destructive testing
- Example: Gage study of destructive testing
- S⁴/IEE assessment

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3. Variance components - Second edition Chapter 22

- Variance Components Analysis
- Application
- Variance components p-value
- Example: Variance of components for pigment paste
- Example: Variance components that include measurement system
- Example: Determine process capability using variance components
- Example: Variance components of injection-molding data
- Exercise: Variance components of looms
- Catapult exercise: Variance components analysis

4. Correlation and Simple Linear Regression - Second edition Chapter 23

- Application
- Scatter plot
- Example: Scatter plot
- Catapult exercise: Scatter plot
- Correlation
- Example: Correlation - Delivery times
- Exercise: Correlation
- Simple regression
- Analysis of residuals
- Example: Simple linear regression
- Exercise: Correlation and regression of part strength
- Catapult Data Exercise: Correlation and regression analysis
- Exercise: Regression analysis comparing four data sets
- Exercise: Scatter plots comparing four data sets
- S⁴/IEE assessment

Week 3 - Tuesday
Project reviews: 4:15-5:00 PM

Report out from Monday's catapult exercises

Homework exercise discussion

5. Single Factor One-way Analysis of Variance - Second edition Chapter 24

- Application
- Significance tests
- Example: Single-factor analysis of variance with multiple comparisons
- Analysis of means
- Example: Analysis of means
- Example: Analysis of means of injection-molding data
- Exercise: ANOVA and ANOM
- Catapult exercise: ANOVA and ANOM
- S^4/IEE assessment

6. Two-Factor (TWO-WAY) Analysis of Variance - Second edition Chapter 25

- Application
- Two-factor factorial design
- Example: Two-factor factorial design of battery life
- Exercise: Two-factor factorial design of breaking strength

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- Catapult exercise: Two-factor factorial design
- S^4/IEE assessment

7. Multiple Regression - Second edition Chapter 26

- Application
- Example: Multiple regression
- Catapult data analysis: Multiple regression
- Other considerations
- Example: Multiple regression, thruput
- Exercise: Multiple regression, cycle time
- Multiple regression considerations
- Indicator (Dummy) variables
- Example: Indicator variables
- Exercise: Indicator variables
- Indicator variables with covariates
- Example: Indicator variables with covariate
- Binary logistic regression
- Example: Logistic regression

8. Tuesday Project Application Homework Assignment

Week 3 - Wednesday
Project reviews: 4:15-5:00 PM

Report out from Tuesday's catapult exercises

Project application presentations

Homework discussion

9. Benefiting from 2^k Design of Experiments (DOE) - Second edition Chapter 27

- Catapult exercise discussion
- Traditional experimentation
- The need for 2^k DOE
- Exercise: Creating a two-factor interaction plot
- Exercise: Development application

10. 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
- Catapult: DOE factors and levels

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11. Facilitating Effective Teams: Norming - Second edition Chapter 53 (Part 3)

- Evolution of a Team: Norming
- Communication Skills: General
- Communication Skills: Team Building
- Exercise: Listening Assessment
- Active Listening
- Parking Lot

12. 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
- S^4 /IEE assessment

Week 3 - Thursday

Project reviews: 4:15-5:00 PM

Homework discussion

13. Chapter 30: Design and Analysis of 2^K DOE's

- 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 7-factor 16-trial DOE design
- Exercise: Creating 11-factor 16-trial DOE design
- Exercise: Creating 10-factor, 16-trial DOE design
- Exercise: Creating 14-factor, 16-trial DOE design with interaction assessment
- Exercise: Creating 8-trial DOE for 4-factors
- Orthogonal Design

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13. CON'T Chapter 30: Design and Analysis of 2^K DOE's

- Catapult exercise: DOE setup
- Exercise: DOE analysis
- Example: A DOE development test (DFSS application)
- Exercise: DOE analysis of hard drive case temperature
- DOE step-by-step summary

- Response optimization
- Example: Response optimization
- Catapult DOE experimentation

14. Thursday Project Application Homework Assignment

Week 3 - Friday

Report out from Thursday's catapult exercises

Project application presentations

Homework discussion

15. Experiment Traps - Chapter 3

- Experimentation traps
- Example: Sources of variability
- Example: Lack of randomization
- Example: Confused effects
- Example: Independently designing and conducting an experiment
- Some sampling considerations

16. Effective presentations: Make it persuasive (Part 3)

- Overview
- Logic on fire
- Audience self-interest
- Analyze your audience
- Your persuasive approach
- Organizing and presenting your persuasive message
- Your emotional appeal

17. Example Project Report Out

- 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

18. Wrap-up

- Project Execution Roadmap
- Implementing DOE
- In Closing

Week Four
Improve Phase (Con't) and Control Phase

Week 4 - Monday

Project reviews: 4:00-5:00 PM

Homework problem

1. Week 4 Kickoff

- Business goals and measures
- S⁴/IEE Methodology
- Black belt course module number cross ref to 2nd ed.
- Exercise: Baseline and passive measurements, part 3
- Exercise: Passive analysis, visual inspection
- Exercise: Passive analysis, accounts receivable
- S⁴/IEE Application examples of DOE
- Exercise: DOE paint coloring

- Control phase
- Exercise: Measurement and improvement strategies

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2. 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
- Catapult exercise: Robust design
- Exercise (call center application): Robust DOE

Week 4 - Tuesday

Project reviews: 4:00-5:00 PM

Catapult Exercise Team Report-outs (Robust Design)

Homework problem

3. Other DOE Fractional Factorial Considerations - Second edition Chapter 31

- Evolutionary Operations
- Steepest Ascent
- Example: 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
- Exercise (call center application): Other DOE considerations

4. Effective teams (Part 4): Performing - Second edition Chapter 53

- Evolution of a Team: Performing
- Characteristics of High Performing Teams
- Exercise: Group Interdependency Activity

LUNCH – Video “Change Management”

5. Leading Change (includes video discussion) -- Second edition Chapter 51

- Why do people change?
- Initiating change
- Building a culture that supports needed change: Lockheed's cavespeak card
- Managing change and transition: Key concepts from the video

6. Response Surface Methodology (Overview) - Second edition Chapter 33

- Application
- Modeling Equations
- Central Composite Design
- Box-Behnken Design
- Exercise (Call center application): RSM

7. Measurement Systems Analysis - Five step method - Second edition Chapter 12

- Application
 - Three Uses of Measurements
 - How to Quantify the Study the Capability of a Measurement System
 - How to study a measurement system
 - Example Five Step Method for MSA
 - Exercise (Call center application): 5-step MSA
8. Control Charts (Review and AQL sampling) - Second edition Chapter 10
- AQL Sampling can be deceptive
 - Example: AQL sampling can be deceptive
 - Application
 - Rational sampling and subgrouping
 - Exercise: Crating test strategy to assess a criterion
 - Exercise (Call center application): Control charts and AQL
9. Short Run and Target Control Charts - Second edition Chapter 34
- Application
 - Difference Chart (Target Chart and Nominal Chart)
 - Example: Target or difference chart
 - Exercise: Target or difference chart
 - Z Chart (Standardized Variables Control Chart)
 - Example: ZmR chart
 - Exercise: ZmR chart (one)
 - Exercise: ZmR Chart (two)
 - Exercise (call center application): Short run and target control charts
10. Tuesday project application exercises

Week 4 - Wednesday
Project reviews: 4:00-5:00 PM

Project Application Exercise

Homework Problem

11. Other Control Charting Alternatives - Second edition Chapter 35
- Application
 - Three-way Control Chart (Monitoring Within and Between Part Variability)
 - Example: Three-way control chart
 - CUSUM Chart
 - Example: CUSUM chart
 - Exercise: CUSUM chart, resistance
 - Exercise: CUSUM chart, attendance
 - Zone Chart
 - Example: Zone chart
 - Exercise: Zone chart, attendance
 - Catapult Exercise Analysis: CUSUM and zone chart analysis
 - Exercise (Call center application): Other control charting alternatives
12. Value Stream Mapping (VSM) in the Improve Phase
- VSM and system thinking
 - Key lean metrics
 - Current state VSM
 - Future state VSM
13. Lean Improvement Strategy: 5S
- 5S Methodology
 - Sort
 - Straighten
 - Shine

- Standardize
 - Sustain
 - How 5S fits into Six Sigma/Lean integration
14. Leveling Production
- Inventory problems
 - Leveling production/Heijunka
 - Just in time production
 - Example: Heijunka box
 - Heijunka box calculation
15. Continuous Flow
- Traditional batch production
 - Small lot production
 - U-shaped cell
 - Examples 1-3: Work cell flow
16. Lean Improvement Strategy: Kaizen
- Kaizen principles
 - Improvement types and Kaizen
 - Kaizen execution process/
- LUNCH
17. TOC Workflow Management Exercise - Second edition Chapter 45
- Exercise – Dice simulation
 - Workflow system-pull
 - Exercise (call center application): TOC workflow management
18. Process Modeling - Second edition Chapter 4
- Process Flowcharting
 - Process Simulation
 - Exercise (call center application): Process modeling
19. Lean Improvement Strategy: Total Productive Maintenance (TPM) Implementation
- Description
 - TPM losses
 - TPM metrics
 - TPM: implementation phase
20. Lean Implementation Examples within S⁴/IEE
- Case study: Inside sales quote turn-around time
 - Example: Sales quoting process
 - Example: Flow for cell phone assembly

Week 4 - Thursday
Project reviews: 4:00-5:00 PM

Catapult Exercise Team Report-outs (CUSUM, zone chart analysis, and control plan)

Homework Problem

21. EWMA/EPC (Overview) - Second edition Chapter 36
- Application
 - Description
 - Summary of EWMA and EPC process steps
 - Exercise (call center application): EWMA and EPC
22. Pre-control Charts - Second edition Chapter 37
- Description
 - Pre-control Set Up (Qualification Procedure)
 - Classical Pre-control
 - Two-Stage Pre-Control
 - Modified Pre-Control

- Application Considerations
 - Exercise (call center application): Pre control charts
23. Control Plan for Maintaining the Gain - Second edition Chapter 38
- Application
 - Poka-yoke
 - Realistic Tolerances
 - Exercise: Realistic tolerances
 - Control Plan
 - Leveraging and Sustaining the Gains
 - Catapult exercise: Creating a control plan
 - Exercise (call center application): Control plan and other strategies
24. 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
- LUNCH
25. 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
 - Exercise (Call center application): Reliability assessment
26. Reliability Testing/Assessment - Non-repairable Devices (Applying Weibull distribution) - Second edition Chapter 41
- Application
 - Weibull Distribution
 - Example: Weibull distribution
 - Exercise: 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
 - Exercise (call center application): Weibull distribution and censored
27. Triz for Idea Generation (Overview) - Second edition Chapter 48
- Description
 - Levels of Solutions
 - Laws of Engineering System Development
 - Contradictions and Abstractions
 - Standard Features
 - Inventive Principles
 - Exercise: Pizza delivery
 - Exercise (call center application): TRIZ
28. 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
29. Project Application Homework

Week 4 - Friday

Project Application Exercise

Homework Problem

30. 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
31. Effective Presentations (Part 4): Inspire Your Audience
- The Value of Inspiration
 - The Great Speech
 - Who Are You?
 - What Will You Say?
 - Preparing Your Talk
 - Presenting the Talk
32. 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
33. Advanced Tools for Master Black Belts
- Master Black Belt Six Sigma Roles and Responsibilities
 - Training
34. Wrap-up
- S⁴/IEE methodology
 - Six Sigma Metrics and Implementation Strategy
 - Project reports