



CD-ROM contains a
limited use version
of the powerful
SigmaFlow simulation
software package.

Design for
Six Sigma
for Green Belts
and Champions

6 σ

**Applications for Service Operations—Foundations,
Tools, DMADV, Cases, and Certification**

Howard S. Gitlow, Ph.D.

David M. Levine, Ph.D.

Edward A. Popovich, Ph.D.

DESIGN FOR SIX SIGMA FOR GREEN BELTS AND CHAMPIONS

APPLICATIONS FOR SERVICE OPERATIONS— FOUNDATIONS, TOOLS, DMADV, CASES, AND CERTIFICATION

Howard S. Gitlow, Ph.D.
David M. Levine, Ph.D.
Edward A. Popovich, Ph.D.



An Imprint of PEARSON EDUCATION
Upper Saddle River, NJ • New York • London • San Francisco • Toronto • Sydney
Tokyo • Singapore • Hong Kong • Cape Town • Madrid
Paris • Milan • Munich • Amsterdam

www.ft-ph.com

Design for Six Sigma for Green Belts and Champions: Applications for Service Operations--Foundations, Tools, DMADV, Cases, and Certification

Table of Contents

Contents

Acknowledgments and Thanks

About the Authors

Preface

PART I: DESIGN FOR SIX SIGMA BASICS

1 FOUNDATIONS OF SIX SIGMA MANAGEMENT

- 1.1 Successful Applications of Six Sigma Management
- 1.2 Key Ingredients for Success with Six Sigma Management
- 1.3 Benefits of Six Sigma Management
- 1.4 Fundamentals of Improving a Product, Service, or Process
- 1.5 Fundamentals of Inventing/Innovating a Product, Service, or Process
- 1.6 What Is New about Six Sigma Management?
- 1.7 Six Sigma in Non-Manufacturing Industries

Summary

References

2 SIX SIGMA ROLES, RESPONSIBILITIES, AND TERMINOLOGY

- 2.1 Roles and Responsibilities in Six Sigma Management
- 2.2 Technical Terminology of Six Sigma Management

Table of Contents

Summary

References

3 MACRO MODEL OF SIX SIGMA MANAGEMENT (DASHBOARDS)

3.1 Beginning Six Sigma Management

3.2 Benefits of a Dashboard

3.3 Structure of a Dashboard

3.4 Components of a Dashboard

3.5 Example of a Dashboard

3.6 Another Example of a Dashboard

3.7 Managing with a Dashboard

3.8 Project Prioritization for a Dashboard

3.9 Management Decides if a Project Team Is Necessary

3.10 Types of Six Sigma Projects

Summary

References

PART II: THE DESIGN FOR SIX SIGMA (DFSS) MODEL

4 DEFINE PHASE

4.1 Steps of the Define Phase

4.2 Inputs to the Define Phase

4.3 Develop the Business Case

4.4 Prepare the Opportunity Statement

4.5 Develop the Initial Project Objective

4.6 Develop the Project Scope

4.7 Develop the Project Plan

4.8 Develop the Document Control System

4.9 Assess the Benefits of the Six Sigma Project

4.10 Assess the Risks to the Projects Success

4.11 Activate the DFSS Development Team (DT)

4.12 Finalize the Project Objective

Table of Contents

- 4.13 Conduct Tollgate Review
- 4.14 Define Phase Tollgate Review Check Sheet
- 4.15 Key Outputs of the Define Phase
- Summary
- References

5 MEASURE PHASE

- 5.1 Steps of the Measure Phase
- 5.2 Inputs to the Measure Phase
- 5.3 Market Segmentation
- 5.4 Finding Cognitive Images with Kano Surveys
- 5.5 Convert Cognitive Images into CTQs with Quality Function
Deployment
- 5.6 Select Final Set of CTQs
- 5.7 Develop and Validate a Measurement System for the CTQs
- 5.8 Develop a Design Scorecard
- 5.9 Review Intellectual Property Issues
- 5.10 Plan to Manage the Risk
- 5.11 Revise the Project Objective, if Necessary
- 5.12 Update the Multi-Generational Product Plan (MGPP)
- 5.13 Measure Phase Tollgate Review (Check Sheet)
- 5.14 Outputs of the Measure Phase
- Summary
- References
- Appendix 5.1 Using Minitab for Gage R&R Studies
- Appendix 5.2 Using JMP for Gage R&R Studies

6 ANALYZE PHASE

- 6.1 Steps of the Analyze Phase
- 6.2 Inputs of the Analyze Phase
- 6.3 Generate High-Level Design Concepts for Critical Parameters

Table of Contents

6.4 Investigate Alternative Design Concepts for Each Critical Parameter

6.5 Create a Limited Set of Potential High-Level Design Concepts

6.6 Assess the Risks of the Best Design Concept

6.7 Optimize the Total Life Cycle Cost (TLCC) of the Design

6.8 Develop a Process Model for the Best Design

6.9 Transfer High-Level Design to Process Owner with Design
Scorecards

6.10 Conduct Analyze Phase Tollgate Review (Check Sheet)

6.11 Outputs from the Analyze Phase

Summary

References

7 DESIGN PHASE

7.1 Steps of the Design Phase

7.2 Inputs of the Design Phase

7.3 Constructing a Detailed Design

7.4 Develop Detailed CTPs for CTQs and High-Level CTPs

7.5 Create a Comprehensive Set of Detailed CTPs

7.6 Operationally Define Each Detailed CTP

7.7 Validate the Measurement System for Each Detailed CTP

7.8 Establish Baseline Capabilities for Each CTQ and CTP

7.9 Conduct a Capacity Analysis

7.10 Perform a FMEA of the Detailed CTPs

7.11 Constructing Detailed Design Scorecards

7.12 Performing Accounting Analysis

7.13 Prepare a Control and Verification Plan

7.14 Conduct Design Phase Tollgate Review (Check Sheet)

7.15 Outputs of the Design Phase

Summary

References

Table of Contents

8 VERIFY/VALIDATE PHASE

- 8.1 Steps of the Verify/Validate Phase
- 8.2 Inputs to the Verify/Validate Phase
- 8.3 Build a Prototype of the Detailed Design
- 8.4 Pilot Test the Prototype of the Detailed Design
- 8.5 Conduct Design Reviews Using Design Scorecards
- 8.6 Decide Whether or Not to Scale-Up Design
- 8.7 Build and Operate Full-Scale Process
- 8.8 Decide if the Full-Scale Process Is Meeting Business Objectives
- 8.9 Document the Full-Scale Process
- 8.10 Transition Full-Scale Process to Owners with a Control Plan
- 8.11 Conduct Verify/Validate Phase Tollgate Review (Check Sheet)
- 8.12 Close the DMADV Project
- 8.13 Transfer the Lessons Learned from the Project
- 8.14 Outputs of the Verify/Validate Phase
- Summary
- References

PART III: DESIGN FOR SIX SIGMA TOOLS AND METHODS

9 BASICS OF STATISTICAL STUDIES

- 9.1 Statistics and Design for Six Sigma
- 9.2 Enumerative and Analytic Studies
- 9.3 Types of Variables
- 9.4 Operational Definitions
- Summary
- References
- Appendix 9.1 Introduction to Minitab Version 14
- Appendix 9.2 Introduction to JMP Version 6

10 DESIGN OF EXPERIMENTS

Table of Contents

10.1 Design of Experiments: Background and Rationale

10.2 Two-Factor Factorial Designs

10.3 2^[sup(k)] Factorial Designs

10.4 Fractional Factorial Designs

Summary

References

Appendix 10.1 Using Minitab for the Design of Experiments

Appendix 10.2 Using JMP for the Design of Experiments

11 MULTIPLE REGRESSION

11.1 Review of Simple Linear Regression

11.2 Developing the Multiple Regression Model

11.3 Coefficient of Multiple Determination and the Overall F Test

11.4 Residual Analysis for the Multiple Regression Model

11.5 Inferences Concerning the Population Regression Coefficients

11.6 Using Dummy Variables and Interaction Terms in Regression
Models

11.7 Collinearity

11.8 Model Building

11.9 Logistic Regression

Summary

References

Appendix 11.1 Using Minitab for Multiple Regression

Appendix 11.2 Using JMP for Multiple Regression

12 ADDITIONAL TOOLS AND METHODS

12.1 Brainstorming

12.2 Affinity Diagram

12.3 Cause-and-Effect Diagram and Matrix

12.4 Check Sheets

12.5 Stratification

Table of Contents

12.6 Gantt Chart

Summary

References

Appendix 12.1 Using Minitab for the Cause-and-Effect Diagram

Appendix 12.2 Using JMP for the Cause-and-Effect Diagram

13 DISCRETE EVENT SIMULATION MODELS

13.1 What Is Simulation?

13.2 Applications of Simulation

13.3 Why Use Simulation Modeling?

13.4 Advantages of Simulation

13.5 Precautions When Using Simulation

13.6 Pitfalls of Simulation Models

13.7 Simulation Terminology

13.8 How Discrete Event Simulation Works

13.9 Simulation Project Management

13.10 Optimizing a Process Using Design of Experiments from
Simulations

13.11 Service Industry Application Using the SigmaFlow Software
Package

Summary

References

14 ARTICULATING THE VOICE OF THE STAKEHOLDER

14.1 Market Segmentation

14.2 Kano Surveys

Summary

References

15 ENHANCING CREATIVITY TO DEVELOP ALTERNATIVE DESIGNS

15.1 Using de Bonos Thinking Habits and Tools to Generate

Table of Contents

Alternative Design Concepts

15.2 Using TRIZ to Generate Alternative Design Concepts

15.3 Using Benchmarking to Generate Alternative Design Concepts

Summary

References

Appendix 15.1 Full Contradictions Matrix

16 PROFESSIONAL INTERPERSONAL BEHAVIOR SKILLS, TEAM BEHAVIOR SKILLS, AND SIX SIGMA MANAGEMENT

16.1 Professional Interpersonal Behavior Skills

16.2 Professional Team Behavior Skills

16.3 Product Development Team Basics

Summary

References

PART IV: DESIGN FOR SIX SIGMA CASE STUDY

17 SIX SIGMA DMADV CASE STUDY

17.1 Background

17.2 Define Phase

17.3 Measure Phase

17.4 Analyze Phase

17.5 Design Phase

17.6 Verify/Validate Phase

Summary

PART V: DESIGN FOR SIX SIGMA CERTIFICATION

18 DFSS CHAMPION AND GREEN BELT CERTIFICATION AT THE UNIVERSITY OF MIAMI

18.1 Certification at the University of Miami

18.2 DFSS Certification Examinations

18.3 Costs for DFSS Certification Examinations

18.4 Application Process

Table of Contents

18.5 Sample DFSS Certification Examination Review Questions with
Answers

18.6 DFSS Green Belt Project

Summary

APPENDIX A: SUMMATION NOTATION

APPENDIX B: STATISTICAL TABLES

APPENDIX C: DOCUMENTATION OF DATA FILES

INDEX