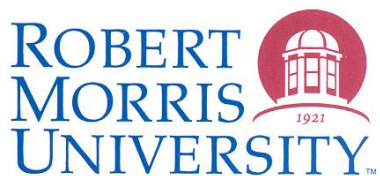


**ROBERT MORRIS UNIVERSITY**  
**CENTER FOR APPLIED RESEARCH IN ENGINEERING**  
**AND SCIENCE**

presents

**Lean Six Sigma Training**



*Center for Applied Research  
in Engineering and Science*

## Executive Summary

**LEAN SIX SIGMA®** is an approach that has its foundation in industry and has been successfully implemented in many companies for one primary reason: *It achieves the breakthrough results that are so desperately needed.* Lean Six Sigma is a structured approach to the reduction of variation and waste in any process; its strong metric component makes it highly applicable to practically any business. **Lean/Sigma puts the customer first and uses rigorous data and information scrutiny to drive better bottom line solutions and decisions.** The tools and methods target three main areas:

- Improving satisfaction by focusing on customer value.
- Reducing delivery and transaction time by dramatically cutting waste in all processes – understand and develop the value stream.
- Eradicating opportunities for defects occurrence through data driven process control in all areas of the enterprise.

Lean/Sigma is a total management commitment to excellence, customer focus, process improvement, and the necessity of using capable measurement rather than “gut feel”. The tools employed make every area of the enterprise better equipped to meet changes in customer needs, markets, and technologies — with benefits for employees, customers, the neighboring business community, and other stakeholders.

Though Lean/Sigma was initially focused on manufacturing processes, businesses have learned that the costs of poor service from any segment of the organization could be catastrophic and quickly harm the entire enterprise. Often times, administrative and service (transactional) processes perform below the efficiency of product generating processes, so institutions with a service delivery focus can benefit tremendously from Lean/Sigma application.

### ★ Who should attend SIX SIGMA?

Executives, managers, and quality professionals involved with: Process Improvement, Risk Management, Production, Administration, Human Resources, Finance, Sales, Training, and other related areas

### ★ With Six Sigma you can:

- Reduce Error Rates and Process Variation
- Recognize the Abnormal
- Improve Critical Thinking Skills in Your Organization
- Lower Costs

### ★ Training Schedule:

- September 29, 2009- Lean Six Sigma Introduction
- October 26-28, 2009 – Lean Six Sigma Green Belt – Session 1 (10 days in 4 sessions)
- November 18-19, 2009 – Lean Six Sigma Green Belt – Session 2
- December 14-16, 2009 – Lean Six Sigma Green Belt – Session 3
- January 19-20, 2010 – Lean Six Sigma Green Belt – Session 4

# Lean Six Sigma Training Programs

## Lean Six Sigma Introduction Training: 8 hours

September 29, 2009

This orientation is designed for senior management and leadership in organizations considering or deploying Lean/Sigma. This should be the first step in a full Lean/Sigma deployment. The program is led by a certified Black Belt and Master Black Belt and includes the following topics plus additional information needed for a successful deployment in the home (participating) organization.

- What is Lean Six Sigma and why it is being adapted by many manufacturing, non-manufacturing, governmental, and educational organizations.
- How Lean Six Sigma is applied to significantly improve: **customer satisfaction, business performance, employee involvement, and sustained continuous improvement.**
- The Lean Six Sigma implementation roadmap and overview of essential tools and methods used in business process management.
- Mini case studies and breakout sessions to illustrate basic concepts.
- Roles and responsibilities in Lean/Sigma.
- How to select Lean/Sigma practitioners and how they will be trained.
- Introductory discussion of how to select projects that will be successful.
- How to sustain the gains from Lean/Sigma deployment.
- A description of the organizational structure needed to support a Lean Six Sigma implementation with proposed timelines.

## Lean Six Sigma Leadership Training: 3 days

### No Dates Scheduled for Fall

**Prerequisite: Lean Six Sigma Introduction Training (8 hours)**

The following outlines goals/deliverables for a Leadership Lean Six Sigma training program. **The focus will be an accelerated walk through to introduce participants to essential techniques and approaches associated with Lean/Sigma to sustain continued organizational growth. The program prepares participants for leadership and involvement with practitioners in actual projects designed to improve and advance the operations and services provided by an enterprise.** Participants will be introduced to the DMAIC\* roadmap and typical tools and methods used in Lean/Sigma deployment.

\* **D**efine, **M**easure, **A**nalyze, **I**mprove, **C**ontrol

**Day 1** – How to define, prioritize, and establish requirements for continuous improvement projects (Define and Measure phases).

- Identifying common elements found in most continuous improvement and quality improvement efforts.
- Working with ideas generated through team involvement – team dynamics and results.
- Source and selection of projects and how to stay focused on customer requirements.
- How to use process observations and measurements for project selection.

Day 1 tools: Project prioritization matrix, Calculation of DPMO (Defects per Million Opportunities), Examples of Project Charters, Project Selection Matrix, SIPOC (Suppliers, Inputs, Process, Outputs, Customers), Value Stream Mapping Templates, Pareto, Critical to Customer (CTC Trees,

Day 2 – Techniques used to analyze data/information, identify root cause, and apply results to improve processes.

- Case Study to introduce DMAIC tools applied to a manufacturing example.
- Continuation of of Measure Phase tools and importance of evaluating measurement systems as part of overall process improvement.
- Understanding of variation through a practical demonstration.
- Develop the use of control charts as a tool to understand and reduce variation.
- Introduction of basic tools in the Analyze & Improve Phases.

Day 2 tools: Process Mapping, Cause & Effect Matrix, Control Charts, Measurement System Evaluations (MSE), Prioritizing process variables (x's), Box Plots, FMEA (Failure Mode and Effects Analysis), Introduction/Elements of DOE (Design of Experiments)

Day 3 – How to sustain improvements and find/apply new best practices (Improve and Control Phases). Further discussions of the role of a “Project Champion”.

- How to determine critical x's through active data collection and experimentation
- Elements of successful project management.
- Mentoring/coaching Green Belts and managing project expectations.
- Validating performance against bottom line results.
- Avoiding pitfalls associated with Six Sigma deployments. .

Day 3 tools: Continuation of DOE, Project Management Tools, Improvement Process Check List, Control Charts, Control Plan, Poka-Yoke Options, Recommended resources of information (books, websites, and free Internet information).

**At the completion of the program, participants will be able to understand and contribute in the following areas:**

- *Fundamental practices in CI and how to use available resources for improving company performance.*
- *A sustaining process to identify and prioritize L/S projects and an understanding of the responsibilities of a Project Champion for supporting practitioners (Green & Black Belts)*
- *Understand where and how to apply a phased approach in problem solving activities.*
- *How reducing variability leads to improved performance.*
- *How to enhance and strengthen team involvement in cross-functional problem solving.*

## Lean Six Sigma Green Belt Training: 10 eight-hour days

October 26-28, 2009; November 18-19, 2009; December 14-16, 2009; January 19-20, 2010

The training of Green Belt students represents the surest path to maximize the impact of Lean Six Sigma for an organization. Green Belt students receive a wide range of course materials in addition to the traditional Define, Measure, Analyze, Improve and Control (abbreviated as DMAIC and pronounced as de-MAY-ick) phases of Lean Six Sigma. Project management, classroom exercises to illustrate variation and Lean principles and tools are examples of a diverse course outline. Students qualify to receive Green Belt certification when their project demonstrates continued gains for four to six months and is documented in a formal project report.



Importantly, we recommend that Green Belt students come to the training program with projects selected *prior* to training. This approach provides frame of reference for the student to better apply the course material and provides instructors the ability to tailor the course content to include examples of those projects over the ten days of training.

*Laptop computers are used to teach data analysis skills*

Green Belt training can be provided at either RMU or *on-site* for a contracted institution. Each option has distinct benefits and disadvantages that must be weighed on a case-by-case basis. Classes can be delivered in two, five day per week sessions that ideally, would be separated by four to six weeks to allow the student time to work on their project between the two sessions. Classes can also be delivered on a more customized schedule that will be considered upon request. Knowledge transfer is provided in the following areas:

- How to build on Lean Principles to sustain Continuous Improvement (CI).
- Understanding the essentials for an organization to meet customer requirements.
- Effectively managing material and informational flow to improve process speed.
- How to eliminate defects through variability reduction.
- Understand the basics of process and systems thinking.
- Why validated data & information is critical in factual decision making.
- Team formation, dynamics, and leadership skills for timely completion of projects.
- The importance of continued learning in the CI process.

## **The Curriculum for Green Belt Training**

### **Session I (Days 1 – 3): Define/Measure Phase**

Setting the Stage for Six Sigma

- a. Defining Six Sigma
- b. Benefits of Six Sigma way of thinking; COPQ (Cost of Poor Quality) benefits
- c. Six Sigma examples in various settings
- d. Six Sigma as a statistical measure, sigma capability
- e. Six Sigma infrastructure, your role as a green belt and support roles
- f. DMAIC and Lean overview

2. Process Measurements
  - a. Qualitative data: DPMO (defects per million opportunities), FPY (first pass yield)
  - b. Quantitative data: descriptive statistics, sigma level, sigma capability, quality measures
  - c. Examples of metrics in manufacturing and transactional environments
3. Project Selection and Management: Define Tools *Students collaborate during classroom exercises*
  - a. Project definition
    1. Understanding VOC (Voice of the Customer)
      1. Operational definitions exercise
    2. Pareto charts
    3. Scoping tools
  - b. SIPOC (Suppliers, Inputs, Process, Outputs, Customers)
  - c. Project documentation – using contracts
  - d. Project timeline
  - e. Effective meetings
  - f. Team dynamics and development
  - g. Managing change and culture change
  - h. DMAIC checklist
4. Measure Tools
  - a. Thought mapping
  - b. Process mapping
  - c. Cause and Effect Matrix (C&E)
  - d. Failure Mode and Effects Analysis (FMEA)

### **Session 2 (Days 4 - 5): Measure/Analyze Phase**

1. Transforming Data into Information
  - a. Minitab (statistical software package) introduction
  - b. Pareto, histograms, run charts, box plots, scatter plots
  - c. Mean, median, mode, standard deviations
2. Understanding Variation
  - a. Exercise to demonstrate common cause vs. special cause variation
  - b. Introduction to control charts to understand and quantify variation
    - i. I-MR Charts (Individuals and Moving Range Charts)
    - ii. X-Bar - R Charts (Average and Range Charts)
3. Measurement System Evaluation (MSE)
  - a. Fundamental principles of measurement processes
  - b. Repeatability, Reproducibility and Discrimination
4. Using Minitab to evaluate measurement systems with quantitative and qualitative data

### **Session 3 (Days 6 - 8): Analyze/Improve Phase**

1. Lean Principles
  - a. Lean thinking, types of activities, types of waste
  - b. Value stream mapping
  - c. Lean toolkit overview: 5S, Poka Yoke, Visual Controls, Single Piece Flow, Kanban, Work Cell Design, Kaizan Blitz
2. Hypothesis Testing
3. Statistical Tests
  - a. F-test
  - b. t-test
  - c. Analysis of Variance (ANOVA)
4. Introduction to Design of Experiments (DOE)

#### **Session 4 (Days 9 - 10): Improve/Control Phase**

1. Project Documentation
  - a. Final report format
2. Control Plans
  - a. Sustaining the gains
  - b. Using control charts to control the improvements
3. Project Reviews
  - a. Discussions/reviews of students' projects

### **Six Sigma Black Belt Training**

**Prerequisite: Completion of the 10-day RMU Lean Six Sigma Green Belt Training.  
No Dates scheduled for fall**

The training of Black Belt students helps an organization to sustain the results of a Six Sigma deployment and facilitate the culture change required to transform the company to the next level of performance. Participants will continue to develop their knowledge of the traditional Define, Measure, Analyze, Improve and Control phases of Lean Six Sigma. Project management, classroom exercises to illustrate variation and advanced data collection tools are examples of a diverse course outline. Students qualify to receive Black Belt certification when at least two of their projects demonstrate continued gains for four to six months and are documented in formal project reports.

Like the Green Belt students, we recommend that Black Belt students come to the training program with projects selected *prior* to training. This approach provides a frame of reference for the student to better apply the course material and provides instructors the ability to tailor the lecture discussions to include examples of those projects over the ten days of training.

Black Belt training can be provided at either RMU or *on-site* for a contracted institution. Each option has distinct benefits and disadvantages that must be weighed on a case-by-case basis. Classes can be delivered in two, five day per week sessions that ideally, would be separated by four to six weeks to allow the student time to work on their project between the two sessions. Classes can also be delivered on a more customized schedule that will be considered upon request. Knowledge transfer is provided in the following areas:

- How to build on advanced Six Sigma Principles to sustain Continuous Improvement (CI).
- Continue to understand the essentials for an organization to meet customer requirements.
- Effectively manage material and informational flow to improve process speed.
- How to eliminate defects through variability reduction and advanced data collection techniques.
- Understand the basics and advanced concepts of process and systems thinking.
- Why validated data & information is critical in factual decision making.
- Team formation, dynamics, and leadership skills for timely completion of projects.
- The importance of continued learning in the CI process.

### **The Curriculum for Black Belt Training**

#### **Session I (Days 1 – 3): Analyze Phase**

1. Expanding knowledge of data collection:
  - e. Comprehensive review of data collection and DOE
  - f. Fractional Factorial DOE techniques
  - g. Introduction of mini-project case study

2. Extensions of DOE
  - a. Multi-level experiments
  - b. Reducing the model to understand experimental error
  - c. Determining practical significance versus statistical significance
  - d. Blocking techniques for further understanding of process variation
  - e. Center point experiments
3. Advanced Measurement System Evaluations (MSE)
  - a. Review of “traditional” gage R&R methods
    - i. X-Bar R Charts for analysis
  - b. Introduce destructive MSE techniques

### **Session 2 (Days 4 - 5): Analyze Phase**

1. Review ANOVA techniques
  - a. Total variation, between group variation and error calculations
  - b. Practical applications
2. Dealing with Non-Normal data
  - a. Box-Cox transformations
  - b. Cautions of transformations
3. Analyzing Attribute Data
  - a. Differences between attribute and continuous data analysis
    - i. Control Charts and DOE
  - b. Appropriate transformations for analysis
  - c. Cautions of using attribute data
4. Case Study Presentations
  - a. Review of DMAIC process

### **Session 3 (Days 6 - 8): Analyze/Improve Phase**

1. Advanced Data Collection & Analysis
  - a. Review of control charts
  - b. Components of variation studies
  - c. Nested vs. crossed data collection and analysis techniques
2. ANOVA & DOE extensions
  - a. Multiple comparison tests
    - i. Tukey, Fisher, Hsu, Dunnett methods
  - b. Fold-over technique for fractional factorial designs
  - c. Dealing with restrictions on randomization
    - i. Factor Relationship Diagram (FRD)
    - ii. Analysis of split-plot designs
3. Advanced Regression Techniques

### **Session 4 (Days 9 - 10): Improve/Control Phase**

1. Response Surface Modeling
  - a. Central Composite Designs (CCD)
  - b. Box-Behnken Designs (BBD)
  - c. Writing prediction equations
2. Control Plans
  - a. Sustaining the gains
  - b. Using control charts to control the improvements
3. Case Study Presentations and Project Reviews
  - a. Discussions/reviews of students’ projects

## Action Learning Approach

All education is founded in adult learning theories and sessions include clearly stated behavioral objectives with student evaluations following the instruction. Education takes the form of small group sessions, classroom experimentation, nominal group, brainstorming, or large group PowerPoint presentations.

Classroom instruction for Green Belt and Black Belt students uses laptop computers and involves data analysis and presentation. Students will be expected to provide an oral presentation of their projects at the beginning of the training program and at selected intervals throughout the training process.

Active experimentation is used in many sessions to provide a truly unique experience that results in an in-depth understanding of variation, its measurement and control. Class size is part, dictated by the instructional methods used to demonstrate the tools and methods of Lean Six Sigma

Case studies involving actual projects are used widely throughout the training sessions. These vignettes help to reinforce the material and illustrate the application of Lean Six Sigma for projects that are selected by the students.

Statistics are one component of the Lean Six Sigma toolkit and the use of KISS (Keep It Simple Statistically) approach maintains a focus on *selection* and *interpretation* of various statistical tests, not the math that is used to perform the calculation. To this end, Minitab is used to keep the Measure, Analyze and Improve phases focused on application for the achievement of business results.

## **Bio of the Instructors**

### **Sharon Gregory, President, Hexagon Solutions and Beyond, Inc.**

Sharon Gregory is the founder and president of Hexagon Solutions and Beyond, Inc. (HexSAB), established January 31, 2001. She provides customized Six Sigma training and project consulting services for organizations dedicated to process improvement and helps them internally implement Six Sigma to achieve business results through training and/or project management services. Her passion for Six Sigma is clearly demonstrated through her enthusiastic, practical, and interactive team-leading and teaching style that has earned her recognition and respect within the companies for which she has consulted.

A former high-school mathematics teacher, Sharon has a bachelor's and master's degree in mathematics education. She is a Six Sigma Master Black Belt with a dozen of years of experience in applying and teaching Six Sigma. As a practitioner for companies including Whirlpool, PPG, and Eaton she has facilitated significant cost saving projects, process improvements, and Six Sigma implementation through expertise in the Six Sigma philosophy, statistical design and analysis techniques, project and resource management, and team building leadership skills. A few clients for whom she has conducted various levels of Six Sigma training include Alstom Power Conversion, American Cap Company, Bombardier, Carnegie Mellon University, Catalyst Connection, Chestnut Ridge Foam, Crucible Research, Eaton Corporation, JLG Industries, JWF Industries, Korns Galvanizing Company, Lake Region Medical, McNeilus/Oshkosh Truck, Medrad, Mine Safety Appliances, North Side Foods, and PTC Alliance.

Sharon allocates her time between classroom training, course development, and hands-on project based consulting. She brings to her clients' executive boardroom and shop-floor, technical and hands-on knowledge in painting, molding, assembly, power distribution, medical devices, and other manufacturing and business processes.

Ms. Gregory also owns and operates a conference center in Pittsburgh, PA, Sigmas Conference and Event Center, that specializes in corporate meetings and trainings and upscale social banquet events.

### **Rick Beaver, VP Quality, Heritage Valley Health System**

Rick was appointed to the position of Vice President, Quality and Safety Officer for Heritage Valley Health System (HVHS) July 9, 2001. Rick also serves as the head of Six Sigma Connections for Healthcare ©, a separate business venture of HVHS that supports the integration of Lean Six Sigma into other healthcare organizations and provides a full range of education for staff, leadership, board members and physicians.

Rick previously served as the leader of Operational Excellence and Quality for Nova Chemicals Inc. in Monaca, PA. Prior to working at Nova, Rick was employed by Sony Electronics Inc. in Mount Pleasant, Pa. as the leader of Operations, Manufacturing, Engineering, Maintenance and Inspection. In both positions, Rick developed an expertise in Lean Six Sigma and other continuous improvement techniques, which he is now applying toward improvement of the processes surrounding patient care. Rick was with Sony from 1993-1999 and with PPG Industries Inc. in Pittsburgh as an engineering project leader for the Fiber Glass Division from 1980-1993.

Rick earned a B.S. in Chemistry at the University of Pittsburgh in 1978 and continued his education with graduate work in polymer chemistry at Carnegie Mellon University. He has 14 patents and is

published in the areas of healthcare quality, chemistry, engineering and Lean Six Sigma. His most recent publication was in Quality Digest, March 2004. Rick completed leadership training at the Center for Creative Leadership and obtained his “Black Belt” in Lean Six Sigma techniques at SONY and NOVA Chemicals.

## **Zbigniew J. Czajkiewicz, Ph.D., Professor of Engineering, RMU Head of the Center for Applied Research in Engineering and Science**

Dr. Czajkiewicz joined the RMU faculty in 2004. He has served as president of his own consulting company since 2000, engaging in many international projects involving the implementation of automation and large-scale software systems and process improvements. He previously served as a faculty member at Texas Tech University, the University of Toledo, Wichita State University and California State University-Fresno, where he was professor and coordinator of the industrial engineering program and director of the Computer Integrated Manufacturing Center from 1989 to 2000. During his career in academia, Dr. Czajkiewicz taught a variety of courses from statistics to management decision support/information systems design. He has more than 50 publications, more than 20 externally funded research grants and many more consultancy cases to his credit. His consulting and industrial experience includes work in England, Kazakhstan, Germany, USA and Poland. The scope of projects includes analysis and productivity improvements, reengineering, implementation of computer management systems (ERP), Total Quality Management (TQM), production automation and project management. Dr. Czajkiewicz earned an M.S. in industrial engineering and management as well as a Ph.D. in industrial engineering from Technical University of Wroclaw in Poland.