**DFSS Foundations**

This 1-week hands-on workshop is specifically tailored to provide the background knowledge and pre-requisite skills necessary for successfully completing DFSS Green Belt or Black Belt training. It teaches participants the foundations of Six Sigma, Design of Experiments (DOE), Measurement System Analysis (MSA), probability, and basic statistical analysis along with an introduction to statistical software. It prepares participants for continued study in the Design for Six Sigma methodology, which is aimed at getting better products and services to market faster and at a lower cost. The course is taught with a “Keep It Simple Statistically” (KISS) approach that makes use of many in-class examples and exercises. Participants have ample opportunity to practice what is taught to ensure they have a practical, working knowledge of MSA, probability and data distributions, and Design of Experiments. This 1 week workshop is designed for participants who have not previously completed Six Sigma Green Belt or Black Belt training, or need to brush up on the fundamentals of DOE and statistical analysis in preparation for further Design for Six Sigma training.

The proven and powerful Design for Six Sigma (DFSS)methodology can be used for both initial design as well as re-design efforts, and provides a way to implement the Six Sigma methodology as early in the product or service life cycle as possible. DFSS teaches participants how to “design in” quality when costs are the lowest in order to create new game-changing products and services which exhibit outstanding performance right from the start. DFSS employs the IDOV methodology, which focuses on identifying the voice of the customer, designing products and processes which satisfy the customer’s requirements, optimizing products and processes to maximize performance, and testing and validating designs to ensure capability.

In the foundations course, emphasis is placed on understanding statistical concepts and methods used in the DFSS process. Participants learn how to set up and assess a measurement system to ensure that it provides accurate and repeatable data. Various data distributions are explored and used to help predict defect levels or probabilities of not meeting requirements. The details of how to plan, design, conduct, and analyze statistically designed experiments is taught so that participants can build transfer functions and models useful for gaining knowledge about a product or process and for optimization and variance reduction. Emphasis is on developing practitioners in the organization who are focused on improving customer satisfaction and generating business growth and breakthrough improvements. During the workshop, participants will complete several in-class exercises which allow them to gain confidence using the software, analyzing data, and applying MSA and DOE. The intended audience is anyone who desires to attend the Breakthrough Performance Design for Six Sigma course and lacks the required background.

**Course Agenda**

Introduction to Design for Six Sigma (DFSS)

* The What and Why of Design for Six Sigma
* Design for Six Sigma Master Strategy: IDOV
* DFSS Studies and Projects
* Key Players and Roles
* Course Philosophy and Instructional Approach

Six Sigma Fundamentals

* Basics of Six Sigma and its Key Principles
* Defining Processes Using IPO Diagrams
* Key Terminology (Distribution, Mean, Median, Standard Deviation, Cp, Cpk, sigma level, first pass yield, defects)
* PF/CE/CNX/SOP (the first line of defense against variation)

Measurement System Analysis

* Properties of a Good Measurement System
* Impact of Measurement System Variation
* How to Set Up, Conduct, and Perform a Measurement System Analysis
* Variables Data
* Attribute Data
* Interpretation of MSA Results and Metrics
* Repeatability
* Reproducibility
* P/Tol ratio
* P/total ratio
* Discrimination (resolution)
* Effectiveness, Probability of False Rejects, Probability of False Accepts

Understanding Data Distributions and Their Applications

* Basic Concepts of Probability
* Fact that Probability is Often Not Intuitive
* Four Common Distributions and Their Application to Problem Solving
* Binomial distribution
* Poisson distribution
* Exponential distribution
* Normal distribution
* Using statistical software for Calculating Probabilities

Introduction to Regression Analysis and Design of Experiments (DOE)

* What is Regression and What is it Used For?
* Terminology Involved in Simple Linear Regression
* Intercept
* Slope
* Prediction Equation
* Residual
* R-Squared
* Use of statistical software for Regression Analysis and Interpretation of Output
* Introduction to Design of Experiments (DOE)

Foundations of Design of Experiments (DOE)

* Purpose of Design of Experiments
* Experimentation Strategies
* Key DOE Terminology
* Introduction to Basic Graphical and Statistical Analysis of Data
* Interactions
* Introduction to DOE Software and Hands-On Experimentation

Using the Statapult®

Design and Analysis of Experiments

* Importance of Planning
* DOE 12 Step Process
* Review and Practice: Graphical and Statistical Analysis of Data
* Building Design Matrices
* Introduction to Fractional Factorial Designs
* DOE Examples
* Hands-on Practice with Modeling and Optimization using the Statapult®
* Reasons why Experiments May Fail to Confirm and How to Recover

Rules of Thumb for DOE

* Sample Size Guidelines for DOE
* Selecting the Best Design
* Determining Statistical Significance
* Interpreting R-square, Adjusted R-square, Tolerance and p-Values

Two-Level Design Summary

* Use and Application of Two Level Designs
* Summary of Two Level Design Options
	+ Full Factorial Designs
	+ Fractional Factorial Designs
	+ Screening Designs
* Awareness of Situations where Standard Designs will Not Apply and KISS Approaches for Dealing with these Situations
	+ Nested Designs
	+ Mixture Designs

Three-Level Designs

* Qualitative vs. Quantitative Factors in DOE
* Use and Application of Three Level Designs
* Full Factorial Designs
* Screening Designs
* Box Behnken and Central Composite Designs
* Setting Up, Conducting, Analyzing, and Confirming a Quadratic Model Using the Statapult®

Variance Reduction Methods and Robust Design

* Strategies for Variance Reduction
* Robust Design and DOE
* Setting up and analyzing Robust Design experiments
* Reducing Transmitted Variation by Taking Advantage of Interactions and Non-Linearities

References, Glossary of Terms and Course Evaluation Forms

**Course Materials**

Participants receive the following materials which are integrated and used throughout the class:

* Participant Guide

Textbooks:

* *Design For Sis Sigma: The Tools Guide for Practitioners*
* *Basic Statistics: Tools for Continuous Improvement*
* *Understanding Industrial Designed Experiments*

Software:

* SPC XL
* DOE Pro

**Prerequisites**

This first course in DFSS is designed to lay the foundations for the study of DFSS. Participants are expected to continue their study of Design for Six Sigma by taking the follow-on course, DFSS (1-week course), with management sponsorship and a project or study selected prior to, or at some point during, this training. Projects are typically begun at some point during the training and are completed within a reasonable timeframe, not usually longer than 6-8 months following completion of the training.

Participants should bring a laptop computer to class with Excel 2000 (or later) so that they can install the supplied software and practice using it during many in-class exercises. A basic working knowledge of Windows and Excel is helpful. Basic math and algebra skills are also desirable.