Quality Guideline

Training Program

Design for Six Sigma Green Belt *Training*

Version: 1.5

Status: 16.01.2023

European
Six Sigma Club Deutschland e.V.
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Contents

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Foreword

Background

Design for Six Sigma Green Belts (DFSS GB) are development engineers, production engineers (industrial engineering) and quality engineers for the realisation of a (simple) development project (e.g. one module of a system to be developed).

A DFSS Green Belt will receive a minimum of 10 days of training, usually spread over two or more training blocks, with no prior knowledge of Six Sigma. With appropriate basic Six Sigma training (the Six Sigma Green Belt training is recognised, with training content in accordance with the ESSC-D e.V. quality guideline), the training duration can be reduced to a minimum of 5 days.

In this role, the DFSS Green Belt leads the team in terms of organisation and methodology, prepares the necessary analyses with the support of a coach if required, and reports on the progress of the project to the client/process owner/sponsor or relevant committee.

Origin

In March 2010, the European Six Sigma Club - Deutschland e.V. (ESSC-D for short) commissioned a working group, headed by Mr Karlheinz Lerch, to draw up a list of training content that describes the minimum requirements for Design for Six Sigma training in the product development area.

Hermann Weigel, Karlheinz Eichinger, Henry Winkler and Stefan Berg were permanent members of the working group.

The Board of the ESSC-D would like to thank the working group for its cooperation and the results achieved.

This quality guideline was subsequently created on this basis and approved and made binding as a quality guideline for the minimum requirements of the European Six Sigma Club - Deutschland e.V.

Changes

The following changes have been made compared to the version dated July 19th, 2017:

a) Adaptation of the document layout to the new design
b) Standardization of the wording of the existing guidelines
c) Supplementary data mining advanced course (recommended additional training)

Previous issues

Version from July 19th 2017

Version from July 12th 2015

Version from December 8th 2011

Abbreviations

6S	Six Sigma
ANOVA	Analysis of Variance
BB	Black Belt
C&E	Cause and Effect
DMAIC	Define - Measure - Analyze - Improve - Control
ESSC-D	European Six Sigma Club Germany e.V.
GB	Green Belt
K	Kick-off
MBB	Master Black Belt
SIPOC	Supplier - Input - Process - Output - Control
SMBB	Senior Master Black Belt
VOC	Voice of Customer

Terms

Quality Guideline	Guideline for ensuring the desired quality in the result
Sponsor	Usually a member of middle management. Supports the project manager and team in completing the tasks.

1 Area of application

The guideline describes the minimum requirements for Design for Six Sigma Green Belt training. The nature, scope and depth of the training are described in classified form and are used for comparison with existing or newly developed training courses.

If the training to be assessed meets the criteria described below, this is the basic requirement for certification as a Design for Six Sigma Green Belt according to the guidelines of the European Six Sigma Club Deutschland e.V.

2 Introduction

The following guide is divided into project phases and a general section, but this does not mean that the tools must be trained in the specified phase.

As many tools can be used in more than one phase, it is the responsibility of the trainer to deliver the content at the appropriate time according to the didactics used.

DfSS Green Belt training can be conducted by one or more trainers. At least one trainer must be a certified DfSS Black Belt.

3 Training duration

For the DfSS Green Belt training program, a minimum of 10 days of instruction with a minimum of 100 teaching units of 45 minutes each plus breaks must be completed to teach the content described below and to achieve the required level of instruction.

Typically, trainings consist of 12 teaching days with a total of 120 teaching units of 45 minutes each plus breaks.

Universities may achieve the required level of instruction by dividing the teaching units between attendance (lecture) and a proportion of self-study. The maximum proportion of self-study allowed is 25% of the total number of teaching units, based on the minimum scope of the standard course described above (100 units). Self-study units will be multiplied by a factor of three. For the Design for Six Sigma Green Belt training, with a maximum use of self-study of 25% and a minimum number of teaching units, this results in 50 teaching units of classroom time and an additional 50 teaching units (50x2) of self-study.

To receive a certificate of attendance, the student must have attended at least 85% of the total number of hours scheduled for this course.

4 Training content, project phase-orientated

4.1 Design for Six Sigma Green Belt (without Six Sigma basic training)

4.1.1 Introduction to Design for Six Sigma (DFSS)

- Overview of DFSS methodology and methodology elements
- Objectives of DFSS
- Methodology sequence and project phases

4.1.2 Overview of the product development process (PEP) and quality gates

- Phases of the product development process according to VDI 2221
- Basics of the Quality Gate concept

4.1.3 Requirements management / requirements analysis / voice of customer process

- Collection, structuring and analysis of requirements
- Classification of requirements according to KANO

4.1.4 Introduction to Quality Function Deployment (QFD)

- Basics, the 4 phases model or the 4 "Houses of Quality" (HoQ)
- Understanding, advantages and benefits of QFD

4.1.5 QFD Procedure HoQ1

- Product development process using QFD
- Structure and procedure HoQ1

4.1.6 Development scorecards

- Scorecards for Critical to Quality (CtQ), critical design parameters, process and software
- Scorecard in conjunction with HoQ and statistics

4.1.7 Decomposition and functional network

- System partitioning
- Functional network and FAST analysis

4.1.8 Decision-making for the concept / Pugh matrix

4.1.9 QFD-HoQ2 / QFD-HoQ3 Contexts

- Determination of critical design and process parameters
- Connection to the Design Scorecards

4.1.10 Potential failure anticipation, Failure Mode and Effects Analysis (FMEA) and Design Review on Failure Mode (DRBFM)

- Technical risk reduction in product development
- Overview of FMEA and DRBFM

4.1.11 Introduction to statistical software

4.1.12 Fundamentals of statistics in development

- Basics of data types and distribution forms
- Statistical capability parameters and confidence intervals

4.1.13 Hypothesis tests (T-test, F-test, χ -test)

- Basics of hypothesis testing
- Risks of statistical tests and sample size

4.1.14 Measurement System Analysis (MSA) Introduction and application in design (continuous/attributive)

- Resolution, accuracy, stability, P/T and %R&R
- MSA in design

4.1.15 Transfer functions

- Introduction and connection to QFD
- Determination of the transfer functions

4.1.16 Analysis of variance ANOVA

- Simple ANOVA
- Practical and statistical significance, multiple comparison and residual value analysis

4.1.17 Regression analysis

- Simple regression linear, quadratic and cubic
- Multiple regression

4.1.18 Introduction to boundary and parameter diagrams

- Definition of system interfaces and their interactions
- Identification of noise variables

4.1.19 Introduction to DoE (Design of Experiments)

- Components, validity and creation of 2k factorial experimental designs
- Analysis and conclusions

4.1.20 Parameter optimization / simulation

- Estimation of the expected capability of a system/product
- Optimization of the capability by changing parameter settings

4.1.21 Robust designs

- Derive the influences, determine functional chains
- Optimization towards robustness

4.1.22 Tolerance calculation methods

- Smallest/largest dimension analysis (worst case design)
- Statistical tolerance analysis according to RSS and 6 Sigma design

4.1.23 Introduction to reliability analyses

- Basics, system planning and requirements definition
- Weibull analysis

4.1.24 Triz introduction

- Introduction and innovation rules
- Contradiction matrix

4.1.25 Application of methods Practical examples/exercises

4.2 Design for Six Sigma Green Belt (with Six Sigma basic training)

Minimum requirement: Six Sigma Green Belt according to ESSC-D standard

4.2.1 Introduction to Design for Six Sigma (DFSS)

- Overview of DFSS methodology and method elements
- Objectives of DFSS
- Method sequence and project phases

4.2.2 Overview of the product development process (PEP) and quality gates

- Phases in the product development process according to VDI 2221
- Basics of the Quality Gate concept

4.2.3 Requirements management / requirements analysis / VoC process

- Collection, structuring and analysis of requirements
- Classification of requirements according to KANO

4.2.4 Introduction to Quality Function Deployment (QFD)

- Basics, the 4 phases model or the 4 "Houses of Quality" (HoQ)
- Understanding, advantages and benefits of QFD

4.2.5 QFD Procedure House of Quality (HoQ1)

- Product development process using QFD
- Structure and procedure HoQ1

4.2.6 Development scorecards

- Scorecards for Critical to Quality (CtQ), critical design parameters, process and software
- Scorecard in conjunction with HoQ and statistics

4.2.7 Decomposition

- System partitioning
- Functional network and FAST analysis

4.2.8 Decision-making for the concept / Pugh matrix

4.2.9 QFD-HoQ2 / QFD-HoQ3 Contexts

- Determination of critical design and process parameters
- Connection to the Design Scorecards

4.2.10 Design Review on Failure Mode (DRBFM)

- Technical risk reduction in product development
- Overview of FMEA and DRBFM

4.2.11 Measurement System Analysis (MSA) Introduction and application in design

- Continuous/attributive
- Resolution, accuracy, stability, P/T and %R&R
- MSA in design

4.2.12 Transfer functions

- Introduction and connection to QFD
- Determination of the transfer functions

4.2.13 Introduction to boundary and parameter diagrams

- Definition of system interfaces and their interactions
- Identification of noise variables

4.2.14 Introduction to DoE (Design of Experiments)

- Components, validity and creation of 2k factorial experimental designs
- Analysis and conclusions

4.2.15 Parameter optimization / simulation

- Estimation of the expected capability of a system/product
- Optimization of the capability by changing parameter settings

4.2.16 Robust designs

- Derive the influences, determine functional chains
- Optimisation in the direction of robustness

4.2.17 Tolerance calculation methods

- Smallest/largest dimension analysis (worst case design)
- Statistical tolerance analysis according to RSS and 6 Sigma design

4.2.18 Introduction to reliability analyses

- Basics, system planning and requirements definition
- Weibull analysis

4.2.19 Triz introduction

- Introduction and innovation rules
- Contradiction matrix

4.2.20 Application of methods Practical examples/exercises

5 Training content, project phase-orientated

5.1 DEFINE (D)

- Definition of project team (disciplines) and scope (project scope)
- Definition of timetable/schedule
- Definition and implementation of project charter DFSS per candidate
- Definition and coordination of project focus
- Coordination & communication of the project boundaries
- Definition of quality gates and quality gates content

5.2 IDENTIFY (I)

- Requirements analysis according to KANO
- Pairwise comparison and priority development requirements
- Creation of House of Quality -1
- Decomposition system level (hierarchical & functional)
- Creation of design scorecard performance (performance criteria)
- Concept selection (Pugh matrix)
- Definition/creation of system-FMEA

5.3 CHARACTERIZE (C)

- House of Quality -2 critical design parameters
- Creation of design scorecard parts (parts incl. tolerances)
- Creation of production process flow chart
- House of Quality -3 Process parameters
- Boundary and parameter diagram
- Creation of design scorecard process
- Design FMEA, Process FMEA, Design Review on Failure Mode (DRBFM)
- Measurement capability of the factors product + process

- Measurement system analysis (MSA)
- Determination of transfer functions (formula/regression analysis/DoE)
- Manufacturability (Design for Manufacturing and Assembly)

5.4 OPTIMIZE (O)

- Regression analyses of product and process factors
- Analyses of variance (ANOVA) of the product and process factors
- Parameter optimization, EVA expected value analysis
- Robust design optimization

5.5 VERIFY (V)

- Robustness checklist (RRCL)
- Verification of the design (validation tests)
- Capability determination
- Tolerance check
- Documentation

6 Recommended additional qualification

In addition to our social environment, digitalisation is also changing the way we communicate and work. The decisive value of digitalisation does not lie in the increase in convenience and efficiency, the improved use of resources, environmental protection or process optimisation. Rather, it lies in the enormous gain in transparency and data, which makes it possible to initiate and automate the process of learning and continuous improvement and take it to a new level.

The opportunities and challenges arising from digitalisation have long since found their way into Six Sigma. Not only is more data from an increasing number of sources of varying quality available in an ever-shorter time, but the possibilities for process optimisation and control have also expanded. The ESSC-D working group "Six Sigma Thinking Ahead" has gathered well-founded cross-industry experience, put the Six Sigma toolbox to the test and added essential tools for the future-proof belt and all those interested in quality management in the age of digitalisation and big data.

These include, among others:

- Different project management methods
- Preparation of structured and unstructured data as well as large amounts of data
- Visualisation options for complex data structures
- common methods of data science (or data mining)
- Possibilities and limits of artificial intelligence (AI) and machine learning (ML)
- Application and use of developed correlation models

Further information and recommended training depths can be found in detail here:
https://www.sixsigmaclub.de/download/ESSCD_QualityGuideLine_DM_Aufbaukurs_DE.pdf

"Learning is like rowing against the current. If you stop, you drift backwards."
(Laozi, Chinese philosopher, 6th century BC)