

# Lean Six Sigma Principles - Green Belt

GoSkills online course syllabus

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**Skill level**

Intermediate

**Lessons**

63

**Accredited by**

CPD

**Pre-requisites**

[Yellow Belt](#)

**Video duration**

6h 12m

**Estimated study time**

31h 30m for all materials

**Instructor**

Ray Sheen

## Overview and Background

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### History of Continuous Improvement

Lean Six Sigma is a proven business process improvement methodology that builds on the best practices and experiences of earlier approaches. It combines best practices around customer focus, empowered teams, process definition, and data analysis.

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### Six Sigma Principles

The Six Sigma methodology seeks to reduce and ultimately eliminate variation within a process. It applies a five-phase project management approach and uses the standard deviation (sigma) as the controlling attribute for the process.

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### Lean Principles

The Lean methodology seeks to reduce and ultimately eliminate waste within a process. It applies a five part approach and uses flow control as the optimizing principle for the process.

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### Lean and Six Sigma

Lean and Six Sigma are easily blended. They have many similarities in methodology – process focused, team based, and project management. The differences, analyzing quality data versus flow data, are complementary and together provide a balanced view of the process.

## Certification

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### IASSC Testing Approach

The International Association of Six Sigma Certification is a recognized international body that certifies Lean Six Sigma Yellow, Green, and Black Belts. The online application process is straightforward.

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### IASSC Green Belt

The IASSC Green Belt certification is appropriate for a Lean Six Sigma project leader. The Green Belt Body of Knowledge is the list of topics and tools that a Green Belt practitioner should know.

## Lean Six Sigma Project

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## 7 Roles and Responsibilities

The Lean Six Sigma methodology has defined roles of Yellow Belt, Green Belt, Black Belt and Master Black Belt with respect to project leadership and execution.

## 8 Project Phases

The Lean Six Sigma methodology relies on a five-phased project management methodology. The phases Define, Measure, Analyze, Improve, and Control provide structure to the project.

## 9 Project Deliverables

The Lean Six Sigma methodology has defined a set of deliverables that should be prepared during each of the five project phases. These deliverables will guide a project team through the improvement process in an orderly and logical manner.

## 10 Project Charter & Business Case

The Lean Six Sigma methodology encourages the use of a project charter and the creation of a business case to set boundaries on the project and to manage stakeholder expectations.

## 11 Project Reviews

The Lean Six Sigma methodology involves stakeholders through a set of project reviews. Each type of review has a goal and purpose.

# Lean Six Sigma Fundamentals

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## 12 Critical To Quality (CTQ)

Lean Six Sigma relies on the use of Critical to Quality (CTQ) characteristics. These are the attributes that will be used to measure success or failure of the project.

## 13 Variation

Variation leads to uncertainty in process performance which requires extra management and buffers elsewhere in the business environment. One of the primary goals of a Lean Six Sigma project is to identify sources of variation in process performance and eliminating or reducing those sources of variation.

## 14 Elements of Waste

Waste can take many forms including high costs, delayed timing, rework, redundant work and idle processes. One of the primary goals of a Lean Six Sigma project is to identify areas of process waste and eliminating or reducing those sources of waste.

## 15 $Y=F(x)$

Lean Six Sigma projects strive to characterize project performance through the creation of a process formula. This formula allows the team to predict and optimize process performance.

## 16 Process Management

Lean Six Sigma analysis considers process level performance. For this reason it is necessary to understand the complete process – both the process steps and the process flow.

## 17 Lean Six Sigma Metrics

Lean Six Sigma has introduced some new metrics into the common business vocabulary including process sigma, DPMO, cycle time and value-added effort.

# Define Phase

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## 18 Project Selection

One of the decisions that must be made during the Define Phase is the selection of the project and its boundaries. Lean Six Sigma projects are often part of a portfolio of projects that may be selected and approved as a bundle.

## 19 Pareto Principle

The Pareto principle is a widely accepted technique for prioritizing effort and activity. The Pareto principle will typically be applied in every phase of a Lean Six Sigma project, including this initial Define phase where it is used to prioritize the areas of focus for the project.

## 20 Voice of the Customer

Lean Six Sigma methodology is grounded on the voice of the customer. The Define phase collects and assesses information concerning the customer perspective and uses it to focus the project activities.

## 21 Cost of Poor Quality (COPQ)

Lean Six Sigma is a problem solving methodology. As such, one of the ways of quantifying the opportunity for improvement is through an aggregation of the costs associated with that problem. This is known as the Cost of Poor Quality and provides insight on the project benefit.

## 22 Process Mapping

In order to improve process performance, the Lean Six Sigma project team must understand the current state of the process. Process Mapping is the technique for describing the process and providing a framework for collecting process data.

## 23 Lean Value

Lean Six Sigma projects apply the Lean principle of value-added effort in the definition of the project and when identifying the opportunity for improvement.

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# Measure Phase

## 24 Problem Statement

The problem statement clarifies the goals and activities of the Lean Six Sigma project by specifying the issue to be resolved. It's an excellent communication tool for the team to use with stakeholders.

## 25 Problem Definition Tools

There are numerous tools to assist the Lean Six Sigma team in the creation of the problem statement. Different tools work better in different applications, but all of them help the Lean Six Sigma team focus on the root cause problems and not chase symptoms.

## 26 Data Types

There are two types of data: variable and attribute. Both types are useful in measuring process performance by analyzing process problems, but they need to be treated differently.

## 27 Measurement Systems

The collection of data assumes that there is a measurement system used to measure and record the data. It is important to understand the characteristics of the measurement systems so that the Lean Six Sigma team will know how far they can trust the data.

## 28 Measurement Errors

All measurement systems introduce an element of error into the measured value. There are techniques for determining the magnitude of that error and thereby determining if a different measurement system needs to be used.

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### X/Y Matrix

The X/Y matrix is a tool that maps the Voice of Customer needs and concerns onto the process steps and inputs. This tool can take on several different formats, but any of them will provide the Lean Six Sigma team with insight as to the contributing factors of customer value.

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### FMEA Principles

The Failure Mode Effects Analysis (FMEA) tool highlights areas of high product design or process execution risk. This tool provides insight into possible causes for observed failures.

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### Value Stream Mapping

Value stream mapping is the Lean process mapping technique. With this map, the Lean Six Sigma team will know which steps are directly contributing to delivering the customer value aspects of the process. It also provides the foundation for deeper flow analysis.

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### Value Stream Map Data Box

The Value Stream Map Data Box is the technique used to capture and analyze data at each step of the Value Stream Map.

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### As-is Metrics

The As-is metrics are the measured current state of the process or problem. It is not the best-case, the worst-case, or the “as-designed” case; it is the current average performance of the process or problem.

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### Data Collection

The purpose of the Measure phase of a Lean Six Sigma project is to collect complete, accurate and meaningful data. There is a simple data collection approach that can be used by the team to ensure this is accomplished.

## Basic Six Sigma Statistics

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### Descriptive Statistics

Lean Six Sigma methodology relies heavily on statistical analysis of problems and solutions. A single data point is not sufficient, rather a collection of data is needed for analysis. This collection will have some natural variability within it and descriptive statistics explain the boundaries of that variability.

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### Normal Distribution

The normal distribution charts the type of variability in a process parameter that is being measured when the only cause for variation is natural random physical effects. It's the desired distribution when improving a process since it delivers a predictable level of process performance.

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### Basic Graphical Analysis

When considering a distribution of data values for a process attribute, a graph of that data can be very insightful. The picture is often easier for team members to understand than a statistical description of the data distribution. This picture will often point the team to the process problem.

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### Graphing of Complex Data

When the process or problem data set has multiple characteristics, there are a set of graphing techniques that can show these effects. Although more complex than the basic techniques, they are easy to use and create a picture of the data set.

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### Process Stability

A stable process is one in which only random variation exists. A Lean Six Sigma team must eliminate sources of instability before attempting to improve the normal process performance.

- 40 Run Chart**  
The run chart is the most common chart of process data. It is easy to create and maintain and gives the process operators immediate insight when a process becomes unstable.
- 41 Process Capability Principles**  
Process capability is the statistical analysis conducted to determine if a process that is performing with only the normal process variation can be expected to meet the customer expectations at all time.
- 42 Z Scores**  
Z scores are a method of normalizing data from different data sets for comparison or prediction. Z scores normalize the data using the process standard deviation. The Z transformation table will convert Z scores into percentages.
- 43 Central Limit Theorem**  
The Central Limit Theorem is a principle that is used to transform non-normal raw data into a data set that is normal.

## Analyze Phase

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- 44 Problem Analysis**  
Problem analysis is the methodical approach to analyzing a problem and finding the root cause or causes. It normally includes creating and testing an hypothesis or an experiment to determine the cause.
- 45 Statistical Analysis**  
Statistical tests are often used to aid the problem analysis. The statistical analysis of a small sample of data can point to root causes of problems in the full data set.
- 46 Visual Analysis**  
Graphical analysis techniques are particularly good for illustrating significance, similarities or differences, and correlation between parameters within a data set.
- 47 Lean Flow Analysis**  
The Lean process analysis will reveal flow process flow problems. Lean techniques can be used to analyze flow at both a total process (macro) level or at a process step (micro) level.
- 48 Lean Quality Analysis**  
The process analysis of the value stream map will reveal quality issues that are occurring within process steps. These are identified by analyzing step data and process flow data.
- 49 Lean Resource Analysis**  
Analysis of the Lean value stream map and the related data can reveal wasted resources; both people and product or service items that are being processed.

## Improve Phase

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- 50 Problem Improvement**  
Problem solving often requires an interim solution while a permanent solution is being developed and validated. When multiple possible solutions are available, the team should recommend a solution approach.

- 51 Solving Special Cause & Common Cause Problems**  
Special cause problems should be resolved first in order to achieve process stability. Then common cause problems are addressed to reduce process variation.
- 52 Intro to Design of Experiments**  
Design of Experiments (DOE) is an experimental technique for identifying the primary factors within a system that determine system performance. DOE is particularly useful in complex systems where there are interactions between factors and relationships are not obvious.
- 53 Lean Improvement: Flow**  
Lean process improvements are designed using a “should be” value stream map that shows the new flow. The data box on this map estimates the impact of the elimination and redesign of process steps and the removal of system constraints.
- 54 Lean Improvement: Pull**  
The benefits of Lean improvements rely on changing the process schedule management approach in addition to process redesign. Pull scheduling and visual management are used to maintain smooth flow in the process.
- 55 Solving Problems with Poka Yoke**  
Many problems can be solved using mistake proofing approaches that are embodied in the five Poka Yoke principles that both detect and prevent errors from occurring.
- 56 Solving Problems with Five S Principles**  
The Five S principles can be used to organize the work place and support and sustain the problem solutions by reducing the likelihood of confusion and rapidly exposing process degradation.

## Control Phase

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- 57 Cost - Benefit Analysis**  
The proof that the Lean Six Sigma team’s solution will be found in the measured change in the process performance. The benefit analysis quantifies this change and translates it into business terms if necessary.
- 58 Control Plan**  
It is hard to make a permanent change to a process. People and systems have a tendency to drift back to the old way of doing things. The control plan provides guidance on how to maintain control of the new process and the measurements that will show the process deviating from the new approach.
- 59 Response Plan**  
A key element of the control plan is the response plan. It tells the process operators what to do when the process begins to deviate from the parameters laid out in the control plan.
- 60 Prevention as Control**  
One of the best techniques for controlling a process to perform in a particular manner is to prevent it from performing in any other manner. There are methodologies that can be used to create prevention of process problems, Poky Yoke and Five S Disciplines.
- 61 Lean Process Control**  
Lean process control focuses on maintaining the process flow of the Should-Be process. It relies on principles of visual control, empowerment, and continuous improvement.

## 62 Statistical Process Control

Statistical process control uses real-time process data to determine whether a process is maintaining the improvements that were implemented. Control charts will indicate special cause and common cause variation, empowering process operators to maintain process quality.

## 63 Implementing the Solution

Implementing the technical changes of the solution are often easy, the difficulty is usually the emotional and cultural resistance to change. The implementation should be planned and managed as a project. The project should include the actions taken to change the business systems and structures in addition to the specific problem solution.

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