CHAPTER 1

Fundamentals of Six Sigma

LEARNING OBJECTIVES

After reading this chapter, you will be able to

- Know what the acronym DMAIC stands for.
- Understand the difference between the role of a Six Sigma green belt, black belt, and master black belt.
- Understand the role of statistics in Six Sigma management.

INTRODUCTION

Six Sigma management is a quality improvement system originally developed by Motorola in the mid-1980s. Six Sigma offers a prescriptive and systematic approach to quality improvement and places a great deal of emphasis on accountability and bottom-line results. Many companies all over the world use Six Sigma management to improve efficiency, cut costs, eliminate defects, and reduce product variation.

1.1 WHAT IS SIX SIGMA?

The name Six Sigma comes from the fact that it is a managerial approach designed to create processes that result in no more than 3.4 defects per million. One of the aspects that distinguishes Six Sigma from other approaches is a clear focus on achieving bottom-line results in a relatively short three- to six-month period of time. After seeing the huge financial successes at Motorola, GE, and other early adopters of Six Sigma management, many companies worldwide have now instituted Six Sigma management programs [see References 1, 2, 3, and 5].

The DMAIC Model

To guide managers in their task of improving short- and long-term results, Six Sigma uses a five-step process known as the **DMAIC model**, named for the five steps in the process: **D**efine, **M**easure, **A**nalyze, **I**mprove, and **C**ontrol.

- **Define.** The problem is defined along with the costs, benefits, and impact on the customer.
- **Measure.** Operational definitions for each **critical-to-quality** (**CTQ**) characteristic are developed. In addition, the measurement procedure is verified so that it is consistent over repeated measurements.
- **Analyze.** The root causes of *why* defects occur are determined, and variables in the process causing the defects are identified. Data are collected to determine benchmark values for each process variable.
- **Improve.** The importance of each process variable on the CTQ characteristic are studied using designed experiments (see Chapter 8, "Design of Experiments"). The objective is to determine the best level for each variable.
- **Control.** The objective is to maintain the benefits for the long term by avoiding potential problems that can occur when a process is changed.

1.2 ROLES IN A SIX SIGMA ORGANIZATION

The roles of senior executive (CEO or president), executive committee, champion, process owner, master black belt, black belt, and green belt are critical to the Six Sigma management process.

The **senior executive** provides the impetus, direction, and alignment necessary for Six Sigma's ultimate success. The most successful, highly publicized Six Sigma efforts have all had unwavering, clear, and committed leadership from top management. Although it may be possible to initiate Six Sigma concepts and processes at lower levels, dramatic success will not be possible until the senior executive becomes engaged and takes a leadership role.

The members of the **executive committee** are the top management of an organization. They should operate at the same level of commitment for Six Sigma management as the senior executive.

Champions take a very active sponsorship and leadership role in conducting and implementing Six Sigma projects. They work closely with the executive committee, the black belt assigned to their project, and the master black belt overseeing their project. A champion should be a member of the executive committee or at least a trusted direct report of a member of the executive committee. He or she should have enough influence to remove obstacles or provide resources without having to go higher in the organization.

A **process owner** is the manager of a process. He or she has responsibility for the process and has the authority to change the process on his or her signature. The process owner should be identified and involved immediately in all Six Sigma projects relating to his or her own area.

Master Black Belt

A **master black belt** takes on a leadership role as keeper of the Six Sigma process and advisor to senior executives or business unit managers. He or she must leverage his or her skills with projects that are led by black belts and green belts. Frequently, master black belts report directly to senior executives or business unit managers. A master black belt has successfully led many teams through complex Six Sigma projects. He or she is a proven change agent, leader, facilitator, and technical expert in Six Sigma management. It is always best for an organization to develop its own master black belts. However, sometimes it is impossible for an organization to develop its own master black belts because of the lead time required to become a master black belt. Thus, circumstances sometimes require hiring master black belts from outside the organization.

Black Belt

A **black belt** is a full-time change agent and improvement leader who may not be an expert in the process under study [see Reference 4]. A black belt is a quality professional who is mentored by a master black belt, but who may report to a manager for his or her tour of duty as a black belt.

Green Belt

A **green belt** is an individual who works on projects part-time (25%), either as a team member for complex projects or as a project leader for simpler projects. Most managers in a mature Six Sigma organization are green belts. Green belt certification is a critical prerequisite for advancement into upper management in a Six Sigma organization.

Green belts leading simpler projects have the following responsibilities:

- Refine a project charter for the project.
- Review the project charter with the project's champion.
- Select the team members for the project.
- Communicate with the champion, master black belt, black belt, and process owner throughout all stages of the project.
- Facilitate the team through all phases of the project.
- Schedule meetings and coordinate logistics.
- Analyze data through all phases of the project.
- Train team members in the basic tools and methods through all phases of the project.

In complicated Six Sigma projects, green belts work closely with the team leader (black belt) to keep the team functioning and progressing through the various stages of the Six Sigma project.

1.3 STATISTICS AND SIX SIGMA

Many Six Sigma tools and methods involve *statistics*. What exactly is meant by statistics, and why is statistics such an integral part of Six Sigma management? To understand the importance of statistics for improving quality, you can go back to a famous 1925 quote of Walter Shewhart, widely considered to be the father of quality control:

> The long-range contribution of statistics depends not so much upon getting a lot of highly trained statisticians into industry as it does in creating a statistically minded generation of physicists, chemists, engineers, and others who will in any way have a hand in developing and directing the production processes of tomorrow.

This quote is just as valid today as it was more than 75 years ago. The goal of this book is *not* to make you a statistician. The goal is to enable you to learn enough so that you will be able to use the statistical methods that are involved in each phase of the DMAIC model. Using Minitab and/or JMP statistical software will help you achieve this goal while at the same time minimize your need for formulas and computations.

Table 1.1 summarizes the statistical methods that are commonly used in the various phases of the DMAIC model.

TABLE 1.1 Phases of the DMAIC Model, Statistical Methods Used, and Chapters in This Book

Phase of DMAIC Model	Statistical Methods	Chapters
Define	Tables and Charts	3
	Descriptive Statistics	4
	Statistical Process Control Charts	11
Measure	Tables and Charts	3
	Descriptive Statistics	4
	Normal Distribution	5
	Analysis of Variance	6, 7, 8
	Statistical Process Control Charts	11
Analyze	Tables and Charts	3
	Descriptive Statistics	4
	Analysis of Variance	6, 7, 8
	Regression Analysis	9, 10
	Statistical Process Control Charts	11
Improve	Tables and Charts	3
	Descriptive Statistics	4
	Analysis of Variance	6, 7, 8
	Regression Analysis	9, 10
	Design of Experiments	8
Control	Statistical Process Control Charts	11

1.4 LEARNING STATISTICS FOR SIX SIGMA USING THIS BOOK

This book assumes no previous knowledge of statistics. Perhaps you may have taken a previous course in statistics. Most likely, such a course focused on computing results using statistical formulas. If that was the case, you will find the approach in this book very different. This book provides the following approach:

- **Provides a simple nonmathematical presentation of topics.** Every concept is explained in plain English with a minimum of mathematical symbols. Most of the equations are separated into optional boxes that complement the main material.

- **Covers statistical topics by focusing on the interpretation of output generated by the Minitab and JMP software.**
- **Includes chapter-ending appendices that provide step-by-step instructions (with screenshots of dialog boxes) for using Minitab Version 14 and JMP Version 6 for the statistical topics covered in the chapter.**
- **Provides step-by-step instructions using worked-out examples for each statistical method covered.**

SUMMARY

Six Sigma management is used by many companies around the world. Six Sigma uses the DMAIC model that contains five phases: Define, Measure, Analyze, Improve, and Control. Many different roles are important in a Six Sigma organization. Statistics is an important ingredient in such an organization. The purpose of this book is to enable you to learn enough so that you will be able to use statistical methods as an integral part of Six Sigma management.

REFERENCES

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