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Instructor's Manual and Transparency Masters
to accompany

Six Sigma

Basic Tools and Techniques

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**Six Sigma:
Basic Tools and Techniques**

Donna C.S. Summers

Answers to Selected Chapter Questions

Chapter 1 Questions

1.1 Describe the Six Sigma methodology to someone who has not heard of it.

Six Sigma projects have eight essential phases: recognize, define, measure, analyze, improve, control, standardize, and integrate. This cycle is sometimes expressed as DMAIC (define, measure, analyze, improve and control). As The tools utilized during a project include statistical process control techniques, customer input, Failure Modes and Effects Analysis, Design of Experiments, process mapping, cause and effect diagrams, multivariate analysis, pre-control, design for manufacturability. Six Sigma also places a heavy reliance on graphical methods for analysis. Statistical methods, teamwork, and project management are key components of Six Sigma.

1.2 What do Six Sigma projects focus on? Why?

Essentially, Six Sigma is about results, enhancing profitability through improved quality and efficiency. Improvement projects are chosen based on their ability to contribute to the bottom line on a company's income statement by being connected to the strategic objectives and goals of the corporation. Projects that do not directly tie to customer issues or financial results are often difficult to sell to management. Six Sigma projects are easy to identify, since the Six Sigma methodology seeks to reduce the variability present in processes, project teams seek out sources of waste, such as overtime and warranty claims, investigate production backlogs or areas in need of more capacity, and focus on customer and environmental issues.

1.3 Describe the changes that occur to the spread of the process when the amount of variation in the process decreases.

When the amount of variation decreases, whatever is being produced or whatever service is being provided becomes more homogeneous. Each product or service becomes more similar to the one previous and the one following. By removing the variation present in the process, Six Sigma organizations narrow the spread of the process. This enables the products produced or the services provided to more easily meet the specifications placed on them by the customer.

1.4 What are the benefits of implementing the Six Sigma methodology?

An organization that implements the Six Sigma methodology is better able to produce more products and services with its existing resources through an improved customer focus and streamlined work processes. With its increased awareness of its internal and external customers, there is a greater focus on what really needs to be accomplished in order to meet their customers' needs and expectations, therefore increasing their profitability through increased customer retention. Being able to meet customer expectations the first time and

every time will enable the organization to increase its market share as new customers seek them out. Six Sigma organizations seek out sources of waste in the process. They focus on reducing the variability present in the process. Since a Six Sigma organization has focused and streamlined its work processes they will benefit from lower costs because of reduced waste and rework. One of the major savings that occurs is fewer customer complaints and warranty claims. More satisfied customers results in greater market share.

1.5 Why would a company want to follow the Six Sigma methodology?

Following the Six Sigma methodology enables organizations to capture more market share. This is due to their focus on the key processes that provide the organization's customers with valuable products or services. A Six Sigma organization looks at how they do business from all perspectives, from manufacturing, marketing, information technology, to research and development. Six Sigma organizations strive to provide value for their customers by adhering to a customer-centered philosophy that includes paying attention to organizational, strategic, environmental, and people factors. Following the Six Sigma methodology enables an organization to remain competitive in a changing, challenging business environment.

1.6 Describe what it takes to become a green belt.

Green belts are individuals who have completed a designated number of hours of training in the Six Sigma methodology (Figure 1.1). They must also complete a cost-savings project of a specified size, often \$10,000, within a stipulated amount of time.

1.7 What does a person need to do to become a black belt?

Having achieved green belt status, black belt status may be achieved by continuing training and education in the Six Sigma methodology (Figure 1.2). Black belts must complete a specified number of successful projects, often resulting in a savings of \$100,000 or more.

1.8 Describe the difference between a black belt and a master black belt.

Master black belt status can only be achieved by individuals with extensive training. These individuals have an in-depth understanding of design of experiments, regression analysis, and statistics. They also have training in project management. Many organizations require that the person have a master's degree from an accredited university. Master black belts have also completed several large scale improvement projects, often resulting in a savings of \$1,000,000 or more.

1.9 How do green belts, black belts, and master black belts interact when working on projects?

Responsibilities for the successful completion of a project are shared among green belts, black belts, and master black belts (Figure 1.3). Leadership on the project is the responsibility of the master black belt. The master black belt may also provide additional training or guidance to both green and black belts.

1.10 How does the Six Sigma methodology compare with the continuous improvement methodology?

One of the biggest differences between the two is Six Sigma's focus on results. Six Sigma projects are selected based on what they can contribute to the financial health of the organization. Continuous improvement methodologies focus on the organizations overall commitment to quality. Both seek to reduce variability through process improvement. See Table 1.2.

Chapter 2 Questions

2.1 Why is an organizational philosophy focusing on delighting customers key to organizational success?

Customers are the reason an organization is in business. An organization is always seeking to keep the customers they have and gain new customers. In order to do this consistently, effective organizations must focus on creating successful, satisfied customers each time an interaction occurs.

2.2 Use Dr. Feigenbaum's definition of quality as a guide and describe an experience you have had with a product or service.

For example:

Customer determination: replacement muffler is new, not used, that it is needed.

Actual experience: does the muffler muffle? Service?

Requirements: Service at time of replacement? On time? As promised?

Technically operational: does the muffler fit the car?

Entirely subjective: cleanliness of shop? Courtesy of service people?

Or

Customer determination: clean clothing from dry cleaner meets the expectations of customer?

Actual experience: Does the clothing feel, smell, look clean before wearing?

Requirements: clean, pressed clothing

Technically operational: clean, pressed, no damage

Entirely subjective: does the clothing look, smell, feel good?

2.3 Describe in your own words, the two types of variation that Shewhart identified.

Controlled variation (common causes) is variation present in a process due to the very nature of the process. This type of variation can be removed from the process only by changing the process. For example, consider a person who has driven the same route to work dozens of times and determined that it takes about 20 minutes to get from home to work regardless of minor changes in weather or traffic conditions. If this is the case, then the only way the person can improve upon this time is to change the process by finding a new route.

Uncontrolled variation (special or assignable causes) comes from sources external to the process. This type of variation is not normally part of the process. It can be identified and isolated as the cause of the change in the behavior of the process. For instance, the commuter describe above would experience

uncontrolled variation if a major traffic accident stopped traffic or a blizzard made traveling nearly impossible.

2.6 How do Dr. Deming's 14 points interact with each other?

Deming's fourteen points describe an overall change in management and organizational philosophy. Each of the points focuses on a weakness in companies that needs to be overcome in order to improve organizational effectiveness. The points support overall systems improvement, the creation of non-faulty systems.

2.7 How are the teachings of each of the people in this chapter similar? Where do they agree?

Deming, Feigenbaum, and Shewhart encourage organizations to:

- determine who their customers are
- determine the key critical success factors for meeting their customers' needs, requirements and expectations
- establish effective processes that enable them to provide products and services that meet their customers' needs, requirements and expectations
- focus on process measurement and improvement
- provide the management involvement and commitment required for organizational success.

2.8 How are the teachings of each of the people in this chapter different? Where do they disagree?

Deming, Feigenbaum, and Shewhart discuss different ways of reaching the goals. Deming focuses primarily on leadership efforts and management commitment and involvement. Deming provides management with his 14 points to use as guides. Shewhart concentrated on quality improvement through reduction in variation. Their definitions of quality are different too. Feigenbaum's definition is more complete (see text). Like Feigenbaum, Shewhart focuses on two aspects of quality: subjective and objective. Deming focuses on non-faulty systems.

2.9 Describe Taguchi's Loss Function. What was he trying to get company leaders to think about?

Taguchi tried to get company leaders to think about finding ways to improve the performance consistency of processes. Process improvements can be made by reducing variation through defining key process variables and experimenting with their levels. His loss function introduces the concept that quality, or the lack of it, is a loss to society. Any deviation from target specifications causes loss, even if the variation is within specifications.

2.10 How do the teachings of the people in this chapter relate to Six Sigma?

Six Sigma is a philosophy that an organization implements in order to be able to produce more products and services with its existing resources through an improved customer focus and streamlined work processes. The men in this chapter encourage organizations to increase their awareness of its internal and external customers. They all encourage a greater focus on what really needs to be accomplished in order to meet their customers' needs and expectations, therefore increasing their profitability through increased customer retention. They also stress that management involvement is critical to the success of any improvement projects. All men realize that process improvement comes through the reduction of variation through study of key process variables. The use of statistical process control techniques is critical to support process improvement.