Chapter 2

The DMAIC Process

LEARNING OBJECTIVES

After completing this chapter you should be able to:

1. Understand the importance of selecting good projects for improvement activities
2. Explain the five steps of DMAIC: Define, Measure, Analyze, Improve, and Control
3. Explain the purpose of tollgate reviews
4. Understand the decision-making requirements of the tollgate review for each DMAIC step
5. Know when and when not to use DMAIC
6. Understand how DMAIC fits into the framework of the Six Sigma philosophy

IMPORTANT TERMS AND CONCEPTS

Analyze step
Control step
Define step
Design for Six Sigma (DFSS)
DMAIC
Failure modes and effects analysis (FMEA)
Improve step
Key process input variables (KPIV)
Key process output variables (KPOV)
Measure step
Project charter
SIPOC diagram
Six Sigma
Tollgate

EXERCISES

2.7. Explain the importance of tollgates in the DMAIC process.

At a tollgate, a project team presents its work to managers and “owners” of the process. In a six-sigma organization, the tollgate participants also would include the project champion, master black belts, and other black belts not working directly on the project. Tollgates are where the project is reviewed to ensure that it is on track and they provide a continuing opportunity to evaluate whether the team can successfully complete the project on schedule. Tollgates also present an opportunity to provide guidance regarding the use of specific technical tools and other information about the problem. Organization problems and other barriers to success—and strategies for dealing with them—also often are identified during tollgate reviews. Tollgates are critical to the overall problem-solving process; It is important that these reviews be conducted very soon after the team completes each step.

2.11. Suppose that your business is operating at the three-sigma quality level. If projects have an average improvement rate of 50% annually, how many years will it take to achieve Six Sigma quality?

$$3.4 = 66{,}810(1-0.5)^x$$
$$3.4/66{,}810 = 0.5^x$$
$$\ln(3.4/66{,}810) = x\ln 0.5$$
$$x = \frac{\ln(3.4/66{,}810)}{\ln 0.5} = 14.26 \text{ years} \approx 14 \text{ years, 3 months}$$

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2.12. Suppose that your business is operating at the 4.5-sigma quality level. If projects have an average improvement rate of 50% annually, how many years will it take to achieve Six Sigma quality?

$$3.4 = 1350(1-0.5)^x$$
$$3.4/1350 = 0.5^x$$
$$\ln(3.4/1350) = x\ln 0.5$$
$$x = \frac{\ln(3.4/1350)}{\ln 0.5} = 8.63 \text{ years} \approx 8 \text{ years, 8 months}$$

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2.13. Explain why it is important to separate sources of variability into special or assignable causes and common or chance causes.

Common or chance causes are due to the inherent variability in the system and cannot generally be controlled. Special or assignable causes can be discovered and removed, thus reducing the variability in the overall system. It is important to distinguish between the two types of variability, because the strategy to reduce variability depends on the source. Chance cause variability can only be removed by changing the system, while assignable cause variability can be addressed by finding and eliminating the assignable causes.

2.15. Suppose that during the analyze phase an obvious solution is discovered. Should that solution be immediately implemented and the remaining steps of DMAIC abandoned? Discuss your answer.

Generally, no. The advantage of completing the rest of the DMAIC process is that the solution will be documented, tested, and it's applicability to other parts of the business will be evaluated. An immediate implementation of an "obvious" solution may not lead to an appropriate control plan. Completing the rest of DMAIC can also lead to further refinements and improvements to the solution.

2.18. It has been estimated that safe aircraft carrier landings operate at about the 5σ level. What level of ppm defective does this imply?

If the operating limits are around the 5σ level, and we assume the 1.5σ shift in the mean customary for Six Sigma applications, then the probability of a safe landing is the area under the normal curve that is within 5σ of the target mean, given that the true mean is 1.5σ off of the target mean. Thus, the probability of a safe landing is 0.999767 and the corresponding ppm defective is $(1 - 0.999767) \times 1{,}000{,}000 = 233$.
