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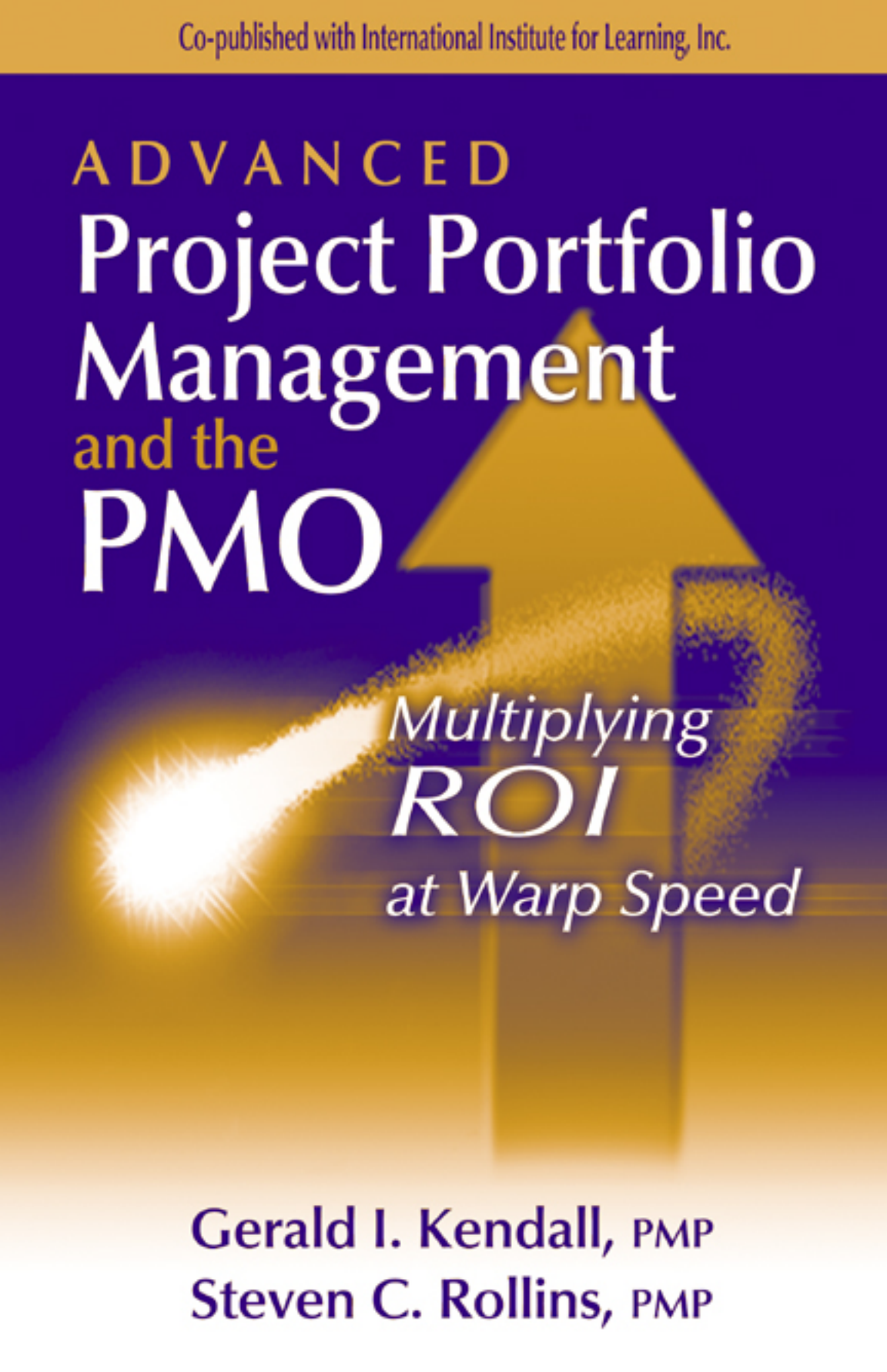

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6

APPLYING DEMING, GOLDRATT, AND SIX SIGMA TO SYSTEMS THINKING

HOLISTIC THINKING

When conducting strategic planning, why make the same huge mistakes others have made? A smart person learns from his mistakes. A wise person learns from other people's mistakes. There are two great geniuses of modern times who have a great deal to teach about strategic planning and holistic thinking. W. Edwards Deming and Eliyahu M. Goldratt, working with many organizations and industries, discovered, firsthand, the underlying root problems causing so much customer dissatisfaction. They analyzed problems, verified the root causes and invented solutions that brought companies to be first in their industry worldwide. Today, their knowledge can be readily combined with other powerful holistic approaches, such as Six Sigma, to exponentially move an organization toward its goals.

Our point in including some of the work of these great, holistic thinkers in our text is that organizations today are burdened with far too many of the wrong projects, and not enough of the right projects. The combined thinking of Deming and Goldratt provides a remedy for this problem. Their holistic approach provides excellent clues that help us understand why some projects will be a complete waste of time and why others will make the situation worse, not better.

There are two common problems with many geniuses. The first problem is that no one can understand them. This is where the genius of Deming and Goldratt is different. They were both able to take their concepts and put them into terms that average people can understand.

The other problem with geniuses is that no one listens to them. Goldratt claims that out of everyone who tells him his analysis of situations is correct, only approximately 1% actually implement his proposed solutions. Why? Often, the answer lies in resistance to change. To the individual or group proposing a solution, the solution is so obvious that, in their minds, you would have to be stupid not to understand it. To another individual or group looking at the exact same situation, there is nothing obvious about it. In fact, the only thing obvious to the other individual is how dangerous or stupid the proposed solution is (for a variety of reasons).

Some of Goldratt's genius in the past few years has revolved around his work on buy-in and overcoming the layers of resistance to change. He realized that we only solve part of a problem when we correctly analyze it and come up with a solution. A major part of solving any problem is to communicate its characteristics in a way that gets buy-in — buy-in to the problem and buy-in to the solution.

SIX SIGMA

This methodology traces its origins to Motorola in the 1970s. Unlike the methodologies of Deming and Goldratt, Six Sigma has been popularized by Wall Street, with the comments of former GE CEO Jack Welch, and books and presentations by many others.

Six Sigma offers a way to achieve a quality breakthrough, in terms of reducing errors to parts per million. It does so by asking the right questions, measuring the correct values, and changing processes to prevent errors from occurring. Correctly applied, it is focused on what matters to a customer much more so than what matters internally.

BLENDING METHODOLOGIES

Sadly, we see people in organizations constantly fighting with each other over which methodology to use. Our message is that each of these methodologies, and others such as Lean, offers different angles toward a complete solution to project management problems. Combine the thinking of all of them, and an organization will begin to move towards its goals at warp speed. What has been missing in the approach to date is the umbrella under

which various methodologies can operate in harmony. We believe that the Theory of Constraints is such an umbrella.

In this chapter, we take a brief look at how the works of Deming and Goldratt converge in the project management arena. Each one contributed greatly to the problem analysis and solutions described below. We also offer our insights into where Six Sigma fits into this picture.

PROJECT MANAGEMENT — A SYSTEM OUT OF CONTROL

Consider any task estimate provided for a project task. A project is, by definition, a one-time effort — something that an organization has not performed before in exactly the same way.

For example, one of the large U.S. telephone companies has an IT group that implements and upgrades local area networks in each location in which the company operates. On the surface, this work might look like repetitive operational work rather than project work. But take a closer look. The following attributes of each local area network are very unique:

- Physical characteristics of each location, which impact ease of laying cable, electrical interference, etc.
- Expertise of people within the location, which impacts how long it will take to turn over local control, amount of training required, and acceptance of the new environment.
- Culture and expertise of the local workforce. For example, some new implementations are a result of a takeover, where the local workforce already had a perfectly good network. Imposing a different network means that the implementation team must overcome huge resistance to change.
- Responsiveness of local suppliers.
- Volume and transaction mix of local work.
- Specific software portfolio used.

Given these characteristics, some network implementations may require 3 days until the new environment is working to the complete satisfaction of the local management, while others may require several weeks.

If the manager of network services gives an estimate for implementing a new network, or for any one of the tasks involved in implementing a new network, we can predict one thing with almost 100% certainty. The estimate will be wrong. It may be too high or too low, but it will almost certainly vary.

In spite of all this uncertainty, in this organization each employee is held accountable for each task estimate he or she provides. Project managers manage employees to finish their tasks on time, according to their estimates.

Dr. W. Edwards Deming, the great quality guru of the 20th century, would probably be appalled at this practice. Dr. Deming described that there are two states for any system — ***in control*** **and** ***out of control*****. Out of control equates to unpredictable, while in control equates to predictable better than 95% of the time.**

Dr. Deming recognized that any system will move from one state to the other. Management's job is to keep the system in control. In order to have a system that is predictable better than 95% of the time, Deming taught managers to design processes that could distinguish between two types of "Murphy", or in his term, variation — common cause and special cause variation.

Common cause variation is an inherent part of any system. For example, in project work, common cause variation includes individual tasks taking longer to complete than the estimates. *Therefore, it is totally ludicrous to hold someone accountable for something that is unpredictable.*

Deming taught managers to not blame employees for common cause variation. He showed managers that when they interfere with common cause variation, they can easily throw the entire system into chaos. Managers must only intervene when they are dealing with special cause variation. *According to this philosophy, managers should say nothing when one task, by itself, takes longer to complete than its estimate (unless the variation itself is determined to be within the realm of special cause variation).*

Therefore, one vital skill of any manager is to be able to design a system where common cause variation can occur and the system can still meet its goals. A second essential management skill is to be able to distinguish between common and special cause variation in any system.

Deming's work was largely in the area of repetitive processes, such as those found in mass production. However, his thinking was extended by Dr. Goldratt and applied to the non-repetitive processes inherent in a project.

What is common and special cause variation in project management? What is common and special cause variation in strategic planning? We will provide some examples shortly. First, we will introduce a process that bridges Deming's and Goldratt's thinking.

DEMING AND GOLDRATT ON PROJECT MANAGEMENT — STEP 1

Every holistic approach has some common elements. A follower of Deming, Domenico Lepore, and a partner of Goldratt, Oded Cohen, got together and

wrote a book defining and explaining 10 steps to any improvement effort.* Step 1, the starting point for improving any system, is that there is a clearly stated and understood system's goal, with holistic measurements.

A system, by definition, consists of interdependent events. Therefore, the measurements of any system must be holistic in nature. The measurements must drive every individual to do what's best for the system as a whole, and not just for his or her local department or function. In our consulting work in strategic planning, often the most important project (and one that is almost always non-existent) is to align the measurement systems across the organization and eliminate all of the de-motivating measurements.

An individual project can be viewed as a system (or a subsystem within the entire collection of all projects of an organization). Goldratt suggests that the goal of a project is to deliver some tangible benefit to an organization. For most projects, the entire project or a major part of it must be completed in order to realize the benefit. Also, for most projects, the sooner the project is complete, the sooner the organization realizes the benefit.

Therefore, for most individual projects, the goal is the fastest successful execution of the project. Unfortunately, the measurements that exist often do not help this goal at all. For example, there are two measurements that often run counter to this goal:

- Finish tasks on time
- Cost reduction

In his book *Critical Chain*,** Goldratt describes how the common practice to hold people accountable to finish individual tasks according to their estimate leads people to inflate estimates or provide totally confusing estimates, masked by bad multi-tasking. In turn, these estimates lead to behaviors such as "Student Syndrome" and "Parkinson's Law," which guarantee that tasks and, therefore, projects will take longer to complete.

Task time estimates are just that — estimates. They are not deterministic (predetermined, exact) numbers. Therefore, Goldratt insists that "it is not important if any individual task finishes on time. The only thing that is important is that the project finishes on time (or early)."

A measurement focused on reducing project cost or budget, without considering the impact on the cycle time of the project, is not holistic. The

*See Oded Cohen and Domenico Lepore, *Deming and Goldratt, The Theory of Constraints and the System of Profound Knowledge*, The North River Press, Great Barrington, MA, 1999.

**Eliyahu M. Goldratt, *Critical Chain*, The North River Press, Great Barrington, MA, 1997.

fact that many project managers do focus so much effort on project cost can often be traced back to poor project definition, especially in identifying the benefits of the project. If many benefits are left as intangible, no wonder so many times project managers are rewarded primarily for meeting or beating their project budgets.

Every organization we visit has a collection of projects, often with common resources that work on more than one project at a time. We call this environment the multi-project environment. The goal of the multi-project environment is to satisfy the goals of the overall organization. This means that the collection of projects must be:

- the correct projects overall to meet the organization's strategic objectives
- implemented quickly — in time to meet competitive threats, real customer needs and shareholder expectations

There is one other important implication. The more projects an organization can flow to completion in a given time period with the same resources, the more successful they will become, assuming that these projects are the correct projects. By correct, we mean having a positive effect on the organization's goals.

In the multi-project environment, we also see measurements and practices that run counter to the goal of this bigger system. The measurements and practices we see include:

- Release new projects as soon as they are authorized, without regard to the capacity of the organization's strategic resources to do the projects. This measurement drives horrible multitasking of resources, increased cycle times of projects and logjams in the work.
- Keep everyone as busy as possible (bad multi-tasking).
- Frequently change priorities as crises occur or executives scream.

Deming would definitely call this a system that is out of control. We can tell because most organizations have less than 50% of the projects finishing on time, on budget and within scope.

DEMING AND GOLDRATT ON PROJECT MANAGEMENT — STEP 2

Once a system's goals are stated and the holistic measurements are in place, Deming claims that there must be a deep understanding of the system before you begin any improvement process. This is what Lepore and Cohen refer to as Step 2 in any improvement process.

We are witnesses to many PMOs that try to drive standardized project management methodology throughout their organizations. They often experience huge resistance from project managers, which may already be a sign that they have not achieved the deep understanding that comes from this step. Or, if they have such an understanding, they may not have agreement on the problem from the groups they are serving.

Goldratt suggests that the first layer of resistance to change is that people do not agree with you on the problem. This implies that people see the system and the interactions in the system differently. Goldratt further suggests that if we cannot communicate our intuition, then the only thing we can communicate is our own confusion.

To understand the project management system and the root problems, we must examine how projects are initiated. In many organizations, there is a formal system and an informal system. In many organizations, projects exist through the informal system. The informal system dramatically interferes with the work coming from the formal system.

Further, how are projects released into the system? How are resources allocated and how are resource conflicts dealt with? How are individual team members managed? Is there one system or many systems? Do executives link their strategic plan to all of the projects active within the organization? Are project benefits formally tracked and managers held accountable? How is reporting done? What other measurements and practices exist within each project team? Do team members also have some full time responsibilities? How do they prioritize their own work? Do project and resource managers always agree on priorities? If not, how are conflicts resolved?

The answers to these questions are the beginning of a deeper understanding of project management within any one organization. Only after we understand what drives human behavior on projects and how the dependencies within and between projects are handled, can we be successful in moving on to Step 3.

DEMING AND GOLDRATT ON PROJECT MANAGEMENT — STEP 3

Step 3 in the process of improving project management is to "make the system stable." This implies having a system in the first place, identifying how the system will distinguish between common and special cause variation, and getting the system to meet its goals more than 95% of the time. For projects, this means delivering on time, on budget and within scope more than 95% of the time.

Deming taught managers to recognize special cause variation through trends. He also taught managers that one statistic alone can be misleading. We find relatively few managers using Deming's concept of Statistical Process Control. Organizations that have implemented Critical Chain have seen that trend reports work beautifully as a predictive tool to give early warning to projects moving out of control.

In project management, there is a set of clearly identified processes. The Project Management Institute (PMI®) offers these processes and knowledge areas in a professional guide called the *Project Management Body of Knowledge (PMBOK®)*. This is an excellent start.

Some processes that are missing or only vaguely defined are the multi-project coordination and strategic processes, as outlined in this book. For example, the portfolio management, governance and prioritization processes must exist formally in any organization in order for project management to improve dramatically.

For project management, Goldratt offers a solution that is complementary to the PMBOK®.* This solution incorporates the principles of following trends to distinguish between common and special cause variation, but without the burden of becoming a statistician. He calls it *buffer management*. While buffer management is a later step in the process of ongoing improvement, the system must be set up in the first place to allow stability.

In making a system stable, Goldratt has the following advice: "When you find yourself in a hole, the first thing to do is to stop digging." In project management, this means stop measuring people in ways that drive behavior that is detrimental to the system's goal.

Statistical fluctuations and Murphy are a normal part of any task execution on a project. The main advice, at the outset of making a project management system stable, is that the system must allow for individual tasks to exceed estimates without causing the project deadline to be blown. One example of special cause variation might be when three or more tasks in a row exceed estimates by a large amount.

The complete system Goldratt suggests is described in Chapter 17. There is an excellent reference for understanding Deming's approach to variation and how to manage it.** This book should be required reading for every project manager.

*Gerald Kendall, George Pitagorsky, and David Hulett, *Integrating Critical Chain and the PMBOK®* white paper, www.iil.com, 2000.

**Donald J. Wheeler, *Understanding Variation – The Key to Managing Chaos*, SPC Press, Knoxville, TN, 2000, with thanks to Mr. Yvon D'Anjou from Alcan for recommending this book.

DEMING AND GOLDRATT ON PROJECT MANAGEMENT — STEP 4

Goldratt defined a system for project management called *Critical Chain*. It has two sides — one that addresses an individual project and the other that solves the problems in the multi-project environment.

We will summarize by stating that within the single project environment, Goldratt describes the root problem as the common practice of holding people accountable to finish their task according to their estimate. Through cause–effect logic, he describes how this measurement drives project cycle times longer and almost guarantees unpredictability in results. The solution is a new measurement that we call "the relay runner work ethic" combined with a system of buffers and buffer management.

Within the multi-project environment, the root problem is the practice of pushing new projects into the system, without regard to the capacity of the strategic resources to do the work. The solution is a pull system that is simple enough to implement in any organization of any size or complexity. Strategic resources are the ones that are involved in most projects, and determine, more than any other resources, how long the combination of projects will take. We discuss this further in Chapter 17.

DEMING AND GOLDRATT ON STRATEGIC PLANNING

If you ask people across an organization what they think of their executives' strategic plan, we encounter many individuals who roll their eyeballs and ask, "What strategic plan?"

Deming's principles apply as much to strategic planning as they apply to any other process. However, in strategic planning, the stakes are much higher. We must build greater predictability into a strategic plan. The book *Execution* (see Bibliography) points out how lame some strategic planning processes are.

One of the major obstacles that Goldratt encountered in trying to implement change across an organization is that people (executives) on the inside do not see their organization holistically or through common eyes. Rather, each executive sees their silo and a partial picture of the other business units. Further, the measurements and practices throughout most organizations are counter to each other and sometimes threaten the goal. This has been borne out by organizations that have implemented the Theory of Constraints methodology. When they attempt to resolve conflicting measurements, it often takes them the better part of a year, and they find themselves going through department by department just to *find* the measurements that are the primary drivers.

Therefore, before we go about improving an organization, we must develop a deep common understanding and put in place holistic measurements. Only then can the strategic planning become predictable.

Goldratt developed a process called the 4 × 4 to address these issues of strategic planning. He called one of the authors when the process was new and asked him, "Did you hear about the 4 × 4 process for strategic planning?" The author (Kendall) responded, "Is that where you hit someone over the head with a big stick?"

Goldratt responded, "No, that's the 2 × 4!" Goldratt described the process and Kendall tried it for the first time in 1999. The results were promising, and he repeated the process with several major clients. The companies that have implemented have done very well, as the case studies show.

Kendall, however, was not completely satisfied. While organizations publicly proclaimed that their strategic plan was allowing them to meet all of their goals, there was still an element missing to help ensure predictability.

Most organizations do not govern their multi-project environment with a sense of order and predictability. When the executives develop a new strategic plan, the tendency is to shove a bunch of additional projects into the system, creating chaos. Many organizations do not have a central group skilled in advanced project management. Many organizations do not have a project portfolio, meaning that they really have no idea how many projects are currently active, what those projects are, relative priorities, etc.

The PMO, in combination with the 4 × 4 process described later, provides an approach to strategic planning that finally has a chance to meet Deming's criteria for predictability. Perhaps with this predictability, we will see a lot less than 54% of CEOs replaced within a three-year period (see footnote in Chapter 5).

SIX SIGMA — WHERE DOES IT FIT IN PROJECT MANAGEMENT?

Six Sigma talks about reducing defects to parts per million. Another way to view Six Sigma is that it will increase predictability of the results your customers expect. Already this implies that we are dealing with a repetitive process (e.g., manufacturing parts or handling service calls, making pizzas, taking mortgage applications, etc.).

While each project is unique in some way, there are some processes that are repeated across all projects. For example, every project involves planning, scheduling and executing. Every project has a requirements definition. Every project has work broken down into tasks, assigned to individuals.

The Critical Chain approach, described earlier, is designed to bring the project management system into control, according to Deming's criteria. The Buffer Management can then be used to recognize where the system needs to improve. This is one obvious place where Six Sigma thinking can play an important role.

In many projects, for example, we hear complaints about poor requirements definitions and the impact on rework. Imagine the impact of reducing this rework in half. We will assume, just for illustration, that 80% of all project complications (measured by buffer penetration in Critical Chain) is due to rework of requirements.

The approach that we have seen some project managers take is to demand detailed, cast in concrete requirements of the end user or customer. The penalty, if requirements change, is that the project manager can either refuse to do the change, or will force the change through some change control board, demanding more time or more money to accomplish the change.

The end customer is therefore understandably reluctant, if not completely paranoid, about allowing requirements to be cast in concrete. This is not a helpful answer to deal with the issue.

In project management, the Six Sigma approach begins with the definition that there are three states we are seeking for requirements definition. (1) We want the requirements to be free of defects (which we would need to define, as not all rework is a result of defects). (2) We want the requirements to be delivered on time. (3) We want the requirements to be delivered at the lowest possible cost.

Five key steps in the Six Sigma methodology are abbreviated as DMAIC:

1. **Define** — Define the processes used in requirements definition which contribute to the problems. What formal steps should be taken?
2. **Measure** — Measure the current performance of these processes. Once the performance factors are known, performance can be charted. One factor might be the number of days of unplanned rework, as a percentage of requirements definition effort.
3. **Analyze** — Analyze the data to assess prevalent patterns and trends (look for the root causes). Is there a correlation, for example, between the amount of rework and the duration of a project? Is there a correlation between the amount of rework and the length of time between definition and implementation?
4. **Improve** — Improve the key product/service characteristics created by the key processes. This might be the statistic highlighted in Step 2 above, or some other service characteristic.
5. **Control** — Control the process variables that exert undue influence. For example, if a key variable turned out to be the skill of the end

customer doing the requirements review, the PMO might choose to perform requirements definition training for end customers. Or it might choose to have the service providers perform prototype (simulation) reviews in order for the end customer to gain some hands-on experience before freezing requirements.

There is obviously much more to Six Sigma than what we have summarized here and many other aspects of projects that Six Sigma can and should contribute to. We are merely suggesting that there is an important place for this methodology in every project management effort. It can be used both to improve the organization and to improve the project management performance. For further information, we recommend reading one of the many books on Six Sigma, such as the one by Harry and Schroeder.*

SUMMARY

Deming and Goldratt provide an integrated systems approach to delivering projects on time, on budget, and within scope. When Deming's philosophy is applied to project management, and Goldratt's Critical Chain and 4×4 strategic planning methodology is implemented, organizations have a better chance of meeting their goals. Further, these powerful holistic approaches blend well with Six Sigma, a way to reduce errors and provide dramatically increased customer satisfaction.

The basic principles are:

- Every system must have a clearly defined goal and holistic measurements.
- Management must have a deep understanding of the system, the dependencies within the system relative to the goal and the cause–effect relationships within the system.
- There must be a way to make the system stable. Within project management, this implies a way to get 95% or more of the projects to meet their goals. Within strategic planning, it means the strategic plan meets or exceeds targets 95% of the time or more.

We are witnesses to many PMOs using approaches that are not driving measurable value for executives. The Deming, Goldratt, and Six Sigma approaches provide a focus for the PMO, better quality of life throughout the organization, and much needed executive support for the PMO staff and effort.

*Mikel Harry and Richard Schroeder, *Six Sigma, The Breakthrough Management Strategy Revolutionizing the World's Top Corporations*, Doubleday, New York, 2000.

QUESTIONS

6.1 Why is it important for management to distinguish between common cause and special cause variation in a project?

6.2 Why is variation from a project task time estimate considered to be common cause variation?

6.3 In their book, Lepore and Cohen describe the 10 steps to any improvement effort. Why should the first step be to define the goal(s) of the system and the measurements?

6.4 What are the goals of the single project environment and the multi-project environment?

6.5 What does "make the system stable" imply for project management?

6.6 What is the biggest problem Goldratt encountered in implementing cross-functional change over the past 20 years?

6.7 How do executives unknowingly contribute to the problems of managing multiple projects?

6.8 Before offering a solution to executives for managing projects holistically, what must you do to overcome the first layer of resistance to change?