Howard S. **Gitlow**
Richard J. **Melnyck**
David M. **Levine**

A GUIDE TO SIX SIGMA AND PROCESS IMPROVEMENT FOR PRACTITIONERS AND STUDENTS

Second Edition

Foundations, DMAIC, Tools, Cases, and Certification

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This book is dedicated to:
Shelly Gitlow
Ali Gitlow
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Beatrice Gitlow

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Eileen Melnyck

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Reuben Levine

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Section III Putting It All Together—Six Sigma Projects

ACCESS TO DATA FILES AND CHAPTERS 17 AND 18

Go to www.ftpress.com/sixsigma and click the Downloads tab to access Minitab practice data files and Chapters 17 and 18.

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1

You Don't Have to Suffer from the Sunday Night Blues!

What Is the Objective of This Chapter?

We all know someone who dreads Sunday night because he or she isn't looking forward to going to work the next day. In fact, many of us know that person very well because that person is us!

Many employees are highly respected and well paid, and you may believe that they are happy with their jobs, but do not be fooled by their smiles. Many of them dislike their jobs. Many people are "burned out" at work. So, if you are an employee just trying to do your job and you think your job is boring, draining, and depressing, just think—you may have to do it for the rest of your work life! How's that for something to look forward to?

Well, we are here to tell you that you don't have to suffer from the Sunday night blues!

Before we tell you what you can do to make that happen we need to first tell you a little bit about intrinsic motivation. Intrinsic motivation comes from the sheer joy or pleasure of performing an act, in this case such as improving a process or making your job better. It releases human energy that can be focused into improvement and innovation of a system. As amazing as it may seem, work does not have to be a drain on your energy. If you can release the intrinsic motivation that lies within all of us it can actually fill you with energy so you can enjoy what you do and look forward to doing it, day after day and year after year. Many artists, athletes, musicians, and professors enjoy their work over the course of their lives. You can enjoy your work also, or at least you can enjoy it much more than you currently do. It just requires a redefinition of work and a management team that promotes the redefined view of work to release the intrinsic motivation within each of us.

In today's world, many of us are asked to self-manage to a great extent, meaning we are given the autonomy and opportunity to direct our work to accomplish important organizational objectives. However, many of us do not take advantage of that opportunity. Why? The reason is that we do not have the tools to release that intrinsic motivation to make our jobs, our organizations, and most importantly our lives better. Now we do!

This book not only explains how it is possible for you to make both your work life and your personal life better using process improvement and Six Sigma, but it gives you the tools and methods to make it happen.

Sarah's Story

Most people go into work every day and are confronted with a long list of crises that require immediate attention. Consider the story of Sarah who is an administrative assistant in a department in a large, urban, private university. Please note that Sarah has not read this book—yet. So she comes to work every day only to be greeted by a long to-do list of mini crises that are boring and repetitive. Sound familiar?

The mini crises include answering the same old questions from faculty and students, week after week after week:

- What room is my class in?
- Does the computer in room 312 work?
- What are my professor's office hours?
- Are the copies I need for class (and requested only 5 minutes ago) ready? Blah, blah, blah.

These crises prevent Sarah from doing her "real" work, which keeps piling up. It is frustrating and depressing. If you ask Sarah what her job is, she will say: "I do whatever has to be done to get through the day without a major disaster."

No one is telling Sarah she cannot improve her processes so that she doesn't have to answer the same questions over and over again. In fact, her bosses would rather her not focus on answering the same old questions and instead prefer her to work on projects that actually add value. The problem is not that she doesn't want to improve her processes; the problem is that she doesn't know how.

Then one day somehow the stars align and Sarah finds a copy of our book on her desk, so she reads it. She starts to apply some of the principles of the book to her job and to her life, and guess what? Things begin to change for the better.

For example, instead of having people call her to see what room their class is in she employs something that she learns in the book called *change concepts,* which are approaches to change that have been found to be useful in developing solutions that lead to improvements in processes. In this case, she uses a change concept related to automation and sends out a daily autogenerated email to all students and staff to let them know what room their classes are located in. Utilizing the change concept eliminates the annoying calls she used to receive to see what room classes are in.

Can you identify with Sarah? Do you want to learn tools and methods that will help you transform your job, your organization, and your life? The upcoming chapters take you on that journey, the journey of process improvement.

Before we go through the structure of the book, it is important for you to understand some key fundamental principles. These are principles that you need to understand as a prerequisite to reading this book and are principles you need to keep referring back to if you want to

transform your job (to the extent management allows you to do it), your organization (if it is under your control), and your life through process improvement.

A young violinist in New York City asks a stranger on the street how to get to Carnegie Hall; the stranger's reply is, "Practice, practice, practice." The same thing applies to process improvement. The only way you get better at it is through practice, practice, practice, and it starts with the nine principles outlined in this chapter.

Nine Principles of Process Improvement to Get the Most Out of This Book

Process improvement and Six Sigma embrace many principles, the most important of which in our opinion are discussed in this section. When understood, these principles may cause a transformation in how you view life in general and work in particular (Gitlow, 2001; Gitlow, 2009).

The principles are as follows:

- **Principle 1—**Life is a process (a process orientation).
- **Principle 2—**All processes exhibit variation.
- **Principle 3—**Two causes of variation exist in all processes.
- **Principle 4—**Life in stable and unstable processes is different.
- **Principle 5—**Continuous improvement is always economical, absent capital investment.
- **Principle 6—**Many processes exhibit waste.
- **Principle 7—**Effective communication requires operational definitions.
- **Principle 8—**Expansion of knowledge requires theory.
- **Principle 9—**Planning requires stability. Plans are built on assumptions.

These principles are outlined in the following sections and appear numerous times throughout the book. Illustrated from the point of view of everyday life, it is your challenge to apply them to yourself, your job, and your organization.

Principle 1: Life is a process. A process is a collection of interacting components that transform inputs into outputs toward a common aim called a mission statement. Processes exist in all facets of life in general, and organizations in particular, and an understanding of them is crucial.

The transformation accomplished by a process is illustrated in Figure 1.1. It involves the addition or creation of time, place, or form value. An output of a process has *time value* if it is available when needed by a user. For example, you have food when you are hungry, or equipment and tools available when you need them. An output has *place value* if it is available where needed by a user. For example, gas is in your tank (not in an oil field), or wood

chips are in a paper mill. An output has *form value* if it is available in the form needed by a user. For example, bread is sliced so it can fit in a toaster, or paper has three holes so it can be placed in a binder.

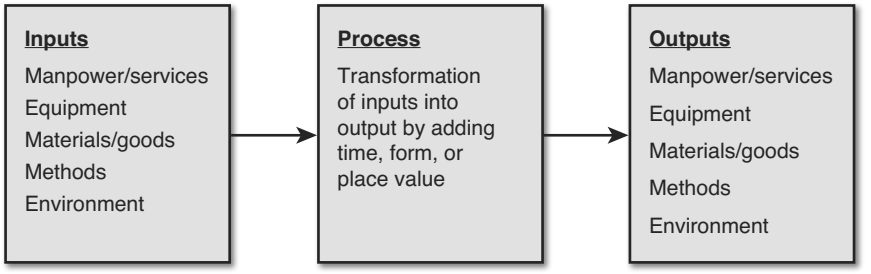

Figure 1.1 Basic process

An example of a personal process is Ralph's "relationship with women he dates" process. Ralph is 55 years old. He is healthy, financially stable, humorous, good looking (at least he thinks so!), and pleasant. At age 45 he was not happy because he had never had a long-term relationship with a woman. He wanted to be married and have children. Ralph realized that he had been looking for a wife for 20 years, with a predictable pattern of four to six month relationships—that is, two relationships per year on average; see Figure 1.2. That meant he had about 40 relationships over the 20 years.

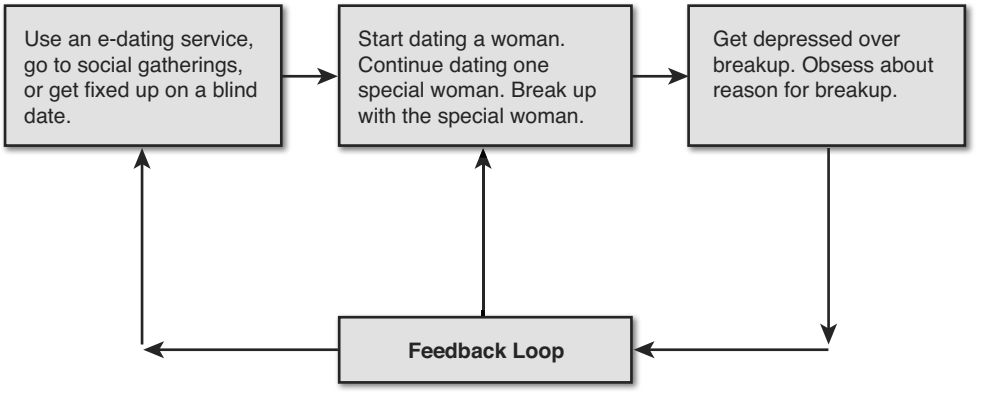

Figure 1.2 Ralph's relationship with women process

Ralph continued living the process shown in Figure 1.2 for more than 20 years. It depressed and frustrated him, but he did not know what to do about it. Read on to the next principles to find out more about Ralph's situation.

Principle 2: All processes exhibit variation. Variation exists between people, outputs, services, products, and processes. It is natural and should be expected, but it must be reduced. The type of variation being discussed here is the unit-to-unit variation in the outputs of a process (products or services) that cause problems down the production or service line and for customers. It is *not* diversity, for example, racial, ethnic, or religious, to name a few sources of diversity. Diversity makes an organization stronger due to the multiple points of view it brings to the decision making process.

Let's go back to our discussion of unit-to-unit variation in the outputs of a process. The critical question to be addressed is: "What can be learned from the unit-to-unit variation in the outputs of a process (products or services) to reduce it?" Less variability in outputs creates a situation in which it is easier to plan, forecast, and budget resources. This makes everyone's life easier.

Let's get back to Ralph's love life or lack thereof. Ralph remembered the reasons for about 30 of his 40 breakups with women. He made a list with the reason for each one. Then he drew a line graph of the number of breakups by year; see Figure 1.3.

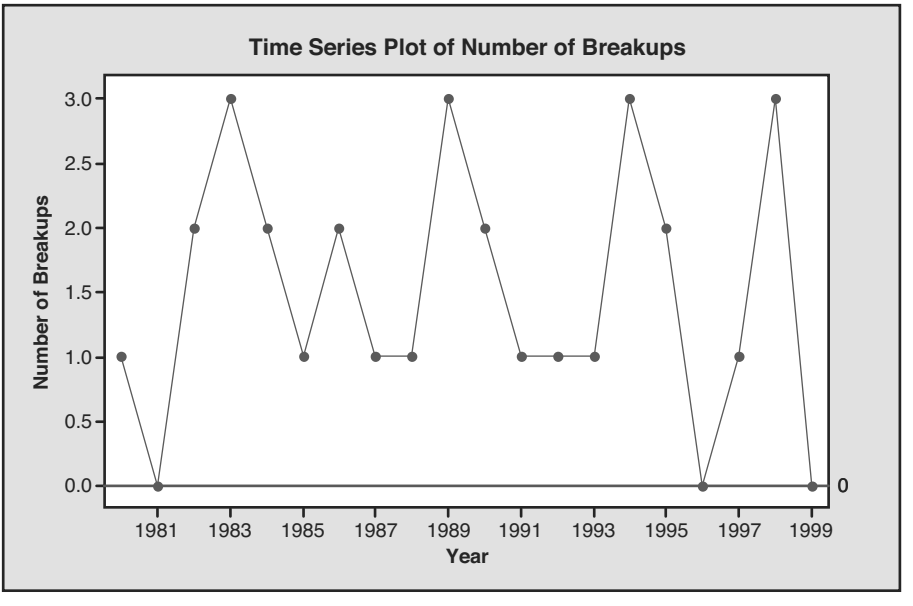

Figure 1.3 Number of breakups by year

As you can see, the actual number of breakups varies from year to year. Ralph's ideal number of breakups per year is zero; this assumes he is happy and in a long-term relationship with a woman whom he has children with. The difference between the actual number of breakups and the ideal number of breakups is unwanted variation. Process improvement and Six Sigma management help you understand the causes of unwanted waste and variation,

thereby giving you the insight you need to bring the actual output of a process and the ideal output of a process closer to each other.

Another example: Your weight varies from day to day. Your *ideal* daily weight would be some medically determined optimum level; see the black dots on Figure 1.4. Your *actual* daily weights may be something entirely different. You may have an unacceptably high average weight with great fluctuation around the average; see the fluctuating squares on Figure 1.4. Unwanted variation is the difference between your ideal weight and your actual weights. Process improvement and Six Sigma management help you understand the causes of this variation, thereby giving you the insight you need to bring your actual weight closer to your ideal weight.

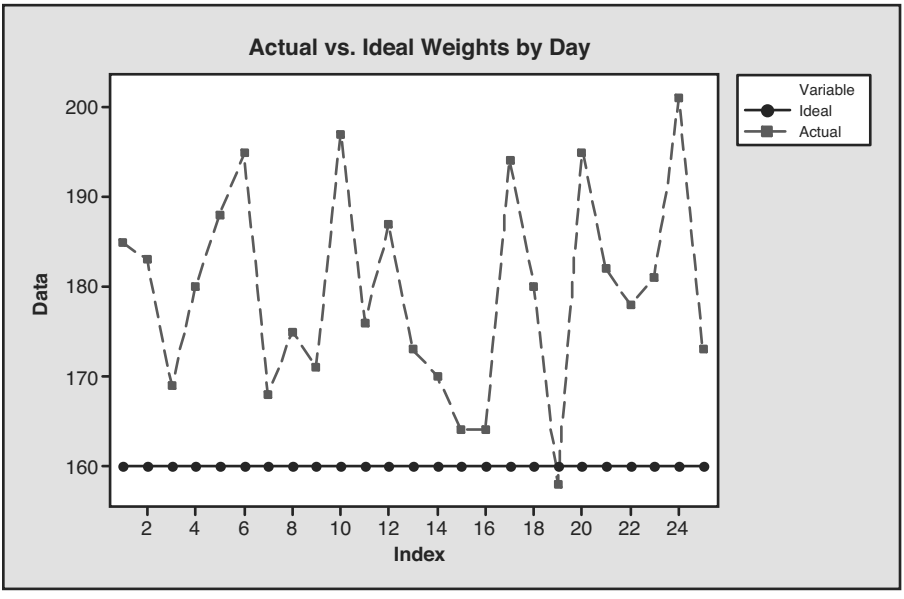

Figure 1.4 Actual versus ideal weights by day

Principle 3: Two causes of variation exist in all processes; they are special causes and common causes of variation. Special causes of variation are due to assignable causes external to the process. Common causes of variation are due to the process itself—that is, variation caused by the structure of the process. Examples of common causes of variation could be stress, values and beliefs, or the level of communication between the members of a family. Usually, most of the variation in a process is due to common causes. A process that exhibits special and common causes of variation is unstable; its output is not predictable in the future. A process that exhibits only common causes of variation is stable (although possibly unacceptable); its output is predictable in the near future.

Let's visit Ralph again. Ralph learned about common and special causes of variation and began to use some basic statistical thinking and tools to determine whether his pattern of

breakups with women was a predictable system of common causes of variation. Ralph constructed a control chart (see Figure 1.5) of the number of breakups with women by year. After thinking about himself from a statistical point of view using a control chart, he realized his relationships with women were not unique events (special causes); rather, they were a common cause process (his relationship with women process).

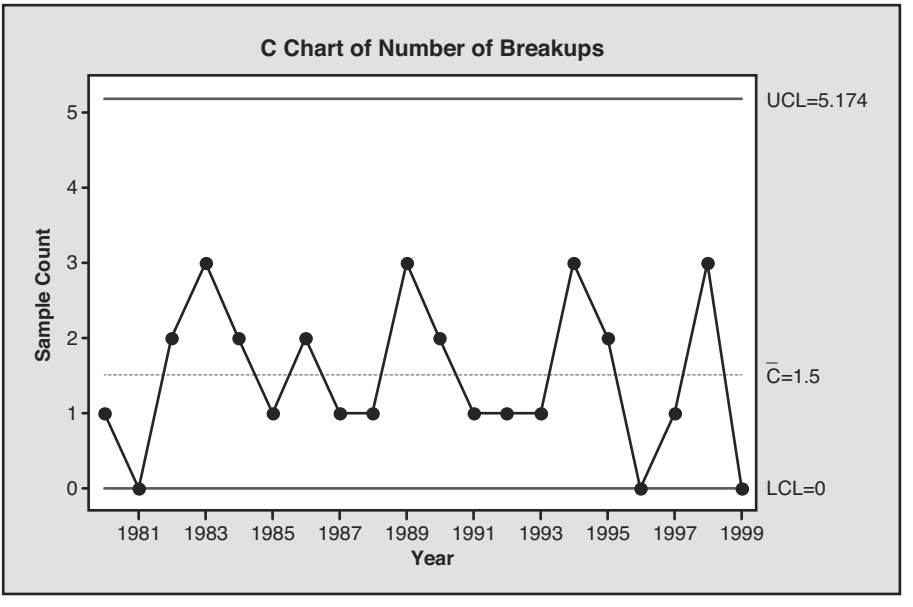

Figure 1.5 Number of breakups with women by year

Control charts are statistical tools used to distinguish special from common causes of variation. All control charts have a common structure. As Figure 1.5 shows, they have a center line, representing the process average, and upper and lower control limits that provide information on the process variation. Control charts are usually constructed by drawing samples from a process and taking measurements of a process characteristic, usually over time. Each set of measurements is called a *subgroup,* for example, a day or month. In general, the center line of a control chart is taken to be the estimated mean of the process; the upper control limit (UCL) is a statistical signal that indicates any point(s) above it are likely due to special causes of variation, and the lower control limit (LCL) is a statistical signal that indicates any point(s) below it are likely due to special causes of variation. Additional signals of special causes of variation are not discussed in this chapter, but are discussed later in the book.

Back to Ralph's love life; Figure 1.5 shows that the number of breakups by year are all between the UCL = 5.174 and the LCL = 0.0. So, Ralph's breakup process with women only exhibits common causes of variation; it is a stable and predictable process, at least into the near future. This tells Ralph that he should analyze all 30 data points for all 20 years as being part

of his "relationship with women" process; he should not view any year or any relationship as special.

Ralph was surprised to see that the reasons he listed for the 30 breakups collapsed down to five basic categories, with one category containing 24 (80%) of the relationships. The categories (including repetitions) are grouped into the frequency distribution shown in Table 1.1.

Table 1.1 Frequency Distribution of Reasons for Breakups with Women for 20 Years

Reason	Frequency	Percentage
Failure to commit	24	80.00
Physical	03	10.00
Sexual	01	3.33
Common interests	01	3.33
Other relationships	01	3.33
Total	30	100.00

Ralph realized that there were not 30 unique reasons (special causes) that moved him to break up with women. He saw that there were only five basic reasons (common causes of variation in his process) that contributed to his breaking up with women, and that "failure to commit" is by far the most repetitive common cause category.

Principle 4: Life in stable and unstable processes is different. This is a *big* principle. If a process is stable, understanding this principle allows you to realize that most of the crises that bombard you on a daily basis are nothing more than the random noise (common causes of variation) in your life. Reacting to a crisis like it is a special cause of variation (when it is in fact a common cause of variation) will double or explode the variability of the process that generated it. All common causes of variation (formerly viewed as crises) should be categorized to identify *80-20 rule* categories, which can be eliminated from the process. Eliminating an 80-20 rule category eliminates all, or most, future repetition of the common causes (repetitive crises) of variation generated by the problematic component of the process.

Let's return to the example of Ralph. Ralph realized that the 30 women were not individually to blame (special causes) for the unsuccessful relationships, but rather, he was to blame because he had not tended to his emotional well-being (common causes in his stable emotional process); refer to Figure 1.5. Ralph realized he was the process owner of his emotional process. Armed with this insight, he entered therapy and worked on resolving the biggest common cause category (80-20 rule category) for his breaking up with women, failure to commit.

The root cause issue for this category was that Ralph was not getting his needs met by the women. This translated into the realization that his expectations were too high because he had a needy personality. In therapy he resolved the issues in his life that caused him to be needy and thereby made a fundamental change to himself (common causes in his emotional

process). He is now a happily married man with two lovely children. Ralph studied and resolved the common causes of variation between his ideal and real self, and moved himself to his ideal; see the right side of Figure 1.6. He did this by recognizing that he was the process owner of his emotional process and that his emotional process was stable, and required a common cause type fix, not a special cause type fix. Ralph is the manager of his life; only he can change how he interacts with the women he forms relationships with.

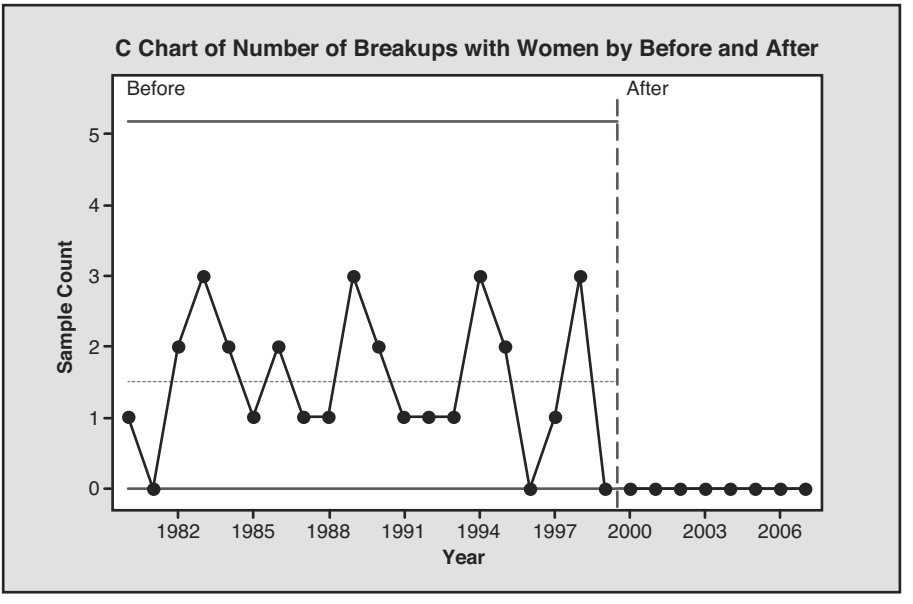

Figure 1.6 Number of breakups with women before and after therapy

Principle 5: Continuous improvement is always economical, absent capital investment. Continuous improvement is possible through the rigorous and relentless reduction of common causes of variation and waste around a desired level of performance in a stable process. It is always economical to reduce variation around a desired level of performance, *without capital investment*, even when a process is stable and operating within specification limits. For example, elementary school policy states that students are to be dropped off at 7:30 a.m. If a child arrives before 7:25 a.m., the teacher is not present and it is dangerous because it is an unsupervised environment. If a child arrives between 7:25 a.m. and 7:35 a.m., the child is on time. If a child arrives after 7:35 a.m., the entire class is disrupted. Consequently, parents think that if their child arrives anytime between 7:25 a.m. and 7:35 a.m. it is acceptable (within specification limits). However, principle 5 promotes the belief that for every minute a child is earlier or later than 7:30 a.m., even between 7:25 am and 7:35 am, a loss is incurred by the class. The further from 7:30 a.m. a child arrives to school, the greater the loss. Please note that the loss may not be symmetric around 7:30 a.m. Under this view, it is each parent's job to continuously reduce the variation in the child's arrival time to school. This minimizes

the total loss to all stakeholders of the child's classroom experience (the child, classmates, teacher, and so on). Table 1.2 shows the loss incurred by the class of children in respect to accidents from early arrivals of children and the disruptions by late arrivals of children for a one year period.

Table 1.2 Loss from Minutes Early or Late

Arrival Times (a.m.)	# Minutes Early or Late	Loss to the Classroom
7:26	4	2 accidents
7:27	3	2 accidents
7:28	2	1 accident
7:29	1	1 accident
7:30	0	0 accidents
7:31	1	1 minor disruption
7:32	2	1 minor disruption
7:33	3	1 medium disruption
7:34	4	1 major disruption
Total		6 accidents 2 minor disruptions 1 medium disruption 1 major disruption

If parents can reduce the variation in their arrival time processes from the distribution in Table 1.2 to the distribution in Table 1.3, they can reduce the loss from early or late arrival to school. Reduction in the arrival time process requires a fundamental change to parents' arrival time behavior, for example, laying out their child's clothes the night before to eliminate time. As you can see, Table 1.2 shows 6 accidents, 2 minor disruptions, 1 medium disruption, and 1 major disruption, while Table 1.3 shows 4 accidents, 2 minor disruptions, and 1 medium disruption. This clearly demonstrates the benefit of continuous reduction of variation, even if all units conform to specifications.

Table 1.3 Improved Loss from Minutes Early or Late

Arrival Times (a.m.)	# Minutes Early or Late	Loss to the Classroom
7:26	4	0 accidents
7:27	3	2 accidents
7:28	2	1 accident
7:29	1	1 accident

Arrival Times (a.m.)	# Minutes Early or Late	Loss to the Classroom
7:30	0	0 accidents
7:31	1	1 minor disruption
7:32	2	1 minor disruption
7:33	3	1 medium disruption
7:34	4	0 disruptions
Total		4 accidents 2 minor disruptions 1 medium disruption

Principle 6: Many processes exhibit waste. Processes contain both value added activities and non-value added activities. Non-value added activities in a process include any wasteful step that

- Customers are not willing to pay for
- Does not change the product or service
- Contains errors, defects, or omissions
- Requires preparation or setup
- Involves control or inspection
- Involves overproduction, special processing, and inventory
- Involves waiting and delays

Value added activities include steps that customers are willing to pay for because they positively change the product or service in the view of the customer. Process improvement and Six Sigma management promote reducing waste through the elimination of non-value added activities (streamlining operations), eliminating work in process and inventory, and increasing productive flexibility and speed of employees and equipment.

Recall Ralph and his love life dilemma. If you consider Ralph's failure to commit as part of his relationship with women process, you can clearly see that it is a non-value added activity. This non-value added activity involves some wasteful elements. First, the women Ralph dates do not want to spend their valuable time dating a man who cannot commit to a long-term relationship. Second, the women ultimately feel tricked or lied to because Ralph failed to discuss his commitment issues early in the relationship. Third, the women resent the emotional baggage (unwanted inventory) that Ralph brings to the prospective relationship. Clearly, Ralph needed to eliminate these forms of waste from his love life.

Principle 7: Effective communication requires operational definitions. An operational definition promotes effective communication between people by putting communicable meaning into a word or term. Problems can arise from the lack of an operational definition

such as endless bickering and ill will. A definition is operational if all relevant users of the definition agree on the definition. It is useful to illustrate the confusion that can be caused by the absence of operational definitions. The label on a shirt reads "75% cotton." What does this mean? Three quarters cotton on average over this shirt, or three quarters cotton over a month's production? What is three quarters cotton? Three quarters by weight? Three quarters at what humidity? Three quarters by what method of chemical analysis? How many analyses? Does 75% cotton mean that there must be some cotton in any random cross-section the size of a silver dollar? If so, how many cuts should be tested? How do you select them? What criterion must the average satisfy? And how much variation between cuts is permissible? Obviously, the meaning of 75% cotton must be stated in operational terms; otherwise confusion results.

An operational definition consists of

- A criterion to be applied to an object or a group
- A test of the object or group in respect to the criterion
- A decision as to whether the object or group did or did not meet the criterion

The three components of an operational definition are best understood through an example.

Susan lends Mary her coat for a vacation. Susan requests that it be returned clean. Mary returns it dirty. Is there a problem? Yes! What is it? Susan and Mary failed to operationally define clean. They have different definitions of clean. Failing to operationally define terms can lead to problems. A possible operational definition of clean is that Mary will get the coat dry-cleaned before returning it to Susan. This is an acceptable definition if both parties agree. This operational definition is shown here:

> Criteria: The coat is dry-cleaned and returned to Susan.
>
> Test: Susan determines if the coat was dry-cleaned.
>
> Decision: If the coat was dry-cleaned, Susan accepts the coat. If the coat was not dry-cleaned, Susan does not accept the coat.

From past experience, Susan knows that coats get stained on vacation and that dry cleaning may not be able to remove a stain. Consequently, the preceding operational definition is not acceptable to Susan. Mary thinks dry cleaning is sufficient to clean a coat and feels the preceding operational definition is acceptable. Since Susan and Mary cannot agree on the meaning of clean, Susan should not lend Mary the coat.

An operational definition of clean that is acceptable to Susan follows:

> Criteria: The coat is returned. The dry-cleaned coat is clean to Susan's satisfaction or Mary must replace the coat, no questions asked.
>
> Test: Susan examines the dry-cleaned coat.
>
> Decision: Susan states the coat is clean and accepts the coat. Or, Susan states the coat is not clean and Mary must replace the coat, no questions asked.

Mary doesn't find this definition of clean acceptable. The moral is: Don't do business with people without operationally defining critical quality characteristics.

Operational definitions are not trivial. Statistical methods become useless tools in the absence of operational definitions because data does not mean the same thing to all its users.

Principle 8: Expansion of knowledge requires theory. Knowledge is expanded through revision and extension of theory based on systematic comparisons of predictions with observations. If predictions and observations agree, the theory gains credibility. If predictions and observations disagree, the variations (special and/or common) between the two are studied, and the theory is modified or abandoned. Expansion of knowledge (learning) continues forever.

Let's visit Ralph again. He had a theory that each breakup had its own and unique special cause. He thought deeply about each breakup and made changes to his behavior based on his conclusions. Over time, Ralph saw no improvement in his relationships with women; that is, the difference between the actual number of breakups by year was not getting any closer to zero; that is a long-term relationship. Coincidently, he studied process improvement and Six Sigma management and learned that there are two types of variation in a process, special and common causes. He used a control chart to study the number of breakups with women by year; refer to the left side of Figure 1.6. Ralph developed a new theory for his relationship with women process based on his process improvement and Six Sigma studies. The new theory recognized that all Ralph's breakups were due to common causes of variation. He categorized them, went into therapy to deal with the biggest common cause problem, and subsequently, the actual number of breakups with women by year equaled the ideal number of breakups with women by year; refer to the right side of Figure 1.6. Ralph tested his new theory by comparing actual and ideal numbers, and found his new theory to be helpful in improving his relationship with women process.

Principle 9: Planning requires stability. Plans are built on assumptions. Assumptions are predictions concerning the future conditions, behavior, and performance of people, procedures, equipment, or materials of the processes required by the plan. The predictions have a higher likelihood of being realized if the processes are stable with low degrees of variation. If you can stabilize and reduce the variation in the processes involved with the plan, you can affect the assumptions required for the plan. Hence, you can increase the likelihood of a successful plan.

Example: Jan was turning 40 years old. Her husband wanted to make her birthday special. He recalled that when Jan was a little girl she dreamed of being a princess. So, he looked for a castle that resembled the castle in her childhood dreams. After much searching, he found a castle in the middle of France that met all the required specifications. It had a moat, parapets, and six bedrooms; perfect. Next, he invited Jan's closest friends, three couples and two single friends, filling all six bedrooms. After much discussion with the people involved, he settled on a particular three day period in July and signed a contract with the count and countess who owned the castle. Finally, he had a plan and he was happy.

As the date for the party drew near, he realized that his plan was based on two assumptions. The first assumption was that the castle would be available. This was not a problem because

he had a contract. The second assumption was that all the guests would be able to go to the party. Essentially, each guest's life is a process. The question is: Is each "guest's life process" stable with a low enough degree of variation to be able to predict attendance at the party. This turned out to be a substantial problem. Due to various situations, several of the guests were not able to attend the party. One couple began to have severe marital problems. One member of another couple lost his job. Jan's husband should have realized that the likelihood of his second assumption being realized was problematic and subject to chance; that is, he would be lucky if all the guests were okay at the time of the party. He found out too late that the second assumption was not met at the time of the party. If he had he realized this, he could have saved money and heartache by renting rooms that could be cancelled in a small castle-type hotel. As a postscript, the party was a great success!

Structure of the Book

We structured the book strategically into five main sections, each building upon each other and each expanding your knowledge so that eventually you can complete a process improvement project on your own.

We use the analogy of building a house in how we structured this book.

Section I—Building a Foundation of Process Improvement Fundamentals

- **Chapter 1—**You Don't Have to Suffer from the Sunday Night Blues!
- **Chapter 2—**Process and Quality Fundamentals
- **Chapter 3—**Defining and Documenting a Process

One of the first steps to building a house is to lay down a foundation. The first section creates your foundation in process improvement by taking you through the process and quality fundamentals you need as you build up your knowledge base. It goes into further detail on many of our nine principles for process improvement, principles critical to your understanding of this material.

Section II—Creating Your Toolbox for Process Improvement

- **Chapter 4—**Understanding Data: Tools and Methods
- **Chapter 5—**Understanding Variation: Tools and Methods
- **Chapter 6—**Non-Quantitative Techniques: Tools and Methods
- **Chapter 7—**Overview of Process Improvement Methodologies
- **Chapter 8—**Project Identification and Prioritization: Building a Project Pipeline

You cannot build a house without tools and without understanding how and when to use them, right? The second section creates your toolbox for process improvement by not only teaching you the tools and methods you need to improve your processes but teaching you when and how to use them.

Section III—Putting It All Together—Six Sigma Projects

- **Chapter 9—**Overview of Six Sigma Management
- **Chapter 10—**DMAIC Model: "D" Is for Define
- **Chapter 11—**DMAIC Model: "M" Is for Measure
- **Chapter 12—**DMAIC Model: "A" Is for Analyze
- **Chapter 13—**DMAIC Model: "I" Is for Improve
- **Chapter 14—**DMAIC Model: "C" Is for Control
- **Chapter 15—**Maintaining Improvements in Processes, Products-Services, Policies, and Management Style

When you build a house you need a framework or guide to follow to make sure you build the house correctly; it's called a blueprint! Once that beautiful house is built you need to maintain it so it stays beautiful, right?

The third section is analogous to the blueprint of a house, and it is where we put everything you have learned together to complete a project. We use a specific set of steps—kind of like a blueprint—to keep us focused and make sure we do the project correctly. Those steps are called the Six Sigma management style. Like the maintenance of a new house, once we improve the process, the last thing we want is for the process to backslide to its former problematic state. We show you how to maintain and sustain those improvements.

Section IV—The Culture Required for Six Sigma Management

- **Chapter 16—**W. Edwards Deming's Theory of Management: A Model for Cultural Transformation of an Organization

The fourth section of this book discusses an appropriate culture for a successful Six Sigma management style. We can use the house building analogy because a house has to be built on a piece of property that can support all its engineering, social, psychological, and so on needs and wants. Without a proper piece of property, the house could fall into a sinkhole.

Section V—Six Sigma Certification

- **Chapter 17—**Six Sigma Champion Certification (online-only chapter)
- **Chapter 18—**Six Sigma Green Belt Certification (online-only chapter)

The fifth section discusses how you can become Six Sigma certified at the Champion and Green Belt levels of certification. Certification is like getting your house a final inspection and receiving a Certificate of Occupancy so you can move in. (This section can be found online at www.ftpress.com/sixsigma.)

We hope you enjoy this book. Feel free to contact the authors concerning any mistakes you have found, or any ideas for improvement. Thank you for reading our book. We hope you find it an invaluable asset on your journey toward a Six Sigma management culture.

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Let's Go!

We are excited to begin this journey with you—the journey of process improvement that we hope transforms your job and more importantly your life! While this is a technical book, we want to make it fun and interesting so that you will remember more of what we are teaching you. We tried to add humor and stories to make the journey a fun one. So what are we waiting for? Let's go!

References

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