

- » Finding out the fundamentals of both “Lean” and “Six Sigma”
- » Getting to grips with key concepts
- » Bringing new thinking into the Lean Six Sigma mix

## Chapter **1**

# Defining Lean Six Sigma

**T**hroughout this book, we cover the tools and techniques available to help you achieve real, sustainable improvement in your organization. In this chapter, we aim to move you down a path of different thinking that gets your improvement taste buds tingling. We look at the main principles behind Lean and Six Sigma and what today’s “Lean Six Sigma” is made up of. We’ll also introduce some of the main concepts and terminology to help you on your way.

## Introducing Lean Thinking

Lean thinking focuses on enhancing value for the customer by improving and smoothing the process flow (covered in Chapter 11) and eliminating waste (discussed in Chapter 10). Lean thinking has evolved since Henry Ford’s first production line, and much of the development has been led by Toyota through the Toyota Production System (TPS). Toyota built on Ford’s production ideas, moving from high volume, low variety, to high variety, low volume.

Although Lean thinking is usually seen as being a manufacturing concept and application, many of the tools and techniques were originally developed in service organizations. These include, for example, spaghetti diagrams, and the visual system used by supermarkets to replenish shelves. Indeed, it was a supermarket that helped shape the thinking behind the Toyota Production System. During a tour to General Motors and Ford, Kiichiro Toyoda and Taiichi Ohno visited Piggly

Wiggly, an American supermarket, and noticed *Just in Time* and *kanban* being applied. This innovation enabled Piggly Wiggly customers to “buy what they need at any time” and avoided the store holding excess stock.



TIP

*Kanban* is a Japanese word meaning “card you can see.” At the Piggly Wiggly, it was a card that provided the signal to order more stock. You’ll see *kanbans* turning up again in Chapter 16 when we look at how Agile principles and approaches can be used to accelerate Lean Six Sigma projects.

Lean is called “Lean” not because things are stripped to the bone. Lean isn’t a recipe for your organization to slash its costs, although it will likely lead to reduced costs and better value for the customer. We trace the concept of the word “Lean” back to 1987, when John Krafcik (who later led Google’s self driving car project) was working as a researcher for MIT as part of the International Motor Vehicle Program. Krafcik needed a label for the TPS phenomenon that described what the system did. On a white board, he wrote the performance attributes of the Toyota system compared with traditional mass production. TPS:

- » Needed less human effort to design products and services.
- » Required less investment for a given amount of production capacity.
- » Created products with fewer delivered defects.
- » Used fewer suppliers.
- » Went from concept to launch, order to delivery and problem to repair in less time and with less human effort.
- » Needed less inventory at every process step.
- » Caused fewer employee injuries.

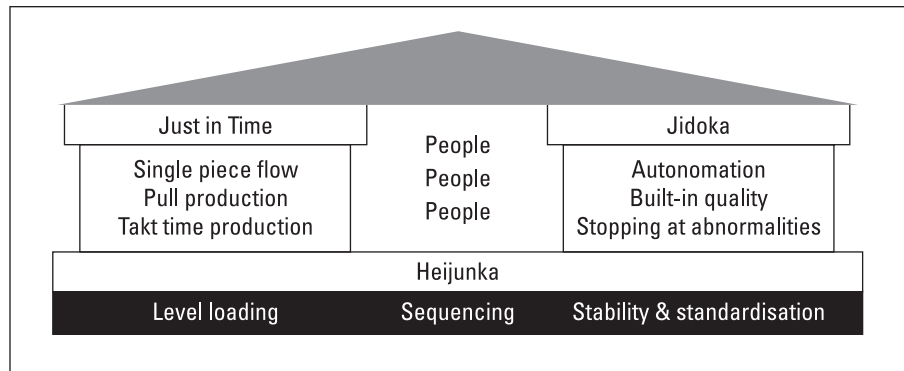
Krafcik commented:

*It needs less of everything to create a given amount of value, so let’s call it Lean.*

And just like that, Lean was born.

## Bringing on the basics of Lean

Figure 1-1 shows the Toyota Production System, highlighting various tools and Japanese Lean thinking terms that we use throughout this book. In this chapter we provide some brief descriptions to introduce the Lean basics and the TPS.



**FIGURE 1-1:**  
The TPS house.

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Toyota’s Taiichi Ohno describes the TPS approach very effectively:

*All we are doing is looking at a timeline from the moment the customer gives us an order to the point when we collect the cash. And we are reducing that timeline by removing the non-value adding wastes.*

The TPS approach really is about understanding how the work gets done, finding ways of doing it better, smoother and faster, and closing the time gap between the start and end points of our processes. And it applies to any process. Whether you’re working in the public or private sector, in service, transactional or manufacturing processes really doesn’t matter.

Think about your own processes for a moment. Do you feel that some unnecessary steps or activities seem to waste time and effort?

We must point out, however, that simply adopting the tools and techniques of the TPS isn’t enough to sustain improvement and embed the principles and thinking into your organization. Toyota chairperson Fujio Cho provides a clue as to what’s also needed:

*The key to the Toyota way is not any of the individual elements but all the elements together as a system. It must be practiced every day in a very consistent manner — not in spurts. We place the highest value on taking action and implementation. By improvement based on action, one can rise to the higher level of practice and knowledge.*

Perhaps this is why Toyota didn’t mind sharing the secrets of their success. It might be easy to replicate certain practices and adopt certain concepts, but it is not easy to replicate a true culture of Continuous Improvement.

## Building people first

“First we build people,” stated Toyota chairperson Fujio Cho. “Then we build cars.” Figure 1-1 shows that people are at the heart of TPS. The system focuses on developing exceptional people and teams that follow the company’s philosophy to gain exceptional results. Consider the following:

- » Toyota creates a strong and stable culture wherein values and beliefs are widely shared and lived out over many years.
- » Toyota works constantly to reinforce that culture.
- » Toyota involves cross-functional teams to solve problems.
- » Toyota keeps teaching individuals how to work together.

Being Lean means involving people in the process, equipping them to be able, and feel able, to challenge and improve their processes and the way they work. Never waste the creative potential of people!

## Looking at the lingo

You can see from Figure 1-1 that Lean thinking involves a certain amount of jargon — some of it Japanese. This section defines the various terms to help you get Lean thinking as soon as possible:

- » **Standardization** seeks to reduce variation in the way the work is carried out, so that everyone operates the process in the “one best way.” This highlights the importance of following a *standard operating process* or procedure. In the spirit of Continuous Improvement, of course the “one best way” of carrying out the process will keep changing, as people in the process identify better ways of doing the work. You need to ensure the new “one best way” is understood and fully deployed.
- » **Heijunka** encompasses the idea of smoothing processing and production by considering leveling and sequencing:
  - **Leveling** involves smoothing the volume of production in the production period, in order to reduce the ups and downs and peaks and troughs that can make planning difficult. Among other things, leveling seeks to prevent “end-of-period” peaks, where production is initially slow at the beginning of the month, but then quickens in the last days of a sale or accounting period, for example.
  - **Sequencing** may well involve mixing the types of work processed. So, for example, when setting up new loans in a bank, the type of loan being processed is mixed to better match customer demand, and help ensure

applications are actioned in date order. So often, people are driven by internal efficiency targets, whereby they process the “simple tasks” first to get them out of the way and “hit their numbers,” leaving the more difficult cases to be processed later on. This means tasks are not processed in date order, and people are reluctant to get down and tackle a pile of difficult cases at the end of the production period, making things even worse for the customer and the business.

» **Jidoka** concerns prevention; it links closely with techniques such as the Failure Mode Effects Analysis (FMEA), which are covered in Chapter 13. Jidoka has two main elements, and both seek to prevent work continuing when something goes wrong:

- **Autonomation** allows machines or processes to operate autonomously, by shutting down if something goes wrong. This concept is also known as automation with human intelligence. The “no” in *autonomation* is often underlined to highlight the fact that no defects are allowed to pass to a follow-on process. An early example hails from 1902, when Sakichi Toyoda, the founder of the Toyota group, invented an automated loom that stopped whenever a thread broke. A simple example today is a printer stopping processing copy when the ink runs out.

Without this concept, automation has the potential to allow a large number of defects to be created very quickly, especially if processing is in batches (see “Single piece flow” below).

- **Stop at every abnormality** is the second element of Jidoka. The employee can stop an automated or manual line if they spot an error. At Toyota, every employee is empowered to “stop the line,” perhaps following the identification of a special cause on a control chart (see Chapter 8).

Forcing everything to stop and immediately focus on a problem can seem painful at first, but doing so is an effective way to quickly get at the root cause of issues. Again, this can be especially important if you’re processing in batches.

» **Just in Time (JIT)** provides the other pillar of the TPS house. JIT involves providing the customer with what’s needed, at the right time, in the right location and in the right quantity. The concept applies to both internal and external customers. JIT comprises three main elements:

- **Single piece flow** means allowing single units of product to flow through the process step by step. When processing in batches, batches (or bundles) of individual cases are processed at each step and are passed along the process only after an entire batch has been completed. Delays are increased when the batches travel around the organization, both in terms of the transport time and the length of time they sit waiting to be actioned. At any given time, most of the units or work items in a batch are sitting idle,

waiting to be processed. This represents excess inventory and can be costly. What's more, errors can neither be picked up nor addressed quickly; if they occur, they often occur in volume. And, of course, this also delays identifying the root cause. With single piece flow, we can get to the root cause analysis faster, which helps prevent a common error recurring throughout the process.

In a single piece flow system each person performs an operation and makes a quick quality check before moving their output to the next person in the following process. Naturally this concept also applies to automated operations where inline checks can be carried out. If a defect is detected, Jidoka is enacted: the process is stopped, and immediate action is taken to correct the situation, taking countermeasures to prevent reoccurrence. This concept is a real change of thinking that moves us away from processing in batches.

- **Pull production** is the second element of JIT. Each process takes what it needs from the preceding process only when it needs it and in the exact quantity. The customer pulls the supply and helps avoid being swamped by items that aren't needed at a particular time.

Pull production reduces the need for potentially costly storage space. All too often, overproduction in one process, perhaps to meet local efficiency targets, results in problems downstream. This increases work in progress, and creates bottlenecks. Overproduction is one of the "eight wastes" covered in Chapter 10.

- **Takt time** is the third element of JIT, providing an important additional measure. It tells you how quickly to action things, given the volume of customer demand. *Takt* is German for "rate." It helps to think about a metronome that musicians use to keep to a consistent tempo, so the takt time is the frequency at which a product or service must be completed in order to meet customer needs.

## Taking the strain out of constraints

Much of the focus in Lean thinking is on understanding and improving the flow of processes and eliminating non-value-added activities. Eliyahu Goldratt's *theory of constraints* (explained more fully in Chapter 11) provides a way to address and tackle bottlenecks that slow the process flow. By addressing what is getting in the way, you can enable a smooth flow, and deliver value to the customer.

## Considering the customer

The customer, not your organization, specifies value. Value is what your customer is willing to pay for. To satisfy your customer, your organization has to provide

the right products and services, at the right time, at the right price and at the right quality. To do this, and to do so consistently, you need to identify and understand how your processes work, improve and smooth the flow, eliminate unnecessary steps in the process, and reduce or prevent waste such as rework.

Imagine the processes involved in your own organization, beginning with a customer order (market demand) and ending with cash in the bank (invoice or bill paid). Ask yourself the following questions:

- » How many steps are involved?
- » Do you need all the steps?
- » Are you sure?
- » How can you reduce the number of steps and the time involved from start to finish?

## Perusing the principles of Lean thinking

Lean thinking has five key principles:

- » Understand the customer and their perception of value.
- » Identify and understand the value stream for each process and the waste within it.
- » Enable the value to flow.
- » Let the customer pull the value through the processes, according to their needs.
- » Continuously pursue perfection (Continuous Improvement).

You'll see that the principles are universal, as they apply to any type of process in any type of organization. They are also timeless, as they're as relevant now as they ever were. In Chapter 2, we show how the principles combine with the key principles of Six Sigma to form *Lean Six Sigma*.

## Sussing Six Sigma

Six Sigma is a systematic and robust approach to improvement, which focuses on the customer and other key stakeholders. Six Sigma seeks to improve processes so that they deliver consistent, reliable outputs. It was developed in the 1980s within

Motorola and was widely used by General Electric. When Jack Welch, former General Electric CEO, introduced Six Sigma, he said:

*We are going to shift the paradigm from fixing products to fixing and developing processes, so they produce nothing but perfection or close to it.*

## Considering the key elements of Six Sigma

Some simple principles underpin Six Sigma:

- » **Understand the CTQs of your customers and stakeholders.** To deliver the best customer experience, you need to know who your customers are and what they want — their requirements and expectations. *CTQ* is short for Critical To Quality, and CTQs are the performance requirements that matter most to your customers. To understand these you need to listen to and understand the *voice of the customer* (VOC). Chapter 4 contains more information on these important elements.
- » **Understand your organization's processes and ensure they reflect your customers' CTQs.** You need to know how your processes work and what they're trying to achieve. A clear objective for each process should exist, focused on the customer requirements (the CTQs).
- » **Manage by fact and reduce variation.** Measurement and management by fact enables more effective decision-making. By understanding variation, you can work out when and when not to take action.
- » **Involve and equip the people in the process.** To be truly effective you need to equip the people in your organization to be able, and to feel able, to challenge and improve their processes and the way they work.
- » **Undertake improvement activity in a systematic way.** Working systematically helps you avoid jumping to conclusions and solutions. Six Sigma uses a process called DMAIC (Define, Measure, Analyze, Improve and Control) to improve existing processes. We cover DMAIC in Chapter 2. In designing new processes, we use DMADV (which is covered in Chapter 14).

You'll recognize some similarities with the principles of Lean outlined earlier in the chapter, and some new concepts. Let's look at those concepts in a little more detail, focusing on measurement and variation in particular. Some of the content might seem a little heavy — we want you to have a clear explanation of the concepts — but remember that pragmatism is a theme of this book.

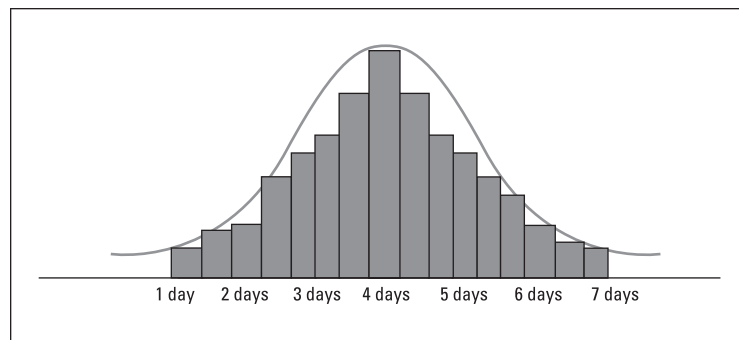
## Getting to grips with variation

The *standard deviation* is a measure that reveals the amount of variation. It is represented as the lower-case Greek letter  $\sigma$  (sigma) and describes the average dispersal of the individual data points from their overall average. Why is this helpful? The smaller the standard deviation value is, the less variation there is. Conversely, the larger the value, the more variation. By understanding the amount and type of variation in our results, we can get closer to understanding the “behavior” of the process (or the thing we are measuring) and what this means for customers.

### Introducing a simple example

Suppose you want to understand the cycle time (lead time) of a process in your organization in days. You could collect a representative sample of data (more on sampling in Chapter 7), and from that sample, calculate the average (or mean) number of days. Calculating the average difference between each cycle time in your data set and the overall average cycle time will give you the standard deviation. The standard deviation is always expressed as the same unit as the “thing” you are measuring; in this case we’re talking about days.

Figure 1-2 shows the time taken to process the orders. The cycle time varies from as short as one day to as long as seven days. Each of the data points represents a customer’s experience of the process. As well as seeing how much performance varies, you can also see the “shape” of the data. This data looks normally distributed. In a normal distribution, the shape is symmetrical around the mean, and the data has a 50-percent chance of falling either side of it. Sometimes this shape is referred to as a *bell curve* or a *Gaussian distribution*. Many things that are measured fall into this shape — for example, the heights of people, the size of snowflakes, and IQ scores.



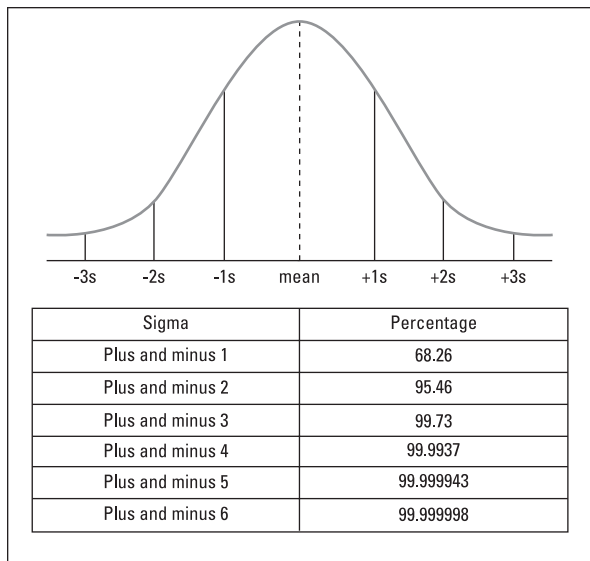
**FIGURE 1-2:**  
Histogram  
showing the time  
taken to process  
orders.

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When the data is normally distributed, we can understand the likely percentage of the population within plus one or minus one standard deviation from the average (or mean), plus two or minus two standard deviations from the average, and so on. Assuming your sample is representative, you can see how your data provides a good picture of the process cycle time. You find that approximately two-thirds of them are between 3 days and 5 days, about 95 percent are in the range of 2 days to 6 days, and about 99.73 percent are between 1 day and 7 days. This is illustrated in Figure 1-3.

The formula used to calculate the standard deviation is shown in Figure 1-4. It looks a little scary at first glance, but as with all formulas, when you start to break it down it becomes more accessible.

- x in the formula represents your individual data points
- $x_i$  represents each x from  $x_1$  up to  $x_n$
- n represents the number of data points in your data set
- $\bar{x}$  represents the average (mean) of your data points
- $\Sigma$  represents the "sum of"



**FIGURE 1-3:**  
Standard deviation.

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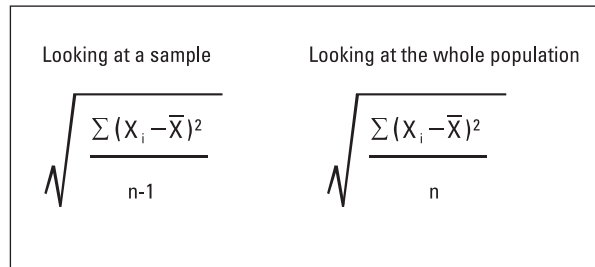
As with most things in life, tackling the formula in stages makes it easier, so let's have a go.

Start by adding up all of the data points you have. For example, if the data points are 5, 6, 7, 8 and 9 (we'll demonstrate with some simple ones), the sum is 35. The number of data points we have is 5, so the value of  $n$  in the formula is 5. We can then work out the mean (average or  $\bar{x}$ ) of those data points, and the mean ( $\bar{x}$ ) is 7 (because  $\frac{35}{5} = 7$ ). Are you with us so far? Great!

Next we need to work out the  $x_i - \bar{x}$  part. This means subtracting the  $\bar{x}$  value (7) from each of our data points.  $5 - 7 = -2$ ,  $6 - 7 = -1$ ,  $7 - 7 = 0$ , and so on. All is going well, but we now have some negative values in the mix, and we need to get rid of them. This is done by squaring the numbers we've just worked out. So  $-2 * -2 = 4$ ,  $-1 * -1 = 1$ ,  $0 * 0 = 0$ , and so on. Next, add together all of the answers we just got. If you're still with us and have done that bit, you should get 10. So now we have real numbers to work with, and the numbers that we put into the formula are  $\frac{10}{5}$  (Yes, we did all that work to get to 10 divided by 5.) 10 divided by 5 is 2. We then, finally, take the square root of 2 to get the standard deviation value of 1.41. Hooray!

Note that there are two versions of the standard deviation formula included in Figure 1-4. The first is used when we have a sample of data, and the second is used when we have the entire population. The data set we used to work through the example above was very small! If we were using the formula for a sample, instead of using  $n$  we'd use  $n - 1$ . So we'd end up with  $\frac{10}{4}$ , which is 2.5. The square root of 2.5 is 1.58.

**FIGURE 1-4:**  
Standard deviation formula.



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In practice, when the sample size is more than 30, there's little difference between using  $n$  or  $n - 1$ . When we refer to a "population," this could relate to people or things that have already been processed, like, for example, a population of completed and dispatched policy documents.



**TIP**

Now for some good news: You can use a scientific calculator, *Excel*, or any number of online calculators to work out the standard deviation of your data, without having to worry about this formula.

The Process Sigma values are calculated by looking at our process performance against the customer requirements, which we cover in the next section.

## Considering customer requirements

So far so good, but without understanding the customer requirements, it's not possible to tell whether cycle time performance is good or bad.

Let's say the customer expects delivery in five days or less. In Lean Six Sigma speak, key customer requirements are called *CTQs*, (*Critical To Quality*). We discuss CTQs in Chapter 2 and describe them in more detail in Chapter 4, but essentially they express the customers' requirements in a way that is measurable. CTQs are a vital element in Lean Six Sigma and provide the basis of your process measurement set. In our example, the CTQ is five days or less, but the average performance in Figure 1-2 is four days. Remember that this is the average; your customers experience the *whole range* of your performance.



WARNING

Too many organizations use averages as a convenient way of making their performance sound better than it really is.

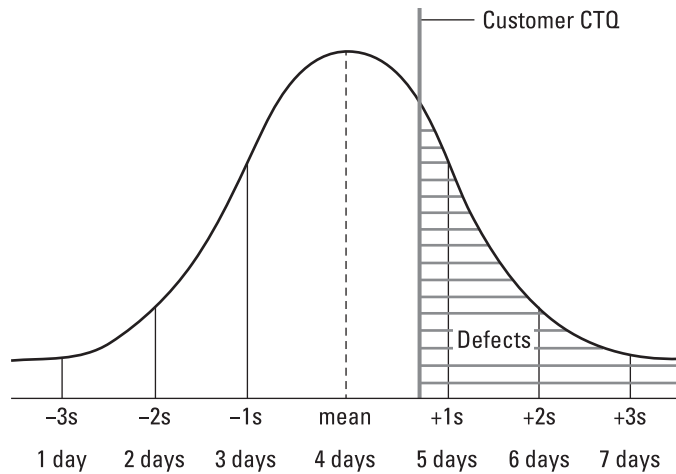
In the example provided, all the orders that take more than five days are *defects* for the customer in Six Sigma language. Orders that take five days or less meet the CTQ. We show this situation in Figure 1-5. We could express the performance as the percentage or proportion of orders processed within five days or we can work out the *Process Sigma value*. The Process Sigma value is calculated by looking at your performance against the customer requirement, the CTQ, and taking into account the number of defects involved where you fail to meet it (that is, all those cases that took more than five days).

We explain the Process Sigma calculation in the next section.

## Calculating Process Sigma values

Here are three good reasons for calculating Process Sigma:

- » It makes you consider customers' performance needs. How long are they prepared to wait for their order to be processed?
- » It makes it easier to compare the performance of different processes. If different metrics are used for each process, comparison is tricky, and it's difficult to prioritize improvements. Process Sigma is a standard quality metric that can be used to measure any process.



**FIGURE 1-5:**  
Highlighting  
defects.

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- » It supports decision-making on what performance needs to be, rather than using an arbitrary target. For example, 99.9 percent success sounds impressive, but it would mean 100 plane crashes worldwide every day, and one hour without electricity every month.

The Process Sigma value represents the population of cases that meet the CTQs right first time. Sigma values are expressed as *defects per million opportunities* (DPMO) to emphasize the need for world-class performance.

Not all organizations using Six Sigma calculate Process Sigma values. Some organizations just use the number of defects or the percentage of orders meeting CTQs to show their performance. Either way, if benchmarking is to be meaningful, the calculations must be made in a consistent manner.

Figure 1-6 includes *yield* figures — the right first time (or ‘first pass yield’) percentage. You can see that Six Sigma performance equates to only 3.4 DPMO.

Calculating the DPMO for your process measures quality using *defects* rather than *defectives*. This is an important distinction that requires more explanation.

Let’s say your customer has several CTQs relating to an order — for example not just the speed (cycle time) but also accuracy and completeness. Each CTQ represents a defect opportunity. Thus, more than one defect may occur in the transaction. You could have a situation whereby the speed CTQ was met, but the accuracy and completeness CTQs were missed. The outcome would be one *defective* delivery (as a result of these two *defects*).

Yield	Sigma	Defects per 1,000,000	Defects per 100,000	Defects per 10,000	Defects per 1,000	Defects per 100
99.99966%	6.0	3.4	0.34	0.034	0.0034	0.00034
99.9995%	5.9	5	0.5	0.05	0.005	0.0005
99.9992%	5.8	8	0.8	0.08	0.008	0.0008
99.9990%	5.7	10	1	0.1	0.01	0.001
99.9980%	5.6	20	2	0.2	0.02	0.002
99.9970%	5.5	30	3	0.3	0.03	0.003
99.9960%	5.4	40	4	0.4	0.04	0.004
99.9930%	5.3	70	7	0.7	0.07	0.007
99.9900%	5.2	100	10	1.0	0.1	0.01
99.9850%	5.1	150	15	1.5	0.15	0.015
99.9770%	5.0	230	23	2.3	0.23	0.023
99.670%	4.9	330	33	3.3	0.33	0.033
99.9520%	4.8	480	48	4.8	0.48	0.048
99.9320%	4.7	680	68	6.8	0.68	0.068
99.9040%	4.6	960	96	9.6	0.96	0.096
99.8650%	4.5	1,350	135	13.5	1.35	0.135
99.8140%	4.4	1,860	186	18.6	1.86	0.186
99.7450%	4.3	2,550	255	25.5	2.55	0.255
99.6540%	4.2	3,460	346	34.6	3.46	0.346
99.5340%	4.1	4,660	466	46.6	4.66	0.466
99.3790%	4.0	6,210	621	62.1	6.21	0.621
99.1810%	3.9	8,190	819	81.9	8.19	0.819
98.930%	3.8	10,700	1,070	107	10.7	1.07
98.610%	3.7	13,900	1,390	139	13.9	1.39
98.220%	3.6	17,800	1,780	178	17.8	1.78
97.730%	3.5	22,700	2,270	227	22.7	2.27
97.130%	3.4	28,700	2,870	287	28.7	2.87
96.410%	3.3	35,900	3,590	359	35.9	3.59
95.540%	3.2	44,600	4,460	446	44.6	4.46
94.520%	3.1	54,800	5,480	548	54.8	5.48
93.320%	3.0	66,800	6,680	668	66.8	6.68
91.920%	2.9	80,800	8,080	808	80.8	8.08
90.320%	2.8	96,800	9,680	968	96.8	9.68
88.50%	2.7	115,000	11,500	1,150	115	11.5
86.50%	2.6	135,000	13,500	1,350	135	13.5
84.20%	2.5	158,000	15,800	1,580	158	15.8
81.60%	2.4	184,000	18,400	1,840	184	18.4
78.80%	2.3	212,000	21,200	2,120	212	21.2
75.80%	2.2	242,000	24,200	2,420	242	24.2
72.60%	2.1	274,000	27,400	2,740	274	27.4
69.20%	2.0	308,000	30,800	3,080	308	30.8
65.60%	1.9	344,000	34,400	3,440	344	34.4
61.80%	1.8	382,000	38,200	3,820	382	38.2
58.00%	1.7	420,000	42,000	4,200	420	42
54.00%	1.6	460,000	46,000	4,600	460	46
50%	1.5	500,000	50,000	5,000	500	50
46%	1.4	540,000	54,000	5,400	540	54
43%	1.3	570,000	57,000	5,700	570	57
39%	1.2	610,000	61,000	6,100	610	61
35%	1.1	650,000	65,000	6,500	650	65
31%	1.0	690,000	69,000	6,900	690	69
28%	0.9	720,000	72,000	7,200	720	72
25%	0.8	750,000	75,000	7,500	750	75
22%	0.7	780,000	78,000	7,800	780	78
19%	0.6	810,000	81,000	8,100	810	81
16%	0.5	840,000	84,000	8,400	840	84
14%	0.4	860,000	86,000	8,600	860	86
12%	0.3	880,000	88,000	8,800	880	88
10%	0.2	900,000	90,000	9,000	900	90
8%	0.1	920,000	92,000	9,200	920	92

**FIGURE 1-6:**  
Abridged Process  
Sigma conversion  
table.

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In calculating sigma values for your processes, you need to understand the following key terms:

- » **Unit:** The item produced or processed.
- » **Defect:** Any event that does not meet the CTQ.
- » **Defect opportunity:** Any event that provides a chance of not meeting a customer CTQ. The number of defect opportunities will equal the number of CTQs.
- » **Defective:** A unit with one or more defects.

You can work out your Process Sigma performance against the CTQs as shown in Figure 1-7. We have a sample of 500 processed units. The customer has three CTQs, so we have three defect opportunities. The CTQs are related to speed, accuracy and completeness. We find 57 defects. With software, you can determine a precise Process Sigma value, but with the abridged table in Figure 1-6, find the sigma value that's closest to your DPMO number of 38000. As you can see, this is 3.3.

❖ Number of units processed	N=500	
❖ Total number of defects made (include defects made and later fixed)	D=57	
❖ Number of defect opportunities per unit (equate to CTQs)	O=3	
❖ Calculate # defects per million opportunities	DPMO	= $1,000,000 \times \frac{D}{(N \times O)}$
		= $1,000,000 \times \frac{57}{(500) \times (3)}$
		= 38000
❖ Look up process sigma in sigma conversion table (see Figure 1-6)	Sigma	= 3.3

**FIGURE 1-7:**  
Calculating  
Process Sigma  
values.

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There is a small quirk to be aware of here. A Process Sigma and standard deviation are not quite the same thing. This results from Motorola adjusting the sigma conversion tables to reflect the variation they observed in their processes over the long term, after studying it for several years. The adjustment is referred to as a "1.5 sigma shift," reflecting the extent of the shift in performance. Although this adjustment related to Motorola's processes, everyone adopting Six Sigma has also adopted the adjusted sigma scale.

When we talk about Six Sigma performance before the adjustment, we're talking about performance data within plus or minus six standard deviations of the average, which embrace 99.99998 per cent of the data. This is the percentage of cases that are right first time in terms of meeting the requirements of the customer. It equates to 0.002 DPMO! Even with the adjustment, we're still looking at a truly demanding standard, with 99.999666 per cent of cases right first time in meeting the CTQs.

## Bringing Lean and Six Sigma together

A natural synergy exists between Lean and Six Sigma, and your organization needs both. Bringing the two together provides a sound set of principles and a broad set of tools and techniques that can enhance effectiveness and delivery efficiency. We'll explore this further in Chapter 2.

# Adding More to the Mix

Lean Six Sigma has evolved significantly since its inception. Today's Lean Six Sigma is more than a combination of Lean and Six Sigma: It includes Change Management, Project Management, Agility, Design Thinking, and more. In the spirit of Continuous Improvement, it's fitting to include "the best of the best" frameworks, tools, techniques and approaches in this edition of *Lean Six Sigma For Dummies*. These firmly establish the ongoing relevance and value of Lean Six Sigma.

But bear in mind the importance of a pragmatic approach. The "new" elements haven't been included because they sound impressive; they've been included because they work. As with Lean and Six Sigma, we'll outline some basics here and delve into detail in future chapters.

## Managing change

Lean Six Sigma practitioners should make good use of frameworks, tools, and techniques to manage change, as people's acceptance and engagement is vital if any change or improvement is going to succeed. Bringing Change Management into Lean Six Sigma can help you to do the following:

- » Establish and communicate a clear need for change and sense of purpose.
- » Build engagement with stakeholders.

- »» Develop a vision and a plan that gives people a clear picture of “what’s in it for me.”
- »» Handle resistance and conflict while supporting the team to make change happen.
- »» Embed change by addressing aspects of behavior that could reinforce or hinder it.
- »» Monitor progress.
- »» Communicate effectively to build acceptance and appetite for change.

Chapter 6 provides further detail on managing people and change.

## Applying Agility

Agile has evolved from being something software developers did to becoming recognized as a way of boosting the performance of projects in general. Applying Agile concepts and an Agile mindset to Lean Six Sigma helps to speed up the delivery of improvement results and bring focus and cohesion to a team.

These aspects of Agile are of particular relevance and value:

- »» Focusing on delivering the benefits in a timely way. For example, not releasing all of the changes or deliverables on one hit but doing so in increments, so customers feel the benefits quicker and can provide feedback on what’s working and what’s not. Letting go of perfection is necessary here. In the words of Mark Twain, “Continuous improvement is better than delayed perfection.”
- »» Embracing a culture of experimentation: being prepared to test and try things out and learn from them. You recognize that not everything will work and are comfortable with failure.
- »» Using aspects from the Scrum approach (see Chapter 16) to deliver the Lean Six Sigma work in timely, focused “sprints” of activity rather than letting projects drag on over long periods of time.
- »» Visualizing the “to do” list of a Lean Six Sigma project by using the kanban approach.
- »» Creating an atmosphere of “psychological safety” where team members feel safe, comfortable, and confident to make their contribution.

Agility is a powerful enabler when it comes to Lean Six Sigma. Chapter 16 looks at Agile in more detail.

## Employing innovation

We live in an age of innovation, where customers' needs and expectations change rapidly and technological advances can make nearly anything possible. Innovation (whether disruptive — the type that creates a dramatic shift away from what's gone before — or more incremental) can help shape effective responses to changes and opportunities, and create new concepts or processes to excite customers.

The basics of Robotic Process Automation are featured in Chapter 13 of this book. There are also some tools for creative thinking and ideas generation that support “thinking differently” (see Chapter 12).

As with all of the new ingredients in today's Lean Six Sigma mix, there are entire books devoted to this subject. A fantastic summary of the mindset required to drive innovation is provided in the *Design Thinking Playbook* (authored by Lewrick, Link, and Leifer and published by Wiley). Lean Six Sigma practitioners can benefit greatly from these, and we'll delve a little deeper into Design Thinking in Chapter 15.

- » Being driven by curiosity, and looking at things from different angles
- » Focusing on the people and their needs
- » Accepting complexity in the systems our work exists in
- » Visualizing and showing to aid understanding
- » Experimenting and iterating in order to learn, solve problems, and improve
- » Seeking to grow and expand capabilities
- » Developing an awareness of the process
- » Collaborating across departments and organizations
- » Reflecting on thinking, activities, and attitudes because they shape actions and assumptions

## Practicing Project Management

Project Management is about getting things done and getting them done in a structured way. Tools and techniques for Project Management can help Lean Six Sigma practitioners to do the following:

- » Establish a project timeline.
- » Plan the work by breaking it down into tasks, including task owners, required resources, due dates, and so on.

- »» Work effectively with a team (remembering the acronym Together Everyone Achieves More).
- »» Monitor progress against the plan.
- »» Manage the scope of the work to avoid the dreaded *scope creep* (the tendency of a project to grow into something bigger and more difficult to manage).
- »» Report the benefits achieved.
- »» Apply *governance* to the project, such as, for example, in identifying and managing risks and holding tollgate reviews.
- »» Identifying and sharing lessons learned.

As you get to know more about Lean Six Sigma, you'll notice there are a few overlaps between Project Management and Lean Six Sigma. The tools and methods of Project Management can certainly help when it comes to managing Lean Six Sigma improvements, and indeed some of them are included in the Lean Six Sigma / DMAIC toolkit (such as planning, managing stakeholders, and establishing a project sponsor).



TIP

Just as “too many cooks spoil the broth,” too many tools might spoil the improvement effort. Trying to use every single aspect of these approaches as well as all the tools in the book is likely to slow you down and overcomplicate things. And it might leave stakeholders with a bad taste in their mouths. Rather than incorporate everything, use only the ingredients that you know will enrich the desired result. As you become more experienced, it gets easier to recognize what could help your situation.

