LEARNING MADE EASY

4th Edition

Lean Six Sigma

for dummies®
A Wiley Brand

Enhance process effectiveness and reduce waste

Successfully apply proven tools to projects and activities

Improve and innovate to achieve sustainable results

Martin Brenig-Jones
Jo Dowdall
Facilitators, trainers, and coaches from Catalyst Consulting

Lean Six Sigma

4th Edition

by Martin Brenig-Jones and Jo Dowdall

for dummies®
A Wiley Brand

Lean Six Sigma For Dummies®, 4th Edition

Published by: **John Wiley & Sons, Inc.,** 111 River Street, Hoboken, NJ 07030-5774, www.wiley.com

Library of Congress Control Number: 2021946527

ISBN 978-1-119-79671-8 (pbk); ISBN 978-1-119-79672-5 (ebk); ISBN 978-1-119-79673-2 (ebk)

Contents at a Glance

Table of Contents

Introduction

Lean Six Sigma provides a rigorous and structured approach to help manage and improve quality and performance, and to solve potentially complex problems. It helps you use the right tools, in the right place and in the right way, not just in process improvement projects but also in your day-to-day work. Lean Six Sigma really is about getting key principles and concepts into the DNA and lifeblood of your organization so that it becomes a natural part of how you do things.

This book is for practitioners using Lean Six Sigma as well as those who are seeking to "lead and live" Lean Six Sigma in their organizations.

We began to blend Lean and Six Sigma together more than 20 years ago, welcoming a pragmatic rather than purist approach. We discovered how essential it has been to consider people and Change Management when improving processes too — leading to higher levels of acceptance and more effective change.

In this 4th Edition of *Lean Six Sigma For Dummies*, we have added a few more ingredients into the cocktail. You can find out how Agile approaches (and an Agile mindset) can accelerate results. We also discuss how Design Thinking approaches, tools, and techniques for creativity can encourage different thinking about the way the work gets done. This stuff really works.

About This Book

This book makes Lean Six Sigma easy to understand and apply. We wrote it because we know that Lean Six Sigma can help organizations of all shapes and sizes, both private and public, improve their performance in meeting their customers' requirements. We know this because we have seen it!

We also wanted to demonstrate a pragmatic approach and the genuine synergy achieved through the combination of Lean and Six Sigma. For some reason unknown to us, a few people still feel they can use only Lean or Six Sigma, but not both. How wrong they are! In this book, you can discover how to create genuine

synergy by applying the principles of Lean and Six Sigma together in your day-to-day operations and activities. And not just that: Change Management, Agile, Design Thinking and Design for Six Sigma are included too. In the true spirit of Continuous Improvement, we are always looking to enhance the approach, adapt the toolkit, and learn as we go.

Foolish Assumptions

In Lean Six Sigma, avoiding the tendency to jump to conclusions and make assumptions about things is crucial. Lean Six Sigma really is about managing by fact. Despite that, we've made some assumptions about why you may have bought this book:

- You're contemplating applying Lean Six Sigma in your business or organization, and you need to understand what you're getting yourself into.
- Your business is implementing Lean Six Sigma and you need to get up to speed. Perhaps you've been lined up to participate in the program in some way.
- Your business has already implemented either Lean or Six Sigma and you're intrigued by what you might be missing.
- You're considering a career or job change and feel that your CV or resume will look much better if you can somehow incorporate Lean or Six Sigma into it.
- You're looking to boost the results and progress of your Lean Six Sigma program and are considering how approaches like Change Management, Agile, and Design Thinking can help.
- You're a student in business, operations or industrial engineering, for example, and you realize that Lean Six Sigma could help shape your future.

We also assume that you realize that Lean Six Sigma demands a rigorous and structured approach to understanding how your work gets done and how well it gets done, and how to go about the improvement of your processes.

Icons Used In This Book

Throughout the book, you'll see small symbols called *icons* in the margins; these highlight special types of information. We use these to help you better understand and apply the material. Look out for the following icons:

TIP

Keep your eyes on the target to find tips and tricks we share to help you make the most of Lean Six Sigma.

REMEMBER

Bear these important points in mind as you get to grips with Lean Six Sigma.

EXAMPLE

Throughout this book, we share true stories of how different companies have implemented Lean Six Sigma to improve their processes.

WARNING

This icon highlights potential pitfalls to avoid.

Beyond This Book

In addition to the material in the print or e-book you're reading right now, this book also comes with some access-anywhere goodies on the web. To view the free Cheat Sheet, go to `www.dummies.com` and type "Lean Six Sigma For Dummies Cheat Sheet" in the search box.

Where to Go From Here

In theory, when you read you begin with ABC, and when you sing you begin with doh-ray-me (thank you Julie Andrews). But with a *For Dummies* book, you can begin where you like. Each part and, indeed, each chapter is self-contained, which means you can start with whichever parts or chapters interest you the most.

That said, if you're new to the topic, starting at the beginning makes sense. Either way, lots of cross-referencing throughout the book helps you to see how things fit together and put them in the right context.

1 Understanding Lean Six Sigma

IN THIS PART . . .

Grasp the basics of Lean and Six Sigma.

Comprehend exactly what "sigma" means and why the term is important in Lean Six Sigma.

Get a clear picture of the synergy created by merging Lean and Six Sigma, and understand the key principles underpinning the approach.

Examine the process improvement method known as DMAIC: Define, Measure, Analyze, Improve, and Control.

Get ready to begin by defining the problems you want to solve using Lean Six Sigma.

IN THIS CHAPTER

- 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

Throughout 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.

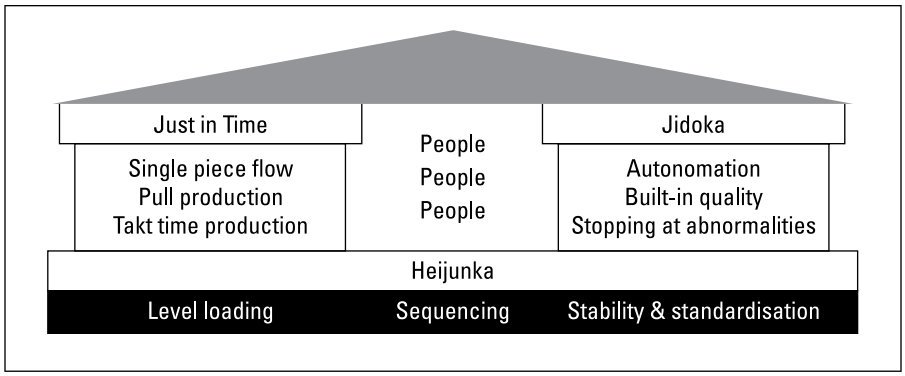


FIGURE 1-1: The TPS house.

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 auto*no*mation 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 σ (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.

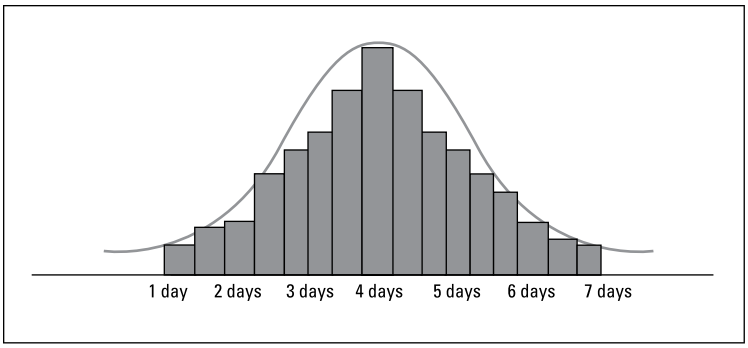


FIGURE 1-2: Histogram showing the time taken to process orders.

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.

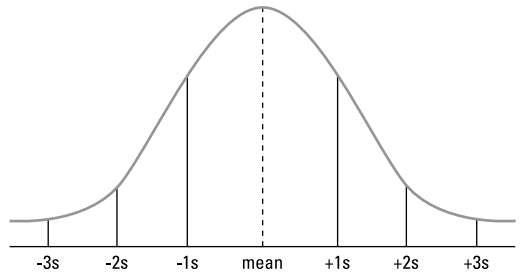
x in the formula represents your individual data points

xi represents each x from x1 up to xn

n represents the number of data points in your data set

$\bar{x}$ represents the average (mean) of your data points

$\sum$ represents the "sum of"



Sigma	Percentage
Plus and minus 1	68.26
Plus and minus 2	95.46
Plus and minus 3	99.73
Plus and minus 4	99.9937
Plus and minus 5	99.999943
Plus and minus 6	99.999998

FIGURE 1-3: Standard deviation.

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