

Foreword by Stephen R. Covey, Author, *The 7 Habits of Highly Effective People*

2nd Edition

# Six Sigma

FOR  
DUMMIES®

## Learn to:

- Grasp what Six Sigma is and how it works
- Achieve quantum leaps in performance and impact the bottom line
- Utilize the DMAIC problem-solving method

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with Neil DeCarlo





*Six Sigma*  
FOR  
DUMMIES®  
2ND EDITION



***Six Sigma***  
FOR  
**DUMMIES®**  
2ND EDITION

**by Craig Gygi and Bruce Williams**  
with Neil DeCarlo

**Foreword by Stephen R. Covey**

*Author, *The 7 Habits of Highly Effective People* and  
*The Leader in Me: How Schools and Parents Around the  
World Are Inspiring Greatness, One Child at a Time**



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# *About the Authors of the Revised Edition*

**Craig Gygi** began studying and applying the elements of Six Sigma and Lean before they were formalized into today's renowned improvement methodologies. As a graduate student in Mechanical Engineering at Brigham Young University, he integrated these cutting-edge improvement techniques into his coaching of student product development teams. Upon beginning his career at Motorola, he was formally introduced to the emerging Six Sigma method. It resonated deeply with his previous findings. From that time, Craig has applied, taught, and led Six Sigma in all his endeavors, including technical, management, and executive capacities at Iomega, General Atomics, ES3, and Fiji Water.

Craig now serves as Executive VP of Global Operations for MasterControl. MasterControl produces software solutions that enable regulated companies to manage their critical quality procedures and get their products to market faster, while reducing overall costs and increasing internal efficiency.

A Master Black Belt, Craig has wielded Six Sigma and Lean techniques now for over 18 years, spanning projects from design to manufacturing to business process management, and at companies as varied as Abbott Labs, American Express, and the US Air Force. He is also an expert teacher, having instructed and mentored at all levels.

Craig lives in Utah with his wife and children, where they enjoy its varied landscape and outdoor activities.

**Bruce David Williams** has been fascinated with complex systems since the launch of Sputnik on his birthday. With degrees from the University of Colorado in physics and astrophysics, he embarked on a career in aerospace systems, where he first encountered Six Sigma after Motorola won the inaugural Baldrige Award in 1988. Later, with graduate degrees from Johns Hopkins and Colorado in computer science and technical management, and as a member of the Hubble Telescope development team, he became intrigued with how large system failures could result from the breakdown of small components. He entered the Six Sigma industry in the late-1990s when he co-founded a software company to develop products for life-cycle traceability.

Bruce has since been the co-founder of two Six Sigma research and technology firms, including the Six Sigma Management Institute. He was co-founder and CEO of Savvi International, a provider of solutions for business performance improvement. He joined webMethods in 2006 to integrate enterprise-class information technologies with business process management and now is the Vice President of Pegasystems, the world leader in business process management.

Bruce resides in the desert foothills of north Scottsdale, Arizona, with his wife and assortment of dogs, cats, birds, horses, and varied native wildlife.



# *Dedication*

**Craig Gygi:** To Esti, my unexpected joy.

**Bruce Williams:** To Hannah and Evan, my remarkable children, as they transition into independent adulthood and put the concept of variance reduction to practical use.

# *About the Co-Author of the First Edition*

**Neil John DeCarlo** was a professional communicator in the continuous improvement, Lean, Six Sigma, sales and marketing, innovation, and corporate finance fields for nearly 25 years, beginning with his work at Florida Power & Light Company when it won the coveted Deming Prize for quality. Following that time, he authored, ghostwrote, or edited more than 150 articles and eight books in association with such companies as General Electric, DuPont, Bose Corporation, BMGI, McKinsey & Company, UPS, AT&T, the Six Sigma Academy, and many others. Neil also worked with several CEOs and consultants, including Japanese quality expert Dr. Noriaki Kano and the original co-architect of Six Sigma, Dr. Mikel Harry.

In addition to his writing accomplishments, Neil managed communication and publishing campaigns for a variety of companies, most notably BMGI, an international consulting firm that teaches and deploys Lean Six Sigma, innovation, and such other methods as Hoshin strategic planning. While not working, Neil enjoyed most all outdoor sports, reading, questioning everything, and practicing yoga. He lived in a small town called Fountain Hills, just outside Scottsdale, Arizona, with Jeannie — his lovely wife and best friend.

## *Dedication*

To Wanda Texon, who helped me believe in myself a long time ago, and who has been a constant source of support and intellectual stimulation for many years.

# *Authors' Acknowledgments to the 2nd Edition*

We're grateful for those who contributed their efforts and support to this 2nd edition of *Six Sigma For Dummies*.

Our deepest gratitude and thanks to Dr. Stephen R. Covey for his foreword — but much more so for his profound life-long insights and contributions to the betterment of individual leadership. Only a few weeks before the printing of this 2nd edition, Dr. Covey passed away. His passing poignantly reminded us of the transcendent power of the individual — both in the example of his own life and his remarkable influence on the world — and in the similar potential he taught resides within each of us.

Thank you also to Natalie Sayer, co-author of both the 1st and 2nd editions of *Lean For Dummies* (Wiley), for her expert collaboration and assistance.

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# Foreword

The world is on the verge of a new economic era. For the past century, the Industrial Age has been defined by tools and skills targeted at control, efficiency, specialization, delegation, scalability, and replicability. Accounting makes people an expense, a piece of equipment, an investment, and people are motivated by the great jackass theory of the carrot and stick. But although this paradigm has led to a 50-fold increase in productivity over the previous farming mindset, it has also led to a control paradigm, an entrenchment of a “leadership by position” mentality, with organizational hallmarks of lack of clarity regarding high priorities, lack of commitment or emotional connection by the workforce, lack of line-of-sight translation to specific action, disabling systems and processes, no synergy — interpersonally and interdepartmentally — and a lack of accountability.

Studies show that the vast majority of employees possess far more talent, more intelligence, more capability, more creativity, and more ability than their jobs require or even allow. Their deep potential remains dormant, untapped, and unused. Today, the Industrial Age is ending, and the Information Age or Knowledge Worker Age is opening. This new, emerging age is defined by “leadership is a choice” with an empowerment or unleashing-potential mentality; choices guided by values in the light of unchanging principles. In the new paradigm, the greatest asset in any organization is its people — whole people — with their bodies, minds, hearts, and consciences all engaged and contributing, and all receiving benefit in the progress of the organization. A trim tab is a small rudder on a boat or airplane that, through its relatively small motion, allows the bigger rudder to achieve the greater effect and leverage. The leaders of the Information Age act as trim tabs within organizations. Their relatively small actions at the bottom or middle can effect a much greater change throughout an entire organization.

Six Sigma has become a key enabling skill of the new Knowledge Workers of the next generation of trim tabs. One of the great values I admire of Six Sigma is the science, the database — and the careful analytic thought processes of problem solving using that data. Six Sigma empowers and enables you to effect remarkable change, no matter your position in your organization. The maturing world has transformed the previously exclusive, academic knowledge of Six Sigma into must-have best practices for everyone wishing to advance and contribute. In a knowledge economy where 70 to 80 percent of the value added to goods and services comes from knowledge work, can you imagine the results flowing from having the entire workforce Six Sigma literate?

That’s why *Six Sigma For Dummies* is a book to be read by everyone.

Stephen R. Covey

Author, *The 7 Habits of Highly Effective People*, *The 8th Habit*, and *The Leader in Me: How Schools and Parents Around the World Are Inspiring Greatness, One Child at a Time*



# Introduction

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**S**ix Sigma is the single most effective problem-solving methodology for improving business and organizational performance. There's not a business, technical, or process challenge that Six Sigma can't improve. The world's top corporations have used it to increase their profits collectively by more than \$100 billion over the past ten years. In certain corporations, indicating Six Sigma proficiency on your résumé is now a prerequisite to moving into a position in management.

If you're part of a *Fortune* 500 company — particularly a manufacturing company — you've heard about Six Sigma. You may even have been through a training regimen and been part of a corporate initiative or an improvement project. If so, you know the capabilities of Six Sigma; you've witnessed its achievements firsthand.

But if, like many people, you're outside of the upper echelons of big business, you may know Six Sigma by name only. It has been too expensive and complicated for small- and medium-sized businesses, public institutions, not-for-profit organizations, educational environments, and even aspiring individuals. Its potential has remained out of reach for the vast majority of professionals and organizations worldwide.

All this is changing. As the methods and tools of Six Sigma have spread, it has become easier to understand and more straightforward to implement. The mysteries of Six Sigma have been revealed.

Simply stated, Six Sigma is about applying a structured, scientific method to improve any aspect of a business, organization, process, or person. It's about engaging in disciplined data collection and analysis to determine the best possible ways of meeting your customers' needs while satisfying yours and minimizing wasted resources and maximizing profit in the process. *Six Sigma For Dummies*, 2nd Edition, helps you do just that.

## About This Book

This book makes Six Sigma accessible to you. We wrote it because Six Sigma is applicable everywhere — not only in large and complex corporations but also in the less complex and more intimate worlds of professional performance and personal accomplishment.

We wrote this book for you, the individual. You may be a small business owner, an ambitious career person, a manager who wants to know what Six Sigma is and how to apply it, a college student, or an applicant who wants to have an edge on upcoming job interviews. For you, this book is the place to turn.

*Six Sigma For Dummies*, 2nd Edition, is more than an overview or survey of Six Sigma. It's a comprehensive, actionable description of the methods and tools of Six Sigma. In this book, you find

- ✔ A reference book that's organized into parts, chapters, and sections so that you can flip right to what you need, when you need it
- ✔ A comprehensive text that addresses both the statistics of Six Sigma and the improvement methodology
- ✔ A description of how Six Sigma and Lean now combine to form the best of both improvement methodologies
- ✔ A guide for leading a Six Sigma initiative, selecting and managing Six Sigma projects, and executing specific Six Sigma tools and analytical procedures
- ✔ A step-by-step instruction manual for the Define, Measure, Analyze, Improve, and Control phases of the Six Sigma process
- ✔ A set of resources you can go to for additional help

Sure, Six Sigma is rigorous, technical, and analytical. But we've taken this difficult subject and made it understandable through examples, simple explanations, and visual aids.

## *Conventions Used in This Book*

When a specialized word first appears in this book, we italicize it and provide a definition. For many terms and phrases that industry practitioners use as acronyms, we define the term first and then use it in its abbreviated form going forward. Additionally, we use **bold** text to highlight the steps you take in numbered lists and the keywords in bulleted lists. Websites appear in monofont.

When we use the term *data*, we always mean it in the plural sense. Although statisticians debate about using *data* in both a plural and singular sense, we stick with the plural only because our editor told us we had to. Otherwise, *datum* is the singular form.

We do use some business management and statistical concepts and language. If you want to get extra smart, check out the latest editions of *Managing For Dummies* by Bob Nelson and Peter Economy and *Statistics For Dummies* by Deborah Rumsey (both published by Wiley).

## What You're Not to Read

We know you're busy, so if you're short on time, you can skip the text in the gray-shaded *sidebars* and anything flagged by a Technical Stuff icon. These tidbits are interesting but contain more historical or technical detail than you need to understand the basic topic at hand.

## Foolish Assumptions

We assume you've heard about Six Sigma and are intrigued and compelled to find out more for any one or more of the following reasons:

- ✔ You're contemplating applying Six Sigma in your business, and you need to understand what you may be getting yourself into.
- ✔ Your business is implementing Six Sigma, and you need to get up to speed. Perhaps you've even been tapped to participate as a Champion, Black Belt, Green Belt, or Yellow Belt.
- ✔ You believe Six Sigma is a pathway to better performance in your job and can help you advance your career.
- ✔ You're considering a career or job change, and your opportunities require you to understand Six Sigma.
- ✔ You're a student in industrial engineering or business school and realize that Six Sigma is part of a path to success.

We also assume that you realize Six Sigma demands a rigorous and structured approach to problem-solving that calls for capturing data and applying statistical analysis to discover the true causes of the challenges you may be facing in manufacturing, service, healthcare, or even transactional environments. For that reason, several chapters of this book describe and define the statistical tools of Six Sigma.

## How This Book Is Organized

We break this book into six separate parts. Each is written as a stand-alone section, permitting you to move about the book and delve into a given topic without necessarily having to read all the preceding material first. Anywhere we expound upon or extend other material, we reference the chapter or part of origin so that you can tie the discussions together.

## ***Part I: Getting Acquainted with Six Sigma Basics***

Part I is an overview of the Six Sigma methodology, the system of deployment, roles, and responsibilities. In this part, we address the key principles underlying the science of Six Sigma and its applications. Chapter 1 is a comprehensive overview of Six Sigma. Chapter 2 connects quality improvement to business performance. Chapter 3 introduces the key principles. Chapter 4 discusses roles and phases in the implementation of a Six Sigma deployment.

## ***Part II: DMAIC: Defining and Measuring***

Part II is where we begin digging into the depths and details of practicing Six Sigma by presenting the information in the context of Six Sigma's DMAIC problem-solving road map. The first two phases, Define and Measure, enable you to properly scope and launch a project (Chapters 5 and 6) and then objectively identify all possible causes of problems (Chapters 7, 8, and 9).

## ***Part III: DMAIC: Analyzing***

In this part, we discuss the Analyze phase of Six Sigma's DMAIC problem-solving road map. This phase is where you objectively eliminate trivial and non-important factors, zeroing in on the true root cause. Chapter 10 shows how you can use basic charts and graphs in this effort. Chapter 11 discusses value analysis, while Chapters 12 and 13 cover normal variation and analyzing for capability. In Chapter 14, you discover the important topic of analyzing your own measurements, and Chapter 15 discusses how to glean insight just from watching a process in operation. Chapter 16 concludes this part by showing you how to measure the risk and confidence in your analysis decisions.

## ***Part IV: DMAIC: Improving and Controlling***

Part IV wraps up the methods and tools used in the DMAIC problem-solving road map. The intent of the Improve and Control phases is to synthesize an improvement and then lock in the gains that you've achieved. Chapter 17 introduces the science of making predictions about future performance, and Chapter 18 gives you the lowdown on how to design, conduct, and analyze powerful experiments. In Chapter 19, we show you ways to make newly achieved improvements permanent. Chapter 20 covers the important topic of statistical process control.