The background of the entire page is a light blue Sri Yantra, a complex geometric diagram consisting of nine interlocking triangles that radiate from a central point, enclosed by two circles of lotus petals and a square frame with four T-shaped gates.

**THE TEN  
COMMANDMENTS  
OF  
LEAN SIX  
SIGMA  
A GUIDE FOR  
PRACTITIONERS**

**JIJU ANTONY  
VIJAYA SUNDER M  
CHAD LAUX  
ELIZABETH CUDNEY**

# THE TEN COMMANDMENTS OF LEAN SIX SIGMA

PRAISE FOR THE TEN COMMANDMENTS OF LEAN SIX SIGMA:

*I am delighted to finally see a well-structured Lean Six Sigma book that focuses on the behavioural and cultural necessities for successful Lean Six Sigma programs rather than on the use of tools and techniques. The authors have drawn upon their vast experiences working with Operational Excellence programs across diverse industries to bring us the absolute must-have components for success.*

— **John Dennis**, Chairman, International Lean Six Sigma Institute, UK

*I would recommend this book as it captures the essence of results-based references to the tools and concepts required in a structured way to achieve the process of implementing the leverage of Lean Six Sigma to maximise efficiencies and maintain the managerial process. Every business needs to revisit and discover how to propel your organisation to new levels of competitive success this book will support and guide you.*

— **Michael Mitchell**, Managing Director, Bespoke Clinical Care Ltd, UK

*The Ten Commandments of Lean Six Sigma brings together the leading authors of our time and presents a unique guide for any leadership team as they embark on their LSS journey. The final chapter on the future of LSS is a must read for established LSS practitioners.*

— **Stephen G Anthony**, Master Black Belt and CEO of the Institute of Six Sigma Professionals, Wales, UK

*In today's competitive world, any firm needs to be conscious of quality, cost and timely delivery. To achieve this, the book The Ten Commandments of Lean Six Sigma will be a very useful guide for practitioners. The book addresses all that is required by the*

*practitioners to implement LSS in their respective organizations. This book aims to transfer the knowledge that is available with the academic world for its practical application in the competitive business world.*

— *S Navaneetha Krishnan, Senior Deputy General Manager at Warship Design Centre, Larsen & Toubro and Commander (Retd), Indian Navy*

*The authors' experience with training in both academic and industrial settings are evident, as the methods prescribed for preparing individuals for LSS execution are applicable to both scenarios and will likewise prepare the reader for either. They understand that it is not enough to be technically proficient, in order to be a successful LSS practitioner, and they offer solid advice in the critically required soft skills, as well. This book will help any organization preparing to embark upon the continuous improvement journey.*

— *David W. Hoffa, PhD, ASQ CSSBB, External Process Engineering Manager, Johnson & Johnson*

*This book is definitely a new piece of art in Lean Six Sigma literature! The authors present an exceptional combination of rigorous literature review and solid pragmatic recommendations addressing critical topics in Lean Six Sigma from top to bottom. Content is brilliantly presented in an understandable language and the sequencing of commandments flows smoothly and logically in a way that you just can't stop reading.*

— *Marcelo Machado Fernandes, PhD, ASQ Certified Master Black Belt, Lean Six Sigma Consultant at FCV and SETA, Consultant at Minitab LLC, Founder of MF Treinamentos (MF Operational Excellence), Brazil*

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# THE TEN COMMANDMENTS OF LEAN SIX SIGMA

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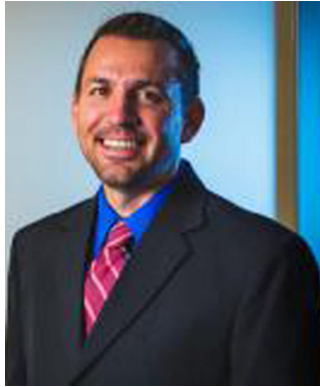
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# PREFACE

Lean Six Sigma (LSS) is a powerful Operational Excellence (OE) methodology for making critical business processes more efficient and effective by reducing waste and variation, which results in enhanced customer satisfaction, improved productivity and reduced operational costs. While the success stories speak for themselves, there were critics who have highlighted the failure of LSS due to various reasons. As more and more organisations are joining the journey of LSS, the failure of this initiative is also surfacing from various organisations. Though there is significant research evidence available on critical success and failure factors of LSS implementation in organisations, these aspects have been merely restricted to the tactical side of LSS.

Though organisations initially realised LSS as an effective toolkit with a collection of problem-solving tools for process improvements, later the evolution of understanding clarified LSS as an organisation strategy and a leadership approach for imbibing the quality culture in organisations. Although a plethora of articles on Lean Six Sigma have been published in a wide variety of sources, the authors have observed that no general guidelines have been provided to organisations for implementing and sustaining this powerful business process improvement strategy.

This book presents *Ten Commandments of Lean Six Sigma* from the perspective of practitioners, researchers and academics who have been involved in the training, teaching, research and consultancy on various topics of quality and continuous improvement such as Lean, Six Sigma and LSS. These commandments can serve as a practical guide for senior managers and executives for achieving operational and service excellence in various manufacturing, service and public sector organisations despite their

size. We hope that business executives and senior managers as well as a number of practitioners and consultants will find this book useful in conveying the key elements to launch and sustain an OE journey in any organisational setting.

The book is divided into 11 chapters. The first chapter is an introduction to Lean Six Sigma (LSS) as a powerful Operational Excellence (OE) methodology for achieving both efficiency and effectiveness in business processes. The remaining chapters are the Ten Commandments of Lean Six Sigma which include some of the most important factors which need to be taken into account for the successful journey of LSS. Some chapters include the latest trends or emerging themes which will be essential for the further growth of OE in the next 25 years or so. We truly hope this book inspires many senior managers in organisations to get into the habit of embracing OE strategy for creating and sustaining competitive advantage. We are indebted to many contributors and leading experts for the development of OE strategy and its associated tools and techniques applied in industry today, especially Mr. Taiichi Ohno as the father of the Toyota Production System, Professor James Womack, Professor Daniel Jones and Professor Daniel Roos for their contributions to the Lean Production System in creating value for customers through continuous improvement, Dr. Mikel Harry who has done some pioneering work in Motorola for the development of Six Sigma as a business process improvement strategy and methodology and, finally, Mr. Michael George for his unique contribution to the integration of the most two powerful OE methodologies such as Lean and Six Sigma.

**Jiju Antony, Vijaya Sunder M., Chad Laux  
and Elizabeth Cudney**

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# INTRODUCTION TO LEAN SIX SIGMA AND TEN COMMANDMENTS

## 1.1 INTRODUCTION TO LEAN AND SIX SIGMA

While a number of continuous improvement (CI) methodologies exist in the literature, Lean and Sigma have been used for over 30 years in several organisations, proving to be most powerful and renowned. The development of an effective CI strategy is a key factor for long-term success in modern organisations. Over the last 15 years, Lean Six Sigma (LSS) has become one of the most popular and proven business process improvement or CI methodologies organisations have witnessed in the past. This chapter provides a quick overview of Lean, followed by Six Sigma and its integration called LSS. It also outlines the importance of the Ten Commandments of LSS which are primarily aimed for business leaders and senior executives in organisations. The Ten Commandments of LSS are based on several years' experience of four co-authors who act as LSS Master Black Belts, practitioners, trainers and researchers on various topics of Lean, Six Sigma and general quality management/CI topics.

Lean has had a tangential development history compared to Six Sigma. Much of the Lean Production System (LPS) is based on the Toyota Production System (TPS) (Womack, Jones, & Roos, 2007).

TPS has roots that go back to Henry Ford's development of the assembly line and Frederick Taylor's work on scientific management (Womack & Jones, 2003). The concept of LPS involves determining the value of any process in the eyes of customers by distinguishing value-added activities or steps from non-value-added activities or steps and eliminating waste. Krafcik (1988) is generally credited with the first use of the term 'Lean Production System'. Lean began with a manufacturing emphasis and was referred to as lean manufacturing for many years. Gradually, organisations learnt that the same principles of push vs pull system, identification and reduction or even elimination of waste and standardisation of processes/procedures, can also be applied to non-manufacturing settings.

While it is impossible to set a definite date for the beginning of Six Sigma, around the mid-1980s, Bill Smith and his colleagues in Motorola began improvement projects that looked similar to Total Quality Management (TQM). Motorola was facing fierce and stiff competition with its competitors in the pager market and needed to improve quality as well as reduce operational costs to stay in business. Bob Galvin, the CEO of Motorola, along with his colleagues decided to invest in Six Sigma and adopted it as a core strategy at the operational level for delivering quality at low costs. Six Sigma provided an overall roadmap for solving complex problems with unknown solutions (Snee & Hoerl, 2005). Motorola achieved tangible and measurable results to the bottom line, and other organisations began to take notice of Motorola's success including Honeywell (previously Allied Signal). In 1995, Jack Welch who was the CEO of GE (General Electric) stated that the company would incorporate Six Sigma to reduce defects and operational costs. Consequently, this initiative became well recognised, appearing on the front pages of well-known newspapers.

Welch (2001) told Wall Street analysts that Six Sigma would be the biggest initiative ever launched by GE and that it would be his biggest priority for the next five years. Before official results emerged for the company, GE stock began to rise, and many other companies started looking more closely at Six Sigma. Based on GE Capital's success, other financial institutions began Six Sigma initiatives. One of the most successful has been by Bank of America, which has publishing savings in the billions of dollars annually

(Sunder, Ganesh, & Marathe, 2019). Similarly, Commonwealth Health Corporation launched the first major Six Sigma deployment in healthcare in the late 1990s and produced millions of dollars of savings in the radiology department alone within a year (Snee & Hoerl, 2005). In the late 1990s and early 2000s, a large number of organisations, in diverse industries, launched Six Sigma initiatives, including DuPont, Dow Chemical, 3M, Ford and American Express, to name just a few. The US military began major investments in Six Sigma at this time as well. Overseas, companies in Europe and Asia began to implement Six Sigma to varying degrees, particularly Korean companies such as Samsung (Snee & Hoerl, 2003).

## 1.2 WHY IS THE INTEGRATION OF LEAN AND SIX SIGMA A BETTER APPROACH FOR PROBLEM-SOLVING?

Although both Lean and Six Sigma had produced immense and significant benefits to many organisations, they do have some limitations. George (2002) has successfully integrated these two powerful methodologies for business process improvement and claimed that the integrated approach is superior to using Lean or Six Sigma on its own. His view was that Lean is not well suited to resolving complex problems that require intensive data analysis and advanced statistical tools and techniques. Those implementing Six Sigma found that not every problem needed several months of data collection to resolve. Quality professionals found that Lean principles and tools could be primarily applied with minimal data collection and achieve immediate results.

In many Lean applications, the solution to the problem is known to the team and all that is needed is a methodology and a set of tools to implement the known solution. Lean is primarily focused on the flow of information and material between processes. Therefore, if the root cause of the problem is a flow issue, Lean is likely to work well. However, if the problem involves understanding the most critical process parameters which influence the output and if the output varies significantly due to a number of factors, this will be a great candidate for the Six Sigma methodology.

Deploying Six Sigma in isolation cannot remove all types of waste from the business process, and deploying Lean in isolation cannot bring a process into a state of statistical control and remove variation from the process (Corbett, 2011). Therefore, some companies have decided to merge both methodologies, rather than implement them in isolation to come up with a more powerful strategy for process excellence and optimising processes (Bhuiyan, Baghel, & Wilson, 2006). Bertel (2003) highlighted that using either one of the methodologies alone has limitations: Six Sigma will eliminate defects in processes, but it will not address the question of how to optimise process flow. In contrast, Lean principles are not helpful in achieving high-capability and high-stability processes.

According to Antony, Snee, & Hoerl (2017), the integration of Lean and Six Sigma in organisations increases efficiency and effectiveness, helping them to achieve superior performance faster compared to the implementation of each approach in isolation. Lean Six Sigma (LSS) is a business process improvement methodology that focuses on process performance, resulting in enhanced customer satisfaction and improved bottom-line results in hard-cash savings. LSS provides the concepts, methods, tools and techniques for process management. It is an effective leadership development tool as it prepares leaders for their role in managing change. A review of over 20 case studies of LSS has shown the following benefits of LSS:

- Increased profits and financial savings
- Increased customer satisfaction
- Reduced operational cost
- Reduced cycle time
- Improved key performance metrics
- Reduced defects in processes
- Reduced machine breakdown time
- Reduced inventory
- Improved throughput yield
- Increased production capacity

### 1.3 LSS METHODOLOGY: AN OVERVIEW

The LSS methodology is used for solving existing problems in any process when the solution is unknown or when a confirmation is needed to validate the root cause of the problem. LSS experts follow a stringent and disciplined methodology called Define-Measure-Analyse-Improve-Control (DMAIC), and this section presents a brief overview of this powerful methodology.

**Define Phase:** In this phase, we usually define the problem or the opportunity for improvement. This is a very important phase of problem-solving. If we do not define and formulate the problem correctly upfront, one may struggle in the development of appropriate solution at a later stage. The common tools used in this phase are Voice of the Customer (VOC) analysis, Supplier-Input-Process-Output-Customer (SIPOC), Process Mapping, Project Charter, etc.

**Measure Phase:** In this phase, we need to measure the baseline performance of the process, and this measurement is used as a yardstick for further improvement. The common tools used in this phase are Critical-to-Quality drill-down tree, Measurement System Analysis (MSA), Run Charts or Control Charts, Process Capability Analysis, etc.

**Analyse Phase:** In this phase, we need to understand the potential/root causes of the problem due to excessive process variability. Typical tools used in this phase include Hypothesis Testing, Pareto Chart, Scatter Diagram, Correlation Analysis, Cause and Effect Analysis, Histogram, Root Cause Analysis, etc.

**Improve Phase:** In this phase, the process performance will be improved through the development of potential solutions which can eliminate the root causes of the problem at hand. One may generate potential solutions, select and prioritise them, perform risk assessment, pilot the solution for its effectiveness and finally evaluate the benefits. Typical tools used in this phase include Prioritisation Matrix, Design of Experiments, Single Minute Exchange of Dies, etc.

**Control Phase:** The goal of the control step is to sustain the gains by standardising the work methods or processes, anticipating future

improvements and capturing and documenting the key lessons learnt from the project and exploring the opportunities of transferring the knowledge to other operations in the business. Typical tools used in this phase include Standard Operating Procedures (SOP), Visual Management, Control Charts, Poka-Yoke (Mistake-Proofing), etc.

#### 1.4 AN OVERVIEW OF THE TEN COMMANDMENTS OF LSS

In this section, the authors provide an outline of the Ten Commandments of LSS. These are the essential ingredients to be understood by senior executives and business leaders in any organisational setting for the successful deployment of LSS. Each chapter in the book will be focussing on these vital points in detail.

- 1. Alignment of Lean Six Sigma with organisational strategy:** The leaders and business executives should ensure that the LSS is an integral part of the organisational strategy and ensure that selection of projects is aligned with the strategic goals of the business.
- 2. Lean Six Sigma project selection and prioritisation:** For the successful journey of LSS and its sustainability, it is essential that projects must be identified and prioritised for their execution by project teams.
- 3. Selecting the top talent for the execution of projects:** In order to gain momentum for the use of LSS in any organisation, it is critical that one should select the top talented people for the execution of projects and a set of skills should be developed for project leaders at Green Belt and Black Belt levels.
- 4. Leadership for LSS:** Leadership has proved to be one of the most critical success factors of LSS (Laureani & Antony, 2018). Deming suggested that quality excellence could not be achieved in organisations without educating leadership on the

importance of quality, and the same analogy could be applied to process excellence.

5. **Effective training and design of curriculum for different LSS roles:** Training should be imparted to all those concerned such as LSS project champions and LSS project leader (Black Belts, Green Belts, etc). An awareness of LSS through LSS executive workshops is highly desirable for all senior managers in the organisation to understand their level of involvement and commitment throughout the implementation and sustainability of LSS.
6. **Development of reward and recognition system:** A reward and recognition system should be an inherent part of any change management initiative. Leaders in the organisation should introduce some form of incentive or reward and recognition system for sustainability of the LSS initiative.
7. **Lean Six Sigma sustainability:** Sustainability of LSS is one of the biggest challenges for all organisations today. The authors suggest the importance of sustainability in the roadmap of successful LSS deployment and people should be aware of the factors which influence the sustainability of the LSS initiative.
8. **Linking LSS with organisational learning and innovation:** LSS is an enabler of individual learning as it promotes activity-based learning through project management and structured problem-solving. Anand, Ward, Tatikonda, & Schilling (2009) provides empirical evidence of the dynamic capability perspective and its underlying theory of organisational learning for CI such as LSS. A study carried out by Antony, Setijono, & Dahlgaard (2016) with 10 UK-based companies has shown that LSS fosters continuous or incremental innovation.
9. **Linking LSS with Green and environmental sustainability:** Recent research suggests that Lean, Six Sigma and Green approaches make a positive contribution to the economic, social and environmental (i.e. sustainability) performance of organisations. The results of one study showed that the



integration of LSS and Green helped the organisations to reduce their resources consumption on average by 30% and minimise the cost of energy and mass streams by 9% on average (Cherrafi et al., 2017).

- 10. Beyond Lean Six Sigma:** Research has shown that several themes have emerged over the past few years which are complementary to LSS. These themes are derived from authors' interventions with a few companies as well as involvement of several panel discussions and interactive workshops from various conferences the authors have been involved with. These themes include LSS and Big Data, LSS and Industry 4.0, LSS and Rapid Process Automation. Business leaders and senior executives should have a solid understanding of these emerging themes and, consequently, integrate these methodologies within their organisations.

## 1.5 SUMMARY

This chapter provides an overview of the book clearly outlining the origin of LPS, the origin of Six Sigma and then demonstrating the importance of the integration of Lean with Six Sigma or LSS. This chapter also outlines the Ten Commandments of Lean Six Sigma and how these commandments can be beneficial to senior business leaders and executives in organisations, irrespective of their size and nature.