

LEAN Supply Chain Planning

The New Supply Chain Management
Paradigm for Process Industries to
Master Today's VUCA World

Josef Packowski



CRC Press
Taylor & Francis Group

A PRODUCTIVITY PRESS BOOK

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Contents

Introduction: What the Book Is All About.....	xvii
Reader's Guide	xxv
About the Author and the Motivation for This Book	xxxiii
Acknowledgments	xxxvii

PART I Why LEAN SCM Today?

Chapter 1	Supply Chain Management in Process Industries	3
1.1	Supply Chain Management Must Master the VUCA World	5
1.1.1	Supply Chain Management Orchestrates Global Functions and Networks.....	5
1.1.2	Key Pain Points in Supply Chain Organizations Today.....	6
1.1.3	Why Leadership Is Concerned about the Impact of Volatility.....	7
1.2	Supply Chain Planning in the VUCA World Today	8
1.2.1	Planning and Control as the Backbone of Supply Chain Management	9
1.2.2	The VUCA World Poses New Challenges to Supply Chain Planning	11
1.2.3	Today's Supply Chain Planning Approaches and Their Limitations	17
1.3	Why We Need a Paradigm Shift in Supply Chain Planning Now.....	21
1.3.1	Traditional Planning Approaches Fail to Deal with the VUCA World.....	22
1.3.2	Common Lean Approaches Are Insufficient for Global Supply Chain Synchronization.....	27
1.3.3	How to Back Out of the Dead End of Today's Planning	32
	Chapter Summary	35

Chapter 2	Guiding Principles of LEAN SCM Planning: Facing VUCA Challenges	37
2.1	LEAN Demand: How to Cope with Rising Demand Variability	37
2.1.1	Accept Uncertainty and Eliminate the Need for Certainty in Execution	38
2.1.2	A View of Aggregated Demand: Be Prepared for Consumption-Driven Supply	39
2.1.3	Stop Using Forecasts to Trigger Manufacturing: Respond to Real Consumption	41
2.2	LEAN Supply: How to Get a Grip on Supply Uncertainty and Reliability	43
2.2.1	Manage Demand Spikes with Planned and Right-Sized Safety Stock Buffers	43
2.2.2	Level Production Plans to Create Flow and Stabilize Utilization	45
2.2.3	Use Cyclic Production Patterns to Achieve a Common Takt and Regularity	46
2.3	LEAN Synchronization: How to Master Complexity and Ambiguity	48
2.3.1	Separate Planning to Slice Complexity for End-to-End Synchronization	49
2.3.2	“Parameter-Driven” End-to-End Supply Chain Planning	50
2.3.3	Establish Visibility and a Collaborative Environment for Synchronization	51
	Chapter Summary	53
Chapter 3	Fundamentals of LEAN SCM Planning: A Paradigm Shift in Planning	55
3.1	What Is the Most Suitable Supply Chain Planning Approach to Follow?	56
3.1.1	The Lean Supply Chain Is More about Waste Elimination and Cost Efficiency	56
3.1.2	The Agile Supply Chain Is More about Responsiveness and Customer Service	57

3.1.3	The Resilient Supply Chain Is More about Risk-Avoidance and Robustness	58
3.1.4	Trade-Offs among the Common Paradigms in Supply Chain Management	59
3.1.5	How LEAN SCM Combines and Builds upon a New Planning Paradigm	61
3.2	The Building Blocks for LEAN SCM Planning: Concepts and Highlights.....	66
3.2.1	Flexible Rhythm Wheels Enable Cyclic Planning while Responding to Variability.....	67
3.2.2	Dynamic Safety Buffers in Planning for Two-Sided Variability Management	71
3.2.3	Cycle Times and Inventory Targets Aligned to Global Takt for Synchronization ..	73
3.2.4	Separation of Tactical Pre-Parameterization and Planning to Reduce Complexity	75
3.2.5	Enabling IT to Create Global Visibility and Staying Power for Sustainability.....	78
3.3	How LEAN SCM Planning Drives Corporate Success in the VUCA World	81
3.3.1	Creating a Step Change in Supply Chain Performance	81
3.3.2	Better Service Leads to Customer Satisfaction and True Competitive Advantages	82
3.3.3	World-Class Operational Supply Chain Performance Means Financial Success.....	84
	Chapter Summary	85

PART II How to Design and Build LEAN SCM

Chapter 4	Prepare Your Supply Chain for LEAN SCM	89
4.1	Segment and Strategize Your Supply Chain	90
4.1.1	How Many Supply Chain Strategies Are Needed?.....	90
4.1.2	Structure Customers and Products to Build Supply Chain Segments.....	92

4.1.3	Assigning Strategies to Defined Supply Chains	95
4.2	Aligning the Supply Chain from a Top-Down Perspective	99
4.2.1	Create End-to-End Transparency in Supply Chains	99
4.2.2	Identify and Assess Gaps to Improve Supply Chain Synchronization	105
4.2.3	Adopt Three Measures for Preparing the Supply Chain	113
4.3	Aligning the Supply Chain from a Bottom-Up Perspective	120
4.3.1	Gain Transparency into Local Value Streams	121
4.3.2	Analyze Value Streams to Prepare the Shop Floor for LEAN SCM	123
4.3.3	Aim for Leveled Flow Design	130
	Chapter Summary	137

Chapter 5 Strategic LEAN Supply Chain

	Planning Configuration	139
5.1	What to Produce: Replenishment Modes	141
5.1.1	Sell What You Make: Forecast-Based Push Replenishment	142
5.1.2	Make What You Sell: Consumption-Based Pull Replenishment	143
5.2	How to Produce: Production Modes	150
5.2.1	Kanban and Its Advancements for Process Industries	150
5.2.2	Product Wheels and Rhythm Wheels for Cyclic Production Planning	154
5.2.3	How to Manage Variability with Different Rhythm Wheel Types	158
5.3	Supply Chain Mode Selection: Combining Production and Replenishment Modes	167
5.3.1	Define the Configuration Scope of the Supply Chain Segment	168

5.3.2	Analyze Key Impact Dimensions of Mode Selection	170
5.3.3	Select the Appropriate Supply Chain Modes.....	182
5.3.4	Evaluate Your Decision Quantitatively	185
5.4	The Strategic Renewal Process to Configure Agile Supply Chains	188
5.4.1	What Information Base Is Needed on Strategic Level?.....	189
5.4.2	Establish Sustainable Renewal of Supply Chain Modes.....	191
5.4.3	Ensure Supply Chain Agility through Regular Mode Renewal.....	193
5.4.4	Who Is Involved to Enable Governance for Supply Chain Agility?	194
	Chapter Summary	196

Chapter 6 Tactical LEAN Supply Chain Planning

	Parameterization.....	199
6.1	Setting Up the Parameters for LEAN Production Modes	201
6.1.1	Classic Rhythm Wheel Design to Enable Flow in Stable Environments.....	203
6.1.2	Breathing Rhythm Wheel Design to Manage Higher Demand Variability	211
6.1.3	High-Mix Rhythm Wheel Design to Manage Diverse Product Portfolios.....	216
6.2	Setting Up the Parameters for LEAN Replenishment Modes.....	222
6.2.1	How Stocks Are Structured for Variability and Uncertainty	223
6.2.2	Right-Size the Parameters to Enable Consumption-Based LEAN Replenishment.....	227
6.3	Synchronize Parameters to Achieve an End-to- End LEAN Supply Chain.....	234

6.3.1	Synchronize Supply Chain Cycle Times to a Global Takt.....	236
6.3.2	Build on Dynamic Inventory Target Setting to Smooth Cycle Time Oscillation..	245
6.4	The Tactical Renewal Process to Parameterize LEAN Supply Chains	253
6.4.1	What Information Base You Need	255
6.4.2	Establish Regular Renewal of Planning Parameters	256
6.4.3	Alignment of Planning Parameters for the LEAN Supply Chain	263
6.4.4	Who Is Involved in Keeping the Supply Chain LEAN through Synchronized Parameters?	264
	Chapter Summary	267

Chapter 7 Operational LEAN Supply Chain Planning

	Execution.....	269
7.1	How to Execute Planning and Sequencing with Rhythm Wheels	270
7.1.1	The Replenishment Trigger Report as a Link between Production and Replenishment	271
7.1.2	Handling of Demand Signals with Rhythm Wheels.....	274
7.2	How to Level Production with Factoring.....	277
7.2.1	Use Cycle Time Boundaries to Stabilize the Asset Takt.....	277
7.2.2	Use Upper Factoring When the Cycle Becomes Too Long	279
7.2.3	Use Lower Factoring When the Cycle Becomes Too Short.....	282
7.3	Effective Monitoring of Planning Execution in LEAN SCM.....	284
7.3.1	What Should Be Monitored?.....	284
7.3.2	Operational LEAN Production KPIs to Monitor Asset Performance	286

7.3.3 Operational LEAN Replenishment KPIs to Evaluate Inventory Parameterization	289
Chapter Summary	292

PART III What to Implement and Transform for LEAN SCM

Chapter 8 Build an Organization for LEAN SCM	297
8.1 Below the Ground: The Prerequisites for LEAN SCM.....	299
8.1.1 Management Buy-In and Mobilization for LEAN SCM.....	300
8.1.2 Ensuring Leadership and Commitment across Functional Borders.....	302
8.1.3 Shift in Mindsets and Accountabilities in the SCM Community.....	304
8.2 Above the Ground: The Visible Enablers for LEAN SCM.....	307
8.2.1 What Is the Right SCM Organization Model for LEAN SCM?.....	307
8.2.2 Integration of LEAN SCM Processes with the Existing Planning Processes Framework.....	310
8.2.3 Mapping Roles and Responsibilities to Renewal Processes	316
8.3 Managing Change and Transition for LEAN SCM	319
8.3.1 Focus Areas of Change Management	319
8.3.2 Key Activities of Change Management	321
8.3.3 Valuable Tools for Change Management in LEAN SCM.....	324
Chapter Summary	327
Chapter 9 Performance Management for LEAN SCM.....	329
9.1 Role of Performance Management in LEAN SCM	330
9.1.1 Key Objectives of Performance Management for LEAN SCM	330

9.1.2	Orchestrating Supply Chain Planning Processes Successfully.....	333
9.1.3	How the LEAN SCM Paradigm Changes Your Performance Management	335
9.2	How to Measure LEAN SCM Performance.....	337
9.2.1	Metrics to Link Tactical and Operational LEAN Supply Chain Planning.....	338
9.2.2	Metrics for Linking Strategic and Tactical LEAN Supply Chain Planning.....	339
9.2.3	Metrics for Assessing the Maturity of a Supply Chain for LEAN SCM.....	341
9.3	Five Points to Consider for Successful Performance Management	344
9.3.1	Develop a Balanced and Comprehensive System of Metrics	344
9.3.2	Effective Target Definition for Performance Tracking	345
9.3.3	Systematic and Regular Performance Analysis for Sustainability.....	347
9.3.4	Create Clear Responsibility for Metrics	348
9.3.5	Use Data Management and IT Systems for Support.....	349
	Chapter Summary	350

Chapter 10 The Planning System Landscape for LEAN SCM..... 353

10.1	The Evolution of IT Planning Systems.....	354
10.1.1	MRP II: Consideration of Capacity but Captured in the Automation Trap	355
10.1.2	ERP: Functional Integration but Lost in the Details.....	356
10.1.3	APS: Supply Chain Integration but Caught in the Optimization Trap	357
10.1.4	The Forecast Myth: An Overarching Obstacle.....	358
10.1.5	IT for LEAN Planning: How to Escape the Optimization Trap and the Forecast Myth	358

10.2	Enabling LEAN Planning: How to Leverage Past IT Investments	360
10.2.1	Enterprise Resource Planning	361
10.2.2	Master Data Management	362
10.2.3	Market Demand Planning (APS Module).....	362
10.2.4	Supply Network Planning (APS Module).....	363
10.2.5	Detailed Planning and Scheduling (APS Module)	363
10.3	LEAN Planning Add-Ons to Complete the IT System.....	365
10.3.1	Configuring and Renewing Tactical LEAN SCM Parameters.....	366
10.3.2	Planning and Adjusting Production Based on Actual Consumption.....	368
10.3.3	Performance Monitoring for the Renewal Process.....	372
	Chapter Summary	379
Chapter 11	The LEAN SCM Journey	381
11.1	Building Strong Commitment and Leadership for LEAN SCM.....	382
11.2	Creating a Holistic LEAN SCM Architecture	384
11.3	Establishing LEAN SCM Program Management ...	388
	Chapter Summary	390
 PART IV How Your Industry Peers Gained Benefits by LEAN SCM		
Chapter 12	Read How Top-Industry Players Share Their Experiences with LEAN SCM	393
12.1	Motivation and Approaches to LEAN SCM	393
12.1.1	AstraZeneca's Lean SCM Journey.....	394
12.1.2	Eli Lilly's Synchronized Lean Production...	400
12.1.3	Buffer Management at Novartis	409
12.1.4	Leveled Flow Design to Enable LEAN Planning.....	417

12.1.5	AstraZeneca Excellence with Rhythm Wheel Taktet Site.....	425
12.1.6	The LEAN Production Initiative at PCI: A Company of BASF	432
12.2	Why LEAN SCM: Summary of Key Benefits	437
	Bibliography	439
	Index.....	441

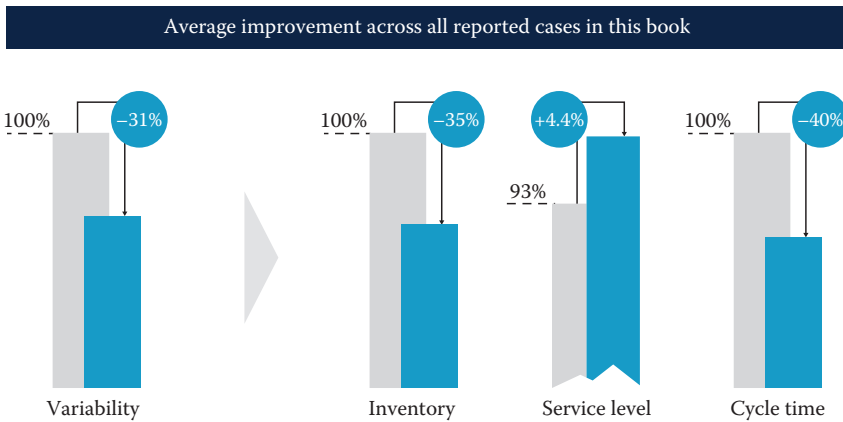
Introduction: What the Book Is All About

Today, many global supply chains in process industries are neither equipped nor orchestrated to cope effectively with the new VUCA world we are facing. VUCA—volatility, uncertainty, complexity, and ambiguity—is an acronym that originated in the military back in the late 1990s and was quickly adapted to the business environment. It describes precisely the conditions of increasing variability and uncertainty of demand, and the complexity and ambiguity of product portfolios and supply chain networks in which companies operate today.

Facing the threat of increasing VUCA challenges, manufacturers are left grasping for what it means to build a superior supply chain management (SCM) organization that is capable of managing these challenges effectively. Which enablers for agility are required to manage future VUCA dynamics? Those in global network structures (the network footprint) or others in the extended supplier relationship configuration (contract manufacturers, service providers, or suppliers)? Which aspects of today's operational and organizational lean initiatives are delivering tangible cost and efficiency results? How can supply chain organizations sustain reliable supply in an era of ever-widening virtualization of supply networks and increasing exposure to global risk? Finally, where can supply chain managers turn for the answers to these questions?

In response to these challenges, CAMELOT Consulting Group has worked jointly with leading research institutes and key global industry players to come up with a “*New Supply Chain Planning Paradigm*” to face the VUCA challenges in SCM in a new way. The paradigm change in orchestrating supply chains is best explained by laying out a new approach to managing variability, uncertainty, and complexity in today's planning processes and systems.

A few pioneering supply chain organizations in the process industry have already embraced the new way of coordinating and synchronizing their global networks. The reports and industry cases included in this book (see Figure 0.1).

**FIGURE 0.1**

A step change in variability management improves key supply chain metrics.

Before we move on to present this new supply chain planning approach, we want you to clearly understand the need for a paradigm shift first. In process industries, today's usual supply chain planning practices aim to determine manufacturing decisions up to 12 months prior to delivering actual products to the customers. To do so, planners reach out to their sales and marketing colleagues and ask them for forecasts—preferably as detailed and accurate as possible at the SKU (stock-keeping unit) level. It is obvious that the supply chain performance resulting from such a forecast-based SCM approach is directly linked to the quality of sales forecasts. Therefore, it is understandable that all excellence initiatives in the past have started inevitably by attempting to improve on forecast accuracy, establishing the forecast myth that all activities could be perfectly planned and which still dominates corporate practices. However, ask yourself if we do not all experience difficulty in determining our own personal futures 12 months out, even regarding the subjects we ought to know most about. How then can we expect our sales organizations to know what the future holds for our products in volatile marketplaces at this detailed level of granularity?

So the real issue in SCM is not about improving the accuracy of the sales forecast and reducing the amount of uncertainty in the future, it is rather about *eliminating the need for certainty* in operational planning. We have therefore anchored our LEAN SCM Planning approach in freeing supply chain planners from the need for certainty, ushering in a paradigm change for most planning practices.

A major change that accompanies our *LEAN SCM Planning paradigm* is the management of demand variability. In traditional planning concepts, this is solved in a one-sided way, through planning and scheduling of manufacturing capacities only. This is because in today's supply chain practices, and in the ERP or APS systems that support them, safety stock levels are used as fixed planning parameters and not touched from a planning perspective to buffer variability. This has negative consequences for operational performance and the way in which companies react to demand fluctuations in planning. In this way, the traditional planning approaches represent a conceptual dead-end for today's variability management problems.

Within the new LEAN SCM Planning paradigm, we are *mastering variability with a two-sided approach*. We manage the demand variability in supply chain planning now on both sides, on manufacturing capacities and in inventories. To be more precise, the safety stock elements in all SKU-based inventories are now actively used in planning runs, as they have been designed for, to level replenishment signals and keep market noise out of manufacturing to the extent possible. To make this happen, we have developed a disciplined approach to the *dynamic adaptation of inventory target levels* to changing conditions along the supply chain. This allows SCM to keep a key component of demand variability—demand peaks—out of manufacturing, smoothing capacity utilization, and spending less time resolving production planning and schedule problems. This might sound intuitive, but represents a paradigm shift in the operation of today's planning processes and systems.

The conceptual foundation for managing variability and leveling capacity utilization in local manufacturing sites is the *cyclic scheduling* with “product wheels.” Industry experts such as Ian F. Glenday, Peter L. King, and Raymond C. Floyd have already been able to connect the general lean (manufacturing) concepts, and the underlying elements of simplicity, flow and pull, with physical restrictions that are typical in process industries. These concepts have already been influential in many process manufacturing organizations. We have built on these experiences but needed to go further to apply product wheels in a high-product-mix and high-volatility environment—which we named “*Breathing*” and “*High-Mix*” *Rhythm Wheels*. They are built around optimal product sequences and cycle times. But the most valuable conceptual advancement we have incorporated is our approach to manage variability with two control parameters: the cycle time boundaries. With these new conceptual elements, we are providing

appropriate flexibility in manufacturing to enable companies to manage increasing market volatility, and we also hold the key for smoothing variability and volatility propagation upstream along the supply chain in our hands.

The LEAN SCM Planning concepts we present here have been worked out in light of and for the purpose of *end-to-end supply chain synchronization*. So the central question is how to manage multi-echelon synchronization along supply chains in process industries, with typically long lead times starting, for example, with chemical conversion processes and moving downstream to shorter physical bulk production and packaging processes? In particular, how should supply chain organizations apply cyclic planning at manufacturing sites while aiming for real consumption-based pull replenishment?

In response, we have formalized a “*global takt*” for *synchronization* and achieving end-to-end flow. In a stable supply chain environment, this might seem easy, but not in situations characterized by high demand volatility and high product mixes in manufacturing portfolios. We have to make the Rhythm Wheel approach more flexible, to “breathe” in sync with cycle times, but in a well-structured, disciplined way, within the defined variability control parameters. The key is to “funnel” variability with the Rhythm Wheel cycle time boundaries along the supply chain and in this way actively counteracting the infamous bullwhip effect and achieve a step change in supply chain performance.

With traditional supply chain concepts, the line between planning parameterization (configuration) and the planning run (execution) is blurred. In contrast to this classical planning approach, in LEAN SCM Planning, we have sliced the given planning complexity precisely. We slice the planning task horizontally into global tactical *pre-parameterization* (conditioning) and local planning run areas. Having done so, we have devised a *new LEAN SCM Planning Framework* to better cope with global synchronization needs.

While working with industry pioneers on this new supply chain planning approach, we were confronted almost immediately with additional questions when we stepped into the first implementations:

- How should the organizational model be adapted to the significant change in supply chain planning?
- What are the new roles and responsibilities required in the global supply chain community?

- Which factors should be aligned in corporate performance management to the new planning principles?
- What system gaps can be closed without discarding prior IT (information technology) investments?
- How can this new planning paradigm be implemented to achieve a step change in performance?

To answer these questions, we have consolidated all our conceptual research results and organizational project experience in this book, developed new IT add-on solutions to complement the existing SCM systems for implementation, and given a name to the holistic transformation approach—*LEAN SCM*. This new planning paradigm answers the VUCA challenges in process industries and overcomes the insufficiencies of traditional planning approaches. To highlight the distinction between lean (in small letters)—with its focus on manufacturing objectives—and LEAN—with its focus on end-to-end supply chain synchronization—we coined the all-capitalized term “LEAN” (see Figure 0.2).

Our implementation experience shows that there are three major obstacles to managing a *LEAN SCM transformation* program. First, a company’s executive leadership must understand that this is not a single-project initiative, but rather a journey—in other words, sticking to LEAN SCM once the journey has started is crucial for success. Introducing the new paradigm of integrated supply chain planning and variability management requires a *new SCM operating model* with clear end-to-end accountabilities. This will make end-to-end integration possible between, for example, global inventory and local asset management. It is a new way of coordinating and synchronizing operations and throughput in a multi-step value chain. Top management support, training (and incentives) for all stakeholders, and strong commitment to the paradigm change are the preconditions for successful transformation. But bear in mind that you are aiming for nothing less than a step change in supply chain performance.

Second, aligned *performance management* is a critical success factor in the LEAN SCM transformation. The new conceptual elements and the new planning processes require new process performance indicators, such as Rhythm Wheel cycle time attainment and cycle time variation, to be monitored carefully. Therefore, an effectively adapted and well-designed performance management system is fundamental. But this typically does not imply the need to reinvent current performance management systems.

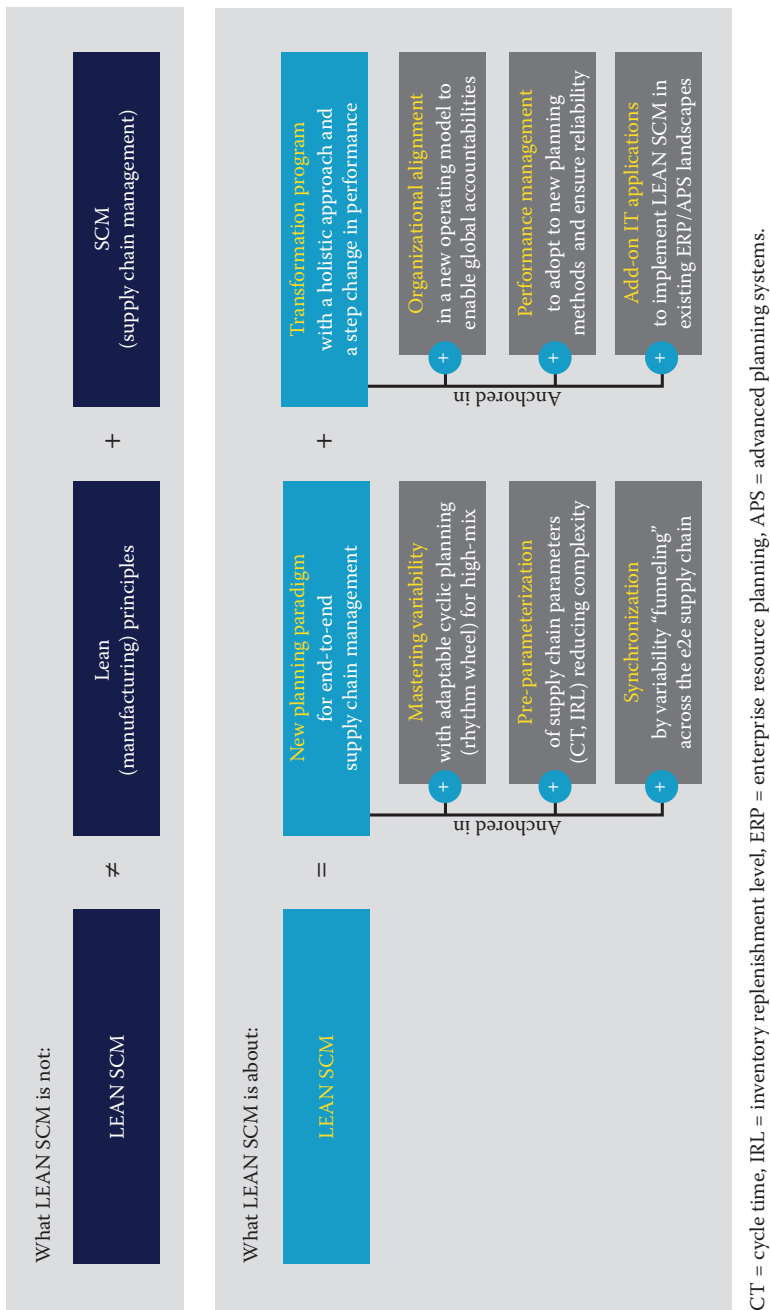


FIGURE 0.2
What lean SCM and LEAN SCM are about.

We will provide a set of meaningful metrics on the basis of which to generate improved supply chain performance through LEAN SCM. Finally, we depict a pragmatic way of creating the right accountabilities within performance management and show you how to anchor it in your planning organization.

Third, technology is instrumental in helping LEAN SCM create sustainable results. Many lean improvement initiatives depend on few individuals and manual techniques—and if those individuals change positions, much of the planning knowledge, enthusiasm, and leadership are lost. In this light, IT applications are even more critical to capture and standardize processes sustainably in a global end-to-end transformation. These additional *IT technologies* are also supposed to institutionalize LEAN SCM Planning. Applications such as the “Rhythm Wheel Designer” or the “Dynamic Target Stock Planner” provide interlocks with concepts such as cyclic planning and balanced variability management in supply chain organizations, ensuring that common LEAN SCM Planning techniques and best practices have staying power in your SCM organization.

You are holding the results of our LEAN SCM work in your hands right now: it is a holistic practitioner’s guide to mastering variability, uncertainty, complexity, and ambiguity in process industry supply chains. It also includes detailed concept descriptions and process explanations. To make it even more practical and valuable for your own reflection, we have enriched all topics with relevant industry cases. We believe that the performance improvements achieved through LEAN SCM initiatives are best described by your industry pioneers themselves. You can therefore also find in this book accounts of how your peers have already lived the LEAN SCM paradigm, used the relevant instruments successfully, and gained:

- Improved customer service and increased supply chain agility through reduced cycle times for Rhythm Wheel-managed products.
- Significant improvements in overall equipment effectiveness (OEE) through leveled and takt material flows that are synchronized to customer demand.
- Significant reductions in working capital through actionable supply chain analytics on variability and risk allocation of stocks across the end-to-end supply network.

I am certain you will enjoy the same outstanding results along your company's supply chain by reading this book and adopting LEAN SCM—because now you are targeting nothing less than a quantum leap in your operations and supply chain performance.

Dr. Josef Packowski
Mannheim, Germany

Reader's Guide

This book will guide your company in undertaking the paradigm shift from traditional planning to LEAN SCM. After learning about and implementing LEAN SCM concepts, your company's supply chain will be able to meet the VUCA challenges of today's global marketplace. You will learn how industry leaders changed their approach to tackle the challenges of variability and uncertainty in supply chain management and how they achieved better customer service at lower cost through LEAN SCM.

In this reader's guide, we provide an overview on

- The contents of this book
- A short summary of each chapter
- A guide to who should read what

What This Book Contains

In this book, we offer you a practitioner's guide to approaching and preparing for all levels of supply chain planning, from the strategic dimension to the daily operational level in light of VUCA challenges. It includes *comprehensive how-to-do-schemes* for flexible Rhythm Wheel planning and *when-to-apply guidelines*. Furthermore, the book contains the argumentation, concepts, and tools related to dynamic inventory target stock-setting and variability buffering across the full range of planning horizons. We describe variability control mechanisms for inventory and capacity that will allow your company to implement all the key elements of the new supply chain synchronization approach.

Designed as a pragmatic and practicable LEAN SCM Planning approach, the concepts we present in this book will enable your company to relieve the real pain points along supply chains. As such, we will show you how your company can achieve an end-to-end LEAN SCM transformation, incorporating all key enablers: organization and stakeholders, accountabilities and performance management, data harmonization, and IT systems.

The book is structured into four parts (see Figure 0.3). In the first part of the book, we focus on the current challenges in the process industries, the insufficiencies of traditional planning approaches, and the ways in which LEAN SCM overcomes these challenges. In the second part, we outline

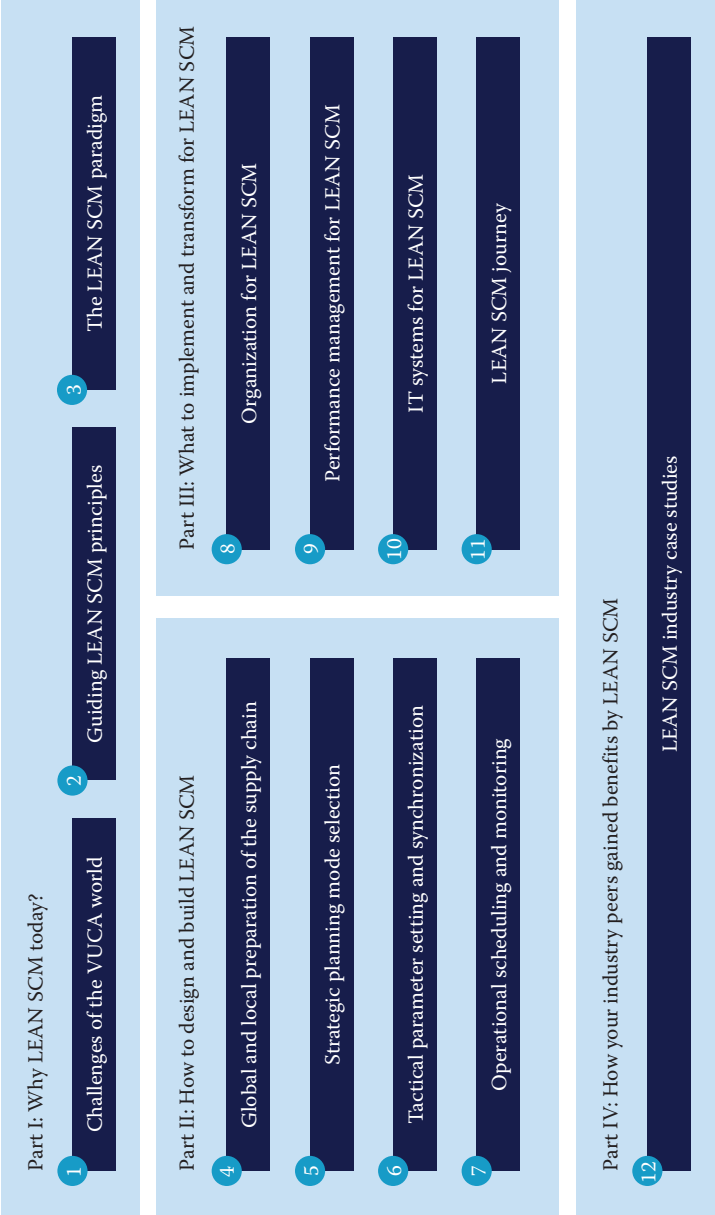


FIGURE 0.3
The book is structured into four parts.

how your company should prepare its supply chain for LEAN SCM from a global and a local perspective. We then explain what planning modes you should choose for your company's supply chains from a strategic perspective, how you can synchronize supply chain operations, and how operational planning and scheduling is conducted with LEAN SCM. In the third part, we draw out the implications of LEAN SCM for your organization, describe its impact on performance management, and explain how IT systems support the entire LEAN SCM process. Furthermore, we present valuable recommendations for your own "LEAN journey." In the fourth part, we conclude the book with selected, useful case studies of thought leader companies that have recently implemented LEAN SCM methods.

Overall, this book contains 12 chapters, which are all readable on their own. Each chapter is summarized to highlight the key takeaways, as are the most important sections within a chapter. Also, the book contains a wealth of useful graphics, as we believe they facilitate the understanding of the contents and serve as quick links when you want to locate key points. Furthermore, we have included a number of text boxes, which contain additional and valuable information with interesting insights from companies of the process industries.

Brief Chapter Overview

Over the course of 12 chapters, we explain the need for a paradigm shift in supply chain planning, the way LEAN SCM and the associated concepts work, and what needs to be changed within your company to successfully implement LEAN SCM.

PART I: WHY LEAN SCM TODAY?

1 Supply Chain Management in Process Industries

In this chapter, we discuss successful supply chain planning as the backbone of modern SCM. As evidence shows, traditional supply chain planning cannot effectively manage the new challenges of the VUCA world, which is an acronym for today's new business reality imposing so much pressure on supply chains. You will see why traditional planning fails and

that the naïve transfer of lean methods to process industries cannot solve these challenges.

2 Guiding Principles of LEAN SCM Planning: Facing VUCA Challenges

LEAN SCM principles are introduced to guide your company along its journey to the paradigm change in SCM in process industries. You will learn about LEAN demand, supply, and synchronization principles and what is fundamentally different between LEAN SCM and traditional planning approaches.

3 Fundamentals of LEAN SCM Planning: A Paradigm Shift in Planning

In this chapter, we show how LEAN SCM ensures resilience along the supply chain against the VUCA world, how LEAN SCM works fundamentally, and what benefits you can expect regarding customer service improvements and greater cost efficiency.

PART II: HOW TO DESIGN AND BUILD LEAN SCM

4 Prepare Your Supply Chain for LEAN SCM

This chapter describes what your company should do before implementing LEAN SCM. You will see how to align the supply chain strategy with overall business goals, how to prepare the supply chain from a global perspective, and how to prepare local shop floor operations and material flows for LEAN SCM.

5 Strategic LEAN Supply Chain Planning Configuration

Once your company's supply chain is prepared for the transition to LEAN SCM, you need to analyze and select appropriate planning modes according to the specific needs of your supply chain. This approach has proven successful in the past for distinguishing between production and replenishment modes. In this chapter, you will learn how to select the best-suited production and replenishment modes for your company's supply chains.

6 Tactical LEAN Supply Chain Planning Parameterization

After having chosen the right production and replenishment modes, you will learn in this chapter how to parameterize them, as we describe how to build and configure Rhythm Wheels and how to right-size stocks along the supply chain. Furthermore, you will learn how to synchronize your company's supply chain from an end-to-end perspective.

7 Operational LEAN Supply Chain Planning Execution

After having set the parameters for the supply chain, the next step is planning execution. In this chapter, you will learn how Rhythm Wheels are applied and executed in day-to-day business with dynamic and variable demand, and how the entire planning process is monitored and continuously improved.

PART III: WHAT TO IMPLEMENT AND TRANSFORM FOR LEAN SCM

8 Building an Organization for LEAN SCM

This chapter provides clear guidelines for establishing an effective LEAN supply chain organization. We investigate what needs to be changed “below” and “above” ground in your organization to successfully implement LEAN SCM and how to best manage the “transition.”

9 Performance Management for LEAN SCM

In this chapter, you will learn how planning and decision making for LEAN SCM can be supported by performance management, which includes important performance metrics that are unique to LEAN SCM. The chapter also covers the most important aspects you should consider for successfully running a LEAN supply chain in your company.

10 Planning System Landscape for LEAN SCM

To fully seize the benefits of the concepts and processes introduced in this book, IT assumes an essential role. In this chapter, you will find out what needs to change in your company's IT system landscape to sustainably support LEAN end-to-end supply chain planning.

11 The LEAN SCM Journey

Through the first 10 chapters of the book, you will have come to understand all the key LEAN SCM concepts, and the impact of LEAN SCM on your company's processes, the organization, performance management, and IT systems. In this chapter, you will find out how and where you should start your company's journey toward LEAN SCM in order to enjoy its benefits.

PART IV: HOW YOUR INDUSTRY PEERS GAINED BENEFITS BY LEAN SCM

12 LEAN SCM Industry Case Studies

In this chapter, we present key industry insights into how thought leader companies in process industries have moved toward LEAN SCM, as we share the experiences they have had with the new concepts.

Who Should Read What?

In general, anyone interested in or representing your company's supply chain organization should read the entire book to fully understand LEAN SCM. However, we know that time is scarce in the business world, so we have added this section of guidelines that indicate who should read what in the book. Regardless of the role, however, everyone should read the first three chapters, since they explain why a paradigm shift in supply chain planning is required and outline the differences between LEAN SCM and traditional planning and scheduling approaches.

Senior Supply Chain and Operations Managers

If you are a senior supply chain and operations manager, it is important to have a thorough understanding of LEAN SCM and the concepts behind it, in order to set priorities and allocate valuable resources within your company. Senior supply chain and operations managers should therefore especially read:

- Chapter 1—to understand what challenges will arise in process industries and why traditional ways of planning fail to manage these effectively.

- Chapter 2—to figure out the major differences between LEAN SCM and traditional planning approaches.
- Chapter 3—to thoroughly comprehend LEAN SCM and its benefits.
- Chapter 8—to understand the implications of LEAN SCM for the supply chain organization and the corresponding shifts in roles and responsibilities.
- Chapter 11—to know how to set out on the “LEAN SCM journey.”
- Chapter 12—to learn how thought leaders in the process industry have successfully raised their companies’ supply chain performance with LEAN concepts.

IT Experts for SCM

Next to understanding the rationale and necessity for adopting LEAN SCM that we make clear in Chapters 1 through 3, those in IT who are responsible for SCM should definitely read:

- Chapter 5—to understand LEAN concepts and recognize the new business requirements of LEAN SCM.
- Chapter 10—to understand the impact of LEAN SCM on the current IT planning system landscape.
- Chapter 11—to comprehend the importance of IT support as enabler for the “LEAN journey.”
- Chapter 12—to see what impact LEAN SCM has on SCM performance.

Tactical and Operational Planners

Planners on the global and local levels ultimately apply LEAN concepts and methods in everyday planning. They should therefore especially focus on

- Chapter 4—to understand which global and local supply chain conditions to address before undertaking a LEAN SCM implementation.
- Chapter 5—to comprehend the production and replenishment concepts behind LEAN SCM and to select those that are most appropriate for their companies.
- Chapter 6—to optimally set global and local supply chain parameters and synchronize them on an end-to-end basis.
- Chapter 7—to understand how LEAN concepts work in everyday business planning and learn how to interpret LEAN KPIs for continuous improvement.

- Chapter 10—to learn which IT systems support global and local parameter setting for LEAN SCM.

Lean Manufacturing Experts

Experts in lean manufacturing who are already familiar with some LEAN SCM concepts can enhance their knowledge especially by reading:

- Chapter 4—to complement the end-to-end perspective on LEAN SCM.
- Chapter 5—to reflect on and learn about the latest LEAN SCM concepts.
- Chapter 6—to enhance parameter-setting skills for production processes.
- Chapter 7—to understand the operational mechanisms associated with LEAN SCM concepts.
- Chapter 12—to learn about the LEAN tools that industry thought leader companies have implemented.

Business Consultants

To support their clients' efforts to successfully implement LEAN SCM, business consultants should especially read:

- Chapter 4—to ensure that a supply chain is prepared for LEAN SCM prior to implementation.
- Chapter 5—to be up-to-date on developments related to LEAN SCM concepts and to give appropriate recommendations regarding their selection.
- Chapter 6—to guarantee optimal and thorough parameter setting for clients.
- Chapter 7—to enable clients to improve continuously by themselves—without consultants.
- Chapter 9—to anchor LEAN SCM in performance management for staying power.
- Chapter 10—to create sustainable IT solutions for clients.

About the Author and the Motivation for This Book



Dr. Josef Packowski is co-founder and CEO of the CAMELOT Consulting Group, an international organization of leading specialists focused on value chain management in core industries comprising chemical, pharmaceutical, and consumer goods manufacturers. He received his doctoral degree in business and IT from Saarland University, and in addition to his professional work he is today a lecturer on advanced planning systems and supply chain management at the University of Mannheim, one of the leading business schools in Germany. He now actively supports the University in the

form of an additional CAMELOT-endowed professorship for SCM, helping to establish a think-tank for modern SCM studies.

Dr. Packowski is a respected industry consultant with over 25 years of experience and a visionary leader in operations management and strategy in process industries. During this time, he has worked for several of CAMELOT's most prominent clients and global industry leaders such as Astellas, AstraZeneca, Bayer, BASF, DSM, Henkel, Lyondell Basell, Merck, Novartis, Roche, Sabic, and others.

However, he has dedicated most of his professional life to advising these companies on how to operate and work more effectively in SCM. Indeed, from the beginning of his academic and professional career, Dr. Packowski has consistently maintained scholarly and professional interest in production and supply chain planning. Starting in the late 1980s, he was privileged to support manufacturing teams in achieving "Class A" certification in MRP II and Sales & Operations Planning, in one of the first initiatives of that kind in the United Kingdom. This was followed by an intensive engagement in an EU-funded research program focusing on the development of *ERP-based "Production Planning for the Process Industry,"*

resulting in the SAP R/3 PP-PI application offered by SAP AG in the early 1990s.

Dr. Packowski's subsequent PhD work, applying theoretical operations research methods in planning for process manufacturers, was more about the new "Advanced Planning" concepts that seemed to offer solutions for coping more effectively with typical planning issues in process industries, issues that ERP platforms had failed to solve and which he was experiencing in practice during his parallel consultancy work. Consequently, this brought him in the late 1990s into implementation projects and a close collaboration within his own CAMELOT consulting organization with Tom Baker, a pioneer in the area of *Advanced Planning and Scheduling* (APS) technology. Tom's mission statement, "Bring us the planning problem, we will solve it," was not only very motivating for him, but also raised the bar high. He experienced this challenge in the beginning of the year 2000, when they began implementing the new SAP SCM/APO planning applications with CAMELOT teams for the very first time in pharmaceutical and chemical companies. Today they can look back on more than 100 successful implementation and transformation projects in the industry around the globe.

During his professional career, Dr. Packowski had the opportunity to apply two major technology-driven SCM paradigms for their respective times: the MRP/ERP-based and the SCM/APS-based planning paradigms. In contrast to other business-related technology, the business-driven SCM paradigms have been changing much more frequently in all those years. Depending on the economic ups or downs of the time and the accompanying business objectives, he has had to emphasize either the *lean* or the *agile* SCM paradigm. Today, all these concepts and associated tools are well known and applied in the industry.

The motivation for this work was triggered by the need of a Big PharmaCo to achieve a step change in supply chain performance. That meant in the first place undertaking a multi-echelon synchronization of *lean* takt and *lean*-controlled process manufacturers, with the objective of achieving greater flexibility. Furthermore, the company wanted greater reliability despite increasing demand variability, and it needed to do this without jeopardizing its achievements in cost improvement.

After the first assessments, it became obvious that this focus on SCM had evolved into an area of high interest across the entire industry, with several practitioners' reports and guidelines already available. However,

early reviews indicated that the bulk of the relevant publications concentrated on providing an isolated manufacturing view. Also, the first academic literature review revealed that this was a research area that had been given little attention. At that stage, Dr. Packowski became excited at the prospect of engaging with this *new supply chain planning domain* as he leveraged his more than 25 years of professional experience.

For further information, please visit the homepage of CAMELOT Management Consultants AG (www.camelot-mc.com) or write an e-mail to office@camelot-mc.com.

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Acknowledgments

The concepts and methods presented in this book have been researched and developed during the past 4 years with great support from leading universities, process industry champions, and supply chain experts at CAMELOT Management Consultants. Although acknowledging the assistance of everyone who contributed to making this happen would be impossible, I would like to acknowledge those individuals and organizations that have provided invaluable suggestions and encouragement throughout this project.

First, I would like to thank *Professor Dr. Thonemann* from the University of Cologne. We kicked off a research program aiming to formalize the multi-echelon supply chain synchronization challenge for process industry networks that apply the concepts of Product Wheels or Rhythm Wheels at local sites. It would have taken me even longer than the last 4 years to complete this book without the dedicated involvement of Diploma and PhD students who contributed challenging ideas regarding various aspects of the new supply chain planning paradigm described herein. Therefore, it is my great pleasure to thank all those academic mentors and project supporters: *Professor Dr. Fleischmann* from the University of Mannheim, *Professor Dr. Briskorn* from the University of Siegen, and finally *Julian Amey* from the University Warwick, UK offered great support and valuable analytical evaluations.

I also wish to acknowledge several courageous industry leaders for their frank discussions and early support when we began transforming the LEAN SCM insights and new ways of working into supply chain practice. In particular, I am grateful to Andy Evans, head of Global Supply Chain Planning at *AstraZeneca*, *Dr. Thomas Proell*, SCM head, and *Tom van Laar*, TechOPS head, at *Novartis Pharma* for their challenging questions and further encouragement. Special thanks go also to *Dr. Robert Blackburn*, president, Information Services and Supply Chain, BASF, who we supported through the global restructuring of his operations and organization. The industry cases collected so far have been the best reality checks for us when transforming intellectual rigor into practicable solutions.

It is a central tenet of SCM that collaboration leads to better insights and results. The same is true for writing, and I gratefully acknowledge

the many coworkers who helped to shape this text. My special thanks go to Michail Heinmann, Ernesto Knein, Philipp Streuber, Dr. David Francas, Michael Hamann, Marco Klein, Melanie Lenhardt, Anna Fitzer, and the CAMELOT Innovation Team, who conscientiously and industriously labored in contributing research and conceptual development and helped with the formulation of the new LEAN SCM Planning paradigm. Furthermore, I am grateful for discussions and reality checks with my Camelot IT Lab colleagues Tobias Heckmann, Christoph Habla, and Steffen Joswig, who transferred and implemented the relevant concepts into a unique LEAN SCM Planning Suite, first based on SAP SCM and later on the SAP HANA platform. Without the great support of all the above-mentioned individuals, the concepts, methods, and tools of LEAN SCM would not have risen to the level of maturity they enjoy today.

Finally, no acknowledgment would be complete without extending my sincere and heartfelt thanks to my great children and wonderful partner for their continued patience and understanding, encouragement, and continued love.

Dr. Josef Packowski
Mannheim, Germany

Part I

Why LEAN SCM Today?

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Supply Chain Management in Process Industries

Process industries represent a key driver of global value creation. Industry segments such as chemicals, pharmaceuticals, food and beverages, and consumer goods comprise more than 50% of industrial production in the United States and Europe. Their products guarantee nutrition and health for the individual consumer and form the basis of virtually all products in our daily lives. However, a recent issue of *Supply Chain Management Review* clearly showed that companies in process industries are experiencing dramatic challenges in fulfilling their business targets and downward pressure on margins due to the unprecedented complexity and variability of today's global economy (see Table 1.1). The need for visibility and optimization across all elements of a supply chain has never been greater.

In the pharmaceutical industry, the rise of emerging markets and increasing price pressure are forcing companies to review established operating models. The dramatic shift in markets toward the so-called “pharmerging” countries adds to increasing pressure to redesign global value chains. Furthermore, the established pharmaceutical companies are threatened by patent expiry and generic competition, which could lead to sales losses of as much as 100 billion USD over a period of 2009–2015.

The chemical sector faces similar dynamics on the market side: saturation in traditional markets and the shift to the rapidly growing and dynamic BRIC (Brazil, Russia, India, and China) and SMIT (South Korea, Mexico, Indonesia, and Turkey) countries. On the supply side, dramatic changes in feedstock sources might alter the rules of the game in the entire industry sector. The shale gas boom in the United States led to a huge decline in feedstock prices and energy costs in a very short time and is thus widely regarded as a potential “game changer” in chemicals and

TABLE 1.1

Trends in Supply Chain Financial Ratios in Process Industries (Data Basis: Annual Reports (2000–2011))

Industry	Average Operating Margin	Average Changes in Financial Ratios Over the Period 2000–2011			
		Operating Margin (%)	SG&A Margin (%)	Return On Assets (%)	Revenue Per Employee (K\$)
Chemical	0.09	–1	1	2	16
Consumer goods	0.16	–2	0	2	29
Food	0.15	–1	1	–2	29
Pharmaceutical	0.24	–4	–1	–6	46

energy-intensive industries, rapidly and substantially changing global investment patterns and global network footprints.

Volatility has always been the key challenge for fast-moving consumer goods manufacturers. Today, however, many industry experts see many markets in this industry sector already in an era of hyper-competition, with product life cycles measured in a few months and sales promotions happening almost every day. Products are more and more tailored to the individual customer, adding a new level of complexity to supply chains, which therefore needs to be more effective and agile than ever before.

The bottom-line result of these changes is intense pressure on supply chain management (SCM) across all process industries: Growth has been slowing, inventories have been climbing, and costs have been escalating, leading to negative trends in operating margins and other key supply chain measures, as summarized in Table 1.1. In the face of these changes and ongoing pressure from customers to deliver outstanding service, it would appear that only a reinvention of best practices along value chains will make it possible for companies of the process industries to meet the expectations of internal and external stakeholders as well as financial markets.

The foundations for successfully orchestrating a global value chain are effective supply chain planning and reliable coordination of customer demand fulfillment. The performance of planning and coordination in SCM is directly impacting top-line results, costs, and capital. Yet we see reasonable and increasing doubt that the old recipes for supply chain success no longer suffice to keep up with the pace of change experienced in business reality today. Obviously, alternatives must be found to approach supply chain planning more effectively. In this book, we show that this

requires not merely minor modifications of business processes, but a change in the entire planning paradigm!

1.1 SUPPLY CHAIN MANAGEMENT MUST MASTER THE VUCA WORLD

The acronym VUCA—volatility, uncertainty, complexity, and ambiguity—accurately describes the conditions under which companies and SCM operate in process industries today. It summarizes the key pressures felt today in SCM. The term VUCA originated in the military in the late 1990s, but was quickly adapted for use in business environments and now stands for strategies designed to cope with increasing volatility, unavoidable changes, and all manner of unpredictable issues that may arise—anything from a change in consumer taste to the onslaught of a recession.

1.1.1 Supply Chain Management Orchestrates Global Functions and Networks

Supply chains in process industries encompass production facilities, distribution centers, and suppliers around the entire globe and connect those entities to global markets. SCM is tasked with integrating all organizational units along value chains and coordinating material, information, and financial flows to fulfill customer demand. The objective of SCM is to maximize customer satisfaction and ensure the most efficient use of required resources, including distribution capacity, inventory, and labor. SCM subsumes all activities related to the design, planning, execution, and monitoring of material procurement, production, and distribution activities along end-to-end value chains, including managing the required information flow. From a functional point of view, all operations-related departments are involved and must collaborate: procurement, manufacturing, quality control and assurance, SCM, planning, customer service, warehousing, and logistics.

As most companies are organized, these departments operate as separate functional units. Thus SCM, in its role as an enabler of end-to-end process interactions along the supply chain, needs to ensure that the required collaboration is achieved. Consequently, SCM requires harmonized and globally interlinked processes. This task also demands appropriate IT (information technology) solutions for advanced planning to ensure the necessary data management and the creation of global transparency.

Business leaders today are well aware of the fundamental role of SCM in managing corporate value chains in a competitive environment and ensuring customer satisfaction at minimum cost and with minimum investment of working capital. However, the majority of supply chain improvement projects struggle to achieve their performance and pay-back targets. To bring these functions back on track, SCM must address the root causes of the VUCA world, which also means that new solutions must be found as the old ones have obviously failed to master volatility, uncertainty, complexity, and ambiguity effectively.

1.1.2 Key Pain Points in Supply Chain Organizations Today

Given the market conditions we have described above, it is not surprising that rising concern about the VUCA world is reflected in what supply chain organizations today regard as their key pain points. According to a recent survey published in *Supply Chain Management Review* in 2013 (addressing the top 10 pain points as shown in Figure 1.1), supply chain leaders are becoming increasingly concerned over the growing lack of supply chain visibility, demand volatility, and supply chain complexity. These three key pain points are directly rooted in the VUCA world.

The lack of visibility in today’s ever-widening supply networks is challenging many companies with a growing ambiguity within global planning organizations, substantially reducing the overall supply chain performance. The impact of weak visibility is further amplified by the strong demand volatility and growing supply chain complexity that are sensed by the majority of supply chain managers. Many supply chain managers thus fear a

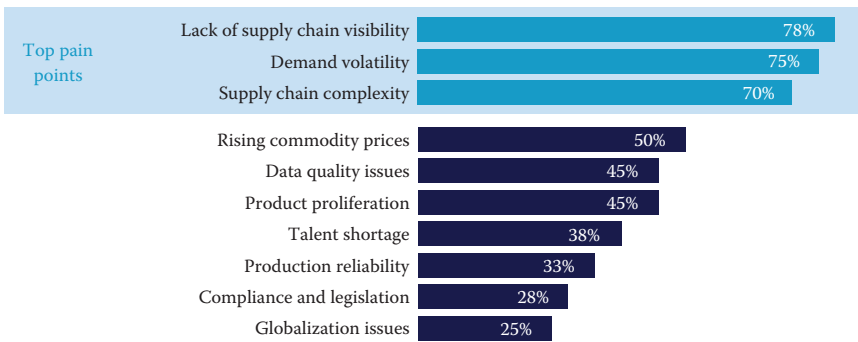


FIGURE 1.1
Top 10 pain points according to supply chain managers.

growing loss of control and deteriorating performance in their global supply chain operations.

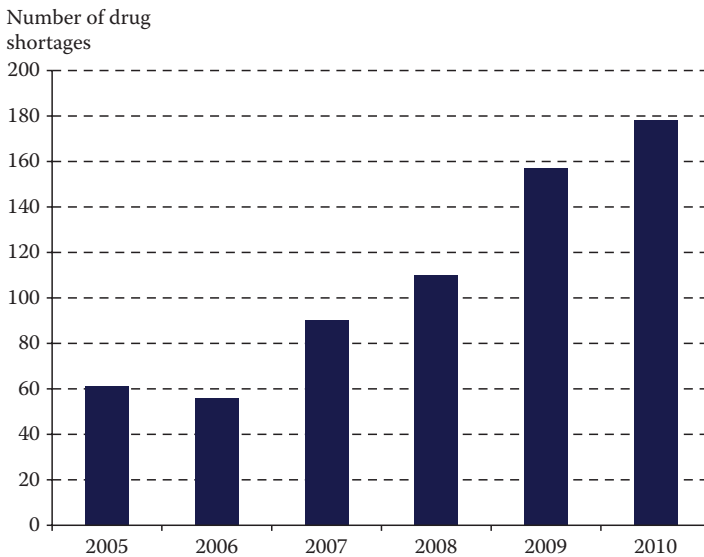
In contrast, formerly key issues such as the impact of globalization or compliance with international regulations seem to have been resolved by most supply chain organizations as shown by the results of the survey. Today, it is indeed the VUCA world that is regarded as the most important challenge; consequently, its impact and the resulting pain points are on the top of most supply chain managers' agendas today.

1.1.3 Why Leadership Is Concerned about the Impact of Volatility

As we all individually experience every day, the pace of change in the global business environment has been increasing dramatically over the past several years. Of all the factors responsible for the VUCA world, variability and volatility are challenging supply chain performance most. Volatility is everywhere and ever-increasing: on the demand side, we face major changes in global demographics, shorter life cycles, and more products, but simultaneously with relatively lower order volumes per product. On the supply side, there are major changes in global feedstock availability, supply disruptions, and price volatility.

Characteristics that are unique to process industries only add to the challenge. Typically, production takes place in continuous processes or in significant batch sizes. As the manufacturing process is not based on small individual units, the corresponding manufacturing assets are considerably less flexible compared with those deployed in discrete manufacturing. Therefore, changeover effort and product sequencing are important factors in supply chain and production planning. By-products and even material waste may occur during the conversion of raw materials into final products. Production yield depends on process conditions as well as on campaign sizes and raw material quality. All those specific factors need to be taken into account by SCM when planning and coordinating operations across global manufacturing networks.

The consequences of the lack of concepts, tools, and capabilities with which to manage volatility in SCM are severe. Looking at inventories in many chemical and pharmaceutical companies shows that some stock levels in the supply chain amount to as much as 60% of annual demand, and there are in many cases up to 20 weeks' worth of finished goods stocks. Consequently, the amount of working capital tied up in those supply chains is by far beyond what management and financial shareholders expect.

**FIGURE 1.2**

The number of drug shortages in the United States is steadily increasing.

But, more working capital tied in inventory and increasing operating costs are not the only consequences of weak response to volatility. In today's fast-paced business environment in process industries, there is an increasing gap between supply lead times and customer expectations of order lead times. Even worse, product shortages might lead to lost sales and reduce long-term revenues. Moreover, stock-outs not only lead to additional costs, lost revenues, and customer dissatisfaction but also cost lives when, for example, dealing with life-saving drugs in the pharmaceutical industry. However, the growing number of drug shortages reported in the United States shows all too clearly that keeping the right stock availability is becoming a more challenging task in the industry (see Figure 1.2). The reported steady increase in drug shortages over the last 5 years can be regarded as one of the main issues resulting from insufficient volatility management.

1.2 SUPPLY CHAIN PLANNING IN THE VUCA WORLD TODAY

Given the dynamics of the VUCA world, SCM is more demanding than ever in process industries. The increasing number of stock-out situations

and continuously rising inventory levels that many companies observe are just two indicators of the growing issues in supply chains that are involved in keeping track of those dynamics in the business environment.

Supply chain planning is crucial for efficiently deploying resources and coordinating all activities along globally dispersed value chains; planning is thus the backbone of SCM. However, despite significant investments made in demand excellence programs or the introduction of the most sophisticated advanced planning techniques, supply chains struggle to manage volatility on both the demand and the supply side. One of the key reasons for this is that there are inherent flaws in the design of global planning approaches that prevent companies from achieving the targeted supply chain performance.

1.2.1 Planning and Control as the Backbone of Supply Chain Management

The backbone of efficient SCM has always been effective planning. Without proper planning, a company risks sacrificing cost efficiency as well as losing customers due to poor service. When properly executed, supply chain planning ensures that all processes along the supply chain are smoothly orchestrated and that the company can match supply and demand on a daily basis. In this vein, supply chain planning ensures competitive inventory levels as well as low costs of goods sold by using a company's resources and assets in the best possible way.

To manage this task, supply chain planning ensures that all customer demands and market needs are taken into account when making replenishment, production, and supply decisions. By effectively balancing supply and demand, planning ensures cost-efficiency and high market responsiveness in line with business objectives and targeted customer service.

In SCM, the planning task is typically hierarchically organized according to a range of time horizons to reduce planning complexity. In addition to long-term strategic planning that is conducted for the next 2–10 years in alignment with a company's overall business strategy, tactical supply chain planning addresses mid-term planning needs for the next 4–36 months. Tactical planning is evaluated at an aggregated level and delivers the basis for sales & operations planning (S&OP). In addition, short-term planning is maintained at the SKU (stock-keeping unit) level, covering, for example, the next 0–12 weeks, which is the basis for fine scheduling of production and order fulfillment.

At all these levels, planners must strike a delicate balance between over-engineering their plans—including complex “black box” methodologies that few stakeholders understand and even fewer buy into—and over-simplified approaches that rely entirely on individual experience and vague rules of thumb.

1.2.1.1 Forecasting and Demand Planning

Since a supply chain should ultimately be driven by customer demand, the planning starts with available and planned customer orders. Long lead times in production force every supply chain manager to consider demand forecasts. The process of forecasting future customer demand is crucial to various aspects of the supply chain—from next month’s production schedule to yearly reviewed supply plans with major contractors to market estimates for identifying capacity requirements in the coming years.

The time horizon of forecast and demand plans must exceed the overall production lead time. The key challenge for demand planning is that longer planning horizons require a greater share of demand to be forecasted; and, typically, the longer the forecast horizon the lower the accuracy of the obtained forecasts.

Companies typically differentiate between long-term forecasts that are inputs to strategic planning and operational forecasts that drive production planning and scheduling for the coming weeks and months. To estimate future demand, many companies employ statistical forecasting methods whose results are reviewed by the sales force and enriched by market intelligence. The final gross sales demand is then balanced against available inventories to derive the net replenishment demand for the production supply.

1.2.1.2 Supply Planning and Production Scheduling

The goal of supply planning is ensuring customer satisfaction in terms of trustworthy order promising, delivery reliability, and responsiveness at the lowest possible cost. However, this means not only responding as quickly as possible to customer requests but also being flexible enough to manage customer request changes. From a financial perspective, supply planning has to minimize the associated purchasing, manufacturing, and distribution costs, including the “costs of change.”

Sales forecasting and net replenishment demand at production sites define the required supply from a company’s own production facilities and