

SIXTH EDITION  
SUPPLY CHAIN MANAGEMENT  
STRATEGY, PLANNING, AND OPERATION

Sunil Chopra | Peter Meindl | Dharam Vir Kalra

*Supply Chain Management, 6e*, employs a strategic framework that identifies and illustrates facilities, inventory, transportation, information, sourcing, and pricing as the key drivers of supply chain performance in order to help readers understand what creates a competitive advantage. The strategic framework and concepts discussed in the text are tied together through a variety of examples to illustrate that a combination of concepts is needed to achieve significant increase in performance.

This book is a must for students of MBA and B. Tech with an interest in supply chain management and logistics. It will also serve as a suitable reference book to understand the concepts and methodology for practitioners.

NEW TO THIS EDITION

- ▶ Several new mini-cases have been added throughout the book.
- ▶ New cases appear in chapters 2, 8, 9, 11, 13, 14, and 16.
- ▶ In Chapter 14, a discussion on the Mumbai *dabbawalas*, a responsive distribution network, has been added.
- ▶ 'Chapter 17: Sustainability and the Supply Chain' has been further developed, with a new section related to the pricing of sustainability.
- ▶ Examples from local Indian companies like Jaipur Rugs, Asian Paints, OM Logistics, Simbhaoli Sugar, Subhiksha, and Dr. Reddy's Laboratories have been incorporated to depict the current Indian scenario.
- ▶ A chapter titled "Information Technology in a Supply Chain" has been updated and placed as part of our online resources.

Globally, all supply chain professionals face a common challenge – how to balance safe and reliable on-time delivery with lower logistics costs. The need for higher reliability, and safe and faster delivery increase the cost of delivery, thus resulting in a problem of optimization. This book provides both theoretical and practical insights into supply chain concepts required to achieve this very optimization, supported by numerous international as well as Indian case studies.

—Vijay Joshi, Adviser, Commercial & Supply Chain, Moser Baer, Formerly Corporate Head-Supply Chain, Procurement & Commercial, Moser Baer Group

*Supply Chain Management, 6e*, is a complete compendium covering all aspects of supply chain – strategizing, planning, and execution. It has a rich collection of Indian as well as global case studies and examples. This book is ... aimed at students, but it is also useful for industry professionals ... trying to formulate an effective supply chain for the respective industries.

—Rakesh Mittal, President, QH Talbros Limited

This book addresses the most fundamental concepts and best practices of contemporary supply chain management. It provides a structured description with a variety of global examples as well as case studies from the Indian context.

—Dr. Anil Kumar, Assistant Professor, IIM Rohtak

Online resources available at  
[www.pearsoned.co.in/sunilchopra](http://www.pearsoned.co.in/sunilchopra)

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This edition is manufactured in India and is authorized for sale only in India, Bangladesh, Bhutan, Pakistan, Nepal, Sri Lanka and the Maldives.

[in.pearson.com](http://in.pearson.com)

ISBN 978-93-325-4823-7



9 789332 548237

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SUPPLY CHAIN  
MANAGEMENT

SIXTH  
EDITION

Chopra  
Meindl  
Kalra

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AND OPERATION



Sunil Chopra | Peter Meindl  
Dharam Vir Kalra

 Pearson



*Sixth Edition*

# **SUPPLY CHAIN MANAGEMENT**

STRATEGY, PLANNING, AND OPERATION

**Sunil Chopra**

*Kellogg School of Management*

**Peter Meindl**

*Kepos Capital*

**Dharam Vir Kalra**

*Guest Faculty*

*Indian Institute of Management Rohtak*

 **Pearson**

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Authorized adaptation from the United States edition, entitled *Supply Chain Management: Strategy, Planning, and Operation*, 6th Edition, ISBN 978-0-13-380020-3 by Chopra, Sunil; Meindl, Peter, published by Pearson Education, Inc. Copyright © 2016.

Indian Subcontinent Adaptation

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ISBN 978-93-325-4823-7

First Impression, 2016

Fifth Impression, 2018

**Sixth Impression**

*This edition is manufactured in India and is authorized for sale only in India, Bangladesh, Bhutan, Pakistan, Nepal, Sri Lanka and the Maldives. Circulation of this edition outside of these territories is UNAUTHORIZED.*

Published by Pearson India Education Services Pvt. Ltd, CIN: U72200TN2005PTC057128.

Head Office: 15th Floor, Tower-B, World Trade Tower, Plot No. 1, Block-C, Sector 16, Noida 201 301, Uttar Pradesh, India.

Registered Office: 4th Floor, Software Block, Elnet Software City, TS-140, Block 2 & 9, Rajiv Gandhi Salai, Taramani, Chennai 600 113, Tamil Nadu, India.

Fax: 080-30461003, Phone: 080-30461060

Website: in.pearson.com, Email: companysecretary.india@pearson.com

Printed in India by Thomson Press India Ltd.

## Dedication

*I would like to thank my colleagues at Kellogg for all I have learned from them about logistics and supply chain management. I am grateful for the love and encouragement that my parents, Krishan and Pushpa, and sisters, Sudha and Swati, have always provided during every endeavor in my life. I thank my children, Ravi and Rajiv, for the joy they have brought me. Finally, none of this would have been possible without the constant love, caring, and support of my wife, Maria Cristina.*

—Sunil Chopra

*I would like to thank three mentors—Sunil Chopra, Hau Lee, and Gerry Lieberman—who have taught me a great deal. Thank you also to my parents and sister for their love, and to my sons, Jamie and Eric, for making me smile and teaching me what life is truly all about. Most important, I thank my wife, Sarah, who makes life wonderful and whom I love with all my heart.*

—Peter Meindl

*I would like to dedicate this work to my dear wife Sunil and my adorable daughters, Ruma and Anju, who have been a constant source of support and encouragement. I love them dearly.*

—Dharam Vir Kalra

## ABOUT THE AUTHORS

### SUNIL CHOPRA

Sunil Chopra is the IBM Distinguished Professor of Operations Management and Information Systems at the Kellogg School of Management. He has served as the interim dean and senior associate dean for curriculum and teaching, and the codirector of the MMM program, a joint dual-degree program between the Kellogg School of Management and the McCormick School of Engineering at Northwestern University. He has a PhD in operations research from SUNY at Stony Brook. Prior to joining Kellogg, he taught at New York University and spent a year at IBM Research.

Professor Chopra's research and teaching interests are in supply chain and logistics management, operations management, and the design of telecommunication networks. He has won several teaching awards at the MBA and Executive programs of Kellogg. He has authored more than 40 papers and two books.

He has been a department editor for *Management Science* and an associate editor for *Manufacturing & Service Operations Management*, *Operations Research*, and *Decision Sciences Journal*. His recent research has focused on understanding supply chain risk and devising effective risk mitigation strategies. He has also consulted for several firms in the area of supply chain and operations management.



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Peter Meindl is a portfolio manager with Kepos Capital in New York. Previously, he was a research officer with Barclays Global Investors, a consultant with the Boston Consulting Group and Mercer Management Consulting, and the director of strategy with i2 Technologies. He holds PhD, MS, BS, and BA degrees from Stanford, and an MBA from the Kellogg School of Management at Northwestern.



### DHARAM VIR KALRA

Dharam Vir Kalra retired from the Indian Army as Lieutenant General in 1993. During his service, he held various prestigious positions in the field of logistics. He was Major General Operational Logistics, and Commandant and Principal in College of Materials Management, Jabalpur. He then rose to become Director General Ordnance Services.

General Kalra obtained his M.Sc. in Defence Studies from Madras University. He also obtained Master's degrees in Political Science and Business Administration (Materials) from Jabalpur University. A graduate of the Defence Services Staff College, he also attended the Long Defence Management Course and the National Defence College Course. He completed a specialist course at the Royal Military College of Science, Shrivenham (UK). He has recently obtained an M.Phil Degree from the University of Madras.

Apart from his military service, General Kalra has been Dean, Faculty of Management, Jabalpur University; Consultant, Ministry of Defence, Government of India; Consultant, Comptroller and Auditor General of India; and Member, National Audit Advisory Board. He is a fellow of the Chartered Institute of Logistics and Transport (UK) and Indian Management Association, and also a Member Board of Studies of Indian Institute of Materials Management.

Currently, he is a guest faculty for Supply Chain Management and International Logistics at the Indian Institute of Management Rohtak.

General Kalra was decorated with an Ati Vishisht Seva Medal by the President of India in 1988 and with Param Vishisht Seva Medal in 1992 for services of an exceptional order.



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## PREFACE

This book is targeted toward an academic as well as a practitioner audience. On the academic side, it should be appropriate for MBA students, engineering master's students, and senior undergraduate students interested in supply chain management and logistics. It should also serve as a suitable reference for both concepts as well as providing a methodology for practitioners in consulting and industry.

### NEW TO THIS EDITION

The sixth edition has focused on allowing students to learn more as they study with the book. We have tightened the link between examples in the book and associated spreadsheets and have added exercises and cases in several chapters. We have also added changes based on specific reviewer feedback that we believe significantly improve the book and its use by faculty and students.

- We have added several new mini-cases throughout the book. New cases appear in Chapters 2, 8, 9, 11, 13, 14, and 16. Information in other cases has been updated to be current.
- In Chapter 11, we have added several new exercises as well as a mini-case.
- In Chapter 12, we have added several new exercises.
- In Chapter 13, we have tried to make the flow of material easier to follow. Given the more advanced concepts, we have tightened the linkage to the associated spreadsheets. We have also added a mini-case.
- In Chapter 14, we have added discussion of the Mumbai *dabbawalas*, a responsive distribution network. We have tightened the linkage of examples to associated spreadsheets and added a couple of mini-cases.
- Chapter 15 has had a very significant revision, with an enhanced discussion of successful third parties as well as the impact of incentives and the sharing of risk and reward in the supply chain.
- Chapter 16 has a new mini-case.
- Information Technology in a Supply Chain has been updated and placed online at [www.pearsoned.co.in/SunilChopra](http://www.pearsoned.co.in/SunilChopra).
- Chapter 17, on sustainability, has been further developed, with a new section related to the pricing of sustainability.
- We have continued to add current examples throughout the book, with a particular focus on bringing in more global examples.

The goal of this class was not only to cover high-level supply chain strategy and concepts, but also to give students a solid understanding of the analytical tools necessary to solve supply chain problems. With this class goal in mind, our objective was to create a book that would develop an understanding of the following key areas and their interrelationships:

- The strategic role of a supply chain
- The key strategic drivers of supply chain performance
- Analytic methodologies for supply chain analysis

Our first objective in this book is for the reader to learn the strategic importance of good supply chain design, planning, and operation for every firm. The reader will be able to understand how good supply chain management can be a competitive advantage, whereas weaknesses in the supply chain can hurt the performance of a firm. We use many examples to illustrate this idea and develop a framework for supply chain strategy.

Within the strategic framework, we identify facilities, inventory, transportation, information, sourcing, and pricing as the key drivers of supply chain performance. Our second goal in the book is to convey how these drivers may be used on conceptual and practical levels during supply chain design, planning, and operation to improve performance. We have presented a variety of cases that can be used to illustrate how a company uses various drivers to improve supply chain performance. For each driver of supply chain performance, our goal is to provide readers with practical managerial levers and concepts that may be used to improve supply chain performance.

Using these managerial levers requires knowledge of analytic methodologies for supply chain analysis. Our third goal is to give the reader an understanding of these methodologies. Every methodological discussion is illustrated with its application in Excel. In this discussion, we also stress the managerial context in which the methodology is used and the managerial levers for improvement that it supports.

The strategic frameworks and concepts discussed in the book are tied together through a variety of examples that show how a combination of concepts is needed to achieve significant increases in performance.

## ONLINE SUPPLEMENTS

Instructors can easily register to gain access to a variety of instructor resources available with this text in downloadable format.

The following supplements are available with this text:

- Instructor's Solutions Manual
- Test Bank
- TestGen<sup>®</sup> Computerized Test Bank
- PowerPoint Presentations

*Chapter A: Information Technology in a Supply Chain* is available online for students.

**Sunil Chopra**

*Kellogg School of Management, Northwestern University*

**Peter Meindl**

*Kepos Capital*

This edition of the book, retains as its principal focus, the linking of general theory of supply chain management and the practical experiences of businesses in the developed world with the ground realities in India, one of the world's fastest growing economies. This has helped produce a text with lessons of equal value for students of the subject across the globe.

The march of international trade towards ever-increasing spatial dispersion at both the supply and the demand ends has been inexorable. In the process, it has embraced not only economies at different levels of development but also diverse sociopolitical environments. This makes it imperative for the study of supply chain management to take a note of the challenges that such diversities throw up, and also the solutions that are emerging under the relentless competitive pressures to which present-day businesses are exposed.

The digital revolution is perhaps the most challenging and game-changing development affecting the business world. It has dawned on India at a time when its traditional supply chains are in a flux. This has added a new dimension to the transformation process, making it a fit case for lessons in the ongoing evolutionary process. An attempt has been made in this edition of the book to document the impact of this revolution as it unfolds.

Rooted in the Indian ethos, the case studies and examples added to this book present a different perspective, thus making the text multidimensional and enhancing its practical utility for a wider readership.

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## ACKNOWLEDGMENTS

We would like to thank the many people who helped us throughout this process. We thank the reviewers whose suggestions significantly improved the book, including: Steven Brown, Arizona State University; Ming Chen, California State University, Long Beach; Sameer Kumar, University of Saint Thomas; Frank Montabon, Iowa State University; Brian Sausser, University of North Texas; and Paul Venderspek, Colorado State University.

We are grateful to the students at the Kellogg School of Management who suffered through typo-ridden drafts of earlier versions of the book. We would also like to thank our editor, Dan Tylman, and the staff at Pearson, including Liz Napolitano, senior production project manager; Anne Fahlgren, executive product marketing manager; Claudia Fernandes, program manager; and Linda Albelli, editorial assistant, for their efforts with the book. Finally, we would like to thank you, our readers, for reading and using this book. We hope it contributes to all your efforts to improve the performance of companies and supply chains throughout the world. We would be pleased to hear your comments and suggestions for future editions of this text.

**Sunil Chopra**

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**Peter Meindl**

*Kepos Capital*

I am grateful to all the companies that have permitted me to draw upon and quote their experiences. Some of the notable contributions have come from M/S Mercurio Pallia, M/S Fresh and Healthy, and M/S Kale Logistics. I would like to thank the authors who have graciously allowed me to incorporate their case studies and research papers in my adaptation. I also gratefully acknowledge the useful inputs provided to me by Mr. Enamul Haque and Naveen Kumar. I extend my gratitude to Professor Vivek Kumar for his encouragement and support throughout the production of this work and Dr. Hema Yadav for her original contribution. My special thanks are due to Mr. N K Chaudhary of Jaipur Rugs who has built a remarkable business model that reflects the Indian socio-economic realities. I also want to acknowledge the contribution of Pricewaterhouse Coopers for allowing me to reproduce the Executive Summary of their very well-researched report which provides a fitting finale to this edition of the book.

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service providers and their customers to monitor and control many business processes through Internet interfaces. Some of our experts also see opportunities for client intervention in the logistics process stemming from the so-called "Ubiquitous computing" being an important part of real-time control and of the entire logistics future. Supply Chain design, including the location of production sites, will need to take energy and emission costs related to logistics processes into account. There will be no reverse globalization, but many supply networks will be established at regional level. Unfortunately it won't result in supply chains that are resistant to external shocks. Implementing an existing plan is generally far more effective than scrambling to react to a crisis, so devising scenarios around various contingencies makes good sense. Transportation costs will be a predominant criterion in determining where to set up production sites, and the minimisation of energy consumption will be a paramount criterion in overall supply chain design, rather than cost efficiency and speed. These trends will not result in purely local supply chains, but one point seems clear—most companies will look to reduce energy consumption and the cost thereof. Logistics service providers will need to balance energy efficiency together with speed to support supply chains which take into account both factors, as well as other cost concerns such as access to raw materials and labor. Logistics service providers should observe how the sourcing strategies of manufacturing companies evolve over the years. Whatever strategies manufacturers use to manage their sourcing costs, it is clear that improving efficiency and reducing the cost of global sourcing by reconsidering the location of production sites—whether from emerging markets like China, Vietnam or Central and Eastern Europe or developed markets—will be a key challenge to achieving global competitiveness in the future.

### Broadening the Perspective

Interviews from two of the sector's top CEOs suggest some of the ways today's executives are already thinking about increasing sustainability to prepare for the future.

Both interviews highlight the importance of the role of collaboration, be it with governments, or with customers, to achieve environmental goals. Harry Hohmeister, CEO of SWISS explains how his company is doing their part to reduce carbon emissions, for example by updating their fleet of aircraft. He calls for governments to do their part as well in ensuring that the aviation industry is able to fly as efficiently as possible. CHEP EMEA's Tom Gorman discusses how his company collaborates with customers, for example by offering Total Pallet Management on premises to reduce transportation costs and the carbon footprint, helping them achieve greater sustainability. The report also includes a section "extreme scenarios" where we encourage a broader perspective by showcasing how two of these areas (the oil price and consumer buying behaviour) may interact in four possible visions of the future. And what is in it for transportation & logistics operators? Some 20 promising future opportunities for transportation and logistics operators have been identified and showcased in our "opportunity radar" based on the findings of the Delphi survey.

### Prospects

Logistics companies should bear in mind for the years to come that logistics networks will change, sometimes dramatically, as their environments change. Climate change and CO<sub>2</sub> emissions will continue to gain urgency and consumers are likely to make more sustainable purchase decisions. New ways of doing business such as co-operations and bundling co-operations will help increase efficiency, and completely new areas of operation such as fabbing supply chains may emerge. These developments offer new opportunities for logistics companies that are informed about upcoming events and flexible enough to adapt their businesses accordingly. Scenario planning and management strategies may provide an edge in keeping one step ahead of the pack as the world in general, and the T&L industry along with it, meet the challenges of the future.\*

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