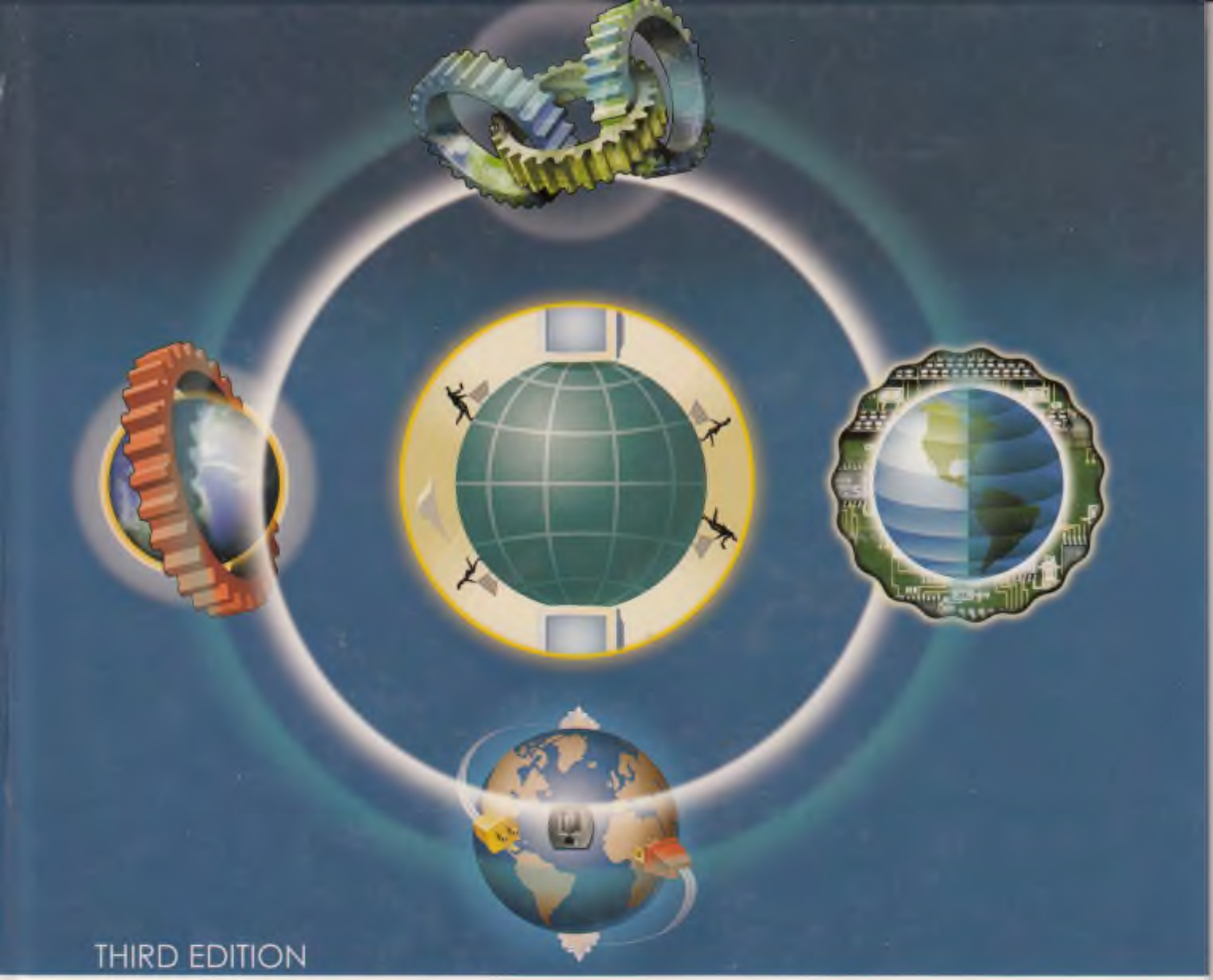

THIRD EDITION

Designing and Managing the Supply Chain

Concepts, Strategies and Case Studies

David Simchi-Levi

Philip Kaminsky

Edith Simchi-Levi

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by Simchi-Levi, Kaminsky, and Simchi-Levi

represents an exciting, substantial revision!

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Additionally, the authors continue to provide state-of-the-art models, concepts, and solution methods that are important for the design, control, operation, and management of supply chain systems.

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Concepts, Strategies, and Case Studies

THIRD EDITION

David Simchi-Levi

Massachusetts Institute of Technology (MIT), Cambridge, Massachusetts

Philip Kaminsky

University of California, Berkeley

Edith Simchi-Levi

LogicTools, Inc., Lexington, Massachusetts

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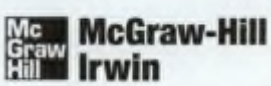

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To our children, Sara and Yuval, who have the patience and humor to survive our work together

D.S.L., E.S.L.

To my family, for their support and encouragement

P.K.

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FOREWORD

In the last few years we have seen an explosion of publications on supply chain management: numerous books have been published and many articles have appeared in academic, trade, and popular magazines. These publications either are too technical—and therefore inaccessible to practitioners and students—or lack the breadth and depth that the topic deserves. Certainly, it is difficult to find a book appropriate for teaching supply chain management to business or engineering students. *Designing and Managing the Supply Chain* solves this problem!

The book is an important contribution and major milestone for the supply chain community. It is the first book that covers a comprehensive breadth of supply chain topics in depth, and addresses the major challenges in this area. It was written by experts from academia and industry who have been researching, consulting, and developing software for supply chain management for many years.

This book includes many classic and new case studies, numerous examples as well as in-depth analyses of some of the technical issues involved in inventory management, network design, and strategic partnering, to name a few. It is therefore an ideal textbook for classes on supply chain management at the undergraduate, Master's, and M.B.A. levels. Since each chapter is self-contained, instructors can pick the chapters they want to use depending on the length of the class and its requirements. The book comes with three computerized games. The Computerized Beer Game provides an excellent instructional tool that engages students in managing a supply chain and provides a starting point for discussing the value of information in the supply chain, strategic partnering, centralized decision making, and so forth. The Risk Pool Game allows students to gain insight on an important concept in supply chain management, called risk pooling. The Bidding Game illustrates important procurement strategies. The authors have been most creative in using games to motivate and expose students to challenging subjects.

Finally, since many companies view supply chain management as the core of their business strategy, this book also will be of interest to managers involved in any of the processes that make up the supply chain.

I want to compliment the authors for having written such an outstanding textbook for the supply chain community.

Hau L. Lee
Kleiner Perkins, Mayfield, Sequoia Capital Professor
Director, Stanford Global Supply Chain Forum
Stanford University

PREFACE

Three years ago, when the second edition of this text was published, we mentioned our goal of building on the positive elements of the first edition and including what we had learned subsequently. We are pleased to note that that revision was successful; as with the first edition, we received a tremendous response from adopters, students, executives, and consultants. Nevertheless, new concepts have subsequently been developed, technological changes continue at an ever-increasing rate, and we have discovered a variety of important new teaching approaches and concepts, so the time is right for a newly revised edition.

The original edition of this book grew out of a number of supply chain management courses and executive education programs we taught at Northwestern University, as well as numerous consulting projects and supply chain decision-support systems we developed at LogicTools. Since then, we have continued teaching executive and regular courses, both at Massachusetts Institute of Technology and at the University of California, Berkeley, and have continued to develop a variety of supply chain decision-support tools. These courses have spawned many innovative and effective supply chain education concepts. The focus in these programs has always been on presenting, in an easily accessible manner, recently developed state-of-the-art models and solution methods important in the design, control, and operation of supply chains. Similarly, the consulting projects and decision-support systems developed by LogicTools have focused on applying these advanced techniques to solve specific problems faced by our clients. In the last three years, we have continued to add new models and techniques to these courses as they have been developed, and we continued the process of integrating these approaches, models, and solution methods into frameworks so that students can better put these ideas into perspective.

Interest in supply chain management, both in industry and in academia, has grown rapidly over the past two decades, and continues to grow. A number of forces have contributed to this trend. In the 90s, many companies recognized that they have reduced manufacturing costs as much as practically possible. Many of these companies discovered the magnitude of savings that can be achieved by planning and managing their supply chains more effectively. Indeed, a striking example in the 90s was Wal-Mart's success, which is partly attributed to implementing a new logistics strategy called cross-docking. At the same time, information and communication systems

were widely implemented, and provide access to comprehensive data from all components of the supply chain.

In particular, the influence of the Internet and e-commerce on the economy in general and business practice in particular has been tremendous. Changes are happening extremely fast, and the scope of these changes is breathtaking! For instance, the direct business model employed by industry giants such as Dell Computers and Amazon.com enables customers to order products over the Internet and thus allows companies to sell their products without relying on third-party distributors or conventional stores. Similarly, the Internet has made a significant impact on business-to-business transactions and collaborations. At the same time, deregulation of the transportation industry has led to the development of a variety of transportation modes and reduced transportation costs, while significantly increasing the complexity of logistics systems.

Finally, new forces contributed to the increased interest in supply chain management in the last five years. As offshoring and globalization of manufacturing operations continue to grow, supply chain complexity and risks have significantly increased. This, together with rising energy costs and the acceleration of merger and acquisition activities, has motivated many companies to reevaluate their supply chain strategies in order to better utilize existing resources and infrastructure.

It is therefore not surprising that many companies are involved in the analysis of their supply chains. In most cases, however, this analysis is performed based on experience and intuition; very few analytical models or planning tools have been used in this process. In contrast, in the last two decades, the academic community has developed various models and tools for supply chain management. Unfortunately, the first generation of this technology was not robust or flexible enough to allow industry to use it effectively. This, however, has changed over the last few years, during which improved analysis and insight, and effective models and decision-support systems, have been developed; however, these are not necessarily familiar to industry. Indeed, to our knowledge there is no published work that discusses these problems, models, concepts, and tools in an accessible manner and at an appropriate level.

In this book, we intend to fill this gap by providing state-of-the-art models, concepts, and solution methods that are important for the design, control, operation, and management of supply chain systems. In particular, we have attempted both to convey the intuition behind many key supply chain concepts and to provide simple techniques that can be used to analyze various aspects of the supply chain.

The emphasis is on a format that will be accessible to executives and practitioners, as well as students interested in careers in related industries. In addition, it will introduce readers to information systems and decision-support tools that can aid in the design, analysis, and control of supply chains.

The book is written to serve as

- A textbook for M.B.A.-level logistics and supply chain management courses.
- A textbook for B.S. and M.S. industrial engineering courses on logistics and supply chain management.
- A reference for teachers, consultants, and practitioners involved in any one of the processes that make up the supply chain.

Of course, supply chain management is a very broad area, and it would be impossible for a single book to cover all of the relevant areas in depth. Indeed, there is considerable disagreement in academia and industry about exactly what these relevant areas are. Nevertheless, we have attempted to provide a broad introduction to many critical

facets of supply chain management. Although many essential supply chain management issues are interrelated, we have strived wherever possible to make each chapter as self-contained as possible, so that the reader can refer directly to chapters covering topics of interest.

The discussion ranges from basic topics of inventory management, logistics network planning, distribution systems, and customer value to more advanced topics of strategic alliances, the value of information in the supply chain, supply contracts, procurement and outsourcing, product design and the interface between product design and supply chain strategies, business processes and information technology including decision-support systems, technology standards and risk management, and international issues in supply chain management. Each chapter utilizes numerous case studies and examples, and mathematical and technical sections can be skipped without loss of continuity.

NEW IN THE THIRD EDITION

The third edition of the book represents a substantial revision. Indeed, while we kept the same structure and philosophy as in the previous editions, we have placed an increasing importance on finding or developing effective frameworks that illustrate many important supply chain issues. At the same time, motivated by new development in industry, we have added material on a variety of topics while increasing the coverage of others.

In brief, the major changes include

- New case studies such as Amazon.com's European Distribution Strategy; Dell Inc.: Improving the Flexibility of the Desktop PC Supply Chain; H. C. Strack, Inc.; Steel Works Inc.; Selectron: From Contract Manufacturer to Global Supply Chain Integrator; and Zara.
- New topics such as network planning, strategic inventory, risk management strategies, global sourcing strategies, and technology standards.
- New chapters on network planning, distribution strategies, supply contracts, pricing, and technology standards.
- New concepts such as the development supply chain, strategic sourcing, and service-oriented architecture.

Specifically,

- We have introduced the concept of the "development supply chain" (Chapter 1) and applied it to product design and supply chain strategies (Chapter 11).
- We have expanded our discussion of network planning and increased our emphasis on strategic safety stock and inventory planning in supply networks (Chapter 3).
- We have added a chapter on supply contracts for strategic and commodity components (Chapter 4).
- We have enhanced our discussion of the impact of lead time on supply chain strategy (Chapter 6).
- We have added a chapter on distribution strategies where we focus on the impact of inventory pooling and customer search (Chapter 7).
- We have substantially revised the chapter on procurement and outsourcing strategies, focusing on framework for outsourcing, strategic purchasing, and supplier footprint (Chapter 9).

- We have developed a new framework for risk management in global supply chains (Chapter 10).
- We have added a chapter on smart pricing and revenue management in supply chains (Chapter 13).
- We have added a chapter on technology standards such as service-oriented architecture and RFID (Chapter 15).
- We have added and updated numerous examples to illustrate various concepts, frameworks, and strategies.

The book also includes three software package — the **Computerized Beer Game,** the **Risk Pool Game,** and the **Bidding Game** — that help to illustrate many of the concepts we discuss in the book. Indeed, in teaching executives and M.B.A. students, we have found that these games help students better understand issues and concepts such as the bullwhip effect, the value of information in the supply chain, and the impact of lead times, centralized decision making, risk pooling, and supplier competition on supply chain operations. As in the second edition, we have included a Microsoft Excel spreadsheet to help students understand many of the supply contracts concepts introduced in Chapter 4.

Parts of this book are based on work we have done either together or with others.

- Chapters 1 and 3 borrow extensively from *The Logic of Logistics*, written by J. Bramel and D. Simchi-Levi and published by Springer in 1997; second edition (with X. Chen and J. Bramel) appeared in October 2004.
- The development supply chain concept was first introduced by C. H. Fine from MIT and then applied by C. H. Fine and D. Simchi-Levi to develop effective supply chain strategies. Some of their ideas are discussed in Chapters 1 and 11.
- Some of the material on the bullwhip effect appears in an article by F. Y. Chen, Z. Drezner, J. K. Ryan, and D. Simchi-Levi in *Quantitative Models for Supply Chain Management*, edited by S. Tayur, R. Ganeshan, and M. Magazine, and published by Kluwer Academic Publishers in 1998.
- The material in Chapter 6 is taken from two papers, one written by D. Simchi-Levi and E. Simchi-Levi and the second written by these two authors and M. Watson. This latter paper appeared in *The Practice of Supply Chain Management*, edited by T. Harrison, H. Lee, and J. Neale, published by Kluwer Academic Publishers in 2003.
- The material on inventory pooling and customer search discussed in Chapter 7 is based on the paper "Centralization of Stocks: Retailers vs. Manufacturer," by R. Anupindi and Y. Bassok, published in *Management Science* in 1999. This paper motivated D. Simchi-Levi to develop (together with X. Chen and Y. Sheng) a simulation model used in Examples 7-2 and 7-3.
- Some of the material in Chapter 9 is based on teaching material received by the authors from C. P. Teo from the National University of Singapore and V.M. de Albeniz from IESE, Spain.
- Chapter 14 borrows extensively from an article by C. Heinrich and D. Simchi-Levi published in *Supply Chain Management Review*, May 2005.
- The discussion on RFID in Chapter 15 is based on a chapter written by D. Simchi-Levi in the book *RFID and Beyond: Growing Your Business Through Real World Awareness*, edited by C. Heinrich and published by Wiley in 2005.
- The Computerized Beer Game is discussed in an article by P. Kaminsky and D. Simchi-Levi that appeared in *Supply Chain and Technology Management*,

edited by H. Lee and S. M. Ng and published by The Production and Operations Management Society.

- The Bidding Game is based on an article by V. Martinez de Albeniz and D. Simchi-Levi "Competition in the Supply Option Market," Working Paper, MIT, 2005.
- Some of the material on risk management is taken from an article by D. Simchi-Levi, L. Snyder, and M. Watson published in *Supply Chain Management Review* in 2002.

ACKNOWLEDGMENTS

It is our pleasure to acknowledge all those who helped us with the three editions of this manuscript. First, we would like to thank Dr. Myron Feinstein, former director of supply chain strategy development at Unilever, New York City, who read through and commented on various chapters of the first edition. Similarly, we are indebted to the instructors who reviewed the manuscript of the first edition, Professors Michael Ball (University of Maryland), Wendell Gilland (University of North Carolina, Chapel Hill), Eric Johnson (Dartmouth College), Douglas Morrice (The University of Texas, Austin), Michael Pangburn (Pennsylvania State University), Powell Robinson (Texas A&M University), William Tallon (Northern Illinois University), and Rachel Yang (University of Illinois, Urbana-Champaign).

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We are grateful to our colleagues at Massachusetts Institute of Technology; the University of California, Berkeley; and LogicTools who have provided us with opportunities to interact with some of the brightest minds in our field and to learn from their research and development. A few people stand out in this regard: Professors Charles H. Fine and Stephen C. Graves (MIT), with whom Professor Simchi-Levi has closely collaborated in the last five years, as well as Peter J. Cacioppi, Derek Nelson, and Dr. Michael S. Watson from LogicTools.

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