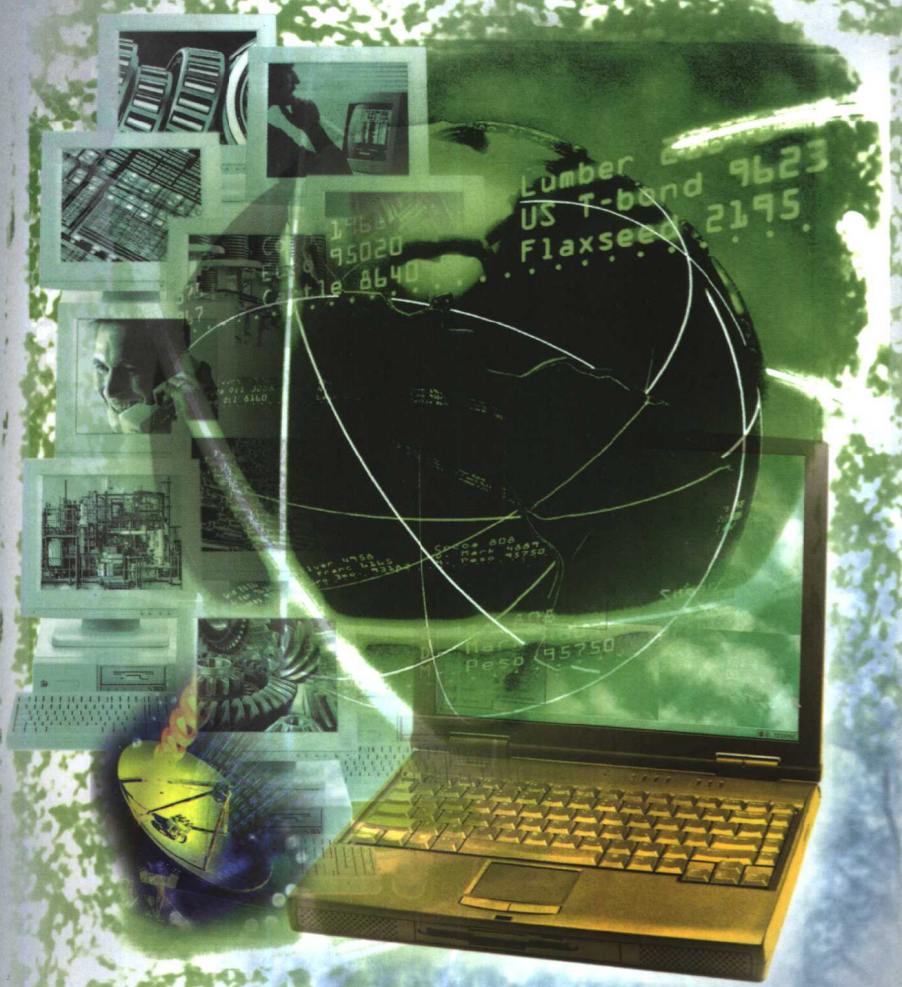
供应链建模

[美] 杰里米·夏皮罗 著　　麻省理工学院斯隆管理学院

Modeling the Supply Chain



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To Martha

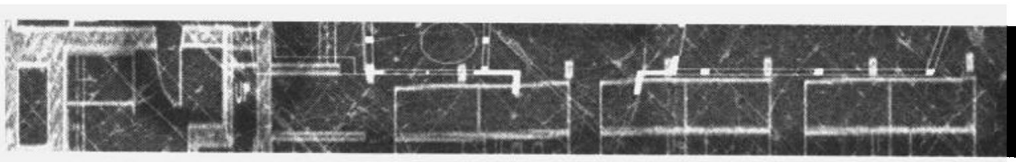
About the Author


Ron Powell

Jeremy Shapiro is professor of operations research and management in the Sloan School of Management at MIT. For 9 years he served as co-director of MIT's Operations Research Center. Previously, he was employed by Procter and Gamble, Hughes Aircraft Company, and the Port of New York Authority. He received B.M.E. and M.I.E. degrees from Cornell and a Ph.D. degree in Operations Research from Stanford. While an undergraduate at Cornell, he studied for 1 year at the University of Paris.

Dr. Shapiro has published over 50 papers in the areas of operations research, mathematical programming, logistics, supply chain management, finance, and marketing and is the author of *Mathematical Programming: Structures and Algorithms,* published by John Wiley in 1979. He is also president of SLIM Technologies, LLC, a Boston-based firm specializing in the implementation and application of modeling systems for supply chain management and other business problems. Outside interests include reading, traveling, biking, and playing tennis. He is married to Martha J. Heigham and has three children, Alexander, Lara, and Nicholas.

Preface



When I began writing this book 8 years ago, I was motivated by my consulting experiences applying mathematical programming (that is, optimization methods) to business planning problems. These experiences convinced me that data-driven models can and should play a central role in helping managers make decisions. As I waxed and waned in my efforts to articulate arguments supporting this viewpoint, developments in the business world and information technology put the issue in much sharper focus. These include:

- the emergence of supply chain management as a important concept underlying the strategy and operations of virtually all firms that manufacture and/or distribute products
- greater globalization in many companies of their supply chain activities
- the torrid pace of improvements and innovations in information technology, which make supply chain management possible and necessary—including faster computers, more flexible software for implementing interfaces and managing data, and the advent of enterprise resource planning systems and e-commerce
- the realization by managers that they must adapt their organizations to fully exploit information technology

As a result of these developments, many more managers today are actively seeking analytical tools to assist them in making effective supply chain decisions. Thus, the book's goal became to explain how models can be effectively constructed and applied to supply chain planning problems, rather than to argue why models must be considered for such purposes.

Although my studies and writing are still chasing the developments just cited, it is not premature to posit principles for exploiting data, models and modeling systems. In an era of dynamic change, such principles are needed to help managers identify coherent, long-term plans for acquiring systems and implementing processes that

support data-driven decision making in their companies. Firms that succeed in such efforts will realize significant competitive advantage.

Harmonizing Qualitative and Quantitative Analysis

A story is told in Cambridge, Massachusetts:

> A young man, obviously a college student, is unloading his purchases at a supermarket checkout counter. A large sign above the counter indicates that it is for customers with eight items or less, but the young man has at least twenty. The clerk tells him, "You either go to MIT and you can't read, or you go to Harvard and you can't count."

The relevance of this story is: Managers and analysts need both qualitative (verbal) and quantitative (numerate) skills to achieve superior supply chain performance. On one hand, qualitative discussions about the importance of integrating decision making across the supply chain must be realized as new data collection and modeling systems and new decision processes if they are to have an impact. Conversely, despite the potential of modeling systems to reduce costs or increase profits, managers will be reluctant to use them if they have little understanding of how their decision problems are represented as models. Moreover, unless managers and analysts are given a vocabulary for describing insights into the qualitative goals of the company that models provide, modeling activities will be treated as sideshows of little importance.

Harmonization of qualitative and quantitative perspectives is also a central issue when we merge concepts from diverse management disciplines when constructing supply chain models. As we shall see, the following disciplines contribute important elements to such constructions: strategy formation, the theory of industrial organizations, operations management, logistics, transportation science, and managerial accounting. Furthermore, supply chain decisions should be integrated with marketing and financial decisions, especially when evaluating strategic plans. Quantitative models of marketing science and corporate finance, as well as qualitative concepts from these disciplines, can be used in extending supply chain models to the study of strategic planning questions from an enterprise-wide perspective.

Finally, research by organizational behaviorists into how individuals and companies actually make decisions helps managers and modeling practitioners understand the nature of barriers to fact-based decision making. These insights provide a good background for designing and implementing new business processes that overcome such barriers. In so doing, companies will better harness advances in information technology to achieve sustainable competitive advantage from the management of their supply chains.

Thus, an important goal of this book is to furnish students, managers, and analysts with discussions and examples that harmonize qualitative and quantitative thinking about supply chain planning problems and models. In so doing, we also attempt to integrate concepts and constructions from the disciplines discussed in the preceding paragraphs. Our approach relies heavily on optimization models, which provide frames or templates for such integration. Viewed another way, we will

attempt to demonstrate that optimization models and methods provide comprehensive systems analysis approaches to integrated business planning, which is the essence of supply chain management.

Intended Audiences

The intended audiences for the book are as follows:

- managers who seek models and modeling systems to help them make better supply chain decisions
- information technologists who are responsible for developing and maintaining such systems, and for integrating them with enterprise resource planning and e-commerce systems
- consultants who conduct supply chain studies using models
- students who will become supply chain managers, information technologists or consultants

In other words, we intend the book to serve the needs of both initial and continuing education in the use of data and models to support supply chain decision making.

The initial objective of the book was to produce a guide for supply chain managers seeking modeling systems. In developing material supporting the merits of operations research models and methods, I examined papers and books written by academics and practitioners in the fields mentioned earlier that were concerned with issues of data, analysis, the role of information technology, and business process redesign in supporting managerial decision making. It seemed worthwhile to extend the book's scope to incorporate convergent ideas from these diverse disciplines. By adding such discussions, plus numerical examples and exercises, I believe I have created a textbook suitable for management students who wish to be educated about the form and function of practical analytical tools for supply chain management.

Overview of Content

The book is divided into four sections as follows:

Part I—Introduction to Supply Chain Management

Part II—Modeling and Solution Methods

Part III—Applications

Part IV—The Future

Part I, which comprises Chapters 1 and 2, discusses motivations for using models to analyze supply chain problems. Particular attention is paid to developments in information technology that have spawned an interest in and a need for integrated supply chain modeling and management. Part I also examines a hierarchy of linked

supply chain modeling systems to support operational, tactical and strategic decision making.

Part II, which comprises Chapters 3, 4, 5, and 6, provides details of linear and mixed integer programming models for optimizing supply chain decisions. The discussion includes small examples of models for production, transportation, and inventory planning problems. Part II also explains algorithmic methods for solving these models and their economic interpretation, and provides illustrations of spreadsheet optimization formulations. Chapter 5 is devoted to the presentation of a unified optimization methodology for combining heuristic methods with mixed integer programming models to analyze operational planning problems. Finally, Chapter 6 examines in detail the supply chain decision database from which optimization models are generated.

Part III, which comprises Chapters 7, 8, 9, 10, and 11, discusses applications of modeling systems to strategic, tactical, and operational supply chain problems. Strategic and tactical planning models are examined in Chapters 7 and 8. The emphasis in Chapter 7 is on state-of-the-art applications in manufacturing and logistics. The chapter includes the presentation of several applications. It also includes a discussion of resource acquisition and allocation planning from the perspective of the resource-based view of the firm, a new paradigm for strategic planning.

The emphasis in Chapter 8 is on innovative applications to strategic and tactical planning of a supply chain. These are applications that may be beyond the current state-of-the-art, but have potential for practical applications in the future. Included are modeling approaches for integrating supply chain and demand management, for evaluating price competition among firms in an industry, and for explicit analysis of decision making under uncertainty using stochastic programming.

Chapter 9 presents modeling approaches for optimizing corporate financial planning decisions and for integrating them with models for optimizing supply chain decisions. This chapter also discusses integrated models for planning in multinational corporations that allow managers to blend decisions involving financial flows with those involving physical flows. The goal is to maximize after-tax profits that are repatriated to the parent company, subject to constraints on the performance of partially or wholly owned foreign subsidiaries.

Modeling systems for operational planning are examined in Chapter 10, including in-depth reviews of a vehicle routing system for an e-commerce company and a production planning and scheduling system for a semi-conductor company. The chapter also contains brief discussions of several other modeling applications to operational problems arising in production scheduling, vehicle routing and human resources planning.

Inventory management applications, which span all levels of planning, are discussed in Chapter 11. The chapter begins with a review of classical inventory theory, which is particularly appropriate for operational inventory decision making. We then examine methods for integrating inventory theory with optimization models for strategic and tactical supply chain planning. The chapter also includes several applications of models to inventory management in high tech and electronics firms.

Finally, Part IV, which consists of Chapter 12, discusses human and organizational issues surrounding a firm's efforts to exploit data and modeling systems when

improving its supply chain management. The chapter discusses at length the conflict between a firm's desire to achieve fact-based supply chain management and the ecology of decision making that conspires to work against it. The chapter contains suggestions about business process re-design to meet the goals of fact-based decision making while overcoming organizational barriers. It also discusses factors that influence the role played by IT in providing the firm with superior supply chain management. The chapter and the book conclude with a forecast of developments in supply chain management over the next 10 years.

Exercises and Website

Except for Chapter 1, the printed book contains exercises at the end of every chapter. Some are modeling exercises while others are discussion questions. In addition, the book's Web site (www.scm-models.com) contains modeling exercises involving data files and discussion questions involving white papers. The Web site also contains hotlinks to other Web sites, organized by sections and chapters where they are relevant. The Web site is also accessible through www.duxbury.com.

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Jeremy Shapiro

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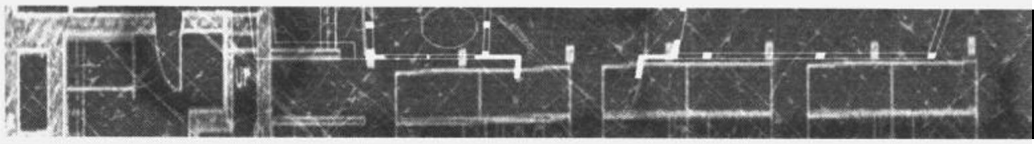

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