

# Preface

In recent years, supply chain planning has emerged as one of the most challenging problems in the industry. As a consequence, the planning focus is shifting from the management of plant-specific operations to a holistic view of the various logistics and production stages, that is an approach in which suppliers, production plants and customers are considered as constituents of an integrated network. A major driving force behind this development lies in the globalization of the world economy, which has facilitated the co-operation between different partners working together in world-wide logistics networks. Hence, considerable cost savings can be gained from optimizing the structure and the operations of complex supply networks linking plants, suppliers, distribution centres and customers. Consequently, to improve the performance of the entire logistic chain, more sophisticated planning systems and more effective decision support are needed.

Clearly, successful applications of supply chain management have driven the development of advanced planning systems (APS), which are concerned with supporting decision-making activities at the strategic, tactical and operational decision level. These software packages basically rely on the application of quantitative methods, which are used to model the underlying complex decision problems considering the limited availability of resources and the need to react on time to customer orders. The core module at the mid-term level of APS comprises operational supply chain planning. In many industries, production stages are assigned to different plants and distribution centres have been established at geographically dispersed locations. Supply chain planning aims at coordinating production activities within such multi-site logistics networks to avoid excessive inventories, inefficient capacity utilization and poor customer service. In APS, advanced optimization techniques are provided to determine the quantities to be produced, stored, transported and procured in the supply network.

This book is divided into five parts. The first one is concerned with decision-making in supply chains. The paper by *Hartmut Stadler* addresses issues of collaboration in inter-organizational supply chains. It analyzes and clusters the approaches that have been developed since the advent of supply chain management about two decades ago and gives an overview on the state-of-the-art. Moreover, the paper provides a framework for collaborative planning in supply chains, with

special emphasis on model-based decision support at the operational level of inter-organizational supply chains.

In their paper, *Christian Almeder, Margaretha Preusser and Richard F. Hartl* present a general framework for combining an optimization model and discrete event simulation to support supply chain planning. Both models are applied in an iterative fashion until convergence is reached. It is shown that this approach delivers competitive results much faster compared to mixed-integer linear programming models in a stochastic environment.

Part 2 comprises five papers on demand management and order fulfillment in supply chains. Revenue management is a topic that has received great attention in service and recently also in manufacturing industries. In their paper, *Rainer Quante, Herbert Meyr and Moritz Fleischmann* analyze the underlying supply chain processes of revenue management and demand fulfillment in different business environments. In particular, they discuss and clarify the relationships between available software solutions and applications as well as scientific models in this field and highlight directions of future research.

A systematic mathematical programming approach for active demand management in process industries is presented by *Aaron A. Levis and Lazaros Papageorgiou*. They develop an iterative algorithm for supporting decision-making on pricing strategies as well as on output levels for substitute products. Several case studies are used to obtain game-theoretical insights for a duopolistic market situation.

The paper by *Herbert Meyr* focuses on the segmentation of customers and the allocation of available quantities. It is shown that the current practice of rule-based order promising can be improved by exploiting information on customer heterogeneity and customer demand. As a practical tool, deterministic linear programming models to support available-to-promise decisions in a make-to-stock environment are presented.

In their paper, *Thomas R. Ervolina, Markus Ettl, Young M. Lee and Daniel J. Peters* propose a novel management process for determining marketable product alternatives in a supply chain. Their approach aims at better integrating the supply chain horizontally by connecting the activities of customers, business partners and sales teams to procurement and manufacturing capabilities of a firm. The proposed mathematical optimization based approach has contributed to substantial business improvements at IBM.

The paper by *Richard Pibernik and Prashant Yadav* focuses on real-time order promising in a make-to-stock environment. An integrated approach is developed that exploits the structure of order arrivals and material receipts to determine inventory reservations for high-priority orders in real time. In a comprehensive numerical study, the impact of inventory reservation and order promising is investigated under varying system parameters.

The three papers included in Part 3 of this book focus on inventory management. In supply chains, safety stocks are needed to be more responsive to customer orders and to meet the target service levels. *Youssef Boulaksil, Jan C. Fransoo and Ernico N. G. van Halm* propose a combination of an optimization and a simulation model. They apply this hybrid modeling approach to determine safety stock levels in a

multi-item multi-stage inventory system. As a case study, the supply chain of a biopharmaceutical company is considered.

The paper by *Pieter L.M. van Nyen, J. Will M. Bertrand, Henny P.G. van Ooijen* and *Nico J. Vandaele* investigates the impact of different variants of supplier-managed inventory on costs in a supply chain consisting of a parts supplier and an original equipment manufacturer's assembly plant. Numerical experiments revealed that substantial system-wide cost savings could be gained compared to a situation in which the assembly plant manages the inventories.

In the subsequent paper on vendor-managed inventory, *Bogdan C. Bichescu* and *Michael J. Fry* analyze decentralized supply chains under different degrees of channel power, that is the agents' ability to control the decision-making process in a supply chain. Game-theoretical models are used to compare the effectiveness of vendor-managed inventory and to analyze different channel power relationships under a variety of environmental conditions.

Applications of supply chain planning in the chemical industry are presented in Part 4. The concept of value chain management can be seen as another challenging extension of classical supply chain management. Considering a case study from the chemical industry, *Matthias Kannegiesser, Hans-Otto Günther, Paul van Beek, Martin Grunow* and *Christoph Habla* present an operative planning model for coordinating sales, distribution and production activities throughout a global value chain. Specifically, the optimization model addresses spot demand for chemical commodities with volatile and uncertain sales prices and evaluates the impact of the respective price-quantity elasticity.

An optimization model based on mixed-integer linear programming to schedule campaigns in a specialty chemicals plant is presented by *Marcus Brandenburg* and *Franz-Josef Tölle*. They focus on a real-world problem, which is characterized by a variety of chemical processes with sequence-dependent setup conditions, complex material flows, flexible use of resources and facility-dependent batch sizes. To solve this complex scheduling problem, a two-stage solution procedure is applied, which determines near-optimal schedules even for large-sized real-world problem instances within reasonable CPU time.

Finally, two papers with applications in the automotive industry are presented in Part 5. The paper by *Herbert Meyr*, originally published in 2004, first gives an overview of short- and mid-term approaches for supply network planning in the automotive industry and specifically discusses the application of OR methodology to support the various planning tasks involved. Afterwards, the author discusses the impact of the ongoing change in strategy, namely the change from a built-to-stock oriented to a customized built-to-order production, on the future application of OR methods.

The final paper by *Ralf Bihlmaier, Achim Koberstein* and *René Obst* considers strategic flexibility and capacity planning under uncertain demand in production networks of automobile manufacturers. Their solution approach is integrated into a decision support system, which determines minimum-cost product allocations and develops tactical workforce plans. The practicality of their approach is demonstrated by the use of an industrial case study.

The primary objective of this book is to reflect the recent developments of supply chain planning and to examine new research issues. It presents recent research results on collaborative planning in supply chains, demand and inventory management in logistics networks as well as industrial applications. The specific focus of this book is on the application of quantitative methods, which also form the basis of commercial advanced planning software systems. Fourteen papers previously published in “OR Spectrum – Quantitative Approaches in Management” have been selected for publication in this volume. All papers have been peer-reviewed according to the standards of the journal.

This book has greatly benefited from the cooperation among the authors, reviewers and editors. We express our sincere thanks to the reviewers for their excellent and timely refereeing. Last, but not least, we thank all authors for their contributions, which made this book possible.

Berlin and Darmstadt,  
February 2009

*Hans-Otto Günther*  
*Herbert Meyr*

Supply Chain Planning  
Quantitative Decision Support and Advanced Planning  
Solutions

Günther, H.-O.; Meyr, H. (Eds.)

2009, X, 392 p. 77 illus., Hardcover

ISBN: 978-3-540-93774-6