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Preface

The title of this edited book, *Supply Chain Optimization*, aims to capture a segment of recent research activity in supply chain management. This research area focuses on applying optimization techniques to supply chain management problems. While the general area of supply chain management research is broader than this scope, our intent is to compile a set of research papers that capture the use of state-of-the-art optimization methods within the field. Several researchers who initially expressed interest in contributing to this effort also expressed concerns that their work might not contain a sufficient degree of optimization. Others were uncertain as to whether the problems they proposed covered a broad enough scope in order to be considered as supply chain research. Our position has been that research that rigorously models elements of supply chain operations with a goal of improving supply chain performance (or the performance of some segment thereof) would fit under the umbrella of *supply chain optimization*. We therefore sought high-quality works from leading researchers in the field that fit within this general scope. We are quite pleased with the result, which has brought together a diverse blend of research topics and novel modeling and solution approaches for difficult classes of supply chain operations, planning, and design problems.

The book begins by taking an in-depth look at the role of information in supply chains. "Information Centric Optimization of Inventories in Capacitated Supply Chains: Three Illustrative Examples," by S. Gavirneni, considers how firms can best take advantage of the vast amounts of data available to them as a result of advanced information technologies. The author considers how capacity, inventory, information, and pricing influence supply chain performance, and provides strategies for leveraging information to enhance performance.

The second chapter, "An Analysis of Advance Booking Discount Programs between Competing Retailers," by K.F. McCardle, K. Rajaram, and C.S. Tang, considers a new mechanism for eliciting information from customers. The authors employ a strategy of providing discounts to cus-

tomers who reserve a product in advance of a primary selling season. This information can be used by a supplier to reduce the uncertainty faced in the selling season, and the authors explore conditions under which equilibrium behavior among two retailers results in applying such a strategy.

In Chapter 3, A.M. Newman, C.A. Yano, and P.M. Kaminsky study a class of combined transportation and inventory planning problems faced by third-party logistics providers, who are becoming increasingly prevalent players in supply chains. This chapter, "Third Party Logistics Planning with Routing and Inventory Costs," considers route selection for full-truckload carriers contracted by manufacturers for repeated deliveries. The logistics provider faces a tradeoff between providing better service to customers through more frequent deliveries versus achieving the most cost-effective delivery pattern from a transportation cost perspective.

E. Bish addresses capacity investment and pricing decisions under demand uncertainty in Chapter 4, "Optimal Investment Strategies for Flexible Resources, Considering Pricing." While a number of past works have considered the problem of investing in flexible resources under uncertainty, this work explores how a firm's ability to set prices influences the value of resource flexibility. This work provides interesting insights on how pricing power can alter flexible resource capacity investment under different product demand correlation scenarios.

In "Multi-Channel Supply Chain Design in B2C Electronic Commerce" (Chapter 5), W.K. Chiang and D. Chhajed provide an interesting look at the challenges manufacturers face in simultaneously selling via traditional retail and direct on-line sales channels. Under a variety of scenarios and using a game-theoretic modeling approach, they provide insights on channel design strategy for both centralized and decentralized supply chains, when consumers have different preferences for direct and retail channels.

While a vast amount of literature applies game-theoretic modeling approaches to supply chain problems, J.J. Bartholdi III and E. Kemahlıoğlu-Ziya provide an innovative new model for sharing gains from cooperation in Chapter 6 ("Using Shapley Value to Allocate Savings in a Supply Chain"). They consider original equipment manufacturers (OEMs) with varying degrees of power who can influence whether a contract supplier may pool upstream inventories of common goods for multiple OEMs. By using the concept of Shapley value to create a mechanism for sharing the gains by allowing inventory pooling, the authors show that this method induces supply chain coordination and leads to a stable solu-

tion, although the resulting solution may still be perceived as "unfair" by some participants.

M.S. Pangburn and E. Stavrulaki consider an economic model of combined pricing, location, and capacity setting decisions in Chapter 7, "Service Facility Location and Design with Pricing and Waiting-Time Considerations." This model accounts for contexts where customers are sensitive to both transportation time and service waiting time that results from congestion effects. Customers will choose a facility if the associated utility (which accounts for distance and waiting-time costs) exceeds some reservation value. The authors address the implications of non-homogeneous customers, as well as equilibrium competitive behavior with two facilities.

Chapter 8 considers a recently emerging focus in supply chain design, where the robustness of the design under uncertainty is critical. In "A Conceptual Framework for Robust Supply Chain Design under Demand Uncertainty," Y. Mo and T.P. Harrison propose a modeling approach for addressing demand uncertainty in the design phase. The authors propose different robustness measures that incorporate various elements of risk and discuss different solution strategies, including the use of stochastic programming and sampling-based methods.

Staying with the supply chain design focus, Chapter 9, "The Design of Production-Distribution Networks: A Mathematical Programming Approach," by A. Martel, considers a wide range of decision factors in design. This chapter highlights important strategic factors, such as performance measures, planning horizon length and the associated uncertainty, process and product structure modeling, network flow modeling, modeling price, demand, and customer service, and facility layout options. The cost model accounts for various financial factors, such as tariffs, taxes, exchange rates, and transfer payments, in addition to transportation, inventory, and location costs. The result is a comprehensive large-scale nonlinear integer math programming model. The author discusses solution methods employed to develop a decision support system for supply chain design decisions.

Chapter 10, "Modeling & Solving Stochastic Programming Problems in Supply Chain Management Using *Xpress-SP*," by A. Dormer, A. Vazacopoulos, N. Verma, and H. Tipi, provides a further look at how to deal with uncertainty in supply chains. The authors identify various sources of risk in supply chains and how these affect performance. This chapter provides a nice discussion of stochastic programming problems in general, and in how to use the *Xpress-SP* package to model and solve these problems. Two illustrative examples of supply chain plan-

ning problems under uncertainty serve to illustrate the effective use of this tool for solving such problems.

Chapter 11 considers an operations-level planning problem facing logistics managers in container terminal operations. In "Dispatching Automated Guided Vehicles in a Container Terminal," Y.-L. Cheng, H.-C. Sen, K. Natarajan, C.-P. Teo, and K.-C. Tan study the problem of dispatching automated vehicles in a port terminal. Their model accounts for congestion effects in transportation using a deadlock prediction and avoidance scheme. They provide greedy and network flow–based heuristic solution approaches, and use a simulation model to validate the performance improvements as a result of the modeling and solution approaches they propose.

In the final chapter ("Hybrid MIP-CP techniques to solve a Multi-Machine Assignment and Scheduling Problem in Xpress-CP"), A. Vazacopoulos and N. Verma discuss hybrid constraint programming and mixed integer programming approaches for difficult multi-machine scheduling problems. While this model is motivated by the problem of scheduling jobs on different machines on a shop floor, it might also apply to the assignment of work to different facilities in a supply chain. The authors discuss the pros and cons of both constraint programming and mixed integer programming approaches, and consider hybrid approaches that combine the strengths of both of these methods. The authors illustrate the use of the *Xpress-CP* software package as a tool for implementing this hybrid approach, and compare the results obtained to prior results from the literature based on a common set of test problems.

This collection represents a set of stand-alone works that captures recent research trends in the application of optimization methods to supply chain operations, planning, and design problems. We are extremely grateful to the authors for their outstanding contributions and for their patience, which have led to a final product that far exceeded our expectations. All chapters were rigorously reviewed, and we would like to thank the anonymous reviewers for their quality reviews and responsiveness. We would also like to thank several graduate students in the ISE Department at the University of Florida for their help; in particular, we thank Ismail Serdar Bakal, Altannar Chinchuluun, and Yasemin Merzifonluoğlu for their contributions to this effort.

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