OPTIMIZATION AND LOGISTICS CHALLENGES IN THE ENTERPRISE
Aims and Scope
Optimization has been expanding in all directions at an astonishing rate during the last few decades. New algorithmic and theoretical techniques have been developed, the diffusion into other disciplines has proceeded at a rapid pace, and our knowledge of all aspects of the field has grown even more profound. At the same time, one of the most striking trends in optimization is the constantly increasing emphasis on the interdisciplinary nature of the field. Optimization has been a basic tool in all areas of applied mathematics, engineering, medicine, economics and other sciences.

The series Springer Optimization and Its Applications publishes undergraduate and graduate textbooks, monographs and state-of-the-art expository works that focus on algorithms for solving optimization problems and also study applications involving such problems. Some of the topics covered include nonlinear optimization (convex and nonconvex), network flow problems, stochastic optimization, optimal control, discrete optimization, multiobjective programming, description of software packages, approximation techniques and heuristic approaches.
OPTIMIZATION AND LOGISTICS CHALLENGES IN THE ENTERPRISE

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Preface

“The wisest mind has something yet to learn.”
-George Santayana-

This book represents a collection of computational challenges and recent advances in supply chain, logistics, and optimization research that practically applies to a collaborative and integrative environment in the enterprise. This book has been designed in response to an explosion of interest by academic researchers and industrial practitioners in highly effective coordination between supply chain partners, dynamic collaborative and strategic alliance relationships, and efficient logistics and supply chain network designs that commonly arise in a wide variety of industries. Rather than concentrating on just methodology or techniques (such as mathematical programming or simulation) or specific application areas (such as production, inventory or transportation), we have chosen to present the reader with a collection of topics, which bridge the gap between the operations research and mathematical optimization research from the academic arena with industrial practice. It will also be of value to investigators and practitioners in academic institutions and industry who become involved in supply chain and logistics in enterprise operations as an aid in translating computational optimization techniques to their colleagues in management levels. This book will be very appealing to graduate (and advanced undergraduate) students, researchers and practitioners across a wide range of industries (e.g., pharmaceutical, chemical, transportation, shipping, etc.), who require a detailed overview of the practical aspects of the design, conduct, and the analysis of supply chain and logistics problems arising in real life. For this reason, our audience is assumed to be very diverse and heterogeneous, including:

(a) researchers in operations research from engineering, computer science, statistics and mathematics domains as well as practitioners in industry (e.g., strategic planning directors, operation advisors, senior managers);
(b) researchers from engineering and business domains as well as supply chain and logistics practitioners in industry (e.g., management systems directors, supply chain managers, site supervisors);
(c) researchers in systems engineering and chemical and manufacturing process operations fields as well as investigators and practitioners in the industry who become involved in some way in systems operations (e.g., operations supervisors, process engineers, systems analysts).

There are four major research themes in this book: Process Industry, Supply Chain and Logistics Design, Supply Chain Operation, and Networking and Transportation. Each theme addresses the answer to a classic, yet extremely important, question from industry, “How do we go from the mathematical modeling and optimization techniques to the practical solutions to the enterprise’s operations?”

The first theme includes four chapters focused on optimization and logistics challenges in the process industry. The first chapter, by Grossmann and Furman, lays down the platform of this book by discussing the integration of optimization systems in the process industry throughout an entire enterprise. Enterprise-wide optimization involves the coordinated optimization of research, development, supply, manufacturing, and distribution operations across business functions, organizations and the hierarchy of strategic, tactical and operational decision making. In the second chapter, Zyngier and Kelly consider novel optimization models of inventory for logistics problems in the process industry. These ideas can be applied to process production and distribution planning and scheduling models. The third chapter, by Ierapetritou and Li, presents a review of the methodologies developed to address uncertainty in chemical process planning and scheduling. Recent progress in the areas of sensitivity analysis and parametric programming are highlighted in their application to planning and scheduling in the chemical process industry. In the fourth chapter, Assavapokee et al. address decision making under uncertainty by developing a relative robust optimization algorithm. This work has an impact on supply chain network infrastructure design problems.

The second theme includes four chapters that provides reviews and challenges in supply chain models and logistics design. The fifth chapter, by Mulvey and Erkan, illustrates a supply chain risk management model with a global production problem involving movement of currency. The design of the supply chain includes uncertainty in production and as well as the risks embedded in global financial markets. In the sixth chapter, Miller provides a historical perspective and recommendation on the methods and approaches in the use of optimization technology for decision support by firms at the strategic level down through operations. The seventh chapter, by He et al., presents mathematical models for hub location problems as well as recent advances in optimization used to solve the problems. These problems are primarily of interest for supply chain modelers, especially in warehouse location design. In the eight chapter, Chen et al. present a review of the well-known Nested Partitions method for the solution of discrete optimization
problems. A hybrid framework combining mathematical programming and Nest Partitions is developed and demonstrated on the intermodel hub location class of problems.

The third theme includes three chapters that address issues in supply chain operation. In the ninth chapter, Benli presents a new modeling scheme for scheduling problems that arise in supply chain optimization. This novel framework is illustrated via the lot streaming problem in the production planning area. In the tenth chapter, Metan and Thiele propose a dynamic and data-driven approach to inventory management that incorporates both historical information and addresses seasonality. This approach is demonstrated through extensive computational results with the news vendor problem. In the 11th chapter, Gong et al. consider a problem in task scheduling for service restoration planning. They apply a combined mathematical programming and constraint programming approach to this problem modeled with multiple objective functions.

The last theme includes four chapters that present recent advances in mathematical programming and algorithms developed for logistics networking and transportation problems. In the 12th chapter, Liang and Chaovalitwongse propose a new network model for the aircraft maintenance routing problem. The new model utilizes the idea of using bidirectional flows of aircrafts. The resulting model is very compact and scalable and has been applied to real-life problems. In the 13th chapter, Shen et al. develop a chance constraint model and tabu search solution procedure to look at vehicle routing in which one wishes to minimize unmet demand while addressing uncertainty in both demand and travel times. This application is important in the area of supply chain distribution during disaster scenarios. In the 14th chapter, Agarwal et al. study both carrier alliances and shipper collaborations as they apply to sea, air and trucking cargo. Game theoretic models are developed to analyze the benefits and sustainability issues surrounding these forms of collaboration. In the last chapter, Arulselvan et al. consider wireless agents in a mobile ad hoc network to determine the routing that maximizes connectivity. New formulations and heuristic algorithms are presented to address this problem which can arise in several military applications.

In order to complete this volume, we have dealt with the authors and anonymous referees over the past few years. The experience has been challenging, yet extremely rewarding. We truly hope that the reader will find the fundamental research and applications chapters presented here as stimulating and valuable as we did. We want to thank Prof. Altannar Chinchuluun from the University of Florida for proofreading the final volume. Last but not least we cannot thank the authors and anonymous referees enough for their time, efforts and dedication to make this volume successful.

New Jersey
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Wanpracha Art Chaovalitwongse
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