Preface

By definition, a configurable (hence also reconfigurable) system can be redesigned and remodeled for specific applications for the new (or changed) environment, and upgraded rather than replaced. With a reconfigurable system, new products and processes can be introduced with considerably less expense and ramp-up time. Reconfiguration efficiency attributed to such systems can be achieved only by means of intelligent decision-making (i.e., use of system synthesis, analysis, and simulation). The supply chain for this system must also be configured, aided, and supported by information systems that enable all supply chain members to learn about these changes expeditiously and adjust their processes accordingly.

Supply chain management deals with complex interactions among supply chain members and decision-making problems. Whether to establish a supply chain configuration or reconfigure an existing supply chain is one of the major decisions to be made. The configuration defines the operating basis of the supply chain. Other managerial decisions are made using the elaborated configuration as input. Therefore, configuration decisions are subjected to particularly comprehensive evaluation, which, in turn, requires utilization of a variety of models and tools. This book aims to cover these models and tools with particular emphasis on model integration and combination.

The supply chain configuration problem in this book is perceived as determining which units (e.g., suppliers, plants) to include in the supply chain, their size and location, and establishing links among the units. In the wider sense, the configuration problem may also include designing and modifying supply chain control structures, information systems, and organizational structures. Such a focused approach allows for thorough coverage of problems, issues, and solutions such as configuration under demand uncertainty, impact of the supply chain power structure, and hybrid modeling.

Explicit focus on the configuration problem, in-depth coverage of configuration models, emphasis on model integration, and application of information modeling techniques in decision-making are distinguishing characteristics of this book.

The primary objectives of this book are to

- Establish a focused scope definition of the supply chain configuration problem
- Develop a supply chain configuration framework supporting development of configuration models for specific cases
- Discuss models and tools available for solving configuration problems
- Emphasize the value of model integration to obtain comprehensive and robust configuration decisions
- Propose solutions for supply chain configuration in the presence of stochastic and dynamic factors
- Illustrate application of the techniques discussed in applied studies

Book Organization

This book is divided into three parts, which are devoted to:

- Defining the supply chain configuration problem and identifying key issues
- Describing solutions to various problems identified
- Discussing applied supply chain configuration problems

The contents of the book are organized in a fifteen chapters format as follows

Chapter 1. Configuration

This chapter describes general nature of configuration. It talks about configurable (reconfigurable) systems, their need, focus, motivation, properties (or characteristics), and general issues and problems faced by configurable systems. Basically, this chapter is intended as an introduction to the "nature of configuration" before delving into the more specific supply chain configuration systems.

Part I Supply Chain Configuration Problem and Issues

Chapter 2. Scope of Supply Chain Configuration Problem

Supply chain configuration is one of the principal supply chain management decisions. It has profound impact on other subsequent managerial decisions. This chapter aims to position supply chain configuration decisions as part of the overall supply chain management decision-making process and to define the scope of the configuration problem. The positioning is described by analyzing the typical sequence of decisions made in the supply chain environ-

ment: definition of strategic objectives • product selection • establishing the supply chain • strategic supply chain management • tactical supply chain management • operational supply chain management. The scope definition describes objectives of supply chain configuration, questions being answered, and parameters and costs involved. Alignment of configuration objectives with strategic objectives of enterprises involved in a supply chain, and the supply chain as a whole, is also analyzed.

Chapter 3. Literature Review

The supply chain configuration has been widely studied by both academicians and practitioners. This chapter aims to review these studies and to identify common characteristics of the supply chain configuration problem. The existing research is categorized according to data used in decision-making and several criteria characterizing the decision-making problem and its environment. These criteria include the modeling approach used, application area, problem size, and others. Results of the literature review are used in defining focus areas of remaining chapters in the book.

Chapter 4. Reconfigurable Supply Chains: An Integrated Framework

The purpose of this chapter is to describe "reconfigurable supply chains," their need, and their advantages. Then, we lay out an integrated framework for their implementation that maps problems and issues with suggested methods and techniques (either published in the literature or those laid out in later chapters). Basically, it lays the foundation for methodology in Chapter 5 and solutions described in Part II of the book.

Chapter 5. Methodology for Supply Chain Configuration

Supply chain configuration is a multiple-step process. This chapter identifies methodological steps involved in this process and provides guidelines for accomplishing these steps.

Part II Solutions

Chapter 6. Knowledge Management as Basis of Crosscutting Problem Solving Approaches

The importance of this chapter is to highlight that solutions to supply chain configuration problems must integrate complex modeling and analysis techniques drawn from a host of disciplines, such as Systems Science, Management Science, Decision Sciences, Operations Research, Systems

Engineering, Industrial Engineering, and Information Systems. A proper knowledge management support to decision-making is required to handle such a cross-sectional approach. Taxonomical and ontological approaches to knowledge management are described.

Chapter 7. Information Modeling Approaches

Information modeling is used to gain understating about a decision-making problem, to formalize the decision-making problem, and to prepare input data for quantitative modeling. Process modeling is used to gain understanding of a decision modeling problem by describing entities involved and their interactions. Data modeling is used to describe decision variables, parameters, and constraints. Application of the Unified Modeling Language (UML) and the Supply Chain Operations Reference (SCOR) model for information modeling purposes is described.

Chapter 8. Mathematical Programming Approaches

Mathematical programming is the most prominent tool used in supply chain configuration, specifically for establishing the supply chain network, because of its ability to deal with spatial issues effectively. This chapter presents the generic mixed integer-programming model used in configuration. Application of this model, computational issues, and modifications of the generic model are also discussed. This chapter also briefly discusses non-linear, dynamic, and stochastic programming formulations of the configuration problem.

Chapter 9. Simulation Modeling Approaches

Simulation models are used in evaluating supply chain configuration decisions because of their ability to represent the problem realistically and to capture a wide range of factors. They can also be applied to select the most appropriate configuration from a limited set of alternative configurations. This chapter describes the characteristic features of simulation models used in supply chain configuration. Issues of validation of simulation models in the context of supply chain configuration are raised. An approach for automated model building in the framework of integrated decision-modeling is discussed.

Chapter 10. Hybrid Approaches

Both mathematical programming models and simulation models have their advantages and disadvantages. The hybrid modeling that combines optimization and simulation aims to inherit advantages and to avoid disadvan-

tages. Application of hybrid modeling in supply chain configuration is described. Two important hybrid modeling approaches are described: a) optimization and simulation models are used sequentially, where optimization is used to establish the configuration and simulation used for comprehensive evaluation of this configuration; and b) simulation-based optimization procedures, where the optimization model receives input data from the simulation model at each iteration. An automated approach to building hybrid models on the basis of common data models is presented.

Chapter 11. Information Technology Support for Configuration Problem Solving

Information Technology (IT) has a major impact on supply chain configuration. IT services are used to find the most appropriate supply chain configuration (decision support) as well as to ensure operations of the established configuration (infrastructural support). The decision support side is implemented on the basis of the supply chain configuration data model. Use of data warehousing technologies is explored. Alternative approaches used by major vendors of supply chain configuration tools are also described. Connections between supply chain configuration tools and geographical information systems are discussed. Supply chain management information systems are used to process transactions in the established supply chain. Different architectures of these systems are discussed, including architectures based on monolithic Enterprise Resource Planning (ERP) systems for supply chains, with one dominant member and truly distributed systems that are integrated using middleware technologies for supply chains with independent members. Interactions between configuration decisions and infrastructural support are discussed.

Part III Applications

Chapter 12. Review of Applied Studies

This chapter reviews significant applied studies reported in literature. Issues arising during adoption of configuration decisions in practical situations are discussed.

Chapter 13. Applications in Automotive Industry

The complexity and importance of supply chain configuration are high in the automotive industry. Supplier consolidation, manufacturing flexibility, and modular assembly are major factors influencing configuration deci-

sions. This chapter discusses the impact of these factors on the configuration decision-making process. Specific cases on information modeling, and configuration of flexible supply chains under demand uncertainty are analyzed.

Chapter 14. Application in Retail: Locating a Distribution Center

The retail industry heavily depends upon efficiency of supply chain management. The magnitude of configuration problems and adoption of modern technologies are characteristically common to this industry. A case study of a European retail operation is used as the basis for describing location decisions in a complex supply chain.

Chapter 15. Future Research Directions in Supply Chain Configuration Problem

A concluding chapter, which lays out the agenda of future research directions for the field as seen by the authors, is presented.

Target Audience

The book is targeted to a broad range of professionals involved in supply chain management. It is modularly structured to appeal to audiences seeking a discussion of theoretical and qualitative supply chain configuration problems or a description of more technical quantitative and computational problems, as well as those interested in applied supply chain configuration problems.

The main target group is graduate students in industrial engineering, systems engineering, management science, decision analysis, logistics management, operations management and applied operations research, and practitioners and researchers working in fields of supply chain management and operations management who aim to combine mathematical aspects of problem solving with the use of modern information technology solutions.

Professional/technical readers. This category includes research directors, research associates, and institutions involved in both the design and implementation of logistics systems in manufacturing and service-related projects. Examples will include the National Center for Manufacturing Sciences and the Southwest Research Institute.

Managers, product and process engineers, logistics coordinators, and production planners within the product design, manufacturing, and logistics departments of various companies will also find the book a useful resource.

Academic readers. Professors and research associates within universities and colleges in industrial engineering, manufacturing engineering, mechanical engineering, automotive engineering and engineering management, management science, and production and operations management, will find the book interesting to read.

This book may be used for teaching in graduate and professional development courses. It is also a valuable reference material for research in the area of supply chain management, logistics management, and operations management. The professional societies interested in these areas are:

- Institute of Industrial Engineers (IIE)
- Society of Manufacturing Engineers (SME)
- Institute of Electrical and Electronics Engineers (IEEE)
- INFORMS and Engineering Management Society
- Production and Operation Management Society (POM)
- Decision Sciences Institute (DSI)
- American Production and Inventory Control Society (APICS)

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About the Authors

CHARU CHANDRA is an associate professor in Industrial and Manufacturing Systems Engineering at the University of Michigan-Dearborn. Prior to this, Charu was post doctoral fellow at Los Alamos National Laboratory, Los Alamos, New Mexico, and at the University of Minnesota, Minneapolis. He has worked in the industry as an information technology manager and systems analyst. He is involved in research in supply chain management, and enterprise integration issues in large complex systems. Specifically, his research focuses on studying complex systems with the aim of developing cooperative models to represent coordination and integration in an enterprise. He has published two books, several papers, and book chapters in leading research publications in the areas of the supply chain management, enterprise modeling, information systems support, inventory management, and group technology. He teaches courses in information technology, operations research and supply chain management. His Ph.D. degree is in industrial engineering and operations research from the Arizona State University. He is a member of Institute of Industrial Engineers, Institute of Operations Research and Management Sciences, Decision Sciences Institute, Production and Operations Management Society, and American Association of Artificial Intelligence.

JĀNIS GRABIS obtained his Ph.D. degree in Information Technology from Riga Technical University in 2001. He spent two years with the University of Michigan-Dearborn as a research associate. Currently, he is an associate professor at Riga Technical University.His main research interests are supply chain management, simulation, enterprise integration, and software project management. He is the author of more than thirty scientific publications.

Charu Chandra
Dearborn, Michigan

Jānis Grabis
Riga, Latvia

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