



EIGHTH EDITION

Operations Management in the Supply Chain

DECISIONS AND CASES

**Mc
Graw
Hill**

Roger Schroeder | Susan Meyer Goldstein



Operations Management in the Supply Chain

Decisions and Cases

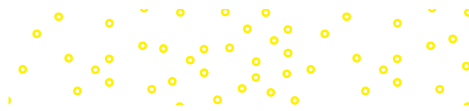
Eighth Edition

Roger G. Schroeder
Susan Meyer Goldstein

*Carlson School of Management
University of Minnesota*

**Mc
Graw
Hill**





OPERATIONS MANAGEMENT IN THE SUPPLY CHAIN: DECISION AND CASES, EIGHTH EDITION

Published by McGraw-Hill Education, 2 Penn Plaza, New York, NY 10121. Copyright © 2021 by McGraw-Hill Education. All rights reserved. Printed in the United States of America. Previous editions © 2018, 2013, and 2011. No part of this publication may be reproduced or distributed in any form or by any means, or stored in a database or retrieval system, without the prior written consent of McGraw-Hill Education, including, but not limited to, in any network or other electronic storage or transmission, or broadcast for distance learning.

Some ancillaries, including electronic and print components, may not be available to customers outside the United States.

This book is printed on acid-free paper.

1 2 3 4 5 6 7 8 9 LWI 24 23 22 21 20

ISBN 978-1-260-36810-9 (bound edition)

MHID 1-260-36810-6 (bound edition)

ISBN 978-1-260-93700-8 (loose-leaf edition)

MHID 1-260-93700-3 (loose-leaf edition)

Portfolio Manager: *Noelle Bathurst*

Product Developers: *Ryan McAndrews*

Marketing Manager: *Harper Christopher*

Content Project Managers: *Fran Simon/Angela Norris*

Buyer: *Sandy Ludovissy*

Design: *Beth Blech*

Content Licensing Specialists: *Gina Oberbroeckling*

Cover Image: ©Shutterstock/Ekaphon maneecho

Compositor: *SPi Global*

All credits appearing on page or at the end of the book are considered to be an extension of the copyright page.

Library of Congress Cataloging-in-Publication Data

Names: Schroeder, Roger G., author. | Goldstein, Susan Meyer.

Title: Operations management in the supply chain decisions and cases / Roger

G. Schroeder, Susan Meyer Goldstein, Carlson School of Management,
University of Minnesota.

Other titles: Operations management

Description: Eighth edition. | New York, NY : McGraw-Hill Education, [2019] |

Original edition entitled: Operations management. | Includes index.

Identifiers: LCCN 2019018226 | ISBN 9781260368109 (acid-free paper) |

ISBN 1260368106 (acid-free paper)

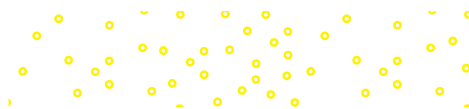
Subjects: LCSH: Production management. | Production management—Case studies.

| Decision making.

Classification: LCC TS155 .S334 2019 | DDC 658.5—dc23

LC record available at <https://lcn.loc.gov/2019018226>

The Internet addresses listed in the text were accurate at the time of publication. The inclusion of a website does not indicate an endorsement by the authors or McGraw-Hill Education, and McGraw-Hill Education does not guarantee the accuracy of the information presented at these sites.



The McGraw-Hill Education Series Operations and Decision Sciences

SUPPLY CHAIN MANAGEMENT

Benton

Purchasing and Supply Chain Management

Third Edition

Bowersox, Closs, Cooper, and Bowersox

Supply Chain Logistics Management

Fifth Edition

Burt, Petcavage, and Pinkerton

Supply Management

Eighth Edition

Johnson

Purchasing and Supply Management

Sixteenth Edition

Simchi-Levi, Kaminsky, and

Simchi-Levi

Designing and Managing the Supply Chain: Concepts, Strategies, Case Studies

Third Edition

Stock and Manrodt

Fundamentals of Supply Chain Management

PROJECT MANAGEMENT

Brown and Hyer

Managing Projects: A Team-Based Approach

Larson

Project Management: The Managerial Process

Eighth Edition

SERVICE OPERATIONS MANAGEMENT

Bordoloi, Fitzsimmons, and Fitzsimmons

Service Management: Operations, Strategy, Information Technology

Ninth Edition

MANAGEMENT SCIENCE

Hillier and Hillier

Introduction to Management Science: A Modeling and Case Studies Approach with Spreadsheets

Sixth Edition

BUSINESS RESEARCH METHODS

Schindler

Business Research Methods

Thirteenth Edition

BUSINESS FORECASTING

Keating and Wilson

Forecasting and Predictive Analytics

Seventh Edition

LINEAR STATISTICS AND REGRESSION

Kutner, Nachtsheim, and Neter

Applied Linear Regression Models

Fourth Edition

BUSINESS SYSTEMS DYNAMICS

Sterman

Business Dynamics: Systems Thinking and Modeling for a Complex World

OPERATIONS MANAGEMENT

Cachon and Terwiesch

Operations Management

Second Edition

Cachon and Terwiesch

Matching Supply with Demand: An Introduction to Operations Management

Fourth Edition

Jacobs and Chase

Operations and Supply Chain Management

Sixteenth Edition

Jacobs and Chase

Operations and Supply Chain Management: The Core

Fifth Edition

Schroeder and Goldstein

Operations Management in the Supply Chain: Decisions and Cases

Eighth Edition

Stevenson

Operations Management

Fourteenth Edition

Swink, Melnyk, and Hartley

Managing Operations Across the Supply Chain

Fourth Edition

BUSINESS MATH

Slater and Wittry

Practical Business Math Procedures

Thirteenth Edition

Slater and Wittry

Math for Business and Finance: An Algebraic Approach

Second Edition

BUSINESS STATISTICS

Bowerman, Drougas, Duckworth,

Froelich, Hummel, Moninger,

and Schur

Business Statistics in Practice

Ninth Edition

Doane and Seward

Applied Statistics in Business and Economics

Sixth Edition

Doane and Seward

Essential Statistics in Business and Economics

Third Edition

Lind, Marchal, and Wathen

Basic Statistics for Business and Economics

Ninth Edition

Lind, Marchal, and Wathen

Statistical Techniques in Business and Economics

Eighteenth Edition

Jaggia and Kelly

Business Statistics: Communicating with Numbers

Third Edition

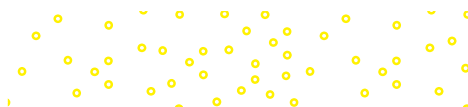
Jaggia and Kelly

Essentials of Business Statistics: Communicating with Numbers

Second Edition

McGuckian

Connect Master: Business Statistics



About the Authors



Roger G. Schroeder

is the Frank A. Donaldson Chair Emeritus in Supply Chain and Operations Management at the Curtis L. Carlson School of Management, University of Minnesota. He received B.S. and MSIE degrees in Industrial Engineering with high distinction from the University of Minnesota, and a Ph.D. from Northwestern University. He held positions in the Carlson School of Management as Director of the Ph.D. program, Chair of the Operations and Management Science Department, and Co-Director of the Joseph M. Juran Center for Leadership in Quality. Professor Schroeder has obtained research grants from the National Science Foundation, the Ford Foundation, and the American Production and Inventory Control Society. His research is in the areas of quality management, operations strategy, and high-performance manufacturing, and he is among the most widely published and cited researchers in the field of operations management. He has been selected as a member of the University of Minnesota Academy of Distinguished Teachers and is a recipient of the Morse Award for outstanding teaching. Professor Schroeder received the lifetime achievement award in operations management from the Academy of Management, and he is a Fellow of the Decision Sciences Institute and a Fellow of the Production and Operations Management Society. Professor Schroeder has consulted widely with numerous organizations, including 3M, Honeywell, General Mills, Motorola, Golden Valley Foods, and Prudential Life Insurance Company.



Susan Meyer Goldstein

is Associate Professor in the Supply Chain and Operations Department at the Curtis L. Carlson School of Management, University of Minnesota. She earned a B.S. degree in Genetics and Cell Biology and an M.B.A. at the University of Minnesota and worked in the health care industry for several years. She later obtained a Ph.D. in operations management from Fisher College of Business at The Ohio State University. She has served on the faculty at the University of Minnesota since 1998 and was a Visiting Professor at the Olin Business School at Washington University in St. Louis for two years. Her current research and teaching interests involve service process design and management, as well as operations strategy issues. Her research has been published in *Decision Sciences*, *Journal of Operations Management*, *Production and Operations Management*, and *Manufacturing and Service Operations Management*, among others. She serves on the editorial boards of many operations and service journals. She is the recipient of several research awards and research grants, and has received the Carlson School of Management Teaching Award and the Carlson School of Management Service Award.

Dedication

To our families, whose encouragement and love we appreciate

—Roger G. Schroeder

—Susan Meyer Goldstein

Preface

FEATURES

Operations and supply chain management is an exciting and vital field in today's complex business world. Therefore, students in both MBA and undergraduate courses have an urgent need to understand operations—an essential function in every business.

This textbook on Operations Management in the Supply Chain emphasizes decision making in operations with a supply chain orientation. The text provides materials of interest to general business students and operations and supply chain management majors. By stressing cross-functional decision making, the text provides a unique and current business perspective for all students. This is the first text to incorporate cross-functional decision making in every chapter, which provides more relevance for non-majors.

The book is organized into five unique sections to help students understand the key types of decisions made by operations and supply chain managers. See the illustration below.

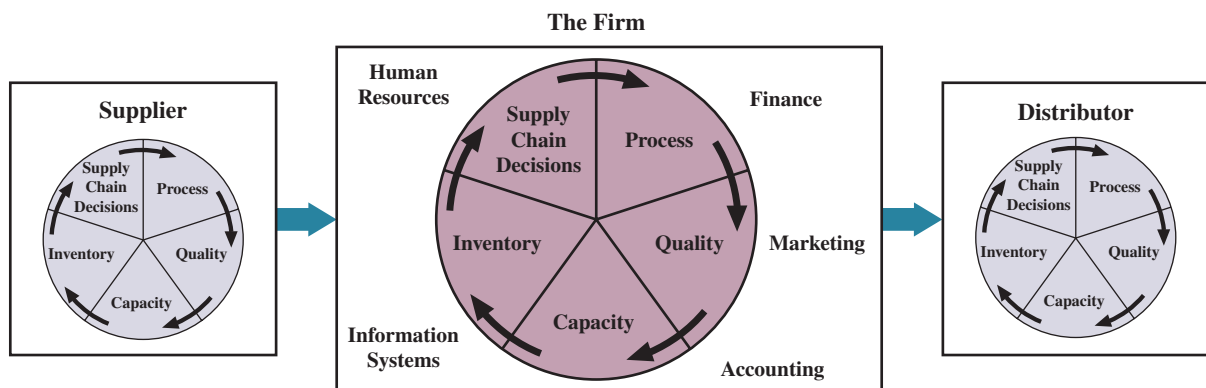
Introduction

1. Process design
 - How to get work done?
2. Quality
 - How to satisfy customers?
3. Capacity and scheduling
 - When and how much work to do?
4. Inventory
 - How to manage parts and products?
5. Supply chain decisions
 - How to manage across organizations?

The text provides a balanced treatment of both service and manufacturing firms. Many books give only cursory treatment to service operations.

The most current knowledge is incorporated, including global operations, supply chain management, service blueprinting, competency-based strategy, Six Sigma, lean systems, 3D printing, blockchain technology, artificial intelligence, analytics, sustainability, and supply chain risk. Complete coverage is also provided on traditional topics, including process design, service systems, quality management, ERP, inventory control, and scheduling.

Decision-making framework for operations in the supply chain.



While covering the concepts of operations and supply chain management in 18 chapters, the book also provides 19 case studies. A key feature of this book is learning how operations issues are tackled in real situations. The cases are intended to strengthen problem formulation skills and illustrate the concepts presented in the text. Long and short case studies are included. The cases are not just large problems or examples; rather, they are substantial management case studies, including some from Amazon, 3M, Mayo Clinic, and Polaris Industries.

The softcover edition with fewer pages than most introductory books covers all the essentials students need to know about operations management in the supply chain, leaving out only superfluous and tangential topics. By limiting the size of the book, we have condensed the material to the basics. The book is also available in Connect and LearnSmart digital versions.

This book is ideal for regular operations and supply chain management courses and also case courses and modular courses. It is particularly useful for those who desire a cross-functional and decision-making perspective that reaches across the supply chain. Instructors can easily supplement the text with their own cases, readings, or course materials as desired.

The Connect Library and Instructor Resources contain 22 Excel templates designed to assist in solving analytic problems at the end of chapters and the case studies. These resources also contain technical chapters on linear programming, simulation, transportation method, and queuing, which can be assigned by the instructor, if desired. Using these resources covers all the main analytics in operations and supply chain management. The resources also have PowerPoint slides, a solutions manual, and the test bank. Access to these resources can be obtained from your McGraw-Hill sales representative or directly in the Connect Library.

Walkthrough of Key Learning Features

- Over forty Operations Leader boxes are included in the chapters to illustrate current practices implemented by leading firms

OPERATIONS LEADER

Nike Does It

Nike and Nike-owned Converse, among other athletic shoe brands, offer customized shoes that can be ordered online for a reasonable price and delivered within a few weeks. Customers can select from numerous fabric or leather colors and patterns on various pieces of the shoe, as well as the colors of laces, stitching, and soles. These shoes, with their many customizable options, are an example of successful mass customization.



obsession.24k/Stockimo/Alamy Stock Photo

Shoes with a customized “fit” are significantly more elusive. While there are firms offering custom-fitted shoes, they sell at prices reflecting the significant work to individually size the shoe, most likely performed in a job shop. These shoes are custom, but not mass customized.

Mass customization gives customers many options, as well as the enjoyment of designing and using a product with their own personal stamp on it.

- Every function in every organization touches Operations and the Supply Chain in some manner. This is the first book to add materials in every chapter to show how topics apply to majors in Marketing, Finance, Accounting, Human Resources, and Information Systems. The handshake symbol indicates these cross-functional decisions.



- To help practice calculations, example boxes are included within chapters and solved problems are added at the end of the chapter.

Example

Suppose demand at the receiving work center B is 2 parts per minute and a standard container holds 25 parts. It takes 100 minutes for a container to make a complete circuit from work center A to work center B and back to A again, including all setup, run, move, and wait times. The number of containers needed in this case is:

$$n = \frac{2(100)}{25} = 8$$

The maximum inventory in the production system, a useful measure of how lean the system is, equal to the container size times the number of containers ($200 \text{ units} = 8 \times 25$), since the most inventory we can have is all containers filled:

$$\text{Maximum inventory} = nC = DT$$

SOLVED PROBLEMS**Problem**

1. **Kanban and takt time.** A work center uses kanban containers that hold 300 parts. To produce enough parts to fill the container, 90 minutes of setup plus run time are needed. Moving the container to the next workstation, waiting time, processing time at the next workstation, and return of the empty container take 140 minutes. There is an overall demand rate of nine units per minute.
 - a. Calculate the number of containers needed for the system.
 - b. What is the maximum inventory in the system?
 - c. A quality team has discovered how to reduce setup time by 65 minutes. If these changes are made, can the number of containers be reduced?
 - d. What is the takt time for this process?

Solution

- a. T is the time required for a container to complete an entire circuit, in this case 90 minutes for setup and run time plus 140 minutes to move the container through the rest of the circuit.

$$n = DT \div C = (9 \times (90 + 140)) \div 300 = 6.9 \text{ (round up to 7)}$$

- b. Since production will stop when all the containers are full, the maximum inventory is when all containers are full, that is, nC :

$$nC = 7(300) = 2100$$

- c. $n = DT \div C = (9 \times (25 + 140)) \div 300 = 4.95$ (round up to 5), so yes, the number of containers can be reduced from 7 to 5.
- d. Takt time = $1/9$ minute = $60/9$ seconds = 6.67 seconds. Since the process produces 9 units per minute, the takt time is $1/9$ minute or 6.67 seconds per unit.

- Students can both **preview** and **review** the key points and terms. These are found at the end of each chapter.

7.7 KEY POINTS AND TERMS

Lean concepts, principles, and tenets can be deployed to reduce waste in manufacturing and service firms. We have seen how the lean tenets create lean production systems with non-value-added activities eliminated and waste minimized. Key points in the chapter include the following:

- Lean thinking is a way of thinking about processes that includes five tenets: specify customer value, improve the value stream, flow the product or service, pull from the customer, and strive for perfection.
- The five lean tenets seek to eliminate waste by utilizing the full capability of workers and partners in continuous improvement efforts. Lean tools, or methods, are described for each of the five tenets.
- In manufacturing, smooth flow is ensured by a stable and level master schedule. This requires consistent daily production within the master schedule and mixed model assembly. Takt time matches the rate of output with the average demand rate in the market.

Key Terms

Toyota Production System (TPS) 119	Push 123	Internal setup 128
Just-in-Time (JIT) manufacturing 119	Pull 123	External setup 128
Lean production 119	Perfection 124	Cellular manufacturing 129
Lean thinking 120	5 Whys 125	Preventative maintenance 129
Waste (muda) 121	5S 125	Cross-training 130
Value stream 121	Stabilizing the master schedule 127	Respect for people 130
Value stream mapping 121	Uniform load 127	Kanban 130
Gemba 121	Takt time 127	Reducing lead time 133
	Reducing setup time 128	Supplier relationships 133
	Single setups 128	Co-location 133
		Kaizen 135

- Twenty-two Excel spreadsheets are included for solving problems and analyzing case studies using analytic methods.

eXcel 11. As cereal boxes are filled in a factory, they are weighed for their contents by an automatic scale. The target value is to put 10 ounces of cereal in each box. Twenty samples of three boxes each have been weighed for quality control purposes. The fill weight for each box is shown below.

Sample	Observation		
	1	2	3
1	10.01	9.90	10.03
2	9.87	10.20	10.15
3	10.08	9.89	9.76
4	10.17	10.01	9.83

- Case studies provide students practice in formulating and solving unstructured problems.

Case Study Lawn King, Inc.: Sales and Operations Planning

eXcel

John Conner, marketing manager for Lawn King, looked over the beautiful countryside as he drove to the corporate headquarters in Moline, Illinois. John had asked his boss, Kathy Wayne, the general manager of Lawn King, to call a meeting in order to review the latest fore-

The changeover cost of the production line depends on which type of mower is being produced and the next production model planned. For example, it is relatively easy to change over from the 20-inch push mower to the 20-inch self-propelled mower, since the mower frame is

- Throughout the text, company and industry examples illustrate real use of the ideas.



Harrah's uses superior customer service to increase profits.
Leonard Zhukovsky/123RF



Grocery self-service is a provider-routed service.
Syda Productions/Shutterstock

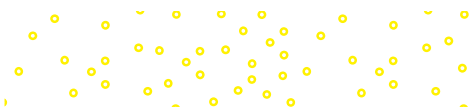
- At the end of every chapter, Learning Enrichment boxes provide videos and websites where students can extend their knowledge on chapter topics using Internet content.

LEARNING ENRICHMENT <i>(for self-study or instructor assignments)</i>	What Is the New Product Development Process? https://youtu.be/vQZjNIRpuFg	Video 2:49
	Prototyping https://youtu.be/5SWt-TSYD08	Video 2:26
	3D Printing Prototype Example https://youtu.be/RpFTRT8FkP0	Video 3:02
	Sustainability in New Product Development https://youtu.be/-HS-sIU-XTc	Video 3:56

KEY CHANGES IN THE EIGHTH EDITION

This book is known for its decision orientation and case studies. We have strengthened the decision-making framework by adding new material on digital technology, lean systems, sustainability, and global supply chains. We also include new and existing cases to address these decisions. The Eighth Edition features a new 4-color design and the following major changes:

1. **Cross-functional.** Most books for operations and supply chain core courses are merely summaries for majors in operations and supply chain management. None address the general business student who is interested in Marketing, Finance, Accounting, or Information Systems. We make this book more applicable and interesting to the approximately 80 percent of business students who don't major in operations and supply chain management. We add cross-functional materials in each chapter to show how the topics apply to non-majors. The handshake symbols in the margin identify the content.
2. **Digital Technology.** The Eighth Edition has substantial updates and additions on four digital technologies. 3D printing is becoming useful for producing spare parts, custom manufacturing, medical devices, dental implants, and architectural models. Blockchain software is being developed and tested by many global logistics companies. Artificial intelligence is rapidly developing for service applications, automobiles, and manufacturing plants. Analytics are being applied to both large and small databases. Analytics that are descriptive, predictive, or prescriptive in nature are discussed. These digital technologies are described in detail in several chapters in the book.
3. **Supply Chain Sustainability.** We introduce the idea of the triple bottom line regarding environmental, social, and economic sustainability. Sustainability is preserving the earth and resources for future generations. Environmental sustainability is related to global warming, clean water, clean air, and environmental protection. Social sustainability means hiring a diverse workforce, ethical practices, providing equal opportunity, and safe working conditions, for example. Economic sustainability is making a sufficient profit for the firm's survival in the future. Operations and supply chain managers are actively pursuing all three aspects of sustainability of operations and associated supply chains.

- 
4. **Global Supply Chains.** In this new edition we have increased our attention to global supply chains by adding new sections on global services, global sourcing, and global logistics. The text explains how to make global decisions that balance the lower costs of overseas sourcing and logistics with the risks of quality failures, loss of intellectual property, increased monitoring costs, and exposure to financial and political risks.
 5. **Lean Systems.** Most books discuss up to 15 techniques of lean including reduced setup time, small lot sizes, uniform load, and takt time. We have completely reorganized the lean chapter around the five tenets and principles of lean systems to include all of these techniques. This clarifies lean systems in terms of creating value for the customer, eliminating waste, ensuring flow, customer pull, and striving for perfection.
 6. **Practical Examples.** The text contains over 70 practical examples of concepts, ideas, and analytics. Nineteen new Operations Leader boxes have been added for companies including Southwest Airlines, Lego Group, Culver's, Nike, LG Electronics, and Trader Joe's. In addition twenty-five existing Operations Leader boxes have been updated in the various chapters.
 7. **Learning Enrichment boxes.** Every chapter ends with a Learning Enrichment box for student self-study or instructor assignments. These boxes have YouTube video links and websites that expand on the coverage in the chapter. They cover ideas from the chapter in more detail or provide examples of the how the ideas are used. This is one of the first books to make extensive use of the Internet to enrich the material covered in the text.

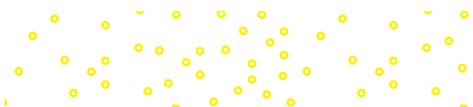
When reviewers of this book were asked how they would describe the text to a colleague, they said:

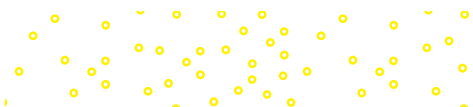
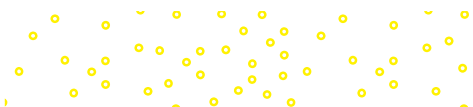
“I would highly recommend the book to them. While other textbooks either focus on the techniques or concepts, this book does a good job in addressing both equally well.”

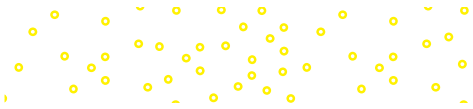
“A solid textbook that is well-written. Good coverage of basic operations management material.”

“It is a guide to operations that takes a practical approach with a strong emphasis on case materials to put concepts into practice.”

CHAPTER REVISIONS AND CASES FOR THE EIGHTH EDITION

1. **Introduction to Operations.** The first part of the chapter is rewritten to clearly define operations and supply chain management. A new section explains the role of operations in the firm and the economy including productivity calculations. The triple bottom line is defined for environmental, social, and economic sustainability. Internet links are provided in the Learning Enrichment box on sustainability and globalization.
 2. **Operations and Supply Chain Strategy.** A new Operations Leader box on Southwest Airlines is added. Sustainability, as an objective, is added to cost, quality, delivery and flexibility. Emphasis is placed on decision making in operations that is contingent on strategy.
 3. **Product Design.** New content is added on the use of 3D printing for creating prototypes. Concurrent engineering is illustrated using a new example from NASA. New Operations Leader boxes describe how The LEGO Group tackles sustainability challenges and how TPI Composites is developing and manufacturing blades for wind turbine energy systems.
- 

- 
4. **Process Selection.** There is a new example of focused operations in a service firm, Midwest Orthopedic Specialty Hospital. Two new Operations Leader boxes describe the food production system at Culver's and mass customization at Nike. We also expand on the role of 3D printing in modern manufacturing, particularly in the medical sector.
 5. **Service Process Design.** The relevance of service operations to non-majors is discussed. A new Operations Leader box on the City of Fort Collins is added. This edition is the first to offer sections on Technology for Services and Globalization of Services.
 6. **Process-Flow Analysis.** Cross-functional material is added to show its importance to systems thinking. A Learning Enrichment box is included with YouTube videos and Internet links on process mapping, Little's Law, and queueing at Disney.
 7. **Lean Thinking and Lean Systems.** This chapter is completely reorganized around the five lean tenets to clarify the principles and concepts underlying lean thinking. New material is added on cellular manufacturing and the pull system. The chapter is the first to take a principle and conceptual approach to lean systems, rather than a listing of techniques and methods used.
 8. **Managing Quality.** YouTube videos are added to the Learning Enrichment box to expand on ISO9000 certification, mistake proofing, and the Baldrige Award for health care. Quality is expanded to include the entire supply chain, not just the focal firm. The highly cross-functional nature of quality is emphasized.
 9. **Quality Control and Improvement.** We explain why all business students should learn about quality control. The difference between special causes and common causes is emphasized. We clarify the differences between statistical process control and process capability. The section on Six Sigma was rewritten to expand the content.
 10. **Forecasting.** We shift our description of forecasting to "analytics" so that students can understand how the popular focus on analytics is utilized in operations and supply chain. There is a new section on big data and its use in forecasting, along with a new Operations Leader box on how Amazon uses big data in its own forecasting. When and how to use MAD_t is clarified, in addition to many minor clarifications in using formulas throughout the chapter.
 11. **Capacity Planning.** We expand discussion about how all functions are involved in and impacted by capacity planning. Improvements in the descriptions of Sales and Operations Planning (S&OP) as well as aggregate planning help to clarify the process involved and the challenges faced. Calculations for level and chase strategies are clarified. New Operations Leader boxes on Delta Airlines and Hostess Brands make these concepts tangible for students.
 12. **Scheduling Operations.** We add new material on the theory of constraints about how to identify the bottleneck constraint and eliminate it while subordinating everything else. In the Learning Enrichment box interesting YouTube videos are provided on job shop scheduling at Washburn Guitar, round-robin CPU scheduling, and the theory of constraints.
 13. **Project Planning and Scheduling.** The chapter is updated to illustrate the many industry settings in which projects require skilled management—from manufacturing to service firms, nonprofits, and government. A new Operations Leader box on the Carlsbad Desalination Plant in San Diego provides a nice example of a major multi-government project. Other updates include the Project Management Institute's Body of Knowledge in Table 13.3.
- 

- 
14. **Independent Demand Inventory.** The chapter includes additional content on vendor managed inventory (VMI), along with a new Operations Leader box illustrating VMI at Procter and Gamble Co. An additional new Operations Leader box on IKEA describes the use of a min/max inventory replenishment system. The Learning Enrichment box at the end of the chapter provides video and web sources for additional information.
 15. **Materials Requirements Planning and ERP.** We clarify for students exactly which elements constitute the MRP system. We also describe the use of Oracle's ERP software at Cleveland Clinic to help students understand the breadth of these system's use in industry. A new Operations Leader box on LG Electronics provides a useful illustration of how a global firm benefits from these systems.
 16. **Supply Chain Management.** This is one of the first books to have a separate section on blockchain technology to explain its uses and methods. More details are also provided on the SCOR model. We rewrote the section on measures of throughput time, cash-to-cash cycle time and total delivered cost for analyzing an entire supply chain. We added a new section on the Amazon effect and omni-channel marketing, also a first in textbooks.
 17. **Sourcing.** The chapter includes an entirely new section on Global Sourcing, including discussion of risks and benefits. Presentation of Total Cost Analysis is expanded. A new Operations Leader box on Trader Joe's sourcing strategy will appeal to students.
 18. **Global Logistics.** A new section on Global Logistics includes a figure to illustrate the multimodal activities in global supply chains. The concepts of intermodal and shipping zones have been added and described. A new Operations Leader box on Home Depot provides insight on how online sales are served from stores and warehouses, while an expanded box on Ryder gives students a glimpse of the people and assets needed for this major 3PL provider.

Case Study Revisions

A few of the 19 case studies are described below:

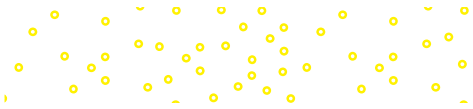
Amazon Revolutionizes Supply Chain Management. This new case, written exclusively for this book, describes the evolution of Amazon's supply chain and its purchase of Whole Foods. It challenges students to think about how Amazon can change the future of Whole Foods to increase its revenues and earnings. The case also contrasts what Walmart is doing to use e-commerce to compete with Amazon. The case asks students to define the effect of the emergent business strategies of Amazon and Walmart on the supply chains of these companies in terms of locations, sourcing, capacity, and inventory.

Operations Strategy at BYD of China, Electrifying the World's Automotive Market. BYD, the leading electric vehicle company in the world, must develop a strategy for adapting its supply chain in the future. We updated this case from its last update in 2015 and revised the teaching note for this rapidly changing industry.

Early Supplier Integration for John Deere Skid-Steer Loader. Deere and Company must decide how to involve suppliers in the design of its new Skid-Steer Loader. This case is updated and the teaching note revised.

The Evolution of Lean Six Sigma at 3M Inc. Students are asked to evaluate 3M's use of Six Sigma and lean thinking. We added significant new information since the last update in 2012.

Consolidated Electric: Inventory Control. Management is designing a new inventory control system. The student questions are tailored to increase student learning about this system.



Altimus Brands: Managing Procurement Risk. Altimus is deciding which of four off-shore suppliers offers the lowest cost and risk for future purchase contracts. We updated the case and wrote a new teaching note.

ShelterBox: A Decade of Disaster Relief. After the Haiti earthquake of 2010, ShelterBox provided immediate relief and is considering what decisions should be made in advance of future disasters. A new teaching note was written for this case.

INSTRUCTOR RESOURCES



McGraw-Hill Connect®

McGraw-Hill Connect® is an online assignment and assessment solution that connects students with the tools and resources they'll need to achieve success through faster learning, higher retention, and more efficient studying. It provides instructors with tools to quickly pick content and assignments according to the topics they want to emphasize.

Instructor Library. The *Connect Operations Management* Instructor Library is your repository for additional resources to improve student engagement in and out of class. You can select and use any asset that enhances your lecture. The *Connect* Instructor Library includes:

- **Solutions Manual.** Prepared by the authors, this manual contains solutions to all the end-of-chapter problems and cases.
- **Test Bank.** The Test Bank includes true/false, multiple-choice, and discussion questions/problems at varying levels of difficulty. All test bank questions are also available in a flexible electronic test generator. The answers to all questions are given, along with a rating of the level of difficulty, chapter learning objective met, Bloom's taxonomy question type, and the AACSB knowledge category.
- **PowerPoint Slides.** The PowerPoint slides draw on the highlights of each chapter and provide an opportunity for the instructor to emphasize the key concepts in class discussions.
- **Digital Image Library.** All the figures in the book are included for insertion in PowerPoint slides or for class discussion.
- **Excel Spreadsheets.** Twenty Excel Spreadsheets are provided for students to solve designated problems at the end of chapters.
- **Technical Chapters.** Additional Operations analytics are available in four inline Technical Chapters. These are available in the Instructor Resource Library through Connect, or by visiting the URL at www.mhhe.com/schroeder8e

The instructor and student resources can also be accessed directly at www.mhhe.com/schroeder8e.



Tegrity Campus: Lectures 24/7

Tegrity Campus is a service that makes class time available 24/7 by automatically capturing every lecture in a searchable format for students to review when they study and complete assignments. With a simple one-click start-and-stop process, you capture all computer screens and corresponding audio. Students can replay any part of any class with easy-to-use browser-based viewing on a PC or Mac.

Educators know that the more students can see, hear, and experience class resources, the better they learn. In fact, studies prove it. With *Tegrity Campus*, students quickly recall key moments by using *Tegrity Campus*'s unique search feature. This search helps students efficiently find what they need, when they need it, across an entire semester of class recordings. Help turn all your students' study time into learning moments immediately supported by your lecture. To learn more about *Tegrity*, watch a two-minute Flash demo at <http://tegritycampus.mhhe.com>.



MCGRAW-HILL CUSTOMER CARE CONTACT INFORMATION

At McGraw-Hill, we understand that getting the most from new technology can be challenging. That's why our services don't stop after you purchase our products. You can e-mail our Product Specialists 24 hours a day to get product-training online. Or you can search our knowledge bank of Frequently Asked Questions on our support website. For Customer Support, call **800-331-5094** or visit www.mhhe.com/support. One of our Technical Support Analysts will be able to assist you in a timely fashion.



ACKNOWLEDGMENTS

The authors would like to acknowledge the many individuals who have assisted with this book. Special thanks go to the reviewers for this edition:

Abirami Radhakrishnan

Morgan State University

Anita Lee-Post

University of Kentucky

Canchu Lin

Carroll University

Enar Tunc

California Polytechnic State University San Luis Obispo

John Wu

California State University San Bernardino

Jooh Lee

Rowan University

Jose Ablanedo-Rosas

University of Texas El Paso

Kathy Schaefer

Southwest Minnesota State University

Kimball Bullington

Middle Tennessee State University

Kwasi Amoako-Gyampah

University of North Carolina Greensboro

Mark Goudreau

Johnson & Wales University

Mark Hanna

Georgia Southern University

Mark Jacobs

University of Dayton

Richard Hopfensperger

Marian University of Wisconsin

Ross Fink

Bradley University

Steven Dickstein

Fisher College- Ohio State University

Therese Gedemer

Marian University of Fond du Lac

Todd Henning

Indiana University

Veena Adlakha

University of Baltimore

Weiyong Zhang

Old Dominion University

William Ramshaw

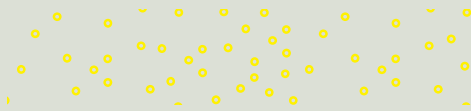
Eastern Washington University

The authors would also like to thank the staff at McGraw-Hill Education who had a direct hand in the editing and production of the text, including Ryan McAndrews, product developer; Noelle Bathurst, portfolio manager; Harper Christopher, executive marketing manager; and Fran Simon and Angela Norris, project managers.

We would like to thank our colleagues at the University of Minnesota who listened to our ideas and provided suggestions for book improvement. Additional thanks go to Doug and Letty Chard, who diligently and carefully prepared the index. We would also like to thank Tom Buchner of the University of Minnesota who carefully prepared the test bank questions. Our thanks to Ed Pappanastos of Troy University for constructing the Connect solutions to problems. Finally, we thank our families for their patience and perseverance during the many months of writing and editing. Without their support and encouragement this textbook would not have been possible.

Roger G. Schroeder

Susan Meyer Goldstein

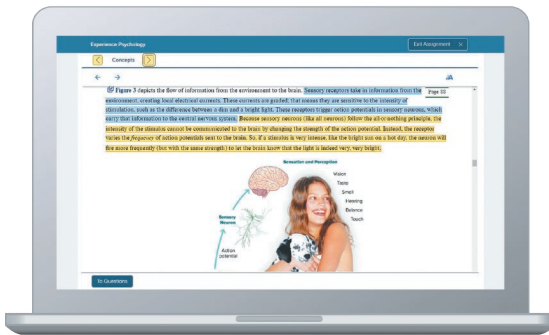


FOR INSTRUCTORS

You're in the driver's seat.

Want to build your own course? No problem. Prefer to use our turnkey, prebuilt course? Easy. Want to make changes throughout the semester? Sure. And you'll save time with Connect's auto-grading too.

65%
Less Time
Grading



Laptop: McGraw-Hill; Woman/dog: George Doyle/Getty Images

They'll thank you for it.

Adaptive study resources like SmartBook® 2.0 help your students be better prepared in less time. You can transform your class time from dull definitions to dynamic debates. Find out more about the powerful personalized learning experience available in SmartBook 2.0 at www.mheducation.com/highered/connect/smartbook

Make it simple, make it affordable.



Connect makes it easy with seamless integration using any of the major Learning Management Systems—Blackboard®, Canvas, and D2L, among others—to let you organize your course in one convenient location. Give your students access to digital materials at a discount with our inclusive access program. Ask your McGraw-Hill representative for more information.

Padlock: Jobalou/Getty Images

Solutions for your challenges.



A product isn't a solution. Real solutions are affordable, reliable, and come with training and ongoing support when you need it and how you want it. Our Customer Experience Group can also help you troubleshoot tech problems—although Connect's 99% uptime means you might not need to call them. See for yourself at **status.mheducation.com**

Checkmark: Jobalou/Getty Images

SUPPORT ^{AT}
every step

FOR STUDENTS

Effective, efficient studying.

Connect helps you be more productive with your study time and get better grades using tools like SmartBook 2.0, which highlights key concepts and creates a personalized study plan. Connect sets you up for success, so you walk into class with confidence and walk out with better grades.

Study anytime, anywhere.

Download the free ReadAnywhere app and access your online eBook or SmartBook 2.0 assignments when it's convenient, even if you're offline. And since the app automatically syncs with your eBook and SmartBook 2.0 assignments in Connect, all of your work is available every time you open it. Find out more at www.mheducation.com/readanywhere

"I really liked this app—it made it easy to study when you don't have your textbook in front of you."

- Jordan Cunningham,
Eastern Washington University



Calendar: owattaphotos/Getty Images

No surprises.

The Connect Calendar and Reports tools keep you on track with the work you need to get done and your assignment scores. Life gets busy; Connect tools help you keep learning through it all.

Learning for everyone.

McGraw-Hill works directly with Accessibility Services Departments and faculty to meet the learning needs of all students. Please contact your Accessibility Services office and ask them to email accessibility@mheducation.com, or visit www.mheducation.com/about/accessibility for more information.

Top: Jenner Images/Getty Images, Left: Hero Images/Getty Images, Right: Hero Images/Getty Images



Brief Table of Contents

About the Authors iv

Preface v

PART ONE

Introduction 1

- 1 Introduction to Operations 2
- 2 Operations and Supply Chain Strategy 20
- 3 Product Design 37

PART TWO

Process Design 53

- 4 Process Selection 54
- 5 Service Process Design 76
- 6 Process-Flow Analysis 97
- 7 Lean Thinking and Lean Systems 118

PART THREE

Quality 141

- 8 Managing Quality 142
- 9 Quality Control and Improvement 163

PART FOUR

Capacity and Scheduling 189

- 10 Forecasting 190
 - Supplement:** Advanced Methods 215
- 11 Capacity Planning 220

12 Scheduling Operations 249

13 Project Planning and Scheduling 267

PART FIVE

Inventory 291

- 14 Independent Demand Inventory 292
 - Supplement:** Advanced Models 320
- 15 Materials Requirements Planning and ERP 323

PART SIX

Supply Chain Decisions 347

- 16 Supply Chain Management 348
- 17 Sourcing 376
- 18 Global Logistics 397

PART SEVEN

Case Studies 423

APPENDIXES 507

INDEX 509

ACRONYMS 519

Technical Chapters available in the Instructor's Resource Library in Connect

Waiting Lines

Simulation

Transportation Method

Linear Programming

Contents

About the Authors iv

Preface v

PART ONE

INTRODUCTION 1

Chapter 1

Introduction to Operations 2

- 1.1 Definition of Operations and Supply Chain Management 3
- 1.2 The Role of Operations and Supply Chain Management 4
- 1.3 Why Study Operations and Supply Chain Management? 6
- 1.4 Decisions at Pizza U.S.A. 9
- 1.5 Operations Decisions in the Supply Chain—A Framework 10
- 1.6 Cross-Functional Decision Making 12
- 1.7 Operations as a Process 13
- 1.8 Trends in Operations and Supply Chain Management 15
 - Sustainability* 15
 - Services* 15
 - Digital Technologies* 16
 - Integration of Decisions Internally and Externally* 16
 - Globalization of Operations and the Supply Chain* 17
- 1.9 Key Points and Terms 17
 - Learning Enrichment* 18
 - Discussion Questions* 18

Chapter 2

Operations and Supply Chain Strategy 20

- 2.1 Operations Strategy Model 22
 - Corporate and Business Strategy* 23
 - Operations Mission* 24
 - Operations Objectives* 24
 - Strategic Decisions* 25
 - Distinctive Competence* 26
- 2.2 Competing with Operations Objectives 27
- 2.3 Cross-Functional Strategic Decisions 28

- 2.4 Global Operations and Supply Chains 30
- 2.5 Supply Chain Strategy 31
- 2.6 Environment and Sustainable Operations 33
- 2.7 Key Points and Terms 34
 - Learning Enrichment* 35
 - Discussion Questions* 36

Chapter 3

Product Design 37

- 3.1 Strategies for New Product Introduction 38
- 3.2 New Product Development Process 39
 - Concept Development* 40
 - Product Design* 40
 - Pilot Production/Testing* 41
- 3.3 Cross-Functional Product Design 42
- 3.4 Supply Chain Collaboration 43
- 3.5 Quality Function Deployment 45
 - Customer Attributes* 46
 - Engineering Characteristics* 46
- 3.6 Modular Design 48
- 3.7 Key Points and Terms 49
 - Learning Enrichment* 50
 - Discussion Questions* 50

PART TWO

PROCESS DESIGN 53

Chapter 4

Process Selection 54

- 4.1 Product-Flow Characteristics 55
- 4.2 Approaches to Order Fulfillment 60
- 4.3 Process Selection Decisions 63
- 4.4 Product-Process Strategy 64
- 4.5 Focused Operations 66
- 4.6 Mass Customization 67
- 4.7 3D Printing and Additive Manufacturing 69
- 4.8 Environmental Concerns 70
- 4.9 Cross-Functional Decision Making 71
- 4.10 Key Points and Terms 72
 - Learning Enrichment* 74
 - Discussion Questions* 74

Chapter 5**Service Process Design 76**

- 5.1** Defining Service 78
- 5.2** Service-Product Bundle 79
- 5.3** Service Delivery System Matrix 80
- 5.4** Customer Contact 83
- 5.5** Service Recovery and Guarantees 86
- 5.6** Technology for Services 87
 - Artificial Intelligence* 88
- 5.7** Globalization of Services 90
- 5.8** Service Profitability and Employees 92
- 5.9** Key Points and Terms 94
 - Learning Enrichment* 95
 - Discussion Questions* 96

Chapter 6**Process-Flow Analysis 97**

- 6.1** Process Thinking 98
- 6.2** The Process View of Business 99
- 6.3** Process Flowcharting 100
- 6.4** Process-Flow Analysis as Asking Questions 104
- 6.5** Process Analytics 106
- 6.6** Analyzing Process Flows at Pizza U.S.A. 108
- 6.7** Process Redesign 110
- 6.8** Key Points and Terms 112
 - Learning Enrichment* 113
 - Solved Problems* 113
 - Discussion Questions* 115
 - Problems* 115

Chapter 7**Lean Thinking and Lean Systems 118**

- 7.1** Evolution of Lean 119
- 7.2** Lean Tenets 120
 - Create Value* 120
 - Value Stream* 121
 - Ensure Flow* 122
 - Customer Pull* 123
 - Strive for Perfection* 124
- 7.3** Ensure Flow 126
 - Stabilize Master Schedule* 127
 - Reducing Setup Time and Lot Sizes* 127
 - Changing Layout and Maintenance* 129
 - Cross-Training and Engaging Workers* 130

- 7.4** Customer Pull 130
- 7.5** Changing Relationships with Suppliers 133
- 7.6** Implementation of Lean 135
- 7.7** Key Points and Terms 137
 - Learning Enrichment* 138
 - Solved Problems* 138
 - Discussion Questions* 139
 - Problems* 140

**PART THREE
QUALITY 141****Chapter 8****Managing Quality 142**

- 8.1** Quality as Customer Requirements 143
- 8.2** Product Quality 144
- 8.3** Service Quality 146
- 8.4** Quality Planning, Control, and Improvement 146
- 8.5** Mistake-Proofing 149
- 8.6** Ensuring Quality in the Supply Chain 150
- 8.7** Quality, Cost of Quality, and Financial Performance 151
- 8.8** Quality Pioneers 154
 - W. Edwards Deming* 154
 - Joseph Juran* 154
- 8.9** ISO 9000 Standards 156
- 8.10** Malcolm Baldrige Award 158
- 8.11** Why Some Quality Improvement Efforts Fail 160
- 8.12** Key Points and Terms 161
 - Learning Enrichment* 162
 - Discussion Questions* 162

Chapter 9**Quality Control and Improvement 163**

- 9.1** Design of Quality Control Systems 164
- 9.2** Process Quality Control 167
- 9.3** Attribute Control Chart 169
- 9.4** Variables Control Chart 170
- 9.5** Using Control Charts 171
- 9.6** Process Capability 172
- 9.7** Continuous Improvement 174
- 9.8** Six Sigma 178

- 9.9** Lean and Six Sigma 180
- 9.10** Key Points and Terms 182
 - Learning Enrichment* 183
 - Solved Problems* 183
 - Discussion Questions* 186
 - Problems* 186

PART FOUR

CAPACITY AND SCHEDULING 189

Chapter 10

Forecasting 190

- 10.1** Forecasting for Decision Making 192
- 10.2** Qualitative Forecasting Methods 193
- 10.3** Time Series Analytics 195
- 10.4** Moving Average 196
- 10.5** Exponential Smoothing 198
- 10.6** Forecast Accuracy 201
- 10.7** Advanced Time-Series Forecasting 203
- 10.8** Causal Forecasting Analytics 204
- 10.9** Selecting a Forecasting Method 206
 - Big Data* 207
- 10.10** Collaborative Planning, Forecasting, and Replenishment 208
- 10.11** Key Points and Terms 209
 - Learning Enrichment* 210
 - Solved Problems* 210
 - Discussion Questions* 212
 - Problems* 213
 - Supplement: Advanced Methods* 215

Chapter 11

Capacity Planning 220

- 11.1** Capacity Defined 221
- 11.2** Facilities Decisions 223
 - Amount of Capacity* 224
 - Size of Facilities* 225
 - Timing of Facility Decisions* 226
 - Facility Location* 226
 - Types of Facilities* 227
- 11.3** Sales and Operations Planning 228
- 11.4** Cross-Functional Nature of S&OP 230
- 11.5** Planning Options 231
- 11.6** Basic Aggregate Planning
 - Strategies 233
- 11.7** Aggregate Planning Costs 234
- 11.8** Aggregate Planning Example 235

- 11.9** Key Points and Terms 239
 - Learning Enrichment* 240
 - Solved Problems* 240
 - Discussion Questions* 245
 - Problem* 246

Chapter 12

Scheduling Operations 249

- 12.1** Batch Scheduling 250
- 12.2** Gantt Charts 251
- 12.3** Finite Capacity Scheduling 254
- 12.4** Theory of Constraints 256
- 12.5** Priority Dispatching Rules 258
- 12.6** Planning and Control Systems 260
- 12.7** Key Points and Terms 262
 - Learning Enrichment* 263
 - Solved Problems* 263
 - Discussion Questions* 265
 - Problems* 265

Chapter 13

Project Planning and Scheduling 267

- 13.1** Objectives and Trade-offs 268
- 13.2** Planning and Control in Projects 269
- 13.3** Scheduling Methods 272
- 13.4** Constant-Time Networks 273
- 13.5** CPM Method 279
- 13.6** Use of Project Management
 - Concepts 281
- 13.7** Key Points and Terms 282
 - Learning Enrichment* 283
 - Solved Problems* 284
 - Discussion Questions* 287
 - Problems* 287

PART FIVE

INVENTORY 291

Chapter 14

Independent Demand Inventory 292

- 14.1** Definition of Inventory 293
- 14.2** Purpose of Inventories 295
- 14.3** Costs of Inventory 296
- 14.4** Independent versus Dependent Demand 297

- 14.5 Economic Order Quantity 298
- 14.6 Continuous Review System 302
- 14.7 Periodic Review System 306
- 14.8 Using P and Q Systems in Practice 309
- 14.9 Vendor Managed Inventory 311
- 14.10 ABC Classification of Inventory 312
- 14.11 Key Points and Terms 313
 - Learning Enrichment* 314
 - Solved Problems* 315
 - Discussion Questions* 317
 - Problems* 317
 - Supplement: Advanced Models* 320

Chapter 15

Materials Requirements Planning and ERP 323

- 15.1 The MRP System 324
- 15.2 MRP versus Order-Point Systems 326
- 15.3 Parts Explosion: How an MRP System Works 327
- 15.4 MRP System Elements 332
 - Master Scheduling* 332
 - Bill of Materials (BOM)* 333
 - Inventory Records* 333
 - Capacity Planning* 334
 - Purchasing* 334
 - Shop-Floor Control* 334
- 15.5 Operating an MRP System 335
- 15.6 The Successful MRP System 336
- 15.7 Enterprise Resource Planning Systems 337
- 15.8 Key Points and Terms 340
 - Learning Enrichment* 341
 - Solved Problem* 341
 - Discussion Questions* 343
 - Problems* 344

PART SIX 347

SUPPLY CHAIN DECISIONS 347

Chapter 16

Supply Chain Management 348

- 16.1 Supply Chain and Supply Chain Management 349
- 16.2 Measuring Supply Chain Performance 351

- 16.3 Supply Chain Dynamics—The Bullwhip Effect 355
- 16.4 Improving Supply Chain Performance 358
- 16.5 Supply Chain Structural Improvements 358
- 16.6 Supply Chain System Improvements 361
- 16.7 Technology and Supply Chain Management 362
 - E-commerce and Omni-channel Marketing* 364
 - Blockchain Technology* 364
- 16.8 Supply Chain Risk and Resilience 366
 - Analysis of Supply Chain Risk* 367
- 16.9 Sustainability of the Supply Chain 369
- 16.10 Key Points and Terms 372
 - Learning Enrichment* 374
 - Discussion Questions and Problems* 374

Chapter 17

Sourcing 376

- 17.1 Importance of Sourcing 377
- 17.2 Sourcing Goals 378
- 17.3 Insource or Outsource? 378
 - Advantages of Outsourcing* 379
 - Disadvantages of Outsourcing* 380
 - Total Cost Analysis* 381
- 17.4 Offshoring 382
 - Costs of Offshoring* 382
 - Reshoring* 383
- 17.5 Global Sourcing 384
- 17.6 Supply Base Optimization 385
 - Spend Analysis* 385
 - Total Number of Suppliers* 385
 - Single or Multiple Suppliers* 386
- 17.7 The Purchasing Cycle 387
 - Internal User-Buyer Interface* 387
 - Sourcing Make-Buy Decision* 388
 - Find Suppliers* 388
 - Supplier Selection* 388
 - Supplier Relationship Management* 389
- 17.8 Challenges Facing Purchasing 389
- 17.9 Key Points and Terms 391
 - Learning Enrichment* 392
 - Solved Problems* 393
 - Discussion Questions* 394
 - Problems* 394

Chapter 18

Global Logistics 397

- 18.1** Role of Logistics in Supply Chain Management 398
- 18.2** Transportation 400
 - Transportation Economics* 400
 - Modes of Transportation* 401
 - Selecting the Transportation Mode* 404
- 18.3** Distribution Centers and Warehousing 405
- 18.4** Logistics Networks 408
 - Location* 408
 - Number of Warehouses (Distribution Centers)* 411
- 18.5** Global Logistics 412
- 18.6** Third-Party Logistics Providers 414
- 18.7** Logistics Strategy 416
- 18.8** Key Points and Terms 418
 - Learning Enrichment* 419
 - Solved Problems* 419
 - Discussion Questions* 421
 - Problems* 421

PART SEVEN

CASE STUDIES

Introduction 423

- Operations Strategy at BYD of China, Electrifying the World's Automotive Market 424
- Early Supplier Integration for John Deere Skid-Steer Loader 430

Process Design

- Eastern Gear, Inc.: Job Shop 432
- Sage Hill Inn Above Onion Creek: Focusing on Service Process and Quality 435
- U.S. Stroller: Lean 439
- The Westerville Physician Practice: Value Stream Mapping 445

Quality

- Mayo Clinic and the Path to Quality 449
- Toledo Custom Manufacturing: Quality Control 455
- The Evolution of Lean Six Sigma at 3M, Inc. 457

Capacity and Scheduling

- Best Homes, Inc.: Forecasting 463
- Polaris Industries Inc.: Global Plant Location 465
- Lawn King, Inc.: Sales and Operations Planning 470

Inventory

- Consolidated Electric: Inventory Control 474
- Southern Toro Distributor, Inc. 479
- ToysPlus, Inc.: MRP 485

Supply Chain

- Amazon Revolutionizes Supply Chain Management 489
- Altimus Brands: Managing Procurement Risk 496
- Murphy Warehouse Company: Sustainable Logistics 499
- ShelterBox: A Decade of Disaster Relief 503

APPENDIXES

- A** Areas Under the Standard Normal Probability Distribution 507
- B** Random Number Table 508

INDEX 509

ACRONYMS 519

Online Technical Chapters

Technical Chapters available in the Instructor's Resource Library in Connect

- Waiting Lines
- Simulation
- Transportation Method
- Linear Programming

