

Managing Supply Chain and OPERATIONS

AN INTEGRATIVE APPROACH

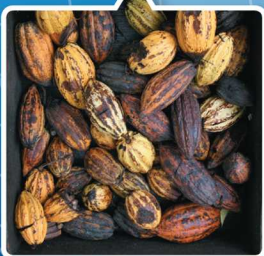


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For Camille

—T. F.

For Kristen

—S. S.

For David and Joyce Wallin

—C. W.

For my best friend, Mary

—S. W.

About the Authors



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Brief Contents

1

Integrating Supply Chain and Operations Management 1

- Chapter 1** Introduction to Supply Chain and Operations Management 2
- Chapter 2** Supply Chain and Operations Strategy 20

2

Innovating Supply Chain and Operations 51

- Chapter 3** Product and Process Design and Mapping 52
- Chapter 4** Service Design 97
- Chapter 5** Customer Relationship Management 125

3

Impacting Supply Chain and Operations Performance 145

- Chapter 6** Strategic Sourcing 146
- Chapter 7** Supplier Management 170
- Chapter 8** Demand Management and Forecasting 199
- Chapter 9** Inventory Management Fundamentals and Independent Demand 247
- Chapter 10** Sales and Operations Planning and Enterprise Resource Planning 278
- Chapter 11** Logistics 309

4

Improving Supply Chain and Operations Management Performance 343

- Chapter 12** Project Management 344
- Chapter 13** Supply Chain Quality Management 385
- Chapter 14** Statistical Process Control 414
- Chapter 15** Lean and Six Sigma Management and Leading Change 459

Contents

Preface xvi

1

Integrating Supply Chain and Operations Management

1

Chapter 1 Introduction to Supply Chain and Operations Management 2

1 Why Are You Studying Supply Chain and Operations Management? 3

Processes 4

Supply Chain Globalization 5

2 Supply Chain and Operations Management 8

Supply Chain Management 8

Supply Chain Flows 10

Service Supply Chains 11

Operations Management 11

Combining Supply Chain and Operations Management 12

3 Integrative Model for SC&O Management 14

The Operating Core 15

Upstream Collaboration 15

Downstream Collaboration 15

Strategic Integration 16

4 The Four I's 16

Impacting 16

Improving 16

Innovating 16

Integrating 17

Summary 17 • Key Terms 18 • Integrative Learning

Exercise 18 • Integrative Experiential Exercise 18 • Discussion

Questions 18

• Case: Williamston Manufacturing 19

Chapter 2 Supply Chain and Operations Strategy 20

1 Generic SC&O Strategies and Alignment 21

Generic Strategies 22

Alignment 22

Assessing Customer Value 25

2 SC&O Strategy Process and Content 26

Hoshin Kanri Strategic Planning 26

SC&O Strategy Content 26

The Resource-Based View 29

3 Competitive Landscapes and Porter's Five Forces 30

Threat of New Competitors 31

Threat of Substitute Products or Services 31

Bargaining Power of Customers and Suppliers 32

Intensity of Competitive Rivalry 32

- 4 Supply Chain Strategy 33**
 - Changes in Strategy 33
 - Types of Relationships 34
 - 5 Strategy Execution 35**
 - Aligning Strategic Levels 35
 - Aligning Incentives 36
 - Focusing on Process 37
 - 6 Strategic Metrics and Measurements 39**
 - Correct Strategic Behavior 39
 - Actionable and Predictive Metrics 39
 - Commonly Used Supply Chain Metrics 40
 - Systems Thinking 40
 - 7 The Changing Strategic Environment: Globalization, Sustainability, and Innovation 41**
 - Globalization 41
 - Sustainability 42
 - Innovation 46
- Summary 47 ● Key Terms 48 ● Integrative Learning
 Exercise 48 ● Experiential Learning Exercise 48 ● Discussion
 Questions 48
- Case: Zara 49

2

Innovating Supply Chain and Operations

51

Chapter 3 Product and Process Design and Mapping 52

- 1 Process Design 53**
 - Processes and Extended Processes 53
 - Process Choice 54
 - The Process Continuum 55
 - Break-Even Analysis 57
 - SOLVED PROBLEM 3.1** > Using Break-Even Analysis to Evaluate an Investment in Processes and Equipment 59
- 2 Process Mapping 60**
 - Extended Process Maps for Supply Chains 60
 - Hybrid Layouts 61
 - Line Balancing 65
 - SOLVED PROBLEM 3.2** > Line Balancing in Action 66
 - Designing Functional Layouts 69
 - SOLVED PROBLEM 3.3** > Load-Distance Model in Action 70
 - SOLVED PROBLEM 3.4** > Muther's Grid in Action 72
- 3 Product Design 73**
 - Product Life Cycle 74
 - Research and Development 75
 - Product Design Process 75
- 4 Quality Function Deployment 78**
 - Concurrent Design Teams 79
 - Design for Manufacture Method 80
 - Design for Maintainability 80
 - Designing for Reliability 81
 - SOLVED PROBLEM 3.5** > Series Reliability 83

SOLVED PROBLEM 3.6 > Reliability Measurement Failure Rates 83

SOLVED PROBLEM 3.7 > System Availability 84

5 Green Design 85

Design for Reuse 85

Other Green Design Concepts 86

Summary 87 ● Key Terms 87 ● Integrative Learning

Exercise 88 ● Integrative Experiential Exercise 88 ● Discussion

Questions 88 ● Solved Problems 89 ● Problems 92

● Case: Hamilton Electronics 95

Chapter 4 Service Design 97

1 Services and Tangibles 98

2 The Key Elements of Service Design 99

Designing for Service Quality 100

Designing for Service Recovery 101

B2B versus B2C Services 101

Customer-Interactive Processes 101

Offerings and Experiences 102

3 Process Chain Network Tool for Service Design 103

Process Chain Networks 104

Process Positioning 105

Three Process Principles 106

Steps in Developing a PCN Diagram 107

SOLVED PROBLEM 4.1 > PCN Diagrams in Action 107

4 Planning Service Capacity for Uncertain Demand 108

Capacity Components 108

Capacity Planning Tools 109

SOLVED PROBLEM 4.2 > The Newsvendor Problem in Action 111

5 Queuing Theory 112

Queuing Psychology 112

Queue Systems and Service Stations 112

Wait Times 113

SOLVED PROBLEM 4.3 > Model I in Action for a Single-Phase Queue with a Single Server and Exponential Service Times 115

SOLVED PROBLEM 4.4 > Model II in Action for a Single-Phase Queue with a Single Server and Constant Service Times 115

SOLVED PROBLEM 4.5 > Model III in Action for a Multiserver System with Exponential Service Times 116

Summary 118 ● Key Terms 119 ● Integrative Learning

Exercise 119 ● Experiential Learning Exercise 119 ● Discussion

Questions 119 ● Solved Problems 120 ● Problems 121

● Case: XLG Enterprises 123

Chapter 5 Customer Relationship Management 125

1 Customer Relationships and Systems 126

Customer Relationship Management Systems 127

Customer Relationships 128

CRM Processes 131

2 Improving Customer Service 131

Understanding and Meeting Customer Expectations 132

Providing Fail-Safe Services	132
Providing Service Guarantees	133
Measuring Service Performance	136
SOLVED PROBLEM 5.1 > Net Promoter Scores in Action	135
Managing Customer Complaints	136
Recovering from Service Failures	136

3 Changing Relationships through Servitization 138

4 Managing Service Supply Chains 139

Summary	141	●	Key Terms	142	●	Integrative Learning	
Exercise	142	●	Integrative Experiential Exercise	142	●	Discussion	
Questions	142	●	Solved Problem	143	●	Problems	143
● Case: Can CRM Help a New Start-Up Business?	144						

3

Impacting Supply Chain and Operations Performance 145

Chapter 6 Strategic Sourcing 146

1 Origins of the Purchasing Profession 148

2 Effect of Strategic Sourcing on the Firm 149

Reducing the Cost of Purchased Products and Services	149
--	-----

SOLVED PROBLEM 6.1 > Economics of Purchasing 149

The Quality of Purchased Goods and Services	151
Cost of Development and Design	151

3 Portfolio Approach to Strategic Sourcing 152

Category Segmentation	153
Routine Items	155
Leverage Items	155
Bottleneck Items	156
Critical Items	156

4 Strategic Cost Management 156

Spend Analysis	157
Price Analysis	158

SOLVED PROBLEM 6.2 > Price Analysis in Action 158

Cost Analysis	159
Total Cost of Ownership Analysis	159

SOLVED PROBLEM 6.3 > Total Cost of Ownership 160

Total Cost of Ownership and Outsourcing Decisions	162
---	-----

SOLVED PROBLEM 6.4 > Total Cost of Ownership and Outsourcing 162

Summary	164	●	Key Terms	164	●	Integrative Learning	
Exercise	164	●	Integrative Experiential Exercise	164	●	Discussion	
Questions	165	●	Solved Problems	165	●	Problems	167

● Case: Hazelton Industries 169

Chapter 7 Supplier Management 170

1 Identifying Needs 172

Identifying the Need for Materials	172
Identifying the Need for Services	173
Identifying the Need for a Type of Relationship	173

2 Supplier Selection 176

Identifying Supplier Requirements with Weighted-Factor Analysis	177
---	-----

SOLVED PROBLEM 7.1 > Creating a Weighted-Factor Analysis 177
 Searching for Potential Suppliers 179
 Supplier Evaluation 180
SOLVED PROBLEM 7.2 > Supplier Evaluation Using Weighted-Factor Analysis 180
 Negotiating the Agreement 182

3 Supplier Development 183
 Identifying Suppliers to Develop 183
 Forming a Cross-Functional Team 184
 Involving Top Management 184
 Identifying Opportunities 185
 Defining Key Metrics and Cost Sharing 185
 Agreeing on Projects and Resources 185
 Monitoring Status and Modifying 185

4 Providing Feedback: The Supplier Scorecard 185
 Designing and Implementing the Supplier Scorecard 187
SOLVED PROBLEM 7.3 > Supplier Scorecard Design 187
 Delivery and Cost Assessment 190
 Supplier Awards 191

Summary 192 ● Key Terms 193 ● Integrative Learning
 Exercise 193 ● Integrative Experiential Exercise 193 ● Discussion
 Questions 193 ● Solved Problems 194 ● Problems 195

● Case: Rockhurst Company 198

Chapter 8 Demand Management and Forecasting 199

1 The Art of Demand Management 201

2 Time Series Forecasting 204
 Components of a Time Series 204
 Forecasting and Bullwhips 205
 Types of Forecasting Models 206
 Judgmental or Experiential Forecasting 206

3 Naive Forecasting Methods 209
 Simple Moving Average 209
SOLVED PROBLEM 8.1 > Using the Moving Average 209
 Weighted Moving Average 210
SOLVED PROBLEM 8.2 > Weighted Moving Average 210
 Single Exponential Smoothing 211
SOLVED PROBLEM 8.3 > Single Exponential Smoothing 212
 Double Exponential Smoothing 213
SOLVED PROBLEM 8.4 > Double Exponential Smoothing 213
 Measures of Forecasting Error 214
SOLVED PROBLEM 8.5 > Measures of Forecasting Error 215

4 Time Series Forecasting Using Regression 216
 Time Series Forecasts Using Simple Linear Regression 217
SOLVED PROBLEM 8.6 > Using Simple Linear Regression 218
 Linear Regression with Seasonality 220
SOLVED PROBLEM 8.7 > Deseasonalizing a Time Series 222
 Econometric and Multiple Regression Models 226

Summary 230 ● Key Terms 231 ● Integrative Learning
 Exercise 232 ● Integrative Experiential Exercise 232 ● Discussion
 Questions 232 ● Solved Problems 232 ● Problems 239

● Case: Demand Planning at BIOCNG 246

Chapter 9 Inventory Management Fundamentals and Independent Demand 247

- 1 Inventory 248**
 - The Role of Inventory 248
 - Types of Inventory 250
- 2 Inventory Management 252**
 - Inventory Velocity 252
 - SOLVED PROBLEM 9.1** > Computing Inventory Turnover 252
 - Consignment Inventory 253
 - Vendor-Managed Inventory 253
 - Inventory and Bullwhips 254
- 3 Demand Analysis 254**
 - Dependent versus Independent Demand 254
 - ABC Analysis 255
 - SOLVED PROBLEM 9.2** > Performing ABC Inventory Analysis 256
 - Review Systems 258
- 4 Inventory Models 260**
 - The Basic Economic Order Quantity Model 260
 - SOLVED PROBLEM 9.3** > Total Annualized Inventory Costs 261
 - SOLVED PROBLEM 9.4** > The Economic Order Quantity in Action 262
 - Quantity Discounts 262
 - SOLVED PROBLEM 9.5** > Using EOQ with Quantity Discounts 264
 - Reorder Points 264
 - SOLVED PROBLEM 9.6** > Computing a Reorder Point with Deterministic Lead Time 265
 - SOLVED PROBLEM 9.7** > Reorder Point with Stochastic Demand during Lead Time 266
 - Periodic Review Inventory Models 266
 - SOLVED PROBLEM 9.8** > Using the Periodic Review Inventory Model 267
 - A Finite Replenishment Rate Inventory Model 267
 - SOLVED PROBLEM 9.9** > Using the Finite Replenishment Rate Model 267
- Summary 269 ● Key Terms 269 ● Integrative Learning
- Exercise 270 ● Integrative Experiential Exercise 270 ● Discussion
- Questions 270 ● Solved Problems 271 ● Problems 273
- Case: Managing Inventory at Nordstrom 277

Chapter 10 Sales and Operations Planning and Enterprise Resource Planning 278

- 1 Sales and Operations Planning 279**
 - Production Planning 280
 - Performing Sales and Operations Planning 282
 - SOLVED PROBLEM 10.1** > A Chase Plan in Action 282
 - SOLVED PROBLEM 10.2** > A Level Plan in Action 284
- 2 Capacity 286**
 - Bottlenecks 286
 - Best Operating Level 287
- 3 Capacity Planning 288**
 - Capacity Planning Process 289
 - Modeling Capacity 290
 - SOLVED PROBLEM 10.3** > Modeling Capacity Measures 291

Rough-Cut Capacity Planning 291
SOLVED PROBLEM 10.4 > Rough-Cut Capacity Planning in Action 291

4 Enterprise Resource Planning 292

5 Material Requirements Management 293

MRP Inputs 294

MRP Record 295

SOLVED PROBLEM 10.5 > MRP Record Computations 295

MRP Logic 296

SOLVED PROBLEM 10.6 > Rolling Cart MRP Logic 297

MRP Outputs 299

Summary 300 ● Key Terms 300 ● Integrative Learning
 Exercise 301 ● Integrative Experiential Exercise 301 ● Discussion
 Questions 301 ● Solved Problems 302 ● Problems 306

● Case: Montclair State University 308

Chapter 11 Logistics 309

1 The Strategic Importance of Logistics 310

Cost 310

Flow 311

Access 312

Sustainability 314

2 Fundamental Logistics Trade-Offs 315

Cost-to-Cost Trade-Offs 315

SOLVED PROBLEM 11.1 > Cost-to-Cost Trade-Off Calculations 316

Modal Trade-Offs 316

Cost-to-Service Trade-Offs 316

Landed Cost 317

SOLVED PROBLEM 11.2 > Landed Cost Trade-Off Calculations 318

3 The Five Logistics Processes 319

Demand Processing 319

Inventory Management 320

Transportation 321

Warehousing 324

SOLVED PROBLEM 11.3 > Warehousing Square Root Rule in Action 325

SOLVED PROBLEM 11.4 > Weighted Center of Gravity in Action 326

Transportation Method 327

SOLVED PROBLEM 11.5 > The Transportation Method in Action 328

Configuring Logistics 330

Structural Network 333

Reverse Logistics 333

Summary 334 ● Key Terms 335 ● Integrative Learning
 Exercise 335 ● Integrative Experiential Exercise 335 ● Discussion
 Questions 335 ● Solved Problems 336 ● Problems 338

● Case: Brentward Logistics 341

Chapter 12 Project Management 344

- 1 Project Management 345**
 - The Human Element in Projects 347
 - Qualifying Projects 350
 - Project Charters 352
 - SOLVED PROBLEM 12.1** > Project Charters in Action 354
 - 2 Project Planning Tools 354**
 - Estimating Task Completion Times 354
 - SOLVED PROBLEM 12.2** > Computing Task Times 356
 - SOLVED PROBLEM 12.3** > Computing Task Variance 356
 - SOLVED PROBLEM 12.4** > Putting It Together: Task Times and Variances 357
 - Managing Multiple Projects 358
 - 3 PERT/CPM 359**
 - SOLVED PROBLEM 12.5** > Drawing AON Networks 360
 - Finding the Critical Path 360
 - Computing Early Times 361
 - Computing Late Times 362
 - Computing Slack and the Critical Path 362
 - SOLVED PROBLEM 12.6** > Finding the Critical Path 364
 - Using PERT/CPM in Delegation Decisions 365
 - Probabilistic PERT 365
 - SOLVED PROBLEM 12.7** > Computing Required Project Completion Times 368
 - SOLVED PROBLEM 12.8** > The Other Side of the Coin: Determining the Probability of Completing a Project in a Given Time 369
 - 4 Gantt Charts with Precedence 370**
 - Managing Costs and Expediting Projects 370
 - Expediting or Crashing Tasks 372
 - SOLVED PROBLEM 12.9** > Crashing Projects 373
- Summary 374 ● Key Terms 375 ● Integrative Learning Exercise 375 ● Integrative Experiential Exercise 375 ● Discussion Questions 375 ● Solved Problems 376 ● Problems 381
- Case: Aligning the Ducks for Project Management 384

Chapter 13 Supply Chain Quality Management 385

- 1 Dimensions of Product and Service Quality 386**
- 2 Well-Known Quality Experts 388**
 - W. Edwards Deming 388
 - Joseph Juran 389
 - Philip Crosby 391
 - Kaoru Ishikawa 391
- 3 What Is Supply Chain Quality Management? 391**
 - Forming Collaborative Relationships 393
 - ISO 9000 and Industry-Specific Standards 393
- 4 Quality in Services 394**
 - Service Quality Dimensions 395

SERVQUAL 395
SOLVED PROBLEM 13.1 > SERVQUAL “Minding the Gap” Exercise 397
 Customer-Driven Excellence 397

5 Quality Tools and Approaches 398

Seven Basic Quality Tools 398
 The Seven Managerial Tools 403
 The Malcolm Baldrige National Quality Award 405
 Benchmarking 405

Summary 408 ● Key Terms 408 ● Integrative Learning
 Exercise 409 ● Integrative Experiential Exercise 409 ● Discussion
 Questions 409 ● Solved Problems 410 ● Problems 410

● Case: Corporate Universities: Teaching the Tools of Quality 412

Chapter 14 Statistical Process Control 414

1 Statistical Thinking and Variation 415

2 Process Stability 417

Sampling and Inspection 417
 Types of Samples 417
 Inspection Methods 419
SOLVED PROBLEM 14.1 > Computing Inspection Ratios 420

3 Variables and Attributes Process Control Charts 421

Understanding Control Charts 422
 A Generalized Procedure for Developing Process Charts 424
 Variables Control Charts 424
SOLVED PROBLEM 14.2 > Developing \bar{x} Charts 428
SOLVED PROBLEM 14.3 > Using Excel to Develop \bar{x} Control Charts 429
SOLVED PROBLEM 14.4 > Developing R Charts 431
SOLVED PROBLEM 14.5 > Developing R Charts in Excel 432
 Attributes Control Charts 434
SOLVED PROBLEM 14.6 > Developing p Charts 436

4 Applying Control Charts 438

Interpreting Control Charts 438
SOLVED PROBLEM 14.7 > Interpreting Control Charts 439
 Corrective Action 440
 Tampering with the Process 440
 Control Charts and Services 440

5 Process Capability 440

SOLVED PROBLEM 14.8 > Capability Analysis 441

Summary 443 ● Key Terms 443 ● Integrative Learning
 Exercise 444 ● Integrative Experiential Exercise 444 ● Discussion
 Questions 444 ● Solved Problems 445 ● Problems 451

● Case: Meeting Standards in Software Quality 458

Chapter 15 Lean and Six Sigma Management and Leading Change 459

1 What Is Six Sigma? 460

Six Sigma Roles 462
 DMAIC 463
 Business Cases 463

2 Principles of Lean 466

Lean Solutions 466
Lean Viewpoints 467
Lean Philosophy 467

3 Lean Practices 468

Practicing Lean Production 469
 SOLVED PROBLEM 15.1 > Determining the Number of Kanban Cards Needed 470
Lean Workforce Practices 473
System-Wide Solutions 474
Lean Supply Chain Management 475

4 Change Management 475

Summary 477 ● Key Terms 477 ● Integrative Learning
Exercise 477 ● Integrative Experiential Exercise 477 ● Discussion
Questions 478 ● Solved Problem 478 ● Problems 478
● Case: Automotive Resources 479

Appendix A-1

Glossary G-1

Name Index I-1

Subject Index I-3

Photo Credits C-1

Preface

Managing Supply Chain and Operations is targeted toward undergraduate- and graduate-level operations management courses that link to supply chain management in an effective and meaningful way. When we implemented this approach at our own university, we saw a tenfold increase in students in our major. Students are responding to the global nature of business, which has led to a realization that firms do not act alone to produce products and services. Although it may sound like a cliché, supply chains do compete against other supply chains.

This book takes a balanced approach and, although rigorous, is not solely focused on quantitative material. We approach the quantitative material from a managerial perspective, answering the question: “Where does it fit into a supply chain and operations (SC&O) management system?” We also recognize that most students in introductory operations courses are not operations or supply chain management majors. Because this course is often a service course, our approach will help students understand how and why this subject area applies to their roles as future managers.

A second motivation for this book emerges from the field. The field of SC&O management has developed from the three academic disciplines of purchasing, logistics, and operations. Faculty members who are coming from these differing fields do not always see the world the same way, which has created some fragmentation within the course. By putting together a world-class team from these three different academic traditions, we have developed the integrative model for SC&O management that brings these areas together. This model presents the glue that integrates these areas to provide a robust and complete textbook for students.

KEY FEATURES

Pearson is the top publisher of business textbooks in the world, and all the resources of this publisher have gone into creating this text. This absolutely cutting-edge and up-to-date book is filled with scenarios and real-world examples that make it relevant to students.

CHAPTER OUTLINE AND LEARNING OBJECTIVES

- 1 Understand the Relationships Between Services and Tangibles.**
 - Identify How Services and Nonservices Differ
- 2 Identify and Apply the Key Elements of Service Design**
 - Describe how managers design for service quality.
 - Explain how managers and designers design products for service recovery.
 - Explain the differences between business-to-consumer (B2C) and business-to-business (B2B) services.
 - Describe customer-interactive services and the components of the customer experience.
- 3 Understand and Apply the Process Chain Network (PCN) Tool for Service Design**
 - Understand process chain networks.
 - Explain process positioning.
 - List the three process principles.
 - List and use the steps in developing a PCN diagram.
- 4 Describe and Use the Planning Service Capacity for Uncertain Demand**
 - Understand the components of capacity planning.
 - Describe the tools that managers use to plan and manage capacity.
- 5 Applying Queuing Theory**

- Each chapter has a defined set of **Learning Objectives**. Because AACSB is requiring faculty to identify learning objectives, we provide them as an aid for faculty and students.

- Managing Across Majors** boxes directly address how students in different majors and disciplines will use SC&O concepts upon graduation. Making a clear connection between the concepts and how students will use them reinforces their importance and relevance.

Managing Across Majors 4.1 Marketing majors, remember that service operations need information from marketing to help identify and understand customer needs.

Customer Inputs to Mobile Phone Service

The customer plays a key role in services. Consider mobile phone service. You may not think that you have much influence on your phone service, but you do. You provide your location and your signal to your phone service provider; both are fundamental elements of mobile phone service. You can also change your carrier based on the quality of its service.

Every mobile phone user knows about those dreaded dead spots, locations where your carrier's signal fails, calls drop, and data slows to a crawl. When you sign up for service, you've got to hope that the signal is decent at your primary locations, such as where you live and where you work.

Wouldn't it be great if there were a way to instantly determine which cell phone carrier is best so that you could better evaluate the service you might receive? In this chapter, we will discuss service design and the role of the customer in design. At the end of the chapter, we will discuss one way to evaluate your cell provider.



- **Opening Vignettes** introduce a problem or scenario that an actual company has encountered. At the end of the chapter, we discuss how that company used concepts from the chapter to address its needs. **End-of-Chapter Vignettes** also require assessment and application. These exercises provide students the skills they will need when they become managers.

- Each chapter spotlights current events and ties them directly to the chapter's concepts. Students see how managers apply the information they are learning in the field. Every chapter has multiple **SC&O Current Events** boxes that make the material relevant to the students.

Building Smaller Stores at Walmart



This new approach has led Walmart to new competitors and competition. Walmart's competitors are now companies such as Dollar General and City Target, a new small-format Target store. In a way, Walmart is trying to replicate the success it has had internationally with small-store formats in the United Kingdom and Brazil.

To be successful, Walmart needs to adapt its supercenter approach. For example, for items such as cereal and jelly at a Walmart Neighborhood Markets, Walmart has tended to stock its supercenters with larger product sizes, which does not work well in a small format store. This change in store capacity drives changes in purchasing, supply chain practices, and merchandising.

Source: S. Banjo, "Can Walmart Think Small?" *Wall Street Journal*, May 17, 2012.

Service Design Changes at Rogers



As managers, you need to understand what is the state of the art in designing the customer experience. One such example is Rogers. Rogers Communications, a wireless telecommunications company, has designed a new retail store concept that includes a new design and a new service strategy.

Rogers introduced the new retail concept in Toronto, Canada. The store includes a high-touch approach that overcomes the coldness of telecommunications technology. In the Rogers store, customers receive tailored services that serve their specific needs. In addition, the customer experience is entertaining and welcoming.

"Service and community are at the heart of our innovative new stores," said Sian Doyle, vice president of retail at Rogers Communications. "This store opening is part of a larger retail transformation to enhance how we service and sell to our customers. With interactive learning sessions and seasoned tech experts available onsite, consumers can learn more and get the latest technology and services in-store."

The following are some of the elements of the Rogers retail experience:

New modern design: The store uses an open concept that focuses the customer on Rogers' innovativeness.

Personalized service: Every customer is met at the entry by a host who assesses the customer's needs and sets the customer up with an appropriate customer service representative. Account questions and hardware needs can both be handled seamlessly in-store.

Latest products and experiences: Exciting product stations have been created where customers can access new products and participate in product demos.

- **Global Connections** boxes focus on how SC&O management ties together supply chains across international boundaries. Learning how managers can use global supply chains and how international linkages benefit firms provides students an advantage once they enter the workforce.

- **Using Technology Boxes** walk students through the ways managers use technology to solve SC&O problems in the workplace. Step-by-step tutorials break down problems and solutions and provide computer-based fundamentals for SC&O problem solving.

You can also use Excel to apply newsvendor analysis to Solved Problem 4.2.

	A	B	C	D	E	F	G	H	I
1	Example 4-1 Newsvendor Analysis								
2									
3		Cost of understocking (\$):	30		Critical Fractile:	0.75			
4		Cost of overstocking (\$):	10						
5		Average demand (tables):	25	Optimal Number of Tables:	28.375				
6		Std dev of demand (tables):	5						
7		z value:	0.675						
8		(z value is from the table in the appendix, or use =norm.s.inv(G3) command)							
9									
10									
11									
12									

FIGURE 4.5
Newsvendor Excel Spreadsheet

The Newsvendor Problem in Action

Problem: In service environments, an “inventory” issue is capacity. Service operations have a capacity for meeting customer demand according to how they are designed. If there is not enough capacity, customer demand may not turn into sales. Excess capacity comes with a cost as well.

For example, a restaurant chain is opening a new location in a business district. The question is how many tables to design in the restaurant. The key revenue period is the weekday lunch seating, so the restaurant desires to plan capacity for that demand. Lunchtime demand is forecast to be normally distributed with a mean of 25 parties and a standard deviation of 5 parties. (Assume one party per table.) How many tables should the restaurant have?

A naive view would have 25 tables, but that ignores the asymmetric cost structure. The average party spends \$40 for lunch, with ingredient costs being 25 percent of that amount.

Solution: Therefore, the cost of insufficient tables (C_U) is $40 - (40 \times 0.25) = \30 per table, which is the average profit contribution per party. Each table takes up 100 square feet of space, and space costs \$3 per square foot per month (approximately \$0.10 per square foot per day).

Therefore, the cost of an extra table is $100 \times 0.10 = \$10$ per table per day. This cost suggests that an optimal number of tables would have $CF = 30/(10 + 30) = 0.75$, or 75 percent of the cumulative distribution. Looking up 0.75 in the normal cumulative distribution table (see Appendix A-2) shows that $z = 0.675$. Therefore, the optimal number of tables is $25 + 0.675 \times 5 = 28.375$, or approximately 28 tables. See Figure 4.5 for the formulas and a sample layout for a newsvendor problem.

< SOLVED PROBLEM 4.2

MyOMLab Video

- The text includes videos in MyOMLab for over 50 **Solved Problems** from the text, allowing students to practice quantitative material prior to coming to class.

E ND OF CHAPTER RESOURCES

Summary

- The chapter began by reviewing the importance of service operations.
 - All services involve direct customer contact.
- What is meant by simultaneous service? What are some major consequences of simultaneous service?
- What are some long-term consequences of decreasing service capacity?
- What is meant by the term "service operation"?
- Customers are generally in a queue. What are some ways to manage customer interaction?
- Briefly define and describe the PCN diagram and its use in service systems.
- How can you shift the focus of the PCN diagram?
- What trade-offs are generally involved in service decisions?

Key Terms

back office 105
 coproduction 109
 critical fractile 110
 customer experience 102
 customer interaction 101
 direct interaction 104
 do-it-yourself (DIY) 105
 entity 103
 front office 105
 independent processing 110
 multiphase queue system 110
 newsvendor analysis 110

Integrative Learning

Identify an organization, company, or service. Use a process chart to analyze the interactions between the organization. Be sure to identify the beginning and end of the process.

Integrative Experience

Together with a student group, identify a service that provides a service. Identify the beginning and end of the process. Use a PCN diagram. Identify the beginning and end of the process.

SOLVED PROBLEM 4.5

- Calls arrive at a help desk at the rate of three every 2 minutes. The help desk has four service representatives who are able to handle incoming calls. If, on average, a representative can process one call in 2 minutes, compute the following:
 - The average utilization of the representatives

$$W_q = \frac{L_q}{\lambda}$$

$$L_q = L_q + \frac{\lambda}{\mu} = 1.5283 + \frac{90}{30} = 4.5283$$

$$W_q = \frac{4.5283}{90} = 0.0503 \text{ hour} = 0.0503 \times 60 = 3.0189 \text{ minutes}$$

Problems

Planning Service Capacity for Uncertain Demand

- NEWSVENDOR PROBLEMS**
- A local bookstore believes that the demand for the Olympic edition of a sports magazine is normally distributed with a mean of 1200 and a standard deviation of 200. Each copy of the magazine costs the bookstore \$1.50 per copy, and the bookstore will sell the issue for \$5.00. Following the Olympic Games, there will be no demand for the magazine, and all leftover copies will be recycled because they will have no salvage value. What is the optimal number of copies of the Olympic edition that the bookstore should order?
 - The demand for next year's wildlife calendar at a bookstore is assumed to be normally distributed with a mean of 500 and a standard deviation of 75. Each calendar costs the bookstore \$5.50 each and will be sold for \$12.50 each.

Any calendars remaining for sale after Christmas will be discounted and sold for \$1.00 each. The bookstore believes that any calendar remaining to be sold after Christmas can be cleared at the \$1.00 price. How many wildlife calendars should the bookstore stock if it wants to maximize its expected profit from wildlife calendars?

- A retail store must decide how many Mother's Day

Solved Problems

Planning Service Capacity for Uncertain Demand

CAPACITY PLANNING TOOLS

SOLVED PROBLEM 4.2

- A bookstore must decide how many copies of a special release of a political thriller to order. The demand for the book is assumed to be normally distributed with a mean of 2500 and a standard deviation of 150. The bookstore will sell the book for \$25. It costs the bookstore \$15 for each copy it stocks. There is no market for the book once the next book in the series is released; therefore, the book has no salvage value for unsold copies. How many copies of the book should the bookstore stock (order) if it wants to maximize its expected profit?

Answer:

$$C_U = \text{price} - \text{cost} = 25 - 15 = \$10$$

$$C_O = \text{cost} - \text{salvage} = 15 - 0 = \$15$$

$$z = \frac{C_U}{C_U + C_O} = \frac{10}{10 + 15} = 0.4$$

$$z = -0.25$$

$$Q = \mu + z(\sigma) = 2500 + (-0.25)(150) = 2462.5,$$

or 2463 books

Queueing Theory

WAIT TIMES

SOLVED PROBLEM 4.3

- A small video store has a single checkout aisle staffed by one cashier. Customers arrive at the checkout aisle at the rate of 25 every hour. The cashier is able to process 40 customers per hour. Her service time is estimated to be exponentially distributed. Find the following:
 - Average server utilization
 - Average line length

Average time spent in line

d. Average number of customers in video store)

e. Average time spent in the video store)

Answer:

$$\lambda = 25 \text{ per hour}$$

$$\mu = 40 \text{ per hour}$$

a. average server utilization = $\frac{\lambda}{\mu}$

b. average line length = $L_q = \frac{\lambda^2}{\mu(\mu - \lambda)}$

1,042 customers

c. average time spent in line = W_q

$$0.0417 \text{ hour} = 0.0417 \times 60 = 2.5 \text{ minutes}$$

d. average number of customers in the video store) = $L_q + \frac{\lambda}{\mu} = 0.0147$

e. average time spent in the video store) = $\frac{1.6667}{25} = 0.0667 \text{ hour} = 0.0667 \times 60 = 4.002 \text{ minutes}$

SOLVED PROBLEM 4.4

- A clothing store has a single machine that screens onto shirts. The time to screen onto a shirt is 3 minutes. On average, there is a rate of 10 shirts per hour. Compute the following:
 - Average use of the machine
 - Average number of shirts waiting to be screened

CASE

XLG Enterprises

Tommy Hernandez had recently been assigned to the service design team at XLG Enterprises. Tommy had been with XLG for a little over two years when the opportunity to join the service design team became available. The service design team performs a variety of roles, one of which is to analyze and recommend improvements for existing customer service operations performed at XLG.

The design team is now analyzing a new customer service process. The process would handle a variety of customer requests, including billing disputes, shipping and product delivery issues, and product returns. These activities would take place at a newly designed service facility close to the XLG headquarters. Most of XLG's customers are small to medium-sized businesses located in the same city as the proposed customer service facility. It is the hope of XLG management that the new central location for customer service will be a way to facilitate and expedite customer requests related to product billing, shipping, and returns. Customer orders would still be placed mostly over the telephone or the Internet. A sizable number of XLG customers would come to the customer service facility to pick up deliveries or to make returns. The facility would also handle customer-related issues concerning service and billing.

A stated goal of XLG management is that the facility should ensure that customers rarely have to wait more than 15 minutes before speaking to a service representative, even during the busiest of times. XLG anticipated that it would staff the new facility with two service representatives at all times. During the busiest times of the day, however, management recognizes that they might have to increase staffing to as many as six service representatives to meet their stated objectives.

Tommy has been asked to join the team that was designing the new facility. As part of his role, he is to conduct analysis of customer waiting times. Tommy has been given information related to expected customer arrival rates during the busiest service periods throughout the day, average service times, and costs related to both resource staffing and customer waiting. Here is a summary of the information given to Tommy:

Time Period	Arrival Rate
7 a.m.–1 p.m.	10 per hour
1 p.m.–5 p.m.	15 per hour
5 p.m.–10 p.m.	6 per hour

- Summaries** review the important topics discussed in the chapter.
- Key Terms** are listed for review purposes, page references showing where the concept was first discussed.
- Integrative Learning Exercises** are designed to get students to integrate multiple concepts throughout the chapter.
- Integrative Experiential Exercises** are designed to get students out into the real world by visiting companies and learning how supply chain and operations concepts are applied.
- Discussion Questions** test student comprehension of the concepts presented.
- Solved Problems** detail how to solve model problems using the techniques presented in the chapter.
- Problems** sharpen students' skills by providing a wide selection of homework material.
- Cases** challenge students to grapple with a problem that can be used as an in-class exercise or a homework assignment or team project.

H OW THIS BOOK IS ORGANIZED

In the first of four parts, (Part 1, Integrating Supply Chain and Operations Management) we introduce the field of SC&O management. Chapter 1 walks the reader through an integrative SC&O model, which conceptualizes the book's content. The model includes upstream activities of supplier management and development, operations management, and downstream customer relationship management. In Chapter 2, we present global supply chain strategy and sustainability. This chapter emphasizes the linkages inherent in supply chains, which include suppliers, producers, and customers. Cooperation and collaboration are essential to a smoothly operating SC&O system.

Part 2, *Innovating Supply Chain and Operations*, focuses on how innovation provides firms and supply chain managers with a competitive advantage. In Chapter 3, we talk about innovatively designing and mapping production and manufacturing processes. We discuss many of the key considerations in product and process design: designing for manufacturability, maintainability, reliability, and sustainability. In Chapter 4, we turn our attention to service design and introduce a new method of service process analysis called a process chain network diagram, **developed by Scott Sampson**. This innovative tool helps us completely reconceptualize service process and service delivery. In Chapter 5, after we discuss how to design service processes, we emphasize the importance of customer relationship management. This discussion includes gathering data about customers and managing customer feedback to drive improvement of service.

Part 3, *Impacting Supply Chain and Operations Performance*, reviews the nuts and bolts of SC&O management by introducing topics that affect performance. Chapter 6 introduces the enhanced profitability that results from managing suppliers and supplier relationships properly. Important tools for improving supplier performance are total cost of ownership and placing an emphasis on trust and collaboration. Chapter 7 introduces purchasing and supply management. This important SC&O function relies on scorecard metrics such as on-time delivery, dollars saved, days of inventory, quality, and contribution to cost savings. Chapter 8 introduces several forecasting models and time series forecasting as well as the judgmental, naive, and causal forecasting methods.

Chapter 9 discusses inventory models for independent demand. Chapter 10 covers the important concepts of sales and operations planning, capacity management, and enterprise resource planning. Chapter 11 details the effect that performance has throughout the entire supply chain by introducing logistics management. There we discuss the five logistics processes: demand management, inventory management, transportation, warehousing, and structural networks.

Part 4, *Improving Supply Chain and Operations Management Performance*, focuses on how managers can improve their process performances. Chapter 12 introduces fundamentals of project management. There we discuss the life cycle of projects, including chartering and organizing projects, identifying project tasks, determining precedence relationships between tasks, determining task times, and the critical path method for controlling projects. We also discuss financial aspects of projects, including expediting. Chapter 13 provides an understanding of the basics of supply chain quality management. The traditional aspects of quality such as Deming's 14 points are discussed, and then we quickly transition into a discussion of quality on a global basis.

Chapter 14 focuses on quality control. We introduce control charts with a generalized process for using and interpreting these charts. Chapter 15 discusses lean, Six Sigma, and change management. It is a fitting capstone to this book that will lay the foundation for success in any SC&O career.

SUPPLEMENTS

At the Instructor Resource Center, <http://www.pearsonhighered.com/irc>, instructors can easily register to gain access to a variety of instructor resources available with this text in downloadable format. If assistance is needed, our dedicated technical support team is ready to help with the media supplements that accompany this text. Visit <http://247.pearsoned.com> for answers to frequently asked questions and toll-free user support phone numbers.

- The **Instructor's Resource Manual**, which includes:
 - A Sample Syllabus
 - Course Outline
 - Teaching Tips
 - In-class Activities
 - Video Suggestions
 - Class Discussion Questions

- The **Instructor's Solutions Manual**, which contains solutions to all:
 - Discussion Questions
 - Problems
 - Case Questions
- The **Test Bank**, which features over 1,000 questions, including True/False, Multiple Choice, Fill-in-the-Blank, and Essay Prompts. Questions are organized by Learning Objectives and tagged by AACSB category.
 - The Test Bank is also offered as a **TestGen® Computerized Test Bank**.
- **PowerPoint Presentations**, which combine art from the text with interesting lecture slides to engage students in classroom learning
- Included in **MyOMLab** are over 70 professionally developed videos. On-camera videos provide introductions to every chapter, and camtasia videos are provided for every quantitative example in the book. This resource supports classroom efforts and allows instructor to “flip the classroom” if they so desire.

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Finally, we are thankful for our faith that keeps us continually improving and progressing.

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Part 1

Integrating Supply Chain and Operations Management

- Chapter 1** Introduction to Supply Chain and Operations Management
- Chapter 2** Supply Chain and Operations Strategy

