INTERNATIONAL EDITION

BUSINESS LOGISTICS/ SUPPLY CHAIN MANAGEMENT

FIFTH EDITION



RONALD H. BALLOU

CONTENTS

PREFACE xxi	
PART I: INTRODUCTION AND PLANNING 1	
CHAPTER 1 Business Logistics/Supply Chain—A Vital Subject 1	
Introduction 1	
Business Logistics Defined 3	
The Supply Chain 7	
The Activity Mix 9	
Importance of Logistics/Supply Chain 13 Costs Are Significant 13 Logistics Customer Service Expectations Are Increasing 14 Supply and Distribution Lines Are Lengthening with Greater Complexity 15 Logistics/SC Is Important to Strategy 17 Logistics/SC Adds Significant Customer Value 18 Customers Increasingly Want Quick, Customized Response 19 Logistics/SC in Nonmanufacturing Areas 20 Service Industry 21 Military 22 Environment 23	5
Business Logistics/SC in the Firm 24	
Objectives of Business Logistics/SC 27	
Approach to the Study of Logistics/SC 28	
Questions and Problems 30	
Examples of Good Logistics/Supply Chain Strategy, or Lack Thereof 32	
CHAPTER 2 Logistics/Supply Chain Strategy and Planning 33	
Corporate Strategy 34	
Logistics/SC Strategy 35	
Logistics/SC Planning 38 Levels of Planning 38 Major Planning Areas 39 Conceptualizing the Logistics/SC Planning Problem 41 When to Plan 42 Guidelines for Strategy Formulation 44	

Selecting the Proper Channel Strategy 53	
Measuring Strategy Performance 57 Cash Flow 57 Savings 57 Return on Investment 57	
Concluding Comments 58	
Questions 58	
PART II: CUSTOMER SERVICE GOALS 6:	2
CHAPTER 3 The Logistics/Supply Chain Product 62	
Nature of the Logistics/SC Product 63 Classifying Products 63 The Product Life Cycle 65	
The 80-20 Curve 68	
Product Characteristics 72 Weight-Bulk Ratio 72 Value-Weight Ratio 73 Substitutability 74 Risk Characteristics 74	
Product Packaging 76	
Product Pricing 77 Geographic Pricing Methods 77	
Some Legal Concerns 84	
Incentive Pricing Arrangements 84 Quantity Discounts 84 The Deal 86	
Concluding Comments 86	
Questions 87	
CHAPTER 4 Logistics/Supply Chain Customer Service 91	1
Customer Service Defined 92 Customer Service Elements 93 Relative Importance of Service Elements 94	
Order Cycle Time 98 Adjustments to Order Cycle Time 101	
Importance of Logistics/SC Customer Service 102 Service Effects on Sales 102 Service Effects on Customer Patronage 104	
Defining a Sales-Service Relationship 105	

Two-Points Method 107 Before-After Experiments 108 Game Playing 108 Buyer Surveys 109	
Cost versus Service 109	
Determining Optimum Service Levels 110 Theory 110 Practice 111	
Service Variability 114 Loss Function 114 Information Substitution 116	
Service as a Constraint 117	
Measuring Service 118	
Service Contingencies 119 System Breakdown 119 Product Recall 123	
Concluding Comments 126	
Questions 126	
CHAPTER 5 Order Processing and Information Systems	130
Defining Order Processing 131 Order Preparation 131 Order Transmittal 132 Order Entry 133 Order Filling 135 Order Status Reporting 136	
Order-Processing Examples 137 Industrial Order Processing 137 Retail Order Processing 138 Customer Order Processing 139 Web-Based Channel Order Planning 141	
Other Factors Affecting Order-Processing Time 145 Processing Priorities 145 Parallel versus Sequential Processing 145 Order-Filling Accuracy 146 Order Batching 146 Lot Sizing 146 Shipment Consolidation 146	
The Logistics Information System 146 Function 146 Internal Operation 153	
Information System Examples 156 A Retail System 156 Vendor-Managed Inventory 157	

E-Commerce 159 A Decision Support System 160
Concluding Comments 161
Questions 161
PART III: TRANSPORT STRATEGY 164
CHAPTER 6 Transport Fundamentals 164
Importance of an Effective Transportation System 16: Greater Competition 165 Economies of Scale 166 Reduced Prices 166
Service Choices and Their Characteristics 167 Price 167 Transit Time and Variability 168 Loss and Damage 169
Single-Service Choices 171 Rail 171 Truck 172 Air 173 Water 174 Pipeline 175
Intermodal Services 176 Trailer on Flatcar 176 Containerized Freight 177
Agencies and Small Shipment Services 178 Agents 178 Small-Shipment Services 179
Company-Controlled Transportation 180
International Transportation 180 Overview 180 Physical Plant 181 Agencies and Services 183
Transport Cost Characteristics 184 Variable and Fixed Costs 185 Common or Joint Costs 185 Cost Characteristics by Mode 187
Rate Profiles 190 Volume-Related Rates 190 Distance-Related Rates 190 Demand-Related Rates 192
Line-Haul Rates 193 By Product 194

By Shipment Size 201 By Route 204 Miscellaneous Rates 204
Special Service Charges 205 Special Line-Haul Services 205 Terminal Services 210
Private Carrier Costing 211
Documentation 212 Bill of Lading 212 Freight Bill 213 Freight Claims 213
International Transport Documentation 214 Exporting 214 Importing 215
Concluding Comments 215
Questions 216
CHAPTER 7 Transport Decisions 219
Transport Service Selection 220 Basic Cost Trade-Offs 220 Competitive Considerations 222 Appraisal of Selection Methods 224
Vehicle Routing 225 Separate and Single Origin and Destination Points 225 Multiple Origin and Destination Points 230 Coincident Origin and Destination Points 232
Vehicle Routing and Scheduling 235 Principles for Good Routing and Scheduling 236 Methods for Routing and Scheduling 240 Route Sequencing 247 Implementation of Vehicle Routing and Scheduling Methods 248 Ship Routing and Scheduling 249
Freight Consolidation 252
Concluding Comments 254
Questions 254
Problems 255
Case Study: Fowler Distributing Company 267
Case Study: Metrohealth Medical Center 270
Case Study: Orion Foods, Inc. 276
Case Study: R&T Wholesalers 280

PART IV: INVENTORY STRATEGY 286	
CHAPTER 8 Forecasting Supply Chain Requirements 286 Nature of Forecasting 287 Spatial versus Temporal Demand 287 Lumpy versus Regular Demand 288 Derived versus Independent Demand 288	
Forecasting Methods 291 Qualitative Methods 291 Historical Projection Methods 291 Causal Methods 296	
Useful Techniques for Logisticians 296 Exponential Smoothing 297 Classic Time Series Decomposition 305 Multiple Regression Analysis 309	
Special Prediction Problems for Logisticians 310 Start-Up 310 Lumpy Demand 310 Regional Forecasting 311 Forecast Error 311	
Collaborative Forecasting 314	
Flexibility and Quick Response—An Alternative to Forecasting	316
Concluding Comments 317	
Questions 317	
Case Study: World Oil 323	
CHAPTER 9 Inventory Policy Decisions 326	
Appraisal of Inventories 328 Arguments for Inventories 328 Arguments Against Inventories 330	
Types of Inventories 330	
Classifying Inventory Management Problems 331 Nature of Demand 332 Management Philosophy 333 Degree of Product Aggregation 334 Multi-Echelon Inventories 334 Virtual Inventories 335	
Inventory Objectives 335 Product Availability 336 Relevant Costs 337	

344

342

Push Inventory Control

Basic Pull Inventory Control Single-Order Quantity 342 Repetitive Order Quantities

Advanced Pull Inventory Control 348 A Reorder Point Model with Uncertain Demand 349 The Reorder Point Method with Known Stockout Costs 353 The Reorder Point Method with Demand and Lead Time Uncertainty A Periodic Review Model with Uncertain Demand 357 Practical Pull Inventory Control Methods 363	355
Pipeline Inventories 374	
Aggregate Control of Inventories 376	
Supply-Driven Inventory Control 384	
Virtual Inventories 385	
Concluding Comments 389	
Glossary of Terms 389	
Questions 390	
Problems 391	
Case Study: Complete Hardware Supply, Inc. 403	
Case Study: American Lighting Products 405	
Case Study: American Red Cross: Blood Services 412	
CHAPTER 10 Purchasing and Supply Scheduling Decisions	424
Coordination in the Supply Channel 425	
Supply Scheduling 427 Just-in-Time Supply Scheduling 428 Just-in-Time Distribution Scheduling 442	
Purchasing 446 Importance of Purchasing 447 Order Quantities and Timing 450 Sourcing 458 Terms of Sale and Channel Management 461	
Concluding Comments 462	
Questions 462	
Problems 463	
Case Study: Industrial Distributors, Inc. 468	
CHAPTER 11 The Storage and Handling System 469	
Need for a Storage System 470	
Reasons for Storage 470 Transportation-Production Cost Reduction 470 Coordination of Supply and Demand 471 Production Needs 472 Marketing Considerations 472	
Storage System Functions 472 Storage Functions 472 Materials Handling Functions 477	

Space Ownership 479 Rented Space 479 Leased Space 485 Storage in Transit 485
Materials Handling Considerations 486 Load Unitization 486 Space Layout 487 Storage Equipment Choice 490 Movement Equipment Choice 490
Storage System Costs and Rates 493 Public Warehousing 493 Leased Warehousing, Manual Handling 495 Private Warehousing, Pallet and Forklift Truck Handling 495 Private Warehousing, Automated Handling 495
Virtual Warehousing 496
Concluding Comments 499
Questions 499
CHAPTER 12 Storage and Handling Decisions 501
Site Selection 502
Planning for Design and Operation 503 Sizing the Facility 503 Selecting the Space Type—Financial Considerations 509 Facility Configuration 513 Space Layout 516 Dock Design 520
Materials Handling System Design 522 Materials Handling System Selection 523 Equipment Replacement 527 Product Layout Decisions 528
Order-Picking Operations 541 Order Handling 541 Interleaving 543 Setting Standards 543
Concluding Comments 544
Questions 544
Technical Supplement 549
PART V: LOCATION STRATEGY 550
CHAPTER 13 Facility Location Decisions 550
Classification of Location Problems 551 Driving Force 551

Storage Alternatives 479

Number of Facilities

Discreteness of the Choices 551 Degree of Data Aggregation 552 Time Horizon 552 A Historical Perspective on Location 552 Bid-Rent Curves 553 Weber's Classification of Industries 553 Hoover's Tapered Transportation Rates 554 Single Facility Location Extensions to the Single Facility Location Model 560 Appraisal of Single Facility Location 561 Multiple Facility Location 562 Exact Methods Simulation Methods 569 573 Heuristic Methods Appraisal of Multiple Facility Location Methods 581 **Dynamic Warehouse Location** 582 587 Retail/Service Location Weighted Checklist 587 589 Spatial-Interaction Model Other Methods 591 Other Location Problems 595 Hub and Spoke 595 595 Obnoxious Facilities Microlocation 595 Concluding Comments 596 **Ouestions** 596 597 **Problems** Case Study: Superior Medical Equipment Company 607 609 Case Study: Ohio Auto and Driver's License Bureau Case Study: Southern Brewery 612 Technical Supplement 616 The Network Planning Process 618 CHAPTER 14 The Problem of Network Configuration 619 Data for Network Planning 621 A Data Checklist 621 622 Data Sources Data Encoding 624 628 Converting Data to Information Missing Information The Tools for Analysis 644 Choices for Modeling 644 **Decision Support Systems** 650

Conducting the Analysis 651 Auditing Customer Service Levels 652 Organizing the Study 653 Benchmarking 655 Network Configuration 656 Channel Design 662 Integrated Supply Chain Planning 668
A Location Case Study 669 Problem Description 669 Managing the Problem Size 669 The Analysis 671 Reporting the Financial Results to Management 671 Conclusion 673
Concluding Comments 673
Questions 674
Case Study: Usemore Soap Company 677
Case Study: Essen USA 687
PART VI: ORGANIZATION AND CONTROL 69
CHAPTER 15 Logistics/Supply Chain Organization 691
Organizing the Logistics/SC Effort 692 Need for Organization Structure 692 Organizational Development 696
Organizational Choices 697 The Informal Organization 698 The Semiformal Organization 699 The Formal Organization 701
Organizational Orientation 704 Process Strategy 704 Market Strategy 704 Information Strategy 704
Organizational Positioning 705 Decentralization versus Centralization 705 Staff versus Line 706 Large versus Small 707
Interfunctional Management 708
Interorganizational Management 709 The Superorganization 710 Managing the Conflict 712
Alliances and Partnerships 716
Concluding Comments 724
Questions 724

CHAPTER 16 Logistics/Supply Chain Control 726
A Control Process Framework 727 A Logistics/SC Control Model 727 Types of Control Systems 730
Control System Details 733 Error Tolerance 734 Response 734
Control in Practice 736 Budgets 736 Service Targets 736 Profit Center Concept 736 Decision Support Systems 737
Control Information, Measurement, and Interpretation 738 Audits 738 Regular Reports 744
Corrective Action 751 Minor Adjustments 751 Major Replanning 751 Contingency Plans 752
A Supply Chain Operations Reference (SCOR) Model 752
Control Links to Artificial Intelligence 754 Pattern Recognition 755 Performance Patterns 757 Courses of Action 757
Concluding Comments 758
Questions 759
APPENDICES
Appendix A Areas Under the Standardized Normal Distribution
Appendix B Unit Normal Loss Integrals 763

SELECTED BIBLIOGRAPHY 766

Author Index 771 Subject Index 775