# Brief Contents

1 Introduction to Operations Management 2 Competitiveness, Strategy, and Productivity 34 12 Aggregate Planning 540  part 2 Forecasting 63 14 JIT and Lean Operations 616 3 Forecasting 64 Supplement to Chapter 14: Maintenance 648  part 3 System Design 119 15 Scheduling 654  4 Product and Service Design 120 Supplement to Chapter 4: Reliability 155 Strategic Capacity Planning for Products and Services 168 16 Supply Chain Management 692 Supplement to Chapter 5: Decision Theory 195 Supplement to Chapter 5: Decision Theory 195 Supplement to Chapter 6: Linear Programming 265 Supplement to Chapter 6: Linear Programming 265 Supplement to Chapter 7: Learning Curves 335 Supplement to Chapter 8: The Transportation Model 374 Appendix A: Answers to Selected Problems Appendix B: Tables Index 858  part 4 Quality 379  Management of Quality 380	part 1	Introduction	1	part 5	Inventory Management ar	nd
and Productivity  Part 2 Forecasting  63 14 JIT and Lean Operations  616  3 Forecasting  64 Supplement to Chapter 14: Maintenance  648  Product and Service Design  Supplement to Chapter 4: Reliability  5 Strategic Capacity Planning for Products and Services 168 16 Supply Chain Theory  691  Process Selection and Facility Layout Supplement to Chapter 6: Linear Programming Programming  70 Design of Work Systems Supplement to Chapter 7: Learning Curves  8 Location Planning and Analysis Supplement to Chapter 8: The Transportation Model  Part 4 Quality  379  Aggregate Planning MRP and ERP  574  Maintenance Supplement to Chapter 14: Maintenance  Supplement to Chapter 14: Maintenance  Supply Chain Management  Supply Chain Management  Froject Management  725  Project Management 725  Part 8 Waiting Lines and Simulation 777  Supplement to Chapter 7: Learning Curves 778  Supplement to Chapter 8: The Transportation Model 778  Appendix A: Answers to Selected Problems Appendix B: Tables Index  836  Index  836  Index  840  Raintenance  648  840  840  840  840  840  840  840	1	Introduction to Operations Management	2		Scheduling	481
and Productivity  Part 2 Forecasting  63 14 JIT and Lean Operations  616  3 Forecasting  64 Supplement to Chapter 14: Maintenance  648  Product and Service Design  Supplement to Chapter 4: Reliability  5 Strategic Capacity Planning for Products and Services 168 16 Supply Chain Theory  691  Process Selection and Facility Layout Supplement to Chapter 6: Linear Programming Programming  70 Design of Work Systems Supplement to Chapter 7: Learning Curves  8 Location Planning and Analysis Supplement to Chapter 8: The Transportation Model  Part 4 Quality  379  Aggregate Planning MRP and ERP  574  Maintenance Supplement to Chapter 14: Maintenance  Supplement to Chapter 14: Maintenance  Supply Chain Management  Supply Chain Management  Froject Management  725  Project Management 725  Part 8 Waiting Lines and Simulation 777  Supplement to Chapter 7: Learning Curves 778  Supplement to Chapter 8: The Transportation Model 778  Appendix A: Answers to Selected Problems Appendix B: Tables Index  836  Index  836  Index  840  Raintenance  648  840  840  840  840  840  840  840	2	Competitiveness, Strategy,		11	Inventory Management	482
Part 2 Forecasting 63 14 JIT and Lean Operations 616 3 Forecasting 64 Supplement to Chapter 14: Maintenance 648  part 3 System Design 119 15 Scheduling 654  4 Product and Service Design 120 Supplement to Chapter 4: Reliability 155 Strategic Capacity Planning for Products and Services 168 16 Supply Chain Management 691 Supplement to Chapter 5: Decision Theory 195 Part 7 Project Management 725  6 Process Selection and Facility Layout 216 17 Project Management 726 Supplement to Chapter 6: Linear Programming 265 Supplement to Chapter 6: Linear Programming 265 Supplement to Chapter 7: Learning Curves 335 18 Waiting Lines and Simulation 777 Supplement to Chapter 7: Learning Curves 335 Supplement to Chapter 18: Simulation 814 Supplement to Chapter 8: The Transportation Model 374 Appendix A: Answers to Selected Problems Appendix B: Tables Index 858		The state of the s	34	12	Aggregate Planning	540
3 Forecasting 64 Supplement to Chapter 14: Maintenance 648  Part 3 System Design 119 15 Scheduling 654  4 Product and Service Design 120 Supplement to Chapter 4: Reliability 155 Part 6 Supply Chain Management 691 Management 691 Management 692 Supplement to Chapter 5: Decision Theory 195 Part 7 Project Management 725 Supplement to Chapter 6: Linear Programming 265 Supplement to Chapter 6: Linear Programming 265 Supplement to Chapter 7: Learning Curves 335 Location Planning and Analysis 346 Supplement to Chapter 8: The Transportation Model 374 Appendix A: Answers to Selected Problems Appendix B: Tables Index 858				. 13	MRP and ERP	574
Maintenance 648 Product and Service Design 120 Supplement to Chapter 4: Reliability 155 Strategic Capacity Planning for Products and Services 168 Supplement to Chapter 5: Decision Theory 195 Process Selection and Facility Layout 216 Supplement to Chapter 6: Linear Programming 265 Supplement to Chapter 7: Learning Curves 335 Location Planning and Analysis 346 Supplement to Chapter 8: The Transportation Model 379  Maintenance 648 Scheduling 654  Supply Chain Management 691 Supply Chain Management 692 Supply Chain Management 692 Supplement 7 Project Management 725 Part 7 Project Management 725 Simulation 777 Project Management 725 Simulation 777 Supplement to Chapter 7: Learning Curves 335 Supplement to Chapter 7: Learning Curves 335 Supplement to Chapter 8: The Transportation Model 374 Appendix A: Answers to Selected Problems 836 Appendix B: Tables 850 Index 858	part 2	Forecasting	63	14	JIT and Lean Operations	616
Part 3 System Design 119 15 Scheduling 654  4 Product and Service Design 120 Supplement to Chapter 4: Reliability 155 Part 6 Supply Chain Management 691 Management 162 Supplement to Chapter 5: Decision Theory 195 Part 7 Project Management 725  6 Process Selection and Facility Layout 216 17 Project Management 726 Supplement to Chapter 6: Linear Programming 265 Part 8 Waiting Lines and Simulation 777 Supplement to Chapter 7: Learning Curves 335 Supplement to Chapter 7: Learning Curves 335 Supplement to Chapter 8: The Transportation Model 374 Appendix A: Answers to Selected Problems Appendix B: Tables Index 858	3	Forecasting	64		Supplement to Chapter 14:	
4 Product and Service Design Supplement to Chapter 4: Reliability 5 Strategic Capacity Planning for Products and Services 168 16 Supply Chain Management 691 Supplement to Chapter 5: Decision Theory 195 6 Process Selection and Facility Layout Supplement to Chapter 6: Linear Programming 265 7 Design of Work Systems Supplement to Chapter 7: Learning Curves 335 8 Location Planning and Analysis Supplement to Chapter 8: The Transportation Model 374  Appendix A: Answers to Selected Problems Appendix B: Tables Index 858					Maintenance	648
Supplement to Chapter 4: Reliability 155	part 3	System Design	119	15	Scheduling	654
5 Strategic Capacity Planning for Products and Services 168 16 Supply Chain Management 691 Supplement to Chapter 5: Decision Theory 195 part 7 Project Management 725 6 Process Selection and Facility Layout 216 17 Project Management 726 Supplement to Chapter 6: Linear Programming 265 part 8 Waiting Lines and Simulation 777 Supplement to Chapter 7: Learning Curves 335 Supplement to Chapter 7: Learning Curves 335 Supplement to Chapter 8: The Transportation Model 374 Appendix A: Answers to Selected Problems 836 Appendix B: Tables Index 858	4	Product and Service Design	120			
and Services  Supplement to Chapter 5: Decision Theory  Project Management  Programming  265 Supplement to Chapter 6: Linear Programming  Design of Work Systems Supplement to Chapter 7: Learning Curves  Location Planning and Analysis Supplement to Chapter 8: The Transportation Model  168  16 Supply Chain Management  Project Management  Project Management  726  Waiting Lines and Simulation  777  Supplement to Chapter 7: Learning Curves  335 Supplement to Chapter 18: Simulation  814  Appendix A: Answers to Selected Problems Appendix B: Tables Index  Part 4  Quality  379		Supplement to Chapter 4: Reliability	155	part O		
Supplement to Chapter 5: Decision Theory  6 Process Selection and Facility Layout Supplement to Chapter 6: Linear Programming  7 Design of Work Systems Supplement to Chapter 7: Learning Curves  8 Location Planning and Analysis Supplement to Chapter 8: The Transportation Model  7 Quality  195 part 7 Project Management 725  17 Project Management 726  8 Waiting Lines and Simulation 777  8 Waiting Lines 778 Supplement to Chapter 18: Simulation 814  8 Appendix A: Answers to Selected Problems Appendix B: Tables Index 858	5	Strategic Capacity Planning for Products			Management	691
Theory  6 Process Selection and Facility Layout Supplement to Chapter 6: Linear Programming  726  727  728  728  729  729  729  720  720  721  721  722  725  726  726  727  726  727  728  728  729  729  720  720  721  722  723  724  725  726  726  727  728  728  729  729  720  720  721  722  723  724  725  726  726  727  728  728  729  729  720  720  721  722  723  724  725  725  726  726  727  728  728  729  729  720  720  721  722  723  724  725  725  726  726  727  728  728  729  729  720  720  720  720  721  722  723  724  725  725  726  726  727  728  728  728  728  729  729  720  720  720  721  722  723  724  725  725  726  726  726  727  728  728  728  728		and Services	168	16	Supply Chain Management	692
6 Process Selection and Facility Layout Supplement to Chapter 6: Linear Programming 265 Design of Work Systems Supplement to Chapter 7: Learning Curves 335 Location Planning and Analysis Supplement to Chapter 8: The Transportation Model  726 Waiting Lines and Simulation 777 Supplement to Chapter 7: Learning Curves 335 Supplement to Chapter 18: Simulation 814 Supplement to Chapter 8: The Transportation Model  726 Appendix A: Answers to Selected Problems Appendix B: Tables Index 858				many		
Supplement to Chapter 6: Linear Programming  7 Design of Work Systems Supplement to Chapter 7: Learning Curves  8 Location Planning and Analysis Supplement to Chapter 8: The Transportation Model  777  Appendix A: Answers to Selected Problems Appendix B: Tables Index  858  Naiting Lines 778  Supplement to Chapter 18: Simulation 814  Appendix A: Answers to Selected Problems 836  Appendix B: Tables 858				part /	Project Management	725
Programming 265 part 8 Waiting Lines and Simulation 777 Supplement to Chapter 7: Learning Curves 335 Supplement to Chapter 8: The Transportation Model 379  Programming 265 part 8 Waiting Lines 3778  Waiting Lines 5778  Supplement to Chapter 18: Simulation 814  Appendix A: Answers to Selected Problems 4Appendix B: Tables 850  Index 858	6		216	17	Project Management	726
7 Design of Work Systems Supplement to Chapter 7: Learning Curves 335 8 Location Planning and Analysis Supplement to Chapter 8: The Transportation Model 374 Appendix A: Answers to Selected Problems Appendix B: Tables Index Appendix B: Tables Index 858			005			
Supplement to Chapter 7: Learning Curves  8 Location Planning and Analysis Supplement to Chapter 8: The Transportation Model  934 Appendix A: Answers to Selected Problems Appendix B: Tables  18 Waiting Lines Supplement to Chapter 18: Simulation 814  Appendix A: Answers to Selected Problems Appendix B: Tables 850  Index 858				part 8	Waiting Lines and	
Curves 335 18 Waiting Lines 7/8  8 Location Planning and Analysis 346 Supplement to Chapter 18: Simulation 814  Supplement to Chapter 8: The Transportation Model 374 Appendix A: Answers to Selected Problems 836  Appendix B: Tables 850  Index 858	7		296		Simulation	777
8 Location Planning and Analysis Supplement to Chapter 8: The Transportation Model  934			225	18	Waiting Lines	778
Supplement to Chapter 8: The Transportation Model  Part 4 Quality  Supplement to Chapter 8: The Appendix A: Answers to Selected Problems Appendix B: Tables  Index  836  Appendix A: Answers to Selected Problems 850  Appendix B: Tables 858					Supplement to Chapter 18: Simulation	814
Transportation Model  374	ð		340			
Part 4 Quality  Appendix B: Tables Index 850 858			27/	Appendix A	: Answers to Selected Problems	836
part 4 Quality 379		If all sportation ivioue	3/4	Appendix B	: Tables	
	part 4	Quality	379	Index		858
5 Management of Quanty 360		1.77				
10 Quality Control 420						
10 Quality Control 430	10		430			
Supplement to Chapter 10: Acceptance Sampling 470			470			

## Contents

#### Hazel Revisited 59 part 1 Introduction **Operations Tour:** 1 Introduction to The US Postal Service 60 Operations Management 2 Introduction 4 part 2 Forecasting The Scope of Operations Management 8 3 Forecasting 64 The Operations Manager and the Management Introduction 66 Process 11 Features Common to All Forecasts 67 **Operations Management and Decision** Elements of a Good Forecast 67 Making 12 Steps in the Forecasting Process 68 Why Study Operations Management? Approaches to Forecasting 68 The Historical Evolution of Operations Forecasts Based on Judgment and Opinion Management 18 Forecasts Based on Time Series Data 70 Trends in Business 21 Associative Forecasting Techniques 85 Readings: Why Manufacturing Matters 27 Accuracy and Control of Forecasts 89 The Challenges of Managing Services 28 Choosing a Forecasting Technique 96 Cases: Using Forecast Information 96 Hazel 28 Computers in Forecasting 97 Total Recall 29 Reading: **Operations Tour:** Gazing at the Crystal Ball 98 Wegmans Food Markets, M&L Manufacturing 118 2 Competitiveness, Strategy, and part 3 System Design Productivity Introduction 36 4 Product and Service Design 120 Competitiveness 36 Introduction 122 Strategy 38 Legal, Ethical, and Environmental Issues 124 Productivity 47 Other Issues in Product and Service Design 125 Reading: Reading: Why Productivity Matters 50 Do You Want Pickled Beets with That? 131 Reading: Phases in the Product Design and Productivity Gains at Whirlpool 55 Development 132 Cases: Readings: An American Tragedy: How a Good Manager's Journal: When Customer Research Company Died 56 Is a Lousy Idea 134 Home-Style Cookies 57 Vlasic on a Roll with Huge Pickle Slices 135

The Transportation Model

374

**Designing Process Layouts** Designing for Manufacturing 137 **Operations Tour:** Reading: Making It (Almost) New Again 140 Morton Salt 262 Quality Function Deployment 142 **Supplement to Chapter 6:** The Kano Model 145 Linear Programming Service Design 146 Reading: 7 Design of Work Systems 296 Time-Based Innovation 150 Introduction 297 **Supplement to Chapter 4:** Job Design Reliability 155 Reading: Workplace Upheavals Seem to Be Eroding Employees' Trust 300 5 Strategic Capacity Planning for Products and Services 168 Reading: Living with a Self-Directed Work Team 303 Introduction 169 Capacity Decisions Are Strategic Reading: Defining and Measuring Capacity 171 What Works to Cut CTD Risk, Improve Job Productivity? 314 Determinants of Effective Capacity 173 Work Measurement 315 Strategy Formulation 174 Compensation 326 Determining Capacity Requirements 175 Reading: Make or Buy 177 Making Hotplates 333 Developing Capacity Alternatives 178 Reading: **Supplement to Chapter 7:** Would You Like That Rare, Medium, or Learning Curves 335 Vacuum-Packed? 178 The Challenges of Planning Service Capacity 8 Location Planning and Analysis 346 Evaluating Alternatives 184 The Need for Location Decisions 347 **Operations Tour:** The Nature of Location Decisions 348 High Acres Landfill 194 General Procedure for Making Location **Supplement to Chapter 5:** Decisions 349 Decision Theory 195 Factors That Affect Location Decisions 349 Service and Retail Locations 6 Process Selection and Facility Global Locations 358 Layout 216 Readings: Introduction 217 Global Strategy: GM Is Building Plants in Developing Nations to Woo Process Selection 218 New Markets 358 Reading: Not-So-Clear Choices: Should You Export, or Tour de Force 224 Manufacture Overseas? 360 Facilities Layout 227 **Evaluating Location Alternatives** 362 Reading: Designing Supermarkets 235 Supplement to Chapter 8:

Designing Product Layouts: Line Balancing

## part 4 Quality 379

## 9 Management of Quality 380

Introduction 381

The Evolution of Quality Management 381

The Foundations of Modern Quality Management:

The Gurus 382

Insights on Quality Management 386

Quality Awards 393

#### Reading:

The Baldrige Core Values and Concepts 393

Quality Certification 396

Total Quality Management 397

#### Readings:

What Keeps Six Sigma Practitioners Up at

Night 401

Quality Programs Don't Guarantee

Results 403

Problem Solving 403

Process Improvement 406

Quality Tools 407

#### Reading:

Continuous Improvement on the Free-Throw

Line 412

#### Reading:

Benchmarking Corporate Websites of Fortune

500 Companies 418

#### Cases:

Chick-n-Gravy Dinner Line 424

Tip Top Markets 424

#### Reading:

Aesop on Quality Systems 426

## 10 Quality Control 430

Introduction 431

Inspection 432

Statistical Process Control 435

Process Capability 451

#### Cases:

Toys, Inc. 466

Tiger Tools 467

#### **Operations Tour:**

In the Chips at Jays 468

## **Supplement to Chapter 10:**

Acceptance Sampling 470

# part 5 Inventory Management and Scheduling 481

### 11 Inventory Management 482

Introduction 483

The Nature and Importance of

Inventories 484

Requirements for Effective Inventory

Management 486

#### Reading:

Chip Tags Tell Stores What's Not on

the Shelf 488

How Much to Order: Economic Order Quantity

Models 492

When to Reorder with EOQ Ordering 504

How Much to Order: Fixed-Order-Interval

Model 511

The Single-Period Model 514

#### Cases:

UPD Manufacturing 532

Harvey Industries 533

Grill Rite 535

#### **Operations Tours:**

Bruegger's Bagel Bakery 536

PSC, Inc. 537

## 12 Aggregate Planning 540

Introduction 541

#### Reading:

Duplicate Orders Can Lead to

Excess Capacity 544

Basic Strategies for Meeting Uneven

Demand 547

Techniques for Aggregate Planning 550

Aggregate Planning in Services 558

Disaggregating the Aggregate Plan 559

Master Scheduling 560

The Master Scheduling Process 560

#### Case:

Eight Glasses a Day (EGAD) 572

#### 13 MRP and ERP 574

MRP 575

An Overview of MRP 576

MRP Inputs 577

MRP Processing 581

MRP Outputs 588

Other Considerations 589

MRP in Services 590

Benefits and Requirements of MRP 591

MRP II 591

Capacity Requirements Planning 593

ERP 595

#### Readings:

The ABCs of ERP 595

[Condensed from] The Top 10 ERP

Mistakes 600

#### Case:

DMD Enterprises 611

#### **Operations Tour:**

Stickley Furniture 612

## 14 JIT and Lean Operations 616

Introduction 618

#### Readings:

The Nuts and Bolts of Japan's Factories 618
Romantic JIT and Pragmatic JIT 620

Supporting Goals 621

Building Blocks 622

#### Reading:

Pedal Pushers 627

#### Reading:

Developing the JIT Philosophy 635

Transitioning to a JIT System 638

JIT in Services 639

JIT II 641

#### Reading:

JIT II 641

#### Case:

Level Operations 645

#### **Operations Tour:**

Boeing 646

## Supplement to Chapter 14:

Maintenance 648

### 15 Scheduling 654

Scheduling Operations 656

Scheduling in Low-Volume Systems 658

Additional Service Considerations 676

#### Reading:

Servicing Passenger Planes 677

## part 6 Supply Chain Management 691

### 16 Supply Chain Management 692

Introduction 693

The Need for Supply Chain Management 695

Benefits of Effective Supply Chain

Management 696

Elements of Supply Chain Management 696

Logistics 697

#### Reading:

Rise of the 3PL 701

E-Commerce 702

Creating an Effective Supply Chain 704

#### Readings:

E-Procurement at IBM 704

CPFR 706

Using Information to Speed Execution 710

Purchasing 713

Supplier Management 717

#### **Operations Tour:**

Wegmans' Distribution System 721

## part 7 Project Management 725

## 17 Project Management 726

#### Reading:

The International Space Station Project (ISS) 727

Introduction 728

Behavioral Aspects of Project

Management 729

#### Reading:

Project Managers Have Never Been More Critical 732

Project Life Cycle 734

Work Breakdown Structure 734

Planning and Scheduling with Gantt Charts 736

PERT and CPM 736

Deterministic Time Estimates 739

A Computing Algorithm 740

Probabilistic Time Estimates 747

Determining Path Probabilities 750

Simulation 753

Time-Cost Trade-Offs: Crashing 753

Advantages of Using PERT and Potential Sources

of Error 756

Technology for Managing Projects 757

Risk Management 758

#### Cases:

The Case of the Mexican Crazy Quilt 773
Time, Please 774

## part 8 Waiting Lines and Simulation 777

## 18 Waiting Lines 778

Why Is There Waiting? 780

Managerial Implications of Waiting Lines 780
Goal of Waiting-Line Analysis 780
Characteristics of Waiting Lines 781
Measures of Waiting Line Performance 786
Queuing Models: Infinite-Source 786
Queuing Model: Finite-Source 799
Other Approaches 805

#### Case:

Big Bank 811

#### Reading:

Stopped at a Light? Why Not Read This, You May Have Time 811

## **Supplement to Chapter 18:**

Simulation 814

Appendix A: Answers to Selected Problems 836 Appendix B: Tables 850 Index 858