

Operations Management **An Integrated Approach**

R. Dan Reid Nada R. Sanders CHAPTER 1

Introduction to Operations Management 1 Operations Strategy and Competitiveness 29 WHAT IS OPERATIONS MANAGEMENT? 2 THE ROLE OF OPERATIONS STRATEGY 31 Links to Practice: The E-tailers 4 The Importance of Operations Strategy 31 DIFFERENCES BETWEEN MANUFACTURING AND SERVICE **DEVELOPING A BUSINESS STRATEGY 32 ORGANIZATIONS 5** Mission 32 Links to Practice: U.S. Postal Service 6 Environmental Scanning 33 OPERATIONS MANAGEMENT DECISIONS 7 Core Competencies 35 Links to Practice: Texas Instruments Incorporated 9 Putting It Together **36** PLAN OF THIS BOOK 10 Links to Practice: Dell Computer Corporation 36 HISTORICAL DEVELOPMENT 11 **DEVELOPING AN OPERATIONS STRATEGY 37** Why OM? **11** Competitive Priorities **37** Historical Milestones 11 Links to Practice: Southwest Airlines Company 38 The Industrial Revolution 12 Links to Practice: FedEx Corporation 40 Scientific Management 13 The Need for Trade-Offs 40 The Human Relations Movement 14 Order Winners and Qualifiers 41 Management Science 14 Translating Competitive Priorities into Production The Computer Age 15 Requirements 42 STRATEGIC ROLE OF TECHNOLOGY 43 Just-in-Time 15 Total Quality Management 15 Types of Technologies 43 Technology as a Tool for Competitive Advantage 44 Business Process Reengineering 16 PRODUCTIVITY 44 Flexibility **16** Time-Based Competition 16 Measuring Productivity 44 Supply Chain Management 16 Interpreting Productivity Measures 47 Links to Practice: The Publishing Industry 17 Productivity and Competitiveness 47 Global Marketplace 18 Productivity and the Service Sector 48 Sustainability and Green Operations 18 **OPERATIONS STRATEGY WITHIN OM: HOW IT ALL FITS TOGETHER 48** Electronic Commerce 18 **OPERATIONS STRATEGY ACROSS** Outsourcing and Flattening of the World 19 THE ORGANIZATION 49 **TODAY'S OM ENVIRONMENT 20** THE SUPPLY CHAIN LINK 49 **OPERATIONS MANAGEMENT IN PRACTICE 21** THE SUSTAINABILITY LINK 50 WITHIN OM: HOW IT ALL FITS TOGETHER 21 Chapter Highlights 50 OM ACROSS THE ORGANIZATION 22 Key Terms 51 THE SUPPLY CHAIN LINK 24 Formula Review 51 THE SUSTAINABILITY LINK 24 Solved Problems 51 Chapter Highlights 25 Discussion Questions **52** Key Terms 25 Problems **52** Discussion Questions 25 CASE: PRIME BANK OF MASSACHUSETTS 53 CASE: HIGHTONE ELECTRONICS, INC. 26 CASE: BOSEMAN OIL AND PETROLEUM (BOP) 54 CASE: CREATURE CARE ANIMAL CLINIC (A) 26 INTERACTIVE CASE: VIRTUAL COMPANY 54 INTERACTIVE CASE: VIRTUAL COMPANY 27 **INTERNET CHALLENGE 55 INTERNET CHALLENGE 28** ONLINE RESOURCES 55 **ONLINE RESOURCES 28** Selected Bibliography **56** Selected Bibliography 28

CHAPTER 2

CHAPTER 3

Product Design and Process Selection 57

PRODUCT DESIGN 59

Design of Services versus Goods 59

THE PRODUCT DESIGN PROCESS 60

Idea Development 60

Links to Practice: IBM Corporation 61

Product Screening 62

Preliminary Design and Testing 64

Final Design 64

FACTORS IMPACTING PRODUCT DESIGN 65

Design for Manufacture 65

Product Life Cycle 66

Concurrent Engineering 67

Remanufacturing 68

PROCESS SELECTION 68

Types of Processes 68

DESIGNING PROCESSES 72

PROCESS PERFORMANCE METRICS 74

LINKING PRODUCT DESIGN AND PROCESS

SELECTION 77

Product Design Decisions 78

Links to Practice: The Babcock & Wilcox Company 78

Competitive Priorities **79**

Facility Layout 79

Product and Service Strategy 81

Degree of Vertical Integration 81

TECHNOLOGY DECISIONS 82

Information Technology 82

Links to Practice: Using GPS Technology in Product

Advertising 83

Automation 83

Links to Practice: Performing Robotic Surgery 85

e-Manufacturing 86

DESIGNING SERVICES 87

How Are Services Different from Manufacturing? 87

How Are Services Classified? 88

The Service Package 89

Differing Service Designs **90**

PRODUCT DESIGN AND PROCESS SELECTION WITHIN

OM: HOW IT ALL FITS TOGETHER 91

PRODUCT DESIGN AND PROCESS SELECTION ACROSS

THE ORGANIZATION 92

THE SUPPLY CHAIN LINK 93

THE SUSTAINABILITY LINK 93

Chapter Highlights 94

Key Terms 94

Formula Review 95

Solved Problems 95

Discussion Questions 97

Problems 97

CASE: BIDDY'S BAKERY (BB) 99

CASE: CREATURE CARE ANIMAL CLINIC (B) 100

INTERACTIVE CASE: VIRTUAL COMPANY 100

INTERNET CHALLENGE 101

ONLINE RESOURCES 101

Selected Bibliography 101

CHAPTER 4

Supply Chain Management 103

WHAT IS A SUPPLY CHAIN? 104

COMPONENTS OF A SUPPLY CHAIN FOR A

MANUFACTURER 106

External Suppliers **106**

Internal Functions 108

External Distributors 108

THE BULLWHIP EFFECT 108

Causes of the Bullwhip Effect 109

Counteracting the Bullwhip Effect **110**

SUPPLY CHAINS FOR SERVICE ORGANIZATIONS 110

Internal Operations 111

The External Distributors 112

MAJOR ISSUES AFFECTING SUPPLY CHAIN

MANAGEMENT 112

Information Technology 112

E-Commerce 112

Business-to-Business (B2B) E-Commerce 113

The Evolution of B2B Commerce 113

The Benefits of B2B E-Commerce 114

Business-to-Consumer (B2C) E-Commerce 114

Consumer Expectations and Competition Resulting

from E-Commerce 115

Links to Practice: Lands' End, Inc. 115

Globalization 116

Government Regulations and E-Commerce 118

Green Supply Chain Management 118

Infrastructure Issues 121

Product Proliferation 122

THE ROLE OF PURCHASING 122

The Traditional Purchasing Process 122

The E-purchasing Process 124

SOURCING ISSUES 127

Insourcing versus Outsourcing Decisions 128

Developing Supplier Relationships 130

How Many Suppliers? 130 COST OF QUALITY 165 Developing Partnerships 131 THE EVOLUTION OF TOTAL QUALITY MANAGEMENT Links to Practice: The Bama Companies 132 (TQM) 166 Critical Factors in Successful Partnering 133 Quality Gurus 167 THE PHILOSOPHY OF TOM 171 Links to Practice: Sweetheart Cup Company/ Georgia-Pacific Corporation 133 Customer Focus 171 Benefits of Partnering 135 Continuous Improvement 171 Ethics in Supply Management 136 Employee Empowerment 173 **SUPPLY CHAIN DISTRIBUTION 137** Links to Practice: The Walt Disney Company 174 The Role of Warehouses 137 Use of Quality Tools 174 Links to Practice: Fingerhut Direct Marketing, Inc. 138 Links to Practice: The Kroger Company/Meijer Stores Limited Partnership 177 Crossdocking 139 Links to Practice: FedEx Freight 139 Product Design 177 Radio Frequency Identification Technology (RFID) 141 Process Management 182 Third-Party Service Providers 142 Managing Supplier Quality 182 **QUALITY AWARDS AND STANDARDS 183 IMPLEMENTING SUPPLY CHAIN MANAGEMENT 143** Strategies for Leveraging Supply Chain The Malcolm Baldrige National Quality Award Management 144 (MBNQA) **183 SUPPLY CHAIN PERFORMANCE METRICS 145** The Deming Prize 184 TRENDS IN SUPPLY CHAIN MANAGEMENT 147 ISO 9000 Standards 184 SUPPLY CHAIN MANAGEMENT WIHTIN OM: ISO 14000 Standards 185 **HOW IT ALL FITS TOGETHER 149** WHY TQM EFFORTS FAIL 186 SCM ACROSS THE ORGANIZATION 149 TOTAL QUALITY MANAGEMENT (TQM) WITHIN OM: THE SUPPLY CHAIN LINK 150 **HOW IT ALL FITS TOGETHER 186** THE SUSTAINABILITY LINK 150 TOTAL QUALITY MANAGEMENT (TQM) ACROSS THE **ORGANIZATION 187** Chapter Highlights 151 Key Terms 152 THE SUPPLY CHAIN LINK 188 THE SUSTAINABILITY LINK 188 Formula Review 152 Solved Problems 152 Chapter Highlights 189 Key Terms 189 Discussion Questions 153 Formula Review 190 Problems 154 Solved Problems 190 CASE: ELECTRONIC POCKET CALENDARS SUPPLY CHAIN MANAGEMENT GAME 155 Discussion Questions 191 CASE: SUPPLY CHAIN MANAGEMENT AT DURHAM INTER-Problems 191 NATIONAL MANUFACTURING COMPANY (DIMCO) 157 CASE: GOLD COAST ADVERTISING (GCA) 192 INTERACTIVE CASE: VIRTUAL COMPANY 158 CASE: DELTA PLASTICS, INC. (A) 193 **INTERNET CHALLENGE 158** INTERACTIVE CASE: VIRTUAL COMPANY 194 **ONLINE RESOURCES 159 INTERNET CHALLENGE 195** Selected Bibliography **159** ONLINE RESOURCES 195 Selected Bibliography 196 CHAPTER 5 CHAPTER 6

Statistical Quality Control 197

CAUSES 200

WHAT IS STATISTICAL QUALITY CONTROL? 198

SOURCES OF VARIATION: COMMON AND ASSIGNABLE

Links to Practice: Intel Corporation 199

Total Quality Management 161

DEFINING QUALITY 162

Differences between Manufacturing and Service Organizations 163 Links to Practice: General Electric

Company/Motorola, Inc. 164

DESCRIPTIVE STATISTICS 200

The Mean 200

The Range and Standard Deviation 201

Distribution of Data 201

STATISTICAL PROCESS CONTROL METHODS 201

Developing Control Charts **202** Types of Control Charts **203**

CONTROL CHARTS FOR VARIABLES 204

Mean (*x*-Bar) Charts **204** Range (*R*) Charts **208**

Using Mean and Range Charts Together 209

CONTROL CHARTS FOR ATTRIBUTES 210

P-Charts **211** *C*-Charts **214**

PROCESS CAPABILITY 216

Measuring Process Capability 216

SIX SIGMA QUALITY 221

Links to Practice: Motorola, Inc. 222

ACCEPTANCE SAMPLING 223

Sampling Plans 223

Operating Characteristic (OC) Curves 224

Developing OC Curves **226**Average Outgoing Quality **227**

IMPLICATIONS FOR MANAGERS 229

How Much and How Often to Inspect 229

Where to Inspect **229**Which Tools to Use **230**

STATISTICAL QUALITY CONTROL IN SERVICES 230

Links to Practice: The Ritz-Carlton Hotel Company, L.L.C./

Nordstrom, Inc. 231

Links to Practice: Marriott International, Inc. 231

STATISTICAL QUALITY CONTROL (SQC) WITHIN OM:

HOW IT ALL FITS TOGETHER 232

STATISTICAL QUALITY CONTROL (SQC) ACROSS THE

ORGANIZATION 232
THE SUPPLY CHAIN LINK 233

THE SUSTAINABILITY LINK 233

Chapter Highlights 234
Key Terms 234

Formula Review 235 Solved Problems 235

Discussion Questions 240

Problems 240

CASE: SCHARADIN HOTELS **243**CASE: DELTA PLASTICS, INC. (B) **244**INTERACTIVE CASE: VIRTUAL COMPANY **244**

INTERNET CHALLENGE 245

ONLINE RESOURCES 245

Selected Bibliography 245

CHAPTER 7

Just-in-Time and Lean Systems 246

THE PHILOSOPHY OF JIT 248

Eliminate Waste 249

A Broad View of Operations 249

Simplicity 249

Continuous Improvement 250

Visibility 250

Flexibility **250**

ELEMENTS OF JIT 251

Just-in-Time Manufacturing 251

Total Quality Management (TQM) 253

Respect for People 253

Links to Practice: Texas Instruments 254

JUST-IN-TIME MANUFACTURING 254

The Pull System **254**

Kanban Production 255

Variations of Kanban Production 258

Small Lot Sizes and Quick Setups 258

Uniform Plant Loading 259

Flexible Resources 260

Facility Layout **261**

Links to Practice: Ryder Integrated Logistics 261

TOTAL QUALITY MANAGEMENT 262

Product versus Process 263

Quality at the Source **263**

Preventive Maintenance 264

Work Environment 264

RESPECT FOR PEOPLE 265

The Role of Production Employees 265

Lifetime Employment **266**

The Role of Management 267

Supplier Relationships 268

BENEFITS OF JIT 269

Links to Practice: Alcoa, Inc. 269

IMPLEMENTING JIT 270

JIT IN SERVICES 271

Improved Quality 271

Uniform Facility Loading 271

Use of Multifunction Workers 272

Reductions in Cycle Time 272

Minimizing Setup Times and Parallel Processing 272

Workplace Organization 272

JIT AND LEAN SYSTEMS WITHIN OM: HOW IT ALL FITS TOGETHER 272

JIT AND LEAN SYSTEMS ACROSS THE ORGANIZATION 272

THE SUPPLY CHAIN LINK 273 THE SUSTAINABILITY LINK 274

Chapter Highlights 274

Key Terms 275

Formula Review 275 Solved Problems 275

Discussion Questions 275

Problems 276

CASE: KATZ CARPETING 276 CASE: DIXON AUDIO SYSTEMS 277

INTERACTIVE CASE: VIRTUAL COMPANY 278

INTERNET CHALLENGE 279 ONLINE RESOURCES 279 Selected Bibliography 279

CHAPTER 8 Forecasting 280

PRINCIPLES OF FORECASTING 281

STEPS IN THE FORECASTING PROCESS 282

Links to Practice: Intel Corporation 283 TYPES OF FORECASTING METHODS 283

Links to Practice: Improving Sales Forecasting 284

Qualitative Methods 284 Ouantitative Methods 286

TIME SERIES MODELS 288

Forecasting Level or Horizontal Pattern 289

Forecasting Trend **297** Forecasting Seasonality 300

Links to Practice: The Ski Industry Forecast 303

CAUSAL MODELS 303

Linear Regression 303 Correlation Coefficient 306 Multiple Regression 307

MEASURING FORECAST ACCURACY 307

Forecast Accuracy Measures 307

Tracking Signal **309**

SELECTING THE RIGHT FORECASTING MODEL 310 FORECASTING SOFTWARE 311

Spreadsheets 311

Statistical Packages 311

Specialty Forecasting Packages 312

Guidelines for Selecting Forecasting Software 312

FOCUS FORECASTING 313

COMBINING FORECASTS 313

Links to Practice: Combining Methods in Weather

Forecasting 314

COLLABORATIVE PLANNING, FORECASTING, AND REPLENISHMENT (CPFR) 314

FORECASTING WITHIN OM: HOW IT ALL FITS

TOGETHER 315

FORECASTING ACROSS THE ORGANIZATION 315

THE SUPPLY CHAIN LINK 316 THE SUSTAINABILITY LINK 316

Chapter Highlights **317**

Key Terms 317

Formula Review 318

Solved Problems 319

Discussion Questions 323

Problems 323

CASE: BRAM-WEAR 327

CASE: THE EMERGENCY ROOM (ER) AT NORTHWEST

GENERAL (A) 328

INTERACTIVE CASE: VIRTUAL COMPANY 329

INTERNET CHALLENGE 329 ONLINE RESOURCES 330 Selected Bibliography **330**

CHAPTER 9

Capacity Planning and Facility Location 331

CAPACITY PLANNING 333

Why Is Capacity Planning Important? 333 Links to Practice: Capacity Planning in the ER 333

Measuring Capacity 334 Capacity Considerations **336**

Links to Practice: Focus in the Retail Industry 339

MAKING CAPACITY PLANNING DECISIONS 339

Identify Capacity Requirements **340** Develop Capacity Alternatives 341 Evaluate Capacity Alternatives **341**

DECISION TREES 341

LOCATION ANALYSIS 344

What Is Facility Location? **345**

Factors Affecting Location Decisions 345

Links to Practice: Locating in Silicon Valley 346

Globalization 347

MAKING LOCATION DECISIONS 349

Procedure for Making Location Decisions **349** Procedures for Evaluating Location Alternatives **349**

CAPACITY PLANNING AND FACILITY LOCATION WITHIN

OM: HOW IT ALL FITS TOGETHER 360

CAPACITY PLANNING AND FACILITY LOCATION ACROSS THE ORGANIZATION 360 THE SUPPLY CHAIN LINK 361

THE SUSTAINABILITY LINK 361

Chapter Highlights 361
Key Terms 362
Formula Review 362
Solved Problems 362
Discussion Questions 365

Problems 365

CASE: DATA TECH, INC. 368

CASE: THE EMERGENCY ROOM (ER) AT NORTHWEST

GENERAL (B) 369

INTERACTIVE CASE: VIRTUAL COMPANY 369

INTERNET CHALLENGE 370
ONLINE RESOURCES 370
Selected Bibliography 371

CHAPTER 10 Facility Layout 372

WHAT IS LAYOUT PLANNING? 373

TYPES OF LAYOUTS 374
Process Layouts 374

Process Layouts 3/4

Links to Practice: Wal-Mart Stores, Inc. 376

Product Layouts 376

Links to Practice: Toyota Motor Corporation 378

Hybrid Layouts **378**Fixed-Position Layouts **379**

DESIGNING PROCESS LAYOUTS 379

Step 1: Gather Information **379** Step 2: Develop a Block Plan **382**

Step 3: Develop a Detailed Layout 385

SPECIAL CASES OF PROCESS LAYOUT 385

Warehouse Layouts **385** Office Layouts **388**

DESIGNING PRODUCT LAYOUTS 389

Step 1: Identify Tasks and Their Immediate Predecessors **389**

Step 2: Determine Output Rate 391

Step 3: Determine Cycle Time 391

Step 4: Compute the Theoretical Minimum Number of Stations 393

Step 5: Assign Tasks to Workstations (Balance the Line) 393

Step 6: Compute Efficiency, Idle Time, and Balance Delay **394**

Other Considerations 395

GROUP TECHNOLOGY (CELL) LAYOUTS 396

FACILITY LAYOUT WITHIN OM: HOW IT ALL FITS TOGETHER 397

FACILITY LAYOUT ACROSS THE ORGANIZATION 397

THE SUPPLY CHAIN LINK 398
THE SUSTAINABILITY LINK 398

Chapter Highlights 399

Key Terms 399

Formula Review **399**Solved Problems **400**

Discussion Questions 402

Problems 403

CASE: SAWHILL ATHLETIC CLUB (A) 407
CASE: SAWHILL ATHLETIC CLUB (B) 408
INTERACTIVE CASE: VIRTUAL COMPANY 409

INTERNET CHALLENGE **409**ONLINE RESOURCES **410**Selected Bibliography **410**

CHAPTER 11 Work System Design 411

DESIGNING A WORK SYSTEM 412 JOB DESIGN 413

Designing a Job 413

Links to Practice: Google 413

Machines or People? 414

Level of Labor Specialization **415**

Eliminating Employee Boredom 416

Team Approaches to Job Design **416** *Links to Practice: The SCO Group* **417**

The Alternative Workplace 417

Links to Practice: AT&T 418

METHODS ANALYSIS 419

THE WORK ENVIRONMENT 421

WORK MEASUREMENT 422

Costing 422

Performance 423

Planning 423

SETTING STANDARD TIMES 423

How to Do a Time Study 423

Elemental Time Data 429

Predetermined Time Data 429

Work Sampling 431

Links to Practice: Pace Productivity 433

COMPENSATION 433

Time-Based Systems 433

Output-Based Systems 433

Group Incentive Plans 434

Links to Practice: Accounatable Care
Organizations (ACO) 434
Incentive Plan Trends 435

LEARNING CURVES 435

WORK SYSTEM DESIGN WITHIN OM: HOW IT ALL FITS TOGETHER 438

WORK SYSTEM DESIGN ACROSS THE ORGANIZATION 438

THE SUPPLY CHAIN LINK 439
THE SUSTAINABILITY LINK 439

Chapter Highlights 440

Key Terms 440
Formula Review 441
Solved Problems 441
Discussion Questions 444

Problems 444

CASE: THE NAVIGATOR III 447

CASE: NORTHEAST STATE UNIVERSITY 447
INTERACTIVE CASE: VIRTUAL COMPANY 448

INTERNET CHALLENGE 449
ONLINE RESOURCES 450
Selected Bibliography 450

CHAPTER 12

Inventory Management 451

TYPES OF INVENTORY 452
HOW COMPANIES USE THEIR INVENTORY 453
OBJECTIVES OF INVENTORY MANAGEMENT 455

Customer Service **455**Cost-Efficient Operations **456**Minimum Inventory Investment **457**RELEVANT INVENTORY COSTS **459**

Item Costs **459**Holding Costs **459**Ordering Costs **461**Shortage Costs **461**

ABC INVENTORY CLASSIFICATION 461

Procedure for an ABC Inventory Analysis **463**Inventory Control Using ABC Classification **463**

INVENTORY RECORD ACCURACY 464

Links to Practice: Cisco Systems, Inc. 464

INVENTORY IN SERVICE ORGANIZATIONS 466

DETERMINING ORDER QUANTITIES 467

MATHEMATICAL MODELS FOR DETERMINING ORDER

QUANTITY 468

Economic Order Quantity (EOQ) **468**Calculating the EOQ **471**Economic Production Quantity (EPQ) **473**Quantity Discount Model **477**

WHY COMPANIES DON'T ALWAYS USE THE OPTIMAL ORDER QUANTITY 481

JUSTIFYING SMALLER ORDER QUANTITIES 481

Links to Practice: Kenworth Trucks **481** Understanding the EPQ Factors **482**

DETERMINING SAFETY STOCK LEVELS 483

How Much Safety Stock? 483
PERIODIC REVIEW SYSTEM 485

Comparison of Continuous Review Systems and Periodic Review Systems **487**

THE SINGLE-PERIOD INVENTORY MODEL 488
INVENTORY MANAGEMENT WITHIN OM: HOW IT ALL
FITS TOGETHER 490

INVENTORY MANAGEMENT ACROSS THE ORGANIZATION 491

THE SUPPLY CHAIN LINK 491
THE SUSTAINABILITY LINK 492

Chapter Highlights 492
Key Terms 493
Formula Review 493
Solved Problems 494
Discussion Questions 497

Problems 498

CASE: FABQUAL LTD. 500

CASE: KAYAKS!INCORPORATED **501**INTERACTIVE CASE: VIRTUAL COMPANY **502**

INTERNET CHALLENGE 503
ONLINE RESOURCES 503
Selected Bibliography 504

CHAPTER 13

Aggregate Planning 505

THE ROLE OF AGGREGATE PLANNING 507

Marketing Plan 507

Aggregate or Production Plan **507**Financial and Engineering Plans **508**Master Production Schedule **508**

Links to Practice: Coca-Cola Midi (CCM) 509

TYPES OF AGGREGATE PLANS 509

Level Aggregate Plan **509** Chase Aggregate Plan **510** Hybrid Aggregate Plan **511**

AGGREGATE PLANNING OPTIONS 511

Demand-Based Options **512** Capacity-Based Options **512**

EVALUATING THE CURRENT SITUATION 514

Links to Practice: UPS Hires Seasonal Workers 515

DEVELOPING THE AGGREGATE PLAN 515

AGGREGATE PLANS FOR COMPANIES WITH TANGIBLE PRODUCTS 517

AGGREGATE PLANS FOR SERVICE COMPANIES WITH NONTANGIBLE PRODUCTS 520

AGGREGATE PLANNING WITHIN OM: HOW IT ALL FITS TOGETHER 524

AGGREGATE PLANNING ACROSS THE ORGANIZATION 525

THE SUPPLY CHAIN LINK 525
THE SUSTAINABILITY LINK 526

Chapter Highlights **526**

Key Terms 526 Solved Problems 527 Discussion Questions 533

Problems 534

CASE: NEWMARKET INTERNATIONAL MANUFACTURING

COMPANY (A) 535

CASE: JPC, INC.: KITCHEN COUNTERTOPS

MANUFACTURER 536

INTERACTIVE CASE: VIRTUAL COMPANY 537

INTERNET CHALLENGE 537
ONLINE RESOURCES 538
Selected Bibliography 538

CHAPTER 14

Resource Planning 539

ENTERPRISE RESOURCE PLANNING 541

ERP Modules 542

THE EVOLUTION OF ERP 542

First-Generation ERP **542** Second-Generation ERP **543**

Links to Practice: Arapahoe County Government 544

THE BENEFITS OF ERP 545

Links to Practice: i2 Technologies 545

Links to Practice: SAP AG 546
THE COST OF ERP SYSTEMS 546
MATERIAL PLANNING SYSTEMS 547

AN OVERVIEW OF MRP 547

TYPES OF DEMAND 548
OBJECTIVES OF MRP 550

MRP INPUTS 550

Authorized MPS **550**Inventory Records **550**Bills of Material **552**

THE MRP EXPLOSION PROCESS 555

ACTION NOTICES 559

COMPARISON OF LOT SIZE RULES 559

THE ROLE OF CAPACITY REQUIREMENTS
PLANNING (CRP) 560

RESOURCE PLANNING WITHIN OM: HOW IT ALL FITS TOGETHER 562

RESOURCE PLANNING ACROSS THE ORGANIZATION 563

THE SUPPLY CHAIN LINK 564
THE SUSTAINABILITY LINK 564

Chapter Highlights **565**

Key Terms 565
Formula Review 566
Solved Problems 566
Discussion Questions 569

Problems 569

CASE: NEWMARKET INTERNATIONAL MANUFACTURING

COMPANY (B) **571**

CASE: DESSERTS BY J.B. 573

INTERACTIVE CASE: VIRTUAL COMPANY 573

INTERNET CHALLENGE 574
ONLINE RESOURCES 574
Selected Bibliography 575

CHAPTER 15 Scheduling 576

SCHEDULING OPERATIONS 578 HIGH-VOLUME OPERATIONS 578

Characteristics of Flow Operations 578

LOW-VOLUME OPERATIONS 579

Gantt Chart 579

SCHEDULING WORK 580

Infinite Loading 580

Finite Loading **581**

Forward Scheduling **581**

Backward Scheduling 582

Monitoring Workflow **582**

HOW TO SEQUENCE JOBS 584

Priority Rules 584

How to Use Priority Rules **585**

MEASURING PERFORMANCE 586

Links to Practice: Airline Scheduling 586

Job Flow Time 586

Average Number of Jobs in the System **587**

Makespan 587

Job Lateness and Tardiness 587

COMPARING PRIORITY RULES 588

Comparing SPT and S/RO 591

SEQUENCING JOBS THROUGH TWO

WORK CENTERS 591

SCHEDULING BOTTLENECKS 593

Links to Practice: 1-800-FLOWERS.com 595

THEORY OF CONSTRAINTS 596

SCHEDULING FOR SERVICE ORGANIZATIONS 596

Scheduling Services Demanded 596

Scheduling Employees 598

DEVELOPING A WORKFORCE SCHEDULE 599

SCHEDULING WITHIN OM: PUTTING IT ALL

TOGETHER 600

SCHEDULING ACROSS THE ORGANIZATION 601

THE SUPPLY CHAIN LINK 602
THE SUSTAINABILITY LINK 602

Chapter Highlights 602

Key Terms 603

Formula Review 603

Solved Problems 603

Discussion Questions 607

Problems 607

CASE: AIR TRAFFIC CONTROLLER

SCH00L (ATCS) **610**

CASE: SCHEDULING AT RED, WHITE AND BLUE

FIREWORKS COMPANY 610

INTERACTIVE CASE: VIRTUAL COMPANY 611

INTERNET CHALLENGE 611
ONLINE RESOURCES 612
Selected Bibliography 612

CHAPTER 16

Project Management 613

PROJECT LIFE CYCLE 615

Conception 615

Feasibility Analysis or Study 615

Planning 616

Execution 616

Termination 616

NETWORK PLANNING TECHNIQUES 616

Links to Practice: PERT and the Polaris Missile 616

Step 1: Describe the Project 617

Step 2: Diagram the Network 618

Step 3: Estimate the Project's Completion

Time 619

Step 3 (a): Deterministic Time Estimates 620

Step 3 (b): Probabilistic Time Estimates **622**

Step 4: Monitor the Project's Progression **628**

Links to Practice: Managing the Olympic Games 628

ESTIMATING THE PROBABILITY OF COMPLETION

DATES 629

REDUCING PROJECT COMPLETION TIME 631

Crashing Projects 631

THE CRITICAL CHAIN APPROACH 634

Adding Safety Time 634

Wasting Safety Time 634

PROJECT MANAGEMENT WITHIN OM: HOW IT ALL FITS

TOGETHER 636

PROJECT MANAGEMENT OM ACROSS THE

ORGANIZATION 636

THE SUPPLY CHAIN LINK 637

THE SUSTAINABILITY LINK 637

Chapter Highlights 637

Key Terms 638

Formula Review 638

Solved Problems 638

Discussion Questions 642

Problems 642

CASE: THE RESEARCH OFFICE MOVES 645

CASE: WRITING A TEXTBOOK 645

INTERACTIVE CASE: VIRTUAL COMPANY 646

INTERNET CHALLENGE **647**

ONLINE RESOURCES **647**

Selected Bibliography 648

APPENDIX A

Solutions to Odd-Numbered Problems 649

APPENDIX B

The Standard Normal Distribution 671

APPENDIX C

P-Chart 672

NAME INDEX 675

SUBJECT INDEX 678

SUPPLEMENT A

Spreadsheet Modeling: An Introduction A1

WHAT ARE MODELS? A2

THE SPREADSHEET MODELING PROCESS A4

EVALUATING SPREADSHEET MODELS A5

Planning the Model **A7**

Implementing the Model in Excel A8

Assessing the Model **A9**

Using the Model for Analysis A11

Adding Data Tables A14

Graphing the Model Results A17

Planning the Model A18

Constructing the Model in Excel A19
Reviewing Relative and Absolute
Cell Referencing A20

Entering Formulas in the Model A21

USEFUL SPREADSHEET TIPS A26
IMPORTANT EXCEL FORMULAS A27
SPREADSHEET MODELING WITHIN OM: HOW IT ALL
FITS TOGETHER A28

Supplement Highlights A29

Key Terms A29

Discussion Questions A29

Problems A30

CASE: DIET PLANNING A31
ONLINE RESOURCES A32
Selected Bibliography A32

SUPPLEMENT B

Introduction to Optimization B1

INTRODUCTION B2

ALGEBRAIC FORMULATION B4

Examining the Formulation **B6**

SPREADSHEET MODEL DEVELOPMENT B7

Testing the Model **B8**

SOLVER BASICS B9

SETTING UP AND RUNNING SOLVER B9

Solving the Problem **B12**

INTERPRETING THE SOLUTION B13

SOLVER SOLUTION REPORTS B14

RECAP B16

OUTCOMES OF LINEAR PROGRAMMING PROBLEMS B16
OPTIMIZATION WITHIN OM: HOW IT ALL FITS
TOGETHER B18

Supplement Highlights **B18**

Key Terms **B19**Solved Problems **B19**Discussion Questions **B23**

Problems **B24**

CASE: EXETER ENTERPRISES **B25**

ONLINE RESOURCES **B26**Selected Bibliography **B26**

SUPPLEMENT C Waiting Line Models C1

ELEMENTS OF WAITING LINES C2

Links to Practice: Waiting for Fast Food **C3** The Customer Population **C3**

The Service System **C4**

Arrival and Service Patterns **C6** Waiting Line Priority Rules **C6**

WAITING LINE PERFORMANCE MEASURES C7
SINGLE-SERVER WAITING LINE MODEL C7
MULTISERVER WAITING LINE MODEL C10
CHANGING OPERATIONAL CHARACTERISTICS C13
LARGER-SCALE WAITING LINE SYSTEMS C14
WAITING LINE MODELS WITHIN OM: HOW IT ALL FITS
TOGETHER C15

Supplement Highlights C15

Key Terms C16

Formula Review **C16**Solved Problems **C16**

Discussion Questions C18

Problems C19

CASE: THE COPY CENTER HOLDUP C19

ONLINE RESOURCES **C20**Selected Bibliography **C20**

SUPPLEMENT D Master Scheduling and Rough-Cut Capacity Planning D1

MASTER PRODUCTION SCHEDULING D2
MPS AS A BASIS OF COMMUNICATION D3
OBJECTIVES OF MASTER SCHEDULING D4
DEVELOPING AN MPS D4
ROUGH-CUT CAPACITY PLANNING D6
EVALUATING AND ACCEPTING THE MPS D9
USING THE MPS D10
USING THE ATP RECORDS D11
STABILIZING THE MPS D14
MASTER PRODUCTION SCHEDULING AND ROUGH-CUT
CAPACITY PLANNING WITHIN OM: HOW IT ALL FITS
TOGETHER D15

Supplement Highlights **D16**

Key Terms **D16**

Formula Review **D16**Solved Problems **D17**

Discussion Questions D22

Problems D22

CASE: NEWMARKET INTERNATIONAL MANUFACTURING

COMPANY (C) D23

ONLINE RESOURCES D24

Selected Bibliography D24

CHAPTER 1

Introduction to Operations Management

LEARNING OBJECTIVES

After completing this chapter you should be able to

- 1 Define operations management.
- 2 Explain the role of operations management in business.
- 3 Describe decisions that operations managers make.
- 4 Describe the differences between service and manufacturing operations.
- 5 Identify major historical developments in operations management.
- 6 Identify current trends in operations management.
- 7 Describe the flow of information between operations management and other business functions.

CHAPTER OUTLINE

What Is Operations Management? 2
Differences between Manufacturing and Service Organizations 5
Operations Management Decisions 7
Plan of This Book 10 Historical Development 11 Today's OM Environment 20 Operations Management in Practice 21 Within OM: How It All Fits Together 21 OM across the Organization 22

WHAT'S IN OM FOR ME?











