

BRIEF CONTENTS

Preface xv

PART I THE STRATEGIC IMPORTANCE OF OPERATIONS 1

- 1 Introduction to Operations and Competitiveness 1
- 2 Operations Strategy 31
- S2 Operational Decision-Making Tools: Decision Analysis 57

PART II DESIGNING THE OPERATING SYSTEM 75

- 3 Products and Services 75
- 4 Processes and Technologies 117
- 5 Facilities 159
- S5 Operational Decision-Making Tools: Facility Location Models 197
- 6 Project Management 215

PART III MANAGING THE SUPPLY CHAIN 265

- 7 Supply Chain Management 265
- S7 Operational Decision-Making Tools: Supplier Selection 321
- 8 Forecasting 333
- 9 Capacity and Aggregate Planning 391
- S9 Operational Decision-Making Tools: Linear Programming 425
- 10 Inventory Management 453
- S10 Operational Decision-Making Tools: Simulation 491
- 11 Just-in-Time and Lean Production 509
- 12 Enterprise Resource Planning 539
- 13 Scheduling 581

PART IV ENSURING QUALITY 611

- 14 Quality Management 611
- 15 Statistical Process Control 671
- S15 Operational Decision-Making Tools: Acceptance Sampling 711
- 16 Waiting Line Models for Service Improvement 721
- 17 Human Resources in Operations Management 755

EPILOGUE 803

APPENDIX A—NORMAL CURVE AREAS 805

SOLUTIONS TO SELECTED ODD-NUMBERED PROBLEMS 806

INDEX 815

CONTENTS

Preface xv

PART I

THE STRATEGIC IMPORTANCE OF OPERATIONS 1

1 *Introduction to Operations and Competitiveness 1*

- Just What Do Operations Managers Do? 2
- The Operations Function 4
- A Brief History of Operations Management 5
- Operations Management in an E-Business Environment 7
 - Business-to-Consumer E-Commerce 8
 - Why Catalogue Companies Love the Net 9
 - Business-to-Business E-Commerce 10
 - The Impact of E-Business on Operations Management 13
- Globalization 16
 - It's a Global Workforce 19
- Competitiveness 19
 - Productivity as a Measure of Competitiveness 20
 - Competitive Industries 21
 - Competitive Firms 22
 - New Balance Stays Home 23
- Primary Topics in Operations Management 23
 - Strategy 23
 - Products and Services 24
 - Processes and Technology 24
 - Facilities 24
 - Project Management 24
 - Managing the Supply Chain 24
 - Forecasting Demand for Products and Services 24
 - Production Planning and Scheduling 25
 - Ensuring Quality 25
- Organization and Purpose of This Book 25
- Summary 26
- Summary of Key Terms 26
- Questions 27
- Case Problem 1.1: What Does It Take to Compete? 28
- Case Problem 1.2: Value-Added Operations at Lands' End 29
- References 30

2 *Operations Strategy 31*

- So You Have A Mission Statement . . . Now What? 32
- Strategy Formulation 33
- Competitive Priorities 34
 - Competing on Cost 34
 - Competing on Quality 35
 - Competing on Flexibility 35
 - Competing on Speed 37
- Operations' Role in Corporate Strategy 38
- Strategy and the Internet 39
 - Cisco's Integrated Value Chain 41
- Strategic Decisions in Operations 41
 - Products and Services 42
 - Processes and Technology 42
 - Capacity and Facilities 46
 - Human Resources 46
 - Quality 46
 - Sourcing 47
 - Operating Systems 47
- Strategy Deployment 47
 - The Strategic Planning Hierarchy 47
 - Policy Deployment 48
 - Balanced Scorecard 50
- Issues and Trends in Operations 51
- Summary 53
- Summary of Key Terms 53
- Questions 53
- Case Problem 2.1: Visualize This 54
- References 55

2 SUPPLEMENT *Operational Decision-Making Tools: Decision Analysis 57*

- Decision Analysis 58
 - Decision-Making without Probabilities 58
 - Decision-Making with Probabilities 61
 - Expected Value of Perfect Information 62
 - Sequential Decision Trees 63
 - Decision Analysis with POM/QM for Windows, Excel, and Excel OM 65
- Summary 67
- Summary of Key Formulas 67
- Summary of Key Terms 67
- Solved Problem 68
- Problems 68

Case Problem S2.1: Transformer Replacement at Mountain States Electric Service	72
References	73

PART II

DESIGNING THE OPERATING SYSTEM 75

3 *Products and Services* 75

Ford's Global Design Network	76
The Design Process	77
Idea Generation	77
Feasibility Study	79
■ 3M Innovation	80
Preliminary Design	80
Form Design	80
Functional Design	81
Production Design	83
Final Design and Process Plans	84
Techniques for Improving the Design Process	84
Design Teams	85
Concurrent Design	86
Design for Manufacture and Assembly	88
■ DFMA Saves Assembly and Repair Costs	89
Design Review	89
Design for Environment	91
Metrics for Design Quality	92
Quality Function Deployment	93
Design for Robustness	99
Technology in Design	100
Computer-Aided Design	100
Collaborative Product Commerce	103
■ A Day in the Life of a Virtual Project	103
Special Considerations in Service Design	104
Characteristics of Services	104
The Service Design Process	105
Summary	108
Summary of Key Terms	109
Summary of Key Formulas	109
Solved Problem	109
Questions	110
Problems	111
Case Problem 3.1: Lean and Mean	113
References	115

4 *Processes and Technologies* 117

Dell Excels	118
Types of Production Processes	120

Projects	120
Batch Production	120
Mass Production	122
Continuous Production	122
Process Selection with Break-Even Analysis	123
Process Planning	126
Make-or-Buy Decisions	126
■ Factories for Hire	127
Specific Equipment Selection	128
■ The Wheels Next Door	130
Process Plans	131
Process Analysis	132
■ Competing at Lands' End—Getting the Product out to the Customer	134
Process Reengineering	137
The Reengineering Process	138
Technology Decisions	140
■ Process Managers at AT&T	141
Information Technology	141
Manufacturing Technology	145
e-Manufacturing	149
Summary	151
Summary of Key Terms	151
Solved Problem	152
Questions	152
Problems	153
Case Problem 4.1: Just the Fax, Please	155
Case Problem 4.2: Streamlining the Refinancing Process	156
References	157

5 *Facilities* 159

The Building with the Green Roof	160
Basic Layouts	161
Process Layouts	161
Product Layouts	163
Fixed-Position Layouts	165
Designing Process Layouts	166
Block Diagramming	166
Relationship Diagramming	169
Computerized Layout Solutions	170
Service Layouts	171
Designing Product Layouts	171
■ Shared Spaces	172
Line Balancing	173
Computerized Line Balancing	176
Hybrid Layouts	176
Cellular Layouts	176
Flexible Manufacturing Systems	181
■ A Cellular Layout at Rowe's	182
Mixed-Model Assembly Lines	184
Summary	187

Summary of Key Formulas	187
Summary of Key Terms	187
Solved Problems	188
Questions	189
Problems	190
Case Problem 5.1: Workout Plus	195
Case Problem 5.2: Jetaway Industries	195
References	196

5 SUPPLEMENT

Operational Decision-Making Tools: Facility Location Models 197

Types of Facilities	198
Site Selection: Where to Locate	199
Global Location Factors	199
Regional and Community Location Factors in the United States	200
Location Incentives	201
Location Analysis Techniques	202
Location Factor Rating	202
Center-of-Gravity Technique	203
Load-Distance Technique	205
Computerized Location Analysis with Excel, POM/QM for Windows, and Excel OM	206
Summary	208
Summary of Key Formulas	208
Summary of Key Terms	208
Solved Problem	209
Questions	209
Problems	210
Case Problem 5.1: Selecting a European Distribution Center Site for American International Automotive Industries	213
References	213

6 Project Management 215

Project "Magic" at Disney Imagineering	216
The Elements of Project Management	218
The Project Team	218
Project Planning	219
Work Breakdown Structure	219
Project Control	221
The Gantt Chart	221
CPM/PERT	222
■ The Mars Pathfinder Project	223
The Project Network	224
The Critical Path	226
Activity Scheduling	227
Activity Slack	230

■ Disposing of the Trojan Nuclear Reactor	231
Probabilistic Activity Times	232
Probabilistic Time Estimates	232
CPM/PERT Network Analysis with POM/QM for Windows	236
Probabilistic Network Analysis	236
Activity-on-Arrow Networks and Microsoft Project	239
The AON Network Convention	239
Microsoft Project	240
Project Crashing and Time-Cost Trade-Off	243
Project Crashing	243
■ Kodak's Advantix Advanced Photo System (APS) Project	244
Project Crashing with POM/QM for Windows	247
The General Relationship of Time and Cost	248
Summary	249
Summary of Key Formulas	249
Summary of Key Terms	249
Solved Problem	250
Questions	252
Problems	252
Case Problem 6.1: The Bloodless Coup Concert	260
Case Problem 6.2: Moore Housing Contractors	262
References	263

PART III

MANAGING THE SUPPLY CHAIN 265

7 Supply Chain Management 265

Supply Chain Success at Harley-Davidson	266
Supply Chain Management	268
Supply Chain Uncertainty	269
■ Supply Chain Management at 3M	270
Information in the Supply Chain	271
Electronic Business	271
Electronic Data Interchange	272
Bar Codes	274
The Internet	274
Intranets and Extranets	275
IT Issues	277
Suppliers	277
Sourcing	279
E-Procurement	280
■ E-Procurement at RadioShack and Charles Schwab Company	281
E-Marketplaces	282
The Wal-Mart Supply Chain	282

Centralized Supply Chain Management at Honda America	283
Distribution	285
Distribution Centers and Warehousing	287
Warehouse Management Systems	288
Vendor-Managed Inventory	288
Collaborative Distribution	289
■ Distribution and Warehouse Management at Timberland	290
Distribution Outsourcing	291
Transportation	291
Rail	292
Trucking	292
Air	293
Package Carriers	293
Intermodal	294
Water	295
Pipelines	295
Internet Transportation Exchanges	295
The Transportation Method	296
Transportation Model Solution with Excel	298
POM/QM for Windows and Excel OM	301
Supply Chain Management (SCM) Software	302
The Global Supply Chain	304
Duties and Tariffs	305
Hong Kong-Based Global Supply Chain Management at Li & Fung	306
Landed Cost	308
Internet-Based International Trade Logistics Systems	308
■ Global Supply Chain Management at Hyundai Motor Company	309
Infrastructure Obstacles to Global Trade	310
Summary	311
Summary of Key Terms	311
Solved Problem	312
Questions	312
Problems	313
Case Problem 7.1: Stateline Shipping and Transport Company	318
References	319

7 SUPPLEMENT

Operational Decision-Making Tools: Supplier Selection 321

AHP with Excel	325
Summary	327
Summary of Key Terms	327
Solved Problem	327
Problems	328

8 Forecasting 333

Product Forecasting at Nabisco	334
The Strategic Role of Forecasting in Supply Chain Management and TQM	336
Supply Chain Management	336
Total Quality Management	337
Strategic Planning	337
Components of Forecasting Demand	338
Time Frame	338
Demand Behavior	338
■ Forecasting Service Calls at Federal Express	339
Forecasting Methods	340
Forecasting Process	341
Time Series Methods	341
Moving Average	343
Weighted Moving Average	345
Exponential Smoothing	346
■ Forecasting Customer Demand at Taco Bell	346
Adjusted Exponential Smoothing	349
Linear Trend Line	351
Seasonal Adjustments	354
Forecast Accuracy	355
■ Demand Forecasting at National Car Rental	356
Mean Absolute Deviation	357
Cumulative Error	358
Forecast Control	360
Time Series Forecasting Using Excel, Excel OM, and POM/QM for Windows	362
Regression Methods	365
Linear Regression	366
Correlation	368
Regression Analysis with Excel	369
Multiple Regression	371
■ Forecasting Daily Demand in the Gas Industry	373
Summary	374
Summary of Key Formulas	374
Summary of Key Terms	375
Solved Problems	376
Questions	378
Problems	378
Case Problem 8.1: Forecasting at State University	388
Case Problem 8.2: The University Bookstore Student Computer Purchase Program	388
References	389

9 Capacity and Aggregate Planning 391

Disney's Planning Process	392
Capacity Planning	393

Aggregate Production Planning 395
 Adjusting Capacity to Meet Demand 397
 ■ Following the Harvest 400
 APP Using Pure Strategies and Mixed Strategies 400
 General Linear Programming Model 405
 APP by the Transportation Method 408
 Other Quantitative Techniques 412
 Demand Management 412
 ■ Books and More Books 413
 Hierarchical and Collaborative Planning 414
 Collaborative Planning 415
 Available-to-Promise 415
 Aggregate Planning for Services 416
 Yield Management 417
 Summary 418
 Summary of Key Terms 419
 Solved Problem 419
 Questions 420
 Problems 421
 Case Problem 9.1: Erin's Energy Plan 424
 References 424

9 SUPPLEMENT *Operational Decision-Making Tools: Linear Programming* 425

Model Formulation 426
 Graphical Solution Method 427
 ■ Grape Juice Management at Welch's 432
 Linear Programming Model Solution 433
 The Simplex Method 433
 Slack and Surplus Variables 433
 Solving Linear Programming Problems with POM/QM
 for Windows and Excel 434
 Summary 437
 Summary of Key Terms 437
 Solved Problem 438
 Questions 439
 Problems 439
 Case Problem S9.1: Mosaic Tile Company 447
 Case Problem S9.2: Summer Sports Camp
 at State University 448
 Case Problem S9.3: Spring Garden Tools 450
 Case Problem S9.4: Walsh's Juice Company 450
 Case Problem S9.5: Spring Garden Tools 449
 References 451

10 Inventory Management 453

Inventory Management along IBM's Supply Chain 454
 The Elements of Inventory Management 456

The Role of Inventory in Supply Chain
 Management 456
 Demand 457
 Inventory and Quality Management 458
 Inventory Costs 458
 Inventory Control Systems 459
 Continuous Inventory Systems 459
 ■ Competing at Lands' End—Managing Inventory
 with Bar Codes and Computers at Lands' End 460
 Periodic Inventory Systems 461
 The ABC Classification System 462
 ABC Classification with POM/QM for Windows 463
 Economic Order Quantity Models 464
 The Basic EOQ Model 464
 The EOQ Model with Noninstantaneous Receipt 468
 Computer Solution of EOQ Models with Excel
 and Excel OM 470
 Quantity Discounts 470
 ■ Parts Inventory Management at Teradyne 472
 Quantity Discounts with Constant Carrying
 Cost 473
 Quantity Discount Model Solution with POM/QM
 for Windows 475
 Reorder Point 475
 Safety Stocks 476
 Service Level 477
 Reorder Point with Variable Demand 477
 Determining the Reorder Point with Excel 479
 Order Quantity for a Periodic Inventory System 479
 Order Quantity with Variable Demand 479
 ■ Inventory Control at Hewlett-Packard 480
 Determining the Order Quantity for the Fixed-Period
 Model with Excel 481
 Summary 481
 Summary of Key Formulas 481
 Summary of Key Terms 482
 Solved Problems 482
 Questions 483
 Problems 483
 Case Problem 10.1: The A to Z Office Supply
 Company 488
 Case Problem 10.2: The Texans Stadium Store 489
 Reference 489

10 SUPPLEMENT *Operational Decision-Making Tools: Simulation* 491

Monte Carlo Simulation 492
 Computer Simulation with Excel 496
 Decision Making with Simulation 498
 Areas of Simulation Application 500

Waiting Lines/Service	501
Inventory Management	501
Production and Manufacturing Systems	501
Capital Investment and Budgeting	501
Logistics	501
Service Operations	501
Environmental and Resource Analysis	501
Summary	502
Summary of Key Terms	502
Solved Problem	502
Questions	503
Problems	504
References	508

11 *Just-in-Time and Lean Production* 509

Kaizen Blitz at Solectron	510
Basic Elements of JIT	512
Flexible Resources	512
Cellular Layouts	514
■ Changes at Corning	515
The Pull System	516
Kanban Production Control System	517
Small-Lot Production	521
Quick Setups	523
Uniform Production Levels	525
Quality at the Source	526
Total Productive Maintenance	528
Supplier Networks	530
■ Have a Seat, JIT Style	531
Benefits of JIT	532
JIT Implementation	532
■ TPS as a Learning Organization	533
JIT in Services	533
Summary	535
Summary of Key Formulas	535
Summary of Key Terms	535
Questions	536
Problems	537
Case Problem 11.1: The Blitz Is On	537
References	538

12 *Enterprise Resource Planning* 539

ERP at Cybex	540
ERP Modules	542
■ The Great Atlantic and Pacific Tea Company	544
ERP Implementation	544
Web-Based ERP and Related E-Business Software	546

Customer Relationship Management (CRM)	546
■ Revving Up for Business	547
Supply Chain Management (SCM)	547
Collaborative Product Commerce (CPC)	548
Connectivity	549
ERP and MRP	549
Material Requirements Planning	550
When to Use MRP	550
Master Production Schedule	552
Product Structure File	553
Item Master File	556
■ Five Million Possibilities at Hubbell Lighting	556
■ The MRP Process	557
MRP Outputs	562
Capacity Requirements Planning	563
Relaxing MRP Assumptions	568
Summary	569
Summary of Key Formulas	570
Summary of Key Terms	570
Solved Problem	571
Questions	571
Problems	572
Case Problem 12.1: Hosuki	578
References	579

13 *Scheduling* 581

When Good Genes Make Good Schedules	582
Objectives in Scheduling	584
Loading	584
The Assignment Method of Linear Programming	585
Sequencing	586
Sequencing Jobs Through One Process	587
Sequencing Jobs Through Two Serial Processes	590
Sequencing Jobs Through Any Number of Processes in Any Order	591
Monitoring	593
Gantt Charts	593
Input/Output Control	595
Advanced Planning and Scheduling Systems	596
■ Scheduling—More Important than Ever	598
Theory of Constraints	599
Employee Scheduling	601
Summary	604
Summary of Key Formulas	604
Summary of Key Terms	604
Solved Problems	605
Questions	606
Problems	606
Case Problem 13.1: From a Different Perspective	609
References	610

PART IV

ENSURING QUALITY 611

14 Quality Management 611

- Motorola's Six Sigma Quality 612
- The Meaning of Quality 614
 - Quality from the Consumer's Perspective 614
 - Quality from the Producer's Perspective 617
- Competing at Lands' End—Giving High Quality Customer Service: A Focal Point at Lands' End 619
- Total Quality Management 619
 - The Evolution of Total Quality Management 619
 - W. Edwards Deming 620
 - Joseph M. Juran, Philip Crosby, Armand V. Feigenbaum, and Kaoru Ishikawa 622
 - TQM and Continuous Process Improvement 623
 - Principles of Total Quality Management 623
 - TQM Throughout the Organization 623
 - TQM and External Suppliers 625
- The Challenge of Becoming a Whirlpool Supplier in a TQM Environment 626
 - TQM and Customer Satisfaction 627
 - TQM and Information Technology 627
- A History of Quality at Gerber Baby Food 628
- Strategic Implications of TQM 629
- TQM in Service Companies 630
 - Providing Quick Service at Taco Bell 631
 - Competing at Lands' End—"Guaranteed. Period." The Team Approach to Quality Improvement at Lands' End 632
 - Ritz-Carlton Hotels: Two-Time Baldrige National Quality Award Winner 634
 - Quality on the Web 634
- The Cost of Quality 636
 - The Cost of Achieving Good Quality 636
 - The Cost of Poor Quality 637
 - Measuring and Reporting Quality Costs 638
 - The Quality-Cost Relationship 640
 - The Bottom Line—Profitability 640
- The Summer of Poor Quality 641
- The Effect of Quality Management on Productivity 642
 - Productivity 642
 - Measuring Product Yield and Productivity 642
 - The Quality-Productivity Ratio 645
 - Indirect Productivity Gains 646
- Quality Improvement and the Role of Employees 646
 - Quality Circles and Process Improvement Teams 647
- Employee Quality Awareness at Disney 649
 - Employee Suggestions 650

- Identifying Quality Problems and Causes 650
 - Employee Suggestions at Johnson Controls Inc. 652
 - Pareto Analysis 652
 - Flowcharts 653
 - Check Sheets and Histograms 653
 - Scatter Diagrams 654
 - Process Control Charts and Statistical Quality Control 654
 - Cause-and-Effect Diagrams 654
 - Quality Awards and the Competitive Spirit 655
 - The Malcolm Baldrige Award 655
 - Baldrige Quality Award Winners: What It Takes 656
 - Other Awards for Quality 657
 - Yellow Pages' Route to Winning the European Quality Award 658
 - ISO 9000 658
 - Implications of ISO 9000 for U.S. Companies 660
 - ISO 9000 Accreditation 661
 - Summary 662
 - Summary of Key Formulas 662
 - Summary of Key Terms 662
 - Solved Problems 663
 - Questions 663
 - Problems 665
 - Case Problem 14.1: Designing a Quality-Management Program for the Internet at D4Q 667
 - Case Problem 14.2: TQM at State University 667
 - Case Problem 14.3: Quality Problems at the Tech Bookstores 668
 - Case Problem 14.4: Product Yield at Continental Luggage Company 670
 - References 670

15 Statistical Process Control 671

- Achieving Six Sigma Quality with Black Belts at Motorola and General Electric 672
- The Basics of Statistical Process Control 673
 - SPC in TQM 674
 - Quality Measures: Attributes and Variables 674
 - SPC Applied to Services 674
 - Control Charts 676
 - Competing at Lands' End—Ensuring Product Quality and Service at Lands' End 647
 - Control Charts for Attributes 677
 - p -Chart 678
 - c -Chart 681
 - SPC at Royal North Shore Hospital (Sydney, Australia) 681
 - Control Charts for Variables 683
 - Range (R -) Chart 683
 - Mean (\bar{x} -) Chart 686
 - Using \bar{x} - and R -Charts Together 687

- Using Control Charts at Kentucky Fried Chicken 688
 - Control Chart Patterns 688
- Using \bar{x} -Charts at Frito-Lay 689
 - Sample Size Determination 691
- Process Capability 691
 - Process Capability Measures 694
- SPC with Excel, Excel OM and POM/QM for Windows 695
- Design Tolerances at Harley-Davidson Company 695
- Summary 698
- Summary of Key Formulas 698
- Summary of Key Terms 698
- Solved Problems 699
- Questions 700
- Problems 701
- Case Problem 15.1: Quality Control at Rainwater Brewery 707
- Case Problem 15.2: Quality Control at Grass, Unlimited 708
- Case Problem 15.3: Improving Service Time at Dave's Burgers 709
- References 709

15 SUPPLEMENT

Operational Decision-Making Tools: Acceptance Sampling 711

- Single-Sample Attribute Plan 712
 - Producer's and Consumer's Risks 713
- The Operating Characteristic Curve 713
- Developing a Sampling Plan with POM/QM for Windows 714
- Average Outgoing Quality 716
- Double- and Multiple-Sampling Plans 716
- Summary 718
- Summary of Key Terms 718
- Solved Problem 718
- Questions 720
- Problems 720

16 *Waiting Line Models for Service Improvement* 721

- Providing Quality Telephone Order Service 722
- Elements of Waiting Line Analysis 724
 - Elements of a Waiting Line 724
 - The Calling Population 725
 - Arrival Rate 725
 - Service Times 725
 - Arrival Rate Less Than Service Rate 725

- Queue Discipline and Length 726
- Basic Waiting Line Structures 726
- Operating Characteristics 727
- Waiting Line Analysis and Quality 728
 - The Traditional Cost Relationships in Waiting Line Analysis 728
 - Waiting Line Costs and Quality Service 728
- Single-Channel, Single-Phase Models 729
 - The Basic Single-Server Model 730
 - Solution of the Single-Server Model with POM/QM for Windows 733
 - Constant Service Times 733
 - Solution of the Constant Service Time Model with Excel 735
 - Finite Queue Length 735
 - Finite Calling Populations 737
 - Computer Solution of the Finite Population Model with Excel OM 738
- Multiple-Channel, Single-Phase Models 739
 - The Basic Multiple-Server Model 739
 - Solution for the Multiple-Server Model with POM/QM for Windows 743
- Competing with Local Area Network Service at Merrill Lynch 744
- Summary 744
- Summary of Key Formulas 744
- Summary of Key Terms 745
- Solved Problems 745
- Questions 746
- Problems 747
- Case Problem 16.1: The College of Business Copy Center 751
- Case Problem 16.2: Northwoods Backpackers 752
- References 753

17 *Human Resources in Operations Management* 755

- Human Resources Management at Baldrige National Quality Award-Winning Companies 756
- Human Resources in the Strategic Planning Process 758
- Employee-Driven Success at Sears 759
- The Changing Nature of Human Resources Management 760
- Competing at Lands' End—Establishing and Maintaining a Much-Envied Work Environment 761
 - The Assembly Line 762
 - Limitations of Scientific Management 762
 - Behavioral Influences on Job Design 763
- Contemporary Trends in Human Resources Management 763
 - Job Flexibility 764

- Responsibility and Empowerment 764
- Job Training 765
- Teamwork 766
- Employee Compensation and Incentives 767
- Technology and Automation 768
- Alternative Workplaces 769
- Alternative Workplaces at IBM 770
- Temporary and Part-Time Employees 771
- Part-Time Employees at UPS 771
- Employee Satisfaction 772
- U.S. Adaptation of Trends in Human Resources Management 772
- The Elements of Job Design 772
 - Task Analysis 773
 - Worker Analysis 774
 - Environmental Analysis 774
- Job Analysis 774
 - Process Flowchart 774
 - Worker-Machine Chart 776
 - Motion Study 776
- Work Measurement 778
 - Stopwatch Time Study 780
 - Number of Cycles 783
 - Elemental Time Files 784

- Predetermined Motion Times 784
- Work Sampling 786
- Learning Curves 788
- Determining Learning Curves with Excel and Excel OM 791
- Summary 792
- Summary of Key Formulas 792
- Summary of Key Terms 792
- Solved Problems 793
- Questions 794
- Problems 794
- Case Problem 17.1: Measuring Faculty Work Activity at State University 800
- References 801

EPILOGUE 803

APPENDIX A—NORMAL CURVE AREAS 805

SOLUTIONS TO SELECTED ODD-NUMBERED PROBLEMS 806

INDEX 815