

OPERATIONS MANAGEMENT

CONCEPTS, METHODS, AND STRATEGIES

Mark A. Vonderembse

University of Toledo

Gregory P. White Southern Illinois University-Carbondale.



www.wiley.com/college/vonderembse



Preface xxii About the Authors xxxi

J_ Introduction to Operations Management in a Global Environment 3

Defining Operations Management 3

Service versus Manufacturing Operations 5 Understanding Operations 7 Global Trade and Competition 11 Understanding the Systems Approach to Operations 12 The Organization as Part of the Economic and Government System 13 Legal and Ethical Issues in Operations 14 **Operations as Part of the Organization** 18 Strategy 18 Organizational Structure 19 Operations and Marketing Interface 19 **Business Processes versus Business Functions** 20 Operations as a Series of Related Subsystems 22 Summary 24 Key Terms 24 URLs 24 Questions 25 Internet Questions 25

PART I BUILDING CAPABILITIES TO COMPETE GLOBALLY 27

١

2, Gaining Competitive Advantage Through Operations 28

Strategic Issues: Achieving Competitive Advantage with Operations 28 Customer Requirements 30 Competitive Capabilities 31

Flexibility 31 Productivity 33 Building Quality into Products 34 Time 35 E-business 36 Designing Business Processes that Build Competitive Capabilities 38 Strategy Development 38 Product Development 38 Developing Systems to Produce Services and Goods 38 Order Fulfillment - 39 Strategy Development and Operations 39 Linking Corporate Strategy to Operations 39 A Changing Global Environment Offers Greater Competition 43 The Role of Computer and Information Technology in Operations 43 Expert Systems 44 Decision Support Systems 44 The Internet 44 Virtual Reality 45 The Role of Computer and Information Technology in Manufacturing 46 The Role of Computer and Information Technology in Service Operations 47 Summary 48 Key Terms 48 URLs 49 Questions 49

Internet Questions 49

Chapter supplements are available online at www.wiley.com/college/vonderembse



Chapter 2 Supplement: Computer-Integrated Manufacturing Introduction Engineering Design with CAD Flexible Manufacturing Systems Production Planning and Control Systems People, Technology, and Computer-Integrated Manufacturing Soft Automation Enhances Flexibility and Improves Productivity

"2 Enhancing Productivity: A Key to Success 51

Introduction 51

Understanding Productivity 52

Is Money More Important than Productivity? 53 Productivity and the Nature of Work 54 Productivity in Manufacturing versus Service Firms 54 The Quality Condition 55

Assessing Productivity 55

The Inputs and Outputs of Productivity 56

Multiple Factor Productivity 59

Productivity: Where Do We Stand 60

Productivity and Wage Rates 61

Impact of Productivity Improvements on the Workforce 62

Productivity and Leisure 63

Enhancing Productivity 63

Technology and Productivity Improvements 66

Summary 67 Key Terms 68 URLs 68 Questions 68 Internet Questions 68 Problems 69

Chapter supplements are available online at www.wiley.com/college/vonderembse



Chapter 3 Supplement: Learning Curves

Using a Learning-Curve chart Estimating the Learning Factor Pricing Under the Learning-Curve Effect

A Quality Management 71

Introduction to Quality Management 71 What Is Quality? 71 Internally Oriented Definitions of Quality 72 Externally Oriented Definitions of Quality 72 **Dimensions of Quality** 72 Dimensions of Service Quality 72 Dimensions of Quality for Goods 73 Costs of Quality 74 Six Sigma 75 The Background of Quality Management - 76 W. Edwards Deming 76 Joseph M. Juran 76 Philip Crosby 76 Genichi Taguchi 77 Total Quality Management 78 Focus on the Customer 78 Quality Function Deployment **79**

Everyone Responsible for Quality 81 Team Problem Solving 82 Employee Training 83 Fact-Based Management 83 Philosophy of Continuous Improvement 84 Controversy Surrounding TQM **85 Quality Awards and Standards 86** The Malcolm Baldrige National Quality Award 86

ISO 9000:2000 International Quality Standards 87 Summary 89 Key Terms 89 URLs 90 Questions 90 Internet Questions 91 Notes 91

Chapter supplements are available online at www.wiley.com/coUege/vonderembse



Chapter 4 Supplement: Acceptance Sampling

Possible Sampling Errors OC Curves MIL-STD-105D Multiple Sampling Plans

Enterprise Integration and Supply Chain Management: <u>A Strategic Perspective</u> 92

Introduction 92 **Overview of Supply Chain Management** 93 Information Sharing in the Supply Chain 94 The Bullwhip Effect 94 Electronic Data Interchange 95 Forecast Accuracy 95 Digital Loyalty Networks 96 Collaborative Planning Forecasting and Replenishment (CPFR) 96 Supply Chain Structure 97 Many Suppliers versus Few Suppliers 97 Insourcing versus Outsourcing 97 Vertical Integration 97 Virtual Organizations 98 Disintermediation 98 Types of Supply Chains 99

Responsive Supply Chains 99 Efficient Supply Chains - 99 Supply Chain Strategies 100 Ouick Response Programs 100 101 Vendor Managed Inventory (VMI) Efficient Consumer Response 101 Postponement 102 Revenue Sharing 103 Cross Docking 104 3PL 104 104 **E-commerce** B2C 105 B2B 105 Enterprise Resource Planning (ERP) 106 Performance Measurement 108 Measures Related to Competitive Priorities 108 Strategic Profit Model 108 **Global Issues in Supply Chain Management** 109 Principles of Supply Chain Management 110 Build a Competitive Infrastructure 110 Leverage the Worldwide Logistics Network 110 Synchronize Supply to Demand 111 Measure Performance Globally 111 Summary 111 Key Terms 112 URLs 112 Questions 113 Internet Ouestions 113 Problems 114

<u>part II</u>

DESIGNING THE SYSTEM TO PRODUCE SERVICES AND GOODS 115

Product Development: A Team Approach 116

Introduction 116

The Product Life Cycle 117

Development Stage 117 Growth Stage 118 Maturity/Saturation Stage 118 Decline Stage 118

X CONTENTS

The Increasing Importance of Product Development 118 **Global Aspects of Product Development** 119 Using Teams for Product Development 120 **Overview of Product Development** 121 Initial Assessment Phase 121 Engineering and Economic Analysis 123 Development and Testing Phase 124 Final Planning 124 Launch Phase and Market Surveys 124 Mortality in Product Design 124 A Concurrent, Not a Sequential, Process 125 Product Development, Safety, and Liability 127 Allies in Product Development: The Role of Suppliers 127 **Improving Product Quality and Costs through Product Development** 128 Product Development as a Determinant of Product Quality and Cost 128 Quality Function Deployment 130 Summary 130 Key Terms 131 URLs 131 Questions 131 Internet Questions 131

Chapter supplements are available online at www.wiley.com/college/vonderembse

Chapter 6 Supplement: Roles of the Participants in Product Development

Introduction

Looking beyond the Firm: The Role of Marketing From Consumer Needs to Product Ideas: The Role of Engineering Product Ideas to Product Reality: The Role of Operations Capital Formation and Evaluation: The Role of Finance Information for Decision Making: The Roles of Accounting and Information Systems

T Models and Forecasting 132

Introduction 132 Models and Decision Making 132 Types of Models 133 The Application of Models 134 Forecasting 135 The Nature of Forecasting 135 Forecasting Methods 137 Qualitative Approaches to Forecasting 138 Analyzing a Time Series **139** Regression and Correlation Analysis **144** Measuring Forecasting Error **151** Summary 152 Key Terms 153 URLs 153 Questions 153 Internet Questions 153 Problems 154

Process Selection: Volume Drives Costs and Profits 159

Introduction 159

How Process Selection Relates to Product Design and Capacity 160 Relating Process Selection to Product Design 161 Process Selection and Capacity 161 Building Volume through Global Expansion 164 Understanding the Scale Factor 164 Modeling the Scale Factor: Cost-Volume-Profit Model 165 Process Selection and Economies of Scale and Scope 172 Ethical Issues in Process Selection 181 The Focused Factory 181 **Mass Customization** 182 Types of Customization 183 Containing the Cost-Side of Mass Customization 184 A Learning Organization: The Foundation of Mass Customization 185 Summary 186 Key Terms 186 URLs 187 Questions 187 Internet Questions 187 Problems 188

O Capacity Decisions 192

What Is Capacity? 192
Why Is Capacity Important? 193
Estimating Capacity 193
Changing Product Mix 195
Adding People 196
Increasing Motivation 197
Increasing Machine Production Rate 197
Improving Quality 198
Increasing Product Yield 198

Points to Consider 199 Determining System Capacity 199 ^s Product Layout 199 Process Layout 200 The Product Layout and System Capacity 200 The Process Layout and System Capacity 204 Capacity Decisions for Service Operations 206 Service Operations and System Capacity 206 Making Capacity Decisions for Competitive Advantage 208 When to Add Capacity 208 How Much Capacity to Add 210 Where to Add Capacity 211 What Type of Capacity to Add 211 Adjusting Capacity to Meet Changing Requirements 211 Summary 212 Key Terms 213 URLs 213 Questions 213 Internet Questions 214 Problems 214 •

Chapter supplements are available online at www.wiley.com/college/vonderembse



Chapter 9 Supplement: Modeling for Capacity Decision Making Decision Trees

Facility Location in a Global Environment 220

Introduction 220

Location as a Strategic Decision 221 Factors Affecting the Location Decision 222 Factors Affecting Service Operations 222 Managing the Quantitative Factors 223 Including the Qualitative Factors 228 Analyzing Spatial Relationships 229 The Location Decision's Effect on Other Operating Factors 230 International Dimensions of the Location Decision 230 Why Locate in a Foreign Country? 230 Japanese Automotive Industry Locates in North America 231 Ethical Considerations in the Location Decision 232 Location Analysis for Service Operations 233 The Location Decision Provides the Opportunity to Be SociaUy Responsible 233 Summary 234 Key Terms 235 URLs 235 Questions 235 Internet Questions 235 Problems 236 Appendix: Qualitative Factor in Location Analysis 238

Chapter supplements are available online at www.wiley.com/college/vonderembse



Chapter 10 Supplement: Analyzing Spatial Relationships

Introduction

The Load-Distance Method of Facility Location

The Transportation Problem The Role of the Computer in Analyzing Spatial Relationships

|_1 Facility Layout 242

Introduction 242

Criteria for the Layout Decision 243 Overview of the Layout Question 244

Continuous Flow Processes 245

Continuous Flow Processes and Service Industries 246

Assembly Lines 246

Determining the Layout 246 The Role of Computers in Balancing the Line 257 Motivation 257 Integrating Product Design and Automated Assembly

Integrating Product Design and Automated Assembly 258

Batch Processing 258

Using Group Technology to Organize Manufacturing CeUs and Flexible Manufacturing Systems 259

Methods for Creating Families of Parts 259

Job Shops 261

Finding the Pattern and Determining the Layout 263 The Role of Computers in Job Shop Layout 269 Systematic Layout Planning 270 Using Layout for Competitive Advantage 271

Summary 272

Key Terms 272 URLs 272 Questions 272 Internet Questions 273 Problems 273

PART HI PLANNING AND MANAGING OPERATIONS 285

12 Aggregate Planning 286

Introduction 286 Medium-Range Operations Planning 287 Aggregation in Medium-Range Operations Planning 288 The Organizational Context of Aggregate Planning 288 Strategies for Meeting Demand 292 Proactive Strategies 292 Reactive Strategies 293 Cost Considerations 293 Aggregate Planning for Service Organizations 294 Techniques for Aggregate Planning 295 Three Pure Strategies 296 An Aggregate Plan for a Service Organization 298 The Graphical Approach 300 A Mathematical Procedure for Aggregate Planning 302 Summary 304 Key Terms 305 URLs 305 Questions 305 Internet Questions 306 Problems 306

Chapter supplements are avaUable online at www.wiley.com/college/vonderembse

Chapter 12 Supplement: Linear Programming

Introduction Formulating the Problem MathematicaUy Solving the Mathematical Problem Limitations and Extensions of Linear Programming

Planning for Material and Resource Requirements 312

Introduction 312 Master Production Scheduling 313 Planning Horizons 313 Developing the MPS 313 Matching the Master Schedule to the Aggregate Plan 314 Taking Customer Orders into Account 315 Master Scheduling in Practice 318 The Demand Management Process 320

Rough-Cut Capacity Planning 320
Calculating Requirements by Overall Factors 321
Handling Insufficient Capacity 322
Material Requirements Planning 323
Independent versus Dependent Demand 324
The Data Files Used by MRP 325
Determining Planned Order Releases for Level 1 Items 327
Determining Planned Order Releases for Lower Level Items 330
Combining Requirements 330
How MRP Coordinates Purchasing and Operations 331
Capacity Requirements Planning 332
The Ethics of MRP 334
Extensions of MRP 334
Closed-Loop MRP 335
Manufacturing Resource Planning 335
MRP in Service Organizations 336
The Role of MIS in Planning 339
Summary 340
Key Terms 340
URLs 340
Questions 340
Internet Questions 341
Problems 342

A Inventory Management 347

Introduction 347 Purposes and Types of Inventory 347 Types of Inventory 348 Information Systems for Inventory Management 348 Perpetual Inventory Systems 349 Periodic Inventory Systems 349 Aggregate Performance Measures 349 ABC Classification 350 The Economic Order Quantity Model 351 Cost of Ordering 351 Cost of Holding Inventory 352 Assumptions of the EOQ Model 353 354 Mathematical Statement of the Model A Variation of the EOQ Model 358 Quantity Discounts 359 Stockouts and Safety Stock 361 Order-Point Determination 361

Safety Stock **The Fixed-Order-Interval Model 366** Review Interval Order-Up-to Level Safety Stock for the Fixed-Order Interval Model *Summary* 369 *Key Terms URLs* 370 *Internet QuestionsProblems*

Just-In-Time and Theory of Constraints 373

Introduction 373 Introduction to Just-In-Time (JIT) 373 Fundamental Concepts of JIT 374 The JIT "Pull" System 378 Simplifying the Production Process 381 Planning in JIT Systems 384 The Role of MIS in JIT 387 388 JIT in Service Operations Strategic Planning and JIT 389 JIT II 391 Lean Systems 391 **Theory of Constraints** 391 The Goal of Operations **392** The Impact of Constraints **392** Applying TOC in Operations 394 The Drum, Buffer, and Rope 396 Comparing TOC, MRP, and JIT 398 Combining TOC, MRP, and JIT 398 Summary 399 Key Terms 399

Key Terms 399 URLs 400 Questions 400 Internet Questions 401 Problems 401

Scheduling 405

Introduction 405

Overview of the Scheduling Process 407 Data Collection 407 Order Entry 408

Orders Released for Production 409 Sequencing and Dispatching 409 Managerial Considerations in Scheduling 409 Ethical Issues in Scheduling 410 Techniques for Scheduling Line-Flow and Batch Processes 411 Scheduling Continuous Flow Processes **41**1 Scheduling an Assembly Line 412 Scheduling Batch Processes 412 Flexible Manufacturing Systems 413 Job Shop Scheduling 414 Sequencing Using Dispatching Rules 414 Sequencing Jobs Using Johnson's Rule 416 **Dispatching in MRP** 418 Machine Loading 418 Sequencing 422 Finite Capacity Scheduling 422 Input/Output Control 423 Simulation in Developing Schedules 423 Special Problems in Scheduling Services 424 When the Customer Is Waiting 424 Scheduling Strategies for Services 424 Workforce Scheduling for Services 425 Summary 427 Key Terms 427 URLs 428 Questions 428 Internet Questions 428 Problems 429

Chapter supplements are avaUable online at www.wUey.com/coUege/vonderembse



Chapter 16 Supplement: Management Science Tools and Scheduling

Applications of Waiting-Line Models to Schedules Simulation as a Scheduling Tool

Project Management 433

Introduction433The Beginnings of Project Management434Planning for Projects434Network Representation of a Project435Activities on Nodes435Activities on Arcs436

mil CONTENTS

Dummy Activities 436 The Critical Path Method 437 Calculating Start and Finish Times 437 Avoiding Late Completion 439 Project Management Is Used Throughout Organizations 440 Introducing Probability with PERT 441 Estimating Activity Time 442 Probability of Completion by a Given Time 442 Other Resource Considerations 444 Balancing Resource Requirements 444 Crashing the Critical Path: Time/Cost Trade-Offs 445 **Critical Chain Scheduling and Buffer Management** 448 Three Types of Buffers 449 Buffer Management 451 Summary 451 Key Terms 451 URLs 451 Questions 452 Internet Questions 452 Problems 452

The following chapters are found on the companion Web site for this text at www.wiley.com/college/vonderembse

13 <u>Time-Based Competition</u>

Introduction

Time: The New Competitive Battle Ground

Competing on Time

Achieving Time Reductions

Reducing Product Development Time through Early Involvement

Cutting Costs and Improving Quality with Time-based Competition Innovative Product Development with Time-based Competition Is Co-location Essential in a Global Environment? Creating Time-Based Operations Understanding the Order Fulfillment Process Reducing Wait Time Reducing Work Time Using Teams and Early Involvement to Reduce Operating Time **Using Information Systems to Cut Tune**

Increasing Communication Capabilities WU1 Shrink the Globe

Ethical Issue: Squeezing Out Time May Generate Difficult Trade-Offs

Summary Key Terms Questions



J_O Redesigning Business Processes

Global Competition Is Driving Fundamental Change

Evolving From An Industrial to a Postindustrial Organization

Changing Characteristics from the Industrial to the Postindustrial Stage Changing Premises and Patterns of Thinking

Reengineering Business Processes

Defining Business Process Reengineering Determining When Business Process Reengineering Should Be Used Steps in Reengineering Keeping the Process Going after Implementation Using Information Technology as an Enabler for BPR A Word about Teams before We Move On Summary Key Terms Questions

^{fw}wj 20 <u>Quality Control</u>

Introduction

The Concept of Variation

Two Causes of Variation Process Capability Taguchi Loss Function Taguchi Methods

Tools for ControUing Processes

Control Charts for Attributes

Tools for CoUecting Data

Check Sheets

Histograms and Graphs

Tools for Analyzing Data

Pareto Analysis Cause-Effect Diagrams Scatter Diagrams Putting the Tools into Practice Summary Key Terms Internet Questions Questions Problems

2,1 Supply Management

Introduction

Defining Terms Materials: A Management Perspective

Material Flow and the Organization

Physical Flows

Information Flows

Purchasing

Defining Specifications

Obtaining Price Quotations

Developing Criteria for Supplier Selection

Classifying Suppliers According to Performance

Evaluating the Make-or-Buy Decision

Awarding the Contract

Expediting

Gathering Information for Follow-Up and Evaluation

Just-in-Time Purchasing versus Traditional Purchasing

How Purchasing Is Changing

EthicalIssuesin Purchasing

Global Sourcing of Materials

Ethics and Global Trade

Inventory Control

What Is Inventory? Why Maintain Inventory? Inventory in Service Operations The Role of Computers in Inventory Control

Material Handling and Storage

Receiving and Shipping Storage Devices Intelligent Warehouse Systems

Distribution Systems

Building a Production Chain The Levels in a Distribution System Distribution Requirements Planning

Changes in Distribution Systems

Summary

Key Terms

Solved Problems

Questions

Problems

22 Job Design and Work Measurement

Introduction to Job Design

Specifying the Tasks and Responsibilities of a Job Ethical Considerations in Job Design

Methods Analysis to Improve Productivity

Flow Process Charts

Multiple Activity Charts

Measurement of Work

Historical Data Time Studies

Time Studies

Predetermined Time Standards

Work Sampling

Compensation

Individual Rewards

Gainsharing

International Aspects of Employee Compensation

Summary

Key Terms

Internet Questions

Questions

Problems