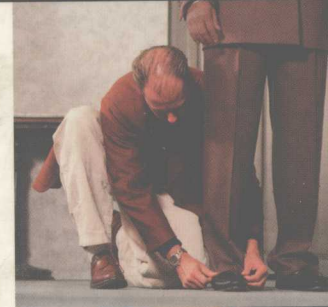
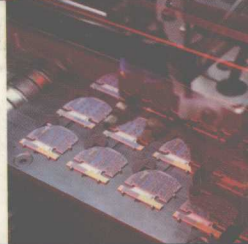


**SIXTH EDITION**

# PRODUCTION OPERATIONS MANAGEMENT

 **WILLIAM J. STEVENSON**

CD INCLUDED



F406.2  
E330

# PRODUCTION/OPERATIONS MANAGEMENT

---

## **SIXTH EDITION**

**WILLIAM J. STEVENSON**

*Rochester Institute of Technology*

 **Irwin  
McGraw-Hill**

Boston Burr Ridge, IL Dubuque, IA Madison, WI New York San Francisco St. Louis

Bangkok Bogotá Caracas Lisbon London Madrid

Mexico City Milan New Delhi Seoul Singapore Sydney Taipei Toronto

# THE IRWIN/MCGRAW-HILL SERIES OPERATIONS AND DECISION SCIENCES

---

## Operations Management

Bowersox and Closs

*Logistical Management: The Integrated Supply Chain Process*  
First Edition

Chase, Aquilano, and Jacobs

*Production and Operations Management*  
Eighth Edition

Chu, Hottenstein, and Greenlaw

*PROSIM for Windows*  
Third Edition

Cohen and Apte

*Manufacturing Automation*  
First Edition

Davis, Aquilano, and Chase

*Fundamentals of Operations Management*  
Third Edition

Dilworth

*Operations Management*  
Second Edition

Dobler

*Purchasing and Supply Management*  
Sixth Edition

Flaherty

*Global Operations Management*  
First Edition

Fitzsimmons and Fitzsimmons

*Service Management: Operations, Strategy, Information Technology*  
Second Edition

Hill

*Manufacturing Strategy: Text and Cases*  
Second Edition

Hopp and Spearman

*Factory Physics*  
First Edition

Lambert and Stock

*Strategic Logistics Management*  
Third Edition

Leenders and Fearon

*Purchasing and Supply Chain Management*  
Eleventh Edition

Lotfi and Pegels

*Decision Support Systems for Operations and Management Science*  
Third Edition

Melnyk and Denzler

*Operations Management*  
First Edition

Moses and Seshadri

*HOM Operations Management Software for Windows*  
First Edition

Nahmias

*Production and Operations Analysis*  
Third Edition

Nicholas

*Competitive Manufacturing Management*  
First Edition

Pinedo, Chao

*Operations Scheduling*  
First Edition

Sanderson and Uzumeri

*Managing Product Families*  
First Edition

Schroeder

*Operations Management*  
Fourth Edition

Schonberger and Knod

*Operations Management: Customer-Focused Principles*  
Sixth Edition

Stevenson

*Production/Operations Management*  
Sixth Edition

Vollmann, Berry, and Whybark

*Manufacturing Planning and Control Systems*  
Fourth Edition

Zipkin

*Foundations of Inventory Management*  
First Edition

## Quantitative Methods and Management Science

Bodily, Carraway, Frey, and Pfeifer

*Quantitative Business Analysis: Casebook*  
First Edition

Bodily, Carraway, Frey, and Pfeifer

*Quantitative Business Analysis: Text and Cases*  
First Edition

Bonini, Hausman, and Bierman

*Quantitative Analysis for Business Decisions*  
Ninth Edition

Hesse

*Managerial Spreadsheet Modeling and Analysis*  
First Edition

Lotfi and Pegels

*Decision Support Systems for Operations and Management Science*  
Third Edition

Stevenson

*Introduction to Management Science*  
Second Edition

# PREFACE

The material in this book is intended as an introduction to the field of production and operations management. It is suitable for both undergraduate and graduate students. The field of production and operations management is dynamic, and very much a part of many of the good things that are happening in business organizations. The book is intended to be interesting and informative. Much of what you learn will have practical application.

The subject matter represents a blend of concepts from industrial engineering, cost accounting, general management, quantitative methods, and statistics. Production and operations activities, such as forecasting, choosing a location for an office or plant, allocating resources, designing products and services, scheduling activities, and assuring and improving quality are core activities and often strategic issues in business organizations. Some of you are or will be employed directly in these areas, while others will have jobs that are indirectly related to this area. So whether this is your field of study or not, knowledge of this field will certainly benefit you and the organization you work for.

The text contains more material than one could normally hope to cover in a one-semester course. Rather than rely on the author's personal bias, each instructor can choose those topics most suited to his or her own proclivities. Those who prefer an analytic quantitative emphasis, for example, will be quite comfortable with the abundance of examples and student problems. Those who prefer a more qualitative approach will welcome the fact that some of the more quantitative material is placed in chapter supplements and that there are memo exercises, operations tours, and cases for assignment. Obviously, there are many possibilities between these two extremes.

## ACKNOWLEDGMENTS

I would like to thank the reviewers of this edition who contributed significantly to the final product. They are: W. C. Benton, Ohio State University; Roy Boykin, Cali-

fornia State University—Chico; Renato de Matta, University of Iowa; Ed Duplaga, Bowling Green State University; Frank Forst, Loyola University; Mark Gershon, Temple University; Nicholas A. Glaskowsky, University of Miami; Lisa Houts, California State University—Fresno; Tim Ireland, Oklahoma State University; Tom Johnson, University of South Florida; Xenophone Koufteras, University of Texas—El Paso; Arundhati Kumar, California State University—Northridge; Satish Mehra, University of Memphis; Mike Pesch, St. Cloud State University; Gregory J. Petrakis, Ottawa University and University of Missouri; Jeff Rummel, University of Connecticut; Buddhadev Roychoudhury, Mankato State University; Leonard Ross, California State Polytechnic University; Harold Schramm, University of Dubuque; and Victor Sower, Sam Houston State University.

I would also like to thank all of the reviewers of previous editions for their valuable contributions to the success of this book.

Many students and instructors offered valuable suggestions, and I want to thank them as well. And, Lee Tangedahl, Renato de Matta, and Frank Forst did a superb job of accuracy checking.

I would also like to thank the authors of the various CD-ROM supplements and stand-alone supplements that are designed to accompany the textbook. Lee Tangedahl developed the spreadsheet templates; Mehdi Kaighobadi put together the data files; Ceyhun Ozgur updated the Instructor's Manual; Ralph Butler developed Powerpoint presentations; Seung Lae Kim updated the Test Bank and the CompuTest; and Paul Van Ness coauthored the Study Guide.

Finally, I want to extend my thanks to all of the people at Irwin/McGraw-Hill for their efforts and support. It is always a pleasure to work with such a competent and professional group of people. Special thank you's go to Dick Hercher, Wanda Zeman, and Jean Lou Hess.

William J. Stevenson

# NOTE TO THE STUDENT

The material in this text is part of the core knowledge in your education. Consequently, you will derive considerable benefit from your study of operations management, *regardless of your major*. Practically speaking, production and operations is a course in *management*.

This book describes principles and concepts of production and operations management. You should be aware that many of these principles and concepts are applicable to other aspects of your professional and personal life. Consequently, you should expect the benefits of your study of production and operations management to serve you in those other areas as well.

Some students approach this course with apprehension, and perhaps even some negative feelings. It may be that they have heard that the course contains a certain amount of quantitative material which they may feel uncomfortable with, or that the subject matter is dreary, or that the course is about “factory management.” This is unfortunate, because the subject matter of this book is interesting and vital for all business students. While it is true that some of the material is quantitative, numerous examples, solved problems, and answers at the back of the book will help you with the quantitative material. As for “factory management,” there is material on manufacturing as well as on services. Manufacturing is important, and something that you should know about for a number of reasons. Look around you. Most of the “things” you see were manufactured: cars, trucks, planes, clothing, shoes, computers, books, pens and pencils, stereos and cell phones. And these are just the tip of the iceberg. So it makes sense to know something about how these sorts of things are produced. Beyond all that is the fact that manufacturing is largely responsible for the high standard of living people have in industrialized countries.

After reading each chapter or supplement in the text, attending related classroom lectures, and completing assigned questions and problems, you should be able to do each of the following:

1. *Identify the key features* of that material.
2. *Define and use terminology*.

3. *Solve typical problems*.

4. *Recognize applications* of the concepts and techniques covered.

5. *Discuss the subject matter* in some depth, including its relevance, managerial considerations, and advantages and limitations.

You will encounter a number of chapter supplements. Check with your instructor to determine whether or not to study them.

This book places an emphasis on problem solving. There are many examples throughout the text illustrating solutions. In addition, at the end of most chapters and supplements you will find a group of solved problems. The examples within the chapter itself serve to illustrate concepts and techniques. Too much detail at those points would be counterproductive. Yet, later on, when you begin to solve the end-of-chapter problems, you will find the *solved problems* quite helpful. Moreover, those solved problems usually illustrate more and different details than the problems within the chapter.

I suggest the following approach for studying and problem solving:

1. Look over the chapter outline and learning objectives.
2. Read the chapter summary, and then skim the chapter.
3. Read the chapter and take notes using the study questions on the CD-ROM.
4. Look over and try to answer the discussion and review questions.
5. Solve the problems, referring to the solved problems and chapter examples as needed.

Note that the answers to many problems are given at the end of the book. Try to solve each problem before turning to the answer. Remember—tests don’t come with answers.

A study guide is also available. If your bookstore does not stock it, you can ask them to order it for you.

Enjoy!

W.J.S.

# *This Book Is Dedicated to You*

## **Irwin/McGraw-Hill**

*A Division of The McGraw-Hill Companies*

### PRODUCTION/OPERATIONS MANAGEMENT

Copyright © 1999 by The McGraw-Hill Companies, Inc. All rights reserved. Previous editions © 1982, 1986, 1990, 1992, and 1996 by Richard D. Irwin, a Times Mirror Higher Education Group, Inc. company. Printed in the United States of America. Except as permitted under the United States Copyright Act of 1976, no part of this publication may be reproduced or distributed in any form or by any means, or stored in a data base or retrieval system, without the prior written permission of the publisher.

This book is printed on acid-free paper.

international 1 2 3 4 5 6 7 8 9 0 VNH/VNH 9 3 2 1 0 9 8  
domestic 1 2 3 4 5 6 7 8 9 0 VNH/VNH 9 3 2 1 0 9 8

ISBN 0-07-366112-0 (student ed.)  
ISBN 0-07-366113-9 (instructor's ed.)  
ISBN 0-07-115856-1 (international edition)

Vice president and editorial director: *Michael W. Junior*  
Publisher: *Jeffrey J. Shelstad*  
Executive editor: *Richard T. Hercher, Jr.*  
Developmental editor: *Wanda J. Zeman*  
Senior marketing manager: *Colleen J. Suljic*  
Senior project manager: *Jean Lou Hess*  
Senior production supervisor: *Heather D. Burbridge*  
Senior designer: *Laurie J. Entringer*  
Cover and interior designer: *Ellen Pettengel Design*  
Supplement coordinator: *Cathy L. Tepper*  
Compositor: *GAC Shepard Poorman Communications*  
Typeface: *10.5/12 Goudy*  
Printer: *Von Hoffmann Press, Inc.*

### Library of Congress Cataloging-in-Publication Data

Stevenson, William J.  
Production/operations management / William J. Stevenson. — 6th  
ed.  
p. cm.  
Includes index.  
ISBN 0-07-366112-0  
1. Production management. I. Title.  
TS155.S7824 1999  
658.5—dc21

98-24796

### INTERNATIONAL EDITION

Copyright © 1999. Exclusive rights by The McGraw-Hill Companies, Inc. for manufacture and export.

This book cannot be re-exported from the country to which it is consigned by McGraw-Hill.  
The International Edition is not available in North America.

When ordering the title, use ISBN 0-07-115856-1

<http://www.mhhe.com>

# BRIEF CONTENTS

---

## **PART I**

### **INTRODUCTION 1**

- 1** Production and Operations Management 3
- 2** Productivity, Competitiveness, and Strategy 37
  - Supplement to Chapter 2*
  - Decision Making 63

## **PART II**

### **FORECASTING 85**

- 3** Forecasting 87

## **PART III**

### **DESIGN OF PRODUCTION SYSTEMS 147**

- 4** Product and Service Design 149
  - Supplement to Chapter 4*
  - Reliability 180
- 5** Process Selection and Capacity Planning 195
  - Supplement to Chapter 5*
  - Linear Programming 233
- 6** Facilities Layout 267
- 7** Design of Work Systems 309
  - Supplement to Chapter 7*
  - Learning Curves and Analysis 348
- 8** Location Planning and Analysis 361
  - Supplement to Chapter 8*
  - The Transportation Model 389

## **PART IV**

### **QUALITY 417**

- 9** Introduction to Quality 419
- 10** Quality Control 439
  - Supplement to Chapter 10*
  - Acceptance Sampling 478
- 11** Total Quality Management (TQM) 491

## **PART V**

### **OPERATING AND CONTROLLING THE SYSTEM 521**

- 12** Aggregate Planning 523
- 13** Inventory Management 557
- 14** Material Requirements Planning 617
- 15** Just-in-Time Systems 657
- 16** Supply Chain Management 693
- 17** Scheduling 721
  - Supplement to Chapter 17*
  - Maintenance 757
- 18** Project Management 765
- 19** Waiting Lines 811
  - Supplement to Chapter 19*
  - Simulation 845

# CONTENTS

---

## **PART ONE**

### **INTRODUCTION 1**

#### **CHAPTER 1**

- Production and Operations Management 3
- Introduction 4
- Why Study Operations Management? 5
- Functions within Business Organizations 6
- Designing and Operating Production Systems 10
- Differentiating Features of Production Systems 11
- The Operations Manager and the Management Process 15
- Operations Managers and Decision Making 15
- The Historical Evolution of Operations Management 18
- Recent Trends 23
  - Reading:** Agile Manufacturing 26
  - Case:** Hazel 31
  - Operations Tour:** Wegmans Food Markets, 32

#### **CHAPTER 2**

- Productivity, Competitiveness, and Strategy 37
- Introduction 38
- Productivity 38
- Competitiveness 43
- Strategy 45
  - Reading:** Time-Based Innovation 53
  - Reading:** Productivity Gains at Whirlpool 58
  - Cases:** An American Tragedy: How a Good Company Died 58
    - Home-Style Cookies 59
    - Hazel Revisited 61

#### **SUPPLEMENT TO CHAPTER 2**

- Decision Making 63
- The Decision Process 64

Decision Theory 66

## **PART TWO**

### **FORECASTING 85**

#### **CHAPTER 3**

- Forecasting 87
- Introduction 88
- Features Common to All Forecasts 89
- Elements of a Good Forecast 90
- Steps in the Forecasting Process 90
- Approaches to Forecasting 90
- Forecasts Based on Judgment and Opinion 91
- Forecasts Based on Time Series Data 93
- Associative Forecasting Techniques 110
- Accuracy and Control of Forecasts 115
- Choosing a Forecasting Technique 122
- Using Forecast Information 123
- Operations Strategy 124
  - Case:** M & L Manufacturing 144

## **PART THREE**

### **DESIGN OF PRODUCTION SYSTEMS 147**

#### **CHAPTER 4**

- Product and Service Design 149
- Introduction 150
- The Design Process 152
- Regulations and Legal Considerations 153
- Research & Development 155
  - Reading:** Manager's Journal: When Customer Research Is a Lousy Idea 155



Standardization 156

Product Design 158

**Readings:** Making It (Almost) New Again 160

Computers Speed the Design of More Workaday  
Products 165

Service Design 166

Quality Function Deployment 170

Reliability 174

Operations Strategy 175

**Case:** Toys, Inc. 178

#### **SUPPLEMENT TO CHAPTER 4**

Reliability 180

Introduction 181

Quantifying Reliability 181

Availability 187

#### **CHAPTER 5**

Process Selection and Capacity Planning 195

Process Selection 196

**Readings:** Custom-Made, Direct from the Plant 203

Electric Car Drives Factory Innovations 206

Operations Strategy 207

Capacity Planning 208

**Operations Tours:** Morton Salt 229

High Acres Landfill 231

#### **SUPPLEMENT TO CHAPTER 5**

Linear Programming 233

Introduction 234

Linear Programming Models 234

Graphical Linear Programming 237

The Simplex Method 250

Computer Solutions 250

Sensitivity Analysis 253

**Case:** Son, Ltd. 264

#### **CHAPTER 6**

Facilities Layout 267

Introduction 268

Basic Layout Types 268

Cellular Layouts 274

Other Service Layouts 276

**Reading:** Designing Supermarkets 277

Designing Product Layouts: Line Balancing 278

Designing Process Layouts 288

#### **CHAPTER 7**

Design of Work Systems 309

Introduction 310

Operations Strategy 310

Job Design 311

**Reading:** Tour De Force 314

Work Measurement 326

Compensation 336

**Reading:** Making Hotplates 346

#### **SUPPLEMENT TO CHAPTER 7**

Learning Curves and Analysis 348

The Concept of Learning Curves 349

Applications of Learning Curves 353

Operations Strategy 353

Cautions and Criticisms 354

**Case:** Product Recall 358

#### **CHAPTER 8**

Location Planning and Analysis 361

The Need for Location Decisions 362

The Nature of Location Decisions 362

General Procedure for Making Location Decisions 363

Factors That Affect Location Decisions 364

Global Locations 372

**Reading:** New U.S. Factory Jobs Aren't in the Factory 373

Evaluating Location Alternatives 375

**Reading:** Global Strategy: GM Is Building Plants in  
Developing Nations to Woo New Markets 387

#### **SUPPLEMENT TO CHAPTER 8**

The Transportation Model 389

Introduction 390

Obtaining an Initial Solution 391

Testing for Optimality 393

Obtaining an Improved Solution 399

Special Problems 402

Summary of Procedure 404

Location Decisions 404

Other Applications 405

Computer Solutions 405

## **PART FOUR** **QUALITY 417**

### **CHAPTER 9**

Introduction to Quality 419

Introduction 420

The Evolution of Quality Management 420

Quality: The Basics 421

Quality Gurus 426

Quality Awards 430

**Reading:** Perception Is the Reality 430

Quality Certification 434

**Reading:** AESOP on Quality Systems 434

### **CHAPTER 10**

Quality Control 439

Introduction 440

Inspection 440

Statistical Process Control 443

Process Capability 460

Operations Strategy 462

**Reading:** Six-Sigma Quality 463

**Case:** Tiger Tools 475

**Operations Tour:** In the Chips at Jays 475

### **SUPPLEMENT TO CHAPTER 10**

Acceptance Sampling 478

Introduction 479

Sampling Plans 479

Operating Characteristic Curve 480

Average Quality of Inspected Lots 484

### **CHAPTER 11**

Total Quality Management (TQM) 491

Introduction 492

**Reading:** CalComp: Disaster Becomes Success 494

Problem Solving 496

Process Improvement 497

Tools 498

**Reading:** Continuous Improvement at the Free-Throw Line 506

Operations Strategy 510

**Cases:** Chicken-'N-Gravy Dinner Line 514

Tip Top Markets 515

**Readings:** Making Quality Pay: Return on Quality 516

Quality Programs Don't Guarantee Results 518

Swimming Upstream 519

## **PART FIVE** **OPERATING AND CONTROLLING THE SYSTEM 521**

### **CHAPTER 12**

Aggregate Planning 523

Introduction 524

The Purpose and Scope of Aggregate Planning 527

Basic Strategies for Meeting Uneven Demand 530

Techniques for Aggregate Planning 531

Aggregate Planning in Services 542

Disaggregating the Aggregate Plan 543

Master Scheduling 544

### **CHAPTER 13**

Inventory Management 557

Introduction 558

The Nature and Importance of Inventories 559

Requirements for Effective Inventory Management 561

How Much to Order: Economic Order Quantity Models 567

When to Reorder with EOQ Ordering 579

How Much to Order: Fixed-Order-Interval Model 586

The Single-Period Model 589

Operations Strategy 593

**Cases:** Harvey Industries 611

The Dewey Stapler Company 612

**Operations Tour:** Bruegger's Bagel Bakery 614

### **CHAPTER 14**

Material Requirements Planning 617

Dependent versus Independent Demand 618

An Overview of MRP 619

MRP Inputs 620

MRP Processing 625

MRP Outputs 632

Other Considerations 633

Capacity Requirements Planning 636

Benefits and Requirements of MRP 639

MRP II 641

**Operations Tour:** Stickley Furniture 653

### **CHAPTER 15**

Just-in-Time Systems 657

Introduction 658

**Readings:** The Nuts and Bolts of Japan's Factories 658  
 Romantic JIT and Pragmatic JIT 661

JIT Goals 662

Building Blocks 662

**Reading:** Developing the JIT Philosophy 676

Converting to a JIT System 678

**Reading:** JIT and Quality: A Perfect Fit 682

JIT in Services 683

**Reading:** Box Maker Keeps the Lid on Lead Times 683

Operations Strategy 685

**Case:** Level Operations 688

**Operations Tour:** Boeing 689

## CHAPTER 16

Supply Chain Management 693

Introduction 694

Purchasing 695

**Reading:** Worldly Desires 700

Suppliers 701

**Reading:** JIT II 705

Logistics 706

Operations Strategy 710

**Reading:** Delivering the Goods 712

**Operations Tour:** PSC, INC. 715

## CHAPTER 17

Scheduling 721

Operations Strategy 722

Scheduling Manufacturing Operations 722

Scheduling in Low-Volume Systems 725

Scheduling Service Operations 741

**Reading:** Servicing Passenger Planes 743

## SUPPLEMENT TO CHAPTER 17

Maintenance 757

Introduction 758

Preventive Maintenance 759

Breakdown Programs 761

Replacement 762

## CHAPTER 18

Project Management 765

Introduction 766

Behavioral Aspects of Project Management 767

Project Life Cycle 769

Work Breakdown Structure 770

Planning and Scheduling with Gantt Charts 770

PERT and CPM 771

Deterministic Time Estimates 775

A Computing Algorithm 776

Probabilistic Time Estimates 781

Activity-on-Arrow Diagram 787

Project Management Software 787

Simulation 788

Time-Cost Trade-Offs: Crashing 788

Advantages of Using PERT and Potential Sources of Error 791

**Cases:** The Case of the Mexican Crazy Quilt 806

Fantasy Products 807

## CHAPTER 19

Waiting Lines 811

**Reading:** Waiting—A New Popular Pastime:  
 Miss Manners 812

Why Is There Waiting? 813

Goal of Queuing Analysis 813

System Characteristics 815

Measures of System Performance 818

Queuing Models: Infinite-Source 819

Queuing Models: Finite-Source 833

Other Approaches 837

## SUPPLEMENT TO CHAPTER 19

Simulation 845

Introduction 846

Steps in the Simulation Process 846

Monte Carlo Simulation 848

Computer Simulation 856

Advantages and Limitations of Using Simulations 857

**Case:** Coquille Refinery Corporation 864

## APPENDIX A

Answers to Selected Problems 866

## APPENDIX B

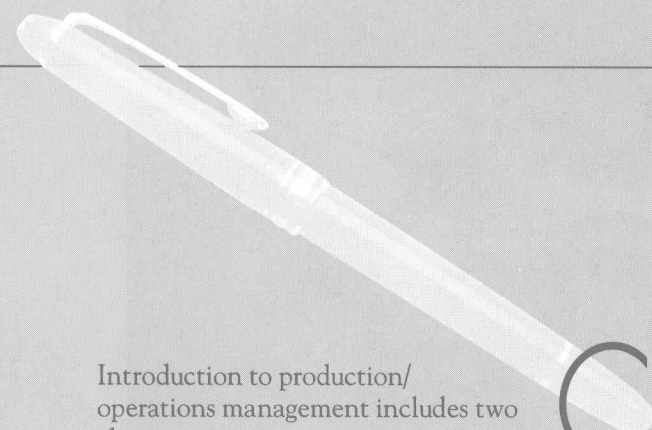
Tables 880

Photo Credits 889

Index 891



# PART ONE INTRODUCTION



Introduction to production/operations management includes two chapters:

- 1 Production and operations management, Chapter 1
- 2 Productivity, competitiveness, and strategy, Chapter 2

**C**hapter 1 introduces you to the field of operations management. It describes the nature and scope of operations management, and how operations management relates to other parts of the organization. Among the important topics it covers are the different types of production systems, a comparison of manufacturing and service operations, a brief history of operations management, and a list of recent trends in operations. After you have read this chapter, you will have a good understanding of what the operations function of a business organization encompasses.

Chapter 2 discusses operations management in a broader context, and presents the issues of productiv-

ity, competition, and strategy. After you have read Chapter 2, you will understand the importance of the operations function relative to the goals of a business organization. This chapter also describes time-based strategies, which many organizations are now adopting as they seek to become more competitive and to better serve their customers. The supplement of Chapter 2 describes *decision theory*.





## LEARNING OBJECTIVES

After completing this chapter, you should be able to:

- 1 Define the term *production/operations management* (POM).
- 2 Identify the three major functional areas of organizations and describe how they interrelate.
- 3 Describe the operations function and the nature of the operations manager's job.
- 4 Differentiate between design and operation of production systems.
- 5 Provide a general description of the different types of operations.
- 6 Compare and contrast service and manufacturing operations.
- 7 Briefly describe the historical evolution of POM.
- 8 Describe the key aspects of operations management decision making.
- 9 Identify some of the current trends in operations management.
- 10 Describe the *Pareto phenomenon* and tell why it is important in problem solving.

# CHAPTER ONE PRODUCTION AND OPERATIONS MANAGEMENT

## CHAPTER OUTLINE

Introduction, 4

Why Study Operations Management? 5

Functions within Business

Organizations, 6

Operations, 6

Finance, 8

Marketing, 9

Other Functions, 9

Designing and Operating Production Systems, 10

Differentiating Features of Production Systems, 11

Degree of Standardization, 11

Type of Operation, 11

Production of Goods versus Service Operations, 12

The Operations Manager and the Management Process, 15

Operations Managers and Decision Making, 15

Quantitative Approaches, 15

Analysis of Trade-Offs, 16

A Systems Approach, 16

Establishing Priorities, 17

Ethics, 17

The Historical Evolution of Operations Management, 18

The Industrial Revolution, 18

Scientific Management, 19

The Human Relations Movement, 22

Decision Models and Management Science, 22

The Influence of Japanese Manufacturers, 23

Recent Trends, 23

Newsclip: NAFTA Offers Real Opportunities, 24

Reading: Agile Manufacturing, 26

Summary, 28

Key Terms, 29

Discussion and Review Questions, 29

Memo Writing Exercises, 29

Case: Hazel, 31

Operations Tour: Wegmans Food Markets, 32

This book is about production and operations management (POM), which involves the planning, coordinating, and executing of all activities that create goods or provide services. The subject matter is fascinating and timely: productivity, quality, foreign competition, and customer service are very much in the news. All are part of production and operations management. This first chapter presents an introduction and overview of operations management. Among the issues it addresses are: What is operations management? Why is it important? What does an operations manager do?

The chapter also provides a brief description of the historical evolution of operations management, and a discussion of the current trends that impact operations management.

## INTRODUCTION

To many people, the term *production* conjures up images of factories, machines, and assembly lines. Interestingly enough, the field of production management in the past focused almost exclusively on manufacturing management, with a heavy emphasis on the methods and techniques used in operating a factory. In recent years, the scope of production management has broadened considerably. Production concepts and techniques are applied to a wide range of activities and situations *outside* manufacturing; that is, in *services* such as health care, food service, recreation, banking, hotel management, retail sales, education, transportation, and government. This broadened scope has given the field the name *production/operations management*, or more simply, **operations management**, a term that more closely reflects the diverse nature of activities to which its concepts and techniques are applied.

We can use an airline company to illustrate a production/operations system. The system consists of the airplanes, airport facilities, and maintenance facilities, sometimes spread out over a wide territory. Most of the activities performed by management and employees fall into the realm of operations management:

*Forecasting* such things as weather and landing conditions, seat demand for flights, and the growth in air travel.

*Capacity planning*, essential for the airline to maintain the cash flow and make a reasonable profit. (Too few or too many planes, or even the right number of planes but in the wrong places, will hurt profits.)

### operations management

The management of systems or processes that *create goods and/or provide services*.

Southwest Airlines workers at the maintenance hangar in Dallas performing a routine maintenance check on a Boeing 737 engine. Checks are periodically performed based on a maintenance schedule guided by FAA regulations.



[www.iflyswa.com](http://www.iflyswa.com)



*Scheduling* of planes for flights and for routine maintenance; scheduling of pilots and flight attendants; and scheduling of ground crews, counter staff, and baggage handlers.

*Managing inventory* of such items as foods and beverages, first-aid equipment, in-flight magazines, pillows and blankets, life preservers.

*Assuring quality*, essential in flying and maintenance operations, where the emphasis is on safety. Also important in dealing with customers at ticket counters, check-in, telephone reservations, and curbside service, where the emphasis is on efficiency and courtesy.

*Employee motivation and training* in all phases of operations.

*Location of facilities* according to managers' decisions on which cities to provide service for, where to locate maintenance facilities, and where to locate major and minor hubs.

Now consider a bicycle factory. This might be primarily an *assembly* operation: buying components such as frames, tires, wheels, gears, and other items from suppliers, and then assembling bicycles. The factory might also do some of the *fabrication* work itself, forming frames, making the gears and chains, and buy mainly raw materials and a few parts and materials such as paint, nuts and bolts, and tires. Among the key management tasks in either case are scheduling production, deciding which components to make and which to buy, ordering parts and materials, deciding on the style of bicycle to produce and how many, purchasing new equipment to replace old or worn out equipment, maintaining equipment, motivating workers, and ensuring that quality standards are met.

Obviously, an airline company and a bicycle factory are completely different types of operations. One is primarily a service operation, the other a producer of goods. Nonetheless, these two operations have much in common. Both involve scheduling of activities, motivating employees, ordering and managing supplies, selecting and maintaining equipment, satisfying quality standards, and—above all—satisfying customers. In both systems, the success of the business depends on short- and long-term planning.

## WHY STUDY OPERATIONS MANAGEMENT?

You may be wondering why you need to study operations management. Actually, there are a number of very good reasons. One is that operations management activities are at the core of *all* business organizations, regardless of what business they are in. Second, 35 percent or more of all jobs are in operations management-related areas—such areas as customer service, quality assurance, production planning and control, scheduling, job design, inventory management, and many more. Third, activities in all of the other areas of business organizations, such as finance, accounting, human resources, logistics, marketing, purchasing, as well as others are all interrelated with operations management activities, so it is essential for these people to have a basic understanding of operations management. But beyond all of this is the reality that production/operations management is about *management*, and *all managers* need to possess the knowledge and skills in the content areas you will learn about here. Among them are productivity, strategy, forecasting, quality, inventory control, and scheduling. Also, you will learn how to use a range of quantitative tools that enhance managerial decision making.

If you are thinking of a career in production/operations management, you can benefit by joining one or more of the professional societies.

American Production and Inventory Control Society (APICS)  
500 West Annandale Road, Falls Church, Virginia 22046-4274

American Society for Quality (ASQ)  
230 West Wells Street, Milwaukee, Wisconsin 53203

National Association of Purchasing Management (NAPM)  
2055 E. Centennial Circle, Tempe, AZ 85284

Association for Systems Management  
P.O. Box 38370, Cleveland, Ohio 44130-0307



[www.apics-stlouis.com/](http://www.apics-stlouis.com/)  
[www.apics-houston.org/](http://www.apics-houston.org/)  
[www.apicsaustin.com/](http://www.apicsaustin.com/)

[www.napm.org](http://www.napm.org)

[www.infoanalytic.com/asm/](http://www.infoanalytic.com/asm/)



APICS and NAPM both offer a practitioner certification examination that can enhance your qualifications. Information about job opportunities can be obtained from all of these societies as well as from other sources, such as the Decision Sciences Institute (University Plaza, Atlanta, Georgia, 30303), and the Institute of Industrial Engineers (25 Technology Park, Norcross, Georgia, 30092).

## FUNCTIONS WITHIN BUSINESS ORGANIZATIONS

Organizations are formed to pursue goals that are achieved more efficiently by the concerted efforts of a group of people than by individuals working alone. Business organizations are devoted to producing goods and/or providing services. They may be for-profit or nonprofit organizations. Their goals, products, and services may be similar or quite different. Nonetheless, their functions and the way they operate are similar.

A typical business organization has three basic functions: finance, marketing, and production/operations (see Figure 1-1). These three functions, and other supporting functions, perform different but *related* activities necessary for the operation of the organization. The interdependency of the major functions is depicted by overlapping circles in Figure 1-2. The functions must interact to achieve the goals and objectives of the organization, and each makes an important contribution. Often the success of an organization depends not only on how well each area performs but also on how well the areas *interface* with each other. For instance, unless production and marketing work together, marketing may promote goods or services that production cannot profitably deliver, or production may turn out goods or services for which there is no demand. Similarly, unless finance and production people work closely, funds for expansion or new equipment may not be available when needed.

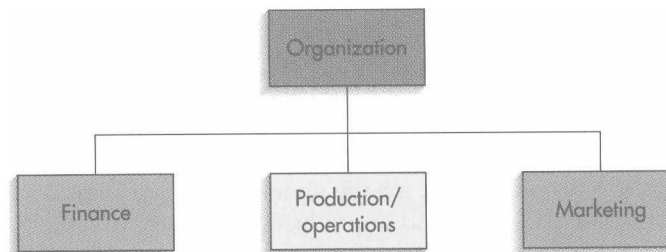
Let's take a closer look at these functions.

### Operations

The operational function consists of all activities *directly* related to producing goods or providing services. The production function exists not only in manufacturing and as-

**FIGURE 1-1**

The three basic functions of business organizations



**FIGURE 1-2**

The three major functions of business organizations overlap

