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**TWELFTH EDITION**

# OPERATIONS MANAGEMENT

SUSTAINABILITY AND  
SUPPLY CHAIN MANAGEMENT

Introducing  
MyLab | South Asia  
Operations  
Management

See the inside cover  
for access code



**Jay Heizer**  
**Barry Render**  
**Chuck Munson**  
**Amit Sachan**

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TWELFTH EDITION

# OPERATIONS MANAGEMENT

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Sustainability and Supply Chain Management

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Indian Subcontinent Adaptation

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**To Karen Heizer Herrmann, all a sister could ever be**

J.H.

---

**To Donna, Charlie, and Jesse**

B.R.

---

**To Kim, Christopher, and Mark Munson for their unwavering support,  
and to Bentonville High School teachers Velma Reed and Cheryl Gregory,  
who instilled in me the importance of detail and a love of learning**

C.M.

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**To Parents, Family, and Friends**

A.S.

---

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# Preface

Welcome to your operations management (OM) course. In this book, we present a state-of-the-art view of the operations function. Operations is an exciting area of management that has a profound effect on productivity. Indeed, few other activities have as much impact on the quality of our lives. The goal of this text is to present a broad introduction to the field of operations in a realistic, practical manner. Even if you are not planning on a career in the operations area, you will likely be working with people in operations. Therefore, having a solid understanding of the role of operations in an organization will be of substantial benefit to you. This book will also help you understand how OM affects society and your life. Certainly, you will better understand what goes on behind the scenes when you attend a concert or major sports event; purchase a bag of Frito-Lay potato chips; buy a meal at an Olive Garden or a Hard Rock Cafe; place an order through [Amazon.com](https://www.amazon.com); board a flight on Alaska Airlines; or enter a hospital for medical care. More than one and a half million readers of our earlier editions seem to have endorsed this premise.

We welcome comments by email from our North American readers and from students using the International edition, the Indian edition, the Arabic edition, and our editions in Portuguese, Spanish, Turkish, Indonesian, and Chinese. Hopefully, you will find this material useful, interesting, and even exciting.

## Lean Operations

In previous editions, we sought to explicitly differentiate the concepts of just-in-time, Lean, and Toyota Production System in Chapter 16. However, there is significant overlap and interchangeability among those three concepts, so we have revised Chapter 16 to incorporate the three concepts into an overall concept of “Lean.” The chapter suggests that students view Lean as a comprehensive integrated operations strategy that sustains competitive advantage and results in increased returns to all stakeholders.

# Instructor Resources

At the Instructor Resource Center, <http://www.pearsoned.co.in/JayHeizer/> instructors can easily register to gain access to a variety of instructor resources available with this text in downloadable format.

The following supplements are available with this text:

## Instructor's Resource Manual

The Instructor's Resource Manual, updated by co-author Chuck Munson, contains many useful resources for instructors—PowerPoint presentations with annotated notes.

## Instructor's Solutions Manual

The Instructor's Solutions Manual, written by the authors, contains the answers to all of the discussion questions, *Ethical Dilemmas*, Active Models, and cases in the text, as well as worked-out solutions to all the end-of-chapter problems, additional homework problems, and additional case studies.

## PowerPoint Presentations

An extensive set of PowerPoint presentations, created by Professor Jeff Heyl of Lincoln University, is available for each chapter. With well over 2,000 slides, this set has excellent color and clarity.

## Test Bank/TestGen® Computerized Test Bank

The test bank, updated by James Roh, contains a variety of true/false, multiple-choice, short-answer, and essay questions, along with a selection of written problems, for each chapter. Test questions are annotated with the following information:

- ◆ Difficulty level
- ◆ Type: multiple-choice, true/false, short-answer, essay, problem
- ◆ Learning objective

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In this edition, we were thrilled to be able to include one of the country's premier airlines, Alaska Airlines, in our ongoing Video Case Study series. This was possible because of the wonderful efforts of COO/EVP-Operations Ben Minicucci, and his superb management team. This included John Ladner (Managing Director, Seattle Station Operations), Wayne Newton (Managing Director, Station Operations Control), Mike McQueen (Director, Schedule Planning), Chad Koehnke (Director, Planning and Resource Allocation), Cheryl Schulz (Executive Assistant to EVP Minicucci), Jeffrey Butler (V.P. Airport Operations & Customer Service), Dan Audette (Manager of Operations Research and Analysis), Allison Fletcher (Process Improvement Manager), Carlos Zendejas (Manager Line-Flying Operations, Pilots), Robyn Garner (Flight Attendant Trainer), and Nikki Meier and Sara Starbuck (Process Improvement Facilitators). We are grateful to all of these fine people, as well as the many others that participated in the development of the videos and cases during our trips to the Seattle headquarters.

We also appreciate the efforts of colleagues who have helped to shape the entire learning package that accompanies this text. Professor Howard Weiss (Temple University) developed the Active Models; Professor Jeff Heyl (Lincoln University) created the PowerPoint presentations; and Professor James Roh (Rowan University) updated the test bank. Beverly Amer (Northern Arizona University) produced and directed the video series; Professors Keith Willoughby (Bucknell University) and Ken Klassen (Brock University) contributed the two Excel-based simulation games; and Professor Gary LaPoint (Syracuse University) developed the Microsoft Project crashing exercise and the dice game for SPC. We have been fortunate to have been able to work with all these people.

*We wish you a pleasant and productive introduction to operations management.*

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# Preface to the Indian Edition

The purpose of the adaptation of the 12<sup>th</sup> edition of this book on Operations Management is to incorporate the new concepts that have been developed due to the changes in technology and globalization. The strength of this adapted edition is to actively engage the students by including the real-life examples of Indian companies along with the empirical Indian researches that are carried out in the area of operations management in India.

In this edition, we show you how OM concepts are applied in India. Through Indian case studies we take a look at how an Indian dairy company is improving productivity by using technology (chapter 1). Chapter 2 has a case study on how Juniper Networks, an American multinational is planning to be part of the Digital India programme. Chapter 3 case study focusses on how Agra-Lucknow Expressway project was executed. In chapter 4 case study we examined how bandwidth of Wi-Fi in rural India is estimated. In the case study in chapter 5, we discuss what product innovation Micromax has brought out in order to become successful in the Indian market. In chapter 6, the case study focusses on the process and benefits of Six Sigma in an Indian University library. Chapter 7 case study examines how Value Stream Mapping (VSM) was implemented in an Indian firm for lean operations. Chapter 8 case study discusses location strategy of D-Mart. The case study in chapter 9 discusses how traditional retail stores are getting a modern makeover to compete with big retailers in India. Chapter 10 discusses on process and benefits of time and motion study in a hospital in Hyderabad. Chapter 11 case study examines the benefits PinkBlue.in is having by an integrating supply chain. Chapter 12 case study discusses how inventory is handled in rural public health facilities in Udupi district. Chapter 13 case study focuses on the dynamic pricing introduced by Indian Railways. The case study in chapter 14 identifies Critical Success Factors (CSF) of ERP implementation. Chapter 16 case study discusses the factors behind Indigo Airlines. Lastly, in chapter 17, the case study focusses on the process and benefits of total productive maintenance in Indian Tube Mills.

## Chapter-by-Chapter Changes

To highlight the extent of the revisions in this edition, here are a few of the changes on a chapter-by-chapter basis.

### Chapter 1: Operations and Productivity

We updated Table 1.4 to reflect employment in various sectors and expanded our discussion of Lean operations. Our new case “Chaitale Dairy takes Cows to Cloud” introduces productivity improvement through technology. In addition, there is a new

“Creating Your Own Excel Spreadsheets” example for both labor productivity and multifactor productivity. Also added new OM in Action Major Indian Ports Improve Productivity.

## Chapter 2: Operations Strategy in a Global Environment

We have updated Figure 2.1 to better reflect changes in the growth of world trade and Figure 2.5 to reflect product life cycle changes. Example 1 (National Architects) has been expanded to clarify factor rating calculations and is also demonstrated with a “Creating Your Own Excel Spreadsheets” presentation. A new case study Juniper Networks to benefit from Digital India programme is also added.

## Chapter 3: Project Management

We rewrote and updated the Bechtel Global Company Profile and added a new section on well defined projects with the “agile” and “waterfall” approaches. There are two new OM in Action boxes: “Agile Project Management at Mastek,” and “IOC Butadiene Extraction Project.” A new case study “Agra-Lucknow Expressway” is also added.

## Chapter 4: Forecasting

We created a new table comparing the MAD, MSE, and MAPE forecasting error measures. There are two new OM in Action boxes called “NYC’s Potholes and Regression Analysis” and “Forecasting the Next Fog”. A new case study Estimating Bandwidth of Wi-Fi in Rural India is also added.

## Chapter 5: Design of Goods and Services

We expanded our treatment of *concurrent engineering* and added two new discussion questions. Solved Problem 5.1 has been revised. There is also new OM in Action box called “StoreKing: E Commerce in Rural India.” A new case study “Micromax Dominating the Indian Market” is also added.

## Supplement 5: Sustainability in the Supply Chain

We wrote a new introductory section on Corporate Social Responsibility. There is also a new OM in Action box called “Together for Sustainability (TfS) for sustainable supply chains”.

## Chapter 6: Managing Quality

We added new material to expand our discussion of Taguchi’s quality loss function. There is a new section on SERVQUAL, and a new OM in Action box called “Flipkart Assured”. A new case study Six Sigma in an Indian University Library is also added.

## Supplement 6: Statistical Process Control

We added a figure on the relationship between sample size and sampling distribution. We also added raw data to Examples S2 and S3 to illustrate how ranges are computed. There is a new Excel spreadsheet to show students how to make their own c-chart. There is also a new OM in Action box called “Statistical Process Control Software”.

## Chapter 7: Process Strategy

We wrote a new section on machine technology and additive manufacturing. There are two new discussion questions. There is a new OM in Action box “Kolhapur Municipal Transport to use RFID”. A new case study “Value Stream Mapping (VSM) for Lean Implementation” in Indian firm is also added.

## Supplement 7: Capacity and Constraint Management

We added a new Table S7.1 which compares and clarifies three capacity measurements. There is a new treatment of expected output and actual output in Example S2. The discussion of bottleneck time versus throughput time has also been expanded. We have also added a new “Creating Your Own Excel Spreadsheets” example for a break-even model. There is a new OM in Action box “World’s largest solar power plant in Tamil Nadu, India.”

## Chapter 8: Location Strategies

We added two new OM in Action boxes: “Cipla to Launch South Africa’s first Biotech Manufacturing Facility” and “Denmark’s Meat Cluster.” We changed the notation for the center-of-gravity model to simplify the equation and provided a new “Creating Your Own Excel Spreadsheets” presentation for the center-of gravity example. A new case study “D-Mart Emerged as Top Retailer” is added.

## Chapter 9: Layout Strategies

We created a new Muther grid for office relationship charting and added a spread of five layouts showing how offices have evolved over time. There is a new OM in Action box called “Solar Panels in Unconventional Layout,” and there is a new graphic example of Proplanner’s Flow Path Calculator. We have included a formula for idle time as a second measure of balance assignment efficiency. A new case study “Traditional Retail Stores go for a Modern Makeover in India” is added.

## Chapter 10: Human Resources, Job Design, and Work Measurement

We added a new OM in Action box, “Toyota to Enhance Manufacturing Skills of Students,” and revised the Operations Chart as a service example. A new case study “Time and Motion Study in a hospital in Hyderabad” is added.

## Chapter 11: Supply Chain Management

We added “outsourcing” as a supply chain risk in Table 11.3. We added a new OM in Action box, “Polymers to aid the Second Green Revolution in India.”

## Supplement 11: Supply Chain Management Analytics

We added a major section on the topic of Warehouse Storage, with a new model for allocating inventory to storage locations. There is a new discussion question. We added a new OM in Action box, “Reducing Product Return.”

### Chapter 12: Inventory Management

New Programs 12.1 and 12.2 illustrate “Creating Your Own Excel Spreadsheets” for both the production run model and the single-period inventory model. The Excel function NORMSINV is introduced throughout the chapter. The Quantity Discount Model section is rewritten to illustrate the feasible solution shortcut. Solved Problem 12.5 is likewise redone with the new approach. A new case study “Inventory Management in Rural Public Health Facilities in Udupi District” is also added.

### Chapter 13: Aggregate Planning and S&OP

We added a new OM in Action box, “Revenue Management Makes Disney the ‘King’ of the Broadway Jungle.” We also provided a new “Creating Your Own Excel Spreadsheets” example for the transportation method for aggregate planning, using the Solver approach. A new case study “Dynamic Pricing Introduced in Indian Railways” is also added.

### Chapter 14: Material Requirements Planning (MRP) and ERP

The MRP II example now includes greenhouse gasses. We added a new OM in Action box, “Microsoft Dynamics 365 integrates CRM and ERP.” A new case study “Critical Success Factors (CSF) for implementation of ERP at Indian SMEs” is also added.

### Chapter 15: Short-Term Scheduling

We begin this chapter with a new Global Company Profile featuring Alaska Airlines and the scheduling issues it faces in its northern climate. We have added two new graphics to help illustrate Forward and Backward Scheduling. There is also a new section called Performance Criteria, detailing how the choice of priority rule depends on four quantifiable criteria. We now explicitly define the performance criteria for sequencing jobs as separate numbered equations. Also, we provide an explicit formula for job lateness. There is a new OM in Action box called “Burger King Improved Operations using Matrix Centralized Time – Attendance Solution .”

### Chapter 16: Lean Operations

This chapter saw a major reorganization and has been rewritten with an enhanced focus on Lean operations. There is more material on supplier partnerships and building lean organizations. We have also added a new case study called “Indigo India’s largest carrier.”

### Chapter 17: Maintenance and Reliability

We have added a new OM in Action box, “Toshiba, Transforming India’s Vertical Expansion.” A new case study “Total Productive Maintenance Implementation in an Indian Tube Mills” is also added.

Finally, I would like to thank the publisher, Pearson Education for bringing out the Indian adaptation, and would also like to acknowledge the team efforts involved in getting this task accomplished in such a short time. I wish to express my love and respect to my parents for their moral support and encouragement. I am grateful to my wife Swati, sister Anju, daughter Aakriti and colleagues at IIM Ranchi who have always supported and encouraged me.

# Operations and Productivity

## CHAPTER OUTLINE

### GLOBAL COMPANY PROFILE: *Hard Rock Cafe*

- ◆ What Is Operations Management? 4
- ◆ Organizing to Produce Goods and Services 4
- ◆ The Supply Chain 6
- ◆ Why Study OM? 6
- ◆ What Operations Managers Do 8
- ◆ The Heritage of Operations Management 9
- ◆ Operations for Goods and Services 12
- ◆ The Productivity Challenge 14
- ◆ Current Challenges in Operations Management 21
- ◆ Ethics, Social Responsibility, and Sustainability 22



Alaska Airlines

**10  
OM**  
STRATEGY  
DECISIONS

- Design of Goods and Services
- Managing Quality
- Process Strategy
- Location Strategies
- Layout Strategies
- Human Resources
- Supply-Chain Management
- Inventory Management
- Scheduling
- Maintenance



## GLOBAL COMPANY PROFILE

*Hard Rock Cafe*

# Operations Management at Hard Rock Cafe

Operations managers throughout the world are producing products every day to provide for the well-being of society. These products take on a multitude of forms. They may be washing machines at Whirlpool, motion pictures at DreamWorks, rides at Disney World, or food at Hard Rock Cafe. These firms produce thousands of complex products every day—to be delivered as the customer ordered them, when the customer wants them, and where the customer wants them. Hard Rock does this for over 35 million guests worldwide every year. This is a challenging task, and the operations manager's job, whether at Whirlpool, DreamWorks, Disney, or Hard Rock, is demanding.



Andre Jenny/Alamy

Hard Rock Cafe in Orlando, Florida, prepares over 3,500 meals each day. Seating more than 1,500 people, it is one of the largest restaurants in the world. But Hard Rock's operations managers serve the hot food hot and the cold food cold.

Operations managers are interested in the attractiveness of the layout, but they must be sure that the facility contributes to the efficient movement of people and material with the necessary controls to ensure that proper portions are served.



Demetric Carrasco/Rough Guides/Dorling Kindersley, Ltd.



Lots of work goes into designing, testing, and costing meals. Then suppliers deliver quality products on time, every time, for well-trained cooks to prepare quality meals. But none of that matters unless an enthusiastic waitstaff, such as the one shown here, holding guitars previously owned by members of U2, is doing its job.

Orlando-based Hard Rock Cafe opened its first restaurant in London in 1971, making it over 45 years old and the granddaddy of theme restaurants. Although other theme restaurants have come and gone, Hard Rock is still going strong, with 150 restaurants in more than 53 countries—and new restaurants opening each year. Hard Rock made its name with rock music memorabilia, having started when Eric Clapton, a regular customer, marked his favorite bar stool by hanging his guitar on the wall in the London cafe. Now Hard Rock has 70,000 items and millions of dollars invested in memorabilia. To keep customers coming back time and again, Hard Rock creates value in the form of good food and entertainment.

The operations managers at Hard Rock Cafe at Universal Studios in Orlando provide more than 3,500 custom products—in this case meals—every day. These products are designed, tested, and then analyzed for

Efficient kitchen layouts, motivated personnel, tight schedules, and the right ingredients at the right place at the right time are required to delight the customer.



cost of ingredients, labor requirements, and customer satisfaction. On approval, menu items are put into production—and then only if the ingredients are available from qualified suppliers. The production process, from receiving, to cold storage, to grilling or baking or frying, and a dozen other steps, is designed and maintained to yield a quality meal. Operations managers, using the best people they can recruit and train, also prepare effective employee schedules and design efficient layouts.

Managers who successfully design and deliver goods and services throughout the world understand operations. In this text, we look not only at how Hard Rock's managers create value but also how operations managers in other services, as well as in manufacturing, do so. Operations management is demanding, challenging, and exciting. It affects our lives every day. Ultimately, operations managers determine how well we live. ▶

# LEARNING OBJECTIVES

- LO 1.1** *Define* operations management 4
- LO 1.2** *Explain* the distinction between goods and services 12
- LO 1.3** *Explain* the difference between production and productivity 15
- LO 1.4** *Compute* single-factor productivity 16
- LO 1.5** *Compute* multifactor productivity 16
- LO 1.6** *Identify* the critical variables in enhancing productivity 18

## STUDENT TIP

Let's begin by defining what this course is about.

### **LO 1.1** *Define* operations management

#### Production

The creation of goods and services.

#### Operations management (OM)

Activities that relate to the creation of goods and services through the transformation of inputs to outputs.

## What Is Operations Management?

Operations management (OM) is a discipline that applies to restaurants like Hard Rock Cafe as well as to factories like Ford and Whirlpool. The techniques of OM apply throughout the world to virtually all productive enterprises. It doesn't matter if the application is in an office, a hospital, a restaurant, a department store, or a factory—the production of goods and services requires operations management. And the *efficient* production of goods and services requires effective applications of the concepts, tools, and techniques of OM that we introduce in this book.

As we progress through this text, we will discover how to manage operations in an economy in which both customers and suppliers are located throughout the world. An array of informative examples, charts, text discussions, and pictures illustrates concepts and provides information. We will see how operations managers create the goods and services that enrich our lives.

In this chapter, we first define *operations management*, explaining its heritage and exploring the exciting role operations managers play in a huge variety of organizations. Then we discuss production and productivity in both goods- and service-producing firms. This is followed by a discussion of operations in the service sector and the challenge of managing an effective and efficient production system.

**Production** is the creation of goods and services. **Operations management (OM)** is the set of activities that creates value in the form of goods and services by transforming inputs into outputs. Activities creating goods and services take place in all organizations. In manufacturing firms, the production activities that create goods are usually quite obvious. In them, we can see the creation of a tangible product such as a Sony TV or a Harley-Davidson motorcycle.

In an organization that does not create a tangible good or product, the production function may be less obvious. We often call these activities *services*. The services may be “hidden” from the public and even from the customer. The product may take such forms as the transfer of funds from a savings account to a checking account, the transplant of a liver, the filling of an empty seat on an airplane, or the education of a student. Regardless of whether the end product is a good or service, the production activities that go on in the organization are often referred to as operations, or *operations management*.

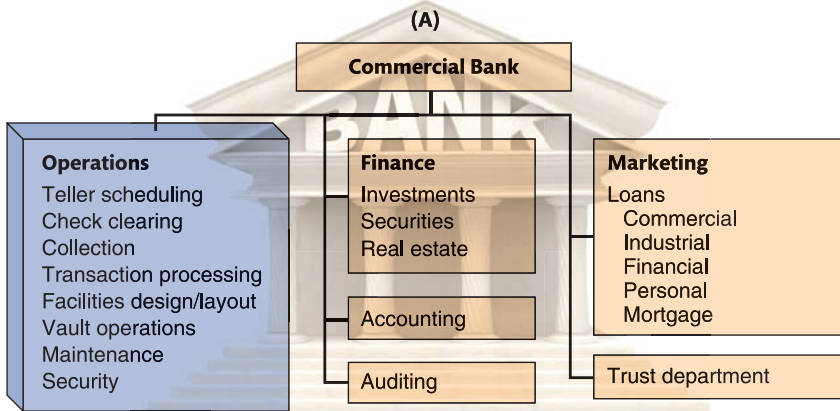
## STUDENT TIP

Operations is one of the three functions that every organization performs.

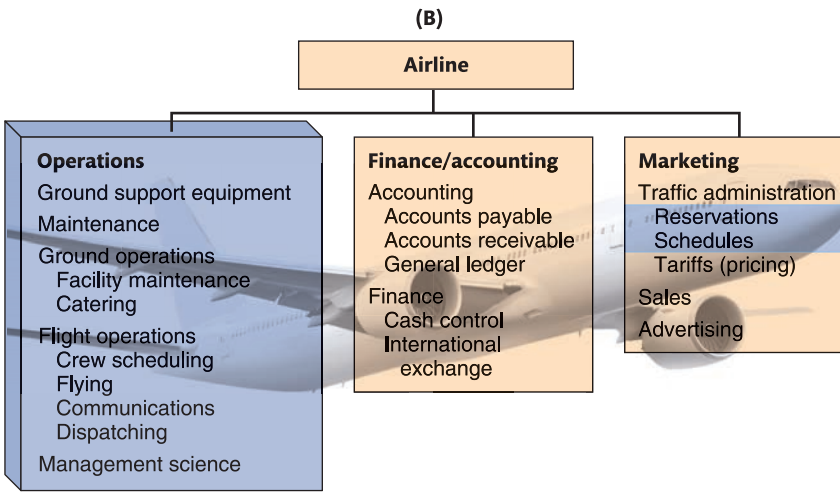
## Organizing to Produce Goods and Services

To create goods and services, all organizations perform three functions (see Figure 1.1). These functions are the necessary ingredients not only for production but also for an organization's survival. They are:

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Sergiy Serdyuk/Fotolia



Alexzel/Shutterstock

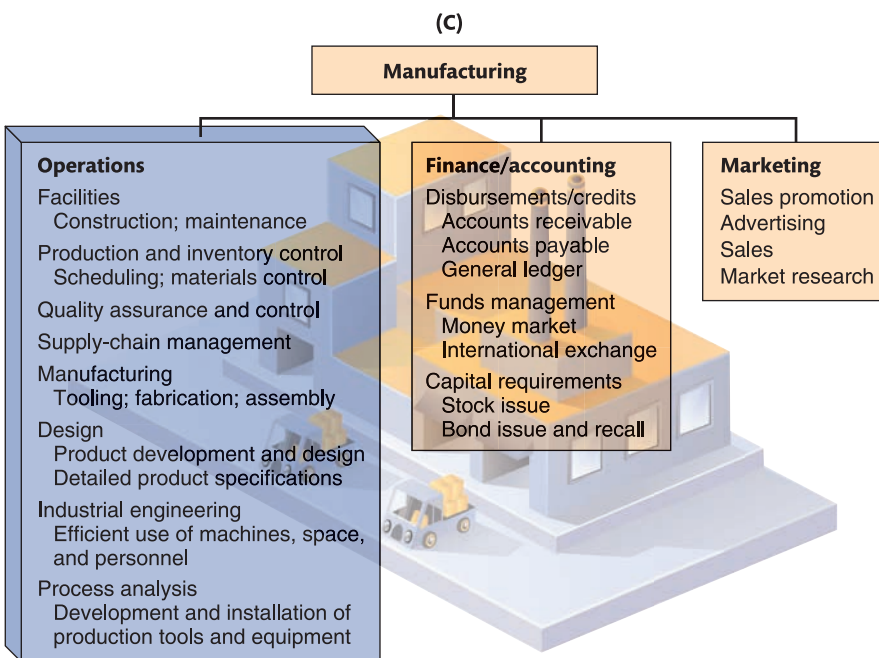


Figure 1.1

**Organization Charts for Two Service Organizations and One Manufacturing Organization**

(A) a bank, (B) an airline, and (C) a manufacturing organization. The blue areas are OM activities.

**STUDENT TIP**

The areas in blue indicate the significant role that OM plays in both manufacturing and service firms.

1. *Marketing*, which generates the demand, or at least takes the order for a product or service (nothing happens until there is a sale).
2. *Production/operations*, which creates, produces, and delivers the product.
3. *Finance/accounting*, which tracks how well the organization is doing, pays the bills, and collects the money.

Universities, churches or synagogues, and businesses all perform these functions. Even a volunteer group such as the Boy Scouts of America is organized to perform these three basic functions. Figure 1.1 shows how a bank, an airline, and a manufacturing firm organize themselves to perform these functions. The blue-shaded areas show the operations functions in these firms.

## The Supply Chain

Through the three functions—marketing, operations, and finance—value for the customer is created. However, firms seldom create this value by themselves. Instead, they rely on a variety of suppliers who provide everything from raw materials to accounting services. These suppliers, when taken together, can be thought of as a *supply chain*. A **supply chain** (see Figure 1.2) is a global network of organizations and activities that supply a firm with goods and services.

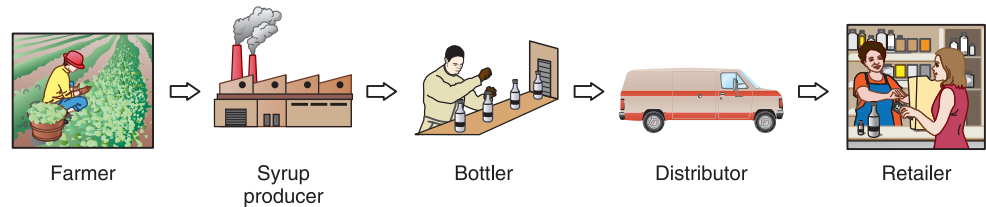
### Supply chain

A global network of organizations and activities that supplies a firm with goods and services.

Figure 1.2

### Soft Drink Supply Chain

A supply chain for a bottle of Coke requires a beet or sugar cane farmer, a syrup producer, a bottler, a distributor, and a retailer, each adding value to satisfy a customer. Only with collaborations between all members of the supply chain can efficiency and customer satisfaction be maximized. The supply chain, in general, starts with the provider of basic raw materials and continues all the way to the final customer at the retail store.



As our society becomes more technologically oriented, we see increasing specialization. Specialized expert knowledge, instant communication, and cheaper transportation also foster specialization and worldwide supply chains. It just does not pay for a firm to try to do everything itself. The expertise that comes with specialization exists up and down the supply chain, adding value at each step. When members of the supply chain collaborate to achieve high levels of customer satisfaction, we have a tremendous force for efficiency and competitive advantage. Competition in the 21st century is not between companies; it is between *supply chains*.

## STUDENT TIP Why Study OM?

Good OM managers are scarce and, as a result, career opportunities and pay are excellent.

We study OM for four reasons:

1. OM is one of the three major functions of any organization, and it is integrally related to all the other business functions. All organizations market (sell), finance (account), and produce (operate), and it is important to know how the OM activity functions. Therefore, we study *how people organize themselves for productive enterprise*.

2. We study OM because we want to know *how goods and services are produced*. The production function is the segment of our society that creates the products and services we use.
3. We study OM to *understand what operations managers do*. Regardless of your job in an organization, you can perform better if you understand what operations managers do. In addition, understanding OM will help you explore the numerous and lucrative career opportunities in the field.
4. We study OM *because it is such a costly part of an organization*. A large percentage of the revenue of most firms is spent in the OM function. Indeed, OM provides a major opportunity for an organization to improve its profitability and enhance its service to society. Example 1 considers how a firm might increase its profitability via the production function.

## Example 1

### EXAMINING THE OPTIONS FOR INCREASING CONTRIBUTION

Fisher Technologies is a small firm that must double its dollar contribution to fixed cost and profit in order to be profitable enough to purchase the next generation of production equipment. Management has determined that if the firm fails to increase contribution, its bank will not make the loan and the equipment cannot be purchased. If the firm cannot purchase the equipment, the limitations of the old equipment will force Fisher to go out of business and, in doing so, put its employees out of work and discontinue producing goods and services for its customers.

**APPROACH** ► Table 1.1 shows a simple profit-and-loss statement and three strategic options (marketing, finance/accounting, and operations) for the firm. The first option is a *marketing option*, where excellent marketing management may increase sales by 50%. By increasing sales by 50%, contribution will in turn increase 71%. But increasing sales 50% may be difficult; it may even be impossible.

**TABLE 1.1** Options for Increasing Contribution

	Options for Increasing Contribution			
	CURRENT	MARKETING OPTION <sup>a</sup> INCREASE SALES REVENUE 50%	FINANCE/ACCOUNTING OPTION <sup>b</sup> REDUCE FINANCE COSTS 50%	OM OPTION <sup>c</sup> REDUCE PRODUCTION COSTS 20%
Sales	\$100,000	\$150,000	\$100,000	\$100,000
Costs of goods	<u>-80,000</u>	<u>-120,000</u>	<u>-80,000</u>	<u>-64,000</u>
Gross margin	20,000	30,000	20,000	36,000
Finance costs	<u>-6,000</u>	<u>-6,000</u>	<u>-3,000</u>	<u>-6,000</u>
Subtotal	14,000	24,000	17,000	30,000
Taxes at 25%	<u>-3,500</u>	<u>-6,000</u>	<u>-4,250</u>	<u>-7,500</u>
Contribution <sup>d</sup>	\$ 10,500	\$ 18,000	\$ 12,750	\$ 22,500

<sup>a</sup>Increasing sales 50% increases contribution by \$7,500, or 71% (7,500/10,500).

<sup>b</sup>Reducing finance costs 50% increases contribution by \$2,250, or 21% (2,250/10,500).

<sup>c</sup>Reducing production costs 20% increases contribution by \$12,000, or 114% (12,000/10,500).

<sup>d</sup>Contribution to fixed cost (excluding finance costs) and profit.

The second option is a *finance/accounting option*, where finance costs are cut in half through good financial management. But even a reduction of 50% is still inadequate for generating the necessary increase in contribution. Contribution is increased by only 21%.

The third option is an *OM option*, where management reduces production costs by 20% and increases contribution by 114%.

**SOLUTION** ► Given the conditions of our brief example, Fisher Technologies has increased contribution from \$10,500 to \$22,500. It may now have a bank willing to lend it additional funds.

**INSIGHT** ► The OM option not only yields the greatest improvement in contribution but also may be the only feasible option. Increasing sales by 50% and decreasing finance cost by 50% may both be virtually impossible. Reducing operations cost by 20% may be difficult but feasible.

**LEARNING EXERCISE** ► What is the impact of only a 15% decrease in costs in the OM option? [Answer: A \$19,500 contribution; an 86% increase.]

Example 1 underscores the importance of the effective operations activity of a firm. Development of increasingly effective operations is the approach taken by many companies as they face growing global competition.

## What Operations Managers Do

All good managers perform the basic functions of the management process. The management process consists of *planning, organizing, staffing, leading, and controlling*. Operations managers apply this management process to the decisions they make in the OM function. The **10 strategic OM decisions** are introduced in Table 1.2. Successfully addressing each of these decisions requires planning, organizing, staffing, leading, and controlling.

**Where Are the OM Jobs?** How does one get started on a career in operations? The 10 strategic OM decisions identified in Table 1.2 are made by individuals who work in the disciplines shown in the blue areas of Figure 1.1. Business students who know their accounting, statistics, finance, and OM have an opportunity to assume entry-level positions in all of these areas. As you read this text, identify disciplines that can assist you in making these decisions. Then take courses in those areas. The more background an OM student has in accounting, statistics, information systems, and mathematics, the more job opportunities will be available. About 40% of *all* jobs are in OM.

The following professional organizations provide various certifications that may enhance your education and be of help in your career:

- ◆ APICS, the Association for Operations Management ([www.apics.org](http://www.apics.org))
- ◆ American Society for Quality (ASQ) ([www.asq.org](http://www.asq.org))
- ◆ Institute for Supply Management (ISM) ([www.ism.ws](http://www.ism.ws))
- ◆ Project Management Institute (PMI) ([www.pmi.org](http://www.pmi.org))
- ◆ Council of Supply Chain Management Professionals ([www.cscmp.org](http://www.cscmp.org))

Figure 1.3 shows some recent job opportunities.

### 10 Strategic OM Decisions

Design of goods and services  
 Managing quality  
 Process strategy  
 Location strategies  
 Layout strategies  
 Human resources  
 Supply-chain management  
 Inventory management  
 Scheduling  
 Maintenance

TABLE 1.2 Ten Strategic Operations Management Decisions

DECISION	CHAPTER(S)
1. <i>Design of goods and services</i> : Defines much of what is required of operations in each of the other OM decisions. For instance, product design usually determines the lower limits of cost and the upper limits of quality, as well as major implications for sustainability and the human resources required.	5, Supplement 5
2. <i>Managing quality</i> : Determines the customer's quality expectations and establishes policies and procedures to identify and achieve that quality.	6, Supplement 6
3. <i>Process and capacity strategy</i> : Determines how a good or service is produced (i.e., the process for production) and commits management to specific technology, quality, human resources, and capital investments that determine much of the firm's basic cost structure.	7, Supplement 7
4. <i>Location strategy</i> : Requires judgments regarding nearness to customers, suppliers, and talent, while considering costs, infrastructure, logistics, and government.	8
5. <i>Layout strategy</i> : Requires integrating capacity needs, personnel levels, technology, and inventory requirements to determine the efficient flow of materials, people, and information.	9
6. <i>Human resources and job design</i> : Determines how to recruit, motivate, and retain personnel with the required talent and skills. People are an integral and expensive part of the total system design.	10
7. <i>Supply chain management</i> : Decides how to integrate the supply chain into the firm's strategy, including decisions that determine what is to be purchased, from whom, and under what conditions.	11, Supplement 11
8. <i>Inventory management</i> : Considers inventory ordering and holding decisions and how to optimize them as customer satisfaction, supplier capability, and production schedules are considered.	12, 14, 16
9. <i>Scheduling</i> : Determines and implements intermediate- and short-term schedules that effectively and efficiently utilize both personnel and facilities while meeting customer demands.	13, 15
10. <i>Maintenance</i> : Requires decisions that consider facility capacity, production demands, and personnel necessary to maintain a reliable and stable process.	17

### STUDENT TIP

An operations manager must successfully address the 10 decisions around which this text is organized.

## The Heritage of Operations Management

The field of OM is relatively young, but its history is rich and interesting. Our lives and the OM discipline have been enhanced by the innovations and contributions of numerous individuals. We now introduce a few of these people, and we provide a summary of significant events in operations management in Figure 1.4.

Eli Whitney (1800) is credited for the early popularization of interchangeable parts, which was achieved through standardization and quality control. Through a contract he signed with the U.S. government for 10,000 muskets, he was able to command a premium price because of their interchangeable parts.

Frederick W. Taylor (1881), known as the father of scientific management, contributed to personnel selection, planning and scheduling, motion study, and the now popular field of ergonomics. One of his major contributions was his belief that management should be much more resourceful and aggressive in the improvement of work methods. Taylor and his colleagues, Henry L. Gantt and Frank and Lillian Gilbreth, were among the first to systematically seek the best way to produce.