

GLOBAL
EDITION



13^e OPERATIONS MANAGEMENT

Sustainability and Supply Chain Management

Jay Heizer • Barry Render • Chuck Munson



THIRTEENTH EDITION
GLOBAL EDITION

OPERATIONS MANAGEMENT

Sustainability and Supply Chain Management

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To Kay Heizer, always at my side

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To Horace Dawson and David Greenberg

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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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Preface

New to This Edition

Operations is an exciting area of management that has a profound effect on productivity. The goal of this text and **MyLab Operations Management** is to present students a broad introduction to the field of operations in a realistic, practical, and applied manner. We want students to understand how operations work within an organization by seeing first-hand what goes on behind the scenes at a concert or major sports event; place an order through Amazon.com; board a flight on Alaska Airlines; or take a cruise with Celebrity Cruises. This text and **MyLab Operations Management** offer behind the scenes views that no other product on the market provides and one that students tell us they value because they gain a true understanding of operations.

With each edition, we work to gather feedback from instructors and students to enhance our text and MyLab. Based on that feedback, we have added the following new features and improvements.

Video Cases – Celebrity Cruise Line

With each edition, we offer in **MyLab Operations Management** integrated Video Cases as a valuable teaching tool for students. These short videos help readers see and understand operations in action within a variety of industries. With this edition, we are pleased to take you behind the scenes of Celebrity Cruises, one of the world's premier cruise lines. This fascinating organization opened its doors—and ships—for us to examine and share with you leading-edge OM in the cruise line industry.

The videos provide an inside look at:

- the 10 operations decisions at Celebrity Cruises (Chapter 1);
- how Celebrity Cruises designs a new product (Chapter 5);
- Celebrity's "Save-the-Waves" sustainability program (Supplement 5);
- how Celebrity Cruises treats quality as the heartbeat of the company (Chapter 6); and
- inventory management at Celebrity Cruises (Chapter 12).

Celebrity Cruises: Operations Management at Sea

Video Case

On any given day, Celebrity Cruises, Inc. has tens of thousands of passengers at sea on more than a dozen spectacular ships, spanning 7 continents and 75 countries. With this level of capital investment along with the responsibility for the happiness and safety of so many passengers, excellence in operations is required. To make it all work, the 10 operations management decisions must be executed flawlessly. From product design (which encompasses the ship's layout, the food, and 300 destinations), to scheduling, supply chain, inventory, personnel, maintenance, and the processes that hold them together, OM is critical.

Cruise lines require precise scheduling of ships, with down-to-the-minute docking and departure times. In addition to ship and port scheduling, some 2,000 plus crew members must be scheduled. And there are many schedule variations. Entertainers may arrive and leave at each port, while officers may have a schedule of 10 weeks on and 10 weeks off. Other crew members have onboard commitments varying from 4 to 9 months.

With \$400 million invested in a ship and more than 5,000 lives involved in a cruise, detailed processes to ensure maintenance and reliability are vital. The modern ship is a technological marvel with hundreds of electronic monitors operating 24/7 to track everything from ship speed and location, to sea depth, to shipboard power demand and cabin temperature.

Celebrity's ship layout, destinations, and routing are adjusted to meet seasonal demands and the expectations of its premium market segment. With destinations from Alaska to Europe to Asia, crews are recruited worldwide, with as many as 70 nationalities represented. Instilling a quality culture requires an aggressive quality service orientation and, of course, meticulous cleanliness

and attention to detail. Processes for food preparation, laundry, quality, and maintenance are complete and detailed.

A cruise ship, as a moving city, requires a comprehensive and precise supply chain that replenishes everything from food to fuel to soap and water. Land-based buyers support Celebrity's annual food and beverage purchases that exceed \$110 million. Included in these expenditures are weekly shipments of 6 to 10 containers from the Miami headquarters destined for ships in European ports. An onboard staff organizes inventories to support this massive operation. The logistics effort includes hedging the weekly use of 24,000 gallons of fuel per ship with purchases 6 years into the future. Reliable global supply chains have been developed that deliver the required inventory on a tight time frame.

These crucial shipboard systems typically represent the best of operations management. Such is the case at Celebrity Cruises.

Discussion Questions*

1. Describe how the 10 OM decisions are implemented at Celebrity Cruises, Inc.
2. Identify how the 10 OM decisions at Celebrity Cruises differ from those decisions at a manufacturing firm.
3. Identify how the 10 OM decisions at Celebrity Cruises differ from those decisions at a retail store.
4. How are hotel operations on a ship different from those at a land-based hotel?

*You may wish to view the video that accompanies this case before addressing these questions.

In addition, we continue to offer our previous Video Cases that cover: Alaska Airlines, Orlando Magic basketball team, Frito-Lay, Darden/Red Lobster Restaurants, Hard Rock Cafe, Arnold Palmer Hospital, Wheeled Coach Ambulances, and Regal Marine.

We take the integration of our video case studies seriously, and for this reason, all of our videos are **created by the authors**, with the outstanding coauthorship of Beverly Amer at Northern Arizona University, to explicitly match text content and terminology.

46 Video Cases Listed by Chapter (new videos in bold)

- ◆ Frito-Lay: Operations Management in Manufacturing (Chapter 1)
- ◆ **Celebrity Cruises: Operations Management at Sea (Chapter 1)**
- ◆ Hard Rock Cafe: Operations Management in Services (Chapter 1)
- ◆ Strategy at Regal Marine (Chapter 2)
- ◆ Hard Rock Cafe's Global Strategy (Chapter 2)
- ◆ Outsourcing Offshore at Darden (Chapter 2)
- ◆ Project Management at Arnold Palmer Hospital (Chapter 3)
- ◆ Managing Hard Rock's Rockfest (Chapter 3)
- ◆ Forecasting Ticket Revenue for Orlando Magic Basketball Games (Chapter 4)
- ◆ Forecasting at Hard Rock Cafe (Chapter 4)
- ◆ **Celebrity Cruises Designs a New Ship (Chapter 5)**
- ◆ Product Design at Regal Marine (Chapter 5)
- ◆ Building Sustainability at the Orlando Magic's Amway Center (Supplement 5)
- ◆ **"Saving the Waves" at Celebrity Cruises (Supplement 5)**
- ◆ Green Manufacturing and Sustainability at Frito-Lay (Supplement 5)
- ◆ Quality Counts at Alaska Airlines (Chapter 6)
- ◆ The Culture of Quality at Arnold Palmer Hospital (Chapter 6)
- ◆ **Celebrity Cruises: A Premium Experience (Chapter 6)**
- ◆ Quality at the Ritz-Carlton Hotel Company (Chapter 6)
- ◆ Frito-Lay's Quality-Controlled Potato Chips (Supplement 6)
- ◆ Farm to Fork: Quality at Darden Restaurants (Supplement 6)
- ◆ Alaska Airlines: 20-Minute Baggage Process—Guaranteed! (Chapter 7)
- ◆ Process Strategy at Wheeled Coach (Chapter 7)
- ◆ Process Analysis at Arnold Palmer Hospital (Chapter 7)
- ◆ Capacity Planning at Arnold Palmer Hospital (Supplement 7)
- ◆ Locating the Next Red Lobster Restaurant (Chapter 8)
- ◆ Where to Place the Hard Rock Cafe (Chapter 8)
- ◆ Facility Layout at Wheeled Coach (Chapter 9)
- ◆ Laying Out Arnold Palmer Hospital's New Facility (Chapter 9)
- ◆ The "People" Focus: Human Resources at Alaska Airlines (Chapter 10)
- ◆ Hard Rock's Human Resource Strategy (Chapter 10)
- ◆ Darden's Global Supply Chains (Chapter 11)
- ◆ Supply Chain Management at Regal Marine (Chapter 11)
- ◆ Arnold Palmer Hospital's Supply Chain (Chapter 11)
- ◆ **Inventory Management at Celebrity Cruises (Chapter 12)**
- ◆ Managing Inventory at Frito-Lay (Chapter 12)
- ◆ Inventory Control at Wheeled Coach (Chapter 12)
- ◆ Using Revenue Management to Set Orlando Magic Ticket Prices (Chapter 13)
- ◆ When 18,500 Orlando Magic Fans Come to Dinner (Chapter 14)
- ◆ MRP at Wheeled Coach (Chapter 14)
- ◆ From the Eagles to the Magic: Converting the Amway Center (Chapter 15)
- ◆ Scheduling at Hard Rock Cafe (Chapter 15)
- ◆ Lean Operations at Alaska Airlines (Chapter 16)
- ◆ JIT at Arnold Palmer Hospital (Chapter 16)
- ◆ Maintenance Drives Profits at Frito-Lay (Chapter 17)
- ◆ Scheduling Challenges at Alaska Airlines (Module B)

Videos from Recent Graduates for Students

Located in [MyLab Operations Management](#) are brief videos of many recent grads who now work in some aspect of operations management. These 2- to 4-minute video clips feature young professionals talking about their jobs in the gamut of OM functions—each tied to a specific chapter and accompanied by multiple-choice quizzes that may be assigned. Each recent grad also talks about tips for success in the job market. This is sure to be a popular feature to engage students!



Kimberly Gersh, Project Manager, Little Green River Software

More Homework Problems—Quantity, Algorithmic, and Conceptual

We know that a vast selection of quality homework problems, ranging from easy to challenging (denoted by one to four dots), is critical for both instructors and students. Instructors need a broad selection of problems to choose from for homework, quizzes, and exams—without reusing the same set from semester to semester. We take pride in having more problems—by far, with 818—than any other OM text.

For this edition, we have added several **HUNDRED new algorithmic problems and concept questions** in [MyLab Operations Management](#)!

New Module Called “Applying Analytics to Big Data in Operations Management”

The marriage of business analytics, big data, and operations/supply chain management is a revolutionary change in our field. We are the first text to include a chapter (Module G) on this subject, which includes sections on data management, data visualization, and predictive and prescriptive business analytics tools. The topics include heat maps, conditional formatting for cleaning data, and pivot tables. The module includes numerous exercises that will use students’ Excel skills and show them the power of Excel in Big Data.

Detailed Chapter-by-Chapter Changes

Chapter 1: Operations and Productivity

We introduced two new learning objectives for the chapter: “*Identify* the 10 strategic decisions of operations management” and “*Identify* career opportunities in operations management.” Our first new video case study is called “Celebrity Cruises: Operations Management at Sea.” We updated several entries for the Globalization Era in Figure 1.4. We updated Table 1.4 to reflect employment in various sectors. Finally, we added a new discussion question.

Chapter 2: Operations Strategy in a Global Environment

We updated Figure 2.1 on the growth of world trade and added several key historical events to the graph. We added the new key term *operational hedging*. There are two new OM in Action boxes in this chapter: “Amazon Updates Sears’ Strategy” and “China Outsources Too—to Ethiopia.” Finally, we updated Figure 2.5 to reflect product life cycle changes.

Chapter 3: Project Management

The Bechtel Global Profile has been rewritten and we have added four new homework problems.

Chapter 4: Forecasting

There are eight new homework problems in this chapter.

Chapter 5: Design of Goods and Services

We modified Figure 5.2 to present the cash flows more clearly. We introduced a discussion of *additive manufacturing* as a new key term to subsume 3-D printing. We added a new discussion of *augmented reality*. There are two new OM in Action boxes: “Product Design at McDonald’s” and “Amazon Pushes Product Design.” Our second new video case study is called “Celebrity Cruises

Designs a New Ship.” We replaced the section on PCN Analysis with a new discussion on service design. We added two discussion questions and have seven new homework problems in this chapter.

Supplement 5: Sustainability in the Supply Chain

There is a new video case study called “Saving the Waves at Celebrity Cruises.” We’ve also added new material on the circular economy and on ISO 50001. There is also a new OM in Action box called “Designing for the End of Life.”

Chapter 6: Managing Quality

Our new video case study is called “Celebrity Cruises: A Premium Experience.” There is also a new OM in Action box called “Inspecting the Boeing 787,” new material on testing Samsung smart phones, and four new homework problems.

Supplement 6: Statistical Process Control

We have added 14 new homework problems and updated the OM in Action box called “Landing a Seat with Frequent Flyer Miles.”

Chapter 7: Process Strategies

We updated Figure 7.8 to simplify the presentation of degree of customization and labor for services. We added an OM in Action box called “500,000 Tons of Steel; 14 Jobs.” Finally, we updated Table 7.4 to provide more examples of technology’s impact on services.

Supplement 7: Capacity and Constraint Management

We modified the numbers used to compute actual output in Table S7.1. We modified Figure S7.6 to improve the exposition for the four approaches to capacity expansion. We added 10 new homework problems for this supplement. Finally, we updated the birth rates in Table S7.4 for the Arnold Palmer Hospital case.

Chapter 8: Location Strategies

We have added seven new homework problems to this chapter.

Chapter 9: Layout Strategies

There is a new OM in Action box called “Amazon Warehouses are Full of Robots,” and we have made major revisions to our coverage of Work Cells, Focused Facilities, Focused Work Centers, and Focused Factories. There are also four new homework problems.

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

We have added five new homework problems to this chapter.

Chapter 11: Supply Chain Management

We begin the chapter with a new Global Company Profile featuring Red Lobster. We’ve added a new section on blockchain, a new OM in Action box called “Samsung and Apple’s Complex Supply Chain,” and updated our treatment of SCOR. We also added three new homework problems.

Supplement 11: Supply Chain Management Analytics

There is a new discussion question and three new homework problems.

Chapter 12: Inventory Management

There is a new video case study called “Inventory Management at Celebrity Cruises.” We have also revised the Amazon Global Company Profile and expanded coverage of the single period model. In addition, there are 13 new homework problems.

Chapter 13: Aggregate Planning and S&OP

We’ve added three new homework problems to this chapter.

Chapter 14: Material Requirements Planning (MRP) and ERP

We deleted Figure 14.6 and moved the presentation of *allocated items* into Example 3. Under *MRP Management*, we introduced a new section and key term for *demand-driven MRP*, along with a new associated Figure 14.6. A discussion of *blockchains* is introduced in the *Enterprise Resource Planning (ERP)* section. Finally, five new homework problems were added for this chapter.

Chapter 15: Short-Term Scheduling

There are six new homework problems to this chapter.

Chapter 16: Lean Operations

There is a new OM in Action box, “Dr. Pepper’s Move to Kaizen,” and two new homework problems.

Chapter 17: Maintenance and Reliability

There is new coverage of predictive maintenance, and there are three new homework problems.

Module A: Decision Making Tools

There is a new case study, “Festival App,” and seven new homework problems.

Module B: Linear Programming

We have added seven new homework problems to this module.

Module C: Transportation Models

We have added one new homework problem to this module.

Module D: Waiting-Line Models

There are five new homework problems in this module.

Module E: Learning Curves

We have revised Figure E.1, which deals with exponential and log-log learning graphs.

Module F: Simulation

There are three new homework problems in this module.

Module G: Applying Analytics to Big Data in Operations Management

This new module includes sections on big data and business analytics, data management, data visualization, and predictive and prescriptive business analytics tools. There are 10 homework problems, two solved problems, and eight discussion questions.

Solving Teaching and Learning Challenges

Now in its 13th edition, the text and [MyLab Operations Management](#) provide an extremely comprehensive learning package. This robust program addresses teaching and learning challenges and affords the student with opportunities to learn and practice employable skills. Here are just a few of the key elements offered with this textbook and [MyLab Operations Management](#).

MyLab Operations Management

MyLab Operations Management is the teaching and learning platform that empowers *every* student. When combined with educational content written by the authors, **MyLab Operations Management** helps deliver the learning outcomes to which students and instructors aspire.



Operations Management Simulations

Five operations management simulations give students hands-on experience in real-world roles, helping them make decisions, think critically, and link course concepts to on-the-job application.

By receiving real-time, dynamic feedback from stakeholders, students see the impact of their choices and can gauge their performance against individual, peer, and system metrics. Results of these simulations are recorded in the MyLab Gradebook.

The five simulations are:

- ◆ Project Management (Chapter 3)
- ◆ Forecasting (Chapter 4)
- ◆ Quality Management (Chapter 6)
- ◆ Supply Chain Management (Chapter 11)
- ◆ Inventory Management (Chapter 12)

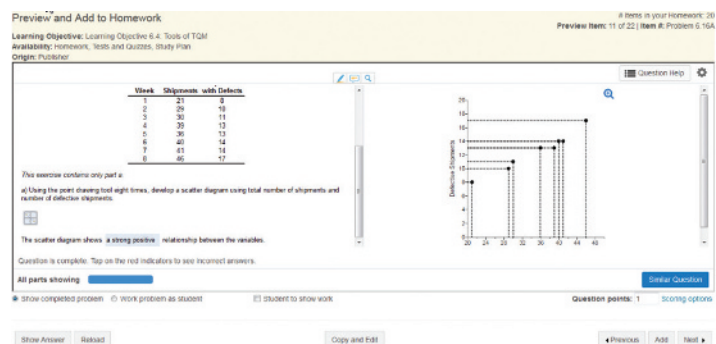
Students tell us that they enjoy learning OM through these simulations!

A Powerful Homework and Test Manager

Problems from the textbook can be assigned to students via a robust platform. This allows instructors to manage, create, and import online homework assignments, quizzes, and tests that are automatically graded. Instructors can choose from a wide range of assignment options, including time limits, proctoring, and maximum number of attempts allowed. The bottom line: **MyLab Operations Management** means more learning and less time grading.

Learning Aids

Right at the time of learning, students can access Learning Aids like Help Me Solve This, Videos from the authors of similar problems being solved, Ask My Instructor, and eText Pages. All of which provides the student feedback and assistance when they need it most.



Working with Excel Software

Excel use in the Operations Management course is becoming more important, and instructors often ask their students to develop their own Excel spreadsheet models. For this reason, we provide “Creating Your Own Excel Spreadsheets,” examples toward the end of numerous chapters.

Decision Support Software

We also provide two decision support software programs, Excel OM for Windows and Mac, and POM for Windows, to help solve homework problems and case studies. More information on these packages can be found in **MyLab Operations Management** in the Download Center.

Using Software to Solve Outsourcing Problems

Excel, Excel OM, and POM for Windows may be used to solve many of the problems in this chapter.

CREATING YOUR OWN EXCEL SPREADSHEETS

Program 2.1 illustrates how to build an Excel spreadsheet for the data in Example 1. In this example the factor rating method is used to compare National Architects' three potential outsourcing providers.

This program provides the data inputs for seven important factors, including their weights (0.0–1.0) and ratings (1–5 scale where 5 is the highest rating) for each country. As we see, BIM is most highly rated, with a 3.9 score, versus 3.3 for S.P.C. and 3.8 for Telco.

Enter factor names and weights in columns A and B.		Enter scores (that come from manager ratings) for BIM, S.P.C., and Telco on each factor in columns C, D, and E.			
		IMPORTANCE	BIM	S.P.C.	TELCO
		WEIGHT	(U.S.)	(INDIA)	(ISRAEL)
1. National Architects, Inc.					
2. Factor Rating Method					
3.					
4.					
5. FACTOR (CRITERION)					
6. 1. Can reduce operating costs	0.2	4	1	5	
7. 2. Can reduce capital investment	0.2	4	1	3	
8. 3. Skilled personnel	0.2	5	4	3	
9. 4. Can improve quality	0.1	4	5	2	
10. 5. Can gain access to technology not in the company	0.1	5	1	5	
11. 6. Can create additional capacity	0.1	4	2	4	
12. 7. Aligns with policy/philosophy/culture	0.1	2	3	3	
13.					
14. Total Weighted Score		3.9	3.3	3.8	
15.					
16.					
17. Actions					
18. Copy C14 to D14 and E14					
19.					
20.					
21.					
22.					
23.					
24.					
25.					
26.					
27.					
28.					

Program 2.1

Using Excel to Develop a Factor Rating Analysis, With Data from Example 1

✕ USING EXCEL OM

Excel OM (free with your text and also found in **MyLab Operations Management**) may be used to solve Example 1 (with the Factor Rating module).

► USING POM FOR WINDOWS

POM for Windows also includes a factor rating module. For details, refer to Appendix II. POM for Windows is also found in **MyLab Operations Management** and can solve all problems labeled with a ►.



JAY, BARRY, & CHUCK'S OM BLOG

A Blog for Operations Management Educators

Home About the Authors MyOMLab Order a Desk Copy

MyLab Operations Management: Features You Will Want to Explore in Class—Part 1

SEPTEMBER 3, 2018

by Barry Render

Super: MyLab Operations Management, teaching OM

Jay, Chuck, and I were just talking about how powerful our MyLab learning system has become over the past five years, when we figured out that even we had trouble listing ALL of the newer features! With over half of our OM text's 500+ adopters now using the platform, its time to layout the options. So here is Part 1 (of 2):

Simulations: We have 5 gaming simulations:

WHY THIS BLOG?

Welcome to our blog for operations management educators. In this site you will find a wide variety of ideas that may help you teach your Operations Management course using one of our two texts. We hope you find this to be a helpful resource as you prepare for your Operations Management course.

SUBSCRIBE TO OUR BLOG

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VISITORS

Jay, Barry, & Chuck's OM Blog

As a complement to this text, we have created a companion blog, with coordinated features to help teach the OM course. There are teaching tips, highlights of OM items in the news (along with class discussion questions and links), video tips, guest posts by instructors using our text, and much more—all arranged by chapter. To learn more about any chapter topics, visit www.heizerrenderOM.wordpress.com. As instructors prepare their lectures and syllabus, they can scan our blog for discussion ideas, teaching tips, and classroom exercises.

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Professor Heizer has co-authored five books and has published more than 30 articles on a variety of management topics. His papers have appeared in the *Academy of Management Journal*, *Journal of Purchasing*, *Personnel Psychology*, *Production & Inventory Control Management*, *APICS—The Performance Advantage*, *Journal of Management History*, *IIE Solutions*, and *Engineering Management*, among others. He has taught operations management courses in undergraduate, graduate, and executive programs.

BARRY RENDER



The Charles Harwood Professor Emeritus of Operations Management, Crummer Graduate School of Business, Rollins College, Winter Park, Florida. He received his B.S. in Mathematics and Physics at Roosevelt University, and his M.S. in Operations Research and Ph.D. in Quantitative Analysis at the University of Cincinnati. He previously taught at George Washington University, University of New Orleans, Boston University, and George Mason University, where he held the Mason Foundation Professorship in Decision Sciences and was Chair of the Decision Sciences Department. Dr. Render has also worked in the aerospace industry for General Electric, McDonnell Douglas, and NASA.

Professor Render has co-authored 10 textbooks for Pearson, including *Managerial Decision Modeling with Spreadsheets*, *Quantitative Analysis for Management*, *Service Management*, *Introduction to Management Science*, and *Cases and Readings in Management Science*. *Quantitative Analysis for Management*, now in its 14th edition, is a leading text in that discipline in the United States and globally. Dr. Render's more than 100 articles on a variety of management topics have appeared in *Decision Sciences*, *Production and Operations Management*, *Interfaces*, *Information and Management*, *Journal of Management Information Systems*, *Socio-Economic Planning Sciences*, *IIE Solutions*, and *Operations Management Review*, among others. Dr. Render has been honored as an AACSB Fellow and was twice named a Senior Fulbright Scholar. He was Vice President of the Decision Science Institute Southeast Region and served as Software Review Editor for *Decision Line* for six years and as Editor of the *New York Times* Operations Management special issues for five years. For nine years, Dr. Render was President of Management Service Associates of Virginia, Inc., whose technology clients included the FBI, NASA, the U.S. Navy, Fairfax County, Virginia, and C&P Telephone. Dr. Render has received Rollins College's Welsh Award as leading Professor and was selected by Roosevelt University as the recipient of the St. Claire Drake Award for Outstanding Scholarship. Dr. Render also received the Rollins College MBA Student Award for Best Overall Course and was named Professor of the Year by full-time MBA students.

Professor of Operations Management and Carson College of Business Ph.D. Program Director, Washington State University, Pullman, Washington. He received his BSBA *summa cum laude* in finance, along with his MSBA and Ph.D. in operations management, from Washington University in St. Louis. For three years, he worked as a financial analyst for Contel Telephone Corporation.

Professor Munson serves as a senior editor for *Production and Operations Management*, and he serves on the editorial review board of four other journals. He has published more than 25 articles in such journals as *Production and Operations Management*, *IIE Transactions*, *Decision Sciences*, *Naval Research Logistics*, *European Journal of Operational Research*, *Journal of the Operational Research Society*, and *Annals of Operations Research*. He is editor of the book *The Supply Chain Management Casebook: Comprehensive Coverage and Best Practices in SCM*, and he has co-authored the research monograph *Quantity Discounts: An Overview and Practical Guide for Buyers and Sellers*. He is also coauthor of *Managerial Decision Modeling: Business Analytics with Spreadsheets* (4th edition), published by deGruyter.

Dr. Munson has taught operations management core and elective courses at the undergraduate, MBA, and Ph.D. levels at Washington State University. He has also conducted several teaching workshops at international conferences and for Ph.D. students at Washington State University. His major awards include winning the Sahlin Faculty Excellence Award for Instruction (Washington State University's top teaching award, 2016); being a Founding Board Member of the Washington State University President's Teaching Academy (2004); winning the WSU College of Business Outstanding Teaching Award (2001 and 2015), Research Award (2004), and Service Award (2009 and 2013); and being named the WSU MBA Professor of the Year (2000 and 2008).

CHUCK MUNSON


Instructor Teaching Resources

This teaching package comes with the following teaching resources.

Supplements available to instructors at http://www.pearsonglobal editions.com/	Features of the Supplement
Instructor's Resource Manual authored by Chuck Munson	• Chapter summary • Class Discussion Ideas • Active Classroom Learning Exercises • Company Videos discussion • Cinematic Ticklers • Jay, Barry, and Chuck's OM Blog • Presentation Slides discussion • Additional Assignment Ideas • Internet Resources and Other Supplementary Materials
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.
Test Bank authored by Jianli Hu, Cerritos College	• More than 1,500 multiple-choice, true-or-false, and essay questions • Keyed by learning objective • Classified according to difficulty level • AACSB learning standard identified (Ethical Understanding and Reasoning; Analytical Thinking Skills; Information Technology; Diverse and Multicultural Work; Reflective Thinking; Application of Knowledge)
Computerized TestGen	TestGen allows instructors to • customize, save, and generate classroom tests. • edit, add, or delete questions from the Test Item Files. • analyze test results. • organize a database of tests and student results.
PowerPoints authored by Jeff Heyl, Lincoln University	An extensive set of PowerPoint presentations is available for each chapter. With well over 2,000 slides, this set has excellent color and clarity. A set of PowerPoints is also available as an ADA-compliant version that meet accessibility standards for students with disabilities. Features include: • Keyboard and screen reader access • Alternative text for images • High contrast between background and foreground colors
Excel Data Files, Excel OM, POM for Windows, and Active Models developed by Howard Weiss, Temple University	• The data files are prepared for specific examples and allow users to solve all the marked text examples without reentering any data. • POM for Windows is a powerful tool for easily solving OM problems. • Excel OM is our exclusive user-friendly Excel add-in. Excel OM automatically creates worksheets to model and solve problems. This software is great for student homework, what-if analysis, and classroom demonstrations. • Active Models are Excel-based OM simulations, designed to help students understand the quantitative methods shown in the textbook examples. Students may change the data to see how the changes affect the answers.

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In this edition, we were thrilled to be able to include one of the country's premier cruise lines, Celebrity Cruises, in our ongoing Video Case Study series. This was possible because of the wonderful efforts of President and CEO Lisa Lutoff-Perlo, and her superb management team. This included Patrik Dahlgren (Senior V.P. Global Marine Operations), Cornelius Gallagher (Associate V.P., Food and Beverage Operations), Brian Abel (V.P., Hotel Operations), and Paul Litvinov (Associate V.P., Strategic Sourcing and Supply Chain Management). 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 Miami headquarters. In addition, we owe a deep gratitude to Rod McLeod, former Executive V.P., Royal Caribbean International, for introducing us to and tutoring us in the intricacies of the cruise industry.

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

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Operations and Productivity

1

CHAPTER

CHAPTER OUTLINE

GLOBAL COMPANY PROFILE: *Hard Rock Cafe*

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- ◆ Organizing to Produce Goods and Services 36
- ◆ The Supply Chain 38
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Beverly Amer/Aspenleaf Productions

A view of the bridge of a Celebrity Cruise ship (Celebrity Cruises is the focus of the new video cases with this edition).

- Design of Goods and Services
- Managing Quality
- Process Strategies
- 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 Stock Photo

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.



Getty Images/Hulton Archive/Getty Images



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.

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.



Orlando-based Hard Rock Cafe opened its first restaurant in London in 1971, making it over 48 years old and the granddaddy of theme restaurants. Although other theme restaurants have come and gone, Hard Rock is still going strong, with 23 hotels and 168 restaurants in more than 68 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 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	36
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STUDENT TIP

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

LO 1.1 Define operations management

VIDEO 1.1

Operations Management at Hard Rock

VIDEO 1.2

Operations Management at Frito-Lay

VIDEO 1.3

Celebrity Cruises: Operations Management at Sea

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:

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

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.

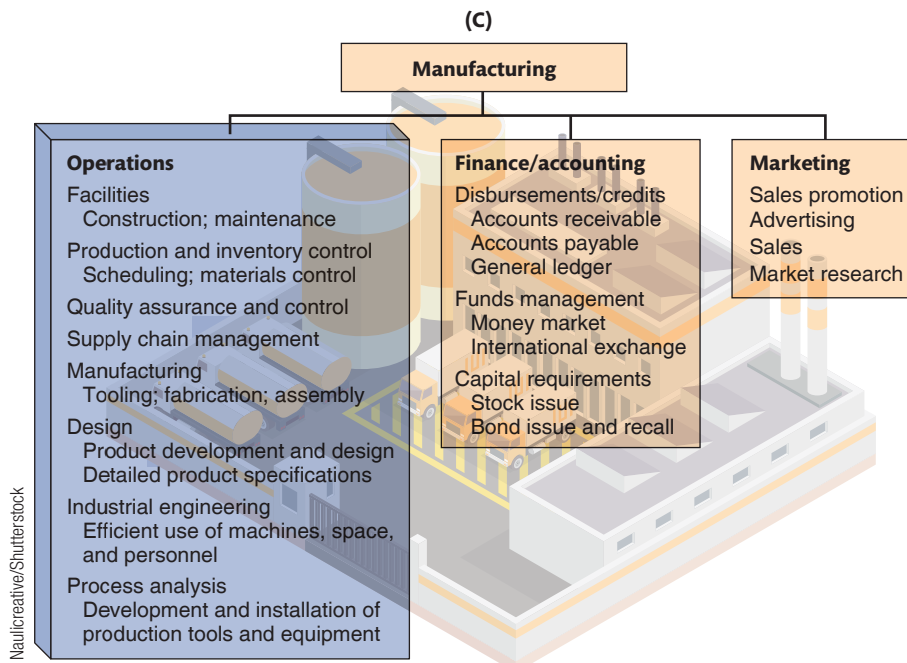
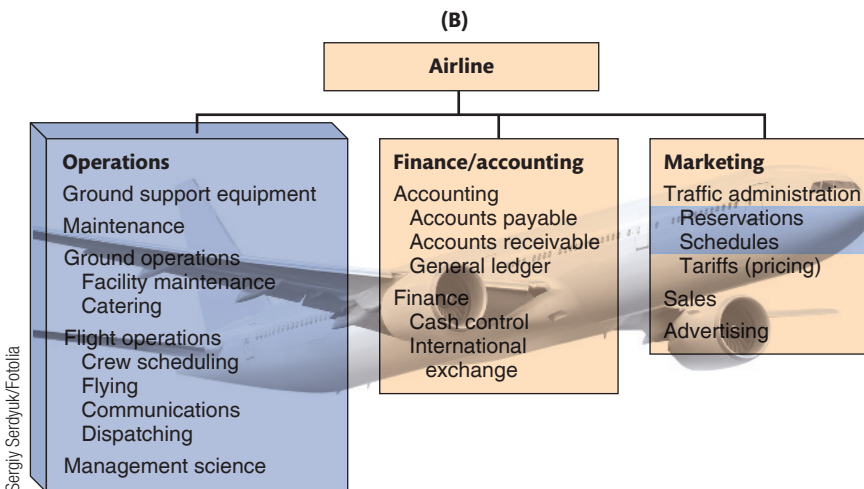
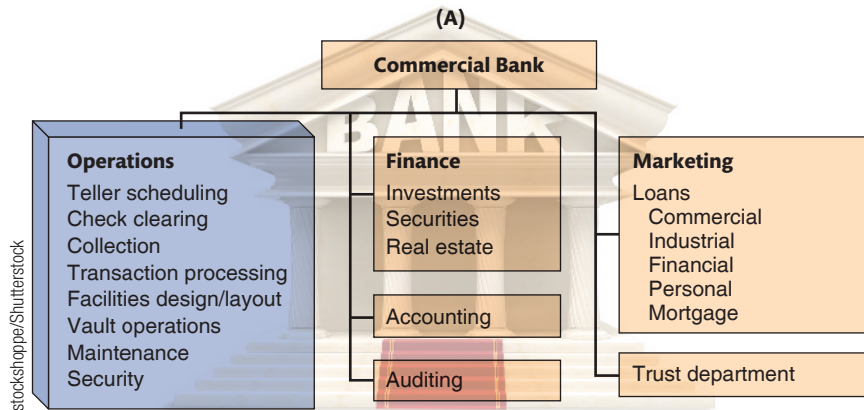
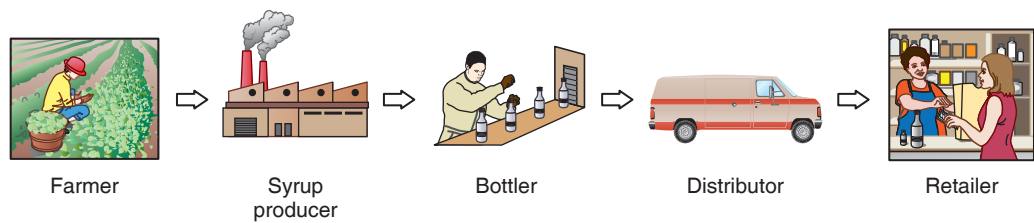


Figure 1.2

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.



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.

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*.

Supply chain

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

STUDENT TIP

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

Why Study OM?

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

	CURRENT	MARKETING OPTION ^a	FINANCE/ ACCOUNTING OPTION ^b	OM OPTION ^c
		INCREASE SALES REVENUE 50%	REDUCE FINANCE COSTS 50%	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 ^d	\$ 10,500	\$ 18,000	\$ 12,750	\$ 22,500

^aIncreasing sales 50% increases contribution by \$7,500, or 71% ($7,500/10,500$).

^bReducing finance costs 50% increases contribution by \$2,250, or 21% ($2,250/10,500$).

^cReducing production costs 20% increases contribution by \$12,000, or 114% ($12,000/10,500$).

^dContribution 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,

10 Strategic OM Decisions

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

STUDENT TIP

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

LO 1.2 *Identify the 10 strategic decisions of operations management*

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 and statistical process control</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 strategies</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 strategies</i> : Requires judgments regarding nearness to customers, suppliers, and talent, while considering costs, infrastructure, logistics, and government.	8
5. <i>Layout strategies</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, job design and work measurement</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 use 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

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)
- ◆ American Society for Quality (ASQ) (www.asq.org)
- ◆ Institute for Supply Management (ISM) (www.ism.ws)
- ◆ Project Management Institute (PMI) (www.pmi.org)
- ◆ Council of Supply Chain Management Professionals (www.cscmp.org)

Figure 1.3 shows some recent job opportunities.

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.

LO 1.3 *Identify career opportunities in operations management*

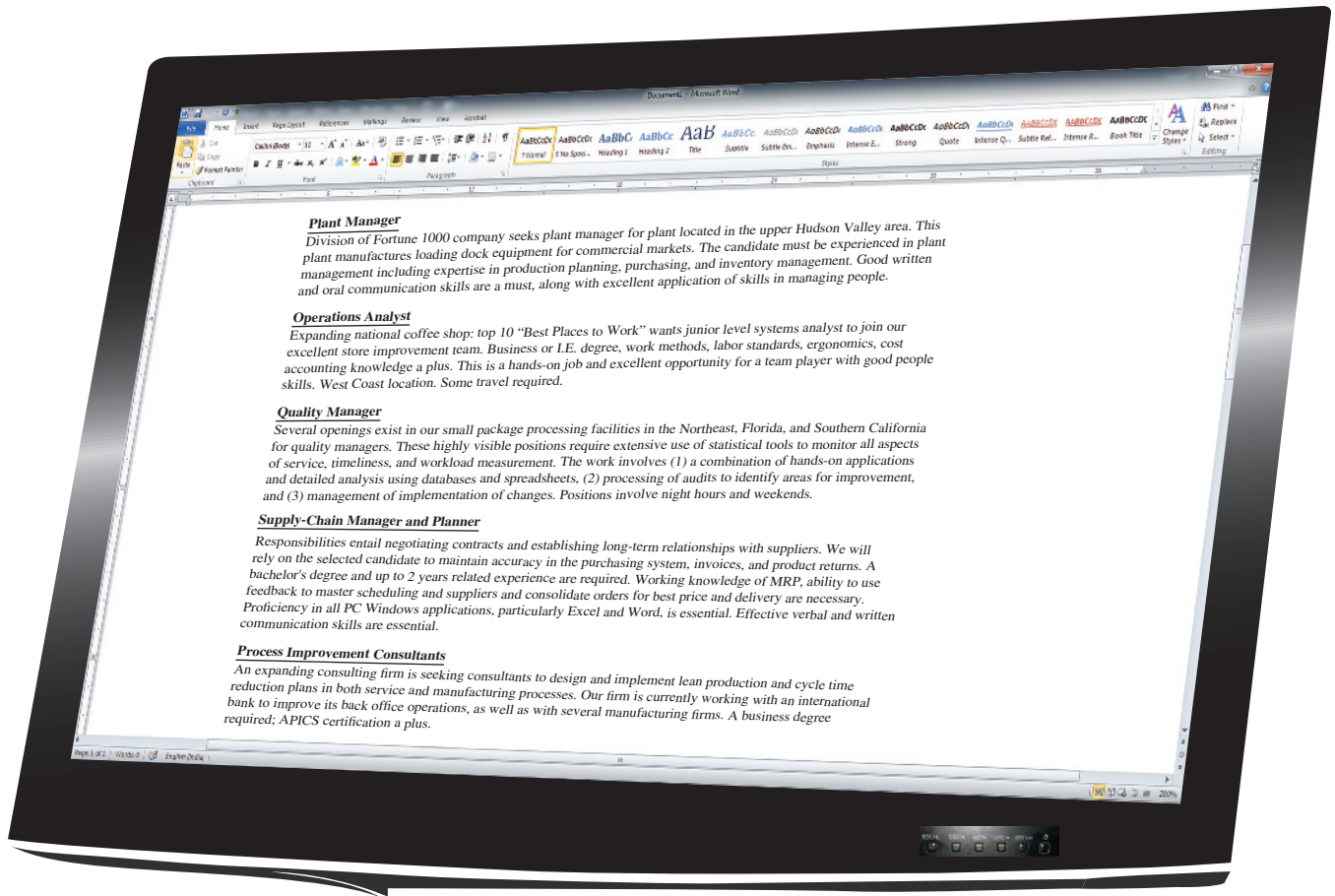


Figure 1.3

Many Career Opportunities Exist for Operations Managers

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.

Another of Taylor's contributions was the belief that management should assume more responsibility for:

1. Matching employees to the right job.
2. Providing the proper training.
3. Providing proper work methods and tools.
4. Establishing legitimate incentives for work to be accomplished.



Cost Focus		Quality Focus	Customization Focus	Globalization Focus
Early Concepts 1776–1880		Lean Production Era 1980–1995	Mass Customization Era 1995–2005	Globalization Era 2005–2025
Labor Specialization (Smith, Babbage)		Just-in-Time (JIT)	Internet/E-Commerce	Global Supply Chains
Standardized Parts (Whitney)		Computer-Aided Design (CAD)	Enterprise Resource Planning	and Logistics
Scientific Management Era 1880–1910		Electronic Data Interchange (EDI)	International Quality Standards (ISO)	Growth of Transnational Organizations
Gantt Charts (Gantt)		Total Quality Management (TQM)	Finite Scheduling	Sustainability
Motion & Time Studies (Gilbreth)		Baldrige Award	Supply Chain Management	Ethics in the Global Workplace
Process Analysis (Taylor)		Empowerment	Mass Customization	Internet of Things (IoT)
Queuing Theory (Erlang)		Kanbans	Build-to-Order	Digital Operations
			Radio Frequency Identification (RFID)	Industry 4.0

Figure 1.4

Significant Events in Operations Management

By 1913, Henry Ford and Charles Sorensen combined what they knew about standardized parts with the quasi-assembly lines of the meatpacking and mail-order industries and added the revolutionary concept of the assembly line, where men stood still and material moved.

Quality control is another historically significant contribution to the field of OM. Walter Shewhart (1924) combined his knowledge of statistics with the need for quality control and provided the foundations for statistical sampling in quality control. W. Edwards Deming (1950) believed, as did Frederick Taylor, that management must do more to improve the work environment and processes so that quality can be improved.

Operations management will continue to progress as contributions from other disciplines, including *industrial engineering*, *statistics*, *management*, *analytics*, and *economics*, improve decision making.

Innovations from the *physical sciences* (biology, anatomy, chemistry, physics) have also contributed to advances in OM. These innovations include new adhesives, faster integrated circuits, gamma rays to sanitize food products, and specialized glass for iPhones and plasma TVs. Innovation in products and processes often depends on advances in the physical sciences.

Especially important contributions to OM have come from *information technology*, which we define as the systematic processing of data to yield information. Information technology—with wireless links, Internet, and e-commerce—is reducing costs and accelerating communication.

Decisions in operations management require individuals who are well versed in analytical tools, in information technology, and often in one of the biological or physical sciences. In this textbook, we look at the diverse ways a student can prepare for a career in operations management.

Operations for Goods and Services

Manufacturers produce a tangible product, while service products are often intangible. But many products are a combination of a good and a service, which complicates the definition of a service. Even the U.S. government has trouble generating a consistent definition. Because definitions vary, much of the data and statistics generated about the service sector are inconsistent. However, we define **services** as including repair and maintenance, government, food and lodging, transportation, insurance, trade, financial, real estate, education, legal, medical, entertainment, and other professional occupations.

The operation activities for both goods and services are often very similar. For instance, both have quality standards, are designed and produced on a schedule that meets customer demand, and are made in a facility where people are employed. However, some major differences *do* exist between goods and services. These are presented in Table 1.3.

We should point out that in many cases, the distinction between goods and services is not clear-cut. In reality, almost all services and almost all goods are a mixture of a service and a tangible product. Even services such as consulting may require a tangible report. Similarly, the sale of most goods includes a service. For instance, many products have the service components of financing and delivery (e.g., automobile sales). Many also require after-sale training and maintenance (e.g., office copiers and machinery). “Service” activities may also be an integral part of production. Human resource activities, logistics, accounting, training, field service, and repair are all service activities, but they take place within a manufacturing organization. Very few services are “pure,” meaning they have no tangible component. Counseling may be one of the exceptions.

STUDENT TIP

Services are especially important because almost 80% of all jobs are in service firms.

Services

Economic activities that typically produce an intangible product (such as education, entertainment, lodging, government, financial, and health services).

LO 1.4 Explain the distinction between goods and services

Growth of Services

Services constitute the largest economic sector in postindustrial societies. Until about 1900, most Americans were employed in agriculture. Increased agricultural productivity allowed people to leave the farm and seek employment in the city. Similarly, manufacturing employment has decreased for the past 60 years. The changes in agriculture, manufacturing, and service employment as a percentage of the workforce are shown in Figure 1.5. Although the *number* of people employed in manufacturing has decreased since 1950, each person is now producing almost 20 times more than in 1950. Services became the dominant

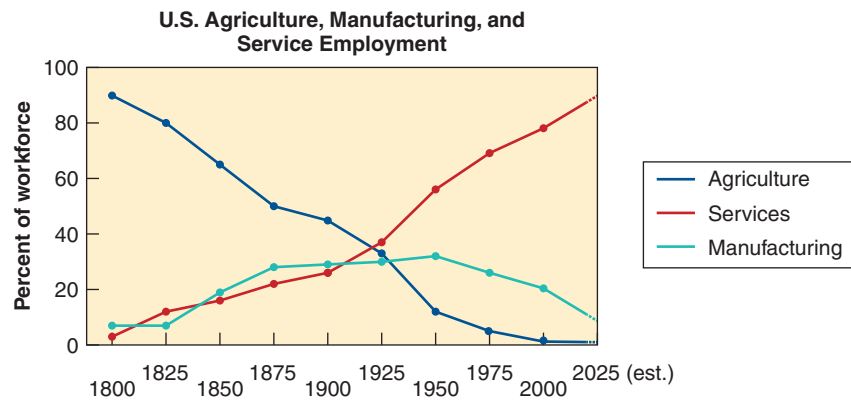
TABLE 1.3 Differences Between Goods and Services

CHARACTERISTICS OF SERVICES	CHARACTERISTICS OF GOODS
Intangible: Ride in an airline seat	Tangible: The seat itself
Produced and consumed simultaneously: Beauty salon produces a haircut that is consumed as it is produced	Product can usually be kept in inventory (beauty care products)
Unique: Your investments and medical care are unique	Similar products produced (iPods)
High customer interaction: Often what the customer is paying for (consulting, education)	Limited customer involvement in production
Inconsistent product definition: Auto insurance changes with age and type of car	Product standardized (iPhone)
Often knowledge based: Legal, education, and medical services are hard to automate	Standard tangible product tends to make automation feasible
Services dispersed: Service may occur at retail store, local office, house call, or via Internet.	Product typically produced at a fixed facility
Quality may be hard to evaluate: Consulting, education, and medical services	Many aspects of quality for tangible products are easy to evaluate (strength of a bolt)
Reselling is unusual: Musical concert or medical care	Product often has some residual value

Figure 1.5

U.S. Agriculture, Manufacturing, and Service Employment

Source: U.S. Bureau of Labor Statistics.



employer in the early 1920s, with manufacturing employment peaking at about 32% in 1950. The huge productivity increases in agriculture and manufacturing have allowed more of our economic resources to be devoted to services. Consequently, much of the world can now enjoy the pleasures of education, health services, entertainment, and myriad other things that we call services. Examples of firms and percentage of employment in the U.S. **service sector** are shown in Table 1.4. Table 1.4 also provides employment percentages for the nonservice sectors of manufacturing, construction, agriculture, and mining on the bottom four lines.

Service sector

The segment of the economy that includes trade, financial, lodging, education, legal, medical, and other professional occupations.

Service Pay

Although there is a common perception that service industries are low paying, in fact, many service jobs pay very well. Operations managers in the maintenance facility of an airline are very well paid, as are the operations managers who supervise computer services to the financial community. About 42% of all service workers receive wages above the national average. However, the service-sector average is driven down because 14 of the U.S. Department of

TABLE 1.4 Examples of Organizations in Each Sector

SECTOR	EXAMPLE	PERCENTAGE OF ALL JOBS	
Service Sector			
Education, Medical, Other	San Diego State University, Arnold Palmer Hospital	16.2	85.9
Trade (retail, wholesale), Transportation	Walgreen’s, Walmart, Nordstrom, Alaska Airlines	17.1	
Information, Publishers, Broadcast	IBM, Bloomberg, Pearson, ESPN	1.8	
Professional, Legal, Business Services, Associations	Snelling and Snelling, Waste Management, American Medical Association, Ernst & Young	17.0	
Finance, Insurance, Real Estate	Citicorp, American Express, Prudential, Aetna	9.6	
Leisure, Lodging, Entertainment	Red Lobster, Motel 6, Celebrity Cruises	10.0	
Government (Fed, State, Local)	U.S., State of Alabama, Cook County	14.2	
Manufacturing Sector	General Electric, Ford, U.S. Steel, Intel		7.9
Construction Sector	Bechtel, McDermott		4.3
Agriculture	King Ranch		1.5
Mining Sector	Homestake Mining		0.4
Grand Total			100.0

Source: Bureau of Labor Statistics, 2017.

Commerce categories of the 33 service industries do indeed pay below the all-private industry average. Of these, retail trade, which pays only 61% of the national private industry average, is large. But even considering the retail sector, the average wage of all service workers is about 96% of the average of all private industries.

The Productivity Challenge

The creation of goods and services requires changing resources into goods and services. The more efficiently we make this change, the more productive we are and the more value is added to the good or service provided. **Productivity** is the ratio of outputs (goods and services) divided by the inputs (resources, such as labor and capital) (see Figure 1.6). The operations manager's job is to enhance (improve) this ratio of outputs to inputs. Improving productivity means improving efficiency.¹

This improvement can be achieved in two ways: reducing inputs while keeping output constant or increasing output while keeping inputs constant. Both represent an improvement in productivity. In an economic sense, inputs are labor, capital, and management, which are integrated into a production system. Management creates this production system, which provides the conversion of inputs to outputs. Outputs are goods and services, including such diverse items as guns, butter, education, improved judicial systems, and ski resorts. *Production* is the making of goods and services. High production may imply only that more people are working and that employment levels are high (low unemployment), but it does not imply high productivity.

Measurement of productivity is an excellent way to evaluate a country's ability to provide an improving standard of living for its people. *Only through increases in productivity can the standard of living improve.* Moreover, only through increases in productivity can labor, capital, and management receive additional payments. If returns to labor, capital, or management are increased without increased productivity, prices rise. On the other hand, downward pressure is placed on prices when productivity increases because more is being produced with the same resources.

The benefits of increased productivity are illustrated in the *OM in Action* box "Improving Productivity at Starbucks."

For well over a century (from about 1869), the U.S. has been able to increase productivity at an average rate of almost 2.5% per year. Such growth has doubled U.S. wealth every 30 years. The manufacturing sector, although a decreasing portion of the U.S. economy, has on occasion seen annual productivity increases exceeding 4%, and service sector increases of almost 1%. However, U.S. annual productivity growth in the early part of the 21st century is slightly below the 2.5% range for the economy as a whole and in recent years has been trending down.²

In this text, we examine how to improve productivity through operations management. Productivity is a significant issue for the world and one that the operations manager is uniquely qualified to address.

STUDENT TIP

Why is productivity important?
Because it determines our standard of living.

Productivity

The ratio of outputs (goods and services) divided by one or more inputs (such as labor, capital, or management).

LO 1.5 Explain the difference between production and productivity

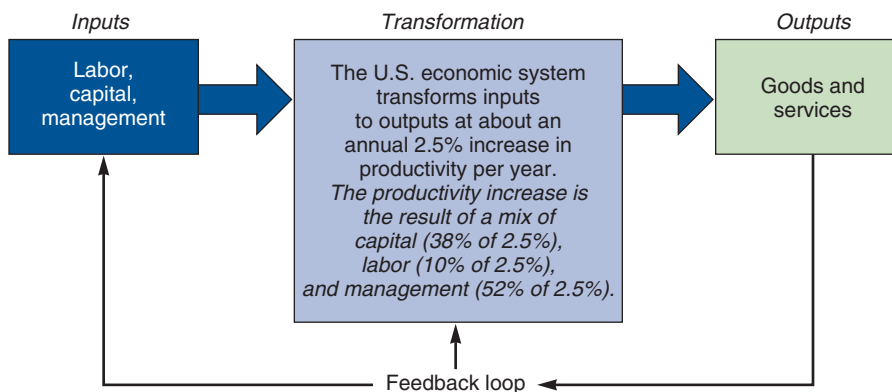


Figure 1.6

The Economic System Adds Value by Transforming Inputs to Outputs

An effective feedback loop evaluates performance against a strategy or standard. It also evaluates customer satisfaction and sends signals to managers controlling the inputs and transformation process.

OM in Action Improving Productivity at Starbucks

"This is a game of seconds ..." says Silva Peterson, whom Starbucks has put in charge of saving seconds. Her team of 10 analysts is constantly asking themselves: "How can we shave time off this?"

Peterson's analysis suggested that there were some obvious opportunities. First, stop requiring signatures on credit-card purchases under \$25. This sliced 8 seconds off the transaction time at the cash register.

Then analysts noticed that Starbucks' largest cold beverage, the Venti size, required two bending and digging motions to scoop up enough ice. The scoop was too small. Redesign of the scoop provided the proper amount in one motion and cut 14 seconds off the average time of 1 minute.

Third were new espresso machines; with the push of a button, the machines grind coffee beans and brew. This allowed the server, called a "barista" in Starbucks's vocabulary, to do other things. The savings: about 12 seconds per espresso shot.

As a result, operations improvements at Starbucks outlets have increased the average transactions per hour to 11.7—a 46% increase—and yearly volume by \$250,000, to about \$1 million. The result: a 27% improvement in overall productivity—about 4.5% per year. In the service industry, a 4.5% per year increase is very tasty.

Sources: *Businessweek* (August 23–30, 2012); *Fortune* (October 30, 2014); and QZ.com/Starbucks.



Kondor83/Shutterstock

LO 1.6 Compute single-factor productivity

Productivity Measurement

The measurement of productivity can be quite direct. Such is the case when productivity is measured by labor-hours per ton of a specific type of steel. Although labor-hours is a common measure of input, other measures such as capital (dollars invested), materials (tons of ore), or energy (kilowatts of electricity) can be used.³ An example of this can be summarized in the following equation:

$$\text{Productivity} = \frac{\text{Units produced}}{\text{Input used}} \quad (1-1)$$

For example, if units produced = 1,000 and labor-hours used is 250, then:

$$\text{Single-factor productivity} = \frac{\text{Units produced}}{\text{Labor-hours used}} = \frac{1,000}{250} = 4 \text{ units per labor-hour}$$

The use of just one resource input to measure productivity, as shown in Equation (1-1), is known as **single-factor productivity**. However, a broader view of productivity is **multifactor productivity**, which includes all inputs (e.g., capital, labor, material, energy). Multifactor productivity is also known as **total factor productivity**. Multifactor productivity is calculated by combining the input units as shown here:

$$\text{Multifactor productivity} = \frac{\text{Output}}{\text{Labor} + \text{Material} + \text{Energy} + \text{Capital} + \text{Miscellaneous}} \quad (1-2)$$

To aid in the computation of multifactor productivity, the individual inputs (the denominator) can be expressed in dollars and summed as shown in Example 2.

Single-factor productivity

Indicates the ratio of goods and services produced (outputs) to one resource (input).

Multifactor productivity

Indicates the ratio of goods and services produced (outputs) to many or all resources (inputs).

Example 2

COMPUTING SINGLE-FACTOR AND MULTIFACTOR GAINS IN PRODUCTIVITY

Collins Title Insurance Ltd. wants to evaluate its labor and multifactor productivity with a new computerized title-search system. The company has a staff of four, each working 8 hours per day (for a payroll cost of \$640/day) and overhead expenses of \$400 per day. Collins processes and closes on 8 titles each day. The new computerized title-search system will allow the processing of 14 titles per day. Although the staff, their work hours, and pay are the same, the overhead expenses are now \$800 per day.

APPROACH ► Collins uses Equation (1-1) to compute labor productivity and Equation (1-2) to compute multifactor productivity.

LO 1.7 Compute multifactor productivity**SOLUTION ►**

Labor productivity with the old system: $\frac{8 \text{ titles per day}}{32 \text{ labor-hours}} = .25 \text{ title per labor-hour}$

Labor productivity with the new system: $\frac{14 \text{ titles per day}}{32 \text{ labor-hours}} = .4375 \text{ title per labor-hour}$

Multifactor productivity with the old system: $\frac{8 \text{ titles per day}}{\$640 + \$400} = .0077 \text{ title per dollar}$

Multifactor productivity with the new system: $\frac{14 \text{ titles per day}}{\$640 + \$800} = .0097 \text{ title per dollar}$

Labor productivity has increased from .25 to .4375. The change is $(.4375 - .25)/.25 = 0.75$, or a 75% increase in labor productivity. Multifactor productivity has increased from .0077 to .0097. This change is $(.0097 - .0077)/.0077 = 0.26$, or a 26% increase in multifactor productivity.

INSIGHT ► Both the labor (single-factor) and multifactor productivity measures show an increase in productivity. However, the multifactor measure provides a better picture of the increase because it includes all the costs connected with the increase in output.

LEARNING EXERCISE ► If the overhead goes to \$960 (rather than \$800), what is the multifactor productivity? [Answer: .00875.]

RELATED PROBLEMS ► 1.1, 1.2, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 1.11, 1.13, 1.14, 1.17

Use of productivity measures aids managers in determining how well they are doing. But results from the two measures can be expected to vary. If labor productivity growth is entirely the result of capital spending, measuring just labor distorts the results. Multifactor productivity is usually better, but more complicated. Labor productivity is the more popular measure. The multifactor-productivity measures provide better information about the trade-offs among factors, but substantial measurement problems remain. Some of these measurement problems are:

1. *Quality* may change while the quantity of inputs and outputs remains constant. Compare a smart LED TV of this decade with a black-and-white TV of the 1950s. Both are TVs, but few people would deny that the quality has improved. The unit of measure—a TV—is the same, but the quality has changed.
2. *External elements* may cause an increase or a decrease in productivity for which the system under study may not be directly responsible. A more reliable electric power service may greatly improve production, thereby improving the firm's productivity because of this support system rather than because of managerial decisions made within the firm.
3. *Precise units of measure* may be lacking. Not all automobiles require the same inputs: Some cars are subcompacts, others are 911 Turbo Porsches.

Productivity measurement is particularly difficult in the service sector, where the end product can be hard to define. For example, economic statistics ignore the quality of your haircut, the outcome of a court case, or the service at a retail store. In some cases, adjustments are made for the quality of the product sold but *not* the quality of the sales presentation or the advantage of a broader product selection. Productivity measurements require specific inputs and outputs, but a free economy is producing worth—what people want—which includes convenience, speed, and safety. Traditional measures of outputs may be a very poor measure of these other measures of worth. Note the quality-measurement problems in a law office, where each case is different, altering the accuracy of the measure “cases per labor-hour” or “cases per employee.”

Productivity Variables

As we saw in Figure 1.6, productivity increases are dependent on three **productivity variables**:

1. *Labor*, which contributes about 10% of the annual increase.
2. *Capital*, which contributes about 38% of the annual increase.
3. *Management*, which contributes about 52% of the annual increase.

These three factors are critical to improved productivity. They represent the broad areas in which managers can take action to improve productivity.

Productivity variables

The three factors critical to productivity improvement—labor, capital, and the art and science of management.

Figure 1.7

About Half of the 17-Year-Olds in the U.S. Cannot Correctly Answer Questions of This Type

 6 yds 4 yds What is the area of this rectangle? _____ 4 square yds _____ 6 square yds _____ 10 square yds _____ 20 square yds _____ 24 square yds	If $9y + 3 = 6y + 15$ then $y =$ _____ 1 _____ 4 _____ 2 _____ 6
	Which of the following is true about 84% of 100? _____ It is greater than 100 _____ It is less than 100 _____ It is equal to 100

LO 1.8 Identify the critical variables in enhancing productivity

Labor Improvement in the contribution of labor to productivity is the result of a healthier, better-educated, and better-nourished labor force. Some increase may also be attributed to a shorter workweek. Historically, about 10% of the annual improvement in productivity is attributed to improvement in the quality of labor. Three key variables for improved labor productivity are:

1. Basic education appropriate for an effective labor force.
2. Diet of the labor force.
3. Social overhead that makes labor available, such as transportation and sanitation.

Illiteracy and poor diets are a major impediment to productivity, costing countries up to 20% of their productivity. Infrastructure that yields clean drinking water and sanitation is also an opportunity for improved productivity, as well as an opportunity for better health, in much of the world.

In developed nations, the challenge becomes *maintaining and enhancing the skills of labor* in the midst of rapidly expanding technology and knowledge. Recent data suggest that the average American 17-year-old knows significantly less mathematics than the average Japanese at the same age, and about half cannot answer the questions in Figure 1.7. Moreover, about one-third of American job applicants tested for basic skills were deficient in reading, writing, or math.

Overcoming shortcomings in the quality of labor while other countries have a better labor force is a major challenge. Perhaps improvements can be found not only through increasing competence of labor but also via *better utilized labor with a stronger commitment*. Training, motivation, team building, and the human resource strategies discussed in Chapter 10, as well as improved education, may be among the many techniques that will contribute to increased labor productivity. Improvements in labor productivity are possible; however, they can be expected to be increasingly difficult and expensive.

Capital Human beings are tool-using animals. Capital investment provides those tools. Capital investment has increased in the U.S. every year except during a few very severe recession periods. Annual capital investment in the U.S. has increased at an annual rate of 1.5% after allowances for depreciation.

Inflation and taxes increase the cost of capital, making capital investment increasingly expensive. When the capital invested per employee drops, we can expect a drop in productivity. Using labor rather than capital may reduce unemployment in the short run, but it also makes economies less productive and therefore lowers wages in the long run. Capital investment is often a necessary, but seldom a sufficient, ingredient in the battle for increased productivity.

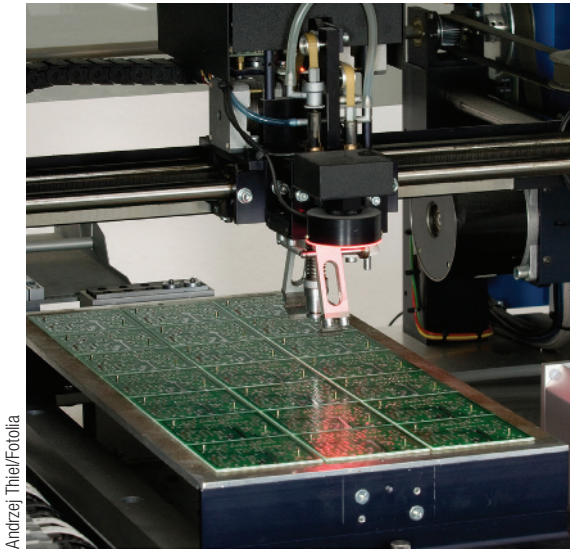
The trade-off between capital and labor is continually in flux. The higher the cost of capital or perceived risk, the more projects requiring capital are “squeezed out”: they are not pursued because the potential return on investment for a given risk has been reduced. Managers adjust their investment plans to changes in capital cost and risk.

Management Management is a factor of production and an economic resource. Management is responsible for ensuring that labor and capital are effectively used to increase productivity. Management accounts for over half of the annual increase in productivity. This increase includes improvements made through the use of knowledge and the application of technology.

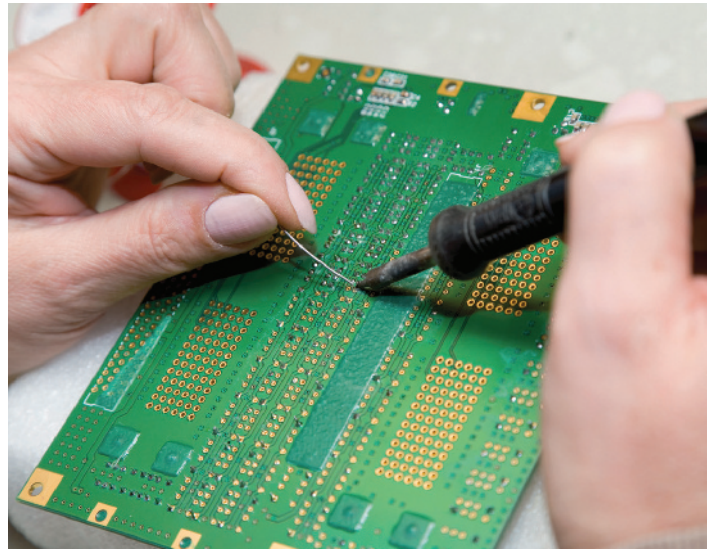
Using knowledge and technology is critical in postindustrial societies. Consequently, postindustrial societies are also known as **knowledge societies**. Knowledge societies are those in which much of the labor force has migrated from manual work to technical and information-processing

Knowledge society

A society in which much of the labor force has migrated from manual work to work based on knowledge.



Andrzej Thiel/Fotolia



Guy Shapira/Shutterstock

The effective use of capital often means finding the proper trade-off between investment in capital assets (automation, left) and human assets (a manual process, right). While there are risks connected with any investment, the cost of capital and physical investments is fairly clear-cut, but the cost of employees has many hidden costs including fringe benefits, social insurance, and legal constraints on hiring, employment, and termination.

tasks requiring ongoing education. The required education and training are important high-cost items that are the responsibility of operations managers as they build organizations and workforces. The expanding knowledge base of contemporary society requires that managers use *technology and knowledge effectively*.

More effective use of capital also contributes to productivity. It falls to the operations manager, as a productivity catalyst, to select the best new capital investments as well as to improve the productivity of existing investments.

The productivity challenge is difficult. A country cannot be a world-class competitor with second-class inputs. Poorly educated labor, inadequate capital, and dated technology are second-class inputs. High productivity and high-quality outputs require high-quality inputs, including good operations managers.

Productivity and the Service Sector

The service sector provides a special challenge to the accurate measurement of productivity and productivity improvement. The traditional analytical framework of economic theory is based primarily on goods-producing activities. Consequently, most published economic data relate to goods production. But the data do indicate that, as our contemporary service economy has increased in size, we have had slower growth in productivity.



Olaf Jandke/Agencia Fotograficzna Caro/Alamy Stock Photo

Siemens, a multi-billion-dollar German conglomerate, has long been known for its apprentice programs in its home country. Because education is often the key to efficient operations in a technological society, Siemens has spread its apprentice-training programs to its U.S. plants. These programs are laying the foundation for the highly skilled workforce that is essential for global competitiveness.

OM in Action

Taco Bell Improves Productivity and Goes Green to Lower Costs

Founded in 1962 by Glenn Bell, Taco Bell seeks competitive advantage via low cost. Like many other services, Taco Bell relies on its operations management to improve productivity and reduce cost.

Its menu and meals are designed to be easy to prepare. Taco Bell has shifted a substantial portion of food preparation to suppliers who could perform food processing more efficiently than a stand-alone restaurant. Ground beef is precooked prior to arrival and then reheated, as are many dishes that arrive in plastic boil bags for easy sanitary reheating. Similarly, tortillas arrive already fried and onions prediced. Efficient layout and automation has cut to 8 seconds the time needed to prepare tacos and burritos and has cut time in the drive-through lines by 1 minute. These advances have been combined with training and empowerment to increase the span of management from one supervisor for 5 restaurants to one supervisor for 30 or more.

Operations managers at Taco Bell have cut in-store labor by 15 hours per day and reduced floor space by more than 50%. The result is a store that can average 164 seconds for each customer, from drive-up to pull-out.

More recently, Taco Bell completed the rollout of its new Grill-to-Order kitchens by installing water- and energy-saving grills that conserve 300 million gallons of water and 200 million kilowatt hours of electricity each year. This “green”-inspired cooking method also saves the company’s 5,800 restaurants \$17 million per year.

Effective operations management has resulted in productivity increases that support Taco Bell’s low-cost strategy. Taco Bell is now the fast-food low-cost leader with a 58% share of the Mexican fast-food market.



Bob Pardue-Signs/Alamy Stock Photo

Sources: *Businessweek* (May 5, 2011) and J. Hueter and W. Swart, *Interfaces* (Vol. 28; issue 1).

Productivity of the service sector has proven difficult to improve because service-sector work is:

1. Typically labor intensive (e.g., counseling, teaching).
2. Frequently focused on unique individual attributes or desires (e.g., investment advice).
3. Often an intellectual task performed by professionals (e.g., medical diagnosis).
4. Often difficult to mechanize and automate (e.g., a haircut).
5. Often difficult to evaluate for quality (e.g., performance of a law firm).

The more intellectual and personal the task, the more difficult it is to achieve increases in productivity. Low-productivity improvement in the service sector is also attributable to the growth of low-productivity activities in the service sector. These include activities not previously a part of the measured economy, such as child care, food preparation, house cleaning, and laundry service. These activities have moved out of the home and into the measured economy as more and more women have joined the workforce. Inclusion of these activities has probably resulted in lower measured productivity for the service sector, although, in fact, actual productivity has probably increased because these activities are now more efficiently produced than previously.

However, despite the difficulty of improving productivity in the service sector, improvements are being made. And this text presents a multitude of ways to make these improvements. Indeed, what can be done when management pays attention to how work actually gets done is astonishing!

Although the evidence indicates that all industrialized countries have the same problem with service productivity, the U.S. remains the world leader in overall productivity and service productivity. Retailing is twice as productive in the U.S. as in Japan, where laws protect shopkeepers from discount chains. The U.S. telephone industry is at least twice as productive as Germany’s. The U.S. banking system is also 33% more efficient than Germany’s banking oligopolies. However, because productivity is central to the operations manager’s job and because the service sector is so large, we take special note in this text of how to improve productivity in the service sector. (See, for instance, the *OM in Action* box “Taco Bell Improves Productivity and Goes Green to Lower Costs.”)

Current Challenges in Operations Management

Operations managers work in an exciting and dynamic environment. This environment is the result of a variety of challenging forces, from globalization of world trade to the transfer of ideas, products, and money at electronic speeds. Let’s look at some of these challenges:

- ◆ *Globalization*: The rapid decline in the cost of communication and transportation has made markets global. Similarly, resources in the form of capital, materials, talent, and labor are also now global. As a result, countries throughout the world are contributing to globalization as they vie for economic growth. Operations managers are rapidly seeking creative designs, efficient production, and high-quality goods via international collaboration.
- ◆ *Supply-chain partnering*: Shorter product life cycles, demanding customers, and fast changes in technology, materials, and processes require supply-chain partners to be in tune with the needs of end users. And because suppliers may be able to contribute unique expertise, operations managers are outsourcing and building long-term partnerships with critical players in the supply chain.
- ◆ *Sustainability*: Operations managers' continuing battle to improve productivity is concerned with designing products and processes that are ecologically sustainable. This means designing green products and packaging that minimize resource use, can be recycled or reused, and are generally environmentally friendly.
- ◆ *Rapid product development*: Technology combined with rapid international communication of news, entertainment, and lifestyles is dramatically chopping away at the life span of products. OM is answering with new management structures, enhanced collaboration, digital technology, and creative alliances that are more responsive and effective.
- ◆ *Mass customization*: Once managers recognize the *world* as the marketplace, the cultural and individual differences become quite obvious. In a world where consumers are increasingly aware of innovation and options, substantial pressure is placed on firms to respond in a creative way. And OM must rapidly respond with product designs and flexible production processes that cater to the individual whims of consumers. The goal is to produce customized products, whenever and wherever needed.
- ◆ *Lean operations*: Lean is the management model sweeping the world and providing the standard against which operations managers must compete. Lean can be thought of as the driving force in a well-run operation, where the customer is satisfied, employees are respected, and waste does not exist. The theme of this text is to build organizations that are more efficient, where management creates enriched jobs that help employees engage in continuous improvement, and where goods and services are produced and delivered when and where the customer desires them. These ideas are also captured in the phrase *Lean*.

These challenges must be successfully addressed by today's operations managers. This text will provide you with the foundations necessary to meet those challenges.

STUDENT TIP

One of the reasons OM is such an exciting discipline is that an operations manager is confronted with ever-changing issues, from technology, to global supply chains, to sustainability.

Ethics, Social Responsibility, and Sustainability

The systems that operations managers build to convert resources into goods and services are complex. And they function in a world where the physical and social environment is evolving, as are laws and values. These dynamics present a variety of challenges that come from the conflicting perspectives of **stakeholders**, such as customers, distributors, suppliers, owners, lenders, employees, and community. Stakeholders, as well as government agencies at various levels, require constant monitoring and thoughtful responses.

Identifying ethical and socially responsible responses while developing sustainable processes that are also effective and efficient productive systems is not easy. Managers are also challenged to:

- ◆ Develop and produce safe, high-quality green products
- ◆ Train, retain, and motivate employees in a safe workplace
- ◆ Honor stakeholder commitments

Managers must do all this while meeting the demands of a very competitive and dynamic world marketplace. If operations managers have a *moral awareness and focus on increasing productivity in this system*, then many of the ethical challenges will be successfully addressed. The organization will use fewer resources, the employees will be committed, the market will be satisfied, and the ethical climate will be enhanced. Throughout this text, we note ways in which operations managers can take ethical and socially responsible actions while successfully addressing these challenges of the market. We also conclude each chapter with an *Ethical Dilemma* exercise.

Stakeholders

Those with a vested interest in an organization, including customers, distributors, suppliers, owners, lenders, employees, and community members.

Summary

Operations, marketing, and finance/accounting are the three functions basic to all organizations. The operations function creates goods and services. Much of the progress of operations management has been made in the twentieth century, but since the beginning of time, humankind has been attempting to improve its material well-being. Operations managers are key players in the battle to improve productivity.

As societies become increasingly affluent, more of their resources are devoted to services. In the U.S., more than 85% of the workforce is employed in the service sector. Productivity improvements and a sustainable environment are difficult to achieve, but operations managers are the primary vehicle for making improvements.

Key Terms

Production (p. 36)	Services (p. 43)	Multifactor productivity (p. 46)
Operations management (OM) (p. 36)	Service sector (p. 44)	Productivity variables (p. 47)
Supply chain (p. 38)	Productivity (p. 45)	Knowledge society (p. 48)
10 strategic OM decisions (p. 39)	Single-factor productivity (p. 46)	Stakeholders (p. 51)

Ethical Dilemma

The American car battery industry boasts that its recycling rate now exceeds 95%, the highest rate for any commodity. However, with changes brought about by specialization and globalization, parts of the recycling system are moving offshore. This is particularly true of automobile batteries, which contain lead. The Environmental Protection Agency (EPA) is contributing to the offshore flow with newly implemented standards that make domestic battery recycling increasingly difficult and expensive. The result is a major increase in used batteries going to Mexico, where environmental standards and control are less demanding than they are in the U.S. One in five batteries is now exported to Mexico. There is seldom difficulty finding buyers because lead is expensive and in worldwide demand. While U.S.

recyclers operate in sealed, mechanized plants, with smokestacks equipped with scrubbers and plant surroundings monitored for traces of lead, this is not the case in most Mexican plants. The harm from lead is legendary, with long-run residual effects. Health issues include high blood pressure, kidney damage, detrimental effects on fetuses during pregnancy, neurological problems, and arrested development in children.

Given the two scenarios below, what action do you take?

- You own an independent auto repair shop and are trying to safely dispose of a few old batteries each week. (Your battery supplier is an auto parts supplier who refuses to take your old batteries.)
- You are manager of a large retailer responsible for disposal of thousands of used batteries each day.

Discussion Questions

- Why should one study operations management?
- What are some career opportunities in the operations management discipline?
- Identify four people who have contributed to the theory and techniques of operations management.
- Briefly describe the contributions of the four individuals identified in the preceding question.
- Figure 1.1 outlines the operations, finance/accounting, and marketing functions of three organizations. Prepare a chart similar to Figure 1.1 outlining the same functions for one of the following:
 - a newspaper
 - a drugstore
 - a college library
 - a summer camp
 - a small costume-jewelry factory
- Answer Question 5 for some other organization, perhaps an organization where you have worked.
- What are the three basic functions of a firm?
- Identify the 10 strategic operations management decisions.
- "The reasons for failure in productivity are cost reduction programs, which produce narrowness of vision. We must first let go of old-fashioned productivity as a goal; instead, we must set a new but powerful objective of competitiveness" (Skinner, 1986). Discuss this historical but seminal viewpoint.
- The U.S., and indeed much of the rest of the world, has been described as a "knowledge society." How does this affect productivity measurement and the comparison of productivity between the U.S. and other countries?
- What are the measurement problems that occur when one attempts to measure productivity?
- Mass customization and rapid product development were identified as challenges to modern manufacturing operations. What is the relationship, if any, between these challenges? Can you cite any examples?
- What are the five reasons productivity is difficult to improve in the service sector?
- Discuss the overlap amongst operations, marketing, and finance—the three functions basic to all organizations—for small and medium enterprises.
- As a library or Internet assignment, find the U.S. productivity rate (increase) last year for the (a) national economy, (b) manufacturing sector, and (c) service sector.

Using Software for Productivity Analysis

This section presents three ways to solve productivity problems with computer software. First, you can create your own Excel spreadsheets to conduct productivity analysis. Second, you can use the Excel OM software that comes with this text in [MyLab Operations Management](#). Third, POM for Windows is another program that is available with this text in [MyLab Operations Management](#).

CREATING YOUR OWN EXCEL SPREADSHEETS

Program 1.1 illustrates how to build an Excel spreadsheet for the data in Example 2.

	A	B	C	D	E
1	Collins Title Insurance Ltd.	Enter the values for the old system in column B and the new system in Column C.			
2	Productivity Increase Computations				
3					
4	Parameters	Old System	New System		
5	Length of Workday (hours)	8	8		
6	Number of Workers	4	4		
7	Labor Hours per Day	32	32	=C5*C6	
8	Payroll Cost per Day	\$640	\$640		
9	Overhead Expenses	\$400	\$800		
10	Output (Titles per Day)	8	14		
11		=B10/B7		Productivity = Output/Input	
12					
13	Solutions	Old System	New System	% Increase	
14	Labor Productivity (Titles per Labor-Hour)	0.25	0.4375	75.00%	
15	Multifactor Productivity (Titles per Dollar)	0.0077	0.0097	26.39%	
16		=C10/(C8+C9)		=(C14-B14)/B14	
Actions Copy C7 to B7, Copy B14 to C14, Copy C15 to B15, and Copy D14 to D15					
Create a row for each of the inputs used for the productivity measure. Put the output in the last row.					

Program 1.1

✕ USING EXCEL OM

Excel OM is an Excel “add-in” with 26 Operations Management decision support “Templates.” To access the templates, double-click on the *Excel OM* tab at the top of the page, then in the menu bar choose the appropriate chapter (in this case Chapter 1), from either the “Chapter” or “Alphabetic” tab on the left. Each of Excel OM’s 26 modules includes instructions for that particular module. The instructions can be turned on or off via the “instruction” tab in the menu bar.

P USING POM FOR WINDOWS

POM for Windows is decision support software that includes 25 Operations Management modules. The modules are accessed by double-clicking on *Module* in the menu bar, and then double-clicking on the appropriate (in this case *Productivity*) item. Instructions are provided for each module just below the menu bar. Please refer to Appendix II for further details.

Solved Problems

Virtual Office Hours help is available in [MyLab Operations Management](#).

SOLVED PROBLEM 1.1

Productivity can be measured in a variety of ways, such as by labor, capital, energy, material usage, and so on. At Modern Lumber, Inc., Art Binley, president and producer of apple crates sold to growers, has been able, with his current equipment, to produce 240 crates per 100 logs. He currently purchases 100 logs per day, and each log requires 3 labor-hours to process. He believes that he can hire a professional buyer who can buy a better-quality log at the same cost. If this is the case, he can increase his production to 260 crates per 100 logs. His labor-hours will increase by 8 hours per day.

What will be the impact on productivity (measured in crates per labor-hour) if the buyer is hired?

SOLUTION

$$\begin{aligned}
 \text{(a) Current labor productivity} &= \frac{240 \text{ crates}}{100 \text{ logs} \times 3 \text{ hours/log}} \\
 &= \frac{240}{300} \\
 &= .8 \text{ crates per labor-hour} \\
 \text{(b) Labor productivity with buyer} &= \frac{260 \text{ crates}}{(100 \text{ logs} \times 3 \text{ hours/log}) + 8 \text{ hours}} \\
 &= \frac{260}{308} \\
 &= .844 \text{ crates per labor-hour}
 \end{aligned}$$

Using current productivity (.80 from [a]) as a base, the increase will be 5.5% $(.844/.8 = 1.055, \text{ or a } 5.5\% \text{ increase})$.

SOLVED PROBLEM 1.2

Art Binley has decided to look at his productivity from a multi-factor (total factor productivity) perspective (refer to Solved Problem 1.1). To do so, he has determined his labor, capital, energy, and material usage and decided to use dollars as the common denominator. His total labor-hours are now 300 per

day and will increase to 308 per day. His capital and energy costs will remain constant at \$350 and \$150 per day, respectively. Material costs for the 100 logs per day are \$1,000 and will remain the same. Because he pays an average of \$10 per hour (with fringes), Binley determines his productivity increase as follows:

SOLUTION

CURRENT SYSTEM	
Labor:	300 hrs. @10 = 3,000
Material:	100 logs/day 1,000
Capital:	350
Energy:	150
Total Cost:	\$4,500

Multifactor productivity of current system:
 $= 240 \text{ crates}/\$4,500 = .0533 \text{ crates/dollar}$

SYSTEM WITH PROFESSIONAL BUYER	
308 hrs. @10 =	\$3,080
	1,000
	350
	150
	\$4,580

Multifactor productivity of proposed system:
 $= 260 \text{ crates}/\$4,580 = .0568 \text{ crates/dollar}$

Using current productivity (.0533) as a base, the increase will be .066. That is, $.0568/.0533 = 1.066$, or a 6.6% increase.

Problems

Note: **Px** means the problem may be solved with POM for Windows and/or Excel OM.

Problems 1.1 to 1.17 relate to The Productivity Challenge

- **1.1** Chuck Sox makes wooden boxes in which to ship motorcycles. Chuck and his three employees invest a total of 40 hours per day making the 120 boxes.

- What is their productivity?
- Chuck and his employees have discussed redesigning the process to improve efficiency. If they can increase the rate to 125 per day, what will be their new productivity?
- What will be their unit *increase* in productivity per hour?
- What will be their percentage change in productivity? **Px**

- **1.2** Carbondale Casting produces cast bronze valves on a 10-person assembly line. On a recent day, 160 valves were produced during an 8-hour shift.

- Calculate the labor productivity of the line.
- John Goodale, the manager at Carbondale, changed the layout and was able to increase production to 180 units per 8-hour shift. What is the new labor productivity per labor-hour?
- What is the percentage of productivity increase? **Px**

- **1.3** A small electronic manufacturing company that makes communication devices has determined its costs as follows (all value data are expressed in millions euro):

	2013	2014
Output:	2	3
Inputs:		
Labour	1	1.8
Material and supplies	0.6	0.8
Capital equipment depreciation	0.07	0.12

- Calculate and compare all single-factor and multifactor productivity for 2013 and 2014.
- What conclusions do you draw?

- **1.4** Lori Cook produces “Final Exam Care Packages” for resale by her sorority. She is currently working a total of 5 hours per day to produce 100 care packages.

- What is Lori’s productivity?
- Lori thinks that by redesigning the package, she can increase her total productivity to 133 care packages per day. What will be her new productivity?
- What will be the percentage increase in productivity if Lori makes the change? **Px**

- **1.5** George Kyparis makes bowling balls in his Miami plant. With recent increases in his costs, he has a newfound interest in efficiency. George is interested in determining the productivity of his organization. He would like to know if his organization is maintaining the manufacturing average of 3% increase in productivity per year. He has the following data representing a month from last year and an equivalent month this year:

	LAST YEAR	NOW
Units produced	1,000	1,000
Labor (hours)	300	275
Resin (pounds)	50	45
Capital invested (\$)	10,000	11,000
Energy (BTU)	3,000	2,850

Show the productivity percentage change for each category and then determine the improvement for labor-hours, the typical standard for comparison. **Px**

- **1.6** George Kyparis (using data from Problem 1.5) determines his costs to be as follows:

- ♦ **Labor:** \$10 per hour
- ♦ **Resin:** \$5 per pound
- ♦ **Capital expense:** 1% per month of investment
- ♦ **Energy:** \$0.50 per BTU

Show the percent change in productivity for 1 month last year versus 1 month this year, on a multifactor basis with dollars as the common denominator. **Px**

- **1.7** Hokey Min's Kleen Karpet cleaned 65 rugs in October, consuming the following resources:

Labor:	520 hours at \$13 per hour
Solvent:	100 gallons at \$5 per gallon
Machine rental:	20 days at \$50 per day

- What is the labor productivity per dollar?
- What is the multifactor productivity? **Px**

- **1.8** Lillian Fok is president of Lakefront Manufacturing, a producer of bicycle tires. Fok makes 1,000 tires per day with the following resources:

Labor:	400 hours per day @ \$12.50 per hour
Raw material:	20,000 pounds per day @ \$1 per pound
Energy:	\$5,000 per day
Capital costs:	\$10,000 per day

- What is the labor productivity per labor-hour for these tires at Lakefront Manufacturing?
- What is the multifactor productivity for these tires at Lakefront Manufacturing?
- What is the percent change in multifactor productivity if Fok can reduce the energy bill by \$1,000 per day without cutting production or changing any other inputs? **Px**

- **1.9** Brown's, a local bakery, is worried about increased costs—particularly energy. Last year's records can provide a fairly good estimate of the parameters for this year. Wende Brown, the owner, does not believe things have changed much, but she did invest an additional \$3,000 for modifications to the bakery's ovens to make them more energy efficient. The modifications were supposed to make the ovens at least 15% more efficient. Brown has asked you to check the energy savings of the new ovens and also to look over other measures of the bakery's productivity to see if the modifications were beneficial. You have the following data to work with:

	LAST YEAR	NOW
Production (dozen)	1,500	1,500
Labor (hours)	350	325
Capital investment (\$)	15,000	18,000
Energy (BTU)	3,000	2,750

Px



Taras Vyshnya/Shutterstock

- **1.10** Munson Performance Auto, Inc., modifies 375 autos per year. The manager, Adam Munson, is interested in obtaining a measure of overall performance. He has asked you to provide him with a multifactor measure of last year's performance as a benchmark for future comparison. You have assembled the following data. Resource inputs were labor, 10,000 hours; 500 suspension and engine modification kits; and energy, 100,000

kilowatt-hours. Average labor cost last year was \$20 per hour, kits cost \$1,000 each, and energy costs were \$3 per kilowatt-hour. What do you tell Mr. Munson? **Px**

- **1.11** Lake Charles Seafood makes 500 wooden packing boxes for fresh seafood per day, working in two 10-hour shifts. Due to increased demand, plant managers have decided to operate three 8-hour shifts instead. The plant is now able to produce 650 boxes per day.
 - Calculate the company's productivity before the change in work rules and after the change.
 - What is the percentage increase in productivity?
 - If production is increased to 700 boxes per day, what is the new productivity? **Px**

- **1.12** Charles Lackey operates a bakery in Idaho Falls, Idaho. Because of its excellent product and excellent location, demand has increased by 25% in the last year. On far too many occasions, customers have not been able to purchase the bread of their choice. Because of the size of the store, no new ovens can be added. At a staff meeting, one employee suggested ways to load the ovens differently so that more loaves of bread can be baked at one time. This new process will require that the ovens be loaded by hand, requiring additional manpower. This is the only thing to be changed. If the bakery makes 1,500 loaves per month with a labor productivity of 2.344 loaves per labor-hour, how many workers will Lackey need to add? (Hint: Each worker works 160 hours per month.)

- **1.13** Mr. Achebe, who runs his photocopy business working 8 hours per day, processes 100 scripts in a day. He estimates his labor cost to be €9 per hour. Also, he has estimated that the total material cost for each script is approximately €2 while the daily expenses are €28. Calculate the multifactor productivity. In an effort to increase the rate of the photocopy process to 150 scripts, he decides to change the quality of ink, thereby raising the material cost to €2.5 per day. Is the new productivity better than before? If Mr. Achebe would like to increase the photocopy process to 150 scripts without sacrificing the initial multifactor productivity, by what amount has the material costs to be increased?

- **1.14** A production operation is making 150 pieces of a product by engaging 5 workers for 300 hours. However, 40% of the units appear to have various quality problems and the company decides to sell them as seconds at a price of €50 each when the normal unit is sold for €150 each. What is the productivity of the company? In an effort to improve the situation, a number of initiatives were proposed, including a scheme where, for every improvement, 50% will be given to workers and the other 50% will be held by the company. This results in a significant drop in defects as now only 10 units were faulty out of an output of 130 units. What is the new productivity of the company, and what will be the earnings per hour of the workers under the bonus scheme if the cost per unit is €70 both before and after the scheme?

- **1.15** A furniture manufacturing company working on a 40-hour week makes 100 chairs. The sales price is €70 each, and the company has the following costs:

- ◆ Direct materials: €700
- ◆ Direct labor: €300
- ◆ Overhead: €500

- Calculate the productivity of the company.
- What will be the new productivity if the company decides to make 135 chairs per week?
- If the company decides to improve productivity through materials costs reduction only, how much must these costs be reduced in order to achieve a 10% increase in total productivity?

d) If the company repeats the same exercise as in part (c), but through labor costs reduction, how much must these costs be reduced in order to achieve a 10% increase in total productivity?

•• **1.16** An air conditioner factory makes three different types of air conditioners: the ceiling type, the cassette type, and the wall-mounted type. Weekly sales of each type are 2, 4, and 6 units at a price of €350, €450, and €500 each, respectively. The ceiling type can be assembled in 1.5 hours, the cassette type in 1 hour, and the wall-mounted type in 45 minutes. Labor cost is €40 per hour and the current factory's multifactor productivity is 2.2.

- Calculate the average cost per air conditioner based on current multifactor productivity.
- Calculate labor productivity (in euros per hour) for each type of air conditioner.
- Where should the company focus its efforts based on (i) labor productivity, and (ii) average cost?

••• **1.17** As part of a study for the Department of Labor Statistics, you are assigned the task of evaluating the improvement in productivity of small businesses. Data for one of the small businesses you

are to evaluate are shown at right. The data are the monthly average of last year and the monthly average this year. Determine the multifactor productivity with dollars as the common denominator for:

- Last year.
- This year.
- Then determine the percentage change in productivity for the monthly average last year versus the monthly average this year on a multifactor basis.

- ◆ *Labor*: \$8 per hour
- ◆ *Capital*: 0.83% per month of investment
- ◆ *Energy*: \$0.60 per BTU

	LAST YEAR	THIS YEAR
Production (dozen)	1,500	1,500
Labor (hours)	350	325
Capital investment (\$)	15,000	18,000
Energy (BTU)	3,000	2,700

CASE STUDIES

Aldi: Changing the Landscape of Grocery Shopping

According to a recent study by Nielsen,* consumers used to prefer stock-up visits, but 46% of them view shopping as a chore. The one-stop shopping experience that had taken most of the world by storm a couple of decades ago is changing and Aldi, a German supermarket company, is pioneering the way. Stores like Aldi focus on efficiency and challenge the traditional supermarket model, which operates on thousands of square meters and offers a wide variety of choices. Aldi caters to the needs-based shopping clientele who prefer making frequent visits to a store rather than stocking up during one visit. Aldi leads the way for the increasing number of companies that are developing business models to appeal to this segment of customers.

Founded in 1946, Aldi is a discount grocery chain that has gained substantial ground because of its operations management. The company currently has more than 10,000 stores in 17 countries across Europe, Australia, United States, and, most recently, China. The company has been developing its successful business model for decades—splitting operations in Germany between Aldi Nord and Aldi Süd in 1960 and 1962, respectively, and expanding its international operations since 1967.

As part of its business model, Aldi generally operates on 1,000 to 1,500 square meters of space,[†] compared to the approximately 4,000 square meters space utilized by traditional supermarkets.[‡] Sites to accommodate smaller stores are easier to find close to target locations like city centers; this eliminates customers having to travel great distances for grocery shopping and encourages frequent visits.

The smaller store size also naturally reduces the number of products that can be offered. But then again, who needs 35 different types of ketchup to choose from? Aldi carries only a few variants of each product, sometimes limiting the choice to one. This approach reduces the total number of products carried to approximately

10–15% of traditional supermarkets' selection. This enables for more efficient inventory management because planning and forecasting for one or two products, instead of dozens, is easier and reduces the chance of stock-outs (shortages) and products exceeding their shelf life. For most small stores, this also reduces the hassle restocking the shelves. This, however, is not a problem for Aldi. For many products, Aldi's suppliers ship them in boxes that can be kept on the store floor as it is and customers can select the product they want from the boxes. While the improved efficiency may not be immediately obvious, these measures allow for fewer employees working in each shift, with many of them being able to move between stocking shelves and managing the cash register as needed.

In addition, Aldi's reliance on its own exclusive brand products reduces overhead costs and increases efficiency of management while still providing quality products, which makes it highly competitive in a cut-throat industry. It also builds brand awareness and, as the sole supplier of such products, increases customer retention.

Discussion Questions

- Aldi and similar stores offer different customer experience. Do you think a similar business model could work in other industries?
- What are the sacrifices customers have to make in order to have access to this shopping experience?

*<http://www.nielsen.com/apac/en/insights/news/2018/in-todays-hyperconnected-world-convenience-is-the-ultimate-currency.print.html>

[†]https://corporate.aldi.us/fileadmin/fm-dam/real_estates/ALDI_Real_Estate_Flyer_9.17.13.pdf

[‡]<http://business.time.com/2011/01/25/fewer-choices-more-savings-the-new-way-to-buy-groceries/>

Source: Dr. Viktor Miklos Kiss, Metropolitan State University of Denver.

Frito-Lay: Operations Management in Manufacturing

Video Case

Frito-Lay, the massive Dallas-based subsidiary of PepsiCo, has 55 plants and 55,000 employees in North America. Seven of Frito-Lay's 41 brands exceed \$1 billion in sales: Fritos, Lay's, Cheetos, Ruffles, Tostitos, Doritos, and Walker's Potato Chips. Operations is the focus of the firm—from designing products for new markets, to meeting changing consumer preferences, to adjusting to rising commodity costs, to subtle issues involving flavors and preservatives—OM is under constant cost, time, quality, and market pressure. Here is a look at how the 10 decisions of OM are applied at this food processor.

In the food industry, product development kitchens experiment with new products, submit them to focus groups, and perform test marketing. Once the product specifications have been set, processes capable of meeting those specifications and the necessary quality standards are created. At Frito-Lay, quality begins at the farm, with onsite inspection of the potatoes used in Ruffles and the corn used in Fritos. Quality continues throughout the manufacturing process, with visual inspections and with statistical process control of product variables such as oil, moisture, seasoning, salt, thickness, and weight. Additional quality evaluations are conducted throughout shipment, receipt, production, packaging, and delivery.

The production process at Frito-Lay is designed for large volumes and small variety, using expensive special-purpose equipment, and with swift movement of material through the facility. Product-focused facilities, such as Frito-Lay's, typically have high capital costs, tight schedules, and rapid processing. Frito-Lay's facilities are located regionally to aid in the rapid delivery of products because freshness is a critical issue. Sanitary issues and necessarily fast processing of products put a premium on an efficient layout. Production lines are designed for balanced throughput and high utilization. Cross-trained workers, who handle a variety of production lines, have promotion paths identified for their particular skill set. The company rewards employees with medical, retirement, and education plans. Its turnover is very low.

The supply chain is integral to success in the food industry; vendors must be chosen with great care. Moreover, the finished food product is highly dependent on perishable raw materials. Consequently, the supply chain brings raw material (potatoes, corn, etc.) to the plant securely and rapidly to meet tight production schedules. For instance, from the time that potatoes are picked in St. Augustine, Florida, until they are unloaded at the Orlando plant, processed, packaged, and shipped from the plant is under 12 hours. The requirement for fresh product requires on-time, just-in-time deliveries combined with both low raw material and finished goods inventories. The continuous-flow nature of the specialized equipment in the production process permits little work-in-process inventory. The plants usually run 24/7. This means that there are four shifts of employees each week.

Tight scheduling to ensure the proper mix of fresh finished goods on automated equipment requires reliable systems and effective maintenance. Frito-Lay's workforce is trained to recognize problems early, and professional maintenance personnel are available on every shift. Downtime is very costly and can lead to late deliveries, making maintenance a high priority.

Discussion Questions*

1. From your knowledge of production processes and from the case and the video, identify how each of the 10 decisions of OM is applied at Frito-Lay.
2. How would you determine the productivity of the production process at Frito-Lay?
3. How are the 10 decisions of OM different when applied by the operations manager of a production process such as Frito-Lay versus a service organization such as Hard Rock Cafe? (See the Hard Rock Cafe video case below.)

*You may wish to view the video that accompanies this case before addressing these questions.

Hard Rock Cafe: Operations Management in Services

Video Case

In its 48 years of existence, Hard Rock has grown from a modest London pub to a global power managing 163 restaurants, 23 hotels/casinos, and live music venues. This puts Hard Rock firmly in the service industry—a sector that employs over 75% of the people in the U.S. Hard Rock moved its world headquarters to Orlando, Florida, in 1988 and has expanded to more than 50 locations throughout the U.S., serving over 100,000 meals each day. Hard Rock chefs are modifying the menu from classic American—burgers and chicken wings—to include higher-end items such as stuffed veal chops and lobster tails. Just as taste in music changes over time, so does Hard Rock Cafe, with new menus, layouts, memorabilia, services, and strategies.

At Orlando's Universal Studios, a traditional tourist destination, Hard Rock Cafe serves more than 3,500 meals each day. The cafe employs about 400 people. Most are employed in the restaurant, but some work in the retail shop. Retail is now a standard and increasingly prominent feature in Hard Rock Cafes (since close to 48% of revenue comes from this source). Cafe employees include kitchen and waitstaff, hostesses, and bartenders. Hard Rock employees are not only competent in their job skills but are also passionate about music and have engaging personalities. Cafe staff is scheduled down to 15-minute intervals to meet seasonal and daily demand changes in the tourist environment of Orlando. Surveys are done on a regular basis to evaluate quality of food and service at the cafe. Scores are rated on a 1-to-7 scale, and if the score is not a 7, the food or service is a failure.

Hard Rock is adding a new emphasis on live music and is redesigning its restaurants to accommodate the changing tastes. Since Eric Clapton hung his guitar on the wall to mark his favorite bar stool, Hard Rock has become the world's leading collector and exhibitor of rock 'n' roll memorabilia, with changing exhibits at its cafes throughout the world. The collection includes 70,000 pieces, valued at \$40 million. In keeping with the times, Hard Rock also maintains a Web site, www.hardrock.com, which receives more than 100,000 hits per week, and a weekly cable television program on VH1. Hard Rock's brand recognition, at 92%, is one of the highest in the world.

Discussion Questions*

1. From your knowledge of restaurants, from the video, from the *Global Company Profile* that opens this chapter, and from the case itself, identify how each of the 10 OM strategy decisions is applied at Hard Rock Cafe.
2. How would you determine the productivity of the kitchen staff and waitstaff at Hard Rock?
3. How are the 10 OM strategy decisions different when applied to the operations manager of a service operation such as Hard Rock versus an automobile company such as Ford Motor Company?

*You may wish to view the video that accompanies this case before addressing these questions.

Celebrity Cruises: Operations Management at Sea



On any given day, Celebrity Cruises, Inc. has tens of thousands of passengers at sea on more than a dozen spectacular ships, spanning 7 continents and 75 countries. With this level of capital investment along with the responsibility for the happiness and safety of so many passengers, excellence in operations is required. To make it all work, the 10 operations management decisions must be executed flawlessly. From product design (which encompasses the ship's layout, the food, and 300 destinations), to scheduling, supply chain, inventory, personnel, maintenance, and the processes that hold them together, OM is critical.

Cruise lines require precise scheduling of ships, with down-to-the-minute docking and departure times. In addition to ship and port scheduling, some 2,000 plus crew members must be scheduled. And there are many schedule variations. Entertainers may arrive and leave at each port, while officers may have a schedule of 10 weeks on and 10 weeks off. Other crew members have onboard commitments varying from 4 to 9 months.

With \$400 million invested in a ship and more than 5,000 lives involved in a cruise, detailed processes to ensure maintenance and reliability are vital. The modern ship is a technological marvel with hundreds of electronic monitors operating 24/7 to track everything from ship speed and location, to sea depth, to shipboard power demand and cabin temperature.

Celebrity's ship layout, destinations, and routing are adjusted to meet seasonal demands and the expectations of its premium market segment. With destinations from Alaska to Europe to Asia, crews are recruited worldwide, with as many as 70 nationalities represented. Instilling a quality culture requires an aggressive quality service orientation and, of course, meticulous cleanliness

and attention to detail. Processes for food preparation, laundry, quality, and maintenance are complete and detailed.

A cruise ship, as a moving city, requires a comprehensive and precise supply chain that replenishes everything from food to fuel to soap and water. Land-based buyers support Celebrity's annual food and beverage purchases that exceed \$110 million. Included in these expenditures are weekly shipments of 6 to 10 containers from the Miami headquarters destined for ships in European ports. An onboard staff organizes inventories to support this massive operation. The logistics effort includes hedging the weekly use of 24,000 gallons of fuel per ship with purchases 6 years into the future. Reliable global supply chains have been developed that deliver the required inventory on a tight time frame.

These crucial shipboard systems typically represent the best of operations management. Such is the case at Celebrity Cruises.

Discussion Questions*

1. Describe how the 10 OM decisions are implemented at Celebrity Cruises, Inc.
2. Identify how the 10 OM decisions at Celebrity Cruises differ from those decisions at a manufacturing firm.
3. Identify how the 10 OM decisions at Celebrity Cruises differ from those decisions at a retail store.
4. How are hotel operations on a ship different from those at a land-based hotel?

*You may wish to view the video that accompanies this case before addressing these questions.

- **Additional Case Studies:** Visit [MyLab Operations Management](#) for these case studies:

National Air Express: Introduces the issue of productivity, productivity improvement, and measuring productivity.

Zychol Chemicals Corp.: The production manager must prepare a productivity report, which includes multifactor analysis.

Endnotes

1. *Efficiency* means doing the job well—with a minimum of resources and waste. Note the distinction between being *efficient*, which implies doing the job well, and *effective*, which means doing the right thing. A job well done—say, by applying the 10 strategic decisions of operations management—helps us

be *efficient*; developing and using the correct strategy helps us be *effective*.

2. U.S. Dept. of Labor, 2017: bls.gov/emp/ep_table_201.htm
3. The quality and time period are assumed to remain constant.

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Chapter 1 *Rapid Review*

Main Heading	Review Material	MyLab Operations Management
WHAT IS OPERATIONS MANAGEMENT? (p. 36)	■ 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	Concept Questions: 1.1–1.5 VIDEOS 1.1, 1.2 and 1.3 OM at Hard Rock OM at Frito-Lay Celebrity Cruises: Operations Management at Sea
ORGANIZING TO PRODUCE GOODS AND SERVICES (pp. 36–38)	All organizations perform three functions to create goods and services: 1. <i>Marketing</i>, which generates demand 2. <i>Production/operations</i>, which creates the product 3. <i>Finance/accounting</i>, which tracks how well the organization is doing, pays the bills, and collects the money	Concept Questions: 2.1–2.6
THE SUPPLY CHAIN (p. 38)	■ Supply chain—A global network of organizations and activities that supply a firm with goods and services	Concept Questions: 3.1–3.4
WHY STUDY OM? (pp. 38–39)	We study OM for four reasons: 1. To learn how people organize themselves for productive enterprise 2. To learn how goods and services are produced 3. To understand what operations managers do 4. Because OM is a costly part of an organization	Concept Questions: 4.1–4.2
WHAT OPERATIONS MANAGERS DO (pp. 39–40)	Ten OM strategic decisions are required of operations managers: 1. Design of goods and services 2. Managing quality 3. Process strategies 4. Location strategies 5. Layout strategies 6. Human resources 7. Supply chain management 8. Inventory management 9. Scheduling 10. Maintenance About 40% of <i>all</i> jobs are in OM. Operations managers possess job titles such as plant manager, quality manager, process improvement consultant, and operations analyst.	Concept Questions: 5.1–5.6
THE HERITAGE OF OPERATIONS MANAGEMENT (pp. 40–42)	Significant events in modern OM can be classified into six eras: 1. Early concepts (1776–1880)—Labor specialization (Smith, Babbage), standardized parts (Whitney) 2. Scientific management (1880–1910)—Gantt charts (Gantt), motion and time studies (Gilbreth), process analysis (Taylor), queuing theory (Erlang) 3. Mass production (1910–1980)—Assembly line (Ford/Sorensen), statistical sampling (Shewhart), economic order quantity (Harris), linear programming (Dantzig), PERT/CPM (DuPont), material requirements planning 4. Lean production (1980–1995)—Just-in-time, computer-aided design, electronic data interchange, total quality management, Baldrige Award, empowerment, kanbans 5. Mass customization (1995–2005)—Internet/e-commerce, enterprise resource planning, international quality standards, finite scheduling, supply-chain management, mass customization, build-to-order, radio frequency identification (RFID) 6. Globalization era (2005–2025)—Global supply chains and logistics, growth of transnational organizations, sustainability, ethics in the global workplace, Internet of Things (IoT), digital operations, Industry 4.0	Concept Questions: 6.1–6.6
OPERATIONS FOR GOODS AND SERVICES (pp. 43–45)	■ Services—Economic activities that typically produce an intangible product (such as education, entertainment, lodging, government, financial, and health services). Almost all services and almost all goods are a mixture of a service and a tangible product. ■ Service sector—The segment of the economy that includes trade, financial, lodging, education, legal, medical, and other professional occupations. Services now constitute the largest economic sector in postindustrial societies. The huge productivity increases in agriculture and manufacturing have allowed more of our economic resources to be devoted to services. Many service jobs pay very well.	Concept Questions: 7.1–7.5

Chapter 1 **Rapid Review** *continued*

Main Heading	Review Material	MyLab Operations Management
THE PRODUCTIVITY CHALLENGE (pp. 45–50)	■ Productivity—The ratio of outputs (goods and services) divided by one or more inputs (such as labor, capital, or management) High production means producing many units, while high productivity means producing units efficiently. Only through increases in productivity can the standard of living of a country improve. U.S. productivity has averaged a 2.5% increase per year for over a century. $\text{Single-factor productivity} = \frac{\text{Units produced}}{\text{Input used}} \quad (1-1)$ ■ Single-factor productivity—Indicates the ratio of goods and services produced (outputs) to one resource (input). ■ Multifactor productivity—Indicates the ratio of goods and services produced (outputs) to many or all resources (inputs). Multifactor productivity $= \frac{\text{Output}}{\text{Labor} + \text{Material} + \text{Energy} + \text{Capital} + \text{Miscellaneous}} \quad (1-2)$ Measurement problems with productivity include: (1) the quality may change, (2) external elements may interfere, and (3) precise units of measure may be lacking. ■ Productivity variables—The three factors critical to productivity improvement are labor (10%), capital (38%), and management (52%). ■ Knowledge society—A society in which much of the labor force has migrated from manual work to work based on knowledge	Concept Questions: 8.1–8.6 Problems: 1.1–1.17 Virtual Office Hours for Solved Problems: 1.1, 1.2
CURRENT CHALLENGES IN OPERATIONS MANAGEMENT (pp. 50–51)	Some of the current challenges for operations managers include: ■ Global focus; international collaboration ■ Supply chain partnering; joint ventures; alliances ■ Sustainability; green products; recycle, reuse ■ Rapid product development; design collaboration ■ Mass customization; customized products ■ Lean operations; continuous improvement and elimination of waste	Concept Questions: 9.1–9.5
ETHICS, SOCIAL RESPONSIBILITY, AND SUSTAINABILITY (p. 51)	Among the many ethical challenges facing operations managers are (1) efficiently developing and producing safe, quality products; (2) maintaining a clean environment; (3) providing a safe workplace; and (4) honoring stakeholder commitments. ■ Stakeholders—Those with a vested interest in an organization	Concept Question: 10.1

Self Test

■ **Before taking the self-test,** refer to the learning objectives listed at the beginning of the chapter and the key terms listed at the end of the chapter.

- | | |
|---|--|
| <p>LO 1.1 Productivity increases when:</p> <ul style="list-style-type: none"> a) inputs increase while outputs remain the same. b) inputs decrease while outputs remain the same. c) outputs decrease while inputs remain the same. d) inputs and outputs increase proportionately. e) inputs increase at the same rate as outputs. <p>LO 1.2 A strategy that is <i>not</i> one of the 10 strategic operations management decisions is:</p> <ul style="list-style-type: none"> a) maintenance. b) human resources, job design and work measurement. c) location strategies. d) design of goods and services. e) advertising strategies. <p>LO 1.3 Operations management jobs comprise approximately ____% of all jobs.</p> <p>LO 1.4 Services often:</p> <ul style="list-style-type: none"> a) are tangible. b) are standardized. c) are knowledge based. d) are low in customer interaction. e) have consistent product definition. <p>LO 1.5 Productivity:</p> <ul style="list-style-type: none"> a) can use many factors as the numerator. b) is the same thing as production. | <ul style="list-style-type: none"> c) increases at about 0.5% per year. d) is dependent upon labor, management, and capital. e) is the same thing as effectiveness. <p>LO 1.6 Single-factor productivity:</p> <ul style="list-style-type: none"> a) remains constant. b) is never constant. c) usually uses labor as a factor. d) seldom uses labor as a factor. e) uses management as a factor. <p>LO 1.7 Multifactor productivity:</p> <ul style="list-style-type: none"> a) remains constant. b) is never constant. c) usually uses substitutes as common variables for the factors of production. d) seldom uses labor as a factor. e) always uses management as a factor. <p>LO 1.8 Productivity increases each year in the U.S. are a result of three factors:</p> <ul style="list-style-type: none"> a) labor, capital, management b) engineering, labor, capital c) engineering, capital, quality control d) engineering, labor, data processing e) engineering, capital, data processing |
|---|--|

Answers: LO 1.1. b; LO 1.2. e; LO 1.3 40; LO 1.4. c; LO 1.5. d; LO 1.6. c; LO 1.7. c; LO 1.8. a.

Operations Strategy in a Global Environment

2 CHAPTER

CHAPTER OUTLINE

GLOBAL COMPANY PROFILE: *Boeing*

- ◆ A Global View of Operations and Supply Chains **64**
- ◆ Determining Missions and Strategies **67**
- ◆ Achieving Competitive Advantage Through Operations **68**
- ◆ Issues in Operations Strategy **72**
- ◆ Strategy Development and Implementation **73**
- ◆ Strategic Planning, Core Competencies, and Outsourcing **76**
- ◆ Global Operations Strategy Options **80**



Beverly Amer/Aspenleaf Productions

GLOBAL COMPANY PROFILE
Boeing

Boeing's Global Supply-Chain Strategy Yields Competitive Advantage

Boeing's strategy for its 787 Dreamliner is unique for its technologically advanced product design and vast global supply chain.

The Dreamliner incorporates the latest in a wide range of aerospace technologies, from airframe and engine design to super-lightweight titanium-graphite laminate and carbon-fiber composites. The electronic monitoring system that allows the airplane to report maintenance



Peter Carey/Alamy Stock Photo



Dan Lamont/Alamy Stock Photo

With the 787's state-of-the-art design, more spacious interior, and global suppliers, Boeing has garnered record sales worldwide.

Some of the International Suppliers of Boeing 787 Components

SUPPLIER	HQ COUNTRY	COMPONENT
Latecoere	France	Passenger doors
Labinel	France	Wiring
Dassault	France	Design and product life cycle management software
Messier-Bugatti	France	Electric brakes
Thales	France	Electrical power conversion system
Messier-Dowty	France	Landing gear structure
Diehl	Germany	Interior lighting
Cobham	UK	Fuel pumps and valves
Rolls-Royce	UK	Engines
Smiths Aerospace	UK	Central computer system
BAE Systems	UK	Electronics
Alenia Aeronautica	Italy	Upper center fuselage
Toray Industries	Japan	Carbon fiber for wing and tail units
Fuji Heavy Industries	Japan	Center wing box
Kawasaki Heavy Ind.	Japan	Forward fuselage, fixed sections of wing
Teijin Seiki	Japan	Hydraulic actuators
Mitsubishi Heavy Ind.	Japan	Wing box
Chengdu Aircraft	China	Rudder
Hafei Aviation	China	Parts
Korean Airlines	South Korea	Wingtips
Saab	Sweden	Cargo and access doors

requirements in real time to ground-based computer systems is another product innovation. Boeing's collaboration with General Electric and Rolls-Royce has resulted in the development of more efficient engines and an emissions reduction of 20%. The advances in engine technology contribute as much as 8% of the increased fuel/payload efficiency of the new airplane, representing a nearly two-generation jump in technology.

Boeing's design group at its Everett, Washington, facility led an international team of aerospace companies in development of this state-of-the-art plane. Technologically advanced design, new manufacturing processes, and a committed international supply chain have helped Boeing and its partners achieve unprecedented levels of performance in design and manufacture.



View Pictures/Alastair Philip Wiper/VIEW/Newscom

State-of-the-art composite sections of the 787 are built around the world and shipped to Boeing for final assembly.



View Pictures/Alastair Philip Wiper/VIEW/Newscom

Components from Boeing's worldwide supply chain come together on assembly lines in Everett, Washington, and Charleston, South Carolina. Although components come from throughout the world, about 35% of the 787 structure comes from Japanese companies.

The 787 is global not only because it has a range of 8,300 miles, but also because it is built all over the world. With a huge financial commitment of over \$5 billion, Boeing needed partners. The global nature of both the technology and the aircraft market meant finding exceptional engineering talent and suppliers, wherever they might be. It also meant developing a culture of collaboration and integration with firms willing to step up to the risk associated with this revolutionary and very expensive new product.

State-of-the-art technology, multinational aircraft certifications, the cross-culture nature of the communications, and logistical challenges all added to the supply chain risk. The challenge was huge. In the end, Boeing accepted the challenge of teaming with more than 300 suppliers in over a dozen countries. Twenty of these suppliers developed technologies,

design concepts, and major systems for the 787. Some of them are shown in the table. The expectation is that countries that have a stake in the Dreamliner are more likely to buy from Boeing than from its European competitor, Airbus.

This enormous global supply chain delivers more than a billion parts and subassemblies to Boeing plants every year. Modern digital technology and analytics help Boeing determine which suppliers are working well and which are underperforming.

The innovative Dreamliner, with its global range and challenging worldwide supply chain, is setting new levels of operational efficiency. As a result, it is the fastest-selling commercial jet in history with over 1,200 planes sold. Boeing's Dreamliner reflects the global nature of business in the 21st century. █



Copyright Boeing

Boeing's collaborative technology enables a "virtual workspace" that allows Everett, Washington-based engineers, as well as partners in Australia, Japan, Italy, Canada, and across the United States, to make concurrent design changes to the airplane in real time. Digitally designing, building, and testing before production not only reduces design time and errors, but also improves efficiencies in component manufacturing and assembly.

LEARNING OBJECTIVES

- LO 2.1** *Define* mission and strategy 67
- LO 2.2** *Identify* and explain three strategic approaches to competitive advantage 68
- LO 2.3** *Understand* the significance of key success factors and core competencies 74
- LO 2.4** *Use* factor rating to evaluate both country and outsource providers 79
- LO 2.5** *Identify* and explain four global operations strategy options 80

A Global View of Operations and Supply Chains

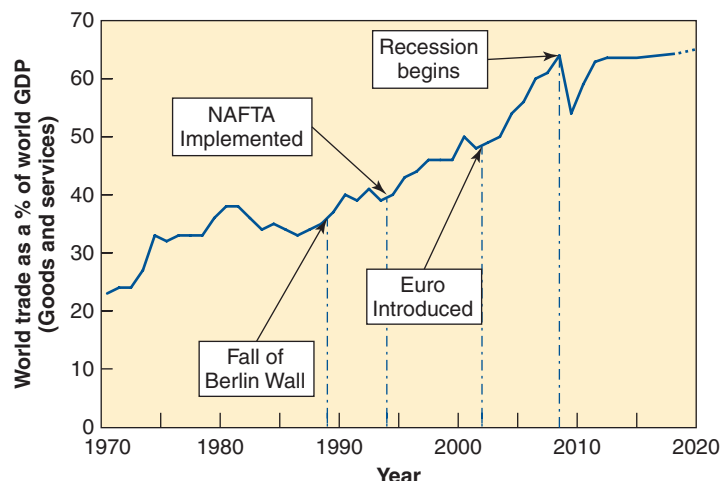
Today's successful operations manager has a global view of operations strategy. Since the early 1990s, nearly 3 billion people in developing countries have overcome the cultural, religious, ethnic, and political barriers that constrain productivity. And now they are all players on the global economic stage. As these barriers disappear, simultaneous advances are being made in technology, tariff reductions, reliable shipping, and inexpensive communication. These changes mean that, increasingly, firms find their customers and suppliers located around the world. The unsurprising result is the growth of world trade (see Figure 2.1), global capital markets, and the international movement of people. This means increasing economic integration and interdependence of countries—in a word, globalization. In response, organizations are hastily extending their distribution channels and supply chains globally. The result is innovative strategies where firms compete not just with their own expertise but with the talent in their entire global supply chain. For instance:

- ◆ Boeing is competitive because both its sales and supply chain are worldwide.
- ◆ Italy's Benetton moves inventory to stores around the world faster than its competition with rapid communication and by building exceptional flexibility into design, production, and distribution.
- ◆ Sony purchases components from a supply chain that extends to Thailand, Malaysia, and elsewhere around the world for assembly of its electronic products, which in turn are distributed around the world.
- ◆ Volvo, considered a Swedish company, was purchased by a Chinese company, Geely. But the current Volvo V40 is assembled in Belgium and Malaysia on a platform shared with the Mazda 3 (built in Japan) and the Ford Focus (built in six countries including the U.S.).
- ◆ China's Haier (pronounced "higher"), from its South Carolina plant, produces compact refrigerators (it has one-third of the U.S. market) and refrigerated wine cabinets (it has half of the U.S. market). Haier also controls 10% of the large appliance market worldwide and owns the GE appliance division, which employs 12,000 in Appliance Park, Kentucky.

Figure 2.1

Growth of World Trade as a Percentage of World GDP

Sources: World Bank; World Trade Organization; and IMF.



Globalization means customers, talent, and suppliers are worldwide. The new standards of global competitiveness impact quality, variety, customization, convenience, timeliness, and cost. Globalization strategies contribute efficiency, adding value to products and services, but they also complicate the operations manager's job. Complexity, risk, and competition are intensified, forcing companies to adjust for a shrinking world.

We have identified six reasons domestic business operations decide to change to some form of international operation. They are:

1. Improve the supply chain.
2. Reduce costs and exchange rate risk.
3. Improve operations.
4. Understand markets.
5. Improve products.
6. Attract and retain global talent.

Let us examine, in turn, each of the six reasons.

Improve the Supply Chain The supply chain can often be improved by locating facilities in countries where unique resources are available. These resources may be human resource expertise, low-cost labor, or raw material. For example, auto-styling studios from throughout the world have migrated to the auto mecca of southern California to ensure the necessary talent in contemporary auto design. Similarly, a perfume manufacturer wants a presence in Grasse, France, where much of the world's perfume essences are prepared from the flowers of the Mediterranean.

Reduce Costs and Exchange Rate Risk Many international operations seek to reduce risks associated with changing currency values (exchange rates) as well as take advantage of the tangible opportunities to reduce their direct costs. Less stringent government regulations on a wide variety of operations practices (e.g., environmental control, health and safety) can also reduce indirect costs.

Shifting low-skilled jobs to another country has several potential advantages. First, and most obviously, the firm may reduce costs. Second, moving the lower-skilled jobs to a lower-cost location frees higher-cost workers for more valuable tasks. Third, reducing wage costs allows the savings to be invested in improved products and facilities (and the retraining of existing workers, if necessary) at the home location.

Many firms use *financial hedging* by purchasing currency options to protect against negative exchange rate changes. Firms can also pursue **operational hedging** by intentionally building extra capacity in different countries and then shifting production from country to country as costs or exchange rates vary. This allows them to finesse currency risks and costs as economic conditions dictate.

The United States and Mexico have created **maquiladoras** (free trade zones) that allow manufacturers to cut their costs by paying only for the value added by Mexican workers. If a U.S. manufacturer, such as Caterpillar, brings a \$1,000 engine to a maquiladora operation for assembly work costing \$200, tariff duties will be charged only on the \$200 of work performed in Mexico.

Trade agreements also help reduce tariffs and thereby reduce the cost of operating facilities in foreign countries. The **World Trade Organization (WTO)** has helped reduce tariffs from 40% in 1940 to less than 3% today. Another important trade agreement is the **North American Free Trade Agreement (NAFTA)**. NAFTA seeks to phase out all trade and tariff barriers among Canada, Mexico, and the U.S. Other trade agreements that are accelerating global trade include APEC (the Pacific Rim countries), SEATO (Australia, New Zealand, Japan, Hong Kong, South Korea, New Guinea, and Chile), MERCOSUR (Argentina, Brazil, Paraguay, and Uruguay), and CAFTA (Central America, Dominican Republic, and United States).

Another trading group is the **European Union (EU)**.¹ The European Union has reduced trade barriers among the participating European nations through standardization and a common currency, the euro. However, this major U.S. trading partner, with over 500 million consumers, is also placing some of the world's most restrictive conditions on products sold in the EU. Everything from recycling standards to automobile bumpers to hormone-free farm products must meet EU standards, complicating international trade.

Operational hedging

Maintaining excess capacity in different countries and shifting production levels among those countries as costs and exchange rates change.

Maquiladoras

Mexican factories located along the U.S.–Mexico border that receive preferential tariff treatment.

World Trade Organization (WTO)

An international organization that promotes world trade by lowering barriers to the free flow of goods across borders.

North American Free Trade Agreement (NAFTA)

A free trade agreement between Canada, Mexico, and the United States.

European Union (EU)

A European trade group that has 28 member states.

Improve Operations Operations learn from better understanding of management innovations in different countries. For instance, the Japanese have improved inventory management, the Germans are aggressively using robots, and the Scandinavians have contributed to improved ergonomics throughout the world.

Another reason to have international operations is to reduce response time to meet customers' changing product and service requirements. Providing quick and adequate service is often improved by locating facilities in the customer's home country.

Understand Markets Because international operations require interaction with foreign customers, suppliers, and other competitive businesses, international firms inevitably learn about opportunities for new products and services. Europe led the way with cell phone innovations, and then the Japanese and Indians led with cell phone fads. Knowledge of markets not only helps firms understand where the market is going but also helps firms diversify their customer base, add production flexibility, and smooth the business cycle.

Another reason to go into foreign markets is the opportunity to extend the *life cycle* (i.e., stages a product goes through; see Chapter 5) of an existing product. While some products in the U.S. are in a "mature" stage of their product life cycle, they may represent state-of-the-art products in less-developed countries.

Improve Products Learning does not take place in isolation. Firms serve themselves and their customers well when they remain open to the free flow of ideas. For example, Toyota and BMW will manage joint research and share development costs on battery research for the next generation of green cars. Similarly, international learning in operations is taking place as South Korea's Samsung and Germany's Robert Bosch join to produce lithium-ion batteries to the benefit of both.

Attract and Retain Global Talent Global organizations can attract and retain better employees by offering more employment opportunities. They need people in all functional areas and areas of expertise worldwide. Global firms can recruit and retain good employees because they provide both greater growth opportunities and insulation against unemployment during times of economic downturn. During economic downturns in one country or continent, a global firm has the means to relocate unneeded personnel to more prosperous locations.

A worldwide strategy places added burdens on operations management. Because of economic and lifestyle differences, designers must target products to each market. For instance, clothes washers sold in northern countries must spin-dry clothes much better than those in warmer climates, where consumers are likely to line-dry them. Similarly, as shown here, Whirlpool refrigerators sold in Bangkok are manufactured in bright colors because they are often put in living rooms.



Kraipit Phanwut/Sipa Press

So, to recap, successfully achieving a competitive advantage in our shrinking world means maximizing all the possible opportunities, from tangible to intangible, that international operations can offer.

Cultural and Ethical Issues

While there are great forces driving firms toward globalization, many challenges remain. One of these challenges is reconciling differences in social and cultural behavior. With issues ranging from bribery, to child labor, to the environment, managers sometimes do not know how to respond when operating in a different culture. What one country's culture deems acceptable may be considered unacceptable or illegal in another. It is not by chance that there are fewer female managers in the Middle East than in India.

In the last decade, changes in international laws, agreements, and codes of conduct have been applied to define ethical behavior among managers around the world. The WTO, for example, helps to make uniform the protection of both governments and industries from foreign firms that engage in unethical conduct. Even on issues where significant differences between cultures exist, as in the area of bribery or the protection of intellectual property, global uniformity is slowly being accepted by many nations.

Despite cultural and ethical differences, we live in a period of extraordinary mobility of capital, information, goods, and even people. We can expect this to continue. The financial sector, the telecommunications sector, and the logistics infrastructure of the world are healthy institutions that foster efficient and effective use of capital, information, and goods. Globalization, with all its opportunities and risks, is here. It must be embraced as managers develop missions and strategies.

Determining Missions and Strategies

An effective operations management effort must have a *mission* so it knows where it is going and a *strategy* so it knows how to get there. This is the case for a small domestic organization as well as a large international organization.

STUDENT TIP

Getting an education and managing an organization both require a mission and strategy.

Mission

Economic success, indeed survival, is the result of identifying missions to satisfy a customer's needs and wants. We define the organization's **mission** as its purpose—what it will contribute to society. Mission statements provide boundaries and focus for organizations and the concept around which the firm can rally. The mission states the rationale for the organization's existence. Developing a good strategy is difficult, but it is much easier if the mission has been well defined. Figure 2.2 provides examples of mission statements.

Once an organization's mission has been decided, each functional area within the firm determines its supporting mission. By *functional area* we mean the major disciplines required by the firm, such as marketing, finance/accounting, and production/operations. Missions for each function are developed to support the firm's overall mission. Then within that function lower-level supporting missions are established for the OM functions. Figure 2.3 provides such a hierarchy of sample missions.

Mission

The purpose or rationale for an organization's existence.

LO 2.1 Define mission and strategy

Strategy

With the mission established, strategy and its implementation can begin. **Strategy** is an organization's action plan to achieve the mission. Each functional area has a strategy for achieving its mission and for helping the organization reach the overall mission. These strategies exploit opportunities and strengths, neutralize threats, and avoid weaknesses. In the following sections, we will describe how strategies are developed and implemented.

Strategy

How an organization expects to achieve its missions and goals.

LO 2.2 Identify and explain three strategic approaches to competitive advantage

VIDEO 2.1
Operations Strategy at Regal Marine

Firms achieve missions in three conceptual ways: (1) differentiation, (2) cost leadership, and (3) response. This means operations managers are called on to deliver goods and services that are (1) *better*, or at least different, (2) *cheaper*, and (3) more *responsive*. Operations managers translate these *strategic concepts* into tangible tasks to be accomplished. Any one or combination of these three strategic concepts can generate a system that has a unique advantage over competitors. Much of the remainder of this text is devoted to the challenging task of translating strategy into execution.

Achieving Competitive Advantage Through Operations

Competitive advantage
The creation of a unique advantage over competitors.

Each of the three strategies provides an opportunity for operations managers to achieve competitive advantage. **Competitive advantage** implies the creation of a system that has a unique advantage over competitors. The idea is to create customer value in an efficient and sustainable way. Pure forms of these strategies may exist, but operations managers will more likely be called on to implement some combination of them. Let us briefly look at how managers achieve competitive advantage via *differentiation*, *low cost*, and *response*.

STUDENT TIP For many organizations, the operations function provides *the* competitive advantage.

Competing on Differentiation

Safeskin Corporation is number one in latex exam gloves because it has differentiated itself and its products. It did so by producing gloves that were designed to prevent allergic reactions about which doctors were complaining. When other glove makers caught up, Safeskin developed hypoallergenic gloves. Then it added texture to its gloves. Then it developed a synthetic disposable glove for those allergic to latex—always staying ahead of the competition. Safeskin’s strategy is to develop a reputation for designing and producing reliable state-of-the-art gloves, thereby differentiating itself.

Differentiation is concerned with providing *uniqueness*. A firm’s opportunities for creating uniqueness are not located within a particular function or activity but can arise in virtually everything the firm does. Moreover, because most products include some service, and most services include some product, the opportunities for creating this uniqueness are limited only by imagination. Indeed, **differentiation** should be thought of as going beyond both physical characteristics and service attributes to encompass everything about the product or service that influences the value that the customers derive from it. Therefore, effective operations managers assist

Differentiation
Distinguishing the offerings of an organization in a way that the customer perceives as adding value.

Figure 2.2
Mission Statements for Three Organizations
Source: Mission statement from Merck. Copyright © by Merck & Co., Inc. Reprinted with permission.

Merck
The mission of Merck is to provide society with superior products and services—innovations and solutions that improve the quality of life and satisfy customer needs—to provide employees with meaningful work and advancement opportunities and investors with a superior rate of return.
PepsiCo
Our mission is to be the world's premier consumer products company focused on convenient foods and beverages. We seek to produce financial rewards to investors as we provide opportunities for growth and enrichment to our employees, our business partners and the communities in which we operate. And in everything we do, we strive for honesty, fairness and integrity.
Arnold Palmer Hospital
Arnold Palmer Hospital for Children provides state of the art, family-centered healthcare focused on restoring the joy of childhood in an environment of compassion, healing, and hope.

Sample Company Mission	
To manufacture and service an innovative, growing, and profitable worldwide microwave communications business that exceeds our customers' expectations.	
Sample Operations Management Mission	
To produce products consistent with the company's mission as the worldwide low-cost manufacturer.	
Sample OM Department Missions	
Product design	To design and produce products and services with outstanding quality and inherent customer value.
Quality management	To attain the exceptional value that is consistent with our company mission and marketing objectives by close attention to design, supply chain, production, and field service opportunities.
Process design	To determine, design, and develop the production process and equipment that will be compatible with low-cost product, high quality, and a good quality of work life.
Location	To locate, design, and build efficient and economical facilities that will yield high value to the company, its employees, and the community.
Layout design	To achieve, through skill, imagination, and resourcefulness in layout and work methods, production effectiveness and efficiency while supporting a high quality of work life.
Human resources	To provide a good quality of work life, with well-designed, safe, rewarding jobs, stable employment, and equitable pay, in exchange for outstanding individual contribution from employees at all levels.
Supply chain management	To collaborate with suppliers to develop innovative products from stable, effective, and efficient sources of supply.
Inventory	To achieve low investment in inventory consistent with high customer service levels and high facility utilization.
Scheduling	To achieve high levels of throughput and timely customer delivery through effective scheduling.
Maintenance	To achieve high utilization of facilities and equipment by effective preventive maintenance and prompt repair of facilities and equipment.

Figure 2.3

Sample Missions for a Company, the Operations Function, and Major OM Departments

in defining everything about a product or service that will influence the potential value to the customer. This may be the convenience of a broad product line, product features, or a service related to the product. Such services can manifest themselves through convenience (location of distribution centers, stores, or branches), training, product delivery and installation, or repair and maintenance services.

In the service sector, one option for extending product differentiation is through an *experience*. Differentiation by experience in services is a manifestation of the growing “experience economy.” The idea of **experience differentiation** is to engage the customer—to use people’s five senses so they become immersed, or even an active participant, in the product. Disney does this with the Magic Kingdom. People no longer just go on a ride; they are immersed in the Magic Kingdom—surrounded by dynamic visual and sound experiences that complement the physical ride. Some rides further engage the customer with virtual reality or changing air flow and smells, as well as having them steer the ride or shoot at targets or villains. Even movie theaters are moving in this direction with surround sound, moving seats, changing “smells,” and mists of “rain,” as well as multimedia inputs to story development.

Experience differentiation

Engaging a customer with a product through imaginative use of the five senses, so the customer “experiences” the product.

VIDEO 2.2

Hard Rock's Global Strategy

Theme restaurants, such as Hard Rock Cafe, likewise differentiate themselves by providing an “experience.” Hard Rock engages the customer with classic rock music, big-screen rock videos, memorabilia, and staff who can tell stories. In many instances, a full-time guide is available to explain the displays, and there is always a convenient retail store so the guest can take home a tangible part of the experience. The result is a “dining experience” rather than just a meal. In a less dramatic way, both Starbucks and your local supermarket deliver an experience when they provide music and the aroma of fresh coffee or freshly baked bread.

Competing on Cost

Southwest Airlines has been a consistent moneymaker while other U.S. airlines have lost billions. Southwest has done this by fulfilling a need for low-cost and short-hop flights. Its operations strategy has included use of secondary airports and terminals, first-come, first-served seating, few fare options, smaller crews flying more hours, and snacks-only or no-meal flights.

In addition, and less obviously, Southwest has very effectively matched capacity to demand and effectively utilized this capacity. It has done this by designing a route structure that matches the capacity of its Boeing 737, the only plane in its fleet. Second, it achieves more air miles than other airlines through faster turnarounds—its planes are on the ground less.

One driver of a low-cost strategy is a facility that is effectively utilized. Southwest and others with low-cost strategies understand this and use financial resources effectively. Identifying the optimum size (and investment) allows firms to spread overhead costs, providing a cost advantage. For instance, Walmart continues to pursue its low-cost strategy with superstores, open 24 hours a day. For 20 years, it has successfully grabbed market share. Walmart has driven down store overhead costs, shrinkage, and distribution costs. Its rapid transportation of goods, reduced warehousing costs, and direct shipment from manufacturers have resulted in high inventory turnover and made it a low-cost leader.

Likewise, Franz Colruyt, a Belgian discount food retailer, is also an aggressive cost cutter. Colruyt cuts overhead by using converted factory warehouses, movie theaters, and garages as outlets. Customers find no background music, shopping bags, or bright lights: all have been eliminated to cut costs. Walmart and Colruyt are winning with a low-cost strategy.

Low-cost leadership entails achieving maximum *value* as defined by your customer. It requires examining each of the 10 OM decisions in a relentless effort to drive down costs while meeting customer expectations of value. A low-cost strategy does *not* imply low value or low quality.

Low-cost leadership

Achieving maximum value, as perceived by the customer.

Competing on Response

The third strategy option is response. Response is often thought of as *flexible* response, but it also refers to *reliable* and *quick* response. Indeed, we define **response** as including the entire range of values related to timely product development and delivery, as well as reliable scheduling and flexible performance.

Flexible response may be thought of as the ability to match changes in a marketplace where design innovations and volumes fluctuate substantially.

Hewlett-Packard is an exceptional example of a firm that has demonstrated flexibility in both design and volume changes in the volatile world of personal computers. HP's products often have a life cycle of months, and volume and cost changes during that brief life cycle are dramatic. However, HP has been successful at institutionalizing the ability to change products and volume to respond to dramatic changes in product design and costs—thus building a *sustainable competitive advantage*.

The second aspect of response is the *reliability* of scheduling. One way the German machine industry has maintained its competitiveness despite having the world's highest labor costs is through reliable response. This response manifests itself in reliable scheduling. German machine firms have meaningful schedules—and they perform to these schedules. Moreover, the results of these schedules are communicated to the customer, and the customer can, in turn,

Response

A set of values related to rapid, flexible, and reliable performance.



Response strategy wins orders at Super Fast Pizza. Using a wireless connection, orders are transmitted to \$20,000 kitchens in vans. The driver, who works solo, receives a printed order, goes to the kitchen area, pulls premade pizzas from the cooler, and places them in the oven—it takes about 1 minute. The driver then delivers the pizza—sometimes even arriving before the pizza is ready.

rely on them. Consequently, the competitive advantage generated through reliable response has value to the end customer.

The third aspect of response is *quickness*. Johnson Electric Holdings, Ltd., with headquarters in Hong Kong, makes 83 million tiny motors each month. The motors go in cordless tools, household appliances, and personal care items such as hair dryers; dozens are found in each automobile. Johnson's major competitive advantage is speed: speed in product development, speed in production, and speed in delivery.

Whether it is a production system at Johnson Electric or a pizza delivered in 5 minutes by Pizza Hut, the operations manager who develops systems that respond quickly and reliably can have a competitive advantage.

In practice, differentiation, low cost, and response can increase productivity and generate a sustainable competitive advantage. Proper implementation of the ten decisions by operations managers (see Figure 2.4) will allow these advantages to be achieved.

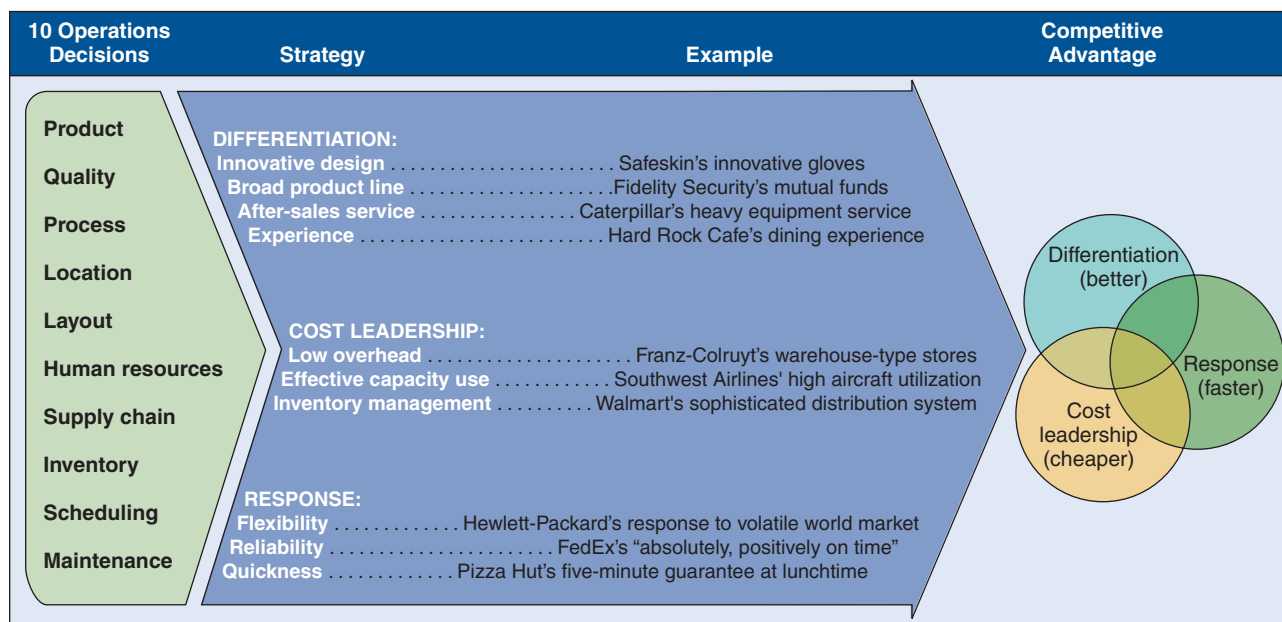


Figure 2.4

Achieving Competitive Advantage Through Operations

Issues in Operations Strategy

Resources view

A method managers use to evaluate the resources at their disposal and manage or alter them to achieve competitive advantage.

Value-chain analysis

A way to identify those elements in the product/service chain that uniquely add value.

Five forces model

A method of analyzing the five forces in the competitive environment.

Whether the OM strategy is differentiation, cost, or response (as shown in Figure 2.4), OM is a critical player. Therefore, prior to establishing and attempting to implement a strategy, some alternate perspectives may be helpful. One perspective is to take a **resources view**. This means thinking in terms of the financial, physical, human, and technological resources available and ensuring that the potential strategy is compatible with those resources. Another perspective is Porter's value-chain analysis.² **Value-chain analysis** is used to identify activities that represent strengths, or potential strengths, and may be opportunities for developing competitive advantage. These are areas where the firm adds its unique *value* through product research, design, human resources, supply-chain management, process innovation, or quality management. Porter also suggests analysis of competitors via what he calls his **five forces model**.³ These potential competing forces are immediate rivals, potential entrants, customers, suppliers, and substitute products.

In addition to the competitive environment, the operations manager needs to understand that the firm is operating in a system with many other external factors. These factors range from economic, to legal, to cultural. They influence strategy development and execution and require constant scanning of the environment.

The firm itself is also undergoing constant change. Everything from resources, to technology, to product life cycles is in flux. Consider the significant changes required within the firm as its products move from introduction, to growth, to maturity, and to decline (see Figure 2.5). These internal changes, combined with external changes, require strategies that are dynamic.

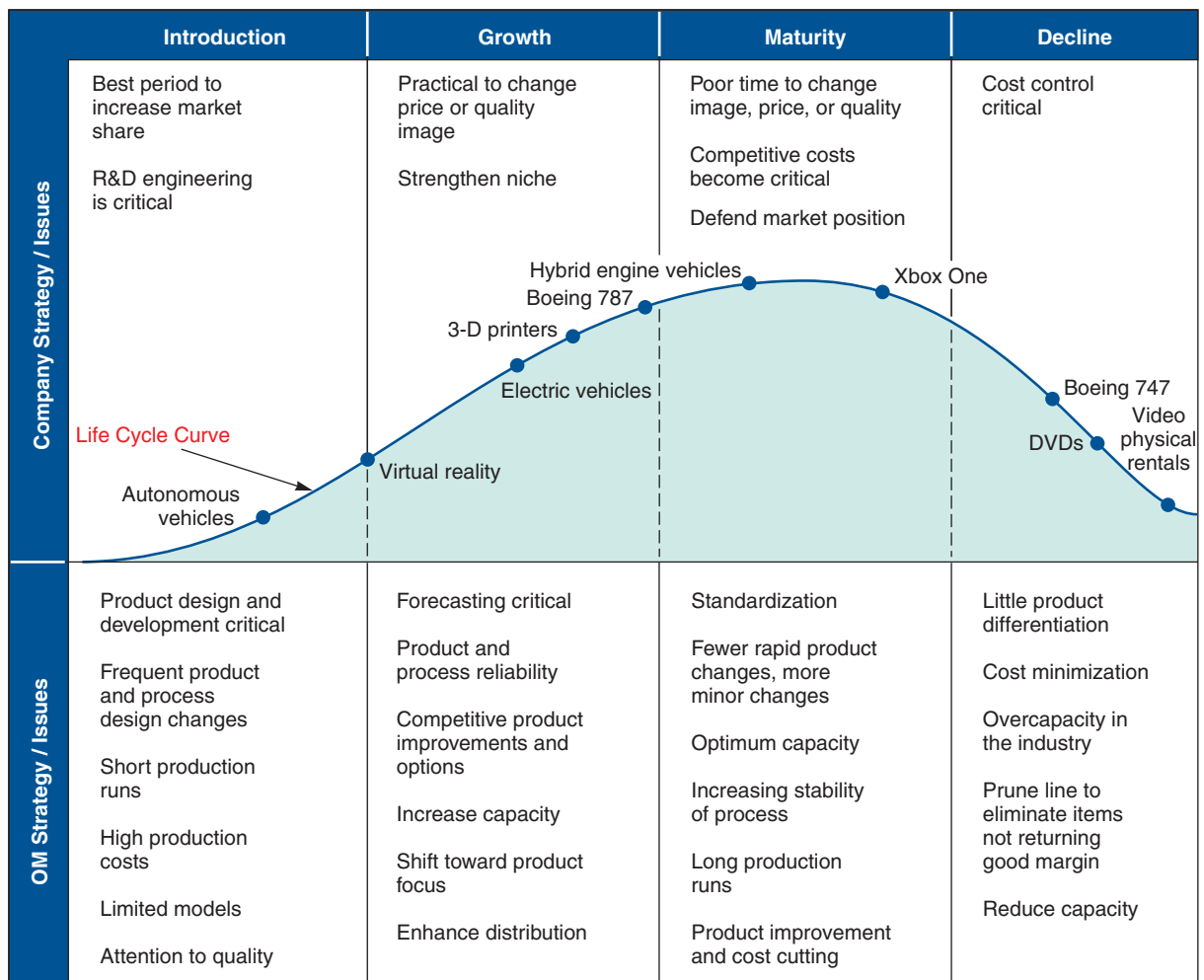


Figure 2.5

Strategy and Issues During a Product's Life

In this chapter's *Global Company Profile*, Boeing provides an example of how strategy must change as technology and the environment change. Boeing can now build planes from carbon fiber, using a global supply chain. Like many other OM strategies, Boeing's strategy has changed with technology and globalization. Microsoft has also had to adapt quickly to a changing environment. Faster processors, new computer languages, changing customer preferences, increased security issues, the Internet, the cloud, and Google have all driven changes at Microsoft. These forces have moved Microsoft's product strategy from operating systems to office products, to Internet service provider, and now to integrator of computers, cell phones, games, and television via the cloud. Also notice, as discussed in the *OM In Action* box "Amazon Updates Sears' Strategy," how Sears has languished while Amazon has embraced the new digital world to build a new worldwide multi-billion dollar business.

The more thorough the analysis and understanding of both the external and internal factors, the more likely that a firm can find the optimum use of its resources. Once a firm understands itself and the environment, a SWOT analysis, which we discuss next, is in order.

Strategy Development and Implementation

A **SWOT analysis** is a formal review of internal strengths and weaknesses and external opportunities and threats. Beginning with SWOT analyses, organizations position themselves, through their strategy, to have a competitive advantage. A firm may have excellent design skills or great talent at identifying outstanding locations. However, it may recognize limitations of its manufacturing process or in finding good suppliers. The idea is to maximize opportunities and minimize threats in the environment while maximizing the advantages of the organization's strengths and minimizing the weaknesses. Any preconceived ideas about mission are then reevaluated to ensure they are consistent with the SWOT analysis. Subsequently, a strategy for achieving the mission is developed. This strategy is continually evaluated against the value provided customers and competitive realities. The process is shown in Figure 2.6. From this process, key success factors are identified.

STUDENT TIP

A SWOT analysis provides an excellent model for evaluating a strategy.

SWOT analysis

A method of determining internal strengths and weaknesses and external opportunities and threats.

OM in Action

Amazon Updates Sears' Strategy

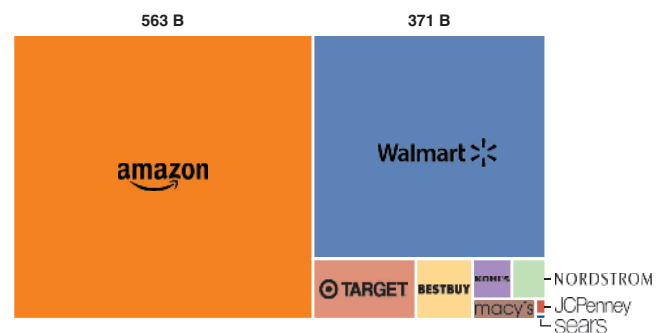
A century ago, a retail giant that shipped millions of products by mail moved swiftly into the brick-and-mortar business, changing retail forever. Is that happening again? A look at Sears' strategy predicts nearly everything Amazon is doing.

In the last few years, Amazon has opened numerous physical bookstores. It bought Whole Foods and its 400 grocery locations, and it announced a partnership with Kohl's to allow returns at the physical retailer's stores. Amazon's corporate strategy is following a familiar playbook—that of Sears. Sears might seem like a zombie today, but it's easy to forget how transformative the company was 100 years ago. To understand Amazon's evolution, strategy, and future, can we look to Sears?

Mail was an internet before the Internet. After the Civil War, the telegraph, rail, and parcel delivery made it possible to shop via catalog at home and have items delivered to your door. Americans browsed catalogs for everything from food, to books, to houses. Merchants sent the parcels by rail. Then Sears made the successful transition to a brick-and-mortar giant. Like Amazon among its online rivals, Sears was not the country's first mail-order retailer, but it became the largest. Like Amazon, it started with a single product category—watches, rather than books. Like Amazon, the company grew to include a range of products, including guns, gramophones, cars, and groceries.

By building a large base of fiercely loyal consumers, Sears was able to buy more cheaply from manufacturers. It managed its deluge of orders with massive warehouses. But the company's brick-and-mortar transformation was astonishing. At the start of 1925, there were no Sears stores. By 1929, there

Amazon's Market Value Is Larger than the Total of Many Brick-and-Mortar Retailers

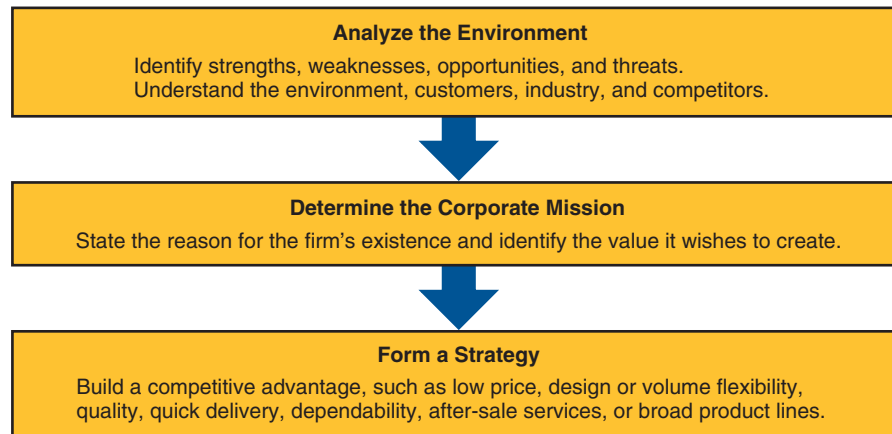


were 300. Like Amazon today, the company used its position to enter adjacent businesses. To supplement its huge auto-parts business, Sears started selling car insurance under the Allstate brand. Perhaps Sears' shift from selling products to services is analogous to the creation of Amazon Web Services—or Amazon's TV shows. The growth of both companies was the result of a strategic vision and a focus on operations efficiency, with an eye on the changes in demographics, technology, and logistics. But Sears failed to adjust to a rapidly changing environment. Will Amazon fair better?

Sources: *The Atlantic* (September 25, 2017); *Entrepreneur* (February 18, 2016); and *USA Today* (November 23, 2017).

Figure 2.6

Strategy Development Process



Key Success Factors and Core Competencies

Key success factors (KSFs)

Activities or factors that are *key* to achieving competitive advantage.

Core competencies

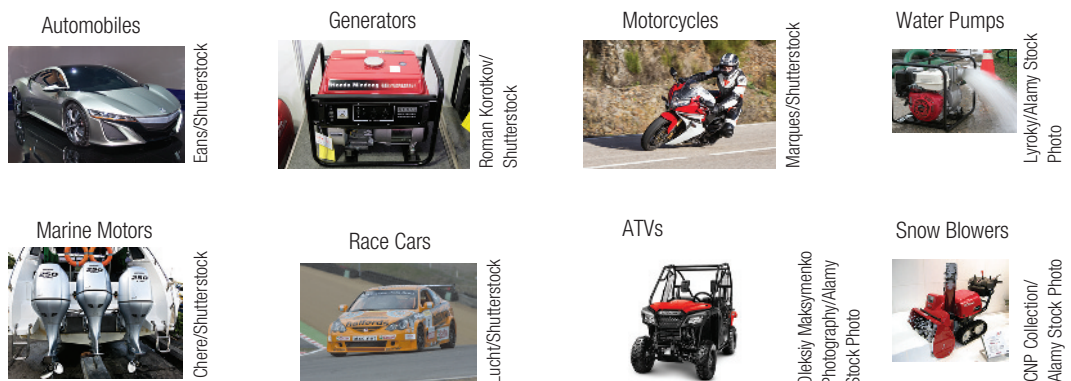
A set of skills, talents, and capabilities in which a firm is particularly strong.

Because no firm does everything exceptionally well, a successful strategy requires determining the firm's key success factors and core competencies. **Key success factors (KSFs)** are those activities that are necessary for a firm to achieve its goals. Key success factors can be so significant that a firm must get them right to survive. A KSF for McDonald's, for example, is layout. Without an effective drive-through and an efficient kitchen, McDonald's cannot be successful. KSFs are often necessary, but not sufficient for competitive advantage. On the other hand, **core competencies** are the set of unique skills, talents, and capabilities that a firm does at a world-class standard. They allow a firm to set itself apart and develop a competitive advantage. Organizations that prosper identify their core competencies and nurture them. While McDonald's KSFs may include layout, its core competency may be consistency and quality. Honda Motors' core competence is gas-powered engines—engines for automobiles, motorcycles, lawn mowers, generators, snow blowers, and more. The idea is to build KSFs and core competencies that provide a competitive advantage and support a successful strategy and mission. A core competency may be the ability to perform the KSFs or a combination of KSFs. The operations manager begins this inquiry by asking:

- ◆ “What tasks must be done particularly well for a given strategy to succeed?”
- ◆ “Which activities provide a competitive advantage?”
- ◆ “Which elements contain the highest likelihood of failure, and which require additional commitment of managerial, monetary, technological, and human resources?”

Only by identifying and strengthening key success factors and core competencies can an organization achieve sustainable competitive advantage. In this text we focus on the 10 strategic OM decisions that typically include the KSFs. These decisions, plus major decision areas for marketing and finance, are shown in Figure 2.7.

Honda's core competence is the design and manufacture of gas-powered engines. This competence has allowed Honda to become a leader in the design and manufacture of a wide range of gas-powered products. Tens of millions of these products are produced and shipped around the world.



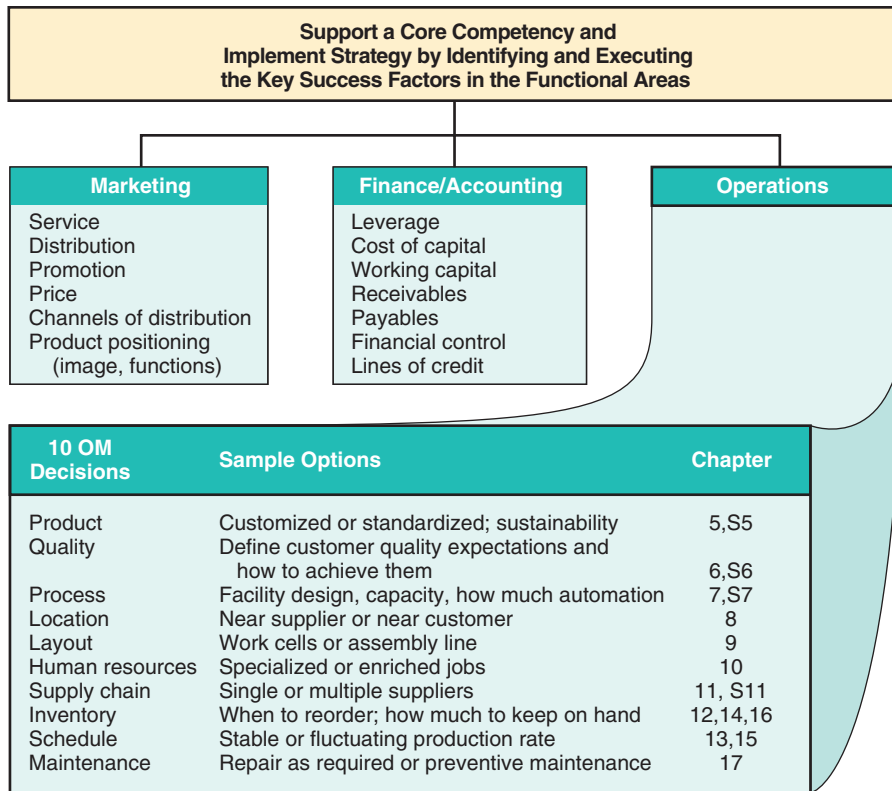


Figure 2.7

Implement Strategy by Identifying and Executing Key Success Factors That Support Core Competencies

STUDENT TIP

These 10 decisions are used to implement a specific strategy and yield a competitive advantage.

Integrating OM with Other Activities

Whatever the KSFs and core competencies, they must be supported by the related activities. One approach to identifying the activities is an **activity map**, which links competitive advantage, KSFs, and supporting activities. For example, Figure 2.8 shows how Southwest Airlines, whose core competency is operations, built a set of integrated activities to support its low-cost competitive advantage. Notice how the KSFs support operations and in turn are supported by other activities. The activities fit together and reinforce each other. In this way, all of the areas support the company's objectives. For example, short-term scheduling in the airline industry is dominated by volatile customer travel patterns. Day-of-week preference, holidays, seasonality, college schedules, and so on all play roles in changing flight schedules. Consequently, airline scheduling, although an OM activity, is tied to marketing. Effective scheduling in the trucking industry is reflected in the amount of time trucks travel loaded. But maximizing the time trucks travel loaded requires the integration of information from deliveries completed, pickups pending, driver availability, truck maintenance, and customer priority. Success requires integration of all of these activities.

The better the activities are integrated and reinforce each other, the more sustainable the competitive advantage. By focusing on enhancing its core competence and KSFs with a supporting set of activities, firms such as Southwest Airlines have built successful strategies.

Activity map

A graphical link of competitive advantage, KSFs, and supporting activities.

Building and Staffing the Organization

Once a strategy, KSFs, and the necessary integration have been identified, the second step is to group the necessary activities into an organizational structure. Then, managers must staff the organization with personnel who will get the job done. The manager works with subordinate managers to build plans, budgets, and programs that will successfully implement strategies that achieve missions. Firms tackle this organization of the operations function in a variety of ways. The organization charts shown in Chapter 1 (Figure 1.1) indicate the way some firms have organized to perform the required activities. *The operations manager's job is to implement an OM strategy, provide competitive advantage, and increase productivity.*

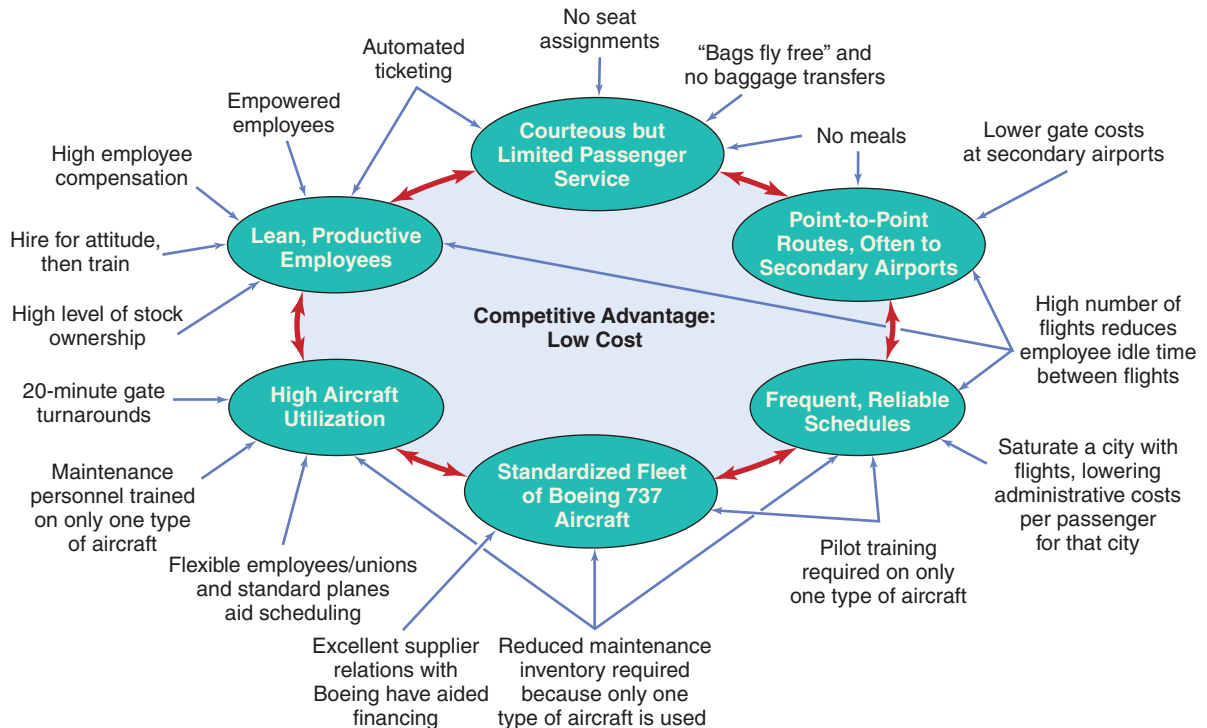


Figure 2.8

Activity Mapping of Southwest Airlines' Low-Cost Competitive Advantage

To achieve a low-cost competitive advantage, Southwest has identified a number of key success factors (connected by red arrows) and support activities (shown by blue arrows). As this figure indicates, Southwest's low-cost strategy is highly dependent on a very well-run operations function.

Implementing the 10 Strategic OM Decisions

As mentioned earlier, the challenging task of implementing the 10 strategic OM decisions is influenced by a variety of issues—from missions and strategy to key success factors and core competencies—while addressing such issues as product mix and product life cycle in a competitive environment. Because each product brings its own mix of attributes, the importance and method of implementation of the 10 strategic OM decisions will vary. Throughout this text, we discuss how these decisions are implemented in ways that provide competitive advantage. How this might be done for two drug companies, one seeking competitive advantage via differentiation and the other via low cost, is shown in Table 2.1.

Strategic Planning, Core Competencies, and Outsourcing

As organizations develop missions, goals, and strategies, they identify their strengths—what they do as well as or better than their competitors—as their *core competencies*. By contrast, *non-core activities*, which can be a sizable portion of an organization's total business, are good candidates for outsourcing. **Outsourcing** is transferring activities that have traditionally been internal to external suppliers.

Outsourcing is not a new concept, but it does add complexity and risk to the supply chain. Because of its potential, outsourcing continues to expand. The expansion is accelerating due to three global trends: (1) increased technological expertise, (2) more reliable and cheaper transportation, and (3) the rapid development and deployment of advancements in telecommunications and computers. This rich combination of economic advances is contributing to both lower cost and more specialization. As a result more firms are candidates for outsourcing of non-core activities.

Outsourcing implies an agreement (typically a legally binding contract) with an external organization. The classic make-or-buy decision, concerning which products to make and which to buy, is the basis of outsourcing. When firms such as Apple find that their core competency is in creativity, innovation, and product design, they may want to outsource manufacturing.

Outsourcing manufacturing is an extension of the long-standing practice of *subcontracting* production activities, which when done on a continuing basis is known as

Outsourcing

Transferring a firm's activities that have traditionally been internal to external suppliers.

VIDEO 2.3

Outsourcing Offshore at Darden

TABLE 2.1

Operations Strategies of Two Drug Companies*

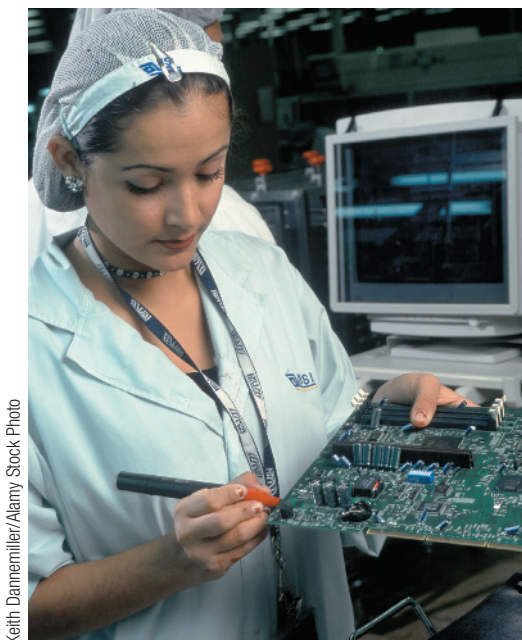
COMPETITIVE ADVANTAGE	BRAND NAME DRUGS, INC.	GENERIC DRUG CORP.
	PRODUCT DIFFERENTIATION STRATEGY	LOW-COST STRATEGY
Product selection and design	Heavy R&D investment; extensive labs; focus on development in a broad range of drug categories	Low R&D investment; focus on development of generic drugs
Quality	Quality is major priority, standards exceed regulatory requirements	Meets regulatory requirements on a country-by-country basis, as necessary
Process	Product and modular production process; tries to have long product runs in specialized facilities; builds capacity ahead of demand	Process focused; general production processes; “job shop” approach, short-run production; focus on high utilization
Location	Still located in city where it was founded	Recently moved to low-tax, low-labor-cost environment
Layout	Layout supports automated product-focused production	Layout supports process-focused “job shop” practices
Human resources	Hire the best; nationwide searches	Very experienced top executives hired to provide direction; other personnel paid below industry average
Supply chain	Long-term supplier relationships	Tends to purchase competitively to find bargains
Inventory	Maintains high finished goods inventory primarily to ensure all demands are met	Process focus drives up work-in-process inventory; finished goods inventory tends to be low
Scheduling	Centralized production planning	Many short-run products complicate scheduling
Maintenance	Highly trained staff; extensive parts inventory	Highly trained staff to meet changing process and equipment demands

*Notice how the 10 decisions are altered to build two distinct strategies in the same industry.

contract manufacturing. Contract manufacturing is becoming standard practice in many industries, from computers to automobiles. For instance, Johnson & Johnson, like many other big drug companies whose core competency is research and development, often farms out manufacturing to contractors. On the other hand, Sony’s core competency is electromechanical design of chips. This is its core competency, but Sony is also one of the best in the world when it comes to rapid response and specialized production of these chips. Therefore, Sony finds that it wants to be its own *manufacturer*, while specialized providers come up with major innovations in such areas as software, human resources, and distribution. These areas are the providers’ business, not Sony’s, and the provider may very well be better at it than Sony.

Other examples of outsourcing non-core activities include:

- ♦ DuPont routing legal services to the Philippines
- ♦ IBM handing travel services and payroll, and Hewlett-Packard providing IT services to P&G



Keith Dammiller/Alamy Stock Photo

Contract manufacturers such as Flextronics provide outsourcing service to IBM, Cisco Systems, HP, Microsoft, Sony, Nortel, Ericsson, and Sun, among many others. Flextronics is a high-quality producer that has won over 450 awards, including the Malcolm Baldrige Award. One of the side benefits of outsourcing is that client firms such as IBM can actually improve their performance by using the competencies of an outstanding firm like Flextronics. But there are risks involved in outsourcing.

- ◆ ADP managing payroll services for thousands of organizations
- ◆ Accenture providing consulting and back office services for 95 of the Global Fortune 100
- ◆ Blue Cross sending hip resurfacing surgery patients to India

Managers evaluate their strategies and core competencies and ask themselves how to use the assets entrusted to them. Do they want to be the company that does low-margin work at 3%–4% or the innovative firm that makes a 30%–40% margin? PC and iPad contract manufacturers in China and Taiwan earn 3%–4%, but Apple, which innovates, designs, and sells, has a margin 10 times as large. (See the *OM in Action* box “China Outsources Too—to Ethiopia.”)

The Theory of Comparative Advantage

Theory of comparative advantage

A theory which states that countries benefit from specializing in (and exporting) goods and services in which they have relative advantage, and they benefit from importing goods and services in which they have a relative disadvantage.

The motivation for international outsourcing comes from the **theory of comparative advantage**. This theory focuses on the economic concept of relative advantage. According to the theory, if an external provider, regardless of its geographic location, can perform activities more productively than the purchasing firm, then the external provider should do the work. This allows the purchasing firm to focus on what it does best—its core competencies. Consistent with the theory of comparative advantage, outsourcing continues to grow. But outsourcing the wrong activities can be a disaster. And even outsourcing non-core activities has risks.

STUDENT TIP ♦ Risks of Outsourcing

The substantial risk of outsourcing requires managers to invest in the effort to make sure they do it right.

Risk management starts with a realistic analysis of uncertainty and results in a strategy that minimizes the impact of these uncertainties. Indeed, outsourcing *is* risky, with roughly half of all outsourcing agreements failing because of inadequate planning and analysis. Timely delivery and quality standards can be major problems, as can underestimating increases in inventory and logistics costs. Additionally, companies that outsource customer service tend to see a drop in customer satisfaction.

When outsourcing is overseas, additional issues must be considered. These issues include financing, people skills and availability, and the general business environment. Another risk of outsourcing overseas is the perceived loss of jobs that has fueled anti-outsourcing rhetoric. This rhetoric is contributing to a process known as *reshoring*, the return of business activity to the originating country.

OM in Action

China Outsources Too—to Ethiopia

With many workers in the Haijian International shoe factory in China complaining about excessive hours and seeking higher pay, that company is sending thousands of their jobs to Ethiopia. Like many Chinese firms, Haijian faces scrutiny from labor activists for how it treats workers. The focus of the activists points to changing labor conditions in China as manufacturers try to get more work out of an increasingly expensive labor pool. But deep economic and demographic shifts imply that a lot of low-end work—like making shoes—doesn't offer huge profit in China.

Today, Chinese workers are less cheap and less willing. More young people are going to college and want office jobs. The blue-collar workforce is aging. Long workdays in a factory no longer appeal to those older workers, even with the promise of overtime pay. Such tensions are fueling the drive of Haijian to outsource . . . in this case to Ethiopia.

In many respects, China's economy is maturing. The number of people who turn 18 each year and do not enroll in college—the group that might consider factory work—had plummeted to 10.5 million by 2015 from 18.5 million in 2000. Wages have increased ninefold since the late 1990s. Haijian peaked at 26,000 employees in China in 2006. Staffing is now down to 7,000–8,000, thanks to automation and the shift to Ethiopia. Citing labor costs and the country's foreign investment push, Haijian has built a

sprawling complex of factories on the southern outskirts of Ethiopia's capital, Addis Ababa, with 5,000 employees. When finished in 2021, the Addis Ababa complex will be ringed by a replica of the Great Wall of China.



Kay Nietfeld/dpa picture alliance/Alamy Stock Photo

Sources: *The Wall Street Journal* (June 1, 2017) and (July 13, 2015); and *Businessweek* (March 5, 2018).

TABLE 2.2 Potential Advantages and Disadvantages of Outsourcing

ADVANTAGES	DISADVANTAGES
Cost savings	Increased logistics and inventory costs
Gaining outside expertise that comes with specialization	Loss of control (quality, delivery, etc.)
Improving operations and service	Potential creation of future competition
Maintaining a focus on core competencies	Negative impact on employees
Accessing outside technology	Risks may not manifest themselves for years

In addition to the external risks, operations managers must deal with other issues that outsourcing brings. These include: (1) reduced employment levels, (2) changes in facility requirements, (3) potential adjustments to quality control systems and manufacturing processes, and (4) expanded logistics issues, including insurance, tariffs, customs, and timing. Table 2.2 identifies some potential advantages and disadvantages of outsourcing.

To summarize, managers can find substantial efficiencies in outsourcing non-core activities, but they must be cautious in outsourcing those elements of the product or service that provide a competitive advantage. The next section provides a methodology that helps analyze the outsourcing decision process.

Rating Outsource Providers

Research indicates that the most common reason for the failure of outsourcing agreements is that the decisions are made without sufficient analysis. The *factor-rating method* provides an objective way to evaluate outsource providers. We assign points for each factor to each provider and then importance weights to each of the factors. We now apply the technique in Example 1 to compare outsourcing providers being considered by a firm.

LO 2.4 Use factor rating to evaluate both country and outsource providers

Example 1

RATING PROVIDER SELECTION CRITERIA

National Architects, Inc., a San Francisco-based designer of high-rise office buildings, has decided to outsource its information technology (IT) function. Three outsourcing providers are being actively considered: one in the U.S., one in India, and one in Israel.

APPROACH ► National's VP-Operations, Susan Cholette, has made a list of seven criteria she considers critical. After putting together a committee of four other VPs, she has rated each firm (boldface type, on a 1–5 scale, with 5 being highest) and has also placed an importance weight on each of the factors, as shown in Table 2.3.

TABLE 2.3 Factor Ratings Applied to National Architects' Potential IT Outsourcing Providers

FACTOR (CRITERION)*	IMPORTANCE WEIGHT	OUTSOURCE PROVIDERS		
		BIM (U.S.)	S.P.C. (INDIA)	TELCO (ISRAEL)
1. Can reduce operating costs	.2	.2 × 3 = .6	.2 × 3 = .6	.2 × 5 = 1.0
2. Can reduce capital investment	.2	.2 × 4 = .8	.2 × 3 = .6	.2 × 3 = .6
3. Skilled personnel	.2	.2 × 5 = 1.0	.2 × 4 = .8	.2 × 3 = .6
4. Can improve quality	.1	.1 × 4 = .4	.1 × 5 = .5	.1 × 2 = .2
5. Can gain access to technology not in company	.1	.1 × 5 = .5	.1 × 3 = .3	.1 × 5 = .5
6. Can create additional capacity	.1	.1 × 4 = .4	.1 × 2 = .2	.1 × 4 = .4
7. Aligns with policy/philosophy/culture	.1	.1 × 2 = .2	.1 × 3 = .3	.1 × 5 = .5
Total Weighted Score		3.9	3.3	3.8

*These seven major criteria are based on a survey of 165 procurement executives, as reported in J. Schildhouse, *Inside Supply Management* (December 2005): 22–29.

(Continued)

SOLUTION ► Susan multiplies each rating by the weight and sums the products in each column to generate a total score for each outsourcing provider. She selects BIM, which has the highest overall rating.

INSIGHT ► When the total scores are as close (3.9 vs. 3.8) as they are in this case, it is important to examine the sensitivity of the results to inputs. For example, if one of the importance weights or factor scores changes even marginally, the final selection may change. Management preference may also play a role here.

LEARNING EXERCISE ► Susan decides that “Skilled personnel” should instead get a weight of 0.1 and “Aligns with policy/philosophy/culture” should increase to 0.2. How do the total scores change? [Answer: BIM = 3.6, S.P.C. = 3.2, and Telco = 4.0, so Telco would be selected.]

RELATED PROBLEMS ► 2.8–2.12

EXCEL OM Data File Ch02Ex1.xls can be found in [MyLab Operations Management](#).

Global Operations Strategy Options

International business

A firm that engages in cross-border transactions.

Multinational corporation (MNC)

A firm that has extensive involvement in international business, owning or controlling facilities in more than one country.

As we suggested early in this chapter, many operations strategies now require an international dimension. An **international business** is any firm that engages in international trade or investment. A **multinational corporation (MNC)** is a firm with *extensive* international business involvement. MNCs buy resources, create goods or services, and sell goods or services in a variety of countries. The term *multinational corporation* applies to most of the world’s large, well-known businesses. Certainly IBM is a good example of an MNC. It imports electronics components to the U.S. from over 50 countries, exports to over 130 countries, has facilities in 45 countries, and earns more than half its sales and profits abroad.

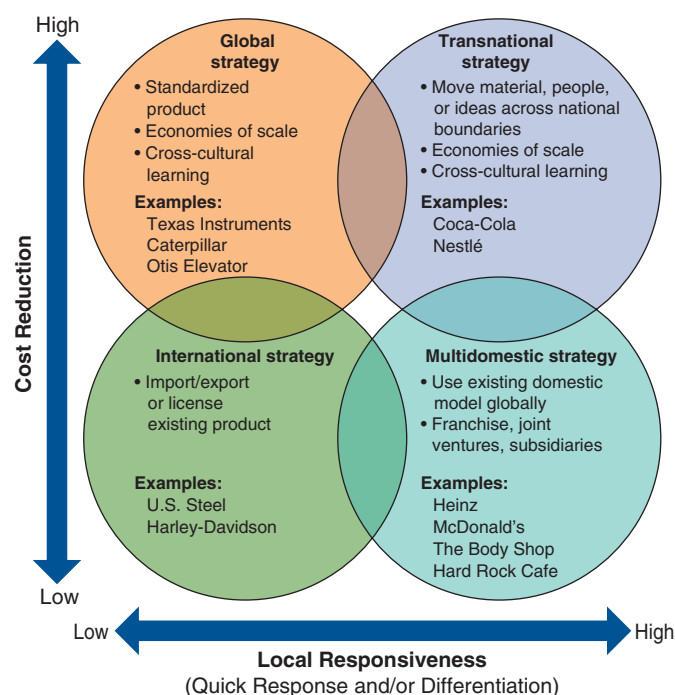
Operations managers of international and multinational firms approach global opportunities with one of four strategies: *international*, *multidomestic*, *global*, or *transnational* (see Figure 2.9). The matrix of Figure 2.9 has a vertical axis of cost reduction and a horizontal axis of local responsiveness. Local responsiveness implies quick response and/or the differentiation necessary for the local market. The operations manager must know how to position the firm in this matrix. Let us briefly examine each of the four strategies.

LO 2.5 Identify and explain four global operations strategy options

Figure 2.9

Four International Operations Strategies

Source: Based on M. Hitt, R. D. Ireland, and R. E. Hoskisson, *Strategic Management: Concepts, Competitiveness, and Globalization*, 8th ed. (Cincinnati: Southwestern College Publishing).



An **international strategy** uses exports and licenses to penetrate the global arena. This strategy is the least advantageous, with little local responsiveness and little cost advantage. But an international strategy is often the easiest because exports can require little change in existing operations, and licensing agreements often leave much of the risk to the licensee.

The **multidomestic strategy** has decentralized authority with substantial autonomy at each business. These are typically subsidiaries, franchises, or joint ventures with substantial independence. The advantage of this strategy is maximizing a competitive response for the local market; however, the strategy has little or no cost advantage. Many food producers, such as Heinz, use a multidomestic strategy to accommodate local tastes because global integration of the production process is not critical. The concept is one of “we were successful in the home market; let’s export the management talent and processes, not necessarily the product, to accommodate another market.”

A **global strategy** has a high degree of centralization, with headquarters coordinating the organization to seek out standardization and learning between plants, thus generating economies of scale. This strategy is appropriate when the strategic focus is cost reduction but has little to recommend it when the demand for local responsiveness is high. Caterpillar, the world leader in earth-moving equipment, and Texas Instruments, a world leader in semiconductors, pursue global strategies. Caterpillar and Texas Instruments find this strategy advantageous because the end products are similar throughout the world. Earth-moving equipment is the same in Nigeria as in Iowa.

A **transnational strategy** exploits the economies of scale and learning, as well as pressure for responsiveness, by recognizing that core competence does not reside in just the “home” country but can exist anywhere in the organization. *Transnational* describes a condition in which material, people, and ideas cross—or *transgress*—national boundaries. These firms have the potential to pursue all three operations strategies (i.e., differentiation, low cost, and response). Such firms can be thought of as “world companies” whose country identity is not as important as their interdependent network of worldwide operations. Nestlé is a good example of such a company. Although it is legally Swiss, 95% of its assets are held and 98% of its sales are made outside Switzerland. Fewer than 10% of its workers are Swiss.

International strategy

A strategy in which global markets are penetrated using exports and licenses.

Multidomestic strategy

A strategy in which operating decisions are decentralized to each country to enhance local responsiveness.

Global strategy

A strategy in which operating decisions are centralized and headquarters coordinates the standardization and learning between facilities.

Transnational strategy

A strategy that combines the benefits of global-scale efficiencies with the benefits of local responsiveness.



Washington Imaging/Alamy Stock Photo



Bernd Wustneck/dpa/picture-alliance/Newscom

In a continuing fierce worldwide battle, both Komatsu and Caterpillar seek global advantage in the heavy equipment market. As Komatsu (left) moved west to the UK, Caterpillar (right) moved east, with 13 facilities and joint ventures in China. Both firms are building equipment throughout the world as cost and logistics dictate. Their global strategies allow production to move as markets, risk, and exchange rates suggest.

Summary

Global operations provide an increase in both the challenges and opportunities for operations managers. Although the task is difficult, operations managers can and do improve productivity. They build and manage global OM functions and supply chains that contribute in a significant way to competitiveness. Organizations identify their strengths and weaknesses. They then develop effective missions and strategies that account for these strengths and weaknesses and complement the opportunities and threats in the environment. If this procedure is performed well, the organization can have competitive advantage through some combination of product differentiation, low cost, and response.

Increasing specialization provides economic pressure to build organizations that focus on core competencies and to outsource the rest. But there is also a need for planning outsourcing to make it beneficial to all participants. In this increasingly global world, competitive advantage is often achieved via a move to international, multidomestic, global, or transnational strategies.

Effective use of resources, whether domestic or international, is the responsibility of the professional manager, and professional managers are among the few in our society who *can* achieve this performance. The challenge is great, and the rewards to the manager and to society are substantial.

Key Terms

Operational hedging (p. 65)
Maquiladoras (p. 65)
World Trade Organization (WTO) (p. 65)
North American Free Trade Agreement (NAFTA) (p. 65)
European Union (EU) (p. 65)
Mission (p. 67)
Strategy (p. 67)
Competitive advantage (p. 68)
Differentiation (p. 68)

Experience differentiation (p. 69)
Low-cost leadership (p. 70)
Response (p. 70)
Resources view (p. 72)
Value-chain analysis (p. 72)
Five forces model (p. 72)
SWOT analysis (p. 73)
Key success factors (KSFs) (p. 74)
Core competencies (p. 74)
Activity map (p. 75)

Outsourcing (p. 76)
Theory of comparative advantage (p. 78)
International business (p. 80)
Multinational corporation (MNC) (p. 80)
International strategy (p. 81)
Multidomestic strategy (p. 81)
Global strategy (p. 81)
Transnational strategy (p. 81)

Ethical Dilemma

As a manufacturer of athletic shoes whose image—indeed performance—is widely regarded as socially responsible, you find your costs increasing. Traditionally, your athletic shoes have been made in Indonesia and China. Although the ease of doing business in those countries has been improving, wage rates have also been increasing. The labor-cost differential between your current suppliers and a contractor who will get the shoes made in Vietnam now exceeds \$1 per pair. Your sales next year are projected to be 10 million pairs, and your analysis suggests that this cost differential is not offset by any other tangible costs; you face only the political risk and potential damage to your commitment to social responsibility. Thus, this \$1 per pair savings should flow directly to your bottom line. There is no doubt that the Vietnamese government remains repressive and is a long way from a democracy. Perhaps more significantly, you will have little or no control over working conditions, sexual harassment, and pollution. What do you do, and on what basis do you make your decision?



Lionel derma/Alamy Stock Photo

Discussion Questions

- Based on the descriptions and analyses in this chapter, would Boeing be better described as a global firm or a transnational firm? Discuss.
- List six reasons to internationalize operations.
- Coca-Cola is called a global product. Does this mean that Coca-Cola is formulated in the same way throughout the world? Discuss.
- Identify and explain the four strategies that operations managers of international and multinational firms use to approach global opportunities.
- What is competitive advantage and what is the theory of comparative advantage?
- Describe how an organization's *mission* and *strategy* have different purposes.

7. Identify the mission and strategy of your automobile repair garage. What are the manifestations of the 10 strategic OM decisions at the garage? That is, how is each of the 10 decisions accomplished?
8. As a library or Internet assignment, identify the mission of a firm and the strategy that supports that mission.
9. How does an OM strategy change during a product's life cycle?
10. There are three primary ways to achieve competitive advantage. Provide an example, not included in the text, of each. Support your choices.
11. Given the discussion of Southwest Airlines in the text, define an *operations* strategy for that firm now that it has purchased AirTran.
12. How must an operations strategy integrate with marketing and accounting?
13. How would you summarize outsourcing trends?
14. Can the operations function on its own provide competitive advantage?
15. Explain, citing appropriate examples, how flexibility saves time and stimulates response.
16. How should a company select an outsourcing provider?
17. What are some of the possible consequences of poor outsourcing?
18. Read about Zara, the Spanish fashion retail company, and explain what is the best descriptive of Zara's strategy approach. Explain some key operations management decisions that help Zara implement this strategy.

Using Software to Solve Outsourcing Problems

Excel, Excel OM, and POM for Windows may be used to solve many of the problems in this chapter.

CREATING YOUR OWN EXCEL SPREADSHEETS

Program 2.1 illustrates how to build an Excel spreadsheet for the data in Example 1. In this example the factor rating method is used to compare National Architects' three potential outsourcing providers.

This program provides the data inputs for seven important factors, including their weights (0.0–1.0) and ratings (1–5 scale where 5 is the highest rating) for each country. As we see, BIM is most highly rated, with a 3.9 score, versus 3.3 for S.P.C. and 3.8 for Telco.

Enter factor names and weights in columns A and B.

Enter scores (that come from manager ratings) for BIM, S.P.C., and Telco on each factor in columns C, D, and E.

A	B	C	D	E
1 National Architects, Inc.				
2 Factor Rating Method				
3				
4				
5 FACTOR (CRITERION)	IMPORTANCE WEIGHT	OUTSOURCE PROVIDERS		
6 1. Can reduce operating costs	0.2	BIM (U.S.)	S.P.C. (INDIA)	TELCO (ISRAEL)
7 2. Can reduce capital investment	0.2	3	3	3
8 3. Skilled personnel	0.2	5	4	3
9 4. Can improve quality	0.1	4	5	2
10 5. Can gain access to technology not in the company	0.1	5	3	5
11 6. Can create additional capacity	0.1	4	2	4
12 7. Aligns with policy/philosophy/culture	0.1	2	3	5
13				
14 Total Weighted Score		3.9	3.3	3.8
15				
16 Actions				
17 Copy C14 to D14 and E14				
18				

=SUMPRODUCT(\$B\$6:\$B\$12,C6:C12)

Compute the weighted scores as the sum of the product of the weights and the scores for each option using the SUMPRODUCT function.

Program 2.1

Using Excel to Develop a Factor Rating Analysis, With Data from Example 1

✕ USING EXCEL OM

Excel OM (found in [MyLab Operations Management](#)) may be used to solve Example 1 (with the Factor Rating module).

P USING POM FOR WINDOWS

POM for Windows also includes a factor rating module. For details, refer to Appendix II. POM for Windows is found in [MyLab Operations Management](#) and can solve all problems labeled with a **P**.

Solved Problems

Virtual Office Hours help is available in [MyLab Operations Management](#).**SOLVED PROBLEM 2.1**

The global tire industry continues to consolidate. Michelin buys Goodrich and Uniroyal and builds plants throughout the world. Bridgestone buys Firestone, expands its research budget, and focuses on world markets. Goodyear spends almost 4% of its sales revenue on research. These three aggressive firms have come to dominate the world tire market, with total market share approaching 60%. And the German tire maker Continental AG has strengthened its position as fourth in the world, with a dominant presence in Germany and a research budget of 6%. Against this formidable array, the old-line Italian tire company Pirelli SpA is challenged to respond effectively. Although Pirelli still has almost 5% of the market, it is a relatively small player in a tough, competitive business.

And although the business is reliable even in recessions, as motorists still need replacement tires, the competition is getting stronger. The business rewards companies that have large market shares and long production runs. Pirelli, with its small market share and 1,200 specialty tires, has neither. However, Pirelli has some strengths: an outstanding reputation for tire research and excellent high-performance tires, including supplying specially engineered tires for performance automobiles, Ducati motorcycles, and Formula 1 racing teams. In addition, Pirelli's operations managers complement the creative engineering with world-class innovative manufacturing processes that allow rapid changeover to different models and sizes of tires.

Use a SWOT analysis to establish a feasible strategy for Pirelli.

SOLUTION

First, find an opportunity in the world tire market that avoids the threat of the mass-market onslaught by the big-three tire makers. Second, use the internal marketing strength repre-

sented by Pirelli's strong brand name supplying Formula 1 racing and a history of winning World Rally Championships. Third, maximize the innovative capabilities of an outstanding operations function. This is a classic differentiation strategy, supported by activity mapping that ties Pirelli's marketing strength to research and its innovative operations function.

To implement this strategy, Pirelli is differentiating itself with a focus on higher-margin performance tires and away from the low-margin standard tire business. Pirelli has established deals with luxury brands Jaguar, BMW, Maserati, Ferrari, Bentley, and Lotus Elise and established itself as a provider of a large share of the tires on new Porsches and S-class Mercedes. Pirelli also made a strategic decision to divest itself of other businesses. As a result, the vast majority of the company's tire production is now high-performance tires. People are willing to pay a premium for Pirellis.

The operations function continued to focus its design efforts on performance tires and developing a system of modular tire manufacture that allows much faster switching between models. This modular system, combined with billions of dollars in new manufacturing investment, has driven batch sizes down to as small as 150 to 200, making small-lot performance tires economically feasible. Manufacturing innovations at Pirelli have streamlined the production process, moving it from a 14-step process to a 3-step process.

Pirelli still faces a threat from the big three going after the performance market, but the company has bypassed its weakness of having a small market share with a substantial research budget and an innovative operations function. The firm now has 19 plants in 13 countries and a presence in more than 160 countries, with sales approaching \$8 billion.

Sources: Based on *The Economist* (January 8, 2011): 65; [www.pirelli.com](#); and [RubberNews.com](#).

SOLVED PROBLEM 2.2

DeHoratius Electronics, Inc., is evaluating several options for sourcing a critical processor for its new modem. Three sources are being considered: Hi-Tech in Canada, Zia in Hong Kong,

and Zaragoza in Spain. The owner, Nicole DeHoratius, has determined that only three criteria are critical. She has rated each firm on a 1–5 scale (with 5 being highest) and has also placed an importance weight on each of the factors, as shown below:

FACTOR (CRITERION)	IMPORTANCE WEIGHT	OUTSOURCE PROVIDERS					
		HI-TECH (CANADA)		ZIA (HONG KONG)		ZARAGOZA (SPAIN)	
		Rating	Wtd. Score	Rating	Wtd. score	Rating	Wtd. Score
1. Cost	.5	3	1.5	3	1.5	5	2.5
2. Reliability	.2	4	.8	3	.6	3	.6
3. Competence	.3	5	1.5	4	1.2	3	.9
Totals	1.0		3.8		3.3		4.0

SOLUTION

Nicole multiplies each rating by the weight and sums the products in each column to generate a total score for each outsourcing

provider. For example the weighted score for Hi-Tech equals $(.5 \times 3) + (.2 \times 4) + (.3 \times 5) = 1.5 + .8 + 1.5 = 3.8$. She selects Zaragoza, which has the highest overall rating.

Problems

Note: **Px** means the problem may be solved with POM for Windows and/or Excel OM.

Problems 2.1–2.3 relate to A Global View of Operations and Supply Chains

- **2.1** Match the product with the proper parent company and country in the table below:

PRODUCT	PARENT COMPANY	COUNTRY
Arrow Shirts	a. Volkswagen	1. France
Braun Household Appliances	b. Bidermann International	2. Great Britain
Volvo Autos	c. Bridgestone	3. Germany
Firestone Tires	d. Campbell Soup	4. Japan
Godiva Chocolate	e. Haier	5. U.S.
Häagen-Dazs Ice Cream (USA)	f. Tata	6. Switzerland
Jaguar Autos	g. Procter & Gamble	7. China
GE Appliances	h. Michelin	8. India
Lamborghini Autos	i. Nestlé	
Goodrich Tires	j. Geely	
Alpo Pet Foods		

- **2.2** Based on the corruption perception index developed by Transparency International (www.transparency.org), rank the following countries from most corrupt to least: Venezuela, Denmark, the U.S., Switzerland, and China.

- **2.3** Based on the competitiveness ranking developed by the Global Competitiveness Index (www.weforum.org), rank the following countries from most competitive to least: Mexico, Switzerland, the U.S., and China.

Problems 2.4 and 2.5 relate to Achieving Competitive Advantage Through Operations

- **2.4** The text provides three primary strategic approaches (differentiation, cost, and response) for achieving competitive advantage. Provide an example of each not given in the text. Support your choices. (*Hint:* Note the examples provided in the text.)
- **2.5** What are the implications for operations management with respect to the following organizational strategies: (1) low price, (2) good quality, (3) response, (4) innovation, (5) variety, and (6) sustainability?

Problem 2.6 relates to Issues in Operations Strategy

- **2.6** Identify how changes within an organization affect the OM strategy for a company. For instance, discuss what impact the following internal factors might have on OM strategy:
- Maturing of a product.
 - Technology innovation in the manufacturing process.
 - Changes in laptop computer design that builds in wireless technology.

Problem 2.7 relates to Strategy Development and Implementation

- **2.7** Identify how changes in the external environment affect the OM strategy for a company. For instance, discuss what impact the following external factors might have on OM strategy:
- Major increases in oil prices.
 - Water- and air-quality legislation.
 - Fewer young prospective employees entering the labor market.
 - Inflation versus stable prices.
 - Legislation moving health insurance from a pretax benefit to taxable income.

Problems 2.8–2.12 relate to Strategic Planning, Core Competencies, and Outsourcing

- **2.8** Claudia Program Technologies, Inc., has narrowed its choice of outsourcing provider to two firms located in different countries. Program wants to decide which one of the two countries is the better choice, based on risk-avoidance criteria. She has polled her executives and established four criteria. The resulting ratings for the two countries are presented in the table below, where 1 is a lower risk and 3 is a higher risk.

SELECTION CRITERION	ENGLAND	CANADA
Price of service from outsourcer	2	3
Nearness of facilities to client	3	1
Level of technology	1	3
History of successful outsourcing	1	2

The executives have determined four criteria weightings: Price, with a weight of 0.1; Nearness, with 0.6; Technology, with 0.2; and History, with 0.1.

- Using the factor-rating method, which country would you select?
- Double each of the weights used in part (a) (to 0.2, 1.2, 0.4, and 0.2, respectively). What effect does this have on your answer? Why? **Px**

- **2.9** Ranga Ramasesh is the operations manager for a firm that is trying to decide which one of four countries it should research for possible outsourcing providers. The first step is to select a country based on cultural risk factors, which are critical to eventual business success with the provider. Ranga has reviewed outsourcing provider directories and found that the four countries in the table that follows have an ample number of providers from which they can choose. To aid in the country selection step, he has enlisted the aid of a cultural expert, John Wang, who has provided ratings of the various criteria in the table. The resulting ratings are on a 1 to 10 scale, where 1 is a low risk and 10 is a high risk.

John has also determined six criteria weightings: Trust, with a weight of 0.4; Quality, with 0.2; Religious, with 0.1; Individualism, with 0.1; Time, with 0.1; and Uncertainty, with 0.1. Using the factor-rating method, which country should Ranga select? **Px**

CULTURE SELECTION CRITERION	MEXICO	PANAMA	COSTA RICA	PERU
Trust	1	2	2	1
Society value of quality work	7	10	9	10
Religious attitudes	3	3	3	5
Individualism attitudes	5	2	4	8
Time orientation attitudes	4	6	7	3
Uncertainty avoidance attitudes	3	2	4	2

•• **2.10** Fernando Garza's firm wishes to use factor rating to help select an outsourcing provider of logistics services.

a) With weights from 1–5 (5 highest) and ratings 1–100 (100 highest), use the following table to help Garza make his decision:

		RATING OF LOGISTICS PROVIDERS		
CRITERION	WEIGHT	OVERNIGHT SHIPPING	WORLDWIDE DELIVERY	UNITED FREIGHT
Quality	5	90	80	75
Delivery	3	70	85	70
Cost	2	70	80	95

b) Garza decides to increase the weights for quality, delivery, and cost to 10, 6, and 4, respectively. How does this change your conclusions? Why?

c) If Overnight Shipping's ratings for each of the factors increase by 10%, what are the new results? **PX**

••• **2.11** As an operations management student, you have been hired by a local restaurant to perform a factor-rating analysis to help the restaurant choose an outsourcing provider. You have identified three important factors: quality, taste, and delivery time; giving the following weightage to each factor: 60% for the quality, 30% for taste, and 10% for the delivery. You have scored three different potential outsourcing providers on the three factors, using a scale of 1 to 5 (with 5 representing the best option and 1 representing the worst). Based on the scores provided in the table below, which outsourcing provider should the restaurant choose?

		PROVIDER RATING (OUT OF 5)		
FACTORS	WEIGHTAGE	PROVIDER A	PROVIDER B	PROVIDER C
Quality	0.6	5	2	3
Taste	0.3	1	4	1
Delivery	0.1	2	5	4

•••• **2.12** You are about to establish your own business; your strategy is to focus on your core business and outsource the customer service to an external service provider to handle the customers' requirement queries and complaints. Based on an extensive study, you have identified 6 key factors for the service provider. Four service providers have offered their service and you and your team have scored 4 different potential providers on the 6 factors, using a scale of 1 to 5, with 5 representing the best option.

a) Based on the scores provided in the table below, which service provider should be chosen?

b) What score should Provider C get in the category "online platform" to be considered the best option?

		SERVICE PROVIDER RATING (OUT OF 5)			
FACTORS	WEIGHT	PROVIDER A	PROVIDER B	PROVIDER C	PROVIDER D
Speak Arabic and English	20	5	2	3	2
Live chat	15	1	4	1	2
24 hours service	25	2	5	4	5
Price	5	4	1	2	1
Location	5	2	3	3	4
Online platform	30	4	3	1	2

Problem 2.13 relates to Global Operations Strategy Options

•• **2.13** When is the application of a multidomestic strategy most appropriate? What kind of industries can this be applied to?

CASE STUDIES

Outsourcing: Ethiopia

It isn't unusual for Western companies in the textile industry to outsource manufacturing to South Asia and Southeast Asia. Countries like China and India are manufacturing hubs for fashion products, supplying a large chunk of the world's apparel. However, with China's labor, raw material, and tax costs rising over the last couple of years, the fashion landscape is getting a makeover.

Ethiopia has emerged as a key destination for outsourcing for several companies, including H&M, Levi's, and Guess, due to the availability of cheap and abundant labor force. According to Bloomberg reports,* the base salary of workers can be about \$25 per month. The Ethiopian government offers an exemption from income tax for the first five years to incentivize foreign companies. While this has created thousands of jobs for Ethiopian market in the last year, the goal is to create 2 million manufacturing jobs by 2025, which would transition the country from a primarily agrarian nation to a manufacturing one.

While H&M and Gap currently source production from local facilities only, some companies are taking a step further and are planning to set up factories in the East African country due to the extreme competitiveness of the fashion industry. These include brands like Levi's, Under Armour, Calvin Klein, Tommy Hilfiger, Giorgio Armani, and Hugo Boss. At the same time, outsourcing to Ethiopia

has potential risks. Ethiopia's political instability may cause problems in the future. In addition, due to underdeveloped infrastructure, the working conditions might not be up to the standards that many companies are used to and the delivery time for products to reach buyers in Europe could be weeks longer than buyers in China.†

Discussion Questions

1. What are the major pros and cons for companies to set up production in Ethiopia?
2. How could inferior working conditions influence the efficiency of production for companies?
3. What factors influence productivity of the companies that decide to set up operations in Ethiopia?

*Bill Donahue, "China Is Turning Ethiopia into a Giant Fast-Fashion Factory," *Bloomberg Businessweek*, March 12, 2018.

†Don-Alvin Adegeest, "How China Is Outsourcing Fast Fashion to Ethiopia," <http://fashionunited.uk/news>, March 27, 2018; and Aaron Maasho, "Ethiopia Bets on Clothes to Fashion Industrial Future," Reuters, November 21, 2017.

Source: Dr. Viktor Miklos Kiss, Metropolitan State University of Denver.

Strategy at Regal Marine



Regal Marine, one of the U.S.'s 10 largest power-boat manufacturers, achieves its mission—providing luxury performance boats to customers worldwide—using the strategy of differentiation. It differentiates its products through constant innovation, unique features, and high quality. Increasing sales at the Orlando, Florida, family-owned firm suggest that the strategy is working.

As a quality boat manufacturer, Regal Marine starts with continuous innovation, as reflected in computer-aided design (CAD), high-quality molds, and close tolerances that are controlled through both defect charts and rigorous visual inspection. In-house quality is not enough, however. Because a product is only as good as the parts put into it, Regal has established close ties with a large number of its suppliers to ensure both flexibility and perfect parts. With the help of these suppliers, Regal can profitably produce a product line of 22 boats, ranging from the \$14,000 19-foot boat to the \$500,000 44-foot Commodore yacht.

“We build boats,” says VP Tim Kuck, “but we’re really in the ‘fun’ business. Our competition includes not only 300 other boat, canoe, and yacht manufacturers in our \$17 billion industry, but home theaters, the Internet, and all kinds of alternative family

entertainment.” Fortunately Regal has been paying down debt and increasing market share.

Regal has also joined with scores of other independent boat makers in the American Boat Builders Association. Through economies of scale in procurement, Regal is able to navigate against billion-dollar competitor Brunswick (makers of the Sea Ray and Bayliner brands). The *Global Company Profile* featuring Regal Marine (which opens Chapter 5) provides further background on Regal and its strategy.

Discussion Questions*

1. State Regal Marine’s mission in your own words.
2. Identify the strengths, weaknesses, opportunities, and threats that are relevant to the strategy of Regal Marine.
3. How would you define Regal’s strategy?
4. How would each of the 10 operations management decisions apply to operations decision making at Regal Marine?

*You may wish to view the video that accompanies the case before addressing these questions.

Hard Rock Cafe’s Global Strategy



Hard Rock brings the concept of the “experience economy” to its cafe operation. The strategy incorporates a unique “experience” into its operations. This innovation is somewhat akin to mass customization in manufacturing. At Hard Rock, the experience concept is to provide not only a custom meal from the menu but a dining event that includes a unique visual and sound experience not duplicated anywhere else in the world. This strategy is succeeding. Other theme restaurants have come and gone while Hard Rock continues to grow. As Professor C. Markides of the London Business School says, “The trick is not to play the game better than the competition, but to develop and play an altogether different game.”* At Hard Rock, the different game is the experience game.

From the opening of its first cafe in London in 1971, during the British rock music explosion, Hard Rock has been serving food and rock music with equal enthusiasm. Hard Rock Cafe has 108 U.S. locations, over a dozen in Europe and the remainder scattered throughout the world, from Bangkok and Beijing to Beirut. New construction, leases, and investment in remodeling are long term; so a global strategy means special consideration of political risk, currency risk, and social norms in a context of a brand fit. Although Hard Rock is one of the most recognized brands in the world, this does not mean its cafe is a natural everywhere. Special consideration must be given to the supply chain for the restaurant and its accompanying retail store. About 48% of a typical cafe’s sales are from merchandise.

The Hard Rock Cafe business model is well defined, but because of various risk factors and differences in business practices and

employment law, Hard Rock elects to franchise about half of its cafes. Social norms and preferences often suggest some tweaking of menus for local taste. For instance, Hard Rock focuses less on hamburgers and beef and more on fish and lobster in its British cafes.

Because 70% of Hard Rock’s guests are tourists, recent years have found it expanding to “destination” cities. While this has been a winning strategy for decades, allowing the firm to grow from one London cafe to nearly 200 facilities in 68 countries, it has made Hard Rock susceptible to economic fluctuations that hit the tourist business hardest. So Hard Rock is signing long-term leases for locations in cities that are not standard tourist destinations. At the same time, menus are being upgraded. Hopefully, repeat business from locals in these cities will smooth demand and make Hard Rock less dependent on tourists.

Discussion Questions†

1. Identify the strategy changes that have taken place at Hard Rock Cafe since its founding in 1971.
2. As Hard Rock Cafe has changed its strategy, how has its responses to some of the 10 decisions of OM changed?
3. Where does Hard Rock fit in the four international operations strategies outlined in Figure 2.9? Explain your answer.

*Constantinos Markides, “Strategic Innovation,” *MIT Sloan Management Review* 38, no. 3: 9.

†You may wish to view the video that accompanies the case before addressing these questions.

Outsourcing Offshore at Darden



Darden Restaurants, owner of popular brands such as Olive Garden, Bahama Breeze, and Longhorn Grill, serves more than 320 million meals annually in more than 1,500 restaurants across the U.S. and Canada. To achieve competitive advantage via its supply chain, Darden must achieve excellence at each step. With purchases from 35 countries, and seafood products with a shelf life as short as 4 days, this is a complex and challenging task.

Those 320 million meals annually mean 40 million pounds of shrimp and huge quantities of tilapia, swordfish, and other fresh purchases. Fresh seafood is typically flown to the U.S. and monitored each step of the way to ensure that 34°F is maintained.

Darden's purchasing agents travel the world to find competitive advantage in the supply chain. Darden personnel from supply chain and development, quality assurance, and environmental relations contribute to developing, evaluating, and checking suppliers. Darden also has seven native-speaking representatives living on other continents to provide continuing support and evaluation of suppliers. All suppliers must abide by Darden's food standards, which typically exceed FDA and other industry standards. Darden expects continuous improvement in durable relationships that increase quality and reduce cost.

Darden's aggressiveness and development of a sophisticated supply chain provide an opportunity for outsourcing. Much food preparation is labor intensive and is often more efficient when handled in bulk. This is particularly true where large volumes may justify capital investment. For instance, Tyson and Iowa Beef prepare meats to Darden's specifications much more economically than can individual restaurants. Similarly, Darden has found that it can outsource both the cutting of salmon to the proper portion size and the cracking/peeling of shrimp more cost-effectively offshore than in U.S. distribution centers or individual restaurants.

Discussion Questions*

1. What are some outsourcing opportunities in a restaurant?
2. What supply chain issues are unique to a firm sourcing from 35 countries?
3. Examine how other firms or industries develop international supply chains as compared to Darden.
4. Why does Darden outsource harvesting and preparation of much of its seafood?

*You may wish to view the video that accompanies this case study before answering these questions.

- **Additional Case Study:** Visit [MyLab Operations Management](#) for this free case study:
Outsourcing to Tata: The Indian outsourcing firm is hired by New Mexico.

Endnotes

1. The 28 members of the European Union (EU) as of 2018 were Austria, Belgium, Bulgaria, Cyprus, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and United Kingdom. Not all have adopted the euro. In addition, Iceland, Macedonia, Montenegro, and Turkey

are candidates for entry into the European Union, and the United Kingdom is in the process of exiting.

2. M. E. Porter, *Competitive Advantage: Creating and Sustaining Superior Performance*. New York: The Free Press, 1985.
3. M. E. Porter, *Competitive Strategy: Techniques for Analyzing Industries and Competitors*. New York: The Free Press, 1980, 1998.

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Chapter 2 *Rapid Review*

Main Heading	Review Material	MyLab Operations Management
A GLOBAL VIEW OF OPERATIONS AND SUPPLY CHAINS (pp. 64–67)	Domestic business operations decide to change to some form of international operations for six main reasons: 1. Improve supply chain 2. Reduce costs and exchange rate risks 3. Improve operations 4. Understand markets 5. Improve products 6. Attract and retain global talent ■ Operational hedging—Maintaining excess capacity in different countries and shifting production levels among those countries as costs and exchange rates change. ■ Maquiladoras—Mexican factories located along the U.S.–Mexico border that receive preferential tariff treatment. ■ World Trade Organization (WTO)—An international organization that promotes world trade by lowering barriers to the free flow of goods across borders. ■ NAFTA—A free trade agreement between Canada, Mexico, and the United States. ■ European Union (EU)—A European trade group that has 28 member states.	Concept Questions: 1.1–1.6 Problems: 2.1–2.3
DETERMINING MISSIONS AND STRATEGIES (pp. 67–68)	An effective operations management effort must have a <i>mission</i> so it knows where it is going and a <i>strategy</i> so it knows how to get there. ■ Mission—The purpose or rationale for an organization's existence. ■ Strategy—How an organization expects to achieve its missions and goals. The three strategic approaches to competitive advantage are: 1. Differentiation 2. Cost leadership 3. Response	Concept Questions: 2.1–2.4 VIDEO 2.1 Operations Strategy at Regal Marine
ACHIEVING COMPETITIVE ADVANTAGE THROUGH OPERATIONS (pp. 68–71)	■ Competitive advantage—The creation of a unique advantage over competitors. ■ Differentiation—Distinguishing the offerings of an organization in a way that the customer perceives as adding value. ■ Experience differentiation—Engaging the customer with a product through imaginative use of the five senses, so the customer “experiences” the product. ■ Low-cost leadership—Achieving maximum value, as perceived by the customer. ■ Response—A set of values related to rapid, flexible, and reliable performance.	Concept Questions: 3.1–3.6 Problems: 2.4–2.5 VIDEO 2.2 Hard Rock's Global Strategy
ISSUES IN OPERATIONS STRATEGY (pp. 72–73)	■ Resources view—A view in which managers evaluate the resources at their disposal and manage or alter them to achieve competitive advantage. ■ Value-chain analysis—A way to identify the elements in the product/service chain that uniquely add value. ■ Five forces model—A way to analyze the five forces in the competitive environment. Forces in Porter's five forces model are (1) immediate rivals, (2) potential entrants, (3) customers, (4) suppliers, and (5) substitute products. Different issues are emphasized during different stages of the product life cycle: ■ Introduction—Company strategy: Best period to increase market share, R&D engineering is critical. OM strategy: Product design and development critical, frequent product and process design changes, short production runs, high production costs, limited models, attention to quality. ■ Growth—Company strategy: Practical to change price or quality image, strengthen niche. OM strategy: Forecasting critical, product and process reliability, competitive product improvements and options, increase capacity, shift toward product focus, enhance distribution. ■ Maturity—Company strategy: Poor time to change image or price or quality, competitive costs become critical, defend market position. OM strategy: Standardization, less rapid product changes (more minor changes), optimum capacity, increasing stability of process, long production runs, product improvement and cost cutting. ■ Decline—Company strategy: Cost control critical. OM strategy: Little product differentiation, cost minimization, overcapacity in the industry, prune line to eliminate items not returning good margin, reduce capacity.	Concept Questions: 4.1–4.6 Problem: 2.6

Chapter 2 **Rapid Review** *continued*

Main Heading	Review Material	MyLab Operations Management
STRATEGY DEVELOPMENT AND IMPLEMENTATION (pp. 73–76)	■ SWOT analysis—A method of determining internal strengths and weaknesses and external opportunities and threats. ■ Key success factors (KSFs)—Activities or factors that are key to achieving competitive advantage. ■ Core competencies—A set of unique skills, talents, and activities that a firm does particularly well. A core competence may be a combination of KSFs. ■ Activity map—A graphical link of competitive advantage, KSFs, and supporting activities.	Concept Questions: 5.1–5.6 Problem: 2.7 Virtual Office Hours for Solved Problem: 2.1
STRATEGIC PLANNING, CORE COMPETENCIES, AND OUTSOURCING (pp. 76–80)	■ Outsourcing—Procuring from external sources services or products that are normally part of an organization. ■ Theory of comparative advantage—The theory which states that countries benefit from specializing in (and exporting) products and services in which they have relative advantage and importing goods in which they have a relative disadvantage. Perhaps half of all outsourcing agreements fail because of inappropriate planning and analysis. Potential risks of outsourcing include: ■ A drop in quality or customer service ■ Political backlash that results from outsourcing to foreign countries ■ Negative impact on employees ■ Potential future competition ■ Increased logistics and inventory costs The most common reason given for outsourcing failure is that the decision was made without sufficient understanding and analysis. The factor-rating method is an excellent tool for dealing with both country risk assessment and provider selection problems.	Concept Questions: 6.1–6.6 Problems: 2.8–2.12 Virtual Office Hours for Solved Problem: 2.2 VIDEO 2.3 Outsourcing Offshore at Darden
GLOBAL OPERATIONS STRATEGY OPTIONS (pp. 80–81)	■ International business—A firm that engages in cross-border transactions. ■ Multinational corporation (MNC)—A firm that has extensive involvement in international business, owning or controlling facilities in more than one country. The four operations strategies for approaching global opportunities can be classified according to local responsiveness and cost reduction: ■ International strategy—A strategy in which global markets are penetrated using exports and licenses with little local responsiveness. ■ Multidomestic strategy—A strategy in which operating decisions are decentralized to each country to enhance local responsiveness. ■ Global strategy—A strategy in which operating decisions are centralized and headquarters coordinates the standardization and learning between facilities. ■ Transnational strategy—A strategy that combines the benefits of global-scale efficiencies with the benefits of local responsiveness. These firms transgress national boundaries.	Concept Questions: 7.1–7.6 Problem 2.13

Self Test

■ Before taking the self-test, refer to the learning objectives listed at the beginning of the chapter and the key terms listed at the end of the chapter.

LO 2.1 A mission statement is beneficial to an organization because it:

- is a statement of the organization's purpose.
- provides a basis for the organization's culture.
- identifies important constituencies.
- details specific income goals.
- ensures profitability.

LO 2.2 The three strategic approaches to competitive advantage are ____, ____, and ____.

LO 2.3 Core competencies are those strengths in a firm that include:

- specialized skills.
- unique production methods.
- proprietary information/knowledge.
- things a company does better than others.
- all of the above.

LO 2.4 Evaluating outsourcing providers by comparing their weighted average scores involves:

- factor-rating analysis.
- cost-volume analysis.
- transportation model analysis.
- linear regression analysis.
- crossover analysis.

LO 2.5 A company that is organized across international boundaries, with decentralized authority and substantial autonomy at each business via subsidiaries, franchises, or joint ventures, has:

- a global strategy.
- a transnational strategy.
- an international strategy.
- a multidomestic strategy.

Answers: LO 2.1. a; LO 2.2. differentiation, cost leadership, response; LO 2.3. e; LO 2.4. a; LO 2.5. d.

Project Management

3 CHAPTER

CHAPTER OUTLINE

GLOBAL COMPANY PROFILE: *Bechtel Group*

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