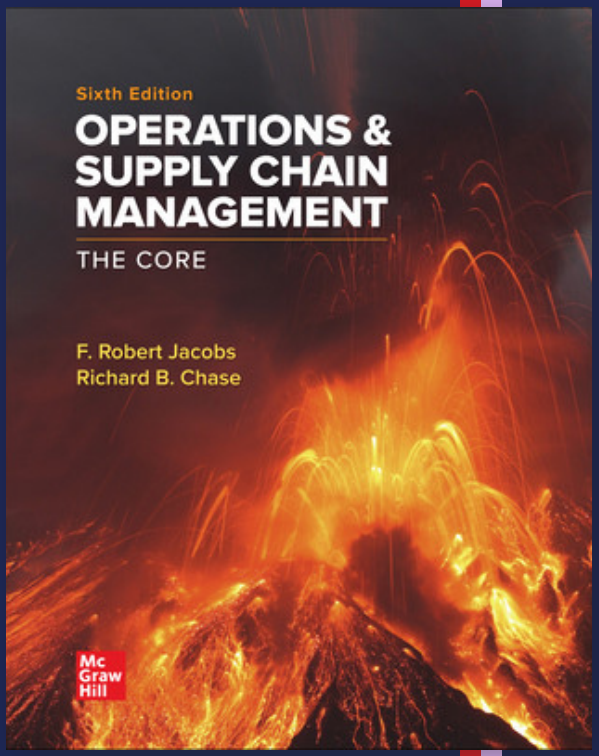
Operation & Supply Chain Management: The Core, 6e

F. Robert Jacobs
Richard B. Chase



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Operations and Supply Chain Management: The Core

Sixth Edition

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Mc Graw Hill

OPERATIONS AND SUPPLY CHAIN MANAGEMENT: THE CORE, SIXTH EDITION

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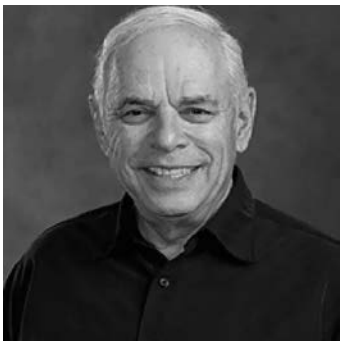
To Jenny and
Suzy, this one is
for you.

About the Authors

F. Robert Jacobs is Professor Emeritus of Operations and Decision Technologies at Indiana University. He received a BS in industrial engineering as well as computer and information science, an MBA, and a PhD in operations management all from The Ohio State University. He has also taught at the University of Houston and The Ohio State University. He has published 7 books and over 50 research articles on topics that include enterprise resource planning, inventory control, the design of manufacturing facilities, cellular manufacturing, and the scheduling of manufacturing operations. He is a Fellow of the Decision Sciences Institute and past president and has received teaching honors such as MBA Teaching Award, Students Award for Teaching Excellence in International Business Issues, and Teaching Excellence in Operations Management.



Richard B. Chase is Justin B. Dart Professor Emeritus of Operations Management at the Marshall School of Business, University of Southern California. He received his PhD in operations management, as well as an MBA and BS from UCLA. He has taught at the Harvard Business School, IMD (Switzerland), and the University of Arizona. His research examines service process design and service strategy. In 2006 he received a POMS Lifetime Achievement Award for his research in service operations and in 2004 received a Scholar of the Year Award by the Academy of Management. In 2009, he was honored in the *Production and Operations Management Journal* for his contributions to operations management. He is a Fellow of the Academy of Management, Production Operations Management Society, and the Decision Sciences Institute. He was also an examiner for the Malcolm Baldrige National Quality Award. Dr. Chase has lectured/consulted recently on service and excellence to such organizations as Cisco Systems, Four Seasons Resorts, General Electric, and the Gartner Group.

PREFACE

Just as lava flows from the core of the earth, operations and supply management is the core of business. Materials must flow through supply processes to create cash output and profits.

In Operations and Supply Management: The Core 6e*, we take students to the center of the business and focus on the core concepts and tools needed to ensure that these processes run smoothly.*

The goal of this book is to provide you with the essential information that every manager needs to know about operations and supply chain–related activities in a firm. Things have changed dramatically over the last few years. Organization structures are now much flatter, and rather than being functionally organized, companies often are organized by customer and product groups. Today's manager cannot ignore how the real work of the organization is done. This book is all about how to get the real work done effectively. It makes little difference if you are officially in finance, marketing, accounting, or operations: The value-added work, the process of creating and delivering products, needs to be completed in a manner that is both high quality and maximally efficient. Many of the things you do, or will do, in your job are repetitive, even some of the most creative and high-profile activities. You should think of this course as preparing you to be your most productive and helping you help your organization be its most productive.

We can consider the importance of the material in this book on many levels, but let's focus on three. First, consider your role as a business unit manager with people working under your supervision. Next, in the longer term, you probably have aspirations to become a senior executive with responsibility for multiple businesses or products. Finally, you may decide to specialize in operations and supply chain management as a long-term career.

In your role as a manager with people working under your supervision, one of your major duties will be to organize the way work is done. There needs to be some structure to the work process, including how information is captured and analyzed, as well as how decisions and changes and improvements are made. Without a logical or structured approach, even a small group may be subject to errors, ineffiencies, and even chaos.

Designing efficient process flows is an important element of getting a group to work together. If your group is involved in creative activities such as designing cars, buildings, or even stock portfolios, there still needs to be structure to how the work is done, who is responsible for what, and how progress is reported. The concepts of project management, manufacturing and service process design, capacity analysis, and quality in this text are all directly related to the knowledge you will need to be a great supervisor in your organization, and getting your group to work productively and efficiently will lead to success and more responsibility for you.

Next, think about becoming a senior executive. Making acquisitions, planning mergers, and buying and selling divisions will get your name and picture in business magazines. Deals are easily explained to boards, shareholders, and the media. They are newsworthy and offer the prospect of nearly immediate gratification, and being a deal maker is consistent with the image of the modern executive as someone who focuses on grand strategy and leaves operations details to others. Unfortunately, the majority of deals are unsuccessful. The critical element of success, even with the grandest deals, can still be found most often in the operational details.

Real success happens when operational processes can be improved. Productivity improvements from things such as sharing customer service processes, purchasing systems, distribution and manufacturing systems, and other processes can lead to great synergies and success. Operations accounts for 60 to 80 percent of the direct expenses that limit the profit of most firms. Without these operations synergies, designed and implemented by executives with a keen understanding of the concepts in this book, companies are often left with expensive debt, disappointed customers and shareholders, and pressure on the bottom line—on earnings.

Finally, you may be interested in a career in operations and supply chain management. Entry-level jobs might be as a forecast strategist, project manager, inventory control manager, production supervisor, purchasing manager, logistics manager, or warehouse specialist. In addition, top operations students may obtain their initial jobs with consulting firms, working as business process analysts and system design specialists.

We encourage you to talk to your instructor about what you want to get out of the course. What are your career aspirations, and how do they relate to the material in this course? Write your instructor a short e-mail describing what you want to do in the future—this is invaluable information for tailoring the material in the course to your needs. As you work through the text, share your experiences and insights with the class. Being an active student is guaranteed to make your experience more valuable and interesting.

ACKNOWLEDGMENTS

Special thanks to those who develop and market the book: Chuck Synovec, Director; Noelle Bathurst, Portfolio Manager; Harper Christopher, Executive Marketing Manager; Ryan McAndrews, Product Developer; Amy Gehl, Content Project Manager; Vanessa McClune, Assessment Project Manager; and Matt Diamond, Senior Designer. The time spent talking to faculty at the conferences is appreciated. Also, thanks to Gary Black who keeps Connect current.

Thanks also to the many loyal adopters of the book. Special thanks to Jess Rose, a student at Maryville University, who was particularly helpful with input for this edition.

Last, but certainly not least, we thank our families. We have stolen countless hours away for this project; time that would otherwise be spent with them. We sincerely appreciate their support.

F. Robert Jacobs

Richard B. Chase

A Note to Instructors

Operations and Supply Chain Management: The Core derives its title from a combination of ideas and trends. The book is designed to be lean and focused, much in the tradition of the concepts taught in the book. The topics selected are the result of the study of the syllabi of dozens of representative U.S. universities. There are a wide variety of topics covered, many more than could be covered in a single course. Our "big book," *Operations and Supply Chain Management,* is comprehensive and is intended for those who want to pick and choose topics that best fit the objectives of their course. The "*Core*" book covers the topics most commonly included in these courses and has material sufficient for a 12- to 15-week course.

As is well known in the field, success for companies today requires successfully managing the entire supply flow, from the sources of the firm, through the value-added processes of the firm, and on to the customers of the firm.

In *Operations and Supply Chain Management: The Core 6e,* we take students to the center of the business and focus on the core concepts and tools needed to ensure that these processes run smoothly.

Discussion of Sixth Edition Revisions

Many of the revisions to the sixth edition have been driven by our focus on supply chain analytics. Supply chain analytics involves the analysis of data to better solve business problems. We recognize that this is not really new since data have always been used to solve business problems. What *is* new is the reality that there are a great deal more data now available for decision making.

In the past, most analysis involved the generation of standard and ad hoc reports that summarized the current state of the firm. Software allowed query and "drill down" analysis to the level of the individual transaction, useful features for understanding what happened in the past. Decision making was typically left to the decision maker based on judgment or simple alerting rules. The new "analytics" movement takes this to a new level using statistical analysis, forecasting to extrapolate what to expect in the future, and even optimization, possibly in real time, to support decisions.

In this new edition, we now have 15 Analytics Exercises (four new ones). These exercises have proven to be popular in our books. These Analytics Exercises use settings that are modern and familiar to students taking the course. They include Starbucks, cell phones, notebook computers, Taco Bell Restaurant, Tesla, a retail website–based company, a tree farm, and industrial products that are sourced from China/Taiwan and sold globally.

In Chapter 1, we have added a new exercise titled *The Supply Chain Improvement Model*. Chapter 2 features a new vignette that describes a company started with a special-purpose acquisition company (SPAC) that features a large indoor farm operation. A new carbon footprint exercise has been added to the chapter. In Chapter 3 a new forecasting analytical exercise has been added. Chapter 6 discusses the use of electronic vehicle platforms to make the manufacturing of new cars at Audi and Porsche efficient. A new inventory management exercise has been added to Chapter 11 that relates to running a tree farm. Insights from the recent Covid-19 pandemic have been added throughout the book, together with many other updates.

In this book, all of the chapters have been designed to be independent. We have put much effort into the organization of the book but recognize that our organization might not align with the way you are using the material in your course. In addition, many of you may custom publish a version of the book to exactly meet your needs. The chapters have been designed to allow this type of customization.

The chapters are all now tightly organized by special learning objectives. The learning objectives for the chapter are defined at the start. Special contiguous sections are designed to cover each objective. The chapter summary and discussion and objective questions are also organized by learning objective. This new organization allows material to be assigned at the level of learning objective. If the desire might be to skip some advanced techniques, for example, this can be done easily by not assigning the specific learning objective. This allows considerable flexibility in how the material is used in a class.

The material has also been adapted to work well with electronic media, since this is now becoming the media of choice at many universities.

TECHNOLOGY

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OPERATIONS MANAGEMENT AND THE AACSB

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Many educational institutions today are focused on the notion of *assurance of learning,* an important element of some accreditation standards. *Operations and Supply Chain Management* is designed specifically to support your assurance of learning initiatives with a simple yet powerful solution.

Each test bank question for *Operations and Supply Chain Management* maps to a specific chapter learning outcome/objective listed in the text. You can use our test bank software, EZ Test and EZ Test Online, or *Connect Operations Management* to easily query for learning outcomes/objectives that directly relate to the learning objectives for your course. You can then use the reporting features of EZ Test to aggregate student results in similar fashion, making the collection, presentation, and assurance of learning data simple and easy.

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The statements contained in *Operations and Supply Chain Management* are provided only as a guide for the users of this textbook. The AACSB leaves content coverage and assessment within the purview of individual schools, the mission of the school, and the faculty. While *Operations and Supply Chain Management* and the teaching package make no claim of any specific AACSB qualification or evaluation, we have within the test bank labeled questions according to the six general knowledge and skill areas.

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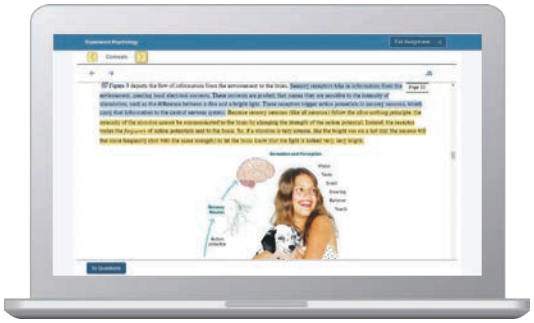

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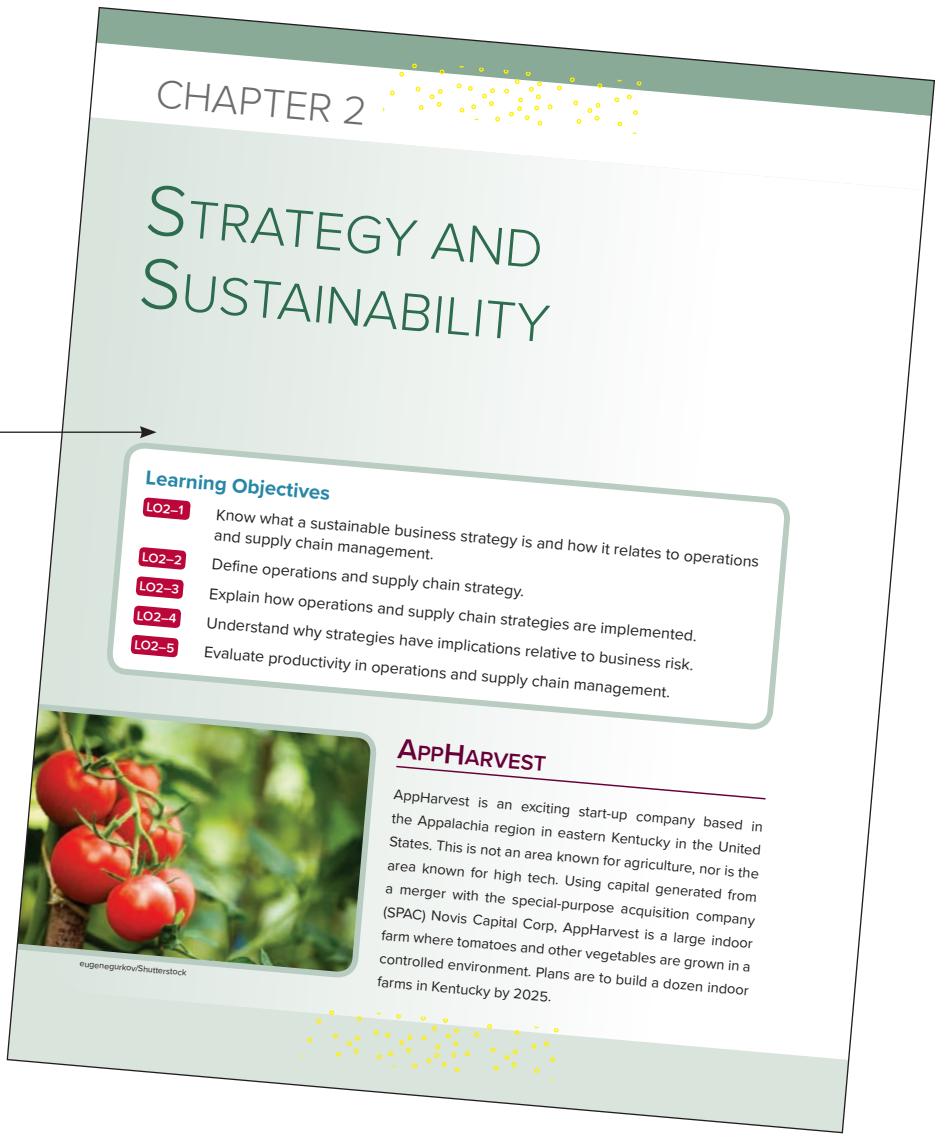
Walkthrough

Major Study and Learning Features

The following section highlights the key features developed to provide you with the best overall text available. We hope these features give you maximum support to learn, understand, and apply operations concepts.

Chapter Opener



CHAPTER 2

STRATEGY AND SUSTAINABILITY

Learning Objectives

- LO2–1 Know what a sustainable business strategy is and how it relates to operations and supply chain management.
- LO2–2 Define operations and supply chain strategy.
- LO2–3 Explain how operations and supply chain strategies are implemented.
- LO2–4 Understand why strategies have implications relative to business risk.
- LO2–5 Evaluate productivity in operations and supply chain management.

APPHARVEST

AppHarvest is an exciting start-up company based in the Appalachia region in eastern Kentucky in the United States. This is not an area known for agriculture, nor is the area known for high tech. Using capital generated from a merger with the special-purpose acquisition company (SPAC) Novis Capital Corp, AppHarvest is a large indoor farm where tomatoes and other vegetables are grown in a controlled environment. Plans are to build a dozen indoor farms in Kentucky by 2025.

Opening Vignettes

Each chapter opens with a short vignette to set the stage and help pique students' interest in the material about to be studied. A few examples include:

- AppHarvest, Chapter 2
- From Bean to Cup: Starbucks Global Supply Chain Challenge, Chapter 3
- Inside an iPhone, Chapter 9
- How the Covid-19 Pandemic Led to Empty Shelves, Chapter 13

franz12/Shutterstock

disruptions to critical supplies and the movement of these supplies for the future. Our global community is connected by the supply chains that move goods and services to every location on the earth. When these operations and supply chain links are broken, life as we know it changes quickly. Examples include the loss of critical medical supplies, and the closure of local businesses that impact the economic health of a community.

Really successful firms have a clear and focused idea of how they intend to make money. Be it high-end products or services that are custom-tailored to the needs of a single customer, or generic, inexpensive commodities that are bought largely based on cost, competitively producing and distributing these products is a great challenge.

In the context of major business functions, operations and supply chain management involves specialists in product design, purchasing, manufacturing, service operations, logistics, and distribution. These specialists are mixed and matched in many ways depending on the product or service. For a firm that sells electronic devices, like Apple, these are the functions responsible for designing the devices, acquiring materials, coordinating equipment resources to convert material to products, moving the product, and exchanging the final product with the customer.

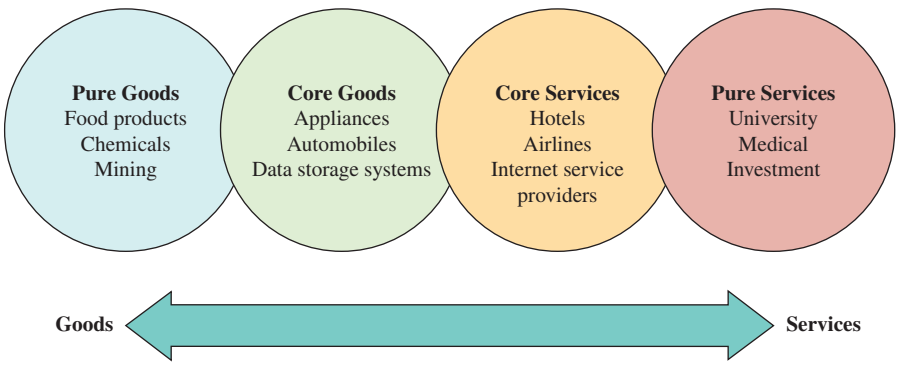
Some firms are focused on services, such as a hospital. Here, the context involves managing resources, including the operating rooms, labs, and hospital beds used to nurse patients back to health. In this context, acquiring materials, moving patients, and coordinating resource use are keys to success. Other firms are more general, such as Amazon. Here, purchasing, website services, logistics, and distribution need to be carefully coordinated for success.

In our increasingly interconnected and interdependent global economy, the process of delivering finished goods, services, and supplies from one place to another is accomplished by means of mind-boggling technological innovation, clever new applications of old ideas, seemingly magical mathematics, powerful software, and old-fashioned concrete, steel, and muscle. This book is about doing this at low cost while meeting the requirements of demanding customers. Success involves the clever integration of a great operations-related strategy, processes that can

Photos and Exhibits

Photos and exhibits in the text enhance the visual appeal and clarify text discussions. Many of the photos illustrate additional examples of companies that utilize the operations and supply chain concepts in their business.

exhibit 1.3 The Goods–Services Continuum



BUSY FEDEX HUBS MOVE THOUSANDS OF PACKAGES ALONG CHUTES AND CONVEYOR BELTS UNDER THE WATCHFUL EYES OF HUB EMPLOYEES.

Daniel Acker/Bloomberg/Getty Images

Concept Connections

Concept Connections draws together various end-of-chapter sections including Key Terms, Solved Problems, Discussion Questions, Objective Questions, Cases, Analytics Exercises, and Practice Exams.

CONCEPT CONNECTIONS

LO1–1 **Identify the elements of operations and supply chain management (OSCM).**

- Processes are used to implement the strategy of the firm.
- Analytics are used to support the ongoing decisions needed to manage the firm.

Operations and supply chain management (OSCM) The design, operation, and improvement of the systems that create and deliver the firm's primary products and services.

Process One or more activities that transform inputs into outputs.

Product–service bundling When a firm builds service activities into its product offerings to create additional value for the customer.

Solved Problems

Representative problems are placed at the end of appropriate chapters. Each includes a worked-out solution giving students a review before solving problems on their own.

SOLVED PROBLEMS

SOLVED PROBLEM 1

Excel: Queue

Quick Lube Inc. operates a fast lube and oil change garage. On a typical day, customers arrive at the rate of three per hour, and lube jobs are performed at an average rate of one every 15 minutes. The mechanics operate as a team on one car at a time.

Assuming Poisson arrivals and exponential service, find:

a. The utilization of the lube team.
b. The average number of cars in line.
c. The average time a car waits before it is lubed.
d. The total time it takes to go through the system (that is, waiting in line plus lube time).

Solution

$\lambda = 3, \mu = 4$

a. Utilization $\rho = \frac{\lambda}{\mu} = \frac{3}{4} = 75$ percent.

b. $L_q = \frac{\lambda^2}{\mu(\mu - \lambda)} = \frac{3^2}{4(4-3)} = \frac{9}{4} = 2.25$ cars in line.

c. $W_q = \frac{L_q}{\lambda} = \frac{2.25}{3} = 0.75$ hour, or 45 minutes.

d. $W_s = \frac{L_s}{\lambda} = \frac{\lambda}{\mu - \lambda}/\lambda = \frac{3}{4-3}/3 = 1$ hour (waiting + lube).

Practice Exam

The practice exam includes many straightforward review questions, but also has a selection that tests for mastery and integration/application level understanding—that is, the kind of questions that make an exam challenging.

PRACTICE EXAM

1. A strategy that is designed to meet current needs without compromising the ability of future generations to meet their needs.
2. The three criteria included in a triple bottom line.
3. The seven operations and supply chain competitive dimensions.
4. It is probably most difficult to compete on this major competitive dimension.
5. This occurs when a company seeks to match what a competitor is doing while maintaining its existing competitive position.
6. A criterion that differentiates the products or services of one firm from those of another.
7. A screening criterion that permits a firm's products to be considered as possible candidates for purchase.
8. A diagram showing the activities that support a company's strategy.
9. A measure calculated by taking the ratio of output to input.

Cases

Cases allow students to think critically about issues discussed in the chapter. Cases include:

Shouldice Hospital—A Cut Above, Chapter 4
Pro Fishing Boats—A Value Stream Mapping Exercise, Chapter 12

CASE: PRO FISHING BOATS—A VALUE STREAM MAPPING EXERCISE

A fishing boat manufacturer, Pro Fishing Boats, is having many problems with critical globally sourced parts. Pro Fishing has two manufacturing facilities in the United States. The firm's reliance on efficient global supply chain operations is increasing as the manufacturer is sourcing more and more parts overseas, including critical components. Recent problems with a number of these critical parts have caused line shutdowns. In response, Pro Fishing has *mandated* a six-week inventory on all globally sourced parts. Management has asked you to evaluate whether this is the right decision.

First, you must understand Pro Fishing's supply chain. Currently, there is very little visibility (knowledge of the current status) of inventory in the supply chain, and communication with the supply base is minimal. In fact, the boat manufacturer does not have *any* visibility past the Tier I suppliers. Adding to the complexity of this problem, each part of the supply chain is handled by diff[illegible] within the

9-week finished goods buffer inventory. Manufacturing time for each component is only about 3 days. The ship bound to the United States takes about 14 days to travel overseas. Upon arrival in the United States, the component is unloaded at the Los Angeles port. This takes about 5 days and customs inspects the shipment in Los Angeles. The goods travel by train to Chicago, which takes about 7 days. Goods are held in Chicago for about half a week. From there, the component is trucked to a Pro Fishing warehouse where the 6-week inventory buffer has been mandated. Shipment to the Pro Fishing warehouse takes 2 days. From the warehouse, the components are trucked to plants in the United States triggered by electronic orders from each of the Pro Fishing plants.

In talking to Manufacturing Inc., Pro Fishing has learned that the component is made up of two main raw materials: one from China and the other from the Unit[illegible]. Due to

Analytics Exercises

There are so much more data now available for decision making. The analytics movement takes this to a new level using statistical analysis to extrapolate what to expect in the future to support operations and supply chain decisions. A series of 15 analytics exercises are spread through the chapters. These include:

Forecasting Supply Chain Demand: Starbucks Corporation, Chapter 3
Designing a Manufacturing Process: Notebook Computer Assembly Line, Chapter 6
Processing Customer Orders: Analyzing a Taco Bell Restaurant, Chapter 7
Global Sourcing Decisions—Grainger: Reengineering the China/U.S. Supply Chain, Chapter 13

ANALYTICS EXERCISE: DESIGNING A MANUFACTURING PROCESS

A Notebook Computer Assembly Line

A manufacturing engineering section manager is examining the prototype assembly process sheet (shown in Exhibit 6.8) for his company's newest subnotebook computer model. With every new model introduced, management felt that the assembly line had to increase productivity and lower costs, usually resulting in changes to the assembly process. When a new model is designed, considerable attention is directed toward reducing the number of components and simplifying parts production and assembly requirements. This new computer was a marvel of high-tech, low-cost innovation and should give the company an advantage during the upcoming fall/winter selling season.

Production of the subnotebook is scheduled to begin in 10 days. Initial production for the new model is to be 150 units per day, increasing to 250 units per day the following week (management thought that eventually production would reach 300 units per day). Assembly lines at the plant normally are staffed by 10 operators who work at a 14.4-meter-long assembly line. The line is organized in a straight line with workers shoulder to shoulder on one side. The line can accommodate up to 12 operators if there is a need. The line normally operates for 7.5 hours a day (employees work from 8:15 A.M. to 5:00 P.M. and regular hours include one hour of unpaid lunch and 15 minutes of scheduled breaks). It is possible to run one, two, or three hours of overtime, but employees need at least three days' notice for planning purposes.

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Operations and Supply Chain Management: The Core

CHAPTER 2

STRATEGY AND SUSTAINABILITY

Learning Objectives

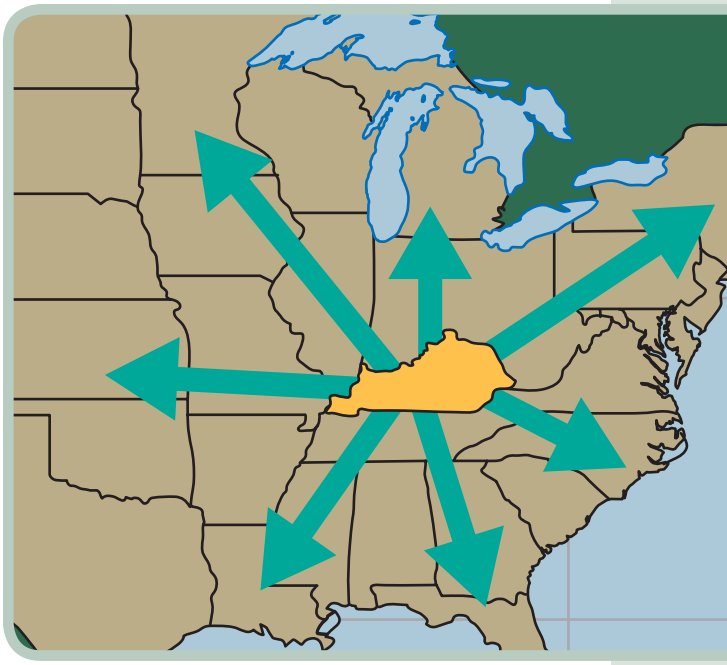
- LO2–1 Know what a sustainable business strategy is and how it relates to operations and supply chain management.
- LO2–2 Define operations and supply chain strategy.
- LO2–3 Explain how operations and supply chain strategies are implemented.
- LO2–4 Understand why strategies have implications relative to business risk.
- LO2–5 Evaluate productivity in operations and supply chain management.

eugenegurkov/Shutterstock

APPHARVEST

AppHarvest is an exciting start-up company based in the Appalachia region in eastern Kentucky in the United States. This is not an area known for agriculture, nor is the area known for high tech. Using capital generated from a merger with the special-purpose acquisition company (SPAC) Novis Capital Corp, AppHarvest is a large indoor farm where tomatoes and other vegetables are grown in a controlled environment. Plans are to build a dozen indoor farms in Kentucky by 2025.

The high-tech farm can efficiently grow crops year-round using computer-controlled lighting, water, and nutrient application. This allows the firm to grow up to 30 times more fruits and vegetables on a single acre compared to normal open-field agriculture. No pesticides are used, and approximately 500 beehives are used to pollinate the more than 700,000 tomato plants in the prototype facility.



Plans call for AppHarvest to be able to ship 49,000 pounds of tomatoes an hour. Automatic carts harvest continuously along preprogrammed routes. Quality inspections track data including weight, color, sugar content, and softness.

The Appalachia region is within a one-day drive of approximately 70 percent of the population of the United States. Fresh tomatoes with a longer shelf life delivered continuously to grocery store and restaurant customers holds great promise.

AppHarvest is an example of the new wave in start-up companies. These innovative companies hope to change the way business is done using radically different production and distribution process strategies. The funding source for these SPAC companies is also different, offering investors and innovators opportunities to quickly benefit from their ideas.

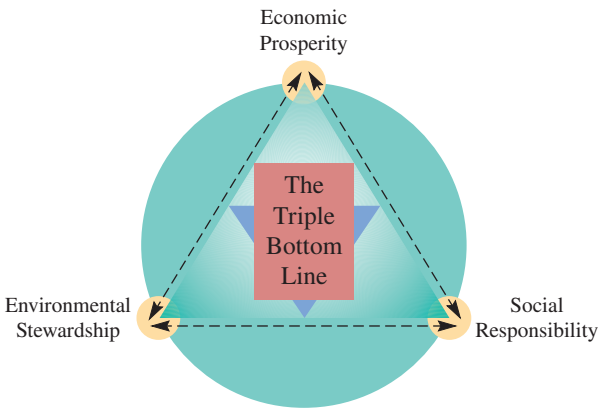
A SUSTAINABLE OPERATIONS AND SUPPLY CHAIN STRATEGY

LO2–1 Know what a sustainable business strategy is and how it relates to operations and supply chain management.

Strategy should describe how a firm intends to create and sustain value for its current shareholders. By adding **sustainability** to the concept, we add the requirement to meet these current needs without compromising the ability of future generations to meet their own needs. *Shareholders* are those individuals or companies that legally own one or more shares of stock in the company. Many companies today have expanded the scope of their strategy to include stakeholders. *Stakeholders* are those individuals or organizations that are influenced, either

Sustainability
The ability to meet current resource needs without compromising the ability of future generations to meet their needs.

exhibit 2.1 The Triple Bottom Line



directly or indirectly, by the actions of the firm. This expanded view means that the scope of the firm's strategy must not only focus on the economic viability of its shareholders, but should also consider the environmental and social impact on key stakeholders.

Triple bottom line
Evaluating the firm against social, economic, and environmental criteria.

To capture this expanded view, the phrase **triple bottom line** has been coined. The triple bottom line, Exhibit 2.1, considers evaluating the firm against social, economic, and environmental criteria. Many companies have developed this expanded view through goals that relate to sustainability along each of these dimensions. Some alternative phrases for the same concept are "People, Planet, and Profit" used by Shell Oil Company, and "Folk, Work, and Place" that originated with the twentieth-century writer Patrick Geddes. The following expands on the meaning of each dimension of the triple bottom line framework.

- **Social responsibility** pertains to fair and beneficial business practices toward labor, the community, and the region in which a firm conducts its business. A triple bottom line company seeks to benefit its employees, the community, and other social entities that are impacted by the firm's existence. A company should not use child labor, and should pay fair salaries to its workers, maintain a safe work environment with tolerable working hours, and not otherwise exploit a community or its labor force. A business can also give back by contributing to the strength and growth of its community through health care, education, and other special programs.
- **Economic prosperity** means the firm is obligated to compensate shareholders who provide capital through stock purchases and other financial instruments via a competitive return on investment. Company strategies should promote growth and grow long-term value to this group in the form of profit. Within a sustainability framework, this dimension goes beyond just profit for the firm; it also provides lasting economic benefit to society.

THE GAP CORPORATE HEADQUARTERS BUILDING UTILIZES A GREEN ROOF WITH SOLAR PANELS.

Steve Proehl/Getty Images

- **Environmental stewardship** refers to the firm's impact on the environment. The company should protect the environment as much as possible—or at least cause no harm. Managers should move to reduce a company's ecological footprint by carefully managing its consumption of natural resources and by reducing waste. Many businesses now conduct "cradle-to-grave" assessments of products to determine what the true environmental costs are—from processing the raw material to manufacture to distribution to eventual disposal by the final customer.

Conventional strategy focuses on the economic part of this framework. Because many of the processes that fall under the domain of operations and supply chain management have a social and environmental impact, it is important these criteria be considered as well. Some proponents argue that in many ways European Union countries are more advanced due to the standardized reporting of ecological and social losses that came with the adoption of the euro.

Although many company planners agree with the goals of improving society and preserving the environment, many others disagree. Dissenting arguments relate to the potential loss of efficiency due to the focus on conflicting criteria. Others argue that these goals may be appropriate only for rich societies that can afford to contribute to society and the environment. A company in a poor or developing society/nation must focus on survival. The economic benefit derived from the use of abundant local resources may be viewed as worth their destruction.

In this chapter, we take a customer-centered approach; issues associated with people and the environment are left to an individual case approach. Depending on the country, industry, and scope of the firm, these other issues vary widely, and it would be difficult to provide a general approach for analysis. The issues and their relationship to operations and supply chain management are very real, however, and we anticipate they will become even more relevant in the future.

WHAT IS OPERATIONS AND SUPPLY CHAIN STRATEGY?

Operations and supply chain strategy is concerned with setting broad policies and plans for using the resources of a firm and must be integrated with corporate strategy. So, for example, if the high-level corporate strategy includes goals related to the environment and social responsibility, then the operations and supply chain strategy must consider these goals. A major focus to the operations and supply chain strategy is operations effectiveness. **Operations effectiveness** relates to the core business processes needed to run the business. The processes span all the business functions, from taking customer orders, handling returns, manufacturing, and managing the updating of the website, to shipping products. Operational effectiveness is reflected directly in the costs associated with doing business. Strategies associated with operational effectiveness, such as quality assurance and control initiatives, process redesign, planning and control systems, and technology investments, can show quick near-term (12 to 24 months) results.

Operations and supply chain strategy can be viewed as part of a planning process that coordinates operational goals with those of the larger organization. Since the goals of the larger organization change over time, the operations strategy must be designed to anticipate future needs. A firm's operations and supply chain capabilities can be viewed as a portfolio best suited to adapting to the changing product and/or service needs of the firm's customers.

Operations and supply chain strategy
The setting of broad policies and plans that will guide the use of the resources needed by the firm to implement its corporate strategy.

LO2–2 Define operations and supply chain strategy.

Operations effectiveness
Performing activities in a manner that best implements strategic priorities at minimum cost.

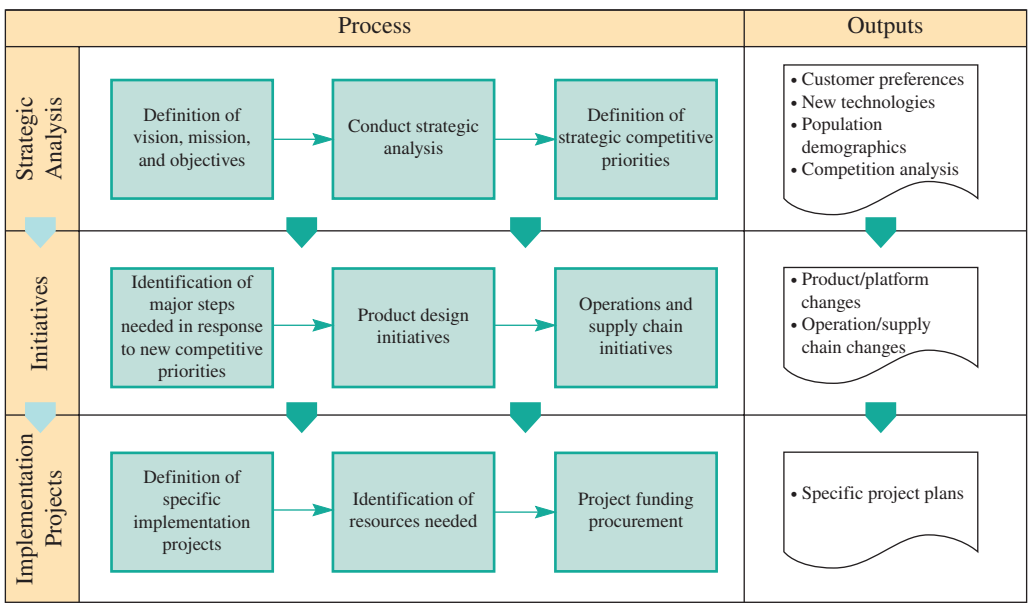
Planning strategy is a process just like making a product or delivering a service. The process involves a set of activities that are repeated at different intervals over time. Just as products are made over and over, the strategy planning activities are repeated. A big difference is that these activities are done by executives in the boardroom!

Exhibit 2.2 shows the major activities of a typical strategic planning process. Strategic analysis is performed at least yearly and is the process through which the overall strategy is developed. This step involves looking out and forecasting how business conditions that impact the firm's strategy are going to change in the future. Here, such things as changes in customer preferences, the impact of new technologies, changes in population demographics, and the anticipation of new competitors are considered. As part of the overall strategy, the firm needs to define a clear set of priorities to help guide the implementation of a plan. When possible, it is useful to define specific measures that relate to the objectives of the firm. A successful strategy will anticipate change and formulate new initiatives in response.

The corporate strategy is operationalized through a set of operations and supply chain initiatives. *Initiatives* are the major steps that need to be taken to drive success in the firm. Many of these initiatives are repeated from year to year, such as the updating of existing product designs and the operation of manufacturing plants in different regions of the world. New initiatives that innovatively respond to market dynamics are extremely important to company success. Initiatives that develop innovative products or open new markets, for example, drive future revenue growth. Other initiatives that reduce costs directly impact the profitability of the firm.

These activities are refined and updated as often as four times a year. Here, each initiative is evaluated and appropriate budget estimates for the next year or more are developed. Measures that relate to the performance of each initiative are needed so that success or failure can be gauged in an unbiased and objective way. Because of the quickly changing nature of global business, many businesses must revise plans several times per year.

exhibit 2.2 Formulating an Operations and Supply Chain Strategy



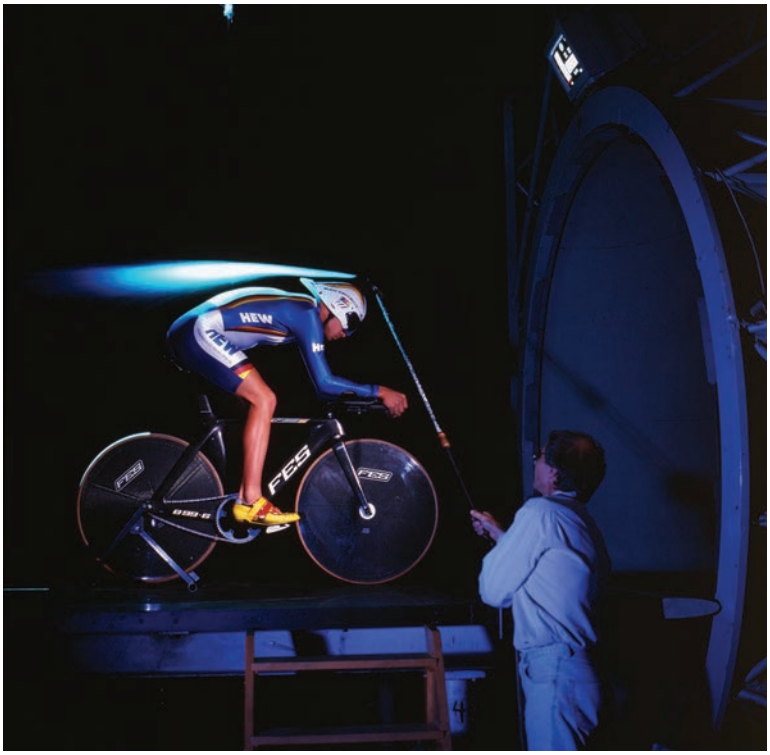
Carefully designed projects are used to implement change. The planning of these projects requires the identification of the resources needed, such as the expertise of the project members, special equipment, and other resources. Specific timing of the activities of the project are analyzed as part of each project implementation plan.

Competitive Dimensions

Given the choices customers face today, how do they decide which product or service to buy? Different customers are attracted by different attributes. Some customers are interested primarily in the cost of a product or service and, correspondingly, some companies attempt to position themselves to offer the lowest prices. The major competitive dimensions that form the competitive position of a firm are discussed next.

Cost or Price: "Make the Product or Deliver the Service Cheap" Within every industry, there is usually a segment of the market that buys solely on the basis of low cost. To successfully compete in this niche, a firm must be the low-cost producer, but even this does not always guarantee profitability and success. Products and services sold strictly on the basis of cost are typically commodity-like; in other words, customers cannot distinguish the product or service of one firm from that of another. This segment of the market is frequently very large, and many companies are lured by the potential for significant profits, which they associate with the large unit volumes. As a consequence, however, competition in this segment is fierce—and the failure rate high. After all, there can be only one low-cost producer, who usually establishes the selling price in the market.

Price, however, is not the only basis on which a firm can compete (although many economists appear to assume it is!). Other companies, such as BMW, seek to attract people who want *higher quality*—in terms of performance, appearance, or features—than what is available in competing products and services, even though it means a higher price.



AN AERODYNAMICS EXPERT LOGS RESULTS FROM A WIND TUNNEL TEST FOR CYCLING CLOTHING AND RACING BICYCLE DESIGN.

imageBROKER/REX/Shutterstock

Quality: "Make a Great Product or Deliver a Great Service" There are two characteristics of a product or service that define quality: design quality and process quality. Design quality relates to the set of features the product or service contains. Obviously, a child's first two-wheel bicycle is of significantly different quality than the bicycle of a world-class cyclist. The use of special aluminum alloys and special lightweight sprockets and chains is important to the performance needs of the advanced cyclist. These two types of bicycles are designed for different customers' needs. The higher-quality cyclist product commands a higher price in the marketplace

due to its special features. The goal in establishing the proper level of design quality is to focus on the requirements of the customer. Overdesigned products and services with too many or inappropriate features will be viewed as prohibitively expensive. In comparison, underdesigned products and services will lose customers to products that cost a little more but are perceived by customers as offering greater value.

Process quality, the second characteristic of quality, is critical because it relates directly to the reliability of the product or service. Regardless of whether the product is a child's first two-wheeler or a bicycle for an international cyclist, customers want products without defects. Thus, the goal of process quality is to produce defect-free products and services. Product and service specifications, given in dimensional tolerances and/or service error rates, define how the product or service is to be made. Adherence to these specifications is critical to ensure the reliability of the product or service as defined by its intended use.

Delivery Speed: "Make the Product or Deliver the Service Quickly" In some markets, a firm's ability to deliver more quickly than its competitors is critical. A company that can offer an onsite repair service in only 1 or 2 hours has a significant advantage over a competing firm that guarantees service only within 24 hours.

Delivery Reliability: "Deliver It When Promised" This dimension relates to the firm's ability to supply the product or service on or before a promised delivery due date. For an automobile manufacturer, it is very important that its supplier of tires provide the needed quantity and types for each day's car production. If the tires needed for a particular car are not available when the car reaches the point on the assembly line where the tires are installed, the whole assembly line may have to be shut down until they arrive. For a service firm such as FedEx, delivery reliability is the cornerstone of its strategy.

Coping with Changes in Demand: "Change Its Volume" In many markets, a company's ability to respond to increases and decreases in demand, referred to as *agility*, is important to its ability to compete. It is well known that a company with increasing demand can do little wrong. When demand is strong and increasing, costs are continuously reduced due to economies of scale, and investments in new technologies can be easily justified. But scaling back when demand decreases may require many difficult decisions about laying off employees and determining reductions in assets. The ability to effectively deal with dynamic market demand over the long term is an essential element of operations strategy.

Flexibility and New-Product Introduction Speed: "Change It" Flexibility, from a strategic perspective, refers to the ability of a company to offer a wide variety of products to its customers. An important element of this ability to offer different products is the time required for a company to develop a new product and to convert its processes to offer the new product.

Other Product-Specific Criteria: "Support It" The competitive dimensions just described are certainly the most common. However, other dimensions often relate to specific products or situations. Notice that most of the dimensions listed next are primarily services in nature. Often, special services are provided to augment the sales of manufactured products.

1. **Technical liaison and support.** A supplier may be expected to provide technical assistance for product development, particularly during the early stages of design and manufacturing.

2. **Ability to meet a launch date.** A firm may be required to coordinate with other firms on a complex project. In such cases, manufacturing may take place while development work is still being completed. Coordinating work between firms and having them work simultaneously on a project will reduce the total time required to complete the project.
3. **Supplier after-sales support.** An important competitive dimension may be the ability of a firm to support its product after the sale. This involves the availability of replacement parts and, possibly, the modification of older, existing products, bringing them up to new performance levels. The speed of response to these after-sale needs is often important as well.
4. **Environmental impact.** A dimension related to criteria such as carbon dioxide emissions, the use of nonrenewable resources, and other factors that relate to sustainability.
5. **Other dimensions.** These typically include such factors as the colors available, size, weight, location of the fabrication site, the customization available, and product mix options.

The Notion of Trade-Offs

Central to the concept of operations and supply chain strategy is the notion of operations focus and trade-offs. The underlying logic is that an operation cannot excel simultaneously on all competitive dimensions. Consequently, management has to decide which parameters of performance are critical to the firm's success and then concentrate the resources of the firm on these particular characteristics.

For example, if a company wants to focus on the speed of delivery, it cannot be very flexible in its ability to offer a wide range of products. Similarly, a low-cost strategy is not compatible with either speed of delivery or flexibility. High quality also is viewed as a trade-off to low cost.

A strategic position is not sustainable unless there are compromises with other positions. Trade-offs occur when activities are incompatible so that more of one thing necessitates less of another. An airline can choose to serve meals—adding cost and slowing turnaround time at the gate—or it can choose not to, but it cannot do both without bearing major inefficiencies.

Straddling occurs when a company seeks to match the benefits of a successful position while maintaining its existing position. It adds new features, services, or technologies onto the activities it already performs. The risky nature of this strategy is shown by Continental Airlines' ill-fated attempt to compete with Southwest Airlines. While maintaining its position as a full-service airline, Continental set out to match Southwest on a number of point-to-point routes. The airline dubbed the new service Continental Lite. It eliminated meals and first-class service, increased departure frequency, lowered fares, and shortened gate turnaround time. Because Continental remained a full-service airline on other routes, it continued to use travel agents and its mixed fleet of planes and to provide baggage checking and seat assignments.

Straddling
When a firm seeks to match what a competitor is doing by adding new features, services, or technologies to existing activities. This often creates problems if certain trade-offs need to be made.

Trade-offs ultimately grounded Continental Lite. The airline lost hundreds of millions of dollars, and the chief executive officer lost his job. Its planes were delayed, leaving hub cities congested, slowed at the gate by baggage transfers. Late flights and cancellations generated a thousand complaints a day. Continental Lite could not afford to compete on price and still pay standard travel agent commissions, but neither could it do without agents for its full-service business. The airline compromised by cutting commissions for all Continental flights. Similarly, it could not afford to offer the same frequent-flier benefits to travelers paying the much lower ticket prices for Lite service. It compromised again

by lowering the rewards of Continental's entire frequent-flier program. The results: angry travel agents and full-service customers. Continental tried to compete in two ways at once and paid an enormous straddling penalty.

Order Winners and Order Qualifiers: The Marketing–Operations Link

A well-designed interface between marketing and operations is necessary to provide a business with an understanding of its markets from both perspectives. The terms *order winner* and *order qualifier* describe marketing-oriented dimensions that are key to competitive success. An **order winner** is a criterion that differentiates the products or services of one firm from those of another. Depending on the situation, the order-winning criterion may be the cost of the product (price), product quality and reliability, or any of the other dimensions developed earlier. An **order qualifier** is a screening criterion that permits a firm's products to even be considered as possible candidates for purchase.

Order winners
One or more specific marketing-oriented dimensions that clearly differentiate a product from competing products.

Order qualifiers
Dimensions used to screen a product or service as a candidate for purchase.

For example, consider your purchase of a notebook computer. You might think that such features as screen size, weight, operating system version, and cost are important *qualifying* dimensions. But the order-winning feature that actually *differentiates* one notebook computer candidate from another for you is battery life. In doing your search, you develop a list of computers that all have 14-inch screens, weigh less than three pounds, run the latest Microsoft Windows operating system, and cost less than $1,000. From this list of acceptable computers, you select the one that has the longest battery life.

In an industrial setting where a firm is deciding on a supplier, the decision can be quite different. Here, consider a firm that is deciding on a supplier for its office supplies. Companies such as Office Depot, Quill, or Staples might be candidates. Here, the qualifying dimensions are the following: Can the company supply the items needed? Can the supplier deliver orders within 24 hours? Are the items guaranteed? And is a private web-based catalog available? Companies that have these capabilities would *qualify* for consideration as possible suppliers. The order winner might be the discount schedule that the company offers on the price of the items purchased.

STRATEGIES ARE IMPLEMENTED USING OPERATIONS AND SUPPLY CHAIN ACTIVITIES—IKEA'S STRATEGY

LO2–3 Explain how operations and supply chain strategies are implemented.

All the activities that make up a firm's operation relate to one another. To make these activities efficient, the firm must minimize its total cost without compromising customers' needs.

To demonstrate how this works, consider how IKEA, the Swedish retailer of home products, implements its strategy using a set of unique activities. IKEA targets young furniture buyers who want style at a low cost. IKEA has chosen to perform activities differently than its rivals.

Consider the typical furniture store, where showrooms display samples of the merchandise. One area may contain many sofas, another area displays dining tables, and there are many other areas focused on particular types of furniture. Dozens of books displaying fabric swatches or wood samples or alternative styles offer customers thousands of product varieties from which to choose. Salespeople escort customers through the store, answering questions and helping them navigate the maze of choices. Once a customer

decides what he or she wants, the order is relayed to a third-party manufacturer. With a lot of luck, the furniture will be delivered to the customer's home within six to eight weeks. This is a supply chain that maximizes customization and service, but does so at a high cost.

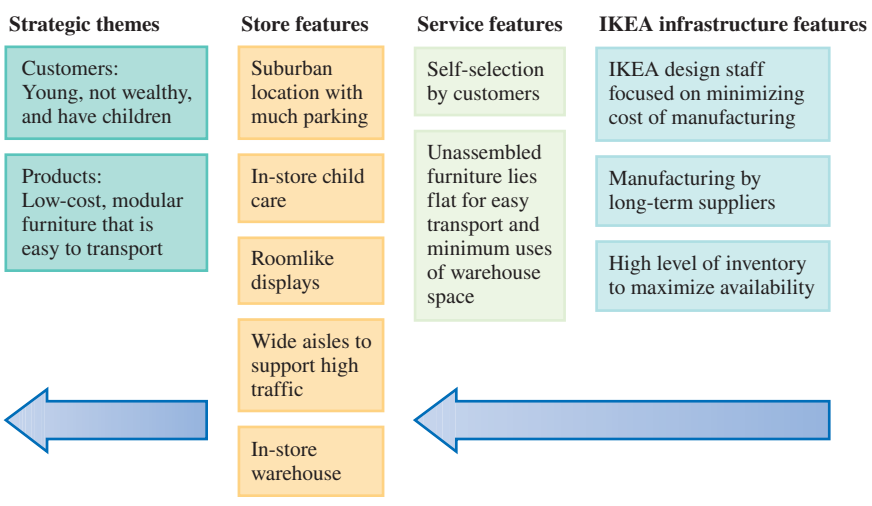
Michael Gordon/Shutterstock

In contrast, IKEA serves customers who are happy to trade service for cost. Instead of using sales associates, IKEA uses a self-service model with roomlike displays where furniture is shown in familiar settings. Rather than relying on third-party manufacturers, IKEA designs its own low-cost, modular, ready-to-assemble furniture. In the store, there is a warehouse section with the products in boxes ready for delivery. Customers do their own picking from inventory and delivery. Much of its low-cost operation comes from having customers service themselves, yet IKEA offers extra services, such as in-store child care and extended hours. Those services align well with the needs of its customers, who are young, not wealthy, and likely to have children, and who need to shop at odd hours.

Exhibit 2.3 shows how IKEA's strategy is implemented through a set of activities designed to deliver it. **Activity-system maps** such as the one for IKEA show how a company's strategy is delivered through a set of tailored activities. In companies with a clear strategy, a number of higher-order strategic themes (shown on the left) can be identified and implemented through clusters of tightly linked activities. This type of map can be useful in understanding how good the fit is between the system of activities and the company's strategy. Competitive advantage comes from the way a firm's activities fit with and reinforce one another.

Activity-system maps
Diagrams that show how a company's strategy is delivered through a set of supporting activities.

exhibit 2.3 IKEA—Stylish Low-Cost Furniture



ASSESSING THE RISK ASSOCIATED WITH OPERATIONS AND SUPPLY CHAIN STRATEGIES

LO2–4 Understand why strategies have implications relative to business risk.

The recent Covid-19 pandemic has changed the global business environment and highlighted the importance of adaptability and crisis management to endure radical changes. The acute restrictions and lockdowns created critical situations that required immediate attention in the early days of the pandemic. Radical changes in demand and losses in production and supply chain capacity forced companies to take emergency measures. The need to protect their employees and adapt to the new reality was crucial.

During the past few decades, the OSCM discussion has focused primarily on cost efficiency. This focus has resulted in superoptimized supply chains, specialized for their specific purpose. While these supply chains have given steady financial advantage to their operators, adaptability and resilience may need to be considered in the future. Some have argued the dilemma that arises from the realization of years of cost savings that might be lost due to the mitigation for a once-in-a-lifetime event. The importance of risk management is more apparent and difficult than ever in our globally connected business world.

Supply chain risk
The likelihood of a disruption that would impact the ability of a company to continuously supply products or services.

The uncertainty in the global environment where most supply chains operate requires strategic planners to evaluate the relative riskiness of their operations and supply chain strategies. **Supply chain risk** is defined as the likelihood of a disruption that would impact the ability of the company to continuously supply products or services. Supply chain disruptions are unplanned and unanticipated events that disrupt the normal flow of goods and materials within a supply chain and expose firms within the supply chain to operational and financial risks. Companies implementing operations and supply chain strategies must consider the risk in their supply chains and develop initiatives to cope with these disruptions and mitigate their impact on the business.

We can categorize risk by viewing the inherent uncertainties related to operations and supply chain management along two dimensions: (1) supply chain coordination risks that are associated with the day-to-day management of the supply chain, which are normally dealt with using safety stock, safety lead time, overtime, and so on; and (2) disruption risks, which are caused by natural or human-made disasters, such as earthquakes, hurricanes, terrorism, and even pandemics.

In this section, our focus is on the concepts and tools that are useful for managing the problems related to disruption risks. The events related to these risks are highly random and virtually impossible to predict with any precision.

Risk Management Framework

The nature of these types of risks lends them to a three-step risk management process that can be applied to situations where disruptions are possible. The three steps are as follows:

1. *Identify the sources of potential disruptions.* Assessing a type of vulnerability is the first step in the risk management framework. These are highly situation-dependent, but the focus should be on highly unlikely events that would cause a significant disruption to normal operations. Such types of events include: natural disasters, capacity failures, infrastructure failures (e.g., air traffic system), terrorists, supplier failures, labor actions, equipment failures, commodity price volatility, and military/civil conflict.
2. *Assess the potential impact of the risk.* Here the goal is to quantify the probability and the potential impact of the risk. Depending on the specific incident, this

assessment could be based on financial impact, environmental impact, ongoing business viability, brand image/reputation, potential human lives, and so on.

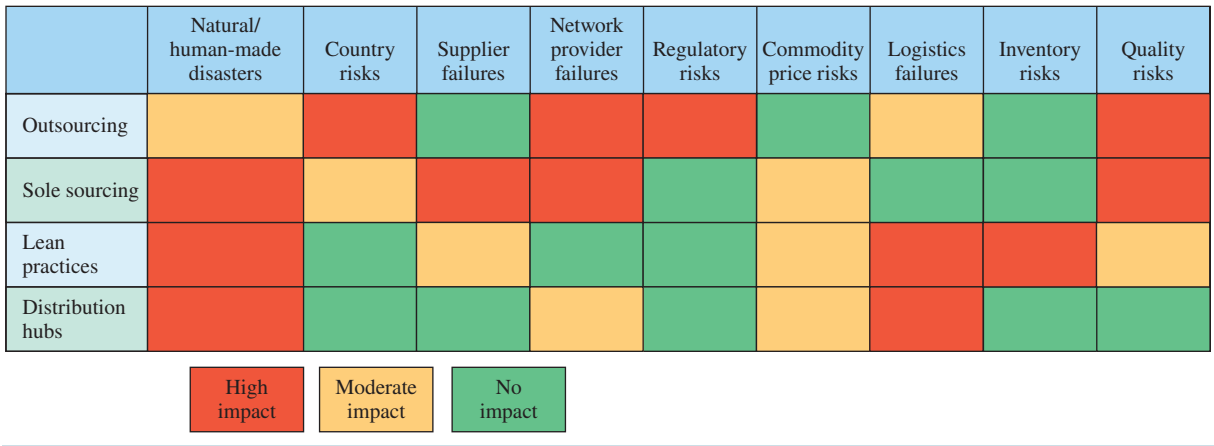
3. *Develop plans to mitigate the risk.* A detailed strategy for minimizing the impact of the risk could take many different forms, depending on the nature of the problem.

Risk mapping involves assessment of the probability or relative frequency of an event against the aggregate severity of the loss. Depending on the evaluation, some risks might be deemed acceptable and the related costs considered a normal cost of doing business. In some cases, the firm may find it is possible to insure against the loss. There may be other cases where the potential loss is so great that the risk would need to be avoided altogether.

A matrix (see Exhibit 2.4) that maps risks against specific operations and supply chain strategies is commonly used. The matrix helps us understand the impact of different types of supply chain disruptions when using specific operations and supply chain strategies. For example, the first column evaluates the impact of natural hazards. Here, we see that sole sourcing, lean practices, and the use of distribution hubs can have a major impact on the firm.

Risk Mitigation Strategies **exhibit 2.4**

Risks	Risk Mitigation Strategy
Natural disasters (e.g., climate change, weather)	Contingency planning (alternate sites, etc.), insurance
Country risks	Currency hedging, locally producing/sourcing
Supplier failures	Multiple suppliers
Network provider failures	Support of redundant digital networks
Regulatory risks (e.g., licensing and regulation issues)	Up-front and continuing research; good legal advice, compliance
Commodity price risks	Multisourcing, commodity hedging
Logistics failures	Safety stock, detailed tracking, and alternate suppliers
Inventory risks	Pool inventory, safety stock
Major quality failures	Careful selection and monitoring of suppliers
Loss of customers	Service/product innovation
Theft and vandalism	Insurance, security precautions, knowledge of likely risks, patent protection, etc.



Unfortunately, some of the most cost-effective strategies are also the riskiest. It is important to keep this in mind as you consider each concept. Thus far in the book, we have not discussed specific operations and supply chain strategies, such as outsourcing and sole sourcing. You will learn about these as we progress through the book.

PRODUCTIVITY MEASUREMENT

LO2–5 Evaluate productivity in operations and supply chain management.

Productivity
A measure of how well resources are used.

Productivity is a common measure of how well a country, industry, or business unit is using its resources (or factors of production). Since operations and supply chain management focuses on making the best use of the resources available to a firm, productivity measurement is fundamental to understanding operations-related performance. In this section, we define various measures of productivity. Throughout the rest of the book, many other performance measures will be defined as they relate to the material.

In its broadest sense, productivity is defined as

$$\text{Productivity} = \frac{\text{Outputs}}{\text{Inputs}} \qquad [2.1]$$

To increase productivity, we want to make this ratio of outputs to inputs as large as practical.

Productivity is what we call a *relative measure.* In other words, to be meaningful, it needs to be compared with something else. For example, what can we learn from the fact that we operate a restaurant and that its productivity last week was 8.4 customers per labor hour? Nothing!

Productivity comparisons can be made in two ways. First, a company can compare itself with similar operations within its industry, or it can use industry data when such data are available (e.g., comparing productivity among the different stores in a franchise). Another approach is to measure productivity over time within the same operation. Here we would compare our productivity in one time period with that in the next.

As Exhibit 2.5 shows, productivity may be expressed as partial measures, multifactor measures, or total measures. If we are concerned with the ratio of some output to a single input, we have a *partial productivity measure.* If we want to look at the ratio of some output to a group of inputs (but not all inputs), we have a *multifactor productivity measure.* If we want to express the ratio of all outputs to all inputs, we can use a *total factor measure of productivity* to describe the productivity of an entire organization or even a nation.

A numerical example of productivity appears in Exhibit 2.5. The data reflect quantitative measures of input and output associated with the production of a certain product. Notice that for the multifactor and partial measures, it is not necessary to use total output as the numerator. Often, it is desirable to create measures that represent productivity as it relates to some particular output of interest. Using Exhibit 2.5 as an example, total units might be the output of interest to a production control manager, whereas total output may be of key interest to the plant manager. This process of aggregation and disaggregation of productivity measures provides a means of shifting the level of the analysis to suit a variety of productivity measurement and improvement needs.

Exhibit 2.5 shows all units in dollars. Often, however, management can better understand how the company is performing when units other than dollars are used. In these cases, only partial measures of productivity can be used, because we cannot combine dissimilar units such as labor hours and pounds of material. Examples of some commonly

Examples of Productivity Measures — exhibit 2.5

Partial measure	$\frac{\text{Output}}{\text{Labor}}$ or $\frac{\text{Output}}{\text{Capital}}$ or $\frac{\text{Output}}{\text{Materials}}$ or $\frac{\text{Output}}{\text{Energy}}$
Multifactor measure	$\frac{\text{Output}}{\text{Labor + Capital + Energy}}$ or $\frac{\text{Output}}{\text{Labor + Capital + Materials}}$
Total measure	$\frac{\text{Output}}{\text{Inputs}}$ or $\frac{\text{Goods and services produced}}{\text{All resources used}}$

Input and Output Production Data ($1,000)		Productivity Measure Examples
Output		Total measure
1. Finished units	$10,000	$\frac{\text{Total output}}{\text{Total input}} = \frac{13,500}{15,193} = 0.89$
2. Work-in-process	2,500	
3. Dividends	1,000	Multifactor measures:
Total output	$13,500	$\frac{\text{Total output}}{\text{Labor + Material}} = \frac{13,500}{3,153} = 4.28$
		$\frac{\text{Finished units}}{\text{Labor + Material}} = \frac{10,000}{3,153} = 3.17$
Input		
1. Labor	$ 153	Partial measures:
2. Material	3,000	$\frac{\text{Total output}}{\text{Energy}} = \frac{13,500}{540} = 25$
3. Capital	10,000	
4. Energy	540	$\frac{\text{Finished units}}{\text{Energy}} = \frac{10,000}{540} = 18.52$
5. Other expenses	1,500	
Total input	$15,193	

Excel: Productivity Measures

Partial Measures of Productivity

Business	Productivity Measure
Restaurant	Customers (meals) per labor hour
Retail store	Sales per square foot
Chicken farm	Pounds of meat per pounds of feed
Utility plant	Kilowatt-hours per ton of coal
Paper mill	Tons of paper per cord of wood

used partial measures of productivity are presented in Exhibit 2.5. Such partial measures of productivity give managers information in familiar units, allowing them to easily relate these measures to the actual operations.

Each summer, *USA Today* publishes annual reports of productivity gains by the largest U.S. firms. Productivity has been on the rise for many years now, which is very good for the economy. Productivity often increases in times of recession; as workers are fired, those remaining are expected to do more. Increases also come from technological advances. Think of what the tractor did for farm productivity.

CONCEPT CONNECTIONS

LO2–1 **Know what a sustainable business strategy is and how it relates to operations and supply chain management.**

- A strategy that is sustainable needs to create value for the firm's shareholders and stakeholders.
- The shareholders are equity owners in the company.
- The stakeholders are those individuals and organizations that are influenced by the actions of the firm.
- This view means that a firm's strategy must focus not only on economic viability, but also on the environmental and social impact of its actions.

Sustainability The ability to meet current resource needs without compromising the ability of future generations to meet their needs.

Triple bottom line Evaluating the firm against social, economic, and environmental criteria.

LO2–2 **Define operations and supply chain strategy.**

- This involves setting the broad policies of a firm and creating a plan for using that firm's resources.
- The operations and supply chain strategy coordinates operational goals with those of the larger organization.
- A firm's operational capabilities should match the changing product or service needs of the firm's customers.

Major competitive dimensions that form the competitive position of a firm include:

- Cost
- Quality
- Delivery speed and reliability
- Changes in volume
- Flexibility and new-product introduction speed
- Other product-specific criteria

Usually there are trade-offs that occur relative to these competitive dimensions.

Operations and supply chain strategy The setting of broad policies and plans that will guide the use of the resources needed by the firm to implement its corporate strategy.

Operations effectiveness Performing activities in a manner that best implements strategic priorities at minimum cost.

Straddling When a firm seeks to match what a competitor is doing by adding new features, services, or technologies to existing activities. This often creates problems if certain trade-offs need to be made.

Order winners One or more specific marketing-oriented dimensions that clearly differentiate a product from competing products.

Order qualifiers Dimensions used to screen a product or service as a candidate for purchase.

LO2–3 **Explain how operations and supply chain strategies are implemented.**

- Strategies are implemented through a set of activities designed to deliver products and services in a manner consistent with the firm's overall business strategy.

Activity-system maps Diagrams that show how a company's strategy is delivered through a set of supporting activities.

LO2–4 **Understand why strategies have implications relative to business risk.**

- Operations and supply chain strategies need to be evaluated relative to their riskiness.
- Supply chain disruptions are unplanned and unanticipated events that disrupt the normal flow of goods and materials.
- Risks can be categorized along two dimensions: supply chain coordination risks and disruption risks.
- A three-step risk management framework involves identifying the potential disruptions, assessing the potential impact of the risk, and developing plans to mitigate the risk.

Supply chain risk The likelihood of a disruption that would impact the ability of a company to continuously supply products or services.

LO2–5 **Evaluate productivity in operations and supply chain management.**

- Productivity measures are used to ensure that the firm makes the best use of its resources.
- Since these are relative measures, they are meaningful only if they are compared to something else. Often, the comparison is to another company.

Productivity A measure of how well resources are used.

$$\text{Productivity} = \frac{\text{Outputs}}{\text{Inputs}} \qquad [2.1]$$

SOLVED PROBLEM

A furniture manufacturing company has provided the following data (units are $1,000). Compare the labor, raw materials and supplies, and total productivity for the past two years.

		Last Year	This Year
Output:	Sales value of production	$22,000	$35,000
Input:	Labor	8,000	12,500
	Raw materials and supplies	10,000	15,000
	Capital equipment depreciation	700	1,200
	Other	2,200	4,800

Solution

	Last Year	This Year
Partial productivities		
Labor	2.75	2.80
Raw materials and supplies	2.20	2.33
Total productivity	1.05	1.04

DISCUSSION QUESTIONS

LO2–1

1. What is meant by a triple bottom line strategy? Give an example of a company that has adopted this type of strategy.
2. Find examples where companies have used features related to environmental sustainability to win new customers.

LO2–2

3. What are the major priorities associated with operations and supply chain strategy? For each major priority, describe the unique characteristics of the market niche with which it is most compatible.
4. Why does the proper operations and supply chain strategy keep changing for companies that are world-class competitors?
5. What do the expressions *order winner* and *order qualifier* mean? What was the order winner for your last major purchase of a product or service?

LO2–3

6. Pick a company that you are familiar with and describe its operations strategy and how it relates to winning customers. Describe specific activities used by the company that support the strategy (see Exhibit 2.3 for an example).

LO2–4

7. At times, the dollar shows relative weakness with respect to foreign currencies such as the yen, euro, and pound. This stimulates exports. Why would long-term reliance on a lower-valued dollar be at best a short-term solution to the competitiveness problem?
8. Identify an operations and supply chain–related disruption that recently impacted a company. What could the company have done to minimize the impact of this type of disruption prior to it occurring?

LO2–5

9. What do we mean when we say productivity is a relative measure?

OBJECTIVE QUESTIONS

LO2–1

1. Shell Oil Company's motto "People, Planet, and Profit" is a real-world implementation of what OSCM concept?
2. A firm's strategy should describe how it intends to create and sustain value for what entities?
3. What is the term used to describe individuals or organizations that are influenced by the actions of a firm?

LO2–2

4. How often should a company develop and refine the operations and supply chain strategy?
5. What is the term used to describe product attributes that attract certain customers and can be used to form the competitive position of a firm?
6. What are the two main competitive dimensions related to product delivery?
7. What are the two characteristics of a product or service that define quality?

LO2–3

8. What is the diagram that shows how a company's strategy is delivered by a set of supporting activities called?
9. In implementing supply chain strategy, a firm must minimize its total cost without compromising the needs of what group of people?

LO2–4

10. What is defined as the likelihood of disruption that would impact the ability of a company to continuously supply products or services?
11. What are risks caused by natural and human-made disasters, which are impossible to reliably predict, called?

12. Match the following common risks with the appropriate mitigation strategy:

_____ Country risks	A. Detailed tracking, alternate suppliers
_____ Regulatory risk	B. Careful selection and monitoring of suppliers
_____ Logistics failure	C. Contingency planning, insurance
_____ Natural disaster	D. Good legal advice, compliance
_____ Major quality failure	E. Currency hedging, local sourcing

13. What is the term used to describe the assessment of the probability of a negative event against the aggregate severity of the related loss?

LO2–5

14. As operations manager, you are concerned about being able to meet sales requirements in the coming months. You have just been given the following production report:

	JAN	FEB	MAR	APR
Units produced	2,300	1,800	2,800	3,000
Hours per machine	325	200	400	320
Number of machines	3	5	4	4

Find the average of the monthly productivity figures (units per machine hour).

15. Sailmaster makes high-performance sails for competitive windsurfers. Below is information about the inputs and outputs for one model, the Windy 2000. Calculate the productivity in sales revenue/labor expense.

Units sold	1,217
Sale price each	$1,700
Total labor hours	46,672
Wage rate	$12/hour
Total materials	$60,000
Total energy	$4,000

16. Live Trap Corporation received the data below for its rodent cage production unit. Find the total productivity.

OUTPUT	INPUT	
50,000 cages	Production time	620 labor hours
Sale price: $3.50 per unit	Wages	$7.50/hour
	Raw materials (total cost)	$30,000
	Component parts (total cost)	$15,350

17. Two types of cars (Deluxe and Limited) were produced by a car manufacturer last year. Quantities sold, price per unit, and labor hours are given below. What is the labor productivity for each car? Explain the problem(s) associated with the labor productivity.

	QUANTITY	$/UNIT
Deluxe car	4,000 units sold	$8,000/car
Limited car	6,000 units sold	$9,500/car
Labor, Deluxe	20,000 hours	$12/hour
Labor, Limited	30,000 hours	$14/hour

18. A U.S. manufacturing company operating a subsidiary in an LDC (less-developed country) shows the following results:

	U.S.	LDC
Sales (units)	100,000	20,000
Labor (hours)	20,000	15,000
Raw materials (currency)	$20,000 (US)	20,000 (FC)
Capital equipment (hours)	60,000	5,000

a. Calculate partial labor and capital productivity figures for the parent and subsidiary. Do the results seem confusing?
b. Compute the multifactor productivity figures for labor and capital together. Do the results make more sense?
c. Calculate raw material productivity figures [units/$ where $1 = 10 (FC)]. Explain why these figures might be greater in the subsidiary.

19. Various financial data for the past two years follow. Calculate the total productivity measure and the partial measures for labor, capital, and raw materials for this company for both years. What do these measures tell you about this company?

	LAST YEAR	THIS YEAR
Output: Sales	$200,000	$220,000
Input: Labor	30,000	40,000
Raw materials	35,000	45,000
Energy	5,000	6,000
Capital	50,000	50,000
Other	2,000	3,000

20. An electronics company makes communications devices for military contracts. The company just completed two contracts. The navy contract was for 2,300 devices and took 25 workers two weeks (40 hours per week) to complete. The army contract was for 5,500 devices that were produced by 35 workers in three weeks. On which contract were the workers more productive?
21. A retail store had sales of $45,000 in April and $56,000 in May. The store employs eight full-time workers who work a 40-hour week. In April, the store also had seven part-time workers at 10 hours per week, and in May the store had nine part-timers at 15 hours per week (assume four weeks in each month). Using sales dollars as the measure of output, what is the percentage change in productivity from April to May?
22. A parcel delivery company delivered 103,000 packages last year, when its average employment was 84 drivers. This year, the firm handled 112,000 deliveries with 96 drivers. What was the percentage change in productivity over the past year?
23. A fast-food restaurant serves hamburgers, cheeseburgers, and chicken sandwiches. The restaurant counts a cheeseburger as equivalent to 1.25 hamburgers and chicken sandwiches as 0.8 hamburger. Current employment is five full-time employees who each work a 40-hour week. If the restaurant sold 700 hamburgers, 900 cheeseburgers, and 500 chicken sandwiches in one week, what is its productivity? What would its productivity have been if it had sold the same number of sandwiches (2,100), but the mix was 700 of each type?

ANALYTICAL EXERCISE: THE CARBON FOOTPRINT QUIZ (LO2-1)

Greenhouse gases have far-ranging environmental and health effects. They cause climate change by trapping heat, and they also contribute to respiratory disease from smog and air pollution. Extreme weather, food supply disruptions, and increased wildfires are other effects of climate change caused by greenhouse gases.

The amount of greenhouse gases, which is mostly carbon dioxide (CO_2), released into the atmosphere by a product is called its carbon footprint. It is usually measured in tons of CO_2 emitted per year.

Assignment

Consider the following six common products that you use each week: a down-filled jacket, a 20-washer-load bottle of laundry detergent, a pair of hiking boots, a half-gallon of milk in a cardboard container, a hybrid compact car, and a six-pack of beer.

1. Before doing any calculations, rank the products from 1 to 6 (where 1 is the smallest carbon footprint and 6 is the largest) based on your best guess of the item's carbon footprint over one full year of usage.
   ____ A down-filled jacket
   ____ A 20-washer-load bottle of laundry detergent
   ____ A pair of hiking boots
   ____ A half-gallon of milk in a cardboard container
   ____ A hybrid compact car
   ____ A six-pack of beer
2. Consider the following additional information about each product.

A down-filled jacket:

Quality Master/Shutterstock

- Most textile products sold in the United States are produced in Asia or Latin America. Fabric may be made in China, zippers made in Japan, and sewing done in Vietnam. Yet all that transportation adds up to less than 1 percent of the product's total carbon footprint.
- About 47 pounds of CO_2 or about 71 percent of the total, is generated from producing the polyester for a jacket, which originates with oil.
- Assume that you buy a new jacket every year.

A 20-washer-load bottle of laundry detergent:

JIANG HONGYAN/Shutterstock

- The 65-ounce bottle can do 20 washer loads of laundry.
- You do about 100 loads of laundry per year, and the detergent accounts for about 3.1 pounds of CO_2 per week.
- The clothes dryer creates the greatest emissions of about 4.4 pounds per load.

A pair of hiking boots:

xMarshall / Alamy Stock Photo

- Transportation of shoes typically accounts for only 5 percent of the carbon footprint even though many companies produce their shoes in Asia and sell them in the United States.
- The materials to make shoes are significant creators of emissions. A total of 106.5 pounds of

CO_2 comes from the raw materials used to make a shoe: rubber for the outsole, ethyl vinyl acetate for the midsole, and leather.

- The average cow from which the leather is made produces an amount of greenhouse gas equivalent to 4 tons of CO_2 every year. Most of that comes not from carbon dioxide, in fact, but from a more potent greenhouse gas: methane.
- A factory used to make boots in China's Guangdong Province produces 8.5 pounds of CO_2 from the electricity used to make a pair of boots.
- You buy a new pair of boots every year.

A half-gallon of milk in a cardboard container:

Jacques Cornell/McGraw Hill

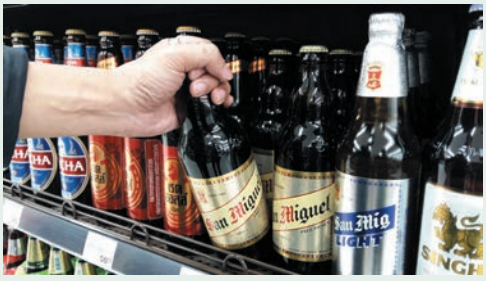
- The single biggest chunk of emissions from milk production, about 25 percent, comes from all that action in the cow's gut that produces methane. Recall from the leather hiking boot data that cows produce 4 tons of CO_2 equivalent per year. An average cow can produce around 6 gallons of milk per day.
- A big difference in milk emissions depends on whether it is sold in plastic or cardboard containers. Plastic containers, because they take more energy to produce, yield about 1.5 pounds more CO_2 than do cardboard ones.
- You drink about a gallon of milk each week.

A hybrid compact car:

CL Shebley/Shutterstock

- For every mile it travels, the average car in the United States emits about 1 pound of carbon dioxide.
- The expected life of a midsize sedan is 120,000 miles. A hybrid compact car can cut emissions by about 60 percent.
- About 4 percent of emissions come from making and assembling a car, 12 percent from materials, and about 25 percent from fuel transportation, car maintenance, and disposal.
- You drive about 20,000 miles per year.

A six-pack of beer:



Koy Hipster/Shutterstock

- For a six-pack of beer, a high proportion of the emissions come from the refrigeration of the beer at stores, almost 2 pounds of CO_2 per six-pack.
- Glass bottle production accounts for almost 22 percent of total emissions, which together with refrigeration make up nearly one-half of the total emissions output.

- Producing the barley and malt and transporting the beer account for the other 50 percent of CO_2 emissions.
- You drink about two six-packs of beer a week.
  a. Calculate the yearly carbon footprint for each of the products based on your usage. Keep in mind that some of the data may not be needed for your calculations.
  b. Compare your initial ranking with the ranking after doing the calculations.
  c. Suggest ways that you could reduce your carbon footprint relative to these six products.

Reference: F. Robert Jacobs and Rhonda R. Lummus, *The Supply Chain Professional,* 2nd ed., Hercher Publishing, 2019, pp. 174–175.

PRACTICE EXAM

1. A strategy that is designed to meet current needs without compromising the ability of future generations to meet their needs.
2. The three criteria included in a triple bottom line.
3. The seven operations and supply chain competitive dimensions.
4. It is probably most difficult to compete on this major competitive dimension.
5. This occurs when a company seeks to match what a competitor is doing while maintaining its existing competitive position.
6. A criterion that differentiates the products or services of one firm from those of another.
7. A screening criterion that permits a firm's products to be considered as possible candidates for purchase.
8. A diagram showing the activities that support a company's strategy.
9. A measure calculated by taking the ratio of output to input.

Answers to Practice Exam 1. Sustainable 2. Social, economic, environmental 3. Cost or price, quality, delivery speed, delivery reliability, coping with changes in demand, flexibility and speed of new-product introduction, other product-specific criteria 4. Cost 5. Straddling 6. Order winner 7. Order qualifier 8. Activity-system map 9. Productivity