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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

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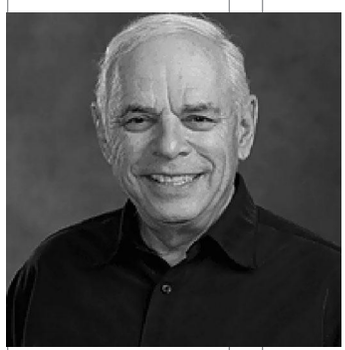

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PREFACE

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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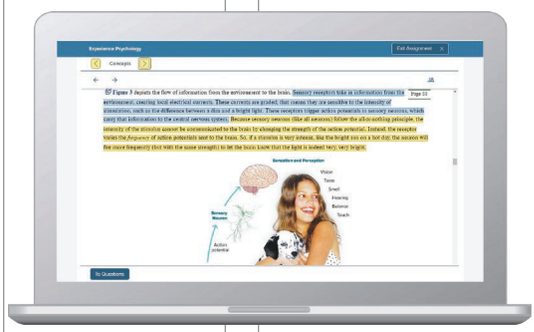

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- Jordan Cunningham, Eastern Washington University

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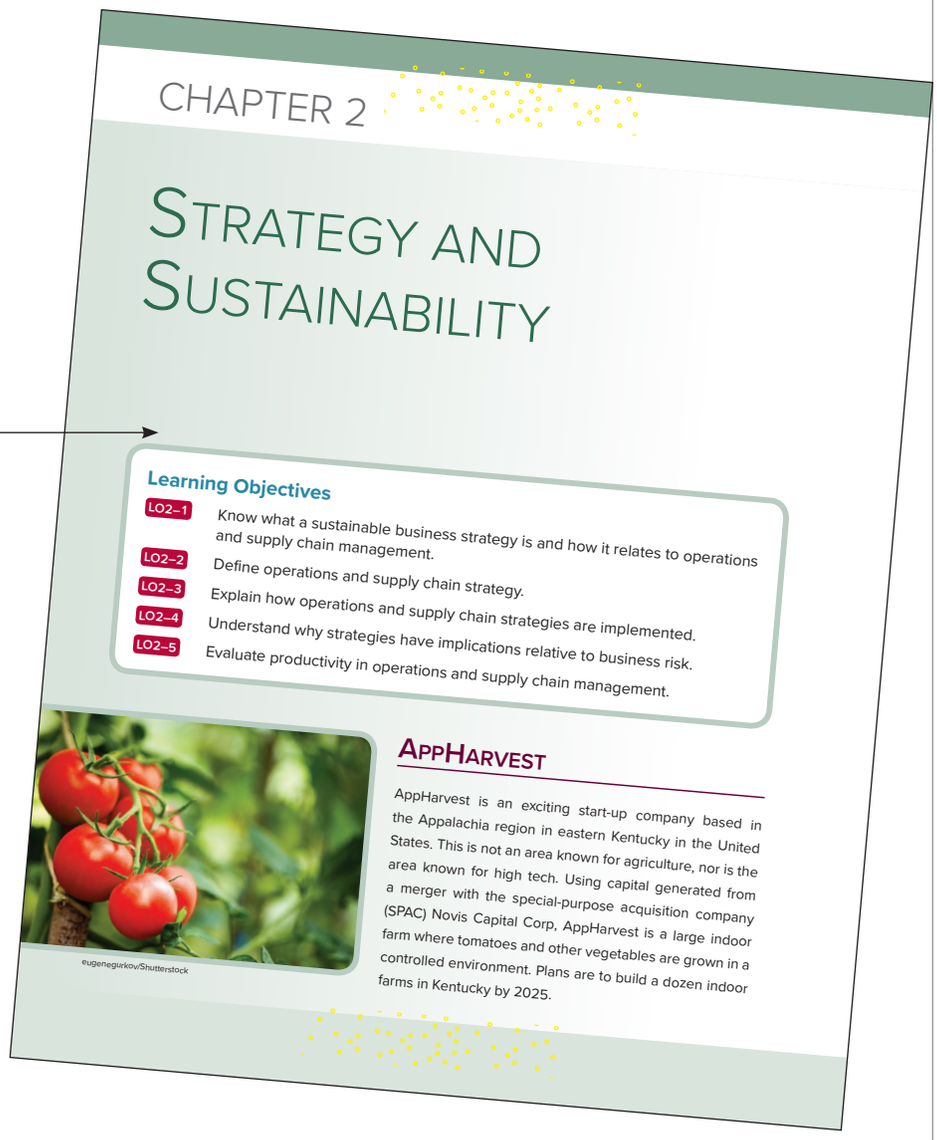
Walkthrough

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

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.

franz12/Shutterstock

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.

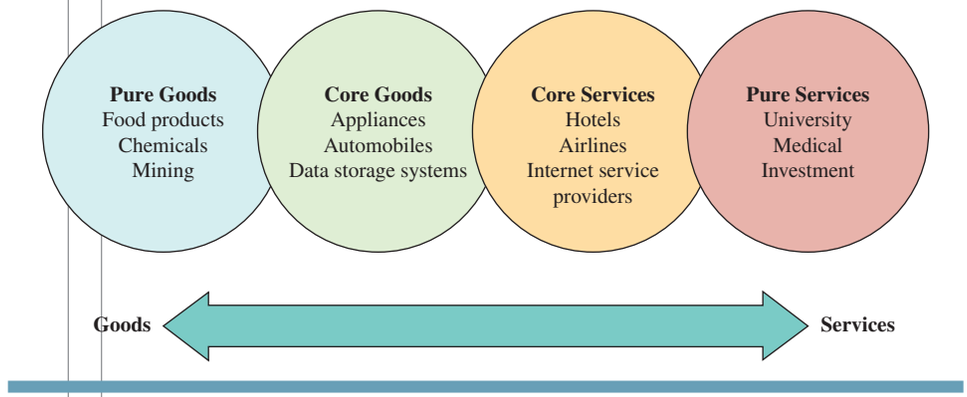
Some firms are focused on services, such as a hospital. Here, the context involves managing resources, including the operating rooms, labs, and hospital beds used to nurse patients back to health. In this context, acquiring materials, moving patients, and coordinating resource use are keys to success. 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 [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
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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 1

Introduction to OSCM

Learning Objectives

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

LO1–2 Evaluate the efficiency of the firm.

LO1–3 Know the potential career opportunities in operations and supply chain management.

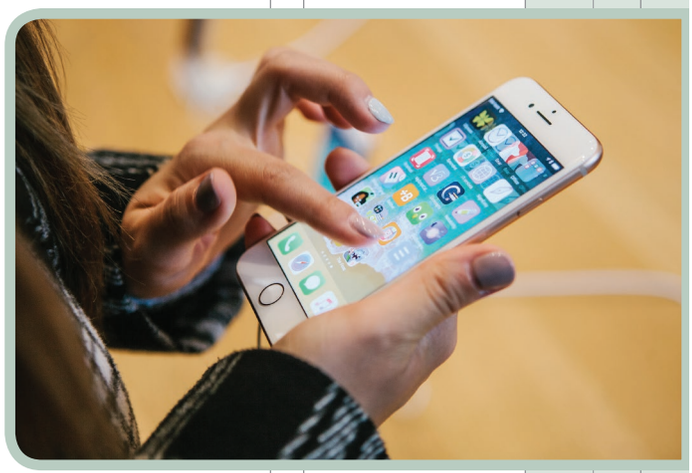
LO1–4 Recognize the major concepts that define the operations and supply chain management field.

STRATEGY, PROCESSES, AND ANALYTICS

This book is about designing and operating processes that deliver a firm's goods and services in a manner that matches customers' expectations. Given the recent disruption caused by Covid-19, we are sure that you now know what supply chains are and are familiar with some of the terminology. Never has OSCM been more important than during the recent Covid-19 pandemic that swept around our planet. Getting emergency supplies and other items needed by humanity was dependent on dramatic and rapid changes to the way the world supplies were directed.

Getting the vaccines produced and distributed to the world has been vital to ending the pandemic. There is little doubt that this historic event has permanently changed the way companies and even nations think about the risk associated with

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.



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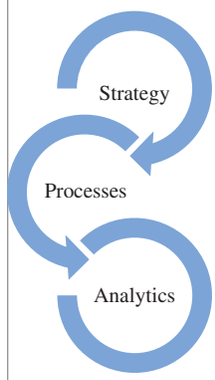
Really successful firms have a clear and focused idea of how they intend to make money. Be it high-end products or services that are custom-tailored to the needs of a single customer, or generic, inexpensive commodities that are bought largely based on cost, competitively producing and distributing these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



deliver the products and services, and analytics that support the ongoing decisions needed to manage the firm. Our goal in this book is to introduce students to basic operations and supply chain concepts so they understand how things should be done and the importance of these functions to the success of the firm.

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

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.

WHAT IS OPERATIONS AND SUPPLY CHAIN MANAGEMENT?

Operations and supply chain management (OSCM) is defined as the design, operation, and improvement of the systems that create and deliver the firm's primary products and services. Like marketing and finance, OSCM is a functional field of business with clear line management responsibilities. OSCM is concerned with the management of the entire system that produces a product or delivers a service. Producing a product, such as the Men's Nylon Supplex Parka, or providing a service, such as a cellular phone account, involves a complex series of transformation processes.

Exhibit 1.1 shows a supply network for a Men's Nylon Supplex Parka sold on websites such as L.L.Bean or Land's End. We can understand the network by looking at the four color-coded paths. The blue path traces the activities needed to produce the Polartec insulation material used in the parkas. Polartec insulation is purchased in bulk, processed to get the proper finish, and then dyed prior to being checked for consistency—or grading—and color. It is then stored in a warehouse. The red path traces the production of the nylon, Supplex, used in the parkas. Using a petroleum-based polymer, the nylon is extruded and drawn into a yarnlike material. From here the green path traces the many steps required to fabricate the clothlike Supplex used to make the parkas. The yellow path shows the Supplex and Polartec material coming together and used to assemble the lightweight and warm parkas. The completed parkas are sent to a warehouse and on to the retailer's distribution center. The parkas are then picked and packed for shipment to individual customers.

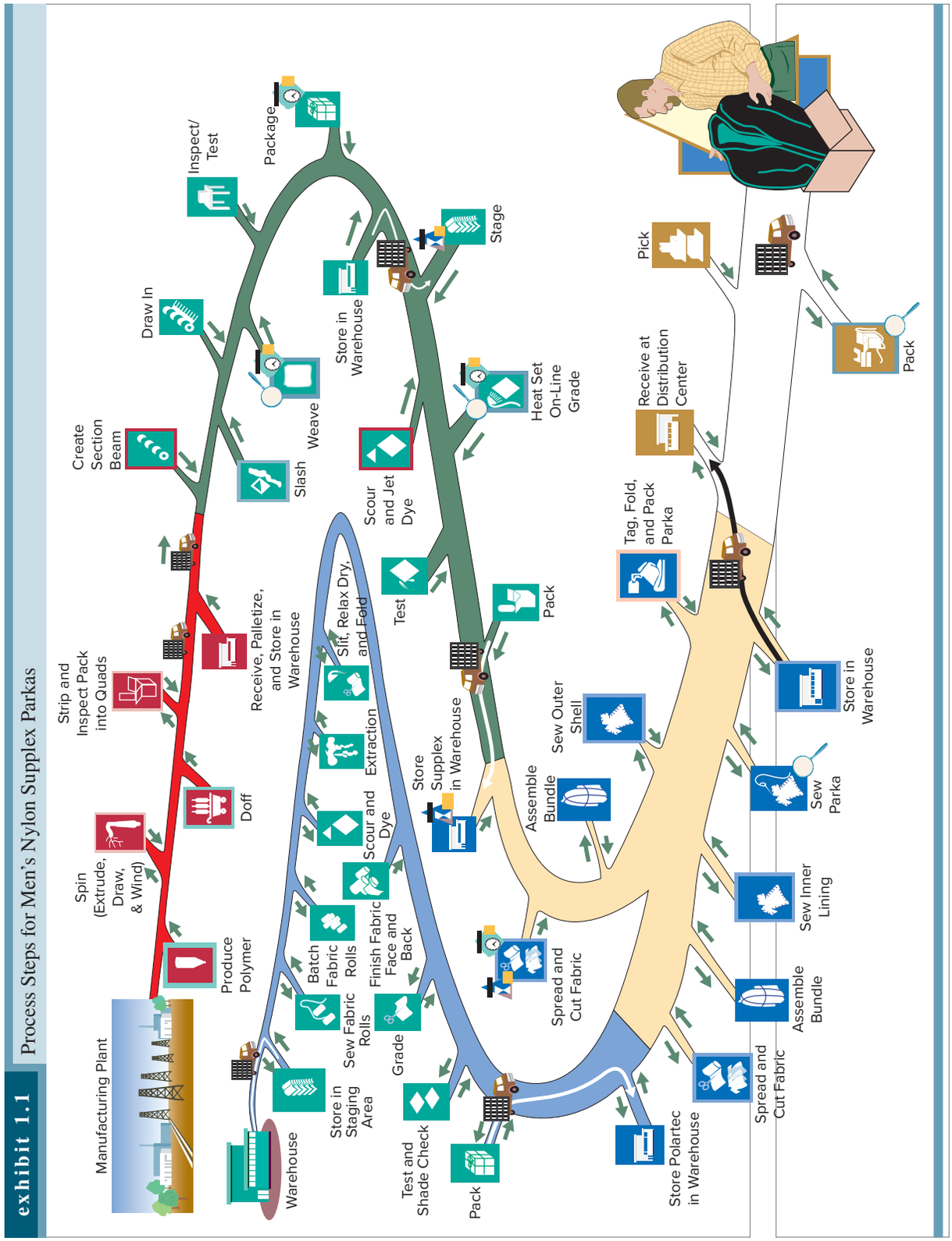
Think of the supply network as a pipeline through which material and information flow. There are key locations in the pipeline where material and information are stored for future use: Polartec is stored near the end of the blue pipeline; Supplex is stored near the end of the red pipeline. In both cases, fabric is cut prior to merging with the yellow pipeline. At the beginning of the yellow path, bundles of Supplex and Polartec are stored prior to their use in the fabrication of the parkas. At the end of the yellow path are the distribution steps, which involve storing to await orders, picking according to the actual customer order, packing, and finally shipping to the customer.

L.L. Bean, Inc.

Networks such as this can be constructed for any product or service. Typically, each part of the network is controlled by different companies, including the nylon Supplex producer, the Polartec producer, the parka manufacturer, and the catalog sales retailer. All of the material is moved using transportation providers, ships and trucks in this case. The network also has a global dimension, with each entity potentially located in a different country.

Success in today's global markets requires a business strategy that matches the preferences of customers with the realities imposed by complex supply networks. A sustainable strategy that meets the needs of shareholders and employees and preserves the environment is critical.

exhibit 1.1 Process Steps for Men's Nylon Supplex Parkas



In the context of our discussion, the terms *operations* and *supply chain* take on special meaning. *Operations* refers to manufacturing and service processes that are used to transform the resources employed by a firm into products desired by customers. For example, a manufacturing process would produce some type of physical product, such as an automobile or a computer. A service process would produce an intangible product, such as a call center that provides information to customers stranded on the highway or a hospital that treats accident victims in an emergency room. Planning the use of these processes involves analyzing capacity, labor, and material needs over time. Ensuring quality and making ongoing improvements to these processes are needed to manage these processes.

Supply chain refers to processes that move information and material to and from the manufacturing and service processes of the firm. These include the logistics processes that physically move product, as well as the warehousing and storage processes that position products for quick delivery to the customer. Supply chain in this context refers to providing products and service to plants and warehouses at the input end and also to the supply of products and service to the customer on the output end of the supply chain.

We consider the topics included in this book to be the foundation or "core" material. Many other topics could be included, but these cover the fundamental concepts. All managers should understand these basic principles that guide the design of transformation processes. This includes understanding how different types of processes are organized, how to determine the capacity of a process, how long it should take a process to make a unit, how the quality of a process is monitored, and how information is used to make decisions related to the design and operation of these processes.

The field of operations and supply chain management is ever changing due to the dynamic nature of competing in global business and the constant evolution of information technology. So while many of the basic concepts have been around for years, their application in new and innovative ways is exciting. Internet technology has made the sharing of reliable real-time information inexpensive. Capturing information directly from the source through such systems as point-of-sale, radio-frequency identification tags, barcode scanners, and automatic recognition has shifted the focus to understanding not only what all the information is saying but how good the decisions are that will use it.

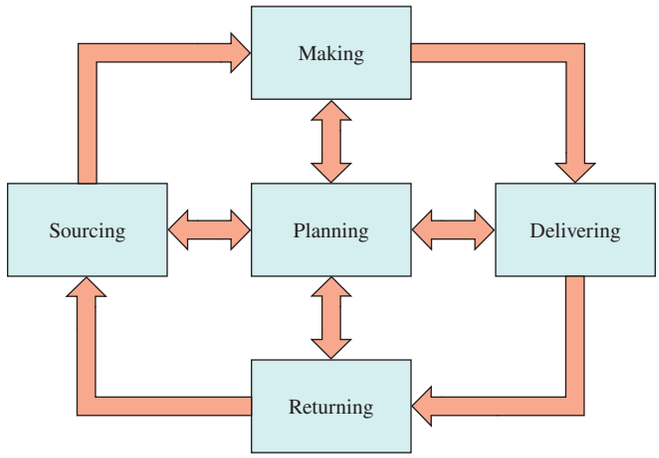
Operations and Supply Chain Processes

Process
One or more activities that transform inputs into outputs.

Operations and supply chain **processes** can be conveniently categorized, particularly from the view of a producer of consumer products and services, as planning, sourcing, making, delivering, and returning. Exhibit 1.2 depicts where the processes are used in different parts of a supply chain. The following describes the work involved in each type of process.

1. **Planning** consists of the processes needed to operate an existing supply chain strategically. Here, a firm must determine how anticipated demand will be met with available resources. A major aspect of planning is developing a set of metrics to monitor the supply chain so that it is efficient and delivers high quality and value to customers.
2. **Sourcing** involves the selection of suppliers that will deliver the goods and services needed to create the firm's product. A set of pricing, delivery, and payment processes are needed together with metrics for monitoring and improving the relationships between partners of the firm. These processes include receiving shipments, verifying them, transferring them to manufacturing facilities, and authorizing supplier payments.

Supply Chain Processes **exhibit 1.2**



3. **Making** is where the major product is produced or the service is provided. The step requires scheduling processes for workers and coordinating material and other critical resources such as the equipment to support producing or providing the service. Metrics that measure speed, quality, and worker productivity are used to monitor these processes.
4. **Delivering** is also referred to as a logistics process. Carriers are picked to move products to warehouses and customers, coordinate and schedule the movement of goods and information through the supply network, develop and operate a network of warehouses, and run the information systems that manage the receipt of orders from customers and the invoicing systems that collect payments from customers.
5. **Returning** involves processes for receiving worn-out, defective, and excess products back from customers and support for customers who have problems with delivered products. In the case of services, this may involve all types of follow-up activities that are required for after-sales support.

To understand the topic, it is important to consider the many different players that need to coordinate work in a typical supply chain. The steps of planning, sourcing, making, delivering, and returning are fine for manufacturing and can also be used for the many processes that do not involve the discrete movement and production of parts. In the case of a service firm such as a hospital, for example, supplies are typically delivered on a daily basis from drug and health care suppliers and require coordination among drug companies, local warehouse operations, local delivery services, and hospital receiving. Patients need to be scheduled into the services provided by the hospital, such as operations and blood tests. Other areas, such as the emergency room, need to be staffed to provide service on demand. The orchestration of all of these activities is critical to providing quality service at a reasonable cost.

Differences between Services and Goods

There are five essential differences between services and goods. The first is that a service is an *intangible* process that cannot be weighed or measured, whereas a good is a tangible output of a process that has physical dimensions. This distinction has important business implications since a service innovation, unlike a product innovation, cannot be patented.

Thus, a company with a new concept must expand rapidly before competitors copy its procedures. Service intangibility also presents a problem for customers since, unlike with a physical product, customers cannot try it out and test it before purchase.

The second is that a service requires some degree of *interaction with the customer* for it to be a service. The interaction may be brief, but it must exist for the service to be complete. Where face-to-face service is required, the service facility must be designed to handle the customer's presence. Goods, on the other hand, are generally produced in a facility separate from the customer. They can be made according to a production schedule that is efficient for the company.

The third is that services, with the big exception of hard technologies such as automated teller machines (ATMs) and information technologies such as answering machines and automated Internet exchanges, are inherently *heterogeneous*—they vary from day to day and even hour by hour as a function of the attitudes of the customers and the servers. Thus, even highly scripted work, such as found in call centers, can produce unpredictable outcomes. Goods, in contrast, can be produced to meet very tight specifications day-in and day-out with essentially zero variability. In those cases where a defective good is produced, it can be reworked or scrapped.

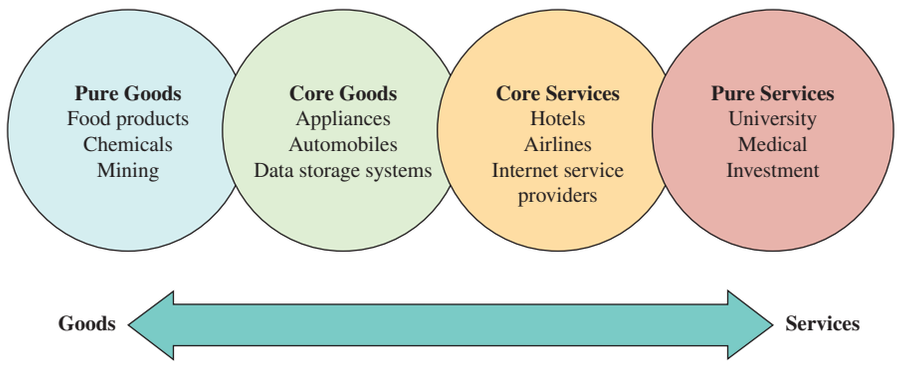
The fourth is that services as a process are *perishable and time dependent*, and unlike goods, they can't be stored. You cannot "come back last week" for an air flight or a day on campus.

And fifth, the specifications of a service are defined and evaluated as a *package of features* that affect the five senses. These features relate to the location, decoration, and layout of the facility where the service is housed, for example. Other features are the training and attitude of employees, and the consistency of service performance. Such attributes as speed, privacy, and security are other features that define a service.

The Goods–Services Continuum

Almost any product offering is a combination of goods and services. In Exhibit 1.3, we show this arrayed along a continuum of "pure goods" to "pure services." The continuum captures the main focus of the business and spans from firms that just produce products to those that only provide services. Pure goods industries have become low-margin commodity businesses, and in order to differentiate, they are often adding some services. Some examples are providing help with logistical aspects of stocking items, maintaining extensive information databases, and providing consulting advice.

exhibit 1.3 The Goods–Services Continuum



Core goods providers already provide a significant service component as part of their businesses. For example, automobile manufacturers provide extensive spare parts distribution services to support repair centers at dealers.

Core service providers must integrate tangible goods. For example, your cable television company must provide cable hookup and repair services and also high-definition cable boxes. Pure services, such as those offered by a financial consulting firm, may need little in the way of facilitating goods, but what they do use—such as textbooks, professional references, and spreadsheets—are critical to their performance.

Product–Service Bundling

Product–service bundling refers to a company building service activities into its product offerings for its customers. Such services include maintenance, spare part provisioning, training, and in some cases, total systems design and R&D. A well-known pioneer in this area is IBM, which treats its business as a service business and views physical goods as a small part of the "business solutions" it provides its customers. Companies that are most successful in implementing this strategy start by drawing together the service aspects of the business under one roof in order to create a consolidated service organization. The service evolves from a focus on enhancing the product's performance to developing systems and product modifications that support the company's move up the "value stream" into new markets. This type of strategy might not be the best approach for all product companies, however. Firms that offer product–service bundles typically generate higher revenues, and they tend to generate lower profits as a percentage of revenues when compared to focused firms. This is because they are often unable to generate revenues or margins high enough to cover the additional investment required to cover service-related costs.

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

EFFICIENCY, EFFECTIVENESS, AND VALUE

LO1–2 Evaluate the efficiency of the firm.

Compared with most of the other ways managers try to stimulate growth—via technology investments, acquisitions, and major market campaigns, for example—innovations in operations are relatively reliable and low cost. As a business student, you are perfectly positioned to come up with innovative operations-related ideas. You understand the big picture of all the processes that generate the costs and support the cash flow essential to the firm's long-term viability.

Through this book, you will become aware of the concepts and tools now being employed by companies around the world as they craft efficient and effective operations. **Efficiency** means doing something at the lowest possible cost. Later in the book, we define this more thoroughly. But roughly speaking, the goal of an efficient process is to produce a good or provide a service by using the smallest input of resources. In general, these resources are the material, labor, equipment, and facilities used in the OSCM processes.

Efficiency
Doing something at the lowest possible cost.

Effectiveness means doing the right things to create the most value for the customer. For example, to be effective at a grocery store, it is important to have plenty of operating checkout lines even though they may often stand idle. This is a recognition that the customer's time is valuable and that they do not like waiting to be served in the checkout line. Often maximizing effectiveness and efficiency at the same time creates conflict between the two goals. We see this trade-off every day in our lives. At the checkout lines, being efficient means using the fewest people possible to ring up customers. Being effective, though, means minimizing the amount of time customers need to wait in line.

Effectiveness
Doing the right things to create the most value for the customer.

Value
The attractiveness of a product relative to its price.

Related to efficiency and effectiveness is the concept of **value**, which can be abstractly defined as quality divided by price. Here quality is the attractiveness of the product, considering its features and durability. If you can provide the customer with a better car without changing price, value has gone up. If you can give the customer a better car at a *lower* price, value goes way up. A major objective of this book is to show how smart management can achieve high levels of value.

How Does Wall Street Evaluate Efficiency?

Investors have great interest in operations and supply chain management since the relative cost of providing a good or service is essential to high earnings growth. When you think about it financially, earnings growth is largely a function of the firm's profitability, and profit can be increased through higher sales and/or reduced cost. Highly efficient firms usually shine when demand drops during recession periods. They often can continue to make a profit due to their low-cost structure. These operations-savvy firms may even see a recession as an opportunity to gain market share as their less-efficient competitors struggle to remain in business.

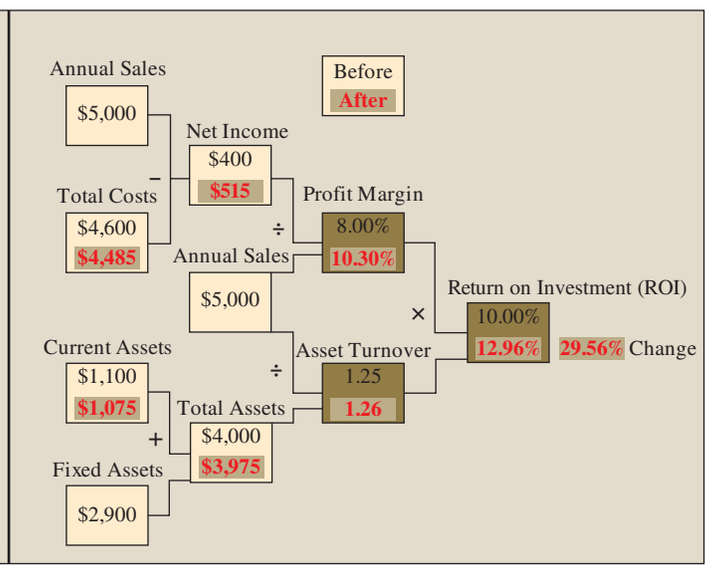
The relationships between the cost, profit margin, and return on assets (ROA) are direct. Reducing the cost of raw materials, for example, might be a typical OSCM focus. Consider a firm that can reduce raw material costs by 5 percent. This reduction should reduce both the operating costs and the assets of the firm, thus improving profit margin, asset turnover, and the firm return on assets (ROA). For the example shown in Exhibit 1.4, the 5 percent reduction leads to a nearly 29 percent increase in profit margin and a 30 percent increase in the company's ROA—thus, in this case an almost 6:1 return for every dollar saved by reducing raw materials costs.

Benchmarking
When one company studies the processes of another company to identify best practices.

Benchmarking is a process in which the processes of companies are compared to identify best practices. Wall Street uses a set of financial indications that are called management efficiency ratios to benchmark companies.

exhibit 1.4 The Impact of Reducing Raw Material Cost

		Before	After	Change
Operating Data	Annual Sales	$5,000	$5,000	
	Labor	$700	$700	
	Materials	$2,300	**$2,185**	–5.00%
	Overhead	$800	$800	
	COGS	$3,800	$3,685	
	Other Costs	$800	$800	
	Total Costs	$4,600	**$4,485**	
Assets	Inventory	$500	**$475**	–5.00%
	Receivables	$300	$300	
	Cash	$300	$300	
	Current Assets	$1,100	$1,075	
	Fixed Assets	$2,900	$2,900	
	Total Assets	$4,000	**$3,975**	



Efficiency at Southwest Airlines

Getting passengers on a plane quickly can greatly affect an airline's costs. Southwest, considered the fastest at turning a plane around, does not assign seats. For Southwest, the goal is to have its airplanes in the air as much as possible. This is difficult, given the multiple short flights that a Southwest jet flies each day.

Southwest has over 700 jets that average just over five flights per day. Turning a jet around—from landing to takeoff—is critical to this type of airline, and it has been estimated that Southwest can do this in between 30 and 55 minutes, depending on the airport and plane. Think about this: even at 45 minutes per turn, a Southwest jet still spends about 3.75 hours on the ground each day being serviced. The precious minutes that Southwest can save in loading passengers results in more flights the airline can fly.

F. Robert Jacobs

CAREERS IN OPERATIONS AND SUPPLY CHAIN MANAGEMENT

LO1–3 Know the potential career opportunities in operations and supply chain management.

So what do people who pursue careers in OSCM do? Quite simply, they specialize in managing the planning, production, and distribution of goods and services. Jobs abound for people who can do this well since every organization is dependent on effective performance of this fundamental activity for its long-term success.

It is interesting to contrast entry-level jobs in OSCM to marketing and finance jobs. Many marketing entry-level jobs focus on actually selling products or managing the sales of products. These individuals are out on the front line trying to push product to potential customers. Frequently, a significant part of their income will depend on commissions from these sales. Entry-level finance (and accounting) jobs are often in large public accounting firms. These jobs involve working at a desk auditing transactions to ensure the accuracy of financial statements. Other assignments involve the analysis of transactions to better understand the costs associated with the business.

Contrast the marketing and finance jobs to OSCM jobs. The operations and supply chain manager is out working with people to figure out the best way to deliver the goods and services of the firm. Sure, OSCM people work with the marketing folks, but rather than being on the selling side, they are on the buying side: trying to select the best materials and hiring the greatest talent. They will use the data generated by the finance people and analyze processes to figure out how to produce those goods and services. OSCM jobs are hands-on, working with people and figuring out the best way to do things.

The following are some typical jobs in OSCM:

- Plant manager—Oversees the workforce and physical resources (inventory, equipment, and information technology) required to produce the organization's product.

- Hospital administrator—Oversees human resource management, staffing, and finances at a health care facility.
- Branch manager (bank)—Oversees all aspects of financial transactions at a branch.
- Department store manager—Oversees all aspects of staffing and customer service at a store.
- Call center manager—Oversees staffing and customer service activities at a call center.
- Supply chain manager—Negotiates contracts with vendors and coordinates the flow of material inputs to the production process and the shipping of finished products to customers.
- Purchasing manager—Manages the day-to-day aspects of purchasing, such as invoicing and follow-up.
- Logistics manager—Oversees the movement of goods throughout the supply chain.
- Warehouse/Distribution manager—Oversees all aspects of running a warehouse, including replenishment, customer order fulfillment, and staffing.
- Business process improvement analyst—Applies the tools of lean production to reduce cycle time and eliminate waste in a process.
- Quality control manager—Applies techniques of statistical quality control, such as acceptance sampling and control charts, to the firm's products.
- Lean improvement manager—Trains organizational members in lean production and continuous improvement methods.
- Project manager—Plans and coordinates staff activities, such as new-product development, new-technology deployment, and new-facility location.
- Production control analyst—Plans and schedules day-to-day production.
- Facilities manager—Ensures that the building facility design, layout, furniture, and other equipment are operating at peak efficiency.

Chief Operating Officer

So how far can you go in a career in OSCM? One goal would be to become the chief operating officer (COO) of a company. The COO works with the chief executive officer (CEO)

Spotlight on an OSCM Professional

This 28-Year-Old Supply Chain Manager Lives on $227,000 a Year in London.

So how would this path to the Chief Operating Officier start? Recently, a supply chain graduate of Arizona State was featured in the CNBC *Make IT Millennial Money* series. Imani Change, age 28, was raised in Oak Park, Illinois, a suburb of Chicago, and began saving for college at age 5. She grew up understanding the value of money and the importance of working hard. She earned a bachelor's degree in supply chain management at Arizona State University and landed her first job with a technology company in Baltimore, Maryland.

After only five years with her company, a new work opportunity came along. The new opportunity gave her the chance to move to London, along with a promotion and a great salary. She never thought that she could advance to senior operations manager so quickly. She is paid both a base salary and restricted stock shares, so what she makes is dependent on the value of the stock she is awarded each year.

Imani has a career and financial plan to become a millionaire by age 30 and to own a house by age 33.

and company president to determine the company's competitive strategy. The COO's ideas are filtered down through the rest of the company. COOs determine an organization's location, its facilities, which vendors to use, and how the hiring policy will be implemented. Once the key decisions are made, lower-level operations personnel carry them out. Operations personnel work to find solutions and then set about fixing the problems. Managing the supply chain, service, and support are particularly challenging aspects of a chief operating officer's job.

Career opportunities in OSCM are plentiful today as companies strive to improve profitability by improving quality and productivity and reducing costs. The hands-on work of managing people is combined with great opportunities to leverage the latest technologies in getting the job done at companies around the world. No matter what you might do for a final career, your knowledge of OSCM will prove to be a great asset.

HISTORICAL DEVELOPMENT OF OPERATIONS AND SUPPLY CHAIN MANAGEMENT

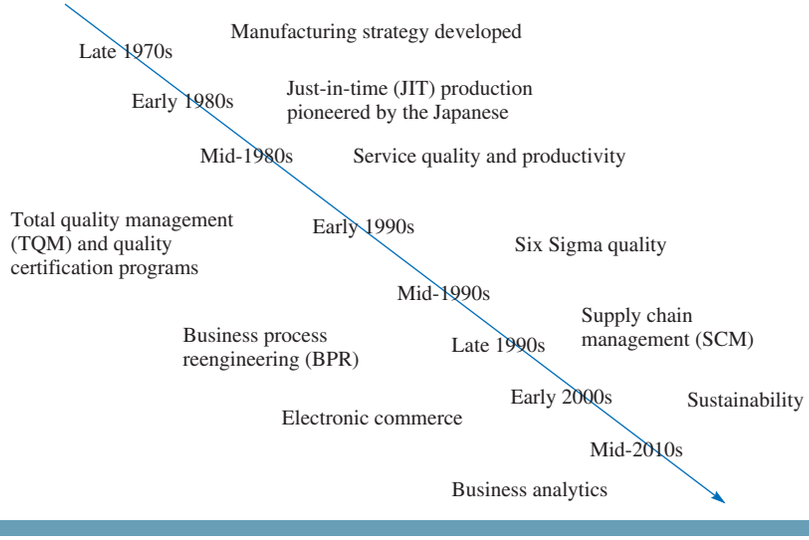
LO1–4 Recognize the major concepts that define the operations and supply chain management field.

Our purpose in this section is not to go through all the details of OSCM; that would require us to recount the entire Industrial Revolution. Rather, the focus is on major operations-related concepts that have been popular since the 1980s. Exhibit 1.5 will help clarify the dates as you read about the concepts. Where appropriate, how a supposedly new idea relates to an older idea is discussed. (We seem to keep rediscovering the past.)

Manufacturing strategy
Emphasizes how a factory's capabilities could be used strategically to gain advantage over a competing company.

Manufacturing Strategy Paradigm The late 1970s and early 1980s saw the development of the **manufacturing strategy** paradigm, which emphasized how manufacturing executives could use their factories' capabilities as strategic competitive weapons. Central

exhibit 1.5 Time Line Depicting When Major OSCM Concepts Became Popular



Just-in-time (JIT) An integrated set of activities designed to achieve high-volume production using minimal inventories of parts that arrive exactly when they are needed.

Total quality control (TQC) Aggressively seeks to eliminate causes of production defects.

Lean manufacturing Term used to refer to the set of concepts relating to JIT and TQC.

Total quality management (TQM) Managing the entire organization so that it excels on all dimensions of products and services that are important to the customer.

Business process reengineering (BPR) An approach to improving business processes that seeks to make revolutionary changes as opposed to evolutionary (small) changes.

Six Sigma A statistical term to describe the quality goal of no more than 3.4 defects out of every million units. Also refers to a quality improvement philosophy and program.

Mass customization The ability to produce a unique product exactly to a particular customer's requirements.

to this thinking was the notion of manufacturing trade-offs among such performance measures as low cost, high quality, and high flexibility.

Lean Manufacturing, JIT, and TQC The 1980s saw a revolution in the management philosophies and technologies by which production is carried out. **Just-in-time (JIT)** production was the major breakthrough in manufacturing philosophy. Pioneered by the Japanese, JIT is an integrated set of activities designed to achieve high-volume production using minimal inventories of parts that arrive exactly when they are needed. The philosophy—coupled with **total quality control (TQC)**, which aggressively seeks to eliminate causes of production defects—is now a cornerstone in many manufacturers' production practices, and the term **lean manufacturing** is used to refer to the set of concepts.

Service Quality and Productivity The unique approach to quality and productivity by McDonald's has been so successful that it stands as a reference point in thinking about how to deliver high-volume standardized services.

Total Quality Management and Quality Certification Another major development was the focus on **total quality management (TQM)** in the late 1980s and 1990s. Helping the quality movement along was the Baldrige National Quality Award, started in 1987 under the direction of the National Institute of Standards and Technology. The Baldrige Award recognizes companies each year for outstanding quality management systems.

The ISO 9000 certification standards, created by the International Organization for Standardization, now play a major role in setting quality standards for global manufacturers.

Business Process Reengineering The need to become lean to remain competitive in the global economic recession in the 1990s pushed companies to seek innovations in the processes by which they run their operations. The **business process reengineering (BPR)** approach seeks to make revolutionary changes as opposed to evolutionary changes (which are commonly advocated in TQM). It does this by taking a fresh look at what the organization is trying to do in all its business processes, and then eliminating non-value-added steps and computerizing the remaining ones to achieve the desired outcome.

Six Sigma Quality Originally developed in the 1980s as part of total quality management, **Six Sigma** in the 1990s saw a dramatic expansion as an extensive set of diagnostic tools was developed. These tools have been taught to managers as part of "Green and Black Belt Programs" at many corporations. The tools are now applied not only to the well-known manufacturing applications, but also to nonmanufacturing processes such as accounts receivable, sales, and research and development. Six Sigma has been applied to environmental, health, and safety services at companies and is now being applied to research and development, finance, information systems, legal, marketing, public affairs, and human resource processes.

Supply Chain Management The central idea of supply chain management is to apply a total system approach to managing the flow of information, materials, and services from raw material suppliers through factories and warehouses to the end customer. Trends such as outsourcing and **mass customization** are forcing companies to find flexible ways to meet customer demand. The focus is on optimizing core activities to maximize the speed of response to changes in customer expectations.

Electronic Commerce The quick adoption of the Internet and the World Wide Web during the late 1990s was remarkable. The term **electronic commerce** refers to the use of the Internet as an essential element of business activity. The use of web pages, forms, and interactive search engines has changed the way people collect information, shop, and communicate. It has changed the way operations managers coordinate and execute production and distribution functions.

Sustainability and the Triple Bottom Line **Sustainability** is the ability to maintain balance in a system. Management must now consider the mandates related to the ongoing economic, employee, and environmental viability of the firm (the **triple bottom line**). Economically, the firm must be profitable. Employee job security, positive working conditions, and development opportunities are essential. The need for nonpolluting and nonresource-depleting products and processes presents new challenges to operations and supply managers.

Business Analytics **Business analytics** involves the analysis of data to better solve business problems. Not that this is something new. Data have always been used to solve business problems. What is new is the reality that so much more data are now captured and available for decision-making analysis than were available in the past. In addition, mathematical tools are now readily available that can be used to support the decision-making process.

In the past, most analysis involved the generation of standard and ad hoc reports that summarized the current state of the firm. Software allowed querying 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. These mathematical results can be used either to support the decision maker or to automate decision making.

Take, for example, an airline manager presented with the task of setting price points for tickets on a flight. Real-time demand data, historic demand patterns, and powerful mathematical models can now be applied to setting price points for different classes of tickets. As it is closer to the time of departure for a particular flight, these price points can be adjusted based on how sales are going. These decisions have a major impact on the utilization of aircraft capacity, which impacts both revenue and costs for the airlines. These decisions can even be made using criteria related to weather conditions, fuel prices, crew schedules, and other flights to maximize the profit of the firm.

SOUTHWEST AIRLINES MANAGER MONITORING FLIGHTS AND PASSENGERS TO DECIDE PRICING.
Erik S.Lesser/EPA/REX/Shutterstock

Electronic commerce
The use of the Internet as an essential element of business activity.

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

Triple bottom line
A business strategy that includes social, economic, and environmental criteria.

Business analytics
The use of current business data to solve business problems using mathematical analysis.

Current Issues in Operations and Supply Chain Management

OSCM is a dynamic field, and issues arising in global enterprise present exciting new challenges for operations and supply chain managers. Looking forward to the future, we believe the major challenges in the field will be as follows:

1. **Adapting to rapidly changing global business relationships.** For years, China and other Asian suppliers have successfully excelled at the production of low-cost products that have been exported to world markets. This has caused economic trade imbalances that some world leaders consider a problem. The rebalancing of this trade will present major challenges to companies in the future.
2. **Accommodating the shift to online retail purchasing.** Consumers are rapidly adopting shopping and purchasing practices that make use of online offerings. The challenges presented to companies as they adapt to this change are significant. These changes require the physical reconfiguration of retail stores, warehouses, and other facilities.
3. **Optimizing global supplier, production, and distribution networks.** As business practices change, optimization of the OSCM networks will become an ongoing activity. New analytics that make use of real-time data and artificial intelligence will become common.
4. **The speedy adoption of new technology and automation.** In virtually every aspect of OSCM, technology will be increasingly more important to remaining competitive. More employees will work from home. Trucks that use automatic driving features and platooning will become common. Robots that automate tasks such as cooking pizzas and making hamburgers will become affordable. These are just a few examples; there will be thousands of new technologies introduced each year. Keeping up with all the new technologies and adopting them quickly will be a major challenge for companies.

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.

LO1–2 **Evaluate the efficiency of the firm.**

Criteria that relate to how well the firm is doing include:

- Efficiency
- Effectiveness
- Value created in its products and services

Efficiency Doing something at the lowest possible cost.

Effectiveness Doing the right things to create the most value for the customer.

Value The attractiveness of a product relative to its price.

Benchmarking When one company studies the processes of another company to identify best practices.

LO1–3 Know the potential career opportunities in operations and supply chain management.

- OSCM people specialize in managing the production of goods and services.
- OSCM jobs are hands-on and require working with others and figuring out the best way to do things.
- The chief operating officer (COO) works with the chief executive officer (CEO) and company president to determine the company's competitive strategy.
- COOs determine an organization's location, its facilities, which vendors to use, and how the hiring policy will be implemented.

LO1–4 Recognize the major concepts that define the operations and supply chain management field.

Many of the concepts that form the OSCM field have their origins in the Industrial Revolution in the 1800s. The focus of this book is on popular concepts developed since the 1980s.

These concepts include:

Manufacturing strategy Emphasizes how a factory's capabilities could be used strategically to gain advantage over a competing company.

Just-in-time (JIT) An integrated set of activities designed to achieve high-volume production using minimal inventories of parts that arrive exactly when they are needed.

Total quality control (TQC) Aggressively seeks to eliminate causes of production defects.

Lean manufacturing Term used to refer to the set of concepts relating to JIT and TQC.

Total quality management (TQM) Managing the entire organization so that it excels on all dimensions of products and services that are important to the customer.

Business process reengineering (BPR) An approach to improving business processes that seeks to make revolutionary changes as opposed to evolutionary (small) changes.

Six Sigma A statistical term to describe the quality goal of no more than 3.4 defects out of every million units. Also refers to a quality improvement philosophy and program.

Mass customization The ability to produce a unique product exactly to a particular customer's requirements.

Electronic commerce The use of the Internet as an essential element of business activity.

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

Triple bottom line A business strategy that includes social, economic, and environmental criteria.

Business analytics The use of current business data to solve business problems using mathematical analysis.

DISCUSSION QUESTIONS

LO1–1

1. Using Exhibit 1.2 as a model, describe the source-make-deliver-return relationships in the following systems:
   a. An airline
   b. An automobile manufacturer
   c. A hospital
   d. An insurance company
2. Define the service package of your college or university. What is its strongest element? Its weakest one?
3. What service industry has impressed you the most with its innovativeness?
4. What is product–service bundling, and what are the benefits to customers?
5. What is the difference between a service and a good?

LO1–2

6. Some people tend to use the terms *effectiveness* and *efficiency* interchangeably, though we have seen they are different concepts. But is there any relationship at all between them? Can a firm be effective but inefficient? Very efficient but essentially ineffective? Both? Neither?
7. Two of the efficiency ratios mentioned in the chapter are the *asset turnover* and the *return on assets*. While they are two separate measures, they are similar. What bit of data is used in one measure but not the other?

LO1–3

8. Look at the job postings at **jobs.apics.org** and evaluate the opportunities for an OSCM major with several years of experience.

LO1–4

9. Recent outsourcing of parts and services that had previously been produced internally is addressed by which current issue facing operation management today?
10. What factors account for the amazing interest in OSCM today?
11. As the field of OSCM has advanced, new concepts have been applied to help companies compete in a number of ways, including the advertisement of the firm's products or services. One recent concept to gain the attention of companies is promoting *sustainability.* Discuss how you have seen the idea of sustainability used by companies to advertise their goods or services.

OBJECTIVE QUESTIONS

LO1–1

1. What are the three elements that require integration to be successful in operations and supply chain management?
2. Operations and supply chain management is concerned with the design and management of the entire system that has what function?

LO1–2

3. Consider the following financial data from the past year for Midwest Outdoor Equipment Corporation.

Annual sales	24,324,000
Net income	2,975,000
Cost of goods sold	12,600,000
Total assets	10,550,000
Inventory	2,875,000
Receivables	3,445,000

   a. Compute the *profit margin.*
   b. Compute the *asset turnover ratio.*
   c. Compute the *return on assets ratio.*

4. The Midwest Outdoor Equipment Corporation (see question 3) has entered into a new contract with a major supplier of raw materials used in the manufacturing process. Under the new arrangement, called *vendor managed inventory,* the supplier manages its raw material inventory inside the manufacturer's plant and bills only the manufacturer when the manufacturer consumes the raw material. This is expected to reduce total assets by $2 million. What is the expected change in *return on assets*?
5. What is the name of the process in which one company studies the processes of another firm to identify best practices?
6. A company has recently implemented an automated online billing and payment processing system for orders it ships to customers. As a result, it has reduced receivables by $500,000. What would be the expected directional change in the *asset turnover* ratio?

LO1–3

7. Match the following OSCM job titles with the appropriate duties and responsibilities.

_____ Plant manager	A. Plans and coordinates staff activities such as new-product development and new-facility location.
_____ Supply chain manager	B. Oversees the movement of goods throughout the supply chain.
_____ Project manager	C. Oversees the workforce and resources required to produce the firm's products.
_____ Business process improvement analyst	D. Negotiates contracts with vendors and coordinates the flow of material inputs to the production process.
_____ Logistics manager	E. Applies the tools of lean production to reduce cycle time and eliminate waste in a process.

8. What high-level OSCM manager is responsible for working with the CEO and company president to determine the company's competitive strategy?

LO1–4

9. Order the following major concepts that have helped define the OSCM field on a time line. Use 1 for the earliest concept to be introduced, and 5 for the most recent.

_____ Supply chain management
_____ Manufacturing strategy
_____ Business analytics
_____ Total quality management
_____ Electronic commerce

10. Which major OSCM concept can be described as an integrated set of activities designed to achieve high-volume production using minimal inventories of parts that arrive at workstations exactly when they are needed?
11. _____ leverage the vast amount of data in enterprise resource planning systems to make decisions related to managing resources.
12. Which current issue in OSCM relates to the ability of a firm to reconfigure its retail stores, warehouses, and other facilities?

ANALYTICS EXERCISE: THE SUPPLY CHAIN IMPROVEMENT MODEL

Improving a company's operations and supply chain is an ongoing job. New ways to make things, to move goods, and to interact with customers, along with a myriad of other opportunities, become available. The challenge is determining where the operations and supply chain managers should focus. Some changes will result in less objective improvements like the quality of a material finish, or a change in the shape of a product. Other improvements can be evaluated analytically such as speeding the delivery process or reducing the failure rate of a part. One uniform criterion that can be used is the financial impact of a potential improvement. This is the focus of *The Supply Chain Improvement Model (SCIM).*

The SCIM is a mathematical version of the diagram shown in Exhibit 1.4. The model consists of a few simple linear equations that capture the relationships in the diagram. Many of these types of models are described in this book. Where possible, the equations are kept simple and intuitive so they can be easily understood and remembered. The best way to analyze a model is with a spreadsheet, since the equations can be easily captured in the formulas.

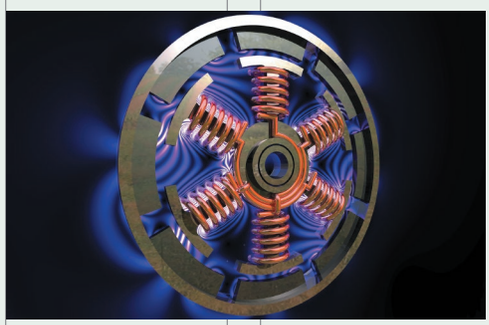
The ability to evaluate the potential financial impact of an OSCM change is the goal of the SCIM. For a public company striving to improve profitability for its shareholders, the ability to predict this impact is important. Using this approach to evaluate a decision is probably not new to you, but a fresh emphasis on how OSCM influences outcomes is the purpose here.

The SCIM uses base data from a company's income statement and the balance sheet. The focus here is on data that is largely dependent on OSCM functions in the firm. From the income statement: Annual sales, Labor, Material, Overhead, and Other costs (typically Sales and Administrative cost) accounts are used. From the balance sheet: Cash, Inventory, Receivables, Fixed assets (these are typically Plant, Equipment, and other assets needed to support OSCM functions), are used.

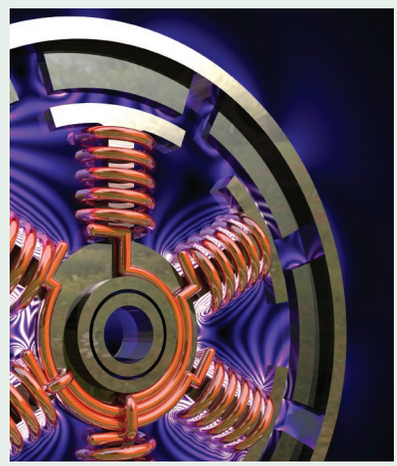
The following are equations that relate these accounts:

Cost of good sold = Labor + Material + Overhead
Total costs = Cost of goods sold + Other costs
Net income = Annual sales − Total costs
Current assets = Inventory + Receivables + Cash
Total assets = Current assets + Fixed assets
Profit margin = Net income/Annual sales
Asset turnover = Annual sales/Total assets
Return on assets (ROA) = Profit margin × Asset turnover

The following scenario has been developed for analysis using the SCIM. The scenario uses estimates of data like what a company such as Tesla might face. Tesla, as you know, is an innovation leader in the development of electric vehicles and clean energy products. The firm manufactures electric vehicles, battery storage devices, and solar panel roof tiles. Tesla management is presented with many opportunities in their ongoing quest to lead the clean energy charge.



Paul Nylander



Paul Nylander

Ken Wolter/Shutterstock

THE TESLA LOGO—THE "T" IS A CROSS-SECTION OF AN ELECTRIC MOTOR.

Base Data–Setting Up the Current Financial Position of the Firm

The first step in the SCIM analysis is to establish the current position of the firm. To analyze the attractiveness of changes, you must first understand how things currently look. The data used here are a simplified version of a recent Tesla annual financial statement. As noted, this is just a starting point for the exercise. The actual scenarios developed are fictitious and for teaching purposes. It is fun to speculate what Tesla might be thinking about, and you will be encouraged to think about this later in the exercise.

The current financial data for our company, eCar, are shown in Exhibit 1.6. The sales and expenses shown in the exhibit are those that relate to the operations of eCar. Our company sells and leases cars and provides other services that relate to repair and maintenance. There are other expense items reported by the company that relate to research, development, selling, and other administrative costs.

The information shown in Exhibit 1.6 is typical of reporting required of publicly traded companies. These reports are filed both quarterly and annually and are closely followed by analysts. The reports are accompanied by extensive notes that explain the information shown in the reports. Companies are not required to report some of the details that might be of interest to an OSCM professional, such as direct material and labor expense. These details are summarized in the COGS entries. Of course, if you work for the company, the details will probably be available for your analysis.

In the following steps, you will be asked to analyze the impact of proposed projects relative to profit margin, asset turnover, and return on investment.

1. **Set up the spreadsheet with the SCIM equations.** To get started, setup a spreadsheet with the data in Exhibit 1.6. In your spreadsheet, make sure to calculate the totals that are given in the exhibit. For example, *Total automotive sales* is the sum of *Automotive sales* and *Automotive leasing*. Further, *Total sales* is the sum of *Total automotive sales,* and *Services and other*. The idea is to make the spreadsheet capture potential changes in the detail accounts. So, if *Automotive sales* changes, the *Total automotive sales* and *Total sales* number automatically change to reflect the update.
   a. Using the data in Exhibit 1.6 and your spreadsheet, calculate the profit margin, asset turnover,

exhibit 1.6 Current Yearly Financials ($millions) for eCar

Annual Sales	
Automobile sales	$19,952
Automotive leasing	869
Total automotive sales	20,821
Services and other	3,226
Total sales	$24,578
Cost of Goods Sold (COGS)	
Automotive sales	$15,939
Automotive leasing	459
Total automotive COGS	$16,398
Services and other	2,770
Total COGS	$20,509
Other Costs	
Research and development	$ 1,343
Selling, general and administrative	2,646
Restructuring and other	149
Total other costs	$ 4,138
Current Assets	
Inventory	$ 3,552
Receivables	1,324
Cash	7,227
Total current assets	$12,103
Fixed Assets	
Property, plant, and equipment	$10,396
Other	11,810
Total fixed assets	$22,206

and return on assets of the company as presented in Exhibit 1.6. (*Hint:* Profit margin and return on assets are negative.)

b. To better understand how the SCIM works, complete the following table. Assume that the change suggested is only to the single account, and the other accounts are the same as presented in Exhibit 1.6. The change can be described in simple "up," "down," or "does not change" terms.

Change	Profit Margin	Asset Turnover	Return on Assets
Automotive sales increase by 25% (no changes in other costs).			
Research and development costs decrease by 50%.			
The investment in inventory is reduced by 50%.			
The company builds a new plant that cost $3 billion.			
Receivables are reduced.			

2. **Analyze the impact of the increase in sales over the next year.**
   eCar expects that automobile sales will increase significantly over the next year. During the year covered by the data in Exhibit 1.6, eCar produced and delivered about 370,000 cars. eCar expects that sales will increase to about 450,000 cars next year. Consider the following questions related to the impact of this increase in sales.
   a. Using your spreadsheet, calculate the average revenue (sales price) and cost of each car produced last year. Base the cost estimate on the *automotive sales COGS* (this reflects the variable cost for each car).
   b. Assume that the relationships between average revenue and cost stay the same next year (revenue/car and variable cost/car stay the same) and that nothing else changes in the financials. If sales do improve to 450,000 cars, what would be the expected profit margin, asset turnover, and return on assets if it were possible for the company to do this?
   c. What questions might you explore with management to evaluate the assumptions that were made in your calculations?
3. **Analyze the impact of building a more efficient manufacturing plant.**
   eCar recognizes that their current manufacturing plant is not very efficient. Investing in their plant would allow greater use of robots and other automation, thus reducing the cost to produce cars. This would be a major change for the company and would have broad implications for their financials. They anticipate that they could use their current cash to pay for the investment. Management also expects to raise the average revenue on each car to $65,000 by offering more options. They expect the average cost to build the cars to go down to $40,000 per car. This reduction is due to the reduction of some labor and better integration of the electronics in the car. They expect to be able to sell 450,000 cars next year.
   a. Return to the original data given in Exhibit 1.6. Assume that they use $2 billion of their cash and invest it in new equipment. Also, assume that they can raise the average revenue and lower the average cost as stated previously. What would be the expected profit margin, asset turnover, and return on assets for the company after the change?
   b. Looking at different worst- and best-case scenarios is often good. What if eCar can only increase the revenue per car to $58,000 and only reduce the cost to $42,000? What would be the expected profit margin, asset turnover, and return on assets if this happened (assume they make the investment in the equipment)?
   c. What questions might you explore with management to evaluate the assumptions that were made in your calculations?

PRACTICE EXAM

1. The pipelinelike movement of the materials and information needed to produce a good or service.
2. A strategy that meets the needs of shareholders, and employees, and that preserves the environment.
3. The processes needed to determine the set of future actions required to operate an existing supply chain.
4. The selection of suppliers.
5. A type of process where a major product is produced or a service is provided.
6. A type of process that moves products to warehouses or customers.
7. Processes that involve the receiving of worn-out, defective, and excess products returned by customers and support for customers who have product problems.
8. A business where the major product is intangible, meaning it cannot be weighed or measured.
9. When a company builds service activities into its product offerings.
10. Doing something at the lowest possible cost.
11. Doing the right things to create the most value for the company.
12. Metaphorically defined as quality divided by price.
13. A philosophy that aggressively seeks to eliminate the causes of production defects.
14. An approach that seeks to make revolutionary changes, as opposed to evolutionary changes (which is advocated by total quality management).
15. An approach that combines TQM and JIT.
16. Tools that are taught to managers in "Green and Black Belt Programs."

Answers to Practice Exam 1. Supply (chain) network 2. Triple bottom line strategy 3. Planning 4. Sourcing 5. Making 6. Delivery 7. Returning 8. Service 9. Product–service bundling 10. Efficiency 11. Effectiveness 12. Value 13. Total quality control 14. Business process reengineering 15. Lean manufacturing 16. Six Sigma quality

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.

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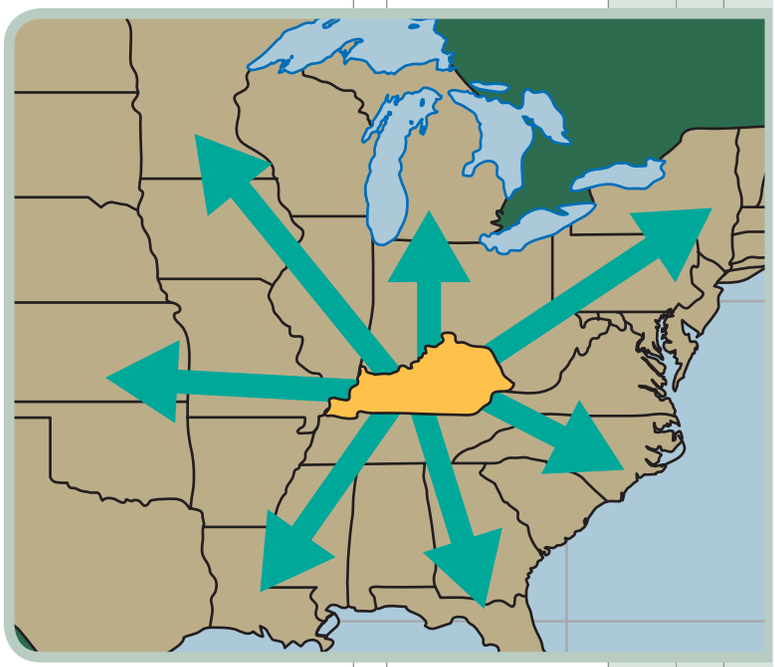
APPHARVEST

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.

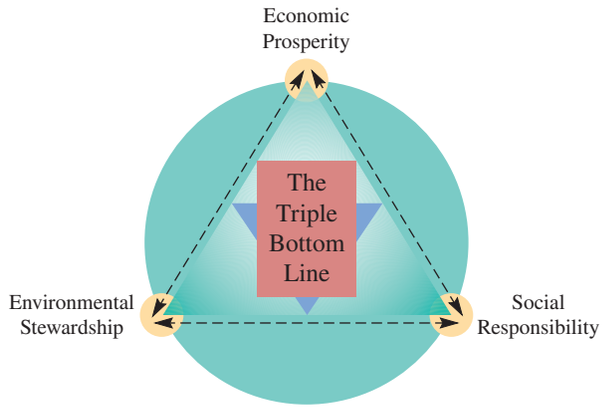
A SUSTAINABLE OPERATIONS AND SUPPLY CHAIN STRATEGY

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.

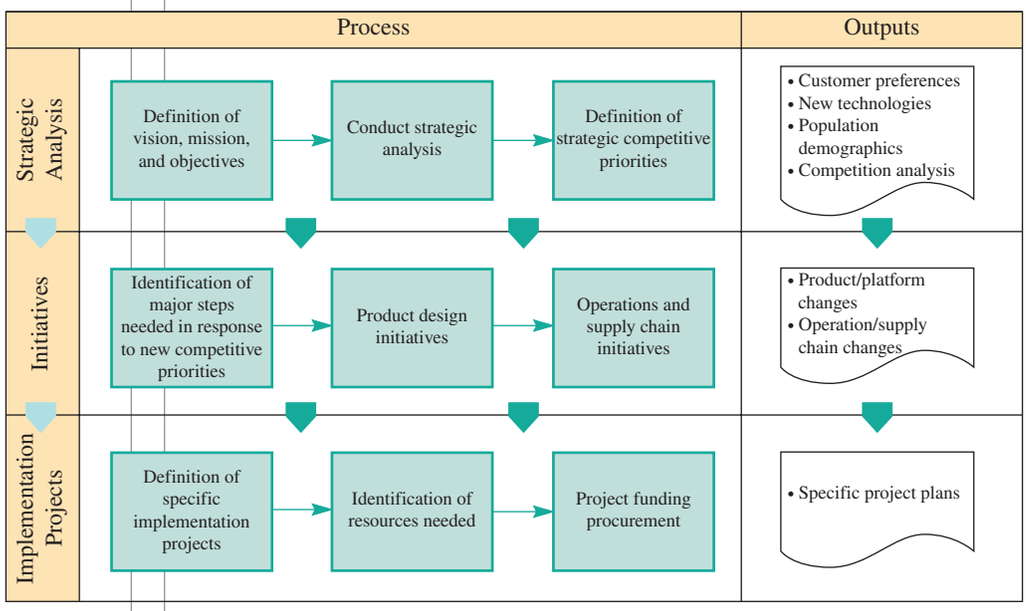
Planning strategy is a process just like making a product or delivering a service. The process involves a set of activities that are repeated at different intervals over time. Just as products are made over and over, the strategy planning activities are repeated. A big difference is that these activities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



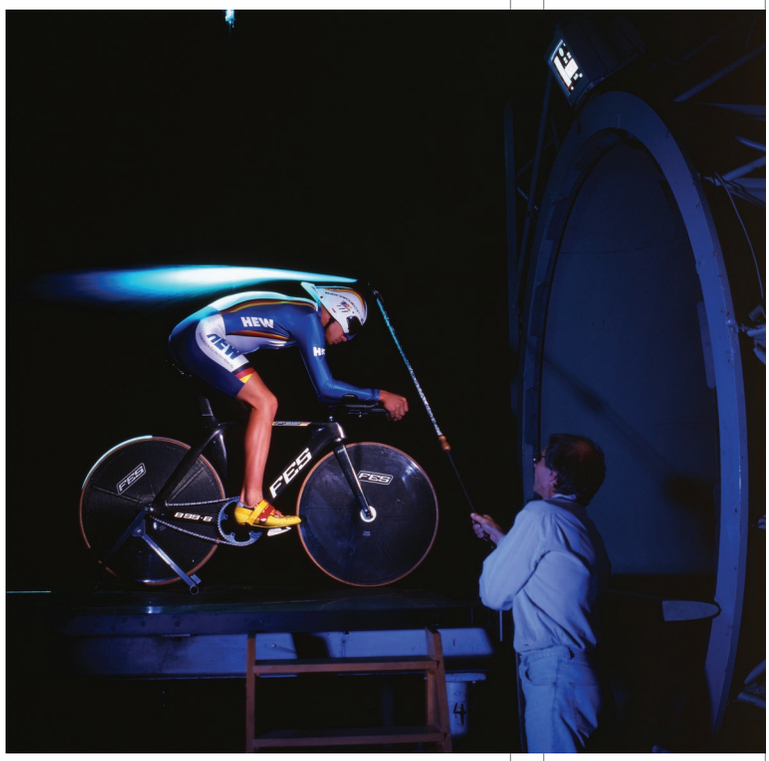
Carefully designed projects are used to implement change. The planning of these projects requires the identification of the resources needed, such as the expertise of the project members, special equipment, and other resources. Specific timing of the activities of the project are analyzed as part of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