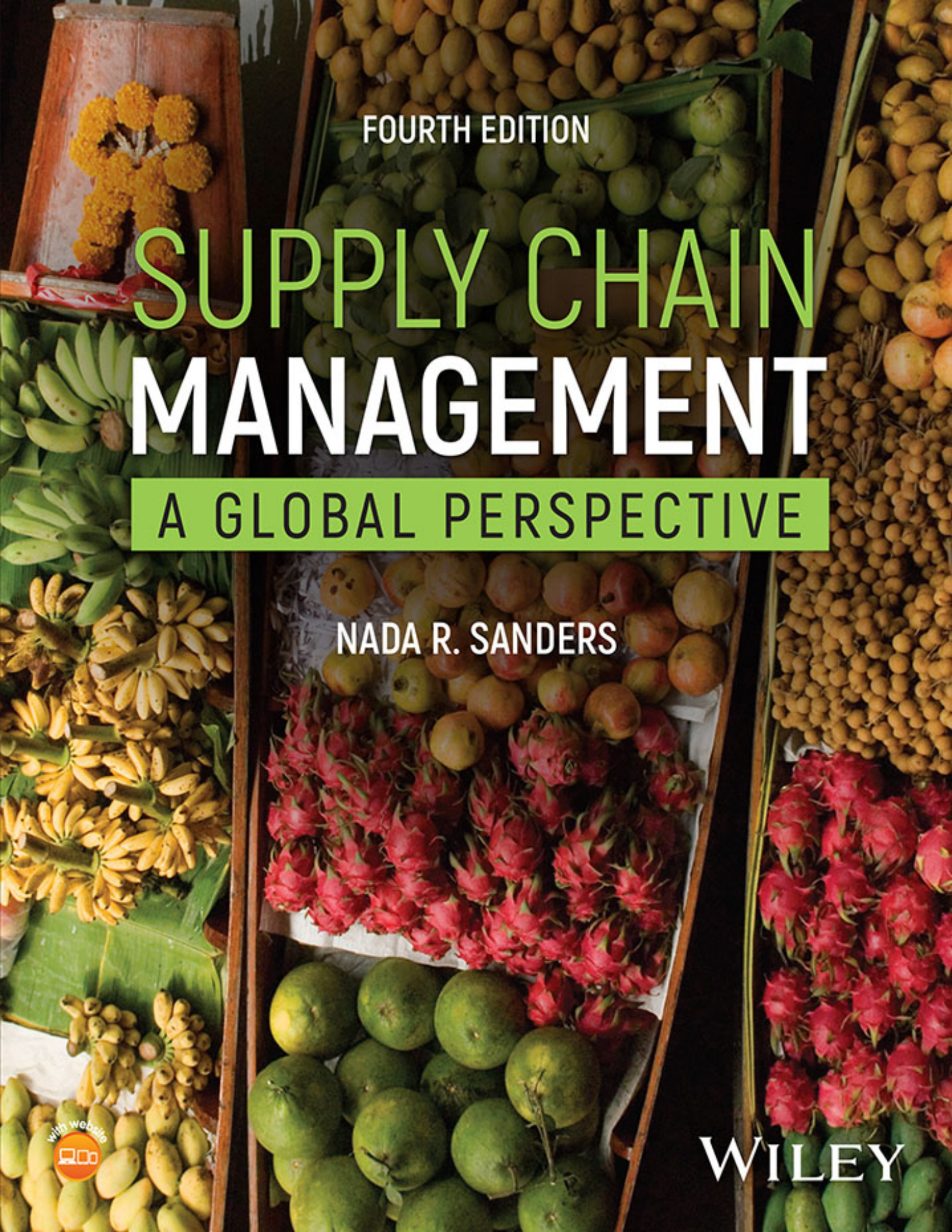




FOURTH EDITION

SUPPLY CHAIN MANAGEMENT

A GLOBAL PERSPECTIVE

NADA R. SANDERS



WILEY

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Supply Chain Management

FOURTH EDITION

A GLOBAL PERSPECTIVE

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D'Amore-McKim School of Business

Northeastern University

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Preface

Supply chain management (SCM) is the fastest-growing area of business today and is at the core of success of most leading companies. Knowledge of SCM is necessary to participate in this growing and exciting career field. However, SCM is challenging in scope and complexity. Even today there is a misunderstanding of SCM. Most people assume that SCM is part of logistics and distribution, or purchasing, or perhaps marketing. They do not understand the intricacies and broad reach of this foundational area of business. This book is designed to provide students with a comprehensive understanding of SCM, key issues involved, and the very latest business thinking. This book is different from other SCM textbooks. It is specifically written as a comprehensive SCM text providing an integrated global and technology focused perspective.

Recent trends have made the study of SCM especially challenging. Today's business environment has forced companies to compete in very different ways than just a few years ago. The following is true of today's organizations:

Global disruptions from the COVID-19 pandemic have created tremendous pressures on companies and their supply chains. Companies are being forced to remain competitive and innovative while cutting, or maintaining, costs, and redesigning more resilient supply chains.

In addition to competing on traditional dimensions such as quality, time, cost, and customization, companies must be rapid innovators. They must stay abreast of quickly changing customer demands and have responsive supply chains in place.

Technological advancements—including artificial intelligence (AI), analytics, autonomous vehicles, 3-D printing, Internet of Things (IoT), and next generation RFID—have transformed supply chains. The “intelligent supply chain” that is technologically driven is becoming the norm for companies.

Today's organizations operate in a globally interconnected environment and are affected by regional and global trade. Many companies serve multiple

global markets, with products sourced and produced in multiple countries across many continents. They must plan, design, and manage a complex supply chain network. Even small companies often source globally.

Focus on “green” and sustainability has become prominent. Issues of environmental and social responsibility are becoming critical elements of SCM, spanning concerns such as sustainable sourcing, eco-friendly product design and packaging, sustainable manufacturing and distribution.

Unprecedented threats to security are forcing companies to invest in systems to protect products and information throughout every step of the supply chain. Addressing issues of security in supply chain design is a critical aspect of SCM.

This text addresses SCM within this realistic global and technologically driven business environment, in a complete and comprehensive manner. It is written in an accessible manner enabling students to easily grasp the material, then extend and elevate discussion in the classroom. Each chapter ends with a business case to reinforce the concepts learned. The textbook is intended to provide the foundational concepts for undergraduate and graduate-level classes in SCM, as well as related areas such as operations management and purchasing. In addition, the book is an excellent resource for executive education and training seminars.

Goals of the Book

Provide a Comprehensive Foundation of SCM. This text is written to provide a comprehensive foundation of SCM, from its broad meaning and strategic implications, to operational concepts and techniques. While there are some excellent textbooks that provide foundational concepts of SCM, few present these concepts in a comprehensive and integrated manner that is the hallmark of SCM.

The text begins with an introduction to the holistic and integrated nature of SCM. Supply chain strategy is discussed next, as the driver of SCM, followed by the design of the supply chain network. Participation of organizational functions—including marketing, operations, sourcing, and logistics—are discussed, as well as their linkages to SCM. Next, planning and controlling the supply chain is discussed, from forecasting and

materials management, to lean systems and Six Sigma. Attention is devoted to topics that are of specific interest to SCM, including collaborative forecasting methods such as CPFR and S & OP. Finally, the text looks at issues of managing the supply chain. This includes managing supply chain relationships, from developing alliances to negotiation strategies. Entire chapters are devoted to the most cutting-edge issues in business today: global business, a technologically driven environment, and sustainable supply chain management.

Provide Cross-Functional and Integrative Coverage of SCM. This text is written to present SCM with an equal and balanced coverage of key business functions, their interactions, and their integration. SCM is truly boundary spanning and is intertwined with all organizational functions. Also, SCM is cross-functional in its decision-making requirements and needs to be presented as such, rather than as an offshoot of another business function. This text has equal coverage of the relevant business functions, their integration, and their impact on the functionality of SCM.

Provide Understanding of Business Issues. SCM is intertwined with best business practices. It is at the core of success of leading companies such as Apple, BMW, Walmart, P&G, Amazon, Zara, Starbucks, and Tesla Motor Company. These companies have achieved world-class status in large part due to a strong focus on SCM. This text is rich in business examples that illustrate SCM best practices and showcase the complexity of SCM business decisions. These examples show SCM to be an exciting area of study, on the cutting edge of business.

Features

Cross-Functional Coverage. SCM is presented as a cross-functional area of business study with equal coverage of functions such as marketing, operations, sourcing, and logistics, and their integration.

Global Focus. Today's supply chains traverse the globe. This creates numerous challenges, such as designing a global supply network, dealing with international tariffs and foreign government regulation, differences in transportation and technology, managing cross-cultural work teams, and addressing customer issues that arise from cultural expectations. Each

chapter has at least one box labeled “*Global Insights*,” which provides a summary of a global issue that pertains to the topic at hand and an associated business example.

Managerial Focus. The text is rich with cutting edge SCM business examples. Each chapter has at least one box labeled ‘*Supply Chain Leaders Box*’ that illustrates the latest business practices of the topic addressed. Each chapter begins with a current business example. In addition, each chapter ends with a unique case written to address key managerial issues and a strong emphasis on managerial decision making.

Strategic Focus. SCM is a strategic function. As a result, the text has a strong strategic focus. Each chapter has at least one box labeled “*Managerial Insights Box*,” which illustrates current business thought, using established and recognized sources (*HBR*, *Business Week*, *The Wall Street Journal*, *Supply Chain Management Review*, etc.).

Strong Pedagogy. The text is written in a readable and accessible manner. Each chapter ends with discussion questions, a case with questions designed to promote managerial thinking, and, where appropriate, homework problems and exercises. Icons throughout chapters show focus on cross-functional coverage, global coverage, sustainability, technology, and the service supply chain. Further, the chapters in the text are linked to the overall topic rather than being presented as an assembled compilation of material.

Changes to This Edition

A number of changes have been made to this edition to make the text as current, user-friendly, and relevant as possible. All the chapters have been updated to incorporate the latest available information, with increased emphasis on technology, digitization, analytics, stressing the cross-functional nature of SCM. All business examples have been updated, as well as charts and statistics within the text, and new technology examples have been added. Coverage of emerging supply chain management topics has been expanded and a number of class exercises have been added. The following features have been added to this edition:

AI & Analytics: All chapters have been updated to include an expanded state-of-the-art impact of AI and analytics on supply chains. Each chapter now has one “*AI & Analytics Box*” that showcases an example of how AI and analytics are impacting the topics covered in the chapter. This ranges from how retailers such as Target capture customer preferences, to how UPS uses its state-of-the-art navigation system.

Technology Focus: Advancements in technology are changing supply chains and this discussion has been updated and expanded. These include 3-D printing, autonomous vehicles (AV), next-generation RFID, Internet of Things (IoT), cloud computing, artificial intelligence (AI), generative AI and large language models (LLMs), and many others. These technologies have enabled the “intelligent supply chain” and are discussed in every chapter.

Empowering Entrepreneurs: Supply chain management is equally important for entrepreneurs and small businesses. However, the concerns of these companies are often different compared to those of larger firms. In each chapter, a section has been added titled “Empowering Entrepreneurs Box,” that discusses the chapter topic with a focus on entrepreneurs. These discussions look at how chapter issues are different for small businesses and start-ups, and how these companies can address them.

Making Decisions with Analytics: While analytics has provided huge capability, managers and executives typically have to make their decisions considering additional factors. At the end of each chapter a new case has been added, titled “Making Decisions with Analytics.” The cases address a chapter topic and are designed to pose thought-provoking questions that require students to make decisions with technology while considering other supply chain and business trade-offs. Also provided are tips for faculty on how to lead discussion of these cases. The goal is for students to understand how to make decisions with technology and that often the decisions may not be clear-cut, as trade-offs have to be made. These cases were designed to add contextual factors that go beyond analytics that students need to consider.

Classroom Exercises: Each chapter now includes updated class exercises designed to foster classroom discussion. These exercises are classroom tested and include instructor details on how to conduct the exercise and

provide a series of questions with suggested solutions to guide the discussion.

Updated Examples: Throughout the chapters, examples and data have been updated. The focus of the update was to make the revision rich in examples of both large supply chains, as well as those of small and medium firms to highlight key concepts.

Instructor Resources

The instructor's website, found at www.wiley.com/go/sanders/supplychainmanagement4e, offers several resources designed to assist professors in preparing lectures and assignments, including:

Instructor's Manual Includes a suggested course outline, teaching tips and strategies, answers to all end-of-chapter material, additional in-class exercises, and more.

Test Bank A comprehensive Test Bank comprised of true/false, multiple-choice, short answer, and essay questions is available on the instructor site. The questions are also available as a Computerized Test Bank.

PowerPoint Slides Full color slides highlight key figures from the text as well as many additional lecture outlines, concepts, and diagrams. These provide a versatile opportunity to add high-quality visual support to lectures.

An Interactive, Multimedia Learning Experience

This fourth edition of *Supply Chain Management* includes an enhanced e-text that engages students with a variety of video and interactive content designed to complement and enrich the reading experience.

Every new copy of the paperback textbook includes access to the e-text, and the video and interactive content is signposted throughout.



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1

Introduction to Supply Chain Management

LEARNING OBJECTIVES

After completing this chapter, you should be able to:

Define “supply chain management” and explain the activities involved.

Identify the flows through a supply chain and explain the bullwhip effect.

Describe the rise of supply chain management and its global implications.

Describe the characteristics of a competitive supply chain.

Identify and explain key trends that drive today's supply chains.

CHAPTER OUTLINE

- **What Is Supply Chain Management (SCM)?**
 - SCM Activities*
 - Managing Flows Through the Supply Chain*
 - The Bullwhip Effect*
 - Customer Focus*
 - The Service Supply Chain*
- **The Boundary-Spanning Nature of SCM**
 - Intraorganizational Integration*
 - Cross-enterprise Integration*
 - SCM vs Logistics*
- **The Rise of SCM**
- **Characteristics of a Competitive Supply Chain**
 - Responsiveness*
 - Reliability*
 - Relationship Management*
- **Trends in SCM**
 - Globalization*
 - Outsourcing and Reshoring*
 - Digital Transformation*
 - Artificial Intelligence (AI) and Analytics*
 - 3-D Printing, Additive Manufacturing, and Robotics*
 - Postponement*
 - The Lean Supply Chain*
 - Supply Chain Resilience*
 - Supply Chain Security*

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[Bloomberg Quicktake Video: The New Economic Era](#)

[Bloomberg Quicktake Video: Antifragile: Rebuilding the Supply Chain](#)

[Bloomberg Quicktake Video: U.S. Manufacturing Expands](#)

Most of us have had the experience of sitting at a Starbucks coffee shop enjoying a cup of coffee, a Frappuccino, or perhaps a Pumpkin Spice Latte. We have enjoyed the “Starbucks experience,” sipping a beverage, lounging in one of the many chairs, and perhaps reading a newspaper or a good book. We may have briefly noticed that Starbucks’ coffee beans come from all across the globe, including Rwanda, Timor, Guatemala, Sumatra, Brazil, Kenya, Mexico, and Ethiopia. However, we have probably not given much thought to the complexity of decisions and coordination required to ensure that we, the customers, receive the beverages we enjoy as we sit in the café.

In fact, for Starbucks to be able to deliver such a high-quality, consistent, and broad product offering to more than 38,000 store locations worldwide, it must manage an extensive global network of trading partners—from coffee growers to roasting plants to coffee distributors. It must manage relationships, ensure the highest quality, and guarantee product availability at each store location, while maintaining efficiency and keeping costs as low as possible. So, while, we, the customers, sit in the dimly lit and hip café enjoying the “Starbucks experience,” behind the scenes is a company that is managing one of the biggest global supply chains in the world.

Global supply chains are what enable every business, including Starbucks, to operate and are the backbone of the world economy. This critical role became evident during the COVID-19 pandemic of 2020 when the world experienced massive shutdowns. The COVID-19 pandemic revealed the criticality of supply chain management (SCM) to everyone—from governments and business leaders to the average person. Global supply chain disruptions resulted in massive shortages of goods—from toilet paper to pharmaceuticals to semiconductors—impacting businesses and consumers alike. Suddenly, even an average person is aware of shortage of an item such as a semiconductor means companies cannot make cars, appliances, and computers. Unlike past disruptions typically of a short-term nature, such as a hurricane or a fire at a manufacturing plant, the protracted duration of the COVID-19 pandemic forced business leaders to understand the criticality of global supply chains and the need to manage them well.

As a result, the focus on SCM is greater than ever and SCM is the fastest-growing area of business today. It is at the core of the success of such

companies as Amazon, Nike, Toyota, Walmart, P&G, Zara, PepsiCo, BMW, L'Oréal, and McDonald's, as well as Starbucks and many other companies. These companies have achieved world-class status in large part due to a strong focus on SCM. Many companies that survived the pandemic attribute their success to excellent SCM.

Most people assume that they have some ideas of what SCM is all about. They usually think it is part of logistics and distribution, or purchasing, or perhaps marketing. It is likely, however, that you do not yet know the full complexity and broad reach of this critical and rapidly evolving business concept. At a recent conference Paul Mathews, Executive Vice President of Service and Supply Chain for the Sunnova Energy joked that people still think of SCM as “kicking boxes and licking labels.” He wanted to highlight the misunderstanding of SCM that many people still have.

The purpose of this book is to help you develop a comprehensive understanding of SCM. This includes understanding the key issues involved in SCM and becoming familiar with the latest business thinking. This will prepare you for a successful career in a new and exciting business field.

Today's business environment, in a postpandemic era, has forced companies to compete in very different ways from just a few years ago. In addition to competing on traditional dimensions such as quality, time, cost, and customization, companies must be rapid innovators. They must stay abreast of quickly changing customer demands and increasing global competition. Advances in technology, artificial intelligence (AI), and unprecedented security threats are forcing companies to be flexible and responsive. At the same time, geopolitical unrest and a globally connected economy have created tremendous financial pressures. SCM is the business concept through which companies can achieve this level of competitiveness while maintaining costs and is intertwined with today's best business practices. Companies understand that they cannot achieve the needed level of competitiveness in the current global economy without SCM.

Knowledge of SCM will give you the skills needed to help your organization gain a competitive advantage in the marketplace. It will also help you move into one of the fastest-growing career fields today.

Concept Check Questions

1. Global supply chains are the backbone of the world economy.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

2. The Covid-19 pandemic had minimal impacts on supply chains.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

3. The focus on supply chain management (SCM) is greater than ever.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

4. In today's business environment, companies must be rapid innovators.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

What Is Supply Chain Management (SCM)?

[Supply chain management \(SCM\)](#) is the design and management of flows of products, information, and funds throughout the supply chain. It involves the coordination and management of all the activities of a supply chain. As such, SCM may appear deceptively simple. It is a complex business concept that is far reaching in the nature and type of decisions involved. Before we begin to look at the full complexity of SCM, it is important to first understand the meaning of the term *supply chain*.

A [supply chain](#) is the network of all entities involved in producing and delivering a finished product to the final customer. This includes sourcing raw materials and parts; manufacturing, producing, and assembling the products; packaging and labeling; storing goods in warehouses; order entry and tracking; distribution; and delivery to the final customer. A simple supply chain is illustrated in [Figure 1.1](#).

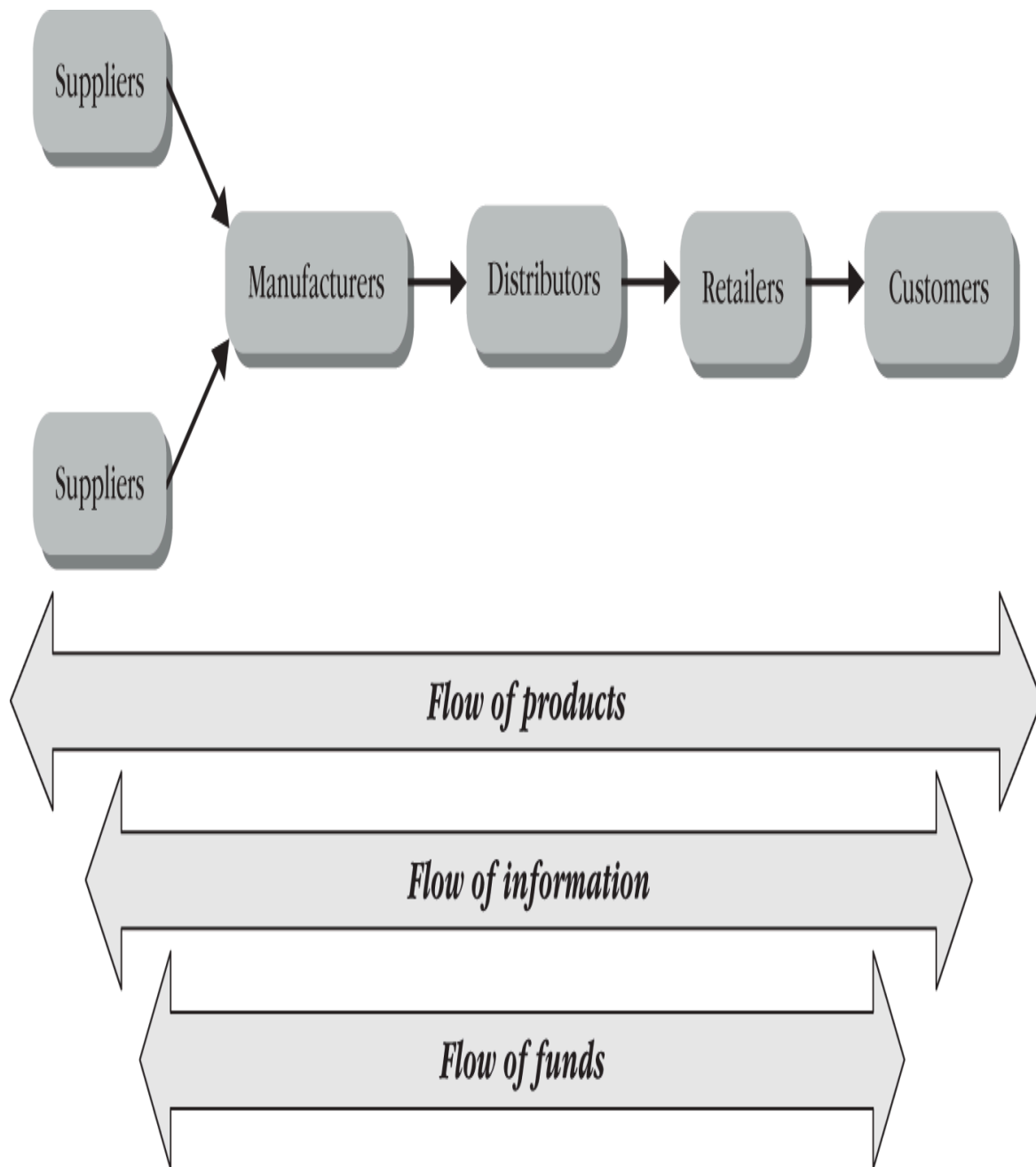


FIGURE 1.1 A simple supply chain.

The flows through the supply chain beginning with suppliers who supply and transport raw materials and components to producers or manufacturers. Manufacturers transform these materials into finished products that are then shipped either to the manufacturers' own distribution centers or to wholesalers. Next, the products are shipped to retailers who sell the product to final customers. Consider the Starbucks supply chain we just discussed. At the beginning of the supply chain are coffee farmers at various locations across

the globe that grow coffee beans. The coffee beans are picked, packaged in burlap bags, and transported to coffee roasters, entities that roast the beans. The roasted beans are then sent to coffee distributors who sort, package, and move the beans to retailer outlets such as Starbucks cafés, to be purchased by the consumer.

A typical supply chain may involve many different trading partners, called stages. These supply chain stages may include the following:

Suppliers

Producers

Wholesalers/distributors

Retailers

Customers

Note that every supply chain is different and that these stages are a generic representation of a supply chain. Each stage may not be present in every supply chain. The number of stages that are part of a supply chain and its appropriate design will depend on the customer's needs, the roles of the stages involved, and the value each stage provides.

Supply chains are under increasing financial pressure, and stages that do not add value to the supply chain are quickly bypassed or eliminated. For this reason, a supply chain is often called a [value chain](#) or a [value network](#).

Today's concept of the supply chain comes from the concept of a “value chain” that was introduced by a Harvard Business School professor, Michael Porter, in the 1980s. Michael Porter explained that a company's competitive advantage cannot be understood by looking at a firm as a whole. Rather, its competitive advantage comes from the many discrete activities that a firm performs and that each of these activities contributes to the firm's total cost position. This concept of each activity contributing to the total value has now been extended to the entire supply chain. It has been often said that it is not companies that compete. Rather, it is their supply chains that compete.

As we look at a supply chain, it is important to point out some common terminology used to describe the relationships of supply chain stages to one another. Each company in a supply chain has its suppliers and customers. The stages of the supply chain that comprise the inbound direction toward the

company, or the “focal firm,” are called the “upstream” part of the supply chain.

The stages of the supply chain away from the “focal firm” are termed “downstream.” This is shown in [Figure 1.2](#). For example, if the focal firm was a manufacturer, all inbound suppliers would be considered “upstream,” whereas distributors/wholesalers and retailers/customers would comprise the “downstream” part of the supply chain. Being able to refer to parts of the supply chain as either “upstream” or “downstream” provides a convenient point of reference. Similarly, suppliers that directly supply goods or services to a company are termed “first-tier suppliers.” Suppliers that supply to a company's “first-tier suppliers” are termed “second-tier suppliers,” and so on moving up the chain. This provides a common terminology for companies to understand which suppliers are being referenced.

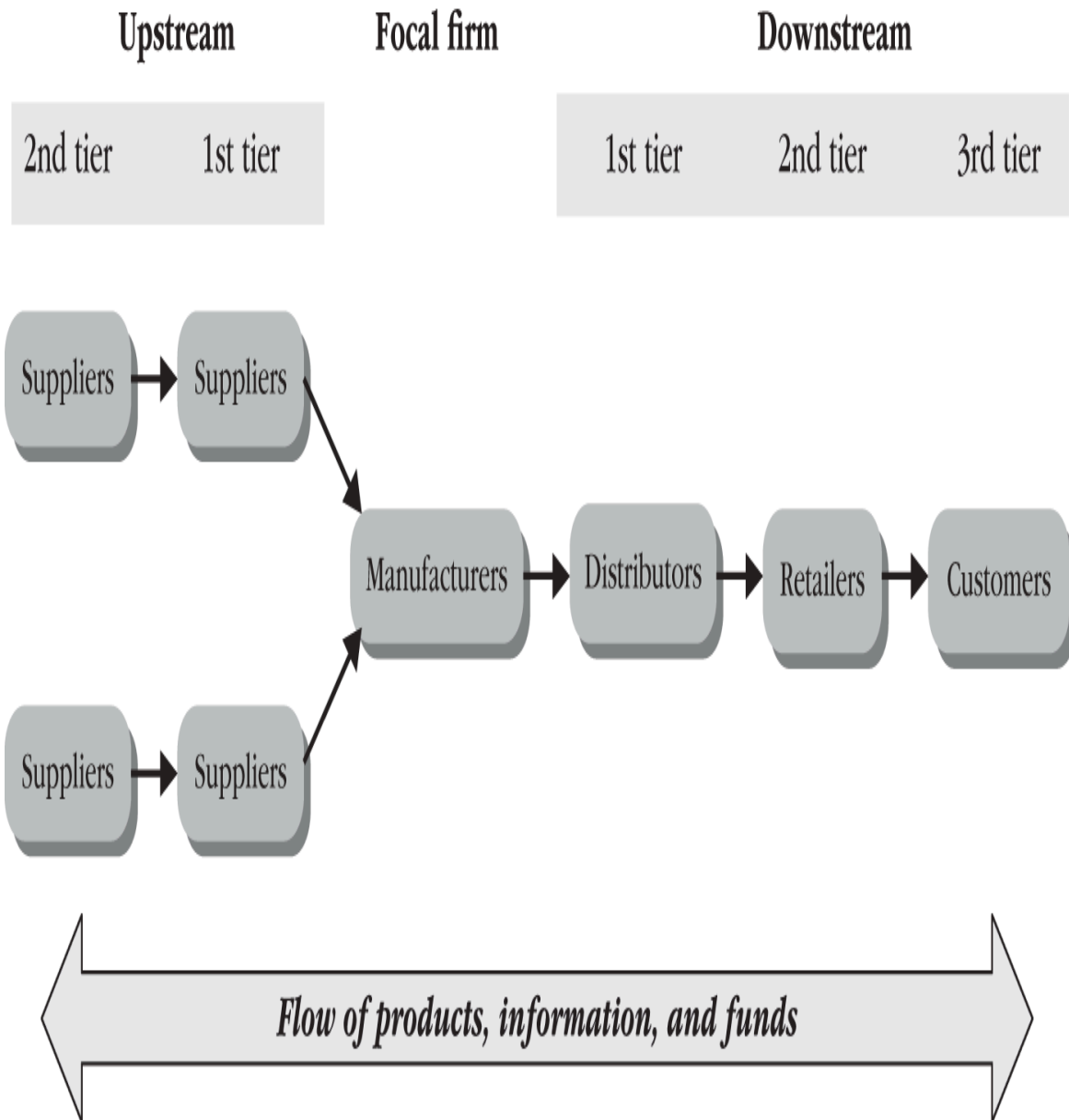


FIGURE 1.2 Stages of the supply chain.

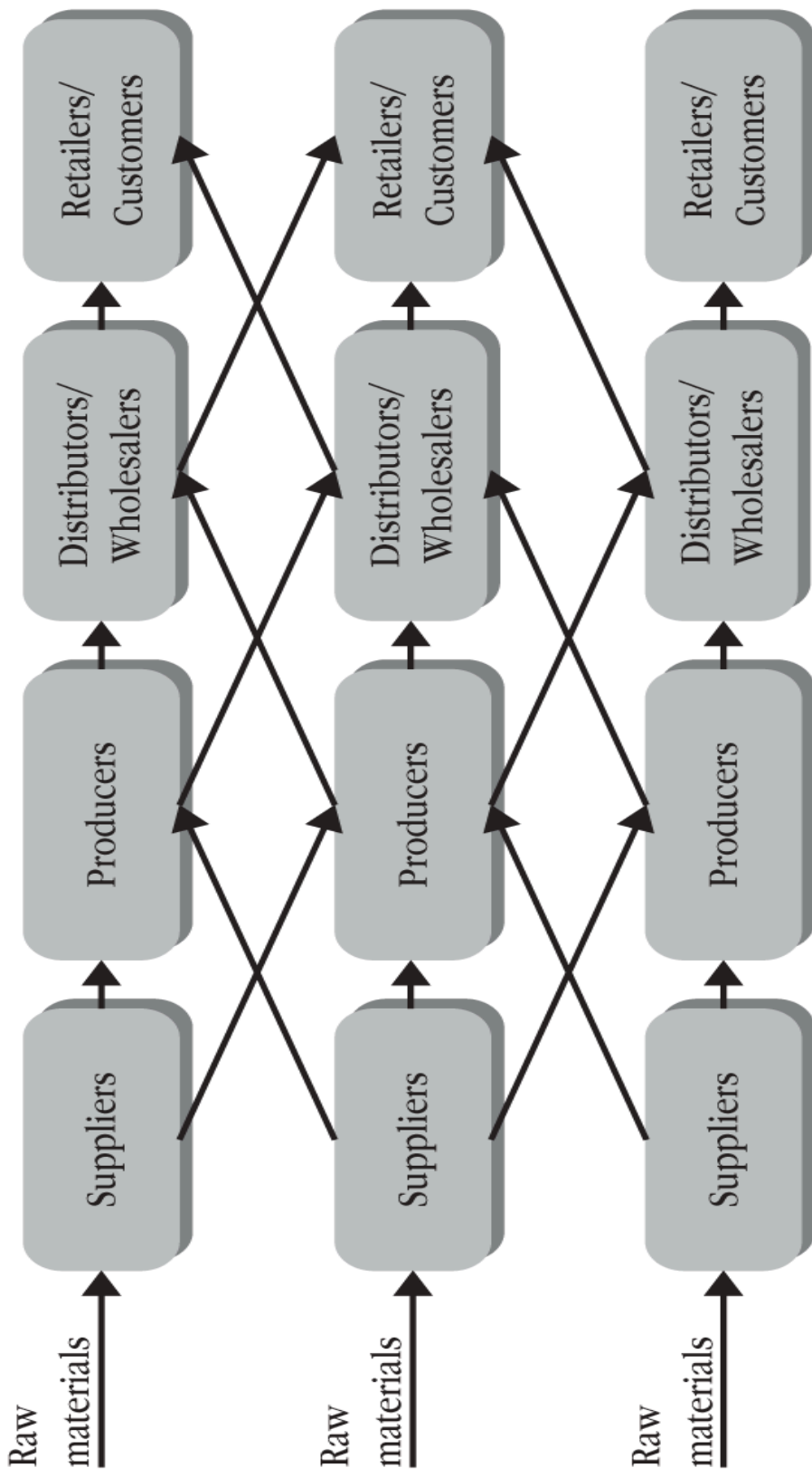


FIGURE 1.3 The supply chain network.

The term “supply chain” implies a linear chain of participants from suppliers to final customers. A true supply chain, however, looks more like a complex network, as shown in [Figure 1.3](#). A producer may receive materials from multiple suppliers. Many distributors and wholesalers receive inventory from many manufacturers, and most retailers receive products from many different distributors. For this reason, a supply chain is often referred to as a supply chain network or supply web, to more accurately describe the nature of these relationships. Many companies are part of multiple supply chains.

The supply chain network can take on many different shapes. Some are linear, as shown in [Figure 1.3](#). Others take on the form of a hub-and-spoke network or a web network. Often, the type of network can be related to the number of suppliers, their locations, and the type of product being produced. For example, Dell Computer Corporation became famous for mandating that all its first-tier suppliers must be within a 15-minute radius anywhere around its Austin, Texas, manufacturing facility. This is an example of a hub-and-spoke supply network, with the focal firm in the center of the design, and a model that has been followed by many other manufacturers.

Concept Check Questions

5. _____ is the design and management of flows of products, information, and funds throughout the supply chain.

- ☐ a) Supply chain management
- ☐ b) Supply chain
- ☐ c) Value chain
- ☐ d) Logistics chain
- ☐ e) None of these

Correct or Incorrect?

Clear

Check Answer

6. A/n _____ is the network of all entities involved in producing and delivering a finished product to the final customer.

- ☐ a) Supply chain management
- ☐ b) Supply chain
- ☐ c) Value chain
- ☐ d) Stages
- ☐ e) None of these

Correct or Incorrect?

Clear

Check Answer

7. A typical supply chain may involve many different trading partners, called a/n what?

- ☐ a) Supply chain management
- ☐ b) Supply chain
- ☐ c) Value chain
- ☐ d) Stages
- ☐ e) None of these

Correct or Incorrect?

Clear

Check Answer

8. A supply chain is often called a/n

- ☐ a) Supply chain management
- ☐ b) Supply chain
- ☐ c) Value chain

- ☐ d) Stages
- ☐ e) None of these

Correct or Incorrect?

Clear

Check Answer

9. The parts of the supply chain that comprise the inbound direction toward the company, or the “focal firm,” are called the _____ part of the supply chain.

- ☐ a) local
- ☐ b) upstream
- ☐ c) downstream
- ☐ d) parallel
- ☐ e) None of these

Correct or Incorrect?

Clear

Check Answer

10. The stages of the supply chain away from the “focal firm” are termed _____.

- ☐ a) local
- ☐ b) upstream
- ☐ c) downstream
- ☐ d) parallel
- ☐ e) None of these

Correct or Incorrect?

Clear

Check Answer

11. All supply chains are linear.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

SCM Activities

Now that we understand what constitutes a supply chain or supply network, we can look at the issues involved in managing it. Recall that SCM involves the coordination and management of “all” activities of a supply chain. It is responsible for managing the system of flows between the different entities of a supply chain to satisfy the final customer and maximize total supply chain profitability. SCM is a dynamic and ever-changing process that requires coordinating all activities among members of the supply chain.

SCM activities include the following:

Coordination: SCM involves coordinating the movement of goods and services through the supply chain, from suppliers to manufacturers to distributors to final customers; it also includes the movement of goods back up the supply chain, as products may be returned. Coordination also involves the movement of funds through the supply chain as products are purchased and sold. This includes various financial arrangements and terms of purchase between buyers and suppliers.

Information sharing: SCM requires sharing relevant information among members of the supply chain. This includes sharing demand and sales forecasts, point-of-sale (POS) data, promotional campaigns planned, and inventory levels. Consider that a manufacturer must know if a retailer is planning an advertising campaign to ensure that enough of the product is

being produced. Otherwise, the retailer may run out of stock. Similarly, the manufacturer's suppliers must be aware of increased production plans to provide sufficient component parts. Sharing this information enables the entire chain to work in unison.

Collaboration: SCM requires collaboration between supply chain members so that they jointly plan, operate, and execute business decisions as one entity. This is important for decisions that range from product design and process improvement to implementing business initiatives or following a particular business strategy. For example, this may include collaborating on ways to cut costs or improve quality standards throughout the entire supply chain.

Concept Check Questions

12. SCM involves the coordination and management of all the activities of a supply chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

13. Which of the following is not considered a SCM activity?

- ☐ a) Coordination
- ☐ b) Payment processing
- ☐ c) Information sharing
- ☐ d) Collaboration

Correct or Incorrect?

Clear

Check Answer

14. SCM involves coordinating the movement of goods and services through the supply chain, from suppliers to manufacturers to distributors to final customers but it does not includes movement of goods back up the supply chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

15. SCM requires sharing relevant information among members of the supply chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

16. SCM requires only minimal collaboration between supply chain members.

- ☐ True
- ☐ False

Correct or Incorrect?

[Clear](#)[Check Answer](#)

Managing Flows Through the Supply Chain

Recall that many flows move through a supply chain network. The first is the flow of [products](#) through the supply chain, from the beginning of the chain through various stages of production, to the final customer. However, goods also flow back through the chain. This is in the form of returned products that are unacceptable to customers for various reasons, such as damaged or obsolete goods. This is an area of SCM called “reverse logistics” because the direction of product flow is reversed. The increased focus on customer accommodation has increased the amount of goods returned from customers.

The second important flow through the supply chain is that of [information](#) that is shared between members of the supply chain. Many simplified supply chains view the product flowing from suppliers to customers and information flowing in the opposite direction, from point of sale back to suppliers. In this simplified case, the primary information is demand or sales data, which is used to trigger replenishment and serves as the basis for forecasting. In a more realistic case, sales information is shared on a real-time basis, which leads to less uncertainty and less safety stock. The sharing of real-time information serves to compress or shorten the supply chain from a time standpoint. The result of this more timely and accurate information is a reduction in the amount of inventory carried throughout the supply chain.

The third important flow through the supply chain is that of [funds](#). In a simplified supply chain, financial flow is often viewed as one directional, flowing backward in the supply chain as payment for products and services received. However, as products flow in both directions so does the transfer of funds. A major impact on fund transfer and the financials of companies has been supply chain compression. A shorter order cycle time means that customers receive their orders faster. It means that they are billed sooner and that companies receive payment sooner. This speeding up of the money collection process has had a huge impact on the profitability of certain firms. Consider Dell Computer Corporation—a company that has gained much from the compressed supply chain. Dell turns over its inventory roughly every four

days. However, they often receive payment a week in advance, well before Dell pays its suppliers, providing a large financial benefit to Dell.

The key to successful SCM is the management of these flows through the chain. SCM is a dynamic process and provides many opportunities to reduce the cost of doing business and improve customer service. At the same time, the challenges of SCM are often underestimated. The reason for the failure of many businesses is due to their inability to manage supply chain flows effectively.

There are countless examples of businesses succeeding and failing due to their management of SCM. The downfall of the fashion retailer Forever 21 was primarily due to supply chain issues, including overexpansion, excessive inventory, and slow turnover. On the contrary, competitors such as Zara and H&M have outperformed by maintaining agile supply chains, swiftly adapting to trends, and satisfying consumer demands. SCM is equally essential for online businesses. Many have excellent business concepts and marketing strategies but they are unable to make products available to customers in a cost-effective manner. For example, Webvan was an online grocery delivery company that failed a few years ago as it was unable to bring the cost of grocery picking and delivery to a competitive level. The success of Internet retailers such as Amazon.com has been primarily driven by excellence in its supply chains.

Concept Check Questions

17. In a supply chain, products only flow through the supply chain, from the beginning of the chain through various stages of production, to the final customer.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

18. To manage a supply chain, information must flow through the chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

19. SCM is a dynamic process and provides many opportunities to reduce the cost of doing business and improve customer service.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

20. The downfall of the fashion retailer Forever 21 was primarily due to supply chain issues.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

21. Zara and H&M have weak SCM.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

The Bullwhip Effect

A supply chain is composed of many different companies or stages—each with its own objectives. For a supply chain to be highly competitive, it is critical that its members engage in the activities of coordination, information sharing, and collaboration. Otherwise, each stage of the supply chain will have differing and possibly conflicting objectives and may focus on simply maximizing its own profits. Similarly, if information is not shared between stages, but is delayed or distorted, each stage may have a distorted view of final customer demand. As a result, they will likely not produce the right quantities of items needed, resulting in either shortages or excess inventory. Both situations result in lowered profitability of the entire supply chain.

It has been observed that fluctuation and distortion of information increase as they move up the supply chain—from retailers to manufacturers, and to suppliers. This is called the [bullwhip effect](#), as inaccurate and distorted information travels in the chain like a bullwhip uncoiling. In response, each stage of the chain carries progressively more inventory to compensate for the lack of information. The bullwhip effect has been well documented in many industries and is costly for all supply chain members.

One of the best-known examples of the bullwhip effect was observed by Procter & Gamble (P&G) in the supply chain of its Pampers diapers. The company discovered that even when demand for diapers was stable at the retail store level, orders for diapers from P&G fluctuated significantly. Even greater fluctuation was observed in orders for raw materials from suppliers

over time. Although consumption of the final product was stable, orders for raw materials were highly variable.

A similar example was observed at Hewlett-Packard (HP). HP observed that fluctuations of orders increased significantly as they moved from the resellers up the supply chain to the printer division to the integrated circuit division. Like P&G, HP observed that although final product demand was fairly stable, orders placed at every stage up the supply chain significantly increased in variability. Both P&G and HP found that the result of the bullwhip effect was an increase in cost and difficulty in filling orders on time.

The longer the supply chain, the greater the opportunity for the bullwhip effect, as manufacturers and suppliers are further away from final customer demand. If there is no coordination or sharing of information, these stages do not know the final customer demand or when a replenishment order might arrive. As a result of this higher uncertainty, they stockpile inventory. The way to combat the bullwhip effect is to share POS information, available from most cash registers, with all members of the supply chain. This allows all stages of the supply chain to make replenishment decisions from the same information source. In addition to information sharing, coordination and collaboration will enable stages of the supply chain to work toward the same goals.

Concept Check Questions

22. It has been observed that fluctuation and distortion of information increases as it moves up the supply chain, from retailers, to manufacturers, and to suppliers. This is called the _____.

- ☐ a) distortion effect
- ☐ b) telephone effect
- ☐ c) upstream effect
- ☐ d) downstream effect
- ☐ e) bullwhip effect

Correct or Incorrect?

Clear

Check Answer

23. The longer the supply chain, the greater the opportunity for the bullwhip effect.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

24. The way to combat the bullwhip effect is carry additional inventory.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Customer Focus

The final customer is the driving force of the supply chain. The primary purpose for the existence of a supply chain is to respond to customer demands and generate profits for companies that are members of the chain. Therefore, meeting customer demands is the primary objective. The process is driven by a customer having a particular product need. The retailer tries to satisfy the customer by ensuring that the product is available. As customers continue to purchase products, the retailer requests additional products from its suppliers to replenish those sold. These suppliers then purchase materials from their

suppliers, and the process “pulls” raw materials through the rest of the chain needed to produce more quantities of the product.

Consider a customer walking into a Walmart store to buy laundry detergent, as shown in [Figure 1.4](#). The process that drives the supply chain starts with the need of the customer to buy detergent. The customer visiting Walmart takes detergent off the shelf that Walmart stocked from an inventory supplied from its finished-goods warehouse or by a distributor. Sales of the detergent trigger the warehouse or distribution center to replenish the sold items. The items “pulled” out of the warehouse or distribution center trigger the manufacturer, such as P&G, to produce more and fill the warehouse with more items. To produce more items, in turn, P&G has to request more raw materials from its suppliers, such as those that supply packaging and chemical components. As P&G requests more raw materials from its suppliers, its first-tier suppliers request more materials from lower-tier suppliers. In this manner, products are moved through the supply chain.

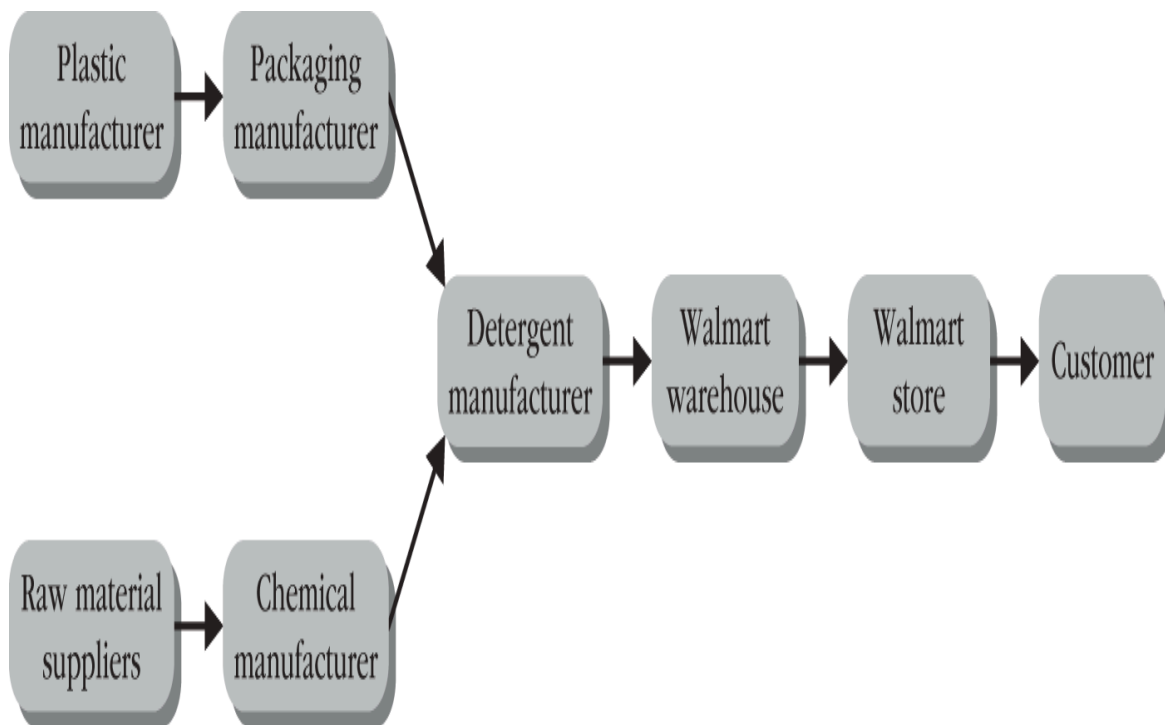


FIGURE 1.4 Products are “pulled” through the supply chain.

SCM is a dynamic process and involves the constant flow of information, products, and funds between different entities of the supply chain. To see how this works, consider the example of Walmart. Walmart provided the product (detergent in this case) to the customer, and the customer transferred its funds

to Walmart. Using POS data, Walmart then conveyed the need to replenish orders to the warehouse or distributor, who transferred the replenishment order via trucks back to the store. After the replenishment was made, Walmart transferred funds to the distributor. Walmart, the distributor, and the manufacturer shared pricing information, delivery schedules, and forecasts of future sales. This type of flow of information, products, and funds takes place across the entire supply chain.

This example illustrates that to provide timely product availability, all the participants in the chain need to coordinate their plans and respond to the same information. Also, notice that many flows move through the supply chain. The process is driven by a customer order and ends when a customer has paid for their purchase. SCM is the coordination and orchestration of all the activities necessary for this process to occur in the most efficient, cost effective, and timely manner.

Concept Check Questions

25. The final customer is the driving force of the supply chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

26. SCM is a dynamic process and involves the constant flow of information, products, and funds between different entities of the supply chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

27. Every supply chain will have a single flow.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

The Service Supply Chain

SCM is just as relevant to companies in the service industry, ranging from healthcare to real estate to banking, as it is to manufacturing companies that produce tangible products. However, service supply chains differ from manufacturing in the role of the customer and the direction of flow of the delivery process. Unlike manufacturing supply chains that focus on the production and delivery of a tangible product, service supply chains tend to focus more on the interaction between the customer and provider. For this reason, the role of the customer is even greater in driving the service supply chain than the customer is in manufacturing.

In service organizations, the customer is also a supplier of inputs and information, which can change the service delivery. Consider the legal environment, where the course of legal action greatly depends on information provided by the client to the attorney. Similarly, a university student may have the option to conduct an independent study under the supervision of a faculty member, changing the set course of study. Another example is in the healthcare industry, where the role of the patient is pivotal in influencing the service supply chain. Patients not only receive medical services but also provide critical information about their health history, symptoms, and

preferences, which can significantly impact the diagnosis, treatment, and overall healthcare delivery.

Service supply chains tend to be considerably shorter than manufacturing supply chains. The provider typically interacts directly with customers, without the buffer of retailers and distributors, enabling easier sharing of information. Service supply chains also tend to look more like hubs than chains. One of the disadvantages is that they do not have the buffers of inventory as seen in manufacturing. This means that they need to have other organizational mechanisms that give them flexibility when handling the variation of customer-supplied inputs and demands. This also makes information sharing with customers much more critical.

Even service companies that provide pure content to customers, such as those in the entertainment industry, rely heavily on their supply chains to deliver customer value and remain competitive. This includes industries such as film, computer games, and sports and includes companies such as Disney, Warner Bros., and Ticketmaster. These companies are increasingly relying on SCM process and technology improvements to ensure coordination of information and maintain competitiveness.



Concept Check Questions

28. SCM is not very relevant to companies in the service industry.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

29. Service supply chains tend to focus on the production and delivery of a tangible product that goes along with the service.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

30. In service organizations the customer is also a supplier of inputs and information.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

31. Service supply chains tend to be considerably _____ than manufacturing supply chains.

- ☐ a) longer
- ☐ b) shorter
- ☐ c) more complex
- ☐ d) more global
- ☐ e) None of these

Correct or Incorrect?

Clear

Check Answer

32. Service companies that provide pure content to customers, such as those in the entertainment industry, tend not to have supply chains.

☐ True

☐ False

Correct or Incorrect?

Clear

Check Answer

Supply Chain Leader's Box

■ AMAZON.COM

The largest Internet-based retailer in the world, Amazon.com, has sought to make itself a customer-centric company from its beginning in July 1995. Amazon.com is a service company that is a leading merchandiser of everything from gourmet food to apparel to electronics, in addition to books and music. From the beginning, Amazon understood that its focus must be on satisfying the customer by providing the highest levels of service. Rather than focusing on marketing or advertising, Amazon placed its focus on having a superior supply chain that provides uncompromised delivery to customers. As of 2023, Amazon was delivering an estimated average of over 2.5 million packages per day in the United States alone, with this number increasing every day. In addition, Amazon conducts business on an international scale, with 235 countries and territories eligible to shop on Amazon. Coordinating and orchestrating this range of product offerings to so many global locations with perfect deliveries is a daunting task. To achieve this, Amazon has built an impressive logistics network that includes its own fleet of jets, automated warehouses, robots, drones, and a digitally driven supply chain. For Amazon, logistics, shipping, and a super-SCM have combined to give the company its stellar reputation.

Part of Amazon's supply chain proficiency is based on its strict operations philosophy, which focuses on lean systems, quality, and efficiency. It is more reminiscent of industrial manufacturing than traditional retail practices. For instance, Amazon takes a Six Sigma¹ approach to its distribution operations and applies lean manufacturing and total quality management (TQM) methodologies to its processes. Amazon's online proficiency is such that many brick-and-mortar retailers, such as Target, use the Amazon website for its e-commerce efforts. However, recognizing the importance of supply chain management, some retailers are moving away from Amazon's platform, where unauthorized sellers can undercut prices. Retailers, such as Nike, have tried Amazon and ultimately decided to develop their own online platform to serve the customer directly.

Concept Check Questions

33. The largest Internet-based retailer in the world is Wish.com, having recently surpassed Amazon.com.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

34. What year was Amazon.com founded?

- ☐ a) 1990
- ☐ b) 1995
- ☐ c) 1998
- ☐ d) 1999
- ☐ e) 2002

Correct or Incorrect?

Clear

Check Answer

35. As of 2023, Amazon was delivering an estimated average of over _____ million packages per day in the United States alone.

- ☐ a) 1.0
- ☐ b) 2.0
- ☐ c) 2.5

- ☐ d) 3.0
- ☐ e) 5.0

Correct or Incorrect?

Clear

Check Answer

36. Nike uses the Amazon platform for its online sales.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

The Boundary-Spanning Nature of SCM

To orchestrate and optimize all flows from source to consumption, SCM must take a total systems viewpoint. SCM must ensure that the needs of final customers are satisfied through the coordination of materials and information flows that extend from the marketplace, through the firm and its operations to all its suppliers.

SCM is unique, as it is truly boundary spanning. First, it spans and integrates functions and processes within the enterprise, called intraorganizational coordination. Second, it spans and integrates functions and processes between enterprises of the supply chain, called “cross-enterprise” coordination. In essence, a supply chain needs to function as an extended enterprise. To achieve this, supply chain management has to cross over the boundaries of individual firms and integrate business functions and processes across enterprises.

Concept Check Questions

37. SCM spans and integrates functions and processes within the enterprise, called _____ coordination.

- ☐ a) intraorganizational
- ☐ b) extraorganizational
- ☐ c) cross-enterprise
- ☐ d) external enterprise
- ☐ e) None of these

Correct or Incorrect?

Clear

Check Answer

38. SCM spans and integrates functions and processes between enterprises of the supply chain, called _____ coordination.

- ☐ a) intraorganizational
- ☐ b) extraorganizational
- ☐ c) cross-enterprise
- ☐ d) external enterprise
- ☐ e) None of these

Correct or Incorrect?

Clear

Check Answer

39. Supply chain management has to cross over the boundaries of individual firms and integrate business functions and processes across enterprises.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Intraorganizational Integration

SCM requires participation and coordination of activities between different organizational functions. The relationship between the functions of marketing, operations, sourcing, and logistics is particularly important. For an organization to be effectively integrated with other members of its supply chain, it must have internal coordination. This means that the various functions must share information and conduct coordinated activities. The relationship between the various functions is shown in [Figure 1.5](#).

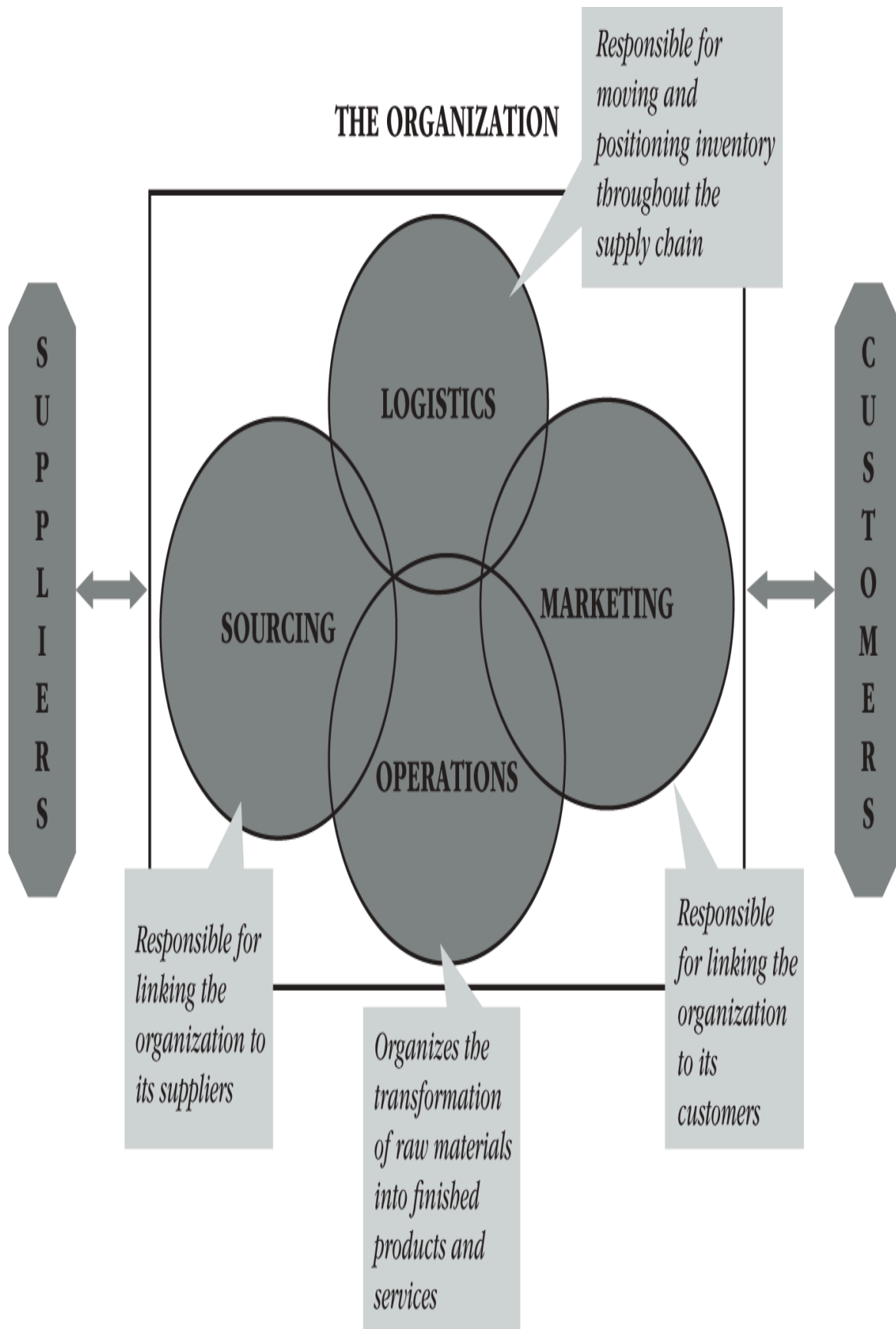


FIGURE 1.5 Organizational integration of enterprise functions.

Marketing is the function responsible for linking the organization to its customers and identifying what customers want in products and services. It is the function that interfaces with the customer. **Operations** ensure that the exact products the customers want are produced efficiently and in a cost-effective manner. It is the function whose job is to organize the transformation of raw materials into finished products. **Sourcing** is the function responsible for linking the organization to its suppliers and ensuring an efficient supply of materials. **Logistics** is responsible for moving and positioning inventory throughout the supply chain and ensuring that the right products are delivered to the right place at the right time. SCM would not be possible without the support of these functions.

To support SCM, each function must also have a systems viewpoint. This type of effort requires company-wide integration and a way of organizational thinking that is different from the traditional “silo” mentality, where each organizational function operates independently. Creating systems thinking can be a big challenge for many companies.

The classic illustration of the “silo” mentality can be seen between the marketing and operations functions of an organization. Historically, the operations function was focused on improving the efficiency of the operating system, through proper scheduling, minimization of setup times, and achieving product standardization. The lexicon of the operations manager, as a result, had focused on operating measures of performance such as productivity measures, units produced, and number of defects. On the contrary, marketing focuses on achieving competitive advantage through expanding market share, creating new market opportunities, offering product variety, and responding to market changes. The lexicon of the marketing manager, by contrast, has focused on sales, profitability, and market share. As a result, often operations and marketing managers were not able to communicate and had different goals.

One of the many disadvantages of working in silos in supply chain management is a lack of coordination between departments, which can lead to excess inventory. For example, if the procurement team is not aware of changes in demand forecast made by the sales team, they may order too much inventory, resulting in increased carrying costs and potential waste.

Today's highly competitive business environment is not forgiving this type of segmented approach between organizational functions. The need to understand and meet customer requirements is a prerequisite for supply chain competitiveness and survival and is the responsibility of marketing. At the same time, economic competitiveness has placed great pressure on cost competition, improvements in quality, and response time, placing the operations function in the limelight. SCM is dependent on operations and marketing working together, sharing information, and making joint decisions.

Another organizational function that has gained increasing appreciation for its critical role in SCM is procurement or purchasing, also known as sourcing. Historically, procurement was concerned with purchasing issues of a primarily transactional nature. Today, leading-edge companies place great focus on the supply side of the chain, which is the domain of purchasing. Not only the cost of purchased materials and supplies form a large part of the total cost of most companies but also purchasing creates an opportunity to integrate the capabilities of the supplier with producers. Therefore, whereas marketing focuses on the customer side of the organization, procurement focuses on the supply side.

Finally, the function of logistics coordinates the materials and information flows that extend from the marketplace, through the firm and its operations, and beyond that of the suppliers to ensure that goods are delivered to the right place. Therefore, like SCM, logistics is an integrative function that has a systems-wide view of the organization, from the customer or market side to the supply side. It has a critical responsibility to ensure that the demands of the marketplace are passed on from marketing to manufacturing and then are linked to purchasing and distribution.

Concept Check Questions

40. _____ is the function responsible for linking the organization to its customers and identifying what customers want in products and services.

- ☐ a) Marketing
- ☐ b) Operations
- ☐ c) Sourcing

- ☐ d) Logistics
- ☐ e) Information Technology (IT)

Correct or Incorrect?

Clear

Check Answer

41. It is the function that interfaces with the customer.

- ☐ a) Marketing
- ☐ b) Operations
- ☐ c) Sourcing
- ☐ d) Logistics
- ☐ e) Information Technology (IT)

Correct or Incorrect?

Clear

Check Answer

42. _____ ensures that the exact products customers want are produced efficiently and in a cost-effective manner.

- ☐ a) Marketing
- ☐ b) Operations
- ☐ c) Sourcing
- ☐ d) Logistics
- ☐ e) Information Technology (IT)

Correct or Incorrect?

Clear

Check Answer

43. _____ is the function responsible for linking the organization to its suppliers and ensuring an efficient supply of materials.

- ☐ a) Marketing
- ☐ b) Operations
- ☐ c) Sourcing
- ☐ d) Logistics
- ☐ e) Information Technology (IT)

Correct or Incorrect?

Clear

Check Answer

44. _____ is responsible for moving and positioning inventory throughout the supply chain and ensuring that the right products are delivered to the right place at the right time.

- ☐ a) Marketing
- ☐ b) Operations
- ☐ c) Sourcing
- ☐ d) Logistics
- ☐ e) Information Technology (IT)

Correct or Incorrect?

Clear

Check Answer

45. The “silo” mentality is where each organizational function operates independently.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

46. Procurement is also known as purchasing or sourcing.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

47. The cost of purchased materials and supplies a small part of the total cost of most companies.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Cross-enterprise Integration

The management of a supply chain as an extended enterprise involves coordinating two-way flows of goods and services, information, and funds.

The integration across the boundaries of several organizations means that the supply chain should function like one organization in satisfying the final customer. The ultimate goal of a supply chain is to operate as a single entity. Information technology (IT) is the key enabler of this capability, without which cross-enterprise integration would not be possible.

This integration can be difficult, as real-world supply chains are usually complex and have many supply chain participants. Achieving integration and coordination of activities in the supply chain is predicated on relationship management. Concepts such as partnerships and alliances have become a part of the SCM vocabulary. Traditional adversarial relationships with suppliers have given way to long-term partnering. However, supply chain relationships need to incorporate more than shared information and a focus on total supply chain cost. Supply chains need to achieve a level of integration that involves collaboration among partners in developing strategic plans and joint setting of long-term goals. An important factor to achieving this level of integration is for companies to have an internal, cross-functional team that engages in ongoing external efforts with suppliers, transportation carriers, and distributors.

Toyota is a good example of successful supplier collaboration. Toyota engages in collaboration with suppliers from the earliest stages of product design—a system called “early supplier involvement.” Toyota not only involves supplier from the early stages of product design but also transfers technology, helps them source more price-competitive raw materials, trains their staff for optimized and efficient processes, and helps them with the logistics so that the transportation costs are also very low. This high involvement of Toyota in about every stage immensely lowers material costs, which in turn gives a great competitive advantage to Toyota. This has led to a significant cost reduction in producing its cars.

In addition to collaborative planning, achieving full cross-enterprise integration requires the sharing of risks and rewards. Most organizations still function in a way that minimizes their own risk and maximizes their own rewards. This strategy may mean that the outcomes they achieve are at the expense of other companies. The cooperative and collaborative approach of SCM is predicated on the win–win outcome. Although adversarial relationships can provide financial gain, the win–win strategy has shown to be the best strategy over the long run.

Concept Check Questions

48. The management of a supply chain as an extended enterprise involves coordinating two-way flows of goods and services, information, and funds.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

49. The ultimate goal of a supply chain is to operate where each firm in the chain is linked to every other firm.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

50. In SCM, suppliers are seen as adversaries.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

51. Toyota is a good example of successful supplier collaboration.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

52. Most organizations still function in a way that minimizes their own risk and maximizes their own rewards.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

SCM vs Logistics

Many people confuse SCM with logistics. Therefore, it is important to clarify their different roles in developing a competitive advantage. SCM is about the collaboration between supply chain partners in a strategic effort to achieve superior competitiveness. Therefore, SCM requires managing different aspects of the coordination process, such as information, technology, distribution, products, raw materials, finances, and most of all, relationships. The relationships involved in SCM are complex and require coordinating managerial processes within firms (intraorganizational) and between firms (cross enterprise).

Logistics, in contrast to SCM, consists of the tasks involved in moving and positioning inventory throughout the supply chain, as shown in [Figure 1.6](#). Logistics is a function that supports SCM on par with marketing, operations, and sourcing. SCM, on the contrary, is a strategic and managerial concept. The function of logistics involves order processing and tracking, inventory management, transportation, warehousing, material handling, and packaging. These activities need to be coordinated and integrated throughout all entities of the chain. Without logistics, there would be inventory stockouts at some locations and too much inventory at others. Consequently, logistics is a function that supports SCM.

Notice that SCM is about managing and coordinating many flows, including inventory. Logistics, on the contrary, is the part of SCM that is concerned with managing the flow of inventory.

Logistics is vital to SCM as it is a key supporting function. Logistics must plan and coordinate all material flow from source to users as one integrated system, rather than a series of independent activities as has been done in the past. Logistics is the function that is responsible for linking the marketplace with the manufacturing process, sourcing activities, and the distribution network to provide high customer service at lower costs. In essence, logistics is the link between the marketplace and the operating activities of the business. The scope of logistics spans from the management of raw materials to the delivery of the final product. Consider an example from the fast-food industry, where logistics is vital for chains such as McDonald's to maintain product quality and timely service. Efficient coordination of food ingredients and supply deliveries to numerous locations worldwide ensures consistency, minimizes waste, and enhances customer satisfaction, bolstering McDonald's competitive edge.



Concept Check Questions

53. Logistics and SCM are the same thing.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

54. _____ is about the collaboration between supply chain partners in a strategic effort to achieve superior competitiveness.

- ☐ a) Logistics
- ☐ b) SCM
- ☐ c) Purchasing
- ☐ d) Marketing
- ☐ e) None of these

Correct or Incorrect?

Clear

Check Answer

55. _____ consists of the tasks involved in moving and positioning inventory throughout the supply chain.

- ☐ a) Logistics
- ☐ b) SCM
- ☐ c) Purchasing
- ☐ d) Marketing
- ☐ e) None of these

Correct or Incorrect?

Clear

Check Answer

56. Logistics is vital to SCM.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

The Rise of SCM

SCM came into global prominence during the COVID-19 pandemic. However, to fully appreciate SCM, it is important to look at its rapid rise as a critical business concept even prior to that. SCM evolved in the 1990s and ushered in a new era of business competition. This was a direct result of the great economic changes of the time for the global economy and an increasingly uncertain business environment. Leading-edge companies, such as Amazon, demonstrated that a reduction in order fulfillment time coupled with customization can be a competitive advantage that the supply chain can provide. SCM enables companies to significantly reduce the time required to design, process, and deliver products to customers, at a lower cost. This allows for greater responsiveness and SCM has evolved into a major strategic tool for companies.

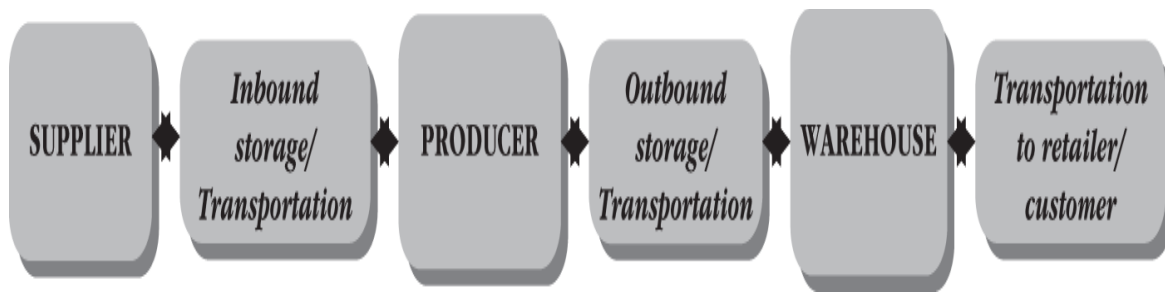


FIGURE 1.6 The logistics function.

Interest in SCM has rapidly grown over the years, as it has proven to be a necessary ingredient for successful global competition. A number of forces have contributed to this trend. First, in recent years, many companies have discovered the large magnitude of savings that can be achieved by planning and managing their supply chain more effectively. Second, advances in information technologies have provided access to comprehensive data from all components of the supply chain. Finally, improvement in transportation methods has led to a reduction in transportation costs, while significantly increasing speed of delivery to multiple locations. One of the most striking examples of this is Walmart's success, which is primarily attributed to mastery of its supply chain. Walmart is highly successful in collaborating with its suppliers, using the latest available technology for data gathering and transfer, and implementing the latest transportation techniques.

Prior to the SCM revolution, order processing was a long process and prone to errors. In the 1980s and 1990s, for example, the average time to process and deliver an order to a customer ranged from weeks to months. There were many steps in the order-to-delivery cycle that had to be completed for the customer to receive the order. Also, many of the steps were performed inefficiently. The customer initiated the order process through telephone, fax, or mail. This order was then processed either manually or using a computer system. The process involved credit authorization, order placement to a warehouse or distribution center, and the arrangement of product delivery by shipper. Often mistakes were made in this process, such as inventories being out of stock. This resulted in expediting orders at extra cost when goods finally arrived. Shipments were often sent to the wrong location, and mistakes were made in the manual processing of forms. To help guard against these problems, companies began to stock large amounts of inventories in warehouses to ensure that they had stock available. Duplicate inventories were often held in different warehouses. The result was a higher cost that was ultimately passed on to the customer.

The larger amounts of inventories, however, still did not guarantee no stockouts, and many firms found themselves having too much of the “wrong” inventory and not enough of what the customer wanted. All this made companies less competitive.

This changed in the 1990s when leading-edge companies such as Dell Computer Corporation began offering highly customized products with a significantly reduced customer response time. Suddenly, other companies had to follow suit or risk going out of business. The result was that the historical management of order fulfillment suddenly became obsolete. Companies found that they had to go beyond their organizations and design competitive supply chains.

One factor that is driving the growth of SCM has been the massive change in the capability and availability of IT. The economy of the 1990s was forever changed by information availability through the Internet and computerization. These technologies provided rapidly accessible information to all parties. They created the foundation for rapid and economical methods of doing business, such as [business-to-business \(B2B\)](#) and [business-to-consumer \(B2C\)](#), from which the new economy quickly emerged.

Another significant factor was greater customer affluence and sophistication, resulting in greater customer demand for a wide choice of quality goods and services. The Internet and other information technologies accelerated this change by empowering consumers. Customers suddenly shifted from being passive and powerless participants to drivers of the new economy. Customers today demand customized products with high quality delivered at record speed. One example of a company meeting the demand for customized products with high quality and fast delivery is Nike's “Nike By You” program. Nike allows customers to personalize their sneakers by choosing colors, materials, and even adding custom text or graphics. These customized orders are then manufactured with high-quality materials and delivered to customers within a relatively short time frame, allowing Nike to meet the expectations of modern customers for personalized, high-quality products delivered quickly.

Then in 2020, the COVID-19 pandemic happened—resulting in simultaneous shocks to demand and supply. The resulting shortages and stockouts put SCM in the limelight and every business understood the consequences of not having a responsive and agile supply chain. Since then, SCM has become a top priority for many firms.



Concept Check Questions

57. SCM evolved in the _____.

- ☐ a) 1970s
- ☐ b) 1980s
- ☐ c) 1990s
- ☐ d) 2000s
- ☐ e) 2010s

Correct or Incorrect?

Clear

Check Answer

58. SCM had little impact on competition.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

59. SCM has grown slowly.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

60. Walmart is a master of its supply chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

61. One factor driving the growth of SCM has been the massive change in the capability and availability of information technology.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

62. Customers have not had an impact on the growth of SCM.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Supply Chain Leader's Box

■ DELL COMPUTER CORPORATION

Dell Computer Corporation made its reputation as an icon of how a company can design and manage its supply chain to reduce customer response time, while still offering product customization at a price lower than competitors. This provided Dell with a clear competitive advantage and a model that others tried to emulate. Dell's supply chain is based on a build-to-order model, which means that it only produces products after receiving customer orders. This model allows Dell to keep inventory levels low and avoid overproduction, which can result in excess inventory and higher costs. Now Dell delivers the products within two to four days once a customized order has been placed by the customer. Dell has focused on the final build of computers using an “assemble and configure to order” strategy. Dell requires its suppliers of variant modules to be in geographically close proximity to produce and deliver overnight for next-day assembly. Suppliers of standard modules, such as processors and memory systems, are in many lower-labor-cost countries. This enables Dell's supply chain to flow end to end in 11 days or less yet still be cost competitive. Such a quick response enabled Dell to reduce its inventory levels compared to the industry standard. Dell has been able to achieve success due to its agile, adaptable, and short supply chain. The system has been set up so that suppliers automatically restock warehouses as needed, and Dell is billed for items only after they are shipped. The result is better value for the customer and less cost for Dell.

Dell's supply chain model was the industry norm for many years. However, as other companies began to emulate this model it was no longer an industry differentiator. To remain competitive Dell has used the strength of its supply chain to shift focus on providing broad IT solutions to different industry segments, such as healthcare, education, and the military. In 2016, the company officially changed its name to Dell Technologies. It is due to the iconic supply chain that the company has been able to be limber and easily adapt to changing markets.

Advances in IT, transportation methods, and greater customer empowerment created a rise in SCM. The 1990s witnessed SCM

becoming a part of the standard vocabulary of corporate presidents and CEOs. SCM has become a new order of business and a tool for companies to survive and thrive. Managers are now focusing on improving all aspects of the process from product design to product delivery, focusing on improving customization, speed of delivery, and a commitment to a concept of zero defects called Six Sigma performance.

Concept Check Questions

63. Dell Computer Corporation made its reputation as an icon of how a company can design and manage their supply chain to reduce customer response time.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

64. Dell's supply chain is based on a build-to-forecast model.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

65. Dell maintains a high inventory level to make sure it can deliver a computer to a customer within 2-4 days once a customized order has been placed by the customer.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

66. Dell is still named Dell Computer Corporation.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Characteristics of a Competitive Supply Chain

There are three key characteristics of a competitive supply chain: responsiveness, reliability, and relationship management. We discuss these here.

Responsiveness

The ability to respond to customers' requirements in ever-shorter time frames has become critical. Today customers want shorter lead times, greater flexibility, and greater product choice. This means that the supplier and manufacturer have to be able to meet the precise demands of the customer in a shorter amount of time than ever before. The ability of a supply chain to have

this level of responsiveness is often described as “agility,” which is the ability to move quickly to meet customer demands. In fact, in rapidly changing environments, agility is more important than long-term strategy, as there is no “long term.” Agility will come from short supply chains that are much more demand driven—responding to what the customer “demands”—rather than forecast driven.

Reliability

Uncertainty is a fact of life for most businesses, such as uncertainty about future demands, uncertainty about a supplier's ability to meet deadlines, or uncertainty about the quality of component materials. In fact, uncertainty is the main reason why companies carry safety stock inventories—to guard against this uncertainty—which then results in higher costs. The best way to reduce uncertainty is by increasing reliability through the redesign of processes that impact performance.

One factor that greatly improves reliability in supply chains is improved visibility. Typically, the further one goes up the supply chain, the more limited the “visibility” of downstream activities. Organizations that are further up the chain have typically relied on demand from their immediate customer in the chain to forecast demand. This lack of coordination has resulted in the classic “bullwhip” effect. Supply chain coordination and sharing of real-time data and information through IT has permitted visibility to all entities in the chain. This results in greatly improved visibility and, consequently, supply chain reliability.

Without visibility supply chain disruptions occur. One example of supply chain disruptions was seen during the COVID-19 pandemic with shortages of personal protective equipment (PPE) and medical supplies in the healthcare industry. As the pandemic hit and the demand for PPE, ventilators, and other medical supplies skyrocketed, it exposed vulnerabilities and uncertainties in the healthcare supply chain, including a lack of visibility and coordination.

Relationship Management

An important characteristic of competitive supply chains is their focus on relationship building and collaboration, rather than the arm's-length adversarial relationships that had been dominant in the past. In many industries, for example, the practice of “single-sourcing” is widespread. It has

been documented that such practices improve quality, product innovation, and design while reducing costs and improving overall responsiveness. Underlying this idea is that the buyer–supplier relationship should be based on a partnership of trust, commitment, and fairness. There are numerous advantages to such relationships that can be long-term and mutually beneficial. The competitive advantage of companies such as Toyota and Honda over their competitors in the auto industry comes from the collaborative relationships they have developed with their suppliers. As we have seen thus far, SCM is primarily about the management of relationships across complex networks of companies. Successful supply chains will be those that are governed by a constant search for win–win relationships based on reciprocity of trust.

Concept Check Questions

67. There are three key characteristics of a competitive supply chain. Which of the following is not one of these?

- ☐ a) Financial stability
- ☐ b) Responsiveness
- ☐ c) Reliability
- ☐ d) Relationship management

Correct or Incorrect?

Clear

Check Answer

68. The ability to respond to customers' requirements in ever-shorter time frames has become critical.

- ☐ a) Financial stability
- ☐ b) Responsiveness
- ☐ c) Reliability
- ☐ d) Relationship management

Correct or Incorrect?

Clear

Check Answer

69. Agile supply chains tend to be longer so as to have more suppliers to draw from.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

70. The best way to reduce uncertainty is by increasing this through the redesign of processes that impact performance.

- ☐ a) Financial stability
- ☐ b) Responsiveness
- ☐ c) Reliability
- ☐ d) Relationship management

Correct or Incorrect?

Clear

Check Answer

71. One factor that greatly improves reliability in supply chains is improved visibility.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

72. An important characteristic of competitive supply chains is their focus on _____ and collaboration.

- ☐ a) financial stability
- ☐ b) responsiveness
- ☐ c) reliability
- ☐ d) relationship building

Correct or Incorrect?

Clear

Check Answer

Global Insights Box

■ ZARA

The Spanish retailer Zara exemplifies that to operate a successful global operation a company may have to defy most of the current conventional wisdom about how supply chains should be run. Zara has adapted numerous best practices to create its own brand of global SCM that may seem unorthodox to some. For example, Zara has been known to send a half-empty truck across Europe, pay to airfreight costs to Japan twice a week, move unsold items out of its retail stores after only two weeks, or run factories for only one shift. For most observers, this would be no way to run a supply chain. Of course, none of these tactics are especially effective by themselves. Rather, they stem from a holistic approach to SCM that optimizes the entire chain instead of focusing on individual parts.

In today's economy, where most companies have rushed to outsource, Zara keeps almost half of its production in-house. Rather than pushing its factories to maximize output, the company focuses capital on building extra capacity to give it flexibility. Also, Zara manufactures and distributes products in small batches, rather than chasing economies of scale. To ensure top performance, the company manages all design, warehousing, distribution, and logistics functions itself. The result is a super-responsive supply chain uniquely tailored to fully support Zara's business model. Zara can design, produce, and deliver a new garment to its 2,200-plus stores worldwide in just a few days. However, Zara keeps a limited amount of inventory. In a Zara shop, customers can always find new products but know that supply is limited. This creates a sense of urgency for the customer to purchase rather than waiting for a markdown, translating into high profit margins and a consistent yearly growth. More recently Zara has noticed growth in online sales and is shifting more inventory to be available online. To further implement its strategy, Zara is increasingly relying on IT, such as radio frequency identification technology (RFID), using cutting-edge systems to track the location of garments instantly and making high-demand items quickly available to customers. Zara offers a

model where profits are gained through controlling the entire end-to-end supply chain.



Concept Check Questions

73. The Spanish retailer Zara operates a fairly standard supply chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

74. Zara keeps almost half of its production in-house.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

75. Zara manufactures and distributes products in large batches in order to create economies of scale.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

76. Zara can design, produce, and deliver a new garment to its 2,200-plus stores worldwide in just a few days.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Trends in SCM

Today's organizations face a number of trends that impact the way supply chains are designed and managed. These trends are a result of a fast-changing global and technologically connected economy that creates unique challenges companies must address. We look at these here.

Globalization

In the eyes of the economist Thomas Friedman, globalization has replaced the so-called Cold War of the post–World War II era as the dominant driving force of world economics.² The concept of the “global marketplace” has changed the meaning of how and where business is conducted, for all enterprises and for individual customers. Changes in IT, transportation, and government policies have made the concept of the global economy a fact of life. A number of countries have aggressively pursued opening up international trade. This

has served to open new markets and sources of supply for most companies, both large and small. Further, these opportunities have been made possible through IT, which has helped break the distance barrier. Companies have benefited from a larger choice of product sources. Consumers have also benefited due to greater product choice, higher quality, and lower cost.

Managing global supply chains, however, has a number of challenges. The distance factor can become a significant barrier when shipments move thousands of miles from suppliers to customers. In an environment of reduced cycle times, expected higher levels of reliability, and emphasis on efficiency, the distance factor presents special challenges to supply chain managers. Nike is an example of a company that transitioned from a local to a global brand, facing challenges such as complex supply chains, labor controversies, and quality control issues. To address them, Nike improved supply chain visibility, quality standards, and sustainability practices, and invested in technology, ultimately becoming a global sportswear leader.

Concept Check Questions

77. Changes in information technology, transportation, and government policies have made the concept of the global economy a fact of life.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

78. Consolidation and outsourcing have forced companies to deal with smaller choices of product sources.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

79. With information technology, managing a global supply chain is as easy as managing a domestic supply chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Outsourcing and Reshoring

Outsourcing is hiring a third party to perform a set of tasks for a fee. Companies have historically and routinely outsourced certain activities, such as janitorial services, records management, or uniform cleaning. The difference today is that companies are outsourcing almost all activities on a much larger scale.

Increased competitive pressure has forced companies to recognize that they compete through their core competencies (sometimes termed “distinctive competencies”). This means that an organization creates superior value for customers by managing their core competencies better than competitors. To be able to focus on core competencies, many companies outsource other activities to those that can do them better. Outsourcing can involve hiring out one aspect of the operation, such as shipping to outsourcing entire part of manufacturing process. The practice has rapidly grown in recent years and has helped companies be more efficient by focusing on what they do best.

The convergence of technologies at the turn of this century has taken the concept of outsourcing to a new level. Massive investments in technology, such as worldwide broadband connectivity, the increasing availability of

lower-cost computers, and the development of software such as e-mail, search engines, and other software have allowed individuals to work together in real time from anywhere in the world. The result has been the outsourcing of virtually any job imaginable. Manufacturers have outsourced software development and product design to engineers in India, accounting firms have outsourced tax preparation to India, and hospitals have outsourced the reading of radiology scans to doctors in India and Australia. India is now the leading country in offshore business services.

Since the COVID-19 pandemic, many companies have been rapidly shifting locations from where they source their products, often moving to domestic sources. This is called **reshoring** and has been helped with recent U.S. policy moves such as The Inflation Reduction Act which took effect in 2023. Days after the bill was signed, Honda and LG Energy announced a \$4.4 billion battery plant to be completed by the end of 2025. Another shift is using what is termed as “friend-shoring” where sourcing and manufacturing are moved closer to countries with similar political ideologies. China's zero COVID-19 policy and political challenges have pushed many companies to relocate to friendlier shores, such as India and Vietnam for all goods – from furniture and footwear to clothing. Similar trends are seen across all sectors with Volvo announcing it will open its first European factory in 60 years in Slovakia, and the United States proposing a Chip 4 Alliance with Japan, South Korea, and Taiwan to cooperate in all phases of the computer-chip supply chain. These measures all illustrate the importance of outsourcing and shifting trends.

Concept Check Questions

80. _____ is hiring a third party to perform a set of tasks for a fee.

- ☐ a) Outsourcing
- ☐ b) Offshoring
- ☐ c) Core competency
- ☐ d) Reshoring
- ☐ e) Rehoming

Correct or Incorrect?

Clear

Check Answer

81. This is also known as a distinctive competency.

- ☐ a) Outsourcing
- ☐ b) Offshoring
- ☐ c) Core competency
- ☐ d) Reshoring
- ☐ e) Rehoming

Correct or Incorrect?

Clear

Check Answer

82. Since the Covid-19 pandemic many companies have been rapidly shifting locations from where they source their products, often moving to domestic sources. This is called _____.

- ☐ a) outsourcing
- ☐ b) offshoring
- ☐ c) core competency
- ☐ d) reshoring
- ☐ e) rehoming

Correct or Incorrect?

Clear

Check Answer

Supply Chain Leader's Box

■ WALMART

Even some of the most successful companies have encountered difficulties in managing their global supply chains. For example, Walmart encountered large problems when entering the Brazilian market. Walmart quickly found that they needed to adapt product offerings to local tastes, such as replacing footballs with soccer balls and offering deli counter items that included sushi. Changing product lines, however, was the easy part. There were other aspects of Walmart operations that caused greater problems. The logistical aspects of operating in the South American markets have been especially challenging. For example, rapid order fulfillment time is not nearly as easy to accomplish in Brazil as in the United States, where Walmart has easy access to suppliers and transportation companies.

São Paulo is characterized by bumper-to-bumper traffic, which impedes timely delivery and smooth replenishment for Walmart stores. Further, there are occasional mysterious “disappearances” of shipments that create significant delivery problems. Finally, large stores in Brazil have difficulty achieving the economies of scale of their U.S. counterparts. Still, Walmart believed in the potential for growth and expansion, and it understood that it needed to adjust to be successful. Despite these obstacles, Walmart's persistence led to a significant presence, with nearly 558 stores at its peak in 2013.

However, the constantly faced challenges in Brazil's grocery sector, struggling with product adaptation, logistical hurdles, security concerns, and achieving economies of scale and on top of that the intense competition eventually led to their exit from the Brazilian market in 2019. As of 2024, there is no name of Walmart in Brazil.

Concept Check Questions

83. Walmart encountered large problems when entering the Brazilian market.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

84. The logistical aspects of operating in the South American markets for Walmart have been fairly minor.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

85. Large stores in Brazil have difficulty achieving the economies of scale of their U.S. counterparts.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

86. Walmart is currently highly competitive in Brazil.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Digital Transformation

Technology is an essential driver of supply chain management. Technological advances have enabled companies to produce products faster, with better quality, at a lower cost, move them from source of supply to final customers, all the while tracking their movement. Many processes that were not imaginable only a few years ago have been made possible through the use of technology. All this has pushed companies to rapidly adopt and implement digital technologies—a process called **digital transformation**. Digital transformation has enabled organizations to create new or modify existing products, services and operations by the means of translating business processes into a digital format.

An important aspect of digital technology is IT which refers to technology that enables storage, processing, and communication within and between firms. IT can be viewed as an enabler of SCM, as without its coordination between supply chain members would not be possible. The Internet has linked trading partners—customers, buyers, and suppliers—and has enabled electronic commerce and the virtual marketplace. This is one of the greatest forces that has made information sharing along the supply chain possible.

Another powerful IT is enterprise software, such as [enterprise resource planning \(ERP\)](#). These are large software programs used for planning and coordinating all resources throughout the entire enterprise. They allow data sharing and communication within and outside the firm, enabling collaborative decision making.

Other examples of information technologies that have impacted the supply chain include [wireless communication technologies](#) significantly improving business operations. For example, wireless homing devices and wearable computers are being used in warehouses to quickly guide workers to the

locations of goods. This serves to significantly improve warehouse operations and logistics. Wireless technologies, enhanced by satellite transmission, can rapidly transmit information from one source to another. For example, Walmart uses company-owned satellites to automatically transmit POS data to computers at its warehouses for replenishment.

Global positioning systems (GPS) are another type of wireless technology that uses satellite transmissions to communicate exact locations and have dramatically improved logistics transportation. GPS has numerous logistics applications such as in distribution, where trucking companies use GPS technology to identify the exact location of their vehicles.

Radio frequency identification (RFID) is yet another wireless technology that is dramatically changing supply chain operations. RFID uses memory chips equipped with tiny radio antennas that can be attached to objects to transmit streams of data about the object. For example, RFID can be used to identify any product movement, reveal a missing product's location, or have a shipment of products “announce” their arrival. Empty store shelves can signal that it is time for replenishment using RFID, or low inventories can signal the vendor that it is time to order more products. In fact, RFID has the potential to become the backbone of logistics, as it can identify and track billions of individual objects all over the world, in real time.

These information technologies collectively provide access to data never before available. This information has changed how products are bought and sold and has changed the modus operandi of the marketplace. Buyers no longer have to go to the seller's place of business to view and buy products. Rather, consumers can complete purchases seven days a week, 24 hours a day. Digital technologies have changed how buyers and sellers interact in the marketplace, both **B2B** and **B2C**. As such, digital transformation is top supply chain priority for firms today.

Concept Check Questions

87. Rapidly adopting and implement digital technologies is a process called _____.

- ☐ a) Digital transformation
- ☐ b) Information technology

- ☐ c) Enterprise resource planning
- ☐ d) Global positioning systems
- ☐ e) Radio frequency identification

Correct or Incorrect?

Clear

Check Answer

88. This refers to technology that enables storage, processing, and communication within and between firms.

- ☐ a) Digital transformation
- ☐ b) Information technology
- ☐ c) Enterprise resource planning
- ☐ d) Global positioning systems
- ☐ e) Radio frequency identification

Correct or Incorrect?

Clear

Check Answer

89. These are large software programs used for planning and coordinating all resources throughout the entire enterprise.

- ☐ a) Digital transformation
- ☐ b) Information technology
- ☐ c) Enterprise resource planning
- ☐ d) Global positioning systems
- ☐ e) Radio frequency identification

Correct or Incorrect?

Clear

Check Answer

90. These use satellite transmissions to communicate exact locations and have dramatically improved logistics transportation.

- ☐ a) Digital transformation
- ☐ b) Information technology
- ☐ c) Enterprise resource planning
- ☐ d) Global positioning systems
- ☐ e) Radio frequency identification

Correct or Incorrect?

Clear

Check Answer

91. These uses memory chips equipped with tiny radio antennas that can be attached to objects to transmit streams of data about the object.

- ☐ a) Digital transformation
- ☐ b) Information technology
- ☐ c) Enterprise resource planning
- ☐ d) Global positioning systems
- ☐ e) Radio frequency identification

Correct or Incorrect?

Clear

Check Answer

92. Radio frequency identification (RFID) is based on satellite transmissions.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Artificial Intelligence (AI) and Analytics

In a recent interview Maria Villablanca, Co-Founder & CEO of Future Insights Network, explained the role of AI in SCM. She said “Pre-COVID AI was this aspirational thing ... then businesses realized they must get a competitive advantage. Technology is offering businesses resilience. AI is no longer a future project. AI is now part of everyday operations and business.”³ The COVID-19 pandemic pushed companies over a “technology tipping point” where the adoption of AI and analytics technology went from incremental, cautious exploration to a must-have organizational resource. Businesses are quickly turning to technology and AI as the answer to the turbulence of the postpandemic era. This is one of the biggest trends impacting SCM today.

This started with [big data analytics](#) a few years earlier. **Big data** was a term used in early 2000s and refers to large datasets whose size is so large that the quantity can no longer fit into the memory that computers use for processing. Businesses are awash in data captured from every source imaginable, which can be structured or unstructured. This data includes POS, RFID, or GPS data, or it can be in the form of Twitter feeds, Facebook, call center data, or consumer blogs. This data can be captured, stored, communicated, aggregated, and analyzed. [Analytics](#) is applying math and statistics to these large datasets. Many of these statistical tools, such as correlation and regression analysis, had been in use for decades.

What became different is the combination of the large data with statistical algorithms—or analytics—fueled by new computing power. This combination creates the ability to extract meaningful insights and turn information into intelligence. Big data analytics has revolutionized supply chain management by offering enhanced visibility, accurate demand forecasting, and inventory

optimization. Further, advancements in machine learning (ML) and AI have created significant new opportunities to use big data and develop new and more powerful algorithms. Predictive analytics and ML identify issues and optimize routes, while supplier collaboration and cost reduction are achieved. It improves risk management, enhances customer service, and enables real-time tracking. Numerous successful use cases demonstrate its transformative potential. Today we just use the term “data” as almost all available data is big in size. It is AI—especially generative AI—that is now making the greatest difference.

Few areas of business have been transformed by AI and analytics as much as supply chain management. Technology has enabled physical objects to be embedded with electronics, such as sensors and software, enabling these objects to collect and exchange data. These objects can be buildings, vehicles, machines, and all other entities that make up the supply chain. The connectivity of these physical objects with electronic devices is called the [Internet of Things \(IoT\)](#). As consumers, we are all accustomed to same-day retail deliveries and the ability to quickly find and purchase items online. However, achieving such high responsiveness requires a data-driven, end-to-end supply chain system.

AI has enhanced all aspects of SCM, such as demand forecasting, reducing inventory issues and stockouts. Automation has streamlined operations, speeding up tasks and reducing errors. Predictive maintenance has minimized downtime and maintenance costs. Real-time data analysis enables agile responses to supply chain disruptions. By end of 2024, it's estimated that 75% of supply chain organizations will invest in AI and ML technologies to improve planning, logistics, and inventory management, leading to a 30% increase in supply chain efficiency.

The current trends in supply chain management in 2024 and beyond focus on the role of automation and emerging technologies. This includes the importance of AI, augmented reality (AR), ML, and virtual reality (VR) in streamlining supply chain operations. Automation, driven by these technologies, enhances efficiency, helps manage inventory, and meets purchasing demands more effectively. These trends are shaping the future of supply chain management by improving productivity and reducing costs.

Concept Check Questions

93. This was a term used in early 2000s and refers to large datasets whose size is so large that the quantity can no longer fit into the memory that computers use for processing.

- ☐ a) Analytics
- ☐ b) Big data
- ☐ c) Internet of Things
- ☐ d) Machine learning
- ☐ e) Augmented reality

Correct or Incorrect?

Clear

Check Answer

94. This is applying math and statistics to these large datasets.

- ☐ a) Analytics
- ☐ b) Big data
- ☐ c) Internet of Things
- ☐ d) Machine learning
- ☐ e) Augmented reality

Correct or Incorrect?

Clear

Check Answer

95. The connectivity of these physical objects with electronic devices is called the _____.

- ☐ a) Analytics
- ☐ b) Big data
- ☐ c) Internet of Things
- ☐ d) Machine learning
- ☐ e) Augmented reality

Correct or Incorrect?

Clear

Check Answer

AI & Analytics Box

■ TESCO

Consider the supply chain of Tesco, the British multinational grocery and general merchandise retailer. The company uses its loyalty program to create data by tracking all sales and linking them to customer information. The data is then mined to inform a variety of decisions, such as best ways to microsegment its customer base, targeting promotions, optimizing product mix, and pricing. Based on data analysis, the company then aligns organizational efforts toward each segment, such as tailoring store formats to particular locations, ranging from convenience stores to online stores. More recently, Tesco has incorporated generative AI to enhance customer experience, predict demand, analyze customer behavior, and prevent fraudulent activities. Generative AI extracts valuable insights from reports and dashboards, streamlining decision making. Also, Tesco is exploring the use of generative AI to make customer service interactions more engaging, such as through platforms like WhatsApp. As a result, Tesco can determine exactly what types of customers buy from each store format, determine what products they buy, and ensure availability. It can also make customer interactions more engaging and interactive for a better customer experience. These insights are digitally linked to sourcing, transportation, distribution, and all areas of the supply chain. This ensures the supply chain is responding to customer availability of these products when and where customers want them. This is the digital supply chain and is a strategy used by almost all major retailers, from Amazon to Walmart to CVS.

Concept Check Questions

96. Tesco uses its loyalty program to create data by tracking all sales and linking them to customer information.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

97. Tesco has incorporated Generative AI to enhance customer experience.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

3-D Printing, Additive Manufacturing, and Robotics

Research conducted by IBM has identified three emerging and transformative manufacturing technologies: three-dimensional (3-D) printing, a new generation of intelligent assembly robots, and the rise of open-source hardware. Each of these trends taken alone is transformative. However, their power is multiplied when they are combined together with big data analytics.

The first of these trends is [3-D printing](#) or [additive manufacturing](#), a technology that is changing the way manufacturing is being conducted. In fact, forecasts expect the market for this technology to reach \$34.5 billion in 2028 from \$15.8 billion in 2020. This technology is similar to ink-jet and laser-jet printers we are familiar with, except that these are 3-D printers. These printers work by depositing thick layers of materials one on top of the other, such as layers of plastics and metals. The layering of these materials gradually builds up until the object is produced. The final creation is a solid object from a software design. This process has enabled desktop manufacturing of one object at a time and does not require economies of scale. Additive

manufacturing is just an industrial version of 3-D printing. This technology is already being used to make items such as medical implants and to produce plastic prototypes for engineers and designers. A number of manufacturers, such as General Electric, are already developing plans to implement 3-D printing on a broader scale.

The second of these trends is a new generation of [intelligent assembly robots](#). These robots have greater capabilities than in the past, while the cost and installation requirements of these technologies have made them broadly accessible. Unlike past robotic systems that required large complex installations and typically started at around \$250,000 per assembly station, the new generation costs a fraction of that price, and can be installed in a day. Now these intelligent assembly robots cost as low as \$25,000 in 2023. These advancements have made state-of-the-art automation within reach of even small manufacturing companies.

The third of these trends is [open-source hardware](#). In the past, design information for electronic or computer hardware was copyrighted or licensed. Often companies engaged in reverse engineering to learn how the product was made. The new trend in open-source hardware allows electronic and computer hardware designs to be made available for use at no charge. This allows the sharing of all the information needed to build the product, such as documentation, schematic diagrams, construction details, parts lists, and logic designs. This will significantly accelerate the design and creation of new products.

Collectively these trends and technologies are removing the physical constraints historically associated with manufacturing, such as building molds, ordering parts, and reconfiguring assembly machinery. The manufacturing process can now be run through software. Driven by big data analytics, it drives the [digital supply chain](#).

Concept Check Questions

98. This is a technology that is changing the way manufacturing is being conducted.

- ☐ a) Additive manufacturing
- ☐ b) Intelligent assembly robots

- ☐ c) Open-source hardware
- ☐ d) Digital supply chain
- ☐ e) None of these

Correct or Incorrect?

Clear

Check Answer

99. These have greater capabilities than in the past, while the cost and installation requirements of these technologies have made them broadly accessible.

- ☐ a) Additive manufacturing
- ☐ b) Intelligent assembly robots
- ☐ c) Open-source hardware
- ☐ d) Digital supply chain
- ☐ e) None of these

Correct or Incorrect?

Clear

Check Answer

100. This allows electronic and computer hardware design to be made available for use at no charge.

- ☐ a) Additive manufacturing
- ☐ b) Intelligent assembly robots
- ☐ c) Open-source hardware
- ☐ d) Digital supply chain
- ☐ e) None of these

Correct or Incorrect?

Postponement

Companies are continually struggling to reach global markets, while providing local customization. Even in a geographically compact area such as Europe, there are still significant needs for local customization. For example, consider differences in preferences for washing machines in different European countries. The French, for example, prefer top-loading machines, whereas the British prefer front loaders. The Germans prefer high-speed spins, but the Italians prefer a lower speed. Similar differences occur with other products, such as soft drinks, requiring the Coca-Cola Corporation to offer many different soft-drink flavors to cater to the unique local tastes. These differences significantly affect SCM.

The challenge for a global company is to achieve the cost advantage of standardization while still catering to local taste. This is essentially mass customization coupled with rapid delivery. One way a company can achieve this is to seek standardized parts, components, and modules, and then, through flexible manufacturing and logistics, provide specific product demands to each market. This is sometimes called **postponement**, where completion of the final product is postponed to the last possible moment until local demands are known with greater certainty. HP was known for this in the production and distribution of its printers in the European market. The company completed the manufacture of the product, storing it in a central location, then waited to finalize packaging and specific country/language labeling until local demand was known. Postponement is an important strategy for companies to reach diverse geographic areas while still providing customization.

Fast-food chains, such as McDonald's, use postponement in their supply chain for customizable burgers. Instead of pre-assembling all combinations, burgers are assembled with specific ingredients when a customer orders. This reduces waste, ensures freshness, and enables a wide range of options without excess inventory. Postponement enhances efficiency, offers customization, and improves customer satisfaction. It's a strategy to meet diverse demands while minimizing waste and maintaining efficiency.

Concept Check Questions

101. Products are rarely customized for different markets.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

102. The challenge for a global company is to achieve the cost advantage of standardization while still catering to local taste.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

103. This is where the completion of the final product is postponed to the last possible moment until local demands are known with greater certainty.

- ☐ a) Delayed completion
- ☐ b) Customization
- ☐ c) Delayment
- ☐ d) Postponement

Correct or Incorrect?

Clear

Check Answer

The Lean Supply Chain

The lean philosophy has been of great importance in business as it has focused on the elimination of waste and has helped numerous companies become more competitive. The importance of lean thinking has now been extended to the supply chain. It has been recognized that although individual firms can become lean by themselves, waste anywhere in the supply chain is passed on to the customer, and ultimately everyone in the supply chain pays for it. For example, shifting inventories to suppliers is ultimately passed on to the customer in the form of higher cost and makes the entire supply chain less competitive.

The lean supply chain can be defined as the set of all organizations directly linked by upstream and downstream flows of products, services, finances, and information that collaboratively work to reduce cost and waste. As such, a lean supply chain requires all supply chain organizations to work together. It requires a coordinated effort among partners to eliminate waste across the entire supply chain by analyzing processes and identifying areas for improvement. A well-known example of lean principles in action within the supply chain is Toyota's production system (TPS). Toyota pioneered many of the concepts that underpin lean supply chain management. Toyota is famous for its just-in-time (JIT) inventory system, where components are ordered and arrive precisely when they are needed for production—minimizing inventory holding costs and waste. This approach has become a model for lean supply chain practices across various industries.

Concept Check Questions

104. The importance of lean thinking has been extended to the supply chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

105. The _____ supply chain can be defined as the set of all organizations directly linked by upstream and downstream flows of products, services, finances, and information that collaboratively work to reduce cost and waste.

- ☐ a) digital
- ☐ b) innovative
- ☐ c) modern
- ☐ d) lean
- ☐ e) green

Correct or Incorrect?

Clear

Check Answer

106. A well-known example of lean principles in action within the supply chain is Toyota's Production System

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Supply Chain Resilience

SCM and global sourcing have lowered purchase prices and expanded market access. This wide reach, however, has increased the level of supply chain risk.

There is an increased risk of product and service flow disruptions and in the magnitude of these disruptions. Supply chain disruptions, as seen during the COVID-19 pandemic, are a significant corporate crisis and can be very costly. Imagine, for example, a producer of an influenza vaccine suddenly not being able to receive its key ingredients from a supplier during peak flu season. Production may be halted, the company's survival may be of serious concern, and the welfare of customers might be jeopardized. In response to the pandemic, companies are reevaluating their supply chain strategies. They are restructuring their supply chains to build resilience into their systems, with 85% planning to invest in resilience and agility, aiming to reduce supply chain disruptions by and increase recovery speed.

Managing supply chain risks is challenging because disruptions can occur for a wide variety of reasons. This can include transportation delays; industrial plant fires; work slowdowns or stoppages; natural disasters, such as earthquakes or hurricanes; and man-made disasters, such as the 9/11 terrorist attacks. As companies have increasingly focused on lean operations, they no longer have the inventory or excess capacity to make up for production losses caused by such disruptions. As a result, they are highly vulnerable to even a short material-flow problem. The vulnerability of lean supply chains was felt globally during the COVID-19 outbreak in 2020. Global supply chains had become increasingly dependent on China for sourcing and manufacture, and the global epidemic left many companies without sources of supply.

Since the pandemic, companies are continuing to look for ways to guard their supply chains against disruptions. Some strategies include having access to backup suppliers, building excess capacity into the system, screening and monitoring suppliers for supply chain risks, requiring suppliers of critical items to develop detailed disruption plans, and including the expected costs of disruptions in the total cost of sourcing. To reduce dependency Apple is accelerating its efforts to decouple its supply chain from China, pushing its partners to establish manufacturing operations in other countries. For example, Hon Hai Precision Industry/Foxconn, Apple's largest partner, plans to invest \$700 million in a new plant in India, which is expected to create around 100,000 jobs. This move aims to reduce Apple's dependency on China for iPhone production and diversify its supply chain. Overall, Apple is committed to building a more diverse and sustainable supply chain. Since 2024, the newly launched iPhone 15 will be the one manufactured in India.

Shifts are also being made in how companies reach consumers. Since the pandemic many brands have accelerated plans to grow directly through their own channels, especially online, rather than retailers and discount stores. This helps companies better address mismatch between demand and supply, and keep control over the consumer experience. For consumers, this also means fewer places to buy leading brand products, such as Nike sneakers, Polo shirts or a Canada Goose coat.

Concept Check Questions

107. SCM and global sourcing have raised purchase prices and expanded market access.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

108. Managing supply chain risks is challenging because disruptions can occur for a wide variety of reasons.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

109. As companies have increasingly focused on lean operations, they have increased their inventory levels.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Supply Chain Security

Related to supply chain disruption is the study of supply chain security and maintaining product integrity as goods are moved across the globe between borders. Today's strict security initiatives make supply chain relationships much more complex, and the study of ways to protect security while maintaining efficiency is now a key issue. This is particularly critical when dealing with international freight movement. Tighter security and inspection at ports can significantly increase transit time and increase costs. Government regulations aimed at preventing terrorist threats, such as Customs-Trade Partnership Against Terrorism (C-TPAT) and the Container Security Initiative (CSI), require companies to engage in high levels of compliance. Although these measures are necessary, companies are working to find ways to comply while still engaging in outsourcing, offshoring, and global sourcing on a cost-efficient scale.

Other concerns are theft and product tampering. This is especially true for high-valued goods and pharmaceuticals, although anything that has intrinsic value can potentially be stolen. Supply chain security looks at different ways to protect the product, from using electronic seals to prevent tampering, to using RFID and GPS technologies to track product location. In 2010, a major pharmaceutical heist occurred in the United States, involving the theft of a tractor-trailer carrying approximately \$75 million worth of prescription drugs. The stolen medications encompassed a range of pharmaceuticals, from painkillers to cancer treatments. This incident underscores the vulnerability of the pharmaceutical supply chain to theft and the critical importance of security

measures such as GPS tracking and tamper-evident packaging. The company affected by this theft, although not specified, represents the pharmaceutical industry's ongoing efforts to secure its supply chain and protect patient safety. More recently in 2024 attacks on cargo ships in the Red Sea have resulted in stolen cargo and rerouting of vessels. These are all examples of ongoing supply chain security issues.

Concept Check Questions

110. Today's strict security initiatives make supply chain relationships much more complex, and the study of ways to protect security while maintaining efficiency is now a key issue.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

111. Theft is rarely a problem with modern supply chains.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Sustainability and the “Green” Supply Chain

Environmental concerns including climate change, energy use, environmental contamination, and resource depletion are here to stay. Consider that the economies of India and China are growing at high rates, and the population of the world continues to grow, creating shortages of many resources that we used to take for granted. Corporations are increasingly aware that they must design their supply chains for sustainability. This means designing processes to use environmentally friendly inputs and creating outputs that can be recycled and that do not contaminate the environment.

Sources of supply and movement of goods are huge factors in ensuring sustainability. Consider that Starbucks selects and manages its growers to ensure the integrity of its environment. Starbucks mandates harvesting practices of its growers that do not damage rainforests.

Other aspects of the supply chain are also important to sustainability, such as packaging and transportation to reduce environmental impacts. Changes such as reducing the amount of cardboard or filler by designing “smart packages” can save companies money. McDonald's has recently introduced new packaging with the goal to source 100% of all fiber-based packaging from recycled or certified sources. Coca-Cola has been producing a partially biobased PlantBottle and is working toward a 100% bio-based PlantBottle, whereas PepsiCo is experimenting with edible packaging. In transportation, companies are working to optimize delivery strategies that reduce the carbon footprint. For example, 3M has developed an innovative system to install adjustable decks in trucks, allowing placement of pallets on two levels, thus reducing the number of daily truckloads. Companies are also realizing that these types of measures are not only important to compliance with environmental regulation and consumer demand, but they are also good business practices. Starbucks, for example, realized that by working with growers to protect the environment, they are assured of a consistent and reliable source of supply. The adoption of sustainable practices in SCM is rapidly becoming a major trend, with 71% of companies reporting that they plan to invest more in sustainability within the period from 2023 to 2028, aiming for a 15% reduction in carbon emissions.

Concept Check Questions

112. Corporations are increasingly aware that they must design their supply chains for sustainability.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

113. Starbucks is one company that exercises no control over its suppliers.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

114. Only about 15 percent of companies are reporting that they plan to invest more in sustainability within the period from 2023 to 2028.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Innovation

Innovation is increasingly becoming a critical capability for companies across the globe. This can include designing new products that satisfy customer demands, designing new cost-cutting production processes, or coming up with more efficient product delivery mechanisms. For example, consider a pharmaceutical company recently involved in developing the flu vaccine for the recent outbreak of H1N1. Innovation involves identifying the vaccine components and doing clinical trials, as well as production, packaging, and distribution. This must be done efficiently, ensuring the highest security, all the while doing it as expediently as possible to reach the market quickly.

Companies that compete on innovation realize that their entire supply chain must be designed to support their efforts and are designing them accordingly. These chains are typically shorter to reduce time to market. Also, innovative products need greater protection from copying and tampering, and security issues become critical. The role of suppliers is especially important in these supply chains. Suppliers need to be involved early in the product design process to shorten the design time. Also, suppliers are an excellent source of product ideas and process improvements. As competitive pressures increase, continuing to find ways to manage supply chains for innovations will remain an important issue. This means coming up with new ideas and being able to produce and deliver products faster than competitors.

Amazon Prime Air, the company's drone delivery service, is designed to revolutionize the way packages are delivered to customers. Drones are used to transport packages quickly and efficiently, especially in remote or hard-to-reach areas. This innovation has the potential to significantly reduce delivery times and costs, offering a new level of convenience for customers and optimizing Amazon's supply chain operations.

Concept Check Questions

115. Innovations are rare in SCM.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

116. Companies that compete on innovation realize that their entire supply chain must be designed to support their efforts.

☐ True

☐ False

Correct or Incorrect?

Clear

Check Answer

Managerial Insights Box—Outsourcing Innovation

■ GOLDCORP, INC.

Goldcorp, Inc. was one of the world's top gold producers and in 2019 merged with Newmont Mining Corporation. A few years earlier the company faced a big problem and illustrates a great example of how traditional procurement can be used creatively. At the time, some of Goldcorp, Inc.'s mines were consistently performing below standard, and the mining engineers were at a loss on how to increase production. Finally, Robert McEwen, the chief executive officer (CEO) of Goldcorp, Inc. at the time, decided to try an unusual strategy. He decided to offer \$575,000 in prize money, with a top award of \$105,000, to the person or company that would find a way for Goldcorp to mine more gold.

The challenge, which was broadcast via the Internet, paid off for Goldcorp, Inc. Two Australian companies collaborated to come up with a 3-D depiction of Red Lake mine, which was especially problematic. The 3-D graphical depiction produced a surprise breakthrough in terms of how to approach and mine more gold at the Red Lake facility. With the new process, the mine produced 504,000 ounces at a production cost of \$59 an ounce, compared to 53,000 ounces at a production cost of \$360 an ounce.

Goldcorp, Inc. showed that the traditional procurement activity can be used in many different ways, even for innovation. The company had effectively outsourced part of its engineering activity to a supplier. More significantly, this was not one of its preferred or even regular suppliers, but one that they had not known previously. Rather than being found and evaluated by Goldcorp, Inc.'s procurement group in the context of predetermined supplier criteria, the supplier had offered their services in innovation through competitive motivation. Goldcorp had moved beyond seeking innovation from its own staff and even its own “local” suppliers and has shown that sources of innovation can be found anywhere in the supply chain.

Concept Check Questions

117. Goldcorp Inc. was one of the world's top gold producers.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

118. Goldcorp Inc. offered prize money to the person or company that would find a way for Goldcorp to mine more gold.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

119. Goldcorp Inc. outsourced part of its engineering activity to a supplier.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

120. Goldcorp Inc. offered prize money to the person or company that would find a way for Goldcorp to mine more gold. Unfortunately, the offer was not successful.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

The Financial Supply Chain

The financial supply chain is intimately tied to SCM and managing the flow of funds is an essential ingredient for its success. In the interconnected global economy companies are under greater financial pressures than ever before to cut costs. The result has been a push to redesign entire supply chains and search for less-costly sources of supply. This includes strategies such as global sourcing and production outsourcing, trying to achieve labor–cost advantages by pushing operations offshore, and outsourcing noncore activities. As companies send operations offshore, however, there are significant financial implications. These include masked hidden costs, such as managing more expensive plants and equipment in emerging countries. Pushing inventory downstream to suppliers often means higher inventory costs, as these suppliers typically have a higher cost of capital. Also, global operations can wreak havoc on the financial supply chain, as the longer chain has a higher amount tied up in working capital.

Another area of interest for management is the “[cash-to-cash cycle](#),” which is the time it takes to convert an order into cash. Although management has long recognized the competitive impact of shorter order cycles, it has recently seen the impact the total order process has on working capital. This is another financial supply chain issue that companies are trying to closely manage.

Technology is having a particularly significant impact on supply chain finance. Just a few years ago FnConn, a subsidiary of Foxconn, partnered with a lender to launch Chained Finance, a blockchain-based supply chain finance

platform. The goal was to create transparency and easy authentication of every payment and every supply chain transaction. Today, more companies are incorporating blockchain technology into supply chain finance to create a trusted network of vendors. Other technologies are also having a significant impact. The IoT, ML, and AI are rapidly being used on issues such as developing credit scores and presenting companies with the best financial proposal for each supplier.

Blockchain is another technology that is transforming supply chain finance. The benefits of blockchain, include transparency, security, and efficiency, in tracking and verifying transactions across the supply chain. By providing a tamper-proof digital ledger, blockchain reduces fraud and errors, streamlines financing processes, and ensures the authenticity of transactions. This innovation is helping businesses gain better access to financing and optimize their supply chain operations.

As the supply chain provides a significant cost-cutting opportunity, the trend of managing finances and identifying the risks and challenges of the financial supply chain will continue to be a significant trend in the future.



Concept Check Questions

121. The financial supply chain is only loosely tied to SCM.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

122. Pushing inventory downstream to suppliers often means higher inventory costs, as these suppliers typically have a higher cost of capital.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

123. This is the time it takes to convert an order into cash.

- ☐ a) Turns
- ☐ b) Turnover
- ☐ c) Credit turnover
- ☐ d) Discount time
- ☐ e) cash-to-cash cycle

Correct or Incorrect?

Clear

Check Answer

124. Today, more companies are incorporating blockchain technology into supply chain finance to create a trusted network of vendors.

- ☐ True
- ☐ False

Correct or Incorrect?

[Clear](#)[Check Answer](#)

Empowering Entrepreneurs Box

In entrepreneurship there is a saying: “Ideas are easy; execution is everything.” Supply chain management is about execution. It is about how products are made, where materials come from, where manufacturing happens, quality control of products, and how the products are eventually delivered to customers. It is taking an idea and making all the decisions involved in creating the actual product. SCM is particularly important for entrepreneurs. Most entrepreneurs have great ideas and understand financing and marketing. However, they are often thrown into dealing with SCM without understanding its full scope.

Entrepreneurs manage supply chains that are much smaller compared to that of large global supply chains. That creates greater opportunities but also requires special understanding. It requires end-to-end SCM knowledge and how the elements of the supply chain are interrelated. Entrepreneurs often have visibility into their suppliers’ suppliers and their customers’ customers. They have choices and control over a complete set of SCM decisions and need to understand how the entire system works from end to end. They also have great potential to scale up, create disruptive innovation, and build long-term value for customers, investors, and employees. Anyone who wants to create a successful company needs to understand the full scope of SCM.

Concept Check Questions

125. Ideas are easy; _____ is everything.

- ☐ a) financing
- ☐ b) marketing
- ☐ c) execution
- ☐ d) operations
- ☐ e) the supply chain

Correct or Incorrect?

Clear

Check Answer

126. Entrepreneurs tend to manage supply chains that are much shorter than average.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Careers in SCM and Professional Organizations

SCM has become an essential competency for corporate executives and managers. The postpandemic era, in particular, has seen a tremendous growth in supply chain jobs. According to the Council of Supply Chain Management Professionals (www.cscmp.org), corporate spending on SCM is growing faster than the overall economy, creating tremendous job opportunities for business professionals. As SCM is boundary spanning, it enables business professionals to touch and see every aspect of the product and provides exceptional upward mobility.

There are many routes to success in SCM. The career path can take an individual to many types of organizations, require them to conduct a variety of tasks, and take them to virtually any location in the world, if they so desire. Potential employers range from traditional manufacturers and retailers to service organizations that are increasingly relying on SCM. They also include specialty organizations such as consulting firms and transportation service providers.

Entry-level management positions in SCM can include titles such as demand planner, vendor management inventory (VMI) analyst, or Consultant. Duties may include conducting product evaluation, product planning, generating forecast reports, managing product investment targets, and performing online replenishment. Middle-level management positions include titles such as sourcing management, Director of SCM, or director of operations. They are responsible for all aspects of product flow and accurate and timely product movement throughout the facility and supply chain. Finally, senior executive positions include VP of SCM or VP of global logistics. These are prominent organizational positions that command top salaries. Duties here include managing and optimizing the global supply chain network with multiple distribution centers. The individual is responsible for documenting and executing a global and comprehensive SCM plan that optimizes customer services and profitability.

Careers in SCM abound, offering individuals opportunities in a great variety of positions and providing the chance to have a high impact on the business as a whole.



Concept Check Questions

127. SCM has become an essential competency for corporate executives and managers.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

128. _____ management positions in SCM can include titles such as Demand Planner, Vendor Management Inventory (VMI) Analyst, or Consultant.

- ☐ a) Entry-level
- ☐ b) Middle level
- ☐ c) Director level
- ☐ d) Senior executive level
- ☐ e) Board of directors level

Correct or Incorrect?

Clear

Check Answer

129. _____ management positions include titles such as Sourcing Management, Director of SCM, or Director of Operations.

- ☐ a) Entry-level
- ☐ b) Middle level
- ☐ c) Director level
- ☐ d) Senior executive level
- ☐ e) Board of directors level

Correct or Incorrect?

Clear

Check Answer

130. _____ positions include VP of SCM or VP of Global Logistics.

- ☐ a) Entry-level
- ☐ b) Middle level
- ☐ c) Director level

- ☐ d) Senior executive level
- ☐ e) Board of directors level

Correct or Incorrect?

Clear

Check Answer

CHAPTER HIGHLIGHTS

SCM is the design and management of flows of products, information, and funds throughout the supply chain. A supply chain is the network of all entities involved in producing and delivering a finished product to the final customer.

The bullwhip effect is the fluctuation and distortion of information as it moves up the supply chain, from retailer to manufacturer to supplier.

SCM activities involve coordination, information sharing, and collaboration.

Intraorganizational integration is the participation and coordination of activities between different organizational functions within the organization.

Cross-enterprise integration is the participation and coordination of activities between different organizations that comprise the supply chain.

Logistics, in contrast to SCM, consists of the tasks involved in moving and positioning inventory throughout the supply chain.

Competitive supply chains are responsive, reliable, and engage in relationship management with members of the supply chain.

Trends that impact today's supply chain include globalization, outsourcing & reshoring, digital transformation, AI and analytics, 3-D printing, additive manufacturing, robotics, postponement, lean supply chain, supply chain resilience, security, sustainability or “green” supply chain, innovation, and the financial supply chain.

KEY TERMS

[Supply chain management \(SCM\)](#)

[Supply chain](#)

[Value chain](#)

[Value network](#)

[Products](#)

[Information](#)

[Funds](#)

Bullwhip effect

Marketing

Operations

Sourcing

Logistics

Outsourcing

Core competencies

Information technology (IT)

Enterprise resource planning (ERP)

Wireless communication technologies

Global positioning systems (GPS)

Radio frequency identification (RFID)

Business-to-business (B2B)

Business-to-consumer (B2C)

Big data analytics

Big data

Artificial intelligence (AI)

Analytics

Internet of Things (IoT)

Digital supply chain

3-D printing

Additive manufacturing

Intelligent assembly robots

Open-source hardware

Postponement

Cash-to-cash cycle

DISCUSSION QUESTIONS

- Identify the primary ways in which SCM has improved the order fulfillment process. What other benefits has SCM provided to businesses?
- Explain the relationship between SCM and logistics. Identify the differences and similarities. Is one a part of the other? How does one support the other?
- Identify two competing enterprises and their supply chains (e.g., Dell Computer Corporation vs Apple; Amazon vs Walmart; Toyota vs GM; UPS vs FedEx). Identify the elements of each chain from source of supply to final customer, and explain how the two chains are meeting (or not meeting) business objectives. Which supply chain appears longer? Does the structure of one appear simpler than the other?
- Identify the primary flows in a supply chain. Explain why there is flow in both directions, and provide examples of each.
- Identify key activities of SCM. Identify other drivers not mentioned in the text.
- Identify at least three trends that impact SCM. Identify other trends not discussed in the text.

Case Study McNulty's Muscular Materials (MMM)

Clayton McNulty, owner of McNulty's Muscular Materials (MMM), is sitting in his dim office located at the top of an old brown brick building, in an industrial area of South Boston. Clayton had just gotten off the phone with Sarah Holden, his longtime friend and sole supplier of his most popular fabric, when his telephone rings again. This call is from John Masterson, his number-one client.

“Clay Buddy,” John says. “Just got off the phone with the owner of Southside Sluggers. Guess who got the New Jersey contract? That's right, pal, and I want you to get 'em to me. That'll be 10,000 jerseys, and I need them by the end of the month. How much do you love me, Clay baby? I'll get you the designs by Monday. Ciao.”

Clayton hangs up the phone, stares out of his small, double-paned office window and watches the rain slide down the glass. Sure, Clayton was excited about the large bid, but how was he to produce the baseball jerseys in time? The season was to start in three months. The one-month deadline was dead-locked, and there was no room for negotiation. The fans will want the new merchandise before the season gets under way.

MMM was a small sports attire manufacturer that primarily focused on making jerseys for local sports teams. Luckily, the factory had been set up for expansion and was capable of handling a production of this magnitude. But where would he get the needed fabric to produce such a large volume? The most he had ever had to produce was one-tenth of the size that John had just ordered. A big order like this means big publicity, and more orders were sure to start rolling in over the next few months.

A call to Sarah confirms his suspicions. She cannot produce that much fabric in such a short amount of time. He needs another supplier, and he needs one fast. It's a rainy day in South Boston, and Clayton McNulty has some tough decisions to make.

Case Questions

1. What potential options does Clayton have to procure the needed volume of fabrics to meet the deadline?

2. What are the trade-offs for each of these potential options?
3. What should Clayton do?
4. What lessons can be learned from Clayton's situation?

Case Study Making Decisions with Data Analytics: FutureChain

You graduated with a business degree and followed your dream to become an entrepreneur. Since then, you have started seven different businesses, and today each of those businesses generates many millions of dollars in revenue. You have marketed all your businesses under the brand name of **FutureChain**.

Spotting a trend in data analytics, you recently began exploring the possibility of a new business in this space. After talking with the business community, you have identified the need of small and medium-sized firms for analytics services in analyzing web traffic on their websites. Given your successful track record as an entrepreneur, a number of businesses have already expressed their willingness to sign a service contract with you, and you have provisioned financing for the new startup.

With financing and clients lined up, you are planning to begin operating your new organization, called FutureChain Analytics, in three months.

Case Questions

1. Identify the supply chain management decision you need to make in order to begin operating.
2. One of your seven ventures, branded as FutureChain Robotics, makes industrial robots. How should its customer contract differ from that of Future Chain Analytics? (Tip: One business is a service, the other manufacturing).

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Notes

- 1 Six Sigma performance is characterized by 3.4 defects per million, or 99.99966% perfect. We will discuss this in detail later in the text.
- 2 Thomas L. Friedman, *The Lexus and the Olive Tree* (New York: Farrar, Straus and Giroux, 2000), 1–25.
- 3 Maria P. Villablanca, Transformation Influencer, Mentor, Keynote Speaker, Co-Founder & CEO, Future Insights Network, Interview January 16, 2023.

2 Supply Chain Strategy

LEARNING OBJECTIVES

After completing this chapter, you should be able to:

Define supply chain strategy and explain how it supports the business strategy.

Explain how the right supply chain design can create a competitive advantage.

Identify and explain the building blocks of a supply chain strategy.

Explain differences in supply chain design based on organizational competitive priorities.

Explain how productivity can be used to measure competitiveness.

CHAPTER OUTLINE

- **What Is Supply Chain Strategy?**
 - Strategic Alignment*
- **Achieving a Competitive Advantage**
 - Cost–Productivity Advantage*
 - Value Advantage*
 - SCM as a Source of Value*
- **Building Blocks of Supply Chain Strategy.**
 - Operations Strategy*
 - Distribution Strategy*
 - Sourcing Strategy*
 - Customer Service Strategy*
- **Supply Chain Strategic Design**
 - Competing on Cost*
 - Competing on Time*
 - Competing on Innovation*
 - Competing on Quality*
 - Competing on Service*
 - Why Not Compete on All Dimensions?*
- **Strategic Considerations**
 - Small vs Large Firms*
 - Supply Chain Adaptability*
- **Productivity as a Measure of Competitiveness**
 - Measuring Productivity*
 - Interpreting Productivity*
- **Chapter Highlights**

- [Key Terms](#)
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[Bloomberg Quicktake Video: Siemens Energy CEO: Supply Chain Management is the Focus](#)

[Bloomberg Quicktake Video: OpenAI Introduces AI Models with Reasoning](#)

Walk into a Zara clothing store, whether in New York, Miami, Atlanta, or London, and you experience the feel of high fashion. The ambiance is contemporary, with dim lighting and the beat of modern music pulsating in the background. The clothing styles on the racks capture the latest fashion for men and women, and there is a wide array of choices. Surprisingly, however, the price point is reasonable and much lower than any comparable retailer or boutique. This is what makes Zara unique.

Zara is a highly successful Spanish retailer with over 3,000-plus stores worldwide. Zara, on average, releases 500 new designs a week and 20,000 new designs each year. It is known for its quick design and delivery, and it needs just two weeks to develop a new product and get it to stores, compared with a six-month industry average. Zara has been called a fashion imitator. It focuses on copying the latest fashion items customers want and delivering them at a considerably lower price. Unlike other retailers, it does not advertise or promote the season's trends to influence shoppers. To achieve this level of success, Zara has a most unusual strategy and its secret lies in supply chain management (SCM).

Zara is a vertically integrated retailer and controls most of its supply chain, including sourcing, design, production, and distribution. This is highly unusual in an industry that overwhelmingly tends to outsource fashion production to low-cost countries. Whereas most competitors outsource all production to Asia, Zara makes over half of its merchandise at a dozen company-owned factories in Spain and Portugal, where labor is cheaper than in Western Europe. Only items with a longer shelf life, such as basic T-shirts, are outsourced to low-cost suppliers in Asia and Turkey. A large part of this is to support its strategy of offering high-fashion items. To accomplish this, Zara designers are located on the floor of its manufacturing facility to shorten production time, and they have weekly talks with store managers across the globe to find out what customers want.

Zara was designed to be responsive from its inception and has a very efficient and lean production process. It has even borrowed best practices from the Toyota Motor Corporation. To sustain this lightning pace, Zara employs just-in-time (JIT) production techniques to minimize turnaround times as much as possible. Zara carries little inventory of expensive items. However, to give itself flexibility and offer a wide product assortment,

Zara carries excess inventories of inexpensive items. This includes buttons and zippers which Zara's designers can use to create differences in clothing items. As a result, Zara can offer considerably greater product variety than its competitors. Also, Zara has an extremely quick design turnover compared to competitors. New designs are developed daily—sometimes three to four a day—and quickly put into production. This short production cycle means greater success in meeting consumer preferences. If a design does not sell well within a week, it is withdrawn from shops, further orders are canceled, and a new design is pursued. No design stays on the shop floor for more than four weeks, which encourages Zara's shoppers to make repeat visits. Customers know that end-of-season markdowns, so common in the retail industry, occur on a smaller scale at Zara; so, they feel a greater need to buy the item they have.

Zara uses its supply chain strategy as a competitive weapon. For Zara, this has proved to be a very successful decision.

Concept Check Questions

1. Zara is the highly successful _____ retailer with over 3,000-plus stores worldwide.

- ☐ a) French
- ☐ b) Indian
- ☐ c) Armenian
- ☐ d) Spanish
- ☐ e) Scottish

Correct or Incorrect?

Clear

Check Answer

2. Zara is known for its quick design and delivery.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

3. Zara is known for its high prices.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

4. Zara employs Just-in-Time (JIT) production techniques to minimize turnaround times as much as possible.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

What Is Supply Chain Strategy?

A company must have a long-range business strategy if it is going to maintain a competitive position in the marketplace. A [business strategy](#) is a plan for the company that clearly defines the company's long-term goals, how it plans to achieve these goals, and the way the company plans to differentiate itself from its competitors. A business strategy should leverage the company's core competencies, or strengths, and carefully consider the characteristics of the marketplace.

[Supply chain strategy](#) is a long-range plan for the design and ongoing management of all supply chain decisions that support the business strategy. Consider that the design of a supply chain should differ based on how the company intends to compete in the marketplace. To maintain competitiveness, companies must design their supply chains to be aligned with their business strategy, satisfy the needs of the customers, take advantage of the company's strengths, and remain adaptive. This relationship between the business strategy and the supply chain strategy is shown in [Figure 2.1](#).

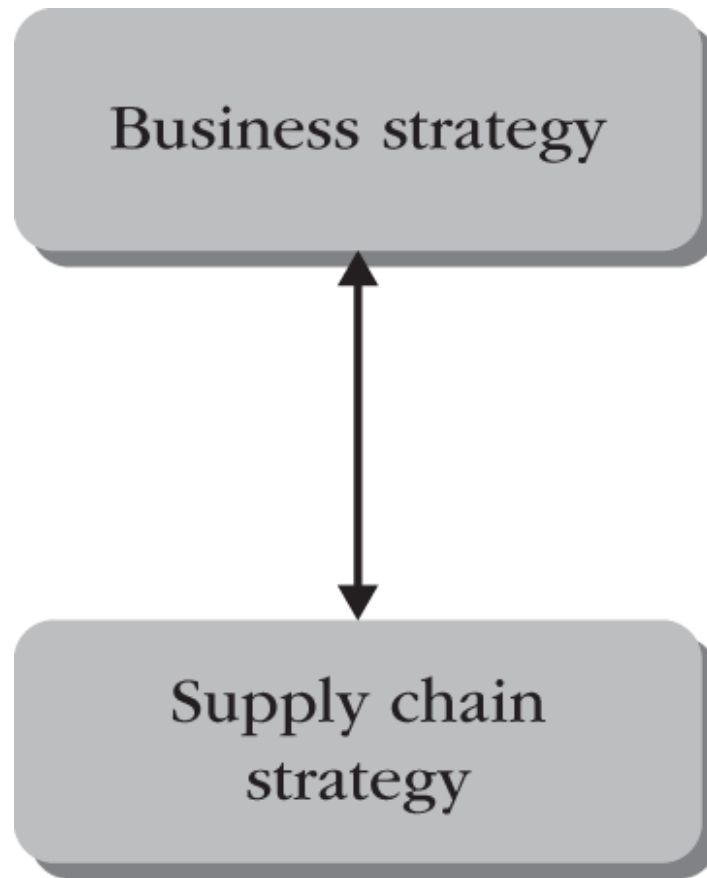


FIGURE 2.1 Supply chain and business strategies are aligned.

Consider the case of Zara, discussed in the chapter opener. Zara's business strategy is to produce and deliver look-alikes of the latest fashion trends to customers at an affordable price. Zara understands that the key to accomplishing this is through a well-thought-out supply chain strategy designed to support its goals. For this reason, the company chooses to be vertically integrated, giving it speed, flexibility, and control of product design and delivery. Also, the company chooses not to outsource most of its production, as doing so would hurt Zara's ability to quickly adapt to fashion trends. As we can see, Zara's supply chain strategy is designed to enable the company to achieve the goals set by its business strategy.

Concept Check Questions

5. A _____ is a plan for the company that clearly defines the company's long-term goals, how it plans to achieve these goals, and the way the company plans to differentiate itself from its competitors.

- ☐ a) business plan
- ☐ b) business strategy
- ☐ c) supply chain strategy
- ☐ d) outsourcing plan
- ☐ e) vendor management plan

Correct or Incorrect?

Clear

Check Answer

6. A _____ is a long-range plan for the design and ongoing management of all supply chain decisions that support the business strategy.

- ☐ a) business plan
- ☐ b) business strategy
- ☐ c) supply chain strategy
- ☐ d) outsourcing plan
- ☐ e) vendor management plan

Correct or Incorrect?

Clear

Check Answer

7. The design of a supply chain should differ based on how the company intends to compete in the marketplace.

- ☐ True
- ☐ False

Correct or Incorrect?

[Clear](#)[Check Answer](#)

Strategic Alignment

It is important to remember that there must be a strategic alignment between the business strategy and supply chain strategy. A company's supply chain strategy should be developed to drive and support its business strategy.

Consider an electronics company that has formulated a business strategy to compete on delivery excellence, such as order-fulfillment time. As a result, the supply chain strategy may be designed for speed of delivery, although perhaps at a higher cost. Now imagine that the company decides to change its business strategy to compete on cost rather than delivery, considering current market competition and customer perceptions of value. If this change in business strategy is not communicated to SCM, the supply chain will continue to focus on delivery rather than cost. The company will continue to excel at delivery while incurring a higher cost, and not meeting the business goals set for the company.

The supply chain should not be designed to merely mimic its competitors or solely focus on cost-cutting efforts. The supply chain should be designed and positioned to support the strategic direction of the firm, giving it a competitive advantage in the marketplace. As we will see later in this chapter, supply chains can have a very different design based on their competitive focus. Today's most successful companies, as illustrated by Zara, have achieved world-class status in large part due to a skillfully designed supply chain strategy that is manifested in the design of its supply chain. Companies all over the globe understand that they cannot achieve the competitiveness needed to survive and thrive in the current global economy without strategically thinking about their supply chains.

In addition, all organizational functions should be designed to support the strategy. This includes marketing, operations, distribution, purchasing, and even finance. In addition, the organizational functions should support each other. This functional support is especially important for SCM given its boundary-spanning nature and high dependence on logistics, marketing, and operations. This functional unity and support of the business strategy will enable the organization to function in a synchronized manner.

Amazon offers a good example of functional unity and alignment with its strategy. Amazon's business strategy centers around fast and efficient product delivery. To achieve this, their organizational functions—such as marketing, operations, distribution, purchasing, and finance—are aligned to support this strategy. The company promotes prime membership for quick shipping, maintains efficient fulfillment centers, strategically places distribution hubs, secures favorable supplier terms, and allocates resources for infrastructure and technology. This alignment ensures synchronized operations and successful execution of their strategy.



Concept Check Questions

8. A company's business strategy should be developed to drive and support its supply chain strategy.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

9. A supply chain should mimic the supply chain of larger competitors.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

10. The supply chain should be designed and positioned to support the strategic direction of the firm, giving it a competitive advantage in the marketplace.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Achieving a Competitive Advantage

Given the highly competitive environment of today's marketplace, seeking a sustainable competitive advantage has become a top business concern. Unlike in the past, where creative marketing initiatives were sufficient to promote products, today's marketplace requires a higher level of strategic positioning. In this section, we will look at how a well-designed supply chain can provide companies with the needed competitive advantage.

To understand supply chain competitiveness, let us look at the concept of competitive advantage. At the most basic level, corporate success in the marketplace can result from two aspects. The first is a [cost-productivity advantage](#); the second is a [value advantage](#). In the first case, the advantage comes from offering the lowest-cost product or service. In the second case, the advantage comes from providing a product with the greatest perceived differential value compared with its competitors. In the ideal situation, a company would have both a cost and a value advantage. These two basic advantages provide a basis for strategy and competitive positioning. We now look at these strategic dimensions in more detail.

Concept Check Questions

11. Seeking a sustainable competitive advantage has become a top business concern.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

12. Creative marketing initiatives are sufficient to promote products.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

13. A _____ advantage comes from offering the lowest-cost product or service.

- ☐ a) value
- ☐ b) marketing
- ☐ c) cost-productivity
- ☐ d) productivity
- ☐ e) first mover

Correct or Incorrect?

Clear

Check Answer

14. A _____ advantage comes from providing a product with the greatest perceived differential value compared with its competitors.

- ☐ a) value
- ☐ b) marketing
- ☐ c) cost-productivity
- ☐ d) productivity
- ☐ e) first mover

Correct or Incorrect?

Clear

Check Answer

Cost–Productivity Advantage

Every marketplace typically has one competitor who is the low-cost producer and who has the greatest sales volume in the particular market. Consider Walmart, which competes on cost, and as a result, the company is a leader in sales volume in the retail market. In fact, there is much evidence to suggest that a large volume can contribute greatly to a cost advantage. One factor contributing to this is economies of scale that enable the company to spread its fixed costs over a greater volume.

Another factor contributing to this is the impact of the [experience curve](#) — derived from the traditional concept of the learning curve. The learning curve tells us that with experience workers become more skilled in processes and tasks and do them more efficiently. The same is true of organizations. Organizational costs are reduced due to experience and learning effects that result from processing a higher volume. This is the experience curve, which describes the relationship between unit costs and cumulative volume, where the cost per unit of a product decreases with increased volume.

Based on the experience curve, it has been assumed that the only way to gain cost reductions and compete on a cost–productivity advantage, is to increase sales volume. Although this is one way to achieve a cost advantage, another way is through an efficient supply chain network. The reason is that an efficient supply chain network can increase efficiency and improve productivity, thereby reducing overall cost per unit.

Toyota is a good example of a company that achieves a cost–productivity advantage through its lean manufacturing principles and the Toyota Production System (TPS). These practices optimize production, minimize waste, and engage employees, enabling Toyota to produce high-quality vehicles at lower costs than competitors. This advantage has bolstered Toyota's market leadership in the automotive industry.

Concept Check Questions

15. Every marketplace typically has one competitor who is the low-cost producer and who has the greatest sales volume in the particular market.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

16. The _____ curve tells us that with experience workers become more skilled in processes and tasks and do them more efficiently.

- ☐ a) productivity
- ☐ b) value
- ☐ c) experience
- ☐ d) learning
- ☐ e) knowledge

Correct or Incorrect?

Clear

Check Answer

17. Organizational costs are reduced due to experience and learning effects that result from processing a higher volume. This is the _____ curve, which describes the relationship between unit costs and cumulative volume, where the cost per unit of a product decreases with increased volume.

- ☐ a) productivity
- ☐ b) value
- ☐ c) experience
- ☐ d) learning
- ☐ e) knowledge

Correct or Incorrect?

Clear

Check Answer

18. The only way to gain cost reductions and compete on a cost–productivity advantage, is to increase sales volume.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

19. The TPS does all of the following except for which one?

- ☐ a) Optimize production
- ☐ b) Maximize productivity
- ☐ c) Minimize waste
- ☐ d) Engage employees

Correct or Incorrect?

Clear

Check Answer

Value Advantage

Consider that customers do not buy products but rather the benefits or value provided by those products. Therefore, there may be multiple products that provide customer value. Also, it is not just the stand-alone product that is the ultimate customer's desire, but many intangible benefits a product offers. For example, customers will often buy a product for its image and reputation rather than pure functionality. On the contrary, a product may be purchased due to performance value that it offers over its competitors and rivals.

An important competitive advantage for companies is to distinguish their products or services in some way from their competitors. Otherwise, their products will be seen as a commodity. When a product is viewed as a commodity, it is typically bought on the spot market for the lowest price. Therefore, companies need to add value to the products and services they offer that differentiate them from their competitors.

Let us look at some of the ways by which companies can gain a value advantage. One way is by segmenting the market and identifying [value segments](#) in the marketplace. This means that different customer groups place value on different product benefits. This analysis permits the company to see which market segments place value on what product features. It may then be possible to create a differential appeal tailored to different segments. For example, auto manufacturers create different versions of the same vehicle to compete in different market segments, such as a basic two-door model vs a four-door model, or a high-performance model. These options enable the manufacturer to satisfy the value of different market segments.

Concept Check Questions

20. Customers do not buy products but rather the benefits or value provided by those products.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

21. An important competitive advantage for companies is to have either the lowest price or the largest amount of advertising.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

22. This means that different customer groups place value on different product benefits.

- ☐ a) Market segments
- ☐ b) Cost segments
- ☐ c) Features segments
- ☐ d) Value segments
- ☐ e) Performance segments

Correct or Incorrect?

Clear

Check Answer

23. Companies are increasingly focusing on service as a way to add value.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

24. Companies can only gain competitiveness either through a value advantage.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

25. A high product value advantage combined with a low product cost advantage.

- ☐ a) Value advantage
- ☐ b) Cost and value advantage
- ☐ c) Commodity

- ☐ d) Cost advantage
- ☐ e) None of these

Correct or Incorrect?

Clear

Check Answer

26. A high product value advantage combined with a high product cost advantage.

- ☐ a) Value advantage
- ☐ b) Cost and value advantage
- ☐ c) Commodity
- ☐ d) Cost advantage
- ☐ e) None of these

Correct or Incorrect?

Clear

Check Answer

27. A low product value advantage combined with a low product cost advantage.

- ☐ a) Value advantage
- ☐ b) Cost and value advantage
- ☐ c) Commodity
- ☐ d) Cost advantage
- ☐ e) None of these

Correct or Incorrect?

Clear

Check Answer

28. A low product value advantage combined with a high product cost advantage.

- ☐ a) Value advantage
- ☐ b) Cost and value advantage
- ☐ c) Commodity
- ☐ d) Cost advantage
- ☐ e) None of these

Correct or Incorrect?

Clear

Check Answer

29. Commodity products are high-cost items.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

30. Selling commodity products is the most desirable position for a company to be on the competitive advantage matrix.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Supply Chain Leader's Box

■ WALMART

Sam Walton was a strategic supply chain visionary who developed the low-cost responsive retail strategy. This was supported by a supply chain strategy of not buying from distributors, but rather directly from manufacturers of a broad range of merchandise. Walmart's legendary partnership with Procter & Gamble (P&G), where replenishment of inventories is done automatically, illustrated to other companies the power of integrating with key suppliers. Walmart extended this type of relationship to other suppliers, letting suppliers manage their own inventories at Walmart's warehouses, a system called [vendor-managed inventory \(VMI\)](#). These supply chain actions were designed to help Walmart meet its overall competitive strategy, which is to provide its customers with a wide product offering at a low price.

Walmart has continued this strategy by being a leader in its use of technology. The company was a leader in the use of RFID, to cut inventory costs and maintain its cost position, and is now using robots for better inventory management. At Walmart stores robots go up and down store aisles as part of regular inventory control, scanning items, and updating information. The company is continuing to invest in emerging technologies, having created an end-to-end digital supply chain and partnering with IBM to develop blockchain technologies for some of its items. By utilizing large datasets and AI technology, Walmart harnesses predictive analytics to detect patterns, trends, and connections within the information, empowering the company to foresee changes in demand, fine-tune inventory management, and enhance operational effectiveness. Now every hour, Walmart collects 2.5 petabytes of unstructured data from 1 million customers only to process it to better understand trends and finetune inventory and respective demand.

In 2024, Walmart started using [generative artificial intelligence \(AI\)](#) for a better understanding of the intent of the customer based on the query, session, and engagement with items on its online searches. Based on the searches, generative AI can create a holistic product offering unique for each customer, covering all possible customer needs, and avoiding overlap

or gaps. The intent is to use AI technology to provide customers with smarter results, help in decision-making, and creating tools that highlight priority product features.

It is for these reasons that Walmart has held a place among Gartner's top 25 supply chains for half a decade.

Concept Check Questions

31. Letting suppliers manage their own inventories at a company's warehouse is a system called _____.

- ☐ a) Outsourced inventory
- ☐ b) Vendor-managed inventory
- ☐ c) Locally sourced inventory
- ☐ d) Off-books inventory
- ☐ e) SCM inventory

Correct or Incorrect?

Clear

Check Answer

32. Walmart is a leader in the use of RFID to cut inventory costs.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

33. Walmart does not use robots because people are less expensive.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

34. In 2024 Walmart began using Generative AI to better understand the intent of the customer based on the query, session, and engagement with items on its online searches.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

In addition to the product itself, companies are increasingly focusing on service as a way to add value. Competition, based on technology and product alone, is becoming increasingly difficult. One reason for this is that technology and best production practices are becoming more for a commodity. Service is one dimension that is more difficult to replicate. This is creating a new way for companies to seek differentiation and a competitive advantage. Service addresses issues such as developing relationships with customers, delivery, after-sales support, financial packages, technical support, maintenance, and other similar services.

Companies can gain competitiveness either through a cost–productivity advantage or a value advantage. In practice, however, some of the most successful companies are those that position themselves based on both. This is

shown in [Figure 2.2](#). Let us now discuss the options provided to companies by this matrix.

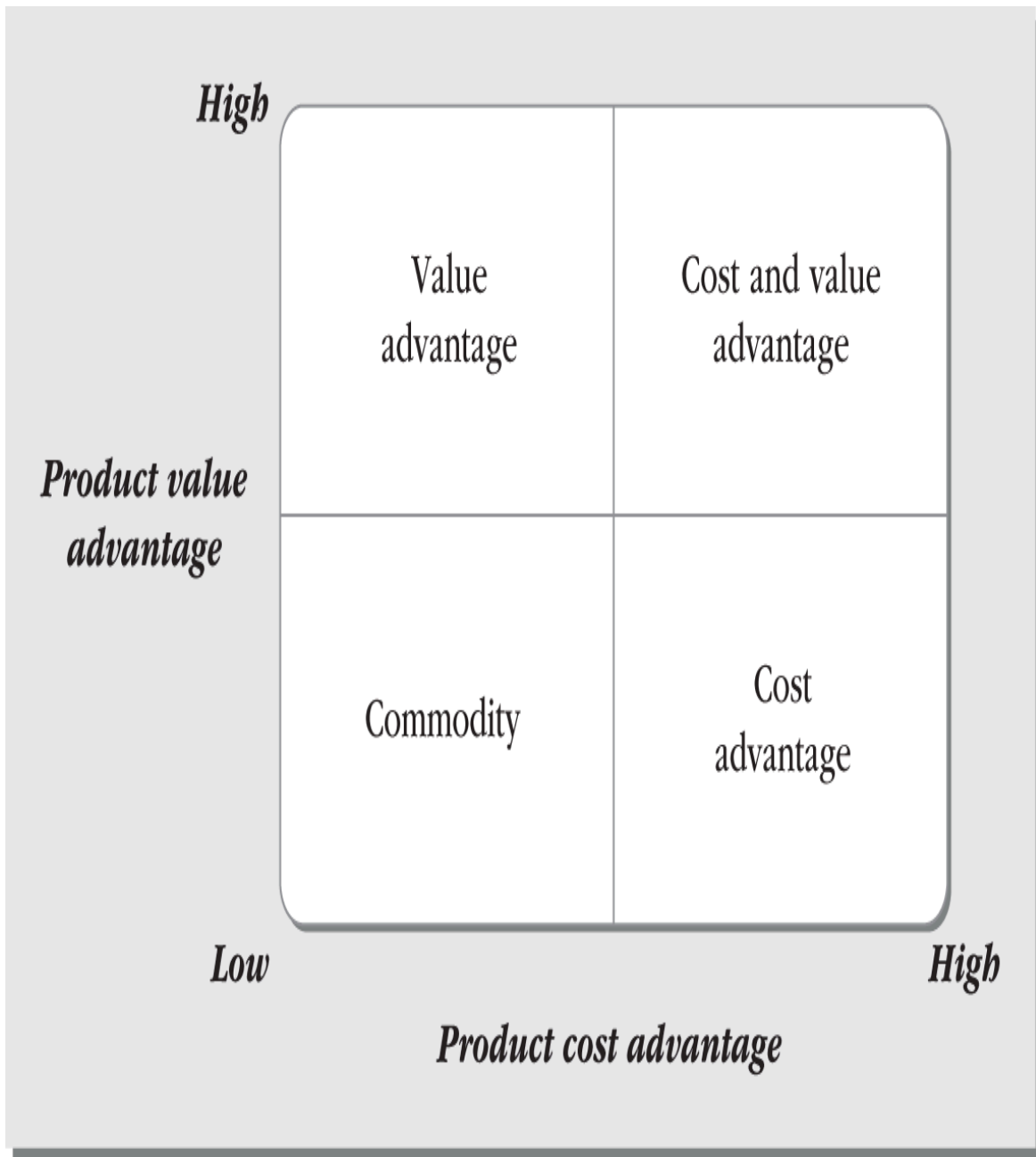


FIGURE 2.2 Competitive advantage matrix.

The least desirable place for a company to be on the matrix shown in [Figure 2.2](#) is in the “commodity” section, namely, the bottom left corner. The reason is that here the company has not differentiated its product from that of its competitors. The result is having to sell the product at the lowest possible price. For companies to remain competitive, they usually try to move to a

more desirable competitive position. One option is to move to a position of cost leadership. Another is to move toward value leadership. The ideal position, however, is at the top right corner, where a company has competitive positioning along both cost and value dimensions.

SCM as a Source of Value

SCM provides a powerful way for companies to achieve a cost–value advantage over their competitors. For example, improvements in the supply chain can dramatically reduce inventory, distribution, and coordination costs. This is a highly effective way to move up the quadrant to a position of cost–value leadership. In later chapters of this text, we will look at specific ways that companies can achieve this, such as developing a lean supply chain and implementing Six Sigma quality.



Concept Check Questions

35. SCM has yet to show much of a cost-value advantage for companies.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

36. Improvements in the supply chain can dramatically reduce inventory, distribution, and coordination costs.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Global Insights Box

■ TOYOTA MOTOR CORPORATION

The Toyota Motor Corporation is a leader in the auto industry and a model of strategic supply chain design. The company has experienced unparalleled growth over the last two decades. Toyota understands that it must have an effective global supply chain strategy to continue this level of success. This has involved building superior strategic alliances with its suppliers, designing an agile global distribution network, and positioning production facilities strategically. Toyota builds deep supplier relationships, it not only purchases semi-finished goods from vendors but trains them, invests in their equipment, and helps design products and supply chains with them in a way that supports Toyota's values; thus, creating a win-win situation and stronger bond with vendors. To have a highly responsive supply chain, Toyota's strategy has been to open factories in every market it serves. An important element of this decision was the production capability at each plant. Prior to 1996, Toyota used a supply chain strategy where every plant was specialized and capable of supplying only local production. Since the early 2000s, however, Toyota redesigned its network for plants to be more flexible and to supply multiple markets, enabling it to easily shift production from one market to another as needed. This strategy has continued, relying on analytics to optimize these decisions, and has enabled Toyota to remain agile.

Another way that firms can move to a cost-leadership position is to develop strategic differentiation based on service excellence. Therefore, the “good” itself remains a commodity, but the total product package is now differentiated from other customers. This is a good strategy, as today's customers demand greater responsiveness and reliability from their suppliers. Customers want shorter lead times, JIT deliveries, and services that help them do a better job of serving their customers. SCM can provide this type of advantage.

Another option is through the introduction of new supply chain technologies. Such technologies can provide an opportunity for a company to lower its cost over competitors. Such has been the case with Walmart, as we discussed earlier. However, this option is typically available to

competitors as well, particularly in today's marketplace, where information travels rapidly. Still, this strategy may preempt competition if the company uses the technology in a way that provides greater customer value.

Concept Check Questions

37. Toyota Motor Corporation has experienced unparalleled growth over the last two decades.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

38. Toyota Motor Corporation changes vendors frequently to get the lowest possible price.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

39. Toyota Motor Corporation tries to produce as many cars in Japan as possible.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

40. Toyota uses a supply chain strategy where every plant was specialized and capable of supplying only local production.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Building Blocks of Supply Chain Strategy

Strategic SCM involves designing a supply chain that is uniquely configured to meet the company's overall business strategy. This is especially challenging given the boundary-spanning nature of SCM. Consequently, the development of a supply chain strategy involves consideration of each of the traditional business functions and their impact on the supply chain. These are the building blocks of a supply chain strategy and include the following:

Operations strategy

Distribution strategy

Sourcing strategy

Customer service strategy

Historically, companies tended to either make decisions regarding each of the preceding functions informally or make decisions about them in isolation from each other. As we mentioned earlier, successful companies understand that organizational functions are interdependent. For example, marketing cannot sell products that operations cannot make, and vice versa. Supply chain strategy is directly impacted by the decisions of the four building blocks and how they are used to support the business. This is shown in the diagram in [Figure 2.3](#). Let us now look at these individual building blocks and how they impact the development of the supply chain strategy.

Concept Check Questions

41. These are the building blocks of a supply chain strategy and include the all of the following except for which one?

- ☐ a) Sourcing strategy
- ☐ b) Distribution strategy
- ☐ c) Customer service strategy
- ☐ d) Marketing strategy
- ☐ e) Operations strategy

Correct or Incorrect?

Clear

Check Answer

42. Strategic SCM involves designing a supply chain that is uniquely configured to meet the company's overall marketing strategy.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

43. Supply chain strategy is directly impacted by the decisions of the four building blocks and how they are used to support the business.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Operations Strategy

The [operations strategy](#) of a company involves decisions about how it will produce goods and services. The operations strategy determines the design and management of a company's manufacturing process, the design of internal processes, the use of equipment and information technology (IT), as well as the types of employee skills needed.

One of the most important aspects of operations strategy is the degree of product customization it offers, called the [product positioning strategy](#). This decision directly relates to the form in which the company stores its finished products and the length of delivery lead time it can provide to its customers. There are three options in this area:

Make-to-stock strategy

Assemble-to-order strategy

Make-to-order strategy

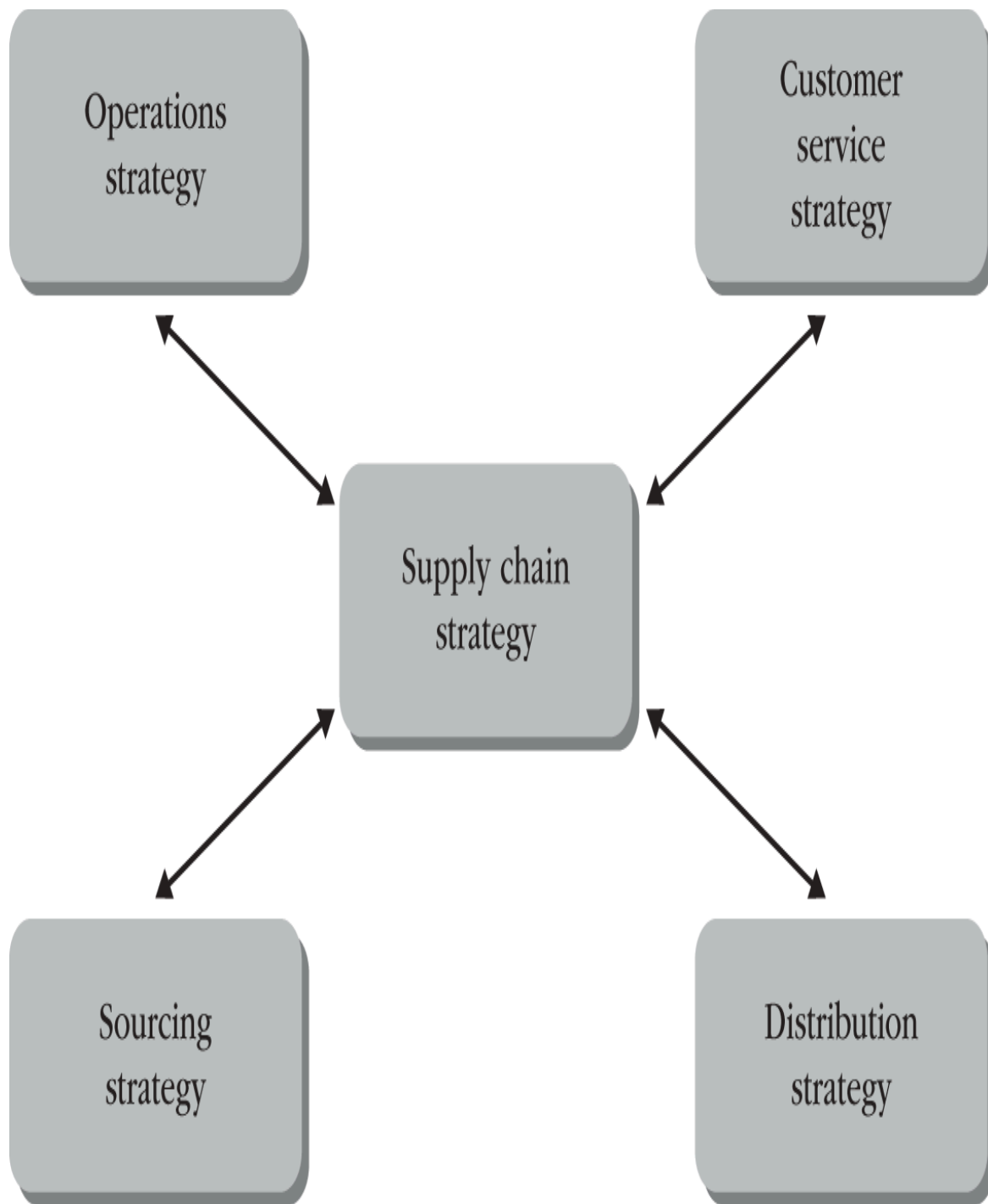


FIGURE 2.3 The building blocks of supply chain strategy.

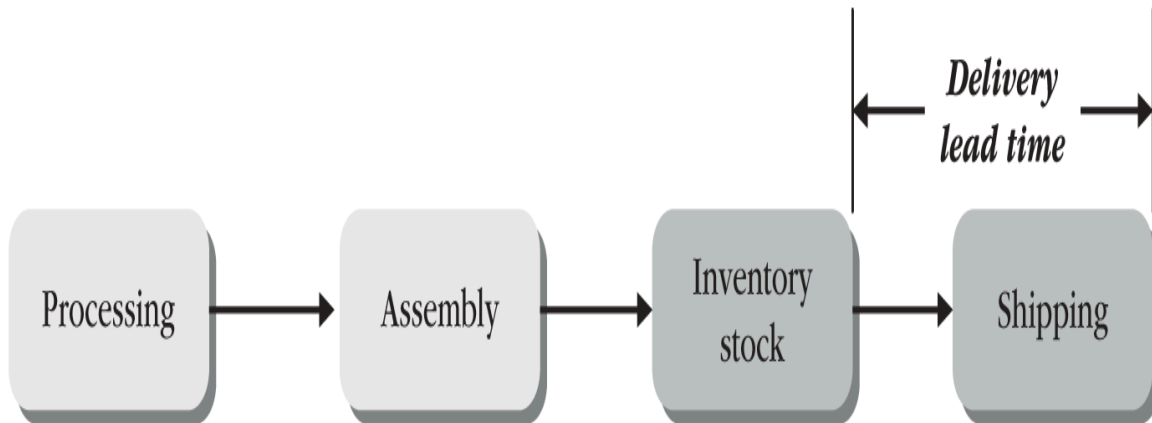
Make-to-stock strategy is a strategy that produces finished products for immediate sale or delivery, in anticipation of demand. Companies using this strategy produce a standardized product in large volumes. Typically, this strategy is seen in assembly line type operations. Delivery lead time is shortest

with this strategy, but the customer has no involvement in product design. This is the best strategy for standardized products that sell in high volume. The production system is set up to produce large production batches that keep manufacturing costs down and having finished products in inventory means that customer demand can be met quickly. Examples include off-the-shelf retail clothing, soft drinks, standard automotive parts, and airline flights. A hamburger patty at a fast-food restaurant such as McDonald's is a made-to-stock strategy. Customers gain speed of delivery with this strategy but lose the ability to customize the product.

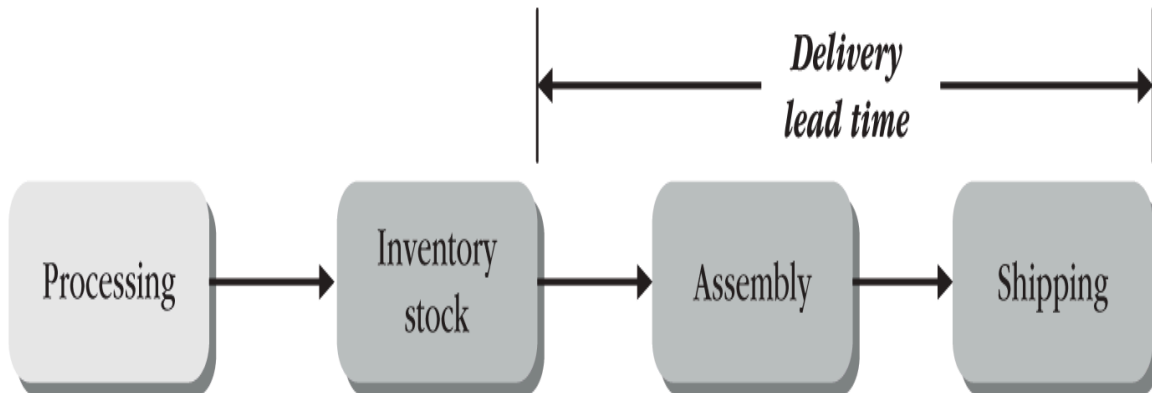
Assemble-to-order strategy, also known as the built-to-order strategy, is where the product is partially completed and kept in a generic form, then finished when an order is received. The inventory that the company holds is that of standard components that can be combined to customer specifications. Delivery time is longer than in the make-to-stock strategy but allows for some customization. This is the preferred strategy when there are many variations of the end product and the company wants to achieve low finished-goods inventory and shorter customer lead times than the make-to-order strategy can deliver. Examples include computer systems, prefabricated furniture with choices of fabric colors, or vacation packages with standard options. Dell offers customers the flexibility to select from a range of processors, hard drives, and displays. This allows greater ability to customize the product.

Make-to-order strategy is a strategy for customized products or products with infrequent demand. It is used to produce products to customer specifications after an order has been received. The delivery system is longest with this strategy, and product volumes are low. Examples are custom-made clothing, custom-built homes, and customized professional services. Companies following this strategy produce a final product only when a firm order has been received. This keeps inventory levels low while allowing for a wide range of product options. For example, aircraft manufacturers, such as Boeing or Airbus, use this strategy because airplanes are highly expensive products and will produce the type of product and amount ordered. The differences in the three strategies are illustrated in [Figure 2.4](#).

I. Make-to-stock strategy



II. Assemble-to-order strategy



III. Make-to-order strategy

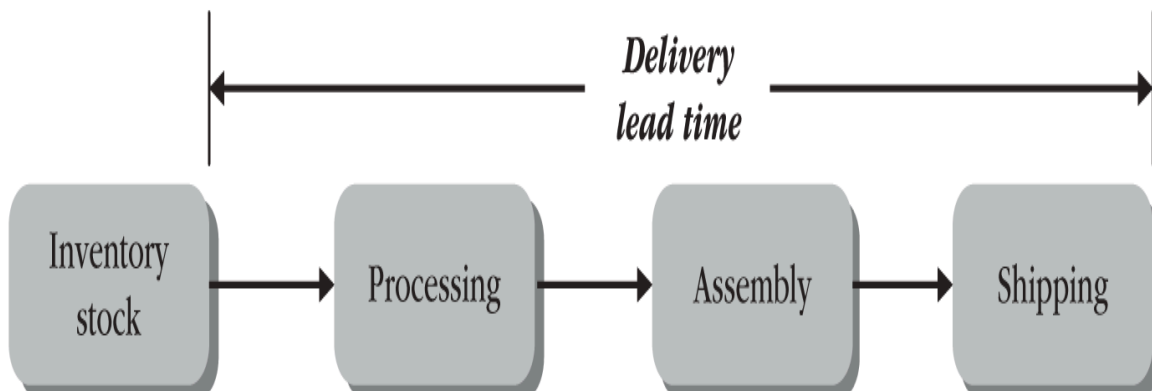


FIGURE 2.4 Product positioning strategies.

Changing the company's operations strategy from one type to another can be a source of competitive advantage. It may not be possible, however, to move from one extreme position to another, such as from a make-to-order strategy to a make-to-stock strategy. In that case, a company would be completely changing its product offering. One option might be to occupy a position of middle ground, such as in an assemble-to-order strategy.

For example, moving from a make-to-stock strategy to an assemble-to-order strategy can serve to improve customer service while reducing inventory. The reason is that in a make-to-stock strategy inventories of all finished goods are carried in stock. This may result in there being too much of one type of inventory and not enough of another. An assemble-to-stock strategy can result in the storage of considerably lower amounts of inventory, primarily held in a generic form. The final assembly can take place when demand for specific products is known with greater certainty.

In some industries, however, it may be difficult to pursue any strategy other than make-to-stock, given high manufacturing costs. For example, automobile manufacturers have historically used a make-to-stock strategy, though some have moved to an assemble-to-order strategy, particularly in the high-end European market. The problem with an assemble-to-order strategy in this market is that there are potentially a countless number of end-product configurations. Trying to satisfy the many different product variations makes it difficult to maintain a competitive lead time. One way to accomplish this is to have suppliers fully integrated into the production process. In addition, it is highly expensive to incur the cost of changing the manufacturing process (called “setup”) so that unique characteristics can be produced. The easiest alternative is to have limited product options, as has been done by most automakers. Otherwise, manufacturing costs become prohibitive.

Operations strategy, like any strategy, is a dynamic process rather than a static one-time decision. It is also highly related to the product life cycle. In the early stages of a product life cycle, demand for a product is uncertain, and companies are better off with a make-to-order strategy as key product attributes are still unknown. As the product moves through its life cycle, companies often move from a make-to-order strategy to an assemble-to-order strategy to reduce inventories while making sure that there is product availability at a competitive price. Products in the mature stage of their life

cycles tend to be produced by manufacturing processes that are designed for a make-to-stock strategy. The reason is that in the mature stage of its life cycle, a product's market is predictable in both its demand and volume. Consequently, the operations strategy needs to change with the product as the product moves through the different life-cycle changes.

Concept Check Questions

44. This strategy of a company involves decisions about how it will produce goods and services.

- ☐ a) Sourcing strategy
- ☐ b) Distribution strategy
- ☐ c) Customer service strategy
- ☐ d) Marketing strategy
- ☐ e) Operations strategy

Correct or Incorrect?

Clear

Check Answer

45. One of the most important aspects of operations strategy is the degree of product customization it offers, called the _____.

- ☐ a) Sourcing strategy
- ☐ b) Product positioning strategy
- ☐ c) Customer service strategy
- ☐ d) Marketing strategy
- ☐ e) Operations strategy

Correct or Incorrect?

Clear

Check Answer

46. This is a strategy that produces finished products for immediate sale or delivery, in anticipation of demand.

- ☐ a) Design-to-order
- ☐ b) Make-to-stock
- ☐ c) Make-to-the-forecast
- ☐ d) Assemble-to-order
- ☐ e) Make-to-order

Correct or Incorrect?

Clear

Check Answer

47. This strategy is where the product is partially completed and kept in a generic form, then finished when an order is received.

- ☐ a) Design-to-order
- ☐ b) Make-to-stock
- ☐ c) Make-to-the-forecast
- ☐ d) Assemble-to-order
- ☐ e) Make-to-order

Correct or Incorrect?

Clear

Check Answer

48. This strategy is also known as build-to-order.

- ☐ a) Design-to-order
- ☐ b) Make-to-stock

- ☐ c) Make-to-the-forecast
- ☐ d) Assemble-to-order
- ☐ e) Make-to-order

Correct or Incorrect?

Clear

Check Answer

49. McDonald's is made-to-stock.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

50. This is a strategy for customized products or products with infrequent demand.

- ☐ a) Design-to-order
- ☐ b) Make-to-stock
- ☐ c) Make-to-the-forecast
- ☐ d) Assemble-to-order
- ☐ e) Make-to-order

Correct or Incorrect?

Clear

Check Answer

51. Changing the company's operations strategy from one type to another can be a source of competitive advantage.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

52. Automobile manufacturers have historically used this strategy.

- ☐ a) Design-to-order
- ☐ b) Make-to-stock
- ☐ c) Make-to-the-forecast
- ☐ d) Assemble-to-order
- ☐ e) Make-to-order

Correct or Incorrect?

Clear

Check Answer

53. Which of the following strategies has the shortest delivery lead time?

- ☐ a) Make-to-stock
- ☐ b) Assemble-to-order
- ☐ c) Make-to-order

Correct or Incorrect?

Clear

Check Answer

54. Which of the following strategies has the longest delivery lead time?

- ☐ a) Make-to-stock
- ☐ b) Assemble-to-order
- ☐ c) Make-to-order

Correct or Incorrect?

Clear

Check Answer

Distribution Strategy

A company's [distribution strategy](#) is about how it plans to get its products and services to customers. An important decision here is whether the company is going to sell directly to customers, such as using the Internet or a direct sales force, or indirectly through distributors or retailers (channel intermediaries). This type of direct-to-customer strategy is the model historically used by Dell. However, in 2009, Michael Dell announced that Dell Computer Corporation would be changing its distribution strategy to sell through retailers such as Best Buy. This change in Dell's distribution strategy was in response to changing markets and shows the importance of this strategy for competitiveness.

The selection and development of a distribution strategy requires doing market segmentation and analyzing the perceived value of each segment, as well as the competition and profitability of each segment. The best distribution strategy varies depending on which market segment the company is trying to reach. Consequently, it is best to use a mix of distribution strategies that vary by market segment and target a particular market. Market segmentation is also valuable to determine which segments should be first to receive the product in situations of product shortages. In [Chapter 4](#) we will discuss market segmentation and implications on SCM in more detail.

A good example of how market segmentation can be used to select different types of distribution strategies is illustrated by the bottled water industry. Most

companies in the industry have two markets. One is spring water and the other is distilled water. Spring water is collected and bottled on-site, whereas distilled water can be bottled at any one of many water sources using any local bottling company. Companies in this industry use two different distribution methods to serve their customer segments. The first strategy is using traditional retail distributors who serve the retail customers, and the second is direct-to-customer strategy, where the water is replenished on-site at either the customer's home or office. Further, the two distribution channels have different versions depending on which market segment they serve. To satisfy each segment, the supply chain uses different processes and assets and has different relationships.

A new entrant in the bottled water industry would have to make some important decisions. First, the company might have to decide whether it wants to sell to distributors who probably have a good relationship with the retailers, or sell directly to the retailers. If a company chooses to use distributors, it will have to make decisions such as whether to purchase an integrated order management system such as that of the distributor. Also, it may have to decide which distributors will be the company's strategic partners and for which the company may be willing to carry extra inventory. These decisions should not be made in isolation, but in concert with the overall business strategy, as they could have a profound impact on profitability and efficiency of the supply chain.

Concept Check Questions

55. A company's _____ strategy is about how it plans to get its products and services to customers.

- ☐ a) logistics
- ☐ b) transportation
- ☐ c) distribution
- ☐ d) location
- ☐ e) sourcing

Correct or Incorrect?

Clear

Check Answer

56. The selection and development of a distribution strategy is fairly straightforward.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

57. Companies in the bottled water industry typically have three different distribution methods to serve their customer segments.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Sourcing Strategy

[Sourcing strategy](#) relates to which of a company's businesses it is going to outsource vs the ones it will retain internally. This includes decisions regarding supplies and parts, as some companies choose to make these themselves. This decision has a great bearing on supply chain strategy, as it directly imposes a particular aspect of the supply chain structure—relationships with outside entities.

The process of developing a sourcing strategy typically begins with a company analyzing its existing supply chain skills and expertise. The company has to identify what areas it is good at and what areas of its expertise have the potential to become strategic differentiators. These activities have to be kept as in-house activities and made even better. On the contrary, activities with a low strategic importance that can be performed by another company are good options for outsourcing.

Outsourcing means that a company has hired a third party or a vendor to perform certain tasks or activities for a fee. This could range from the mundane, such as outsourcing proofing of legal documents or outsourcing the management of unimportant inventory items, to the outsourcing of the entire manufacturing process or even the entire management of the supply chain.

Outsourcing enables companies to quickly respond to changes in demand and enables them to quickly build new products or gain a competitive position in the marketplace. Through outsourcing, a company can leverage another company's capacity and expertise. This provides a tremendous amount of flexibility that is necessary in today's marketplace, which demands high specialization, although no company can do everything well. That is a very important realization for companies that they cannot effectively do all tasks well and may need to turn to vendors for help. Outsourcing something like communication network management to a company that is a leader in that area can provide an advantage. Outsourcing, most important, allows a company to focus on its core competencies. The famed management guru Tom Peters was known for saying: "Do what you do best, and outsource the rest!" For example, Accenture manages Unilever's finance and accounting processes through outsourcing.

Outsourcing used to be considered by managers as a simple make-or-buy decision, where they considered the cheapest alternative. Today, however, managers understand that sourcing is a strategic decision. It may be more expensive to purchase the expertise of an outside vendor, but it may prove to be a more time-saving decision and lucrative in the long run. Before making the final decision, however, companies need to fully consider the risks associated with outsourcing. Whenever control over a task is placed in the hands of a third party there is a risk of loss of control. The more important the outsourced task, or the more strategic it is, the greater the risk. The introduction of new products and ensuring that the configuration of the supply

chain supports the competitive lead times are activities that typically should not be delegated to a third party.

Other considerations related to outsourcing are whether the skills or activities that are being outsourced are going to continue to be maintained internally. This is an important decision as, on the one hand, a company may not want to duplicate what is already being outsourced. On the contrary, a company may choose not to eliminate the activity internally as it may completely lose its capability, and it may find that it is completely dependent on the vendor. Some years ago, a divestiture of an outsourcing agreement occurred between AT&T and Bank One. AT&T was responsible for all of the bank's IT needs. However, Bank One decided that even though IT was not its core competency, it was a highly important capability, given that it directly supports the bank's core competency. Consequently, it brought the function back "in-house."

Outsourcing tasks or functions to third parties can provide a significant competitive advantage. The first advantage is cost, as a third party may be able to offer products or services at a lower price. The reason is that they have reached economies of scale in their production systems for producing this type of product or service. Another advantage is that it enables a company to expand its offering into new markets or geographic areas through outsourcing partners that have reach in those areas. For many companies, this type of access might not be possible if it were not for outsourcing. Finally, outsourcing may help companies achieve state-of-the-art technological capability virtually overnight, which would not be possible otherwise. For many companies, it requires a significant financial investment to develop these capabilities internally, and they simply may not have the resources to keep up. Outsourcing enables a company to take advantage of this expertise from another firm.

All outsourcing engagements, however, entail certain risks that companies need to consider when making the outsourcing decision. In general, more sophisticated sourcing engagements bring greater benefits but also involve significantly higher risks. A number of risk factors need to be considered before a firm passes responsibility to external vendors.

One risk to consider is the risk of [loss of control](#). As the scope of the task passed to the vendor increases, the ability to retain control of the task or function decreases. The purpose of outsourcing is to tap into the talent and unique capability of the vendor. However, unless very specific outcome expectations are set up, the outcome may not meet expectations. Identifying

key performance metrics and their values is a challenge, particularly for service types of tasks, where the final “product” is intangible and often difficult to quantify. For small firms this can be particularly damaging as internal processes are less insulated from disruption.

Another risk to consider is dependency risk. As a firm engages in more sophisticated sourcing engagements, it often tailors and adapts its operations to match those of its vendor. By doing so, the firm may benefit by taking advantage of the vendor's economies of scale. This is particularly true in cases that require specialized technology and equipment and specialized training of staff. However, these arrangements create a risk that the firm will become overly dependent on the vendor. This can have short-term problems, such as a lack of performance on the part of the vendor that disrupts operations. It can also have strategic consequences, as the firm's future direction is tied to that of the vendor. The decision of whether to outsource should be based on the interdependence of the outsourced function with other internal processes. Companies should not outsource such highly integrated functions, particularly when high adaptation with the vendor or supplier is required.

As you can see, outsourcing is not always the right decision. Before turning to outside vendors, a company should always be clear on its source of competitive advantage and not outsource that aspect of its operation.

Interestingly, for many companies, manufacturing is not seen as a strategic function, and they choose to outsource it. Examples of this are Cisco in the electronics industry and Nike in the footwear industry. These companies outsource all aspects of manufacturing. Almost all industries, however, use third-party logistics providers for delivery, transportation, warehousing, and other logistics services. The role of third-party logistics providers has been increasing to include activities such as final packaging, software loading, and even final assembly.

Concept Check Questions

58. A/n _____ strategy relates to which of a company's business it is going to outsource versus the ones it will retain internally.

- ☐ a) outsourcing
- ☐ b) transportation

- ☐ c) distribution
- ☐ d) location
- ☐ e) sourcing

Correct or Incorrect?

Clear

Check Answer

59. The process of developing a sourcing strategy typically begins with a company collecting cost data from various vendors.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

60. Outsourcing means that a company has moved production overseas, usually by shifting production to a third party.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

61. Outsourcing enables companies to quickly respond to changes in demand and enables them to quickly build new products or gain a competitive position

in the marketplace.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

62. Outsourcing is a simple make or buy decision.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

63. Outsourcing tasks or functions to third parties can provide a significant competitive advantage. Which of the following is not one of these?

- ☐ a) A lower price
- ☐ b) It enables a company to expand its offering into new markets or geographic areas
- ☐ c) It helps companies achieve state-of-the art technological capability virtually overnight
- ☐ d) It lowers taxes

Correct or Incorrect?

Clear

Check Answer

64. Outsourcing is risk-free.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Customer Service Strategy

Customer service is extremely important as it brings value to the customer. Consequently, the mechanism by which this is achieved is a key building block of SCM strategy. The customer service strategy of a company should be based first on the overall volume and profitability of market segments. The company must understand what the customers in each segment want and must make a decision on how the company is going to meet the demands of its customers. Typically, this requires dividing the market by volume and profitability. This is shown in [Figure 2.5](#).

Some market segments will be small in volume and low in profit and pursuing them may not be worthwhile. At the other extreme are market segments that are high in volume and profitability, which are highly desirable. The other two segments, low volume, high profit, and high profit, low volume, are segments the company needs to closely evaluate and make a decision that prioritizes resources giving priority to the top right quadrant.

In developing a customer service strategy, companies need to make decisions such as whether all customers need to get same-day delivery or whether different service levels should be designed depending on the importance of the customer. A related decision is whether all products should be equally available to all customers. A company may decide that some customers should have quicker access than others. For example, Delta Airlines, as most airlines, has two separate customer service lines: one for regular customers and one for “platinum” customers. Although the transactions received are the same on

both lines, customers who call on the “platinum” line never have to wait for a customer service representative and receive more prompt service overall.

It is important to keep in mind that not all customers need, or even want, the same level of service. Therefore, a company must know exactly which customers want which type of service and identify the high-value customers. For example, in the computer industry, many commercial customers may not care as much about price as they do about customer service help support that provides rapid problem resolution. In the personal computer market, however, customers care more about price. A good strategy here is to segment the market and provide different services to help support the different market segments. High customer service is costly, and it should not be wasted on market segments that do not place value on it.

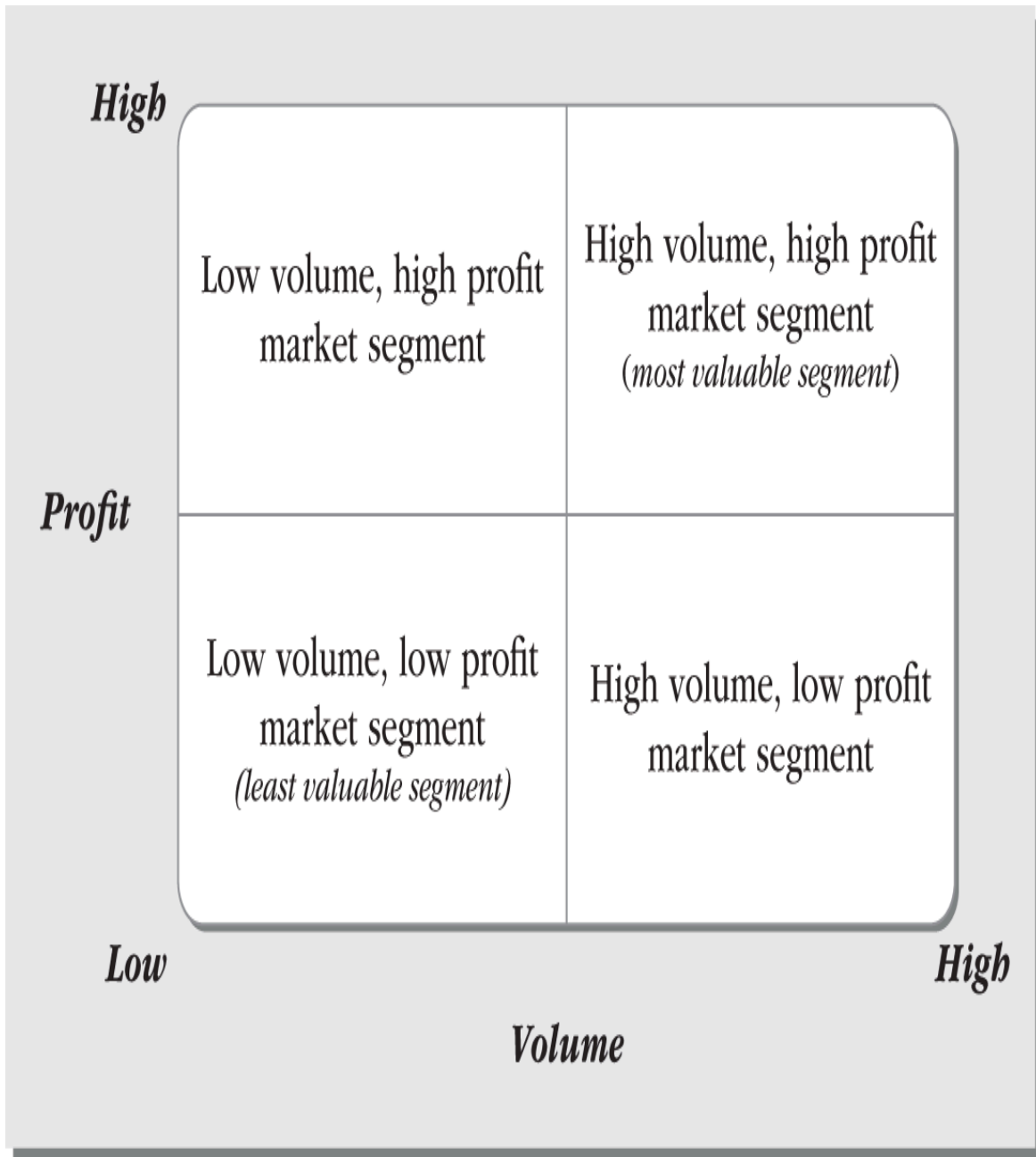


FIGURE 2.5 Market segmentation based on volume and profitability.

Managerial Insights Box—Outsourcing Alliances

■ LI & FUNG LTD.

Strategic alliances are not static but evolve as the company's strategy changes. In early 2010, Walmart announced that they were forming a strategic alliance with Li & Fung Ltd., a Hong Kong-based supply chain giant. Li & Fung Ltd. is known as an intermediary between retailers and manufacturers, especially those wishing to do business in China and Southeast Asia. Founded in southern China a century ago, Li & Fung Ltd. does not own any factories or equipment but orchestrates a network of 10,000 suppliers in over 50 production countries, for over 2,000 customers globally. It sources goods for numerous retailers including The Limited, Walt Disney, Kate Spade, and Target Corporation. In 2008, Li & Fung Ltd. had a turnover of \$14 billion, indicating the sheer volume of their business. So, what benefit could Walmart gain from the alliance?

The alliance provided benefits to both companies, each taking advantage of the other's strength. Walmart benefited by consolidating a part of its multibillion-dollar sourcing portfolio that supplies the goods it sells in stores. In addition, Walmart had access to all of Li & Fung Ltd.'s global connections and was able to leverage its huge purchasing power. In turn, Li & Fung Ltd. was able to expand beyond its core sourcing operations and move into higher-margin businesses such as retailing and brand licensing. In addition, the alliance with the retail giant significantly contributed to its financial position.

In 2015, however, Walmart decided to bring back “in-house” functioning of some of the product-sourcing services that had been handled by Li & Fung Ltd. With the changing business environment, Walmart was under financial pressure to squeeze out costs from its supply chain, and outsourcing costs needed to be reduced. Walmart decided to modify its relationship with Li & Fung Ltd. by choosing to handle some product sourcing internally while keeping Li & Fung Ltd. to handle purchases for its Sam's Club stores.

Entering into such an alliance demonstrates that Walmart understands its sourcing strategy and that using an “expert” to source on a large global scale can make good business sense when needed. This not only is an excellent example of the advantages that the outsourcing alliances can provide but also shows that these relationships change with a company's strategy.

Concept Check Questions

72. Strategic alliances are static.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

73. Li & Fung is known as an intermediary between retailers and manufacturers, especially those wishing to do business in China and Southeast Asia.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

74. Li & Fung owns numerous factories in China that other firms use for outsourced production.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

75. Li & Fung handles all the Chinese sourcing for Walmart.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

This means that companies need to segment the market carefully and consider how to effectively meet demands of those segments. The implications for SCM is that there may be different supply chains for different market segments. Apple employs distinct supply chain strategies for its consumer and professional market segments. For consumers of iPhone and iPad, Apple emphasizes high-volume production, cost-effectiveness, and global distribution, partnering with manufacturers like Foxconn. In the professional segment (for consumers of MacBook Pro), they offer customization options, prioritize performance, and provide specialized support with a more flexible and responsive supply chain, meeting diverse customer needs while maximizing market reach and profitability.



Concept Check Questions

65. Customer service is extremely important, as it is about bringing value to the customer.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

66. The customer service strategy of a company should be based on their competitor's approach.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

67. When using marketing segmentation based on volume and profitability, the high profit and low volume segment is the most valuable.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

68. When using marketing segmentation based on volume and profitability, the high volume and low profit is the least valuable.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

69. In developing a customer service strategy, companies need to make decisions such as whether all customers need to get same-day delivery or whether different service levels should be designed depending on the importance of the customer.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

70. A company should make all products available to all customers equally.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

71. Not all customers want the same level of service.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Supply Chain Strategic Design

Companies often do not give much thought to the design of their supply chains. They often focus on cost reduction through low-cost purchasing, manufacturing, or logistics. This can translate into supply chains that do not necessarily support the overall business strategy. In the previous section, we discussed the building blocks of supply chain strategy. We now address the strategic design of the supply chain and the overriding criteria that must drive its development.

The way a company competes in the marketplace is called a [competitive priority](#). Supply chain strategy and supply chain design greatly depend on a company's competitive priorities. The companies that follow this process—companies such as Amazon, Walmart, Toyota, Nike, McDonald's, and IBM—have been very successful. Unfortunately, too many companies just mimic other companies of the respective industry and create supply chains that look just like those of their competitors. This does not lead to a strong competitive advantage—it simply leads to being a follower in one's industry.

There are five primary competitive priorities:

- . Cost
- . Time
- . Innovation
- . Quality
- . Service

Let us look at each of these competitive priorities and show how each priority results in differing strategic supply chain designs.

Concept Check Questions

76. There are five primary competitive priorities. Which of the following is not one of them?

- ☐ a) Service
- ☐ b) Marketing
- ☐ c) Innovation
- ☐ d) Quality
- ☐ e) Service

Correct or Incorrect?

Clear

Check Answer

77. The way a company competes in the marketplace is called a _____.

- ☐ a) competitive priority
- ☐ b) cost advantage
- ☐ c) price advantage
- ☐ d) price priority
- ☐ e) marketing advantage

Correct or Incorrect?

Clear

Check Answer

Competing on Cost

If the company's business strategy is to compete on cost, then the supply chain strategy must be designed to support this. Companies that compete on cost offer products at the lowest price possible. These companies are either maintaining market share in a commodity market, or they are offering low prices to attract cost-sensitive buyers. Once a company's business strategy has determined that the company will compete on cost, the other functional strategies—including the supply chain strategy—should be designed to support this.

For example, competing on cost requires highly efficient, integrated operations that have cut costs out of the system. The supply chain plays a critical role in keeping both product and supply chain costs down. It may also require going to the least expensive suppliers rather than focusing on high-quality components. The low-cost supply chain focuses on meeting efficiency-based metrics such as asset utilization, inventory days of supply, product costs, and total supply chain costs. The operation strategy is designed for product and process standardization, as are operations of the suppliers. Notice that the supply chain design would be different had the chosen business strategy focused on something else, such as competing on customization. In that case, cost would be less of an issue as would be the ability to provide a wide range of customized products.

Although Dell Computer Corporation has been a model of supply chain excellence, Dell does not compete on cost. Dell does not claim to offer the least expensive computers, but merely customized computers in record time. That is the major difference. Dell's computer prices are within the industry range. This is unlike Walmart, which promises the lowest prices but not special customized products. The important thing is that each company's supply chain is designed to support the chosen business strategy.

Although efficiency and low cost are hallmarks of excellence, they cannot be achieved at the expense of service, innovation, or quality, if one of these is an element of the business strategy. An example of this is the apparel industry, where manufacturers typically outsource production to Southeast Asia. The manufacturers insist on fixed production schedules to keep their costs low. This, however, impacts their flexibility and can hurt retailers when demands unexpectedly shift, such as when there is an unexpected surge of demand. This limits retailers in their ability to respond to demand. For many retailers, being

out of stock regularly can play havoc with customers and erode market share. Focusing on price alone, without considering other aspects of the business strategy, may result in a poor supply chain strategy. In the early 2000s, Mattel faced a major supply chain crisis. They had outsourced much of their toy production to China to reduce manufacturing costs, aiming for lower prices to remain competitive. However, in doing so, they overlooked crucial quality control aspects. This resulted in several product recalls due to unsafe levels of lead in some of their toys, notably the toys from the brands such as Barbie and Fisher-Price.

The focus on low-cost manufacturing without adequately considering quality and safety standards led to serious consequences for Mattel. They not only faced massive product recalls but also damage to their brand reputation, lost consumer trust, and legal implications. Mattel's stock was affected negatively as a result of this supply chain failure.

Concept Check Questions

78. Companies that compete on cost offer products at the lowest price possible.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

79. Competing on cost requires highly efficient, integrated operations.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

80. The low-cost supply chain focuses on maximizing outsourcing.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

81. Dell Computer Corporation competes mainly on price.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

82. The focus on low-cost manufacturing without adequately considering quality and safety standards led to serious consequences for Mattel.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Competing on Time

Time is one of the most important ways companies compete today. Companies in all industries are competing to deliver high-quality products in as short a time as possible. Amazon, FedEx, LensCrafters, and United Parcel Service (UPS) are all examples of companies that compete on time. Customers today are increasingly demanding short lead times and are not willing to wait for products and services. Companies that can meet needs of customers who want fast service are becoming leaders in their respective industries.

Making time a competitive priority means competing based on all time-related dimensions, such as rapid delivery and on-time delivery. Rapid delivery refers to how quickly an order is received; on-time delivery refers to the number of times deliveries are made on time. When time is a competitive priority, the job of the operations function is to critically analyze the system and combine or eliminate processes to save time. Companies can use technology to speed up processes or they can rely on a flexible workforce to meet peak demand periods and eliminate unnecessary steps in the production process.

FedEx is an example of a company that has chosen to compete on time. The company's current slogan in 2024 is “The World on Time,” compared to their slogan “Absolutely, Positively Anytime” in 1995. To support this business strategy, the entire supply chain has been set up to support this criterion. Barcode technology is used to speed up processing and handling, and the company has discovered that it can provide faster service by using its fleet of airplanes. This technology has enabled FedEx to compete on time, but it is costly. Consequently, FedEx neither competes on cost nor does it make any claims regarding its prices. Its business strategy is to compete on time, and all the other functions are aligned to support this strategy.

Concept Check Questions

83. Time is one of the most important ways companies compete today.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

84. Rapid delivery refers to the number of times deliveries are made on time.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

85. FedEx is an example of a company that has chosen to compete on quality.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Competing on Innovation

Companies whose primary strategy is innovation focus on developing products that the customers perceive as “must-haves” and thereby pull the product through the supply chain with significant demand. Examples of such

companies include Sony and Nike—companies that deliver innovative products customers want. Due to the “must-have” nature of these products, these companies can typically command a premium price, which is to their advantage because competing on innovation requires a sizable financial commitment. In addition to the supply chain capability, the real ability to compete in this dimension lies in superior marketing and product development, which is directly related to the supply chain.

Companies that compete on innovation typically have a very short window of opportunity before the imitators enter the market and begin to steal market share. Companies competing on innovation are aware that they must enter the market early with an innovative design. The supply chains of these companies typically focus on two features: speed and product design. This requires a carefully integrated supply chain that enables collaboration on product design between suppliers and manufacturers. Manufacturers with this type of supply chain have to have both internal integration between functions and integration externally with suppliers.

Another challenge for innovative supply chains is the ability to quickly raise production volumes should demand suddenly increase. An innovative product does not accomplish much if the company cannot quickly deliver a large volume of the product to the market to meet demand. Often this cannot be accomplished by one company's manufacturing process alone, and the ability to access production capacity when needed provides a significant competitive advantage. That is why most of these companies, such as Nike, are “virtual companies.” This means that marketing and product design are their strength, yet they outsource all the other aspects of their supply chain and manufacturing processes, albeit through a tightly controlled system.

Concept Check Questions

86. Companies whose primary strategy is innovation focus on developing products that the customers perceive as “must-haves.”

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

87. With “must-have” products, companies typically charge a lower price to increase volume sales.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

88. Companies that compete on innovation typically have a very short window of opportunity before the imitators enter the market and begin to steal market share.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Competing on Quality

Competing on quality means that a company's products and services are known for their premium nature. Two important elements of this competitive priority are consistency and reliability. Examples of companies known for competing on quality are Mercedes-Benz, General Electric, and Motorola. Many aspects of the supply chain are altered when companies compete on

quality vs another dimension, such as cost. This includes sourcing of components, as well as the implementation of concepts such as total quality management (TQM) and Six Sigma throughout the entire supply chain. This means embedding quality in all aspects of transportation, delivery, and packaging. This is particularly challenging when items are perishable, fragile, or of high value, such as luxury goods.

As SCM is a boundary-spanning activity, an important attribute of competing on quality is [product traceability](#). This means that the supply chain can easily trace a product from the point of origin in the supply chain, through to the customer, and back down the supply chain in the case of returns. This feature is increasingly becoming important with greater emphasis on security and sustainability. Radio frequency identification (RFID) tags have provided excellent product traceability. Consider industries where this might be of particular importance, such as the pharmaceutical industry, where safety is critical. Another industry is the area of luxury goods, where counterfeiting is a problem, and traceability is very important in the identification of goods.

In 2023, a major counterfeit luxury goods operation was uncovered in New York City. The authorities raided a warehouse and found over \$35-million-worth counterfeit designer handbags, including knockoff versions of popular brands such as Louis Vuitton, Gucci, and Chanel. These counterfeit bags were sold at a fraction of the price of the authentic items, making them appealing to budget-conscious consumers looking for a deal.

Concept Check Questions

89. Competing on quality means that a company's products and services are known for their premium nature.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

90. Two important elements of competing on quality are consistency and profitability.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

91. As supply chain management is a boundary-spanning activity, an important attribute of competing on quality is product _____.

- ☐ a) quality
- ☐ b) traceability
- ☐ c) consistency
- ☐ d) durability
- ☐ e) reliability

Correct or Incorrect?

Clear

Check Answer

Supply Chain Leader's Box

■ BARLEAN'S ORGANIC OILS

Barlean's Organic Oils is a family-owned private company that provides an example of the success that can be achieved when competing on quality and has designed a supply chain to support its strategy. Barlean's is a company that sells health supplements, but it is most known for its flaxseed oil. Barlean's Organic Oils is a sales leader in the market for flaxseed oil. The business strategy of Barlean's is to focus on quality and freshness. The company maintains a four-month expiration date where competing products may be five months old even before they get to the retail shelf. It is the manufacturing and distribution processes that give Barlean's its edge. Typical competitors have manufacturing processes that expose the flaxseeds to heat, light, air, and overprocessing, all of which reduce the potency of the flaxseeds. In contrast, Barlean's Organic Oils starts with organic flaxseeds and has a system where the seeds are protected from the elements. The seeds are not pressed until an order has already come in from the retailer. Barlean's Organic Oils uses an express mail system for shipping orders to expedite arrival at the retailer. Although this is a more expensive alternative, it is one that supports the company's commitment to quality.

Adapted from: <https://www.barleans.com>.

Competing on Service

Competing on service means that a company understands the dimensions that its target customers define as high service and has chosen to tailor their products to meet those specific needs. An important aspect of this strategy is that these companies typically build customer loyalty, which can often guarantee continued sales. These companies typically have exceptional order-fulfillment systems, with fast invoicing that enables them to be consistent and reliable. These companies typically do not compete on cost and cannot offer the lowest-priced product. However, their target market is one that wants high-quality service and is willing to pay the extra cost.

From an operational viewpoint, companies with superior customer service often avoid unnecessary costs related to expediting orders or the costs of product returns, often faced by other companies. These companies also have a strong ability to segment their customer based on perceived value. This way they can offer services of one type to one market and a modified version to another. For these firms, the relationship between product cost and profitability is well defined. Consequently, highly customized services that are costly to deliver are only offered to customers who meet strict business criteria and tend to be in the high-value segment.

Apple is known for its commitment to providing an exceptional customer experience and service. They invest heavily in customer support, both in terms of their online and offline presence. Apple Stores offer a unique and personalized shopping experience, and their customer service representatives are well trained to provide technical assistance, advice, and solutions to customers. Apple also offers a range of customer support options, including phone support, online chat, and a comprehensive support website.

While Apple's products are often priced at a premium compared to competitors, their focus on delivering top-notch service, including product support, software updates, and a user-friendly ecosystem, has created a loyal customer base. Many customers are willing to pay more for the peace of mind and overall experience that Apple provides. This strategy has allowed Apple to compete effectively based on service quality rather than just cost.

Concept Check Questions

92. Competing on service means that a company understands the dimensions that its target customers define as high service.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

93. Companies that compete on service typically have low prices.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

94. From an operational viewpoint, companies with superior customer service often avoid unnecessary costs related to expediting orders or the costs of product returns.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

95. Apple is known for its commitment to providing an exceptional customer experience and service.

- ☐ True
- ☐ False

Correct or Incorrect?

[Clear](#)[Check Answer](#)

Why Not Compete on All Dimensions?

Successful companies understand that they cannot effectively compete on all dimensions, as they cannot be all things to all people. This is a very important and difficult point for most companies, as they typically want to be good at everything. The companies that succeed are those that understand which dimensions to excel in and are able to focus their energies on those dimensions. This does not mean that a company will have poor performance on the other dimensions. Companies have to continually trade off one competitive dimension for another. However, this means that a company should have merely satisfactory performance, or stay within the norms of the industry, on those strategically less important dimensions.

Two important concepts that companies need to monitor are [order winners](#) and [order qualifiers](#). Order winners are those characteristics that win the company orders in the marketplace. Order qualifiers are those characteristics that will qualify the company to be a participant in a particular market. This means that a company just needs to stay within the industry standard on its order qualifiers to ensure that it is on par with competitors. However, when it comes to order winners—that is where it should excel.

Let us take the example of Tesla in the electric vehicle (EV) market:

Order Qualifiers: In the EV market, certain basic criteria are essential, such as range (how far the vehicle can travel on a single charge), safety features, and reliability. Tesla meets these qualifications by producing EVs that have competitive ranges, excellent safety ratings, and a reputation for reliability. Without meeting these criteria, Tesla would not be able to compete in the EV market.

Order Winners: Tesla's order winners are factors that set it apart from competitors and drive customers to choose Tesla's EVs over other options. One significant order winner for Tesla is its cutting-edge autonomous driving technology, including features such as autopilot and full self-driving (FSD). Tesla's Supercharger network, which allows for faster charging, is another order winner. Additionally, Tesla's brand image, innovation, and a passionate community of supporters contribute to its order-winning factors.

Recall that a supply chain must be designed to support the business strategy, so alignment between the two should be a top priority. It should be remembered, however, that strategy is a dynamic rather than a static process. As such, strategies change over time, and supply chains must adapt accordingly.



Concept Check Questions

96. Successful companies understand that they can effectively compete on all dimensions.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

97. _____ are those characteristics that win the company orders in the marketplace.

- ☐ a) Price matrix
- ☐ b) Strategic values
- ☐ c) Order winners
- ☐ d) Value matrix
- ☐ e) Order qualifiers

Correct or Incorrect?

Clear

Check Answer

98. _____ are those characteristics that will qualify the company to be a participant in a particular market.

- ☐ a) Price matrix
- ☐ b) Strategic values
- ☐ c) Order winners
- ☐ d) Value matrix
- ☐ e) Order qualifiers

Correct or Incorrect?

Clear

Check Answer

Strategic Considerations

Small vs Large Firms

When developing a supply chain strategy, it is important to understand the company's strengths and weaknesses to realistically determine what it can and cannot accomplish. The company must play to its strengths.

For many supply chain companies, a large source of power comes from their sheer size. Companies such as Amazon, Walmart, Toyota, and Home Depot are large firms with equally large market clout. These companies are sometimes called “[supply chain masters](#)” and can “strong-arm” their suppliers into compliance. However, not all companies have this advantage.

When designing its supply chain strategy, a company needs to understand how much influence or power it has in the marketplace. Large companies have the advantage of being able to buy larger quantities of goods and command lower prices due to quantity discounts. Due to their size, these companies can impose their processes and rules on suppliers and customers.

Large companies can also impose the supply chain structure they want. They can impose their own process rules on suppliers and maintain a high degree of control over the entire supply chain. In the auto industry, for example, manufacturers stipulate that if a supplier's delay in delivery shuts down the production line, the supplier can be subject to a substantial penalty due to revenue lost while the line is down. Not every company can make this kind of demand.

Smaller companies have, however, developed their own supply chain strategies. For example, when developing their supply chain strategies, smaller companies should consider that size is relative. Few companies are large on a broad, global scale. When the scope narrows to a particular market segment or region, companies can find that they are really not that small. In that case, they can find select suppliers within that market segment with whom to work and develop strategies to compete within that market. Also, smaller suppliers can create cooperatives to aggregate their power.

Concept Check Questions

99. For many supply chain companies, a large source of power comes from their prices.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

100. Larger companies have difficulty keeping their suppliers in compliance due to the number of items they order.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

101. Smaller companies tend to have more complex supply chains than larger companies.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Supply Chain Adaptability

Successful companies understand that change is a natural part of the business environment and adapt their supply chains in anticipation. As market and environmental conditions shift, new products emerge, and new technology is developed; business strategies need to change. A company's supply chain strategy must quickly adapt to stay in sync with the business strategy. Consequently, the supply chain strategy must be adaptive.

The rate of change and the need for responsiveness, however, vary by industry. Some industries experience frequent and constant change, as seen in the personal computer industry. In this industry, companies need to change constantly such as selling through the Internet, exploring new distribution channels, or moving to an assemble-to-order strategy. In other industries, however, change can take much longer. One example of this is the aerospace industry, where changes in the supply chain typically occur after many years.

Numerous factors can require significant adaptability on the part of a company's supply chain. One of these is the development of a new technology that can change a business and its industry. The Internet is a good example, which created a direct link between businesses and customers. Companies

such as Amazon, Dell, and many others could now sell directly to customers and cut out distributors. The Internet completely changed the “rules of the game” for the business community and required companies to quickly adapt their supply chains.

Another factor that requires supply chain adaptability is a change in the scope of a company's business. Any time a company offers new products or services targets new markets or expands geographically, it needs to completely rethink its supply chain strategy. The reason is that the company may likely need to expand its manufacturing capacity, add new distribution capabilities, develop new channels, or find new suppliers. Any time, the scope of the business changes, the supply chain needs to adapt.

Although these events require adaptability, creating and implementing a supply chain strategy is a dynamic process that should be done continually. It is not an annual or biannual event. Any change in a company's competitive position—a new competitor entering the market, a shift in the market, or a competitive strategy—should automatically result in a reassessment of the company's supply chain strategy.

The Blockbuster vs Netflix rivalry showcases the importance of continuously evolving supply chain strategies. Blockbuster's initial dominance was based on physical stores, but the emergence of Netflix and online streaming disrupted the market. Blockbuster's failure to adapt its supply chain strategy to embrace digital distribution and changing customer preferences led to its bankruptcy. This real-world example highlights that supply chain strategies should be dynamic, triggered by shifts in the competitive landscape, technology, and customer behavior, to ensure long-term competitiveness and survival in evolving markets.



Concept Check Questions

102. Most supply chains rarely change.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

103. The development of a new technology that can change a business and its industry.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

104. Any time a company offers new products or services, targets new markets, or expands geographically, it needs to completely rethink its supply chain strategy.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

105. Implementing a supply chain strategy is a dynamic process that should be done on an annual basis.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

AI & Analytics Box

■ AMAZON

Amazon is a company that is a leader in its use of AI and analytics enabling it to be adaptable and promote its customer-centric strategy. The company has been working on a plan—that would ship products to customers before purchases are even made—which is called “predictive procurement” in 2024, it is a strategic approach that leverages advanced technologies, data analytics, and AI to forecast, anticipate, and proactively address procurement needs and challenges. It uses historical data, market trends, and predictive algorithms to make data-driven decisions and optimize procurement processes. By anticipating future demand, identifying potential supply chain disruptions, and optimizing supplier relationships, predictive procurement can help the company move beyond reactive procurement practices and become more agile, resilient, and strategic in their procurement operations.

The idea is simply to get orders as close as possible to the address of potential customers before they even press the “click” button. Amazon can then preemptively ship products they expect customers to buy. The company may even load products onto trucks and have them sent to shipping hubs in areas where the company believes the purchases will take place. The importance of this idea is to use analytics to cut down delivery times. This would also keep the online retailer ahead of others in the industry. Although the scenario may lead to unwanted deliveries and even returns, the company believes these will be relatively small, given the increased sales and delivery benefits.

Since the launch of “predictive purchasing,” Amazon has built a massive warehousing network around the country, adding smaller warehouses closer to city centers where Prime Now promotes superfast delivery options. In sum, Amazon is relying on analytics technologies to manage its advanced comprehensive supply chain network.

Empowering Entrepreneurs Box

Supply chain strategy is one of the most important areas for small companies, where entrepreneurs often have visibility of their entire supply chain. While there are so many stories in the media about “disruptive startups,” small companies are especially prone to growing pains. They can have difficulties in managing sustained growth. The key is a well-structured supply chain that is driven by a clearly articulated strategy.

What is difficult for entrepreneurs is that often the supply chain strategy is evolving. For this reason, it is often prudent to start small and grow slowly. This approach allows a company to be constantly conducting “environmental scanning,” testing ideas, and switching gears as needed. A great example of a startup needing to evolve its strategy is Groupon that started the concept of online couponing in 2008. The concept was initially a tremendous hit, but Groupon focused too much on customer acquisition and not enough on customer retention. When the company rushed to scale up, it did not address these issues. The result was Groupon's share price plunging from \$20 to \$9 within months of filing its IPO in 2011. The company's revenue which was once \$3 billion in 2016, has been reported to be \$599.1 million in 2023. Their stock prices have continued to be volatile and Groupon is continuing to refine its strategy.

The story of Groupon is common, where a startup is evolving its strategy. However, to be able to shift and evolve, a small company needs to have a flexible supply chain. One of the biggest challenges for entrepreneurs is developing such supply chain flexibility. It requires a strong network that is dependent on relationship building and cultivation of a community.

Having an overarching strategic view is critical, such as understanding the type of company the founders want. For example, a strategy of having a local business will require putting down roots through partnerships and sponsorships in the region. On the contrary, a company that wants global appeal may require the founders to attend conferences and reach out internationally in order to become relevant on a global stage.

The bottom line is that supply chain flexibility is especially important for entrepreneurs, both in strategic focus and supply chain structure, with steady growth and ability to pivot as opportunities develop.

Productivity as a Measure of Competitiveness

The purpose of supply chain strategy is to provide higher competitiveness to firms. Being able to measure competitiveness provides a scorecard for companies to evaluate how they are doing. One of the most common measures of competitiveness is productivity. We now look at its computation and interpretation.

Concept Check Questions

106. The purpose of supply chain strategy is to provide higher competitiveness to firms.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

107. One of the most common measures of supply chain competitiveness is profits.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Measuring Productivity

Productivity is a measure of how well a company uses its resources. It is computed as a ratio of outputs to inputs, where the inputs can be labor or materials and outputs can be goods and services.

$$\text{Productivity} = \frac{\text{Output}}{\text{Input}}$$

The productivity measure can be used to measure the performance of an individual resource, such as workers or machines. It can also be used to measure the performance of the entire organization such as a warehouse, an entire supply chain, or even a nation ([Figure 2.6](#)).

Total productivity measure (output to all inputs)	$\frac{\text{Total output produced}}{\text{All inputs used}}$	<i>Example:</i> Productivity of an entire warehouse
Partial productivity measure (output to only one input)	$\frac{\text{Output}}{\text{Labor}} \text{ or } \frac{\text{Output}}{\text{Machines}} \text{ or } \frac{\text{Output}}{\text{Materials}} \text{ or } \frac{\text{Output}}{\text{Capital}}$	<i>Example:</i> Productivity of sorting machines
Multifactor productivity measure (output to several inputs)	$\frac{\text{Output}}{(\text{Labor} + \text{Machines})} \text{ or }$ $\frac{\text{Output}}{(\text{Labor} + \text{Materials})} \text{ or }$ $\frac{\text{Output}}{(\text{Labor} + \text{Capital} + \text{Energy})}$	<i>Example:</i> Productivity of truck fleet and drivers

FIGURE 2.6 Productivity measures.

Total productivity is used when we want to measure the utilization of all resources combined, such as labor, machines, and capital. Let us say that a dry-cleaning company has a monthly dollar value of outputs worth \$18,000. This includes all items dry-cleaned for customers. Let us also say that the value of its inputs, such as labor, materials, and capital, is \$9,000. The company's total monthly productivity would be computed as follows:

$$\text{Total Productivity} = \frac{\text{Output}}{\text{Input}} = \frac{\$18,000}{\$9,000} = 2.00$$

If the company wanted to compute the productivity of its machines, it would use a partial productivity measure. Say that its machines can clean 32 garments in eight hours, their productivity would be computed as follows:

$$\begin{aligned}\text{Machine productivity} &= \frac{\text{Number of garments}}{\text{cleaning time}} \\ \text{Machine productivity} &= \frac{32 \text{ garments}}{8 \text{ hours}} = 4 \frac{\text{garments}}{\text{hour}}.\end{aligned}$$

Concept Check Questions

108. Which of the following is a measure of total productivity?

- ☐ a) Output / Single input
- ☐ b) Output / Two inputs
- ☐ c) Output / Multiple inputs
- ☐ d) Output / Profits
- ☐ e) Total output produced / All inputs used

Correct or Incorrect?

Clear

Check Answer

109. Which of the following is a measure of partial productivity?

- ☐ a) Output / Single input
- ☐ b) Output / Two inputs
- ☐ c) Output / Multiple inputs
- ☐ d) Output / Profits
- ☐ e) Total output produced / All inputs used

Correct or Incorrect?

Clear

Check Answer

110. Which of the following is a measure of multifactor productivity?

- ☐ a) Output / Single input
- ☐ b) Output / Two inputs
- ☐ c) Output / Multiple inputs
- ☐ d) Output / Profits
- ☐ e) Total output produced / All inputs used

Correct or Incorrect?

Clear

Check Answer

Interpreting Productivity

The more efficiently a company uses its resources, the more productive it is and, therefore, the higher the productivity ratio. However, interpreting productivity is more complicated than it may appear.

Consider the numbers we just computed, such as, for example, a machine's productivity of four garments per hour. Does that number mean anything to you? The answer is no. The reason is that to interpret the meaning of a productivity measure, it must be compared against a baseline. For example, if we know that a competing dry cleaner has a machine productivity of six garments per hour, then the productivity number we just computed—four

garments per hour—tells us that our productivity is low. For our competitor, however, this is good news, as their productivity is higher and suggests that they are more competitive.

In addition to benchmarking productivity measures against others, productivity should be measured over time to observe changes. Let us say that our dry cleaner chose to track machine productivity on a monthly basis and had chosen to purchase new machines in the third month. Perhaps the following is observed:

Month	1	2	3	4	5
Productivity (in garments per hour)	3.8	4.0	5.3	6.4	6.9

Now we can see that productivity had gone up after the purchase of the new machines. However, productivity continued to grow perhaps as the workers adjust to using the new equipment. Looking at productivity over time provides a very different level of understanding than looking at just one number. The best alternative is to track productivity over time and benchmark against industry standards.

When computing productivity, it is important to consider the units used in its computation, as they provide different meanings. Consider a restaurant that measures productivity as either a ratio of customer serviced to labor-hour vs customer serviced to square footage. The first measure looks at utilization of labor, whereas the second measure looks at utilization of space. One consideration is how a company competes in the marketplace. For example, a company that competes on speed would probably measure productivity in units produced over time. However, a company that competes on cost might measure productivity in terms of costs of inputs such as labor, materials, and overhead. Well-chosen units can make productivity a useful metric for evaluating competitiveness over time.



Concept Check Questions

111. Companies prefer lower productivity values.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

112. A single productivity value has great meaning.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

113. A productivity value of 3.1 is better than a value of 2.8.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

CHAPTER HIGHLIGHTS

Supply chain strategy is a long-range plan for the design and ongoing management of the supply chain to support the business strategy.

Strategic alignment needs to exist between the business strategy and the functional strategies. A company's supply chain strategy should be developed to support the company's business strategy.

Companies can gain a competitive advantage through either a cost–productivity advantage or a value advantage. A company with a cost–productivity advantage maintains competitiveness by offering the lowest-cost product or service. A company with a value advantage maintains competitiveness by providing a product with the greatest perceived differential value compared with its competitors.

The experience curve describes the relationship between unit costs and cumulative volume, where organizational costs are reduced due to experience and learning effects that result from processing a higher volume.

The four building blocks of supply chain strategy are operations strategy, sourcing strategy, distribution strategy, and customer service strategy.

The way a company competes in the marketplace is called a competitive priority. The supply chain strategy and supply chain design will be different based on a company's competitive priorities.

Competitiveness can be measured by productivity, which is a measure of how a company utilizes its resources.

KEY TERMS

[Business strategy](#)

[Supply chain strategy](#)

[Cost–productivity advantage](#)

[Value advantage](#)

[Experience curve](#)

[Vendor-managed inventory \(VMI\)](#)

generative artificial intelligence (AI)

Value segments

Operations strategy

Product positioning strategy

Make-to-stock strategy

Assemble-to-order strategy

Make-to-order strategy

Distribution strategy

Sourcing strategy

Loss of control

Dependency risk

Competitive priority

Product traceability

Order winners

Order qualifiers

Supply chain masters

DISCUSSION QUESTIONS

Find an example of a company whose product you like. Identify its business strategy and its supply chain strategy. Explain whether or not the supply chain strategy supports the business strategy.

Identify ways a company can move from a “commodity” position to one of a cost and/or value advantage. Is a commodity position always bad, and how can companies differentiate themselves in this position?

Explain the differences between vertical integration and outsourcing. Identify the strategic advantages of each, and explain how each position can be used to help supply chain strategy.

Provide business examples of the three operations strategies: make-to-stock strategy, assemble-to-order strategy, and make-to-order strategy. Explain what

it would take for a company to move from a make-to-stock strategy to make-to-order strategy, and vice versa. What are the advantages and disadvantages of each strategy?

Provide business examples of companies that compete on each one of the identified competitive priorities. Explain how their supply chain strategies are different based on their specific competitive priority. Select one of the business examples you provided and explain how the company would need to change its supply chain strategy if it shifted its competitive priority.

PROBLEMS

Mario's Pizzeria is a local pizza shop. Mario is trying to evaluate the productivity of his operation. One worker can make approximately three pizzas in 30 minutes, whereas another four pizzas in 20 minutes. Which worker is more productive?

An automated packaging machine used in warehousing can sort and pack six large boxes in 15 minutes. A new machine that is being considered can sort and pack four boxes in 8 minutes. How much more productive is the new machine?

The diagnostic department at Saints Memorial Hospital provides medical tests and evaluations for patients, ranging from analyzing blood samples to performing magnetic resonance imaging (MRI). The average cost to patients is \$60 per patient. Labor costs average \$15 per patient, materials costs are \$20 per patient, and overhead costs are averaged at \$20 per patient.

What is the multifactor productivity ratio for the diagnostic department? What does this finding mean?

If the average lab worker spends three hours for each patient, what is the labor productivity ratio?

Case Study Surplus Styles

Surplus Styles is a manufacturer of hair care products, including shampoos, conditioners, and hair gels. The company, located in Southern California, bottles shampoos and other various hair products in their manufacturing plant but sources the content from a number of chemical suppliers. The company has historically competed on cost and has used competitive bidding to select suppliers and award year-long contracts. The Director of Sourcing, Derick M. Frizzle, has managed the competitive bid process for the past 10 years, having moved up the ranks from purchasing. He was particularly proud that the company was cost-competitive in its market segment.

One recent day the president of the company, Frederick Davenport, called for a meeting with Mr. Frizzle. Derick could tell from the tone of Davenport's message that the meeting would be accompanied by less-than-stellar news. As Derick took the infamous ride up the wood-paneled elevator with green marble floors to the top of their office building, he contemplated what he could have possibly done wrong. He had followed the same type of supplier bidding process for years, and the company was doing well financially. He was anxious to hear what Davenport had to say.

Derick entered Davenport's vast office, a room highlighted by ceiling-to-floor windows. He could see Mr. Davenport sitting at the end of the long, dark wooden table, with his two aides accompanying him on each side. The man on the right was Bo Jenson, and the woman on the left was Gertrude Masterson; neither were taken lightly within the company. Derick could always tell when it was going to be a bad day.

"Darn hippies," Davenport rumbled. "Bo and Gertrude have some troubling news. This swing toward animal rights and 'quality goods' is about to cost me a lot of money," Davenport continued, making mocking "bunny ears" with his bulbous index and middle fingers. "Apparently market trends are changing again and not for the better." Davenport continued to explain that there was going to be a change in the competitive strategy of the firm. The competition in the hair care market had become fierce, and there was a greater focus on quality. Specifically, the recent trend in animal rights and natural, organic products meant ensuring that the shampoo content did not go through animal testing and that it was

ensured to be hypoallergenic. The current products were produced to compete for price and did not agree with the new demands. Davenport wanted to see products on the retail shelf with this quality standard as soon as possible. “Do it,” Davenport continued and sat back down. This concluded the meeting. Luckily Mr. Frizzle had an easy exit, as he had only gotten one foot in the door before his task was demanded.

Derick M. Frizzle was rather pleased with his new detail, as he cared greatly for nature and had always refrained from purchasing his own company's products due to their lack of consideration for both the individual and the environment. However, Derick was now confronted with a problem. His current suppliers offered the lowest cost in the business and would likely not be able to provide the needed quality assurance. His expertise had been in procuring the least-expensive ingredients available, and he did not know where to begin changing his sourcing practices.

Case Questions

1. Identify the steps that Derick should take to solve his problem.
2. Should Derick ask for the required changes from the current suppliers? If they do not comply, should he solicit new suppliers? How might he do this?
3. Should Derick go through a competitive bid in the future? If so, should he do it for all purchased products or just some products?
4. What are the differences when looking for suppliers to meet cost standards vs quality standards?

Case Study Making Decisions with Data Analytics: Whole Goods

You opened your first grocery store in 2013 called Whole Goods, in a suburb of Melbourne, Australia. As a business student, you learned that to differentiate yourself and improve margins, you must develop in-house brands and products. Following this strategy, you increased the percentage of in-house products sold by 30%. However, in the given production costs, you chose to outsource production of these in-house brands and have demanded very strict quality control measures of your suppliers. This was a good strategy. Customers have found your in-house brands to be of much better quality than those of the competition, and revenues and profits have been high.

You have been thrilled with your business success and are now planning for an explosive growth by adding five stores each year for the next five years. At the same time, you plan on increasing the percentage of in-house brands by 70%. This new plan demands a heavy investment in technology to manage the flow of products and information across the supply chain. You have realized that the Microsoft Excel-based system you have been using for sales and records management will no longer be an option as the number of monthly transactions will exceed 10 million. You are also thinking of moving to online sales.

Case Questions

1. Is this a realistic strategy from a supply chain viewpoint? Why or why not?
2. What technological capabilities do you need from a new system to support your strategy? What criteria will you use for selection?
3. How will you go about incorporating the technology to support your supply chain strategy?

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3

Network and System Design

LEARNING OBJECTIVES

After completing this chapter, you should be able to:

Describe the supply chain as a system of processes.

Understand how to manage processes across the supply chain.

Explain system constraints and variation in managing a supply chain network.

Describe the stages of supply chain integration.

Describe key factors in designing a supply chain structure.

Explain enterprise resource planning (ERP) as a system integration technology.

CHAPTER OUTLINE

- **The Supply Chain System**
 - Processes across the Supply Chain*
 - What Is a Business Process?*
 - Managing Supply Chain Processes*
- **Understanding Processes: Theory of Constraints (TOC)**
 - System Constraints*
 - System Variation*
 - Capacity Implications*
- **Integration of Supply Chain Processes**
 - Stages of Integration*
 - Vertical Integration vs Coordination*
- **Designing Supply Chain Networks**
 - Supply Chain Structure and Management*
 - Designing Segmented Structures*
- **Enterprise Resource Planning (ERP)**
 - IT as an Enabler of SCM*
 - What Is ERP?*
 - ERP Configuration*
 - ERP Implementation*
- **Chapter Highlights**
- **Key Terms**
- **Discussion Questions**
- **Problems**
- **Case Study: Boca Electronics, LLC**
- **Case Study: Making Decisions with Data Analytics: J Consulting**

Bibliography



[Bloomberg Quicktake Video: BMW's Oliver Zipse on Supply Chain Issues, Chip Shortages, New 7 Series](#)

[Bloomberg Quicktake Video: Focus on Tech, EV Supply Chain Stocks in 2022: Harris](#)

[Bloomberg Quicktake Video: Financing the Future of Africa](#)

In 1949, Mr. Kihachiro Onitsuka began making basketball shoes from his living room in Kobe, Japan. He chose to make sports shoes, which he thought was the best way to encourage the young to play sports. He wanted his shoes to be the best in footwear and chose to call his company ASICS—an acronym for the Latin phrase *anima sana in corpore sano*—which means “a sound mind in a sound body.”

After years of hard work, ASICS has become a leading maker of athletic footwear, sports apparel, and accessories. Today ASICS’ worldwide sales total around \$2.4 billion. Although its great success was welcome, ASICS found it to be both a blessing and a curse.

In 2008 ASICS America found itself growing 21% annually, and the company found it difficult to keep ahead of demand. ASICS had only one distribution center (DC) in the United States, which had reached capacity. This single DC, located in Southaven, Mississippi, was able to handle a maximum of 50,000 units per day. However, the growth in demand resulted in 70,000 units per day being shipped to the DC. This capacity constraint was not only slowing down order fulfillment but also was now preventing the company from serving new customers and markets. The DC had become a “bottleneck” in the supply chain design network causing service slowdowns. The company understood that the supply chain network had to be changed if they were going to support this new level of demand.

The company's U.S. network was fairly straightforward. It used contract manufacturers in China, Vietnam, and Indonesia to make its shoes and clothing. Those items were shipped in ocean containers to the ports of Los Angeles and Long Beach. It then used a third-party logistics (3PL) provider—APL Logistics (APLL)—to unload ASICS’ ocean containers. The merchandise was then reloaded onto 53-foot trailers for shipment to the 350,000-square-foot DC in Southaven, Mississippi. That facility then shipped orders to the company's 3,000 retail customers in the United States.

ASICS understood that this current network had to be restructured. It turned to Fortna, Inc., a consulting company, for help. After analyzing the network and current demands, Fortna recommended shifting some distribution operations to the West Coast to provide relief for the current DC and then constructing a second DC close to the original site. Fortna's

analysis indicated that establishing a West Coast operation to break down imported containers and build mixed loads for shipment to customers in the western United States could save the company time and money.

The company immediately began to divert a portion of its orders directly to customers and bypass its current DC, using its 3PL provider. These were typically full container loads of products already destined for customers on the West Coast. Its problems had been solved. In 2011, the company constructed a second DC in Byhalia, Mississippi, about 20 miles from the current DC. The new 520,000-square-foot facility uses state-of-the-art technology. The company completely transformed the way it processes orders. It uses technology to efficiently manage all assets and shipping operations, such as using mobile equipment to keep real-time checks of inventory. The company has positioned itself for continued growth and has learned that a good distribution network requires more than buildings and facilities.

As of 2024, there were a total of 4,798 ASICS locations in the United States. The city with the greatest number of ASICS locations in the United States is Houston with 33 locations, which is 1% of all ASICS locations in the United States. Mr. Onitsuka would be proud.

Concept Check Questions

1. The company ASICS is an acronym for the Latin phrase anima sana in corpore sano. What does this mean?

- ☐ a) A sound mind and a fast body
- ☐ b) Treat everyone fairly
- ☐ c) A sound mind in a sound body
- ☐ d) A sound body
- ☐ e) Growth through sports

Correct or Incorrect?

Clear

Check Answer

2. After years of hard work ASICS had become a leading maker of athletic footwear, sports apparel, and accessories.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

3. ASICS does not sell its products in the United States.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

4. All of ASICS' manufacturing takes place in China and Vietnam.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

The Supply Chain System

Processes across the Supply Chain

A supply chain can be viewed as a system of processes that cuts across organizations and delivers customer value, rather than as a series of separate organizations and functions. In this case, the focus is not just to manage each process within the organization, but to manage processes across the entire supply chain. One example might be the order management process, which includes managing the customer order from placement to product receipt through the entire chain; this requires not only process thinking but also managers to view the collection of processes as a system designed to satisfy customer needs.

Let us consider the situation of ASICS, from the chapter opener. Their distribution process required managing the entire network as a system. Their only DC—which was the hub of the network—had a maximum capacity of 50,000 units per day. When the rest of the network began processing 70,000 units per day, the DC could not accommodate this volume. The result was a “bottleneck,” or constraint, in the network that limited how much the system could process. It was not enough to grow sales and improve each facility in the supply chain. The supply chain network needed to be improved as a system.

Supply chain strategy provides the long-range plan for this entire system, which we discussed in [Chapter 2](#). Two key elements support this strategy. The first is the [supply chain network design](#), which includes the physical structure and business processes included in the system. The second is the [information technology \(IT\) design](#), which enables data sharing, communication, and process synchronization. IT is the backbone of supply chain management (SCM) that enables managing processes. Without IT, communication, coordination, and decision making across the supply chain could not take place. Together the supply chain network design and IT system design support the supply chain strategy, as shown in [Figure 3.1](#). These elements have to be aligned and work in unison as one system.

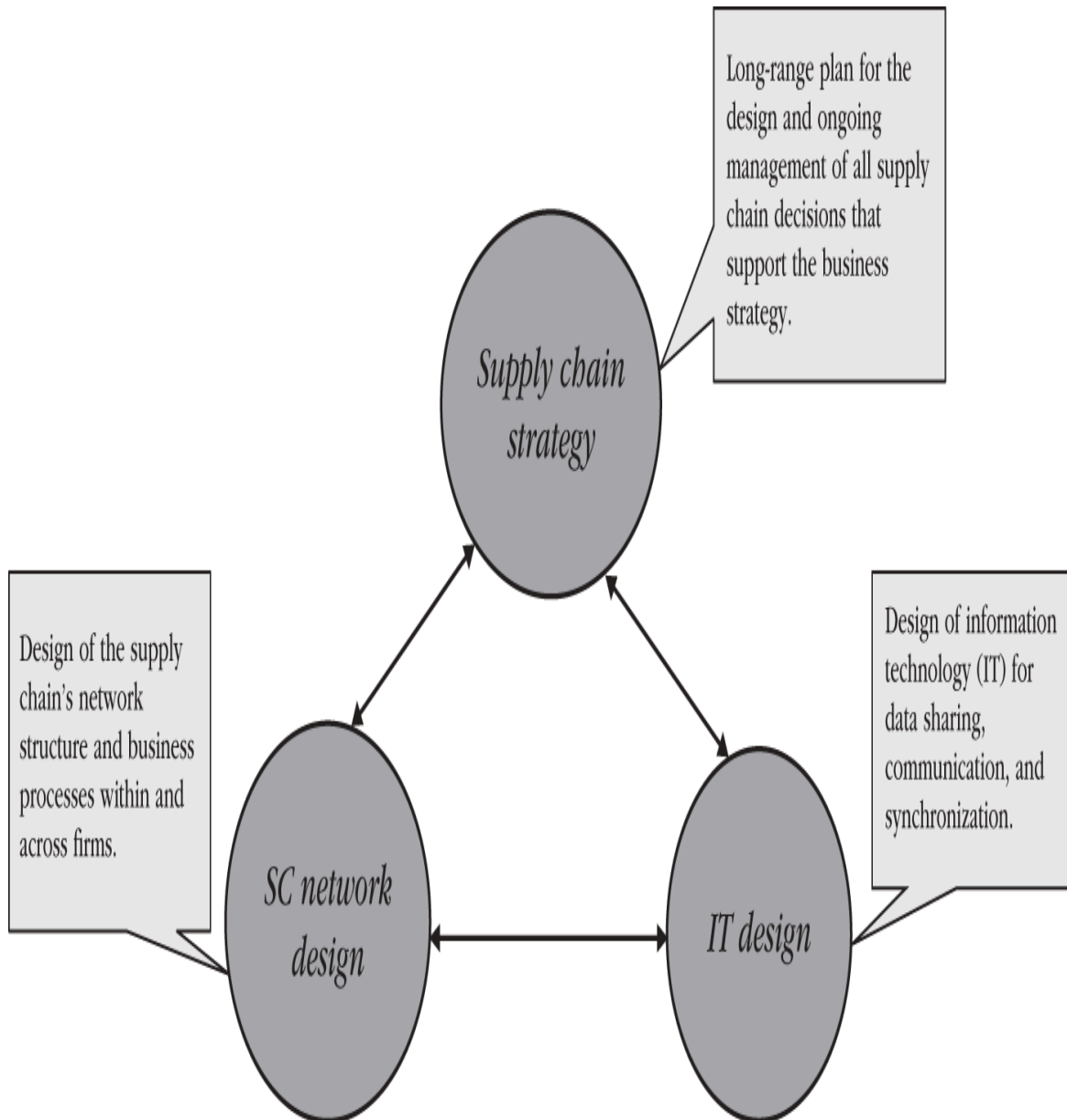


FIGURE 3.1 Network and IT design support supply chain strategy.

Concept Check Questions

5. A supply chain can be viewed as a series of separate organizations and functions.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

6. Supply chain strategy provides the long-range plan for this entire system.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

7. _____ includes the physical structure and business processes included in the system.

- ☐ a) Information technology design
- ☐ b) supply chain network design
- ☐ c) Blockchain design
- ☐ d) Logistics design
- ☐ e) Manufacturing design

Correct or Incorrect?

Clear

Check Answer

8. _____ enables data sharing, communication, and process synchronization.

- ☐ a) Information technology design
- ☐ b) supply chain network design

- ☐ c) Blockchain design
- ☐ d) Logistics design
- ☐ e) Manufacturing design

Correct or Incorrect?

Clear

Check Answer

9. Long-range plan for the design and ongoing management of all supply chain decisions that support the business strategy.

- ☐ a) Blockchain design
- ☐ b) IT design
- ☐ c) Supply chain strategy
- ☐ d) Logistics design
- ☐ e) Supply chain network design

Correct or Incorrect?

Clear

Check Answer

10. Design of the supply chain's network structure and business processes within and across firms.

- ☐ a) Blockchain design
- ☐ b) IT design
- ☐ c) Supply chain strategy
- ☐ d) Logistics design
- ☐ e) Supply chain network design

Correct or Incorrect?

Clear

Check Answer

11. Design of information technology (IT) for data sharing, communication, and synchronization.

- ☐ a) Blockchain design
- ☐ b) IT design
- ☐ c) Supply chain strategy
- ☐ d) Logistics design
- ☐ e) Supply chain network design

Correct or Incorrect?

Clear

Check Answer

Supply Chain Leader's Box

■ WALMART

Walmart is an example of an excellent supply chain network design with a supportive IT. Walmart's supply chain is one of the largest and most sophisticated in the world. This supply chain involves thousands of suppliers with Walmart working with over 100,000 suppliers globally to source products for its stores. The process involves millions of products with Walmart offering a wide product range with some stores carrying up to 150,000 different items. The process also involves hundreds of DCs with Walmart operating a network of over 150 DCs in the United States alone, with many more globally. To manage this level of complexity, Walmart employs a range of information technologies. One important technology is radio frequency identification (**RFID**) tags. Walmart was one of the first retailers to adopt RFID technology for tracking inventory. RFID tags allow Walmart to track products throughout its supply chain, improving inventory accuracy and reducing stockouts. Another is barcode scanners. **Barcode scanners** are used in Walmart stores and DCs to quickly and accurately scan products. This helps Walmart manage inventory levels and streamline checkout processes.

Another link between the network and IT is Walmart's **transportation management systems**, Walmart uses sophisticated transportation management systems to optimize its logistics operations. These systems help Walmart plan and route shipments, reducing transportation costs and improving delivery times. Overall, Walmart's supply chain is a key enabler of its low-cost strategy and ability to offer everyday low prices to its customers.

What Is a Business Process?

Given that supply chains can be viewed as a collection of processes, we need to see what makes a process. A [business process](#) is a structured set of activities or steps with specified outcomes. Consider the “process” involved in enrolling in a class at your university. There are application forms to be reviewed by the admissions office, financial forms to complete at the bursar's

office, and class registration to be completed at the registrar's office. The sequence of steps required, their timing and coordination, the simplicity of forms, and their ease of submission are all part of the enrollment “process.” The sequence of process steps goes beyond the organization and cuts across a supply chain network, as in the case of ASICS. ASICS’ distribution process required unloading shipments from Asia at California ports, loading them onto trailers for shipments to the DC in Mississippi, and then sending shipments to individual retail customers.

Organizations, and entire supply chains, can be viewed as a collection of processes, rather than just a collection of departments or functions.¹ For example, there is the customer service process that involves a series of activities designed to enhance the level of customer satisfaction by meeting or exceeding their expectations. This may involve a series of well-coordinated activities, such as billing and invoicing, handling product returns, and providing real-time information on promised shipping dates, and product availability. Another example is the order-fulfillment process, which involves ensuring that customer orders are filled. It may involve activities such as receiving and processing the order, ensuring movement of product and delivery, and customer follow-up. Other examples of processes include the manufacturing process, which involves ensuring the production of products; the demand management process, which balances demand requirements with operational and supply chain capabilities; and the distribution process, which involves distributing and delivering products to specified locations.

Organizations have many other processes, with each having a series of activities designed to create a particular output for the customer, whether it be a service or a tangible product. The output is a result of the process that produces it. If we want to improve the output, we must improve the process. Process improvement involves making changes and enhancements to the process. In the example of course registration, this may involve reducing the time it takes to register for a class by reducing the number of forms needed, simplifying each form, or shortening the time it takes to review them.

Toyota is known for its continuous improvement process, which is a systematic approach to identifying and implementing process improvements. Toyota uses the continuous improvement process to improve all aspects of its operations, from manufacturing to sales and marketing. As a result of its continuous improvement efforts, Toyota has become one of the most efficient and successful companies in the world. Toyota's commitment to continuous

improvement, or kaizen, has yielded impressive results. Let's look at some of these elements:

Efficiency: Toyota's production system is renowned for its efficiency. The company produces approximately 13,000 vehicles per day worldwide, with a production cycle of just 17 hours per vehicle (Toyota Global).

Quality: Toyota has consistently ranked among the top automakers for vehicle quality and reliability. The Toyota Camry, for example, has been named the “Most American-Made Car” and has received numerous awards for quality and reliability (Cars.com).

Cost Reduction: Toyota's focus on eliminating waste and improving efficiency has helped the company achieve significant cost savings. In 2020, Toyota reported a net profit of \$19.1 billion, despite the challenges posed by the COVID-19 pandemic (Toyota Global).

Innovation: Toyota has been at the forefront of automotive innovation, with a focus on sustainable mobility solutions. The company has invested heavily in hybrid and electric vehicle technology, leading to the development of popular models such as the Toyota Prius (Toyota Global).

Market Leadership: Toyota is one of the largest and most profitable automakers in the world. As of 2023, Toyota was the second-largest automaker by production volume, producing over 9 million vehicles annually (Statista.com).

Every process has structural and resource constraints that limit its amount of output. Because processes are a series of activities, the constraints of each activity are important as well as how the activities are linked. For example, if the university's office is slow in processing payments, there may be a delay in course registration as the registrar's office waits to get financial approval. In the example of ASICS, the slow processing at the DC bursar prevented goods from moving through the system.

Notice that processes involve many organizational functions as shown in [Figure 3.2](#). For example, the customer service process cuts across many different functions. It must involve marketing that interfaces with the customer, logistics that ensures product delivery and movement, and operations that may deal with repairs. Similarly, order fulfillment requires operations to ensure order availability and processing, logistics to arrange for order picking and shipping, and marketing for customer follow-up. For

processes to be effective and efficient, organizational functions must work together and be well coordinated. In addition, these processes require coordinating with suppliers and customers. As such, they cut across not only organizational functions but also the entire supply chain. Let's look at this next.

Concept Check Questions

12. A/n _____ is a structured set of activities or steps with specified outcomes.

- ☐ a) sequence
- ☐ b) algorithm
- ☐ c) methodology
- ☐ d) procedure
- ☐ e) business process

Correct or Incorrect?

Clear

Check Answer

13. Organizations, and entire supply chains, can be viewed as a collection of processes.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

14. If we want to improve the output, we must improve the inputs.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

15. Every process has structural and resource constraints that limit its amount of output.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

16. It is not necessary for organizational functions to work together and be well coordinated in order for processes to be effective and efficient.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Managing Supply Chain Processes

Just as organizations need to coordinate internal functions for processes to run efficiently, they must do so across the supply chain. As the entire supply chain is a collection of processes, rather than separate organizations and functions, the focus is to manage them across the entire supply chain. This requires process thinking and requires managers to view the process as a system designed to satisfy customer needs.

There are two differing views on how to manage processes across the supply chain. The first is the [transactional view](#) that focuses on making supply chain processes more efficient and effective based on quantitative metrics. This can be achieved through supply chain network redesign to promote speed and eliminate redundancy, by standardizing transactions to improve efficiency, and by implementing better IT to improve the transfer of information as well as accuracy.

The second is the [relationship view](#) which focuses on managing relationships across the supply chain. This involves managing relationships between people and organizations and linking-up processes across organizations of the supply chain. For example, this might mean managing the order-fulfillment process throughout the entire chain coordinating with suppliers, and measuring performance along the chain. This also means that managers from each organization who are part of the process coordinate activities, work toward common goals, and have a common language. One example of a company that focuses on the relationship view of SCM is Toyota. Toyota uses a just-in-time inventory system and a kanban system to manage its production process. Toyota also uses a system called judoka to identify and correct problems quickly. Toyota's focus on the relationship view of SCM has helped the company to become one of the most successful automakers in the world.

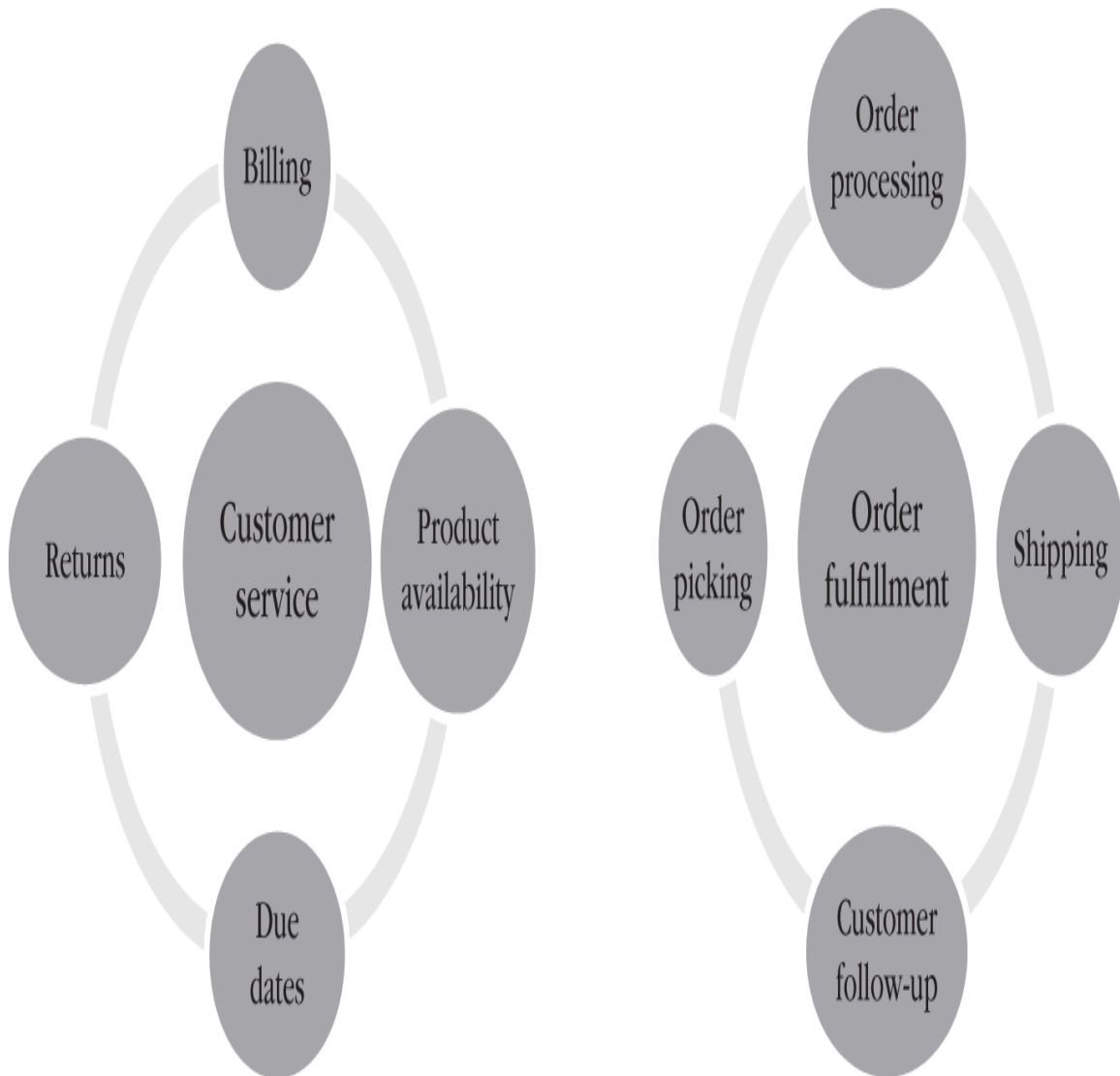


FIGURE 3.2 Organizational processes cut across many functions.

Each approach to managing processes across the supply chain has its advantages. The first focus is to make supply chain transactions more efficient and effective based on measurable metrics. The second objective is to structure interfirm relationships in the supply chain for the long-term benefit of all the supply chain members. This requires a joint vision and partnering. Ultimately the best way to manage processes across the supply chain is to use both approaches—focus on efficiency of transactions and create long-term interfirm relationships. Once again consider ASICS. It focused on both approaches. It first brought efficiency to the distribution network by balancing flows through the network. It also relied on its relationship with its 3PL provider to take over some duties and handle the “overflow” of goods.



Concept Check Questions

17. The entire supply chain is a collection of processes.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

18. There are _____ differing views on how to manage processes across the supply chain.

- ☐ a) two
- ☐ b) three
- ☐ c) four
- ☐ d) many

Correct or Incorrect?

Clear

Check Answer

19. The _____ view on how to manage processes across the supply chain focuses on making supply chain processes more efficient and effective based on quantitative metrics.

- ☐ a) analytical
- ☐ b) relationship
- ☐ c) transactional
- ☐ d) connections
- ☐ e) systems

Correct or Incorrect?

Clear

Check Answer

20. The _____ view on how to manage processes across the supply chain is focused on managing relationships across the supply chain.

- ☐ a) analytical
- ☐ b) relationship
- ☐ c) transactional
- ☐ d) connections
- ☐ e) systems

Correct or Incorrect?

Clear

Check Answer

21. Organizational processes cut across many functions.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

22. The best way to manage processes across the supply chain is to use both approaches is the systems approach.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Supply Chain Leader's Box—Moving to Process Thinking

■ LG ELECTRONICS

A few years ago, LG Electronics made a large organizational shift. Specifically, the company moved from functional thinking to more process-oriented system thinking. This change was part of a large effort by the then chief executive officer, Nam Yong, to shake up a siloed company where managers seldom shared their ideas.

Procurement is an excellent example of this change. Prior to the change, the procurement process of the company was completely decentralized. Each division manager made their deals with suppliers such as Taiwan Semiconductor Manufacturing Company (TSMC), a Taiwan-based chipmaker. That meant a procurement manager at the handset unit in Seoul did not know how much his counterpart at a flat-screen TV factory in Mexico paid for chips from the same foundry. This lack of coordination and systems thinking was costly, and the company decided to coordinate the entire process.

Since the change, however, no one at LG Electronics has been able to issue a purchase order without clearance from the office of “procurement engineering.” This innovation generated huge savings. For example, by centralizing purchases, LG Electronics could cut more than \$2 billion from its annual \$30 billion shopping bill.

Prior to the change, LG had a mishmash of processes developed over the years for 115 factories and subsidiaries worldwide. Part of the change involved merging these processes into a single 50-page procurement manual. This resulted in other savings such as enabling a direct comparison of material prices. For example, the company was able to uncover that by buying aluminum instead of high-priced copper for home appliances, they could save \$25 million. This change of moving to process thinking resulted in significant cost-cutting and more efficient functionality for LG. It also helped LG get through a global downturn better than many competitors. In 2012, the revenue of the company was \$47.9 billion whereas in 2024 this had increased to \$66.77 billion.

Similarly, in 2012 the net income of the company was \$81.45 dollars but in 2024 had increased to \$1.49 dollars.

Understanding Processes: Theory of Constraints (TOC)

To manage the supply chain as a system we need to understand the basic principles that govern how processes interact. This is offered by a management philosophy called the [theory of constraints \(TOC\)](#), which was introduced by Dr. Eliyahu M. Goldratt in his book, *The Goal*.

The premise behind TOC is that every system has one or more limiting factors that are preventing it from further achieving its goal. This is analogous to the weakest link of a chain. For a system to attain significant improvement that weakest link—or a constraint—must be identified. The whole system must be managed with this constraint in mind, and there is always at least one constraint. The TOC process seeks to identify the constraint and restructure the rest of the organization around it to eliminate its impact. The principles offered by TOC apply to managing any system of processes, whether in an organization or the entire supply chain. Let's look at the basic principles of TOC.

Procter & Gamble (P&G) is a good example of a company that uses a variety of TOC principles to manage its supply chain, including identifying and focusing on improving its constraints. For example, P&G uses a process called “drum–buffer–rope” to manage its production process. Drum–buffer–rope is a TOC principle that helps ensure that the right materials are in the right place at the right time, aligning the whole system around the constraints. P&G aligns its entire supply chain around its constraints and then works closely with its suppliers to ensure that they can meet P&G's production demands. P&G also engages in continuous improvement constantly reviewing its supply chain. P&G now uses artificial intelligence (AI) to predict what customers are likely to order, which allows P&G to have the products in stock before customers even place their orders.

P&G's focus on TOC principles has helped the company become one of the most successful consumer goods companies in the world. P&G can offer high-

quality products at a low cost to its customers by managing its supply chain efficiently.

Concept Check Questions

23. To manage the supply chain as a system we need to understand the basic principles that govern how processes interact. This is offered by a management philosophy called _____.

- ☐ a) management by objective
- ☐ b) systems management
- ☐ c) theory of constraints
- ☐ d) constraint management

Correct or Incorrect?

Clear

Check Answer

24. The premise behind TOC is that every system has many limiting factors that are preventing it from further achieving its goal.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

25. P&G uses a variety of TOC principles to manage its supply chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

26. Drum-buffer-rope is a TOC principle for managing bottleneck resources.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

System Constraints

The basic principle of TOC is that every system has at least one constraint. A constraint is anything that prevents the system from being able to achieve its goal and is sometimes called the “bottleneck.” A constraint can be equipment, which may be limited by how much it can produce. It can be people, who may lack skills or simply processing capability. It can also be facilities, such as their size, which may limit how much can be stored. The focus of TOC is to uncover the constraint and manage it.

The system cannot produce any more than the output of its bottleneck or constraining activity. Also, how much a process can produce is related to the structure of the process and the way the activities in the process are linked. Activities in a process can be linked serially, which is in sequence one right after the other. They can also be linked in parallel, where some activities take place simultaneously. Let us look at examples of each.

Recall ASICS' distribution network prior to restructuring. It had a serial network structure, which is simply a series of processes as shown in [Figure 3.3](#). The first process, Process A, was unloading cargo from ships in California ports. Let's assume that this activity had a rate of 95,000 units per day. The next step in the process, Process B, was to load trailers for shipment to the DC, assuming a rate of 80,000 units per day. The goods are then processed at the DC, Process C, which likely involves breaking bulk, sorting, and packing, at a rate of 50,000 units per day. Finally, there was Process D, which involved shipping trailers of goods to retail customers at a rate of 80,000 units per day.

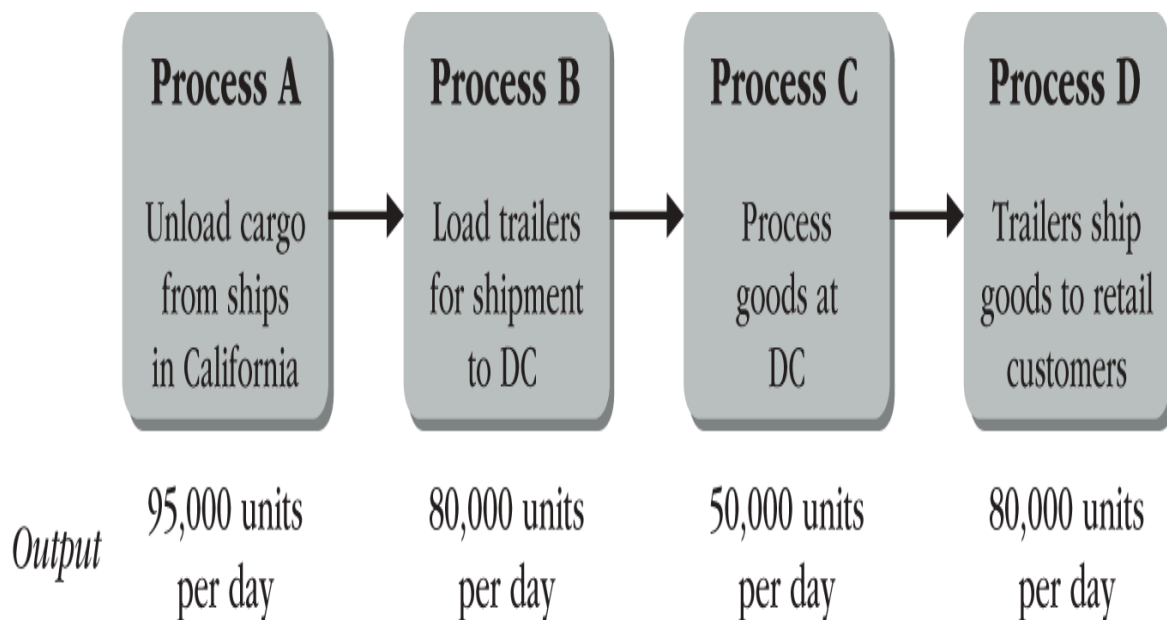


FIGURE 3.3 A serial process: ASICS' original distribution network.

Look carefully at [Figure 3.3](#). What is the maximum number of units that this system can process in a day? It is 50,000 units per day or the bottleneck activity. The reason is that even though Processes A and B can handle more units than Process C, no more than 50,000 units can go through the bottleneck. The extra units will simply accumulate in front of it, as they cannot be processed any faster. This is the constraint.

It is critical to manage the constraints or bottlenecks in the system. The constraint must always be busy, as time lost there is time lost in the entire system. Notice that if ASICS' DC loses an hour of production, the entire system loses an hour of production. However, if the activity of unloading cargo loses an hour it has no impact on the final output of the system, as it is already constrained by the bottleneck of 50,000 units per day. If we want to increase output, we need to find ways of increasing the capacity of the

bottleneck or constraint. In the case of ASICS, it involves increasing output at the DC. Finding ways to increase output of the other activities is a waste of resources, as it does not do anything for the overall output.

Imagine if the company spent money to increase the number of units that could be loaded and shipped onto the trailers going to the DC from 80,000 units per day to, say, 100,000 units per day. What would this accomplish? Nothing. The only thing that would happen is more units would accumulate in front of the DC, which can only process 50,000 units. Understanding how constraints in the system work is an important example of systems thinking.

As part of restructuring its supply chain network, ASICS diverted a part of the unloaded cargo to its 3PL to ship directly to clients. The amount was approximately 20% of 70,000 units per day, which was the average number of daily units needing to be processed. This was approximately 14,000 units per day. The result is shown in [Figure 3.4](#). Notice what happens to the output. While the DC is still processing 50,000 units per day, 14,000 units are being sent directly to customers. This is happening in parallel and is enabling a total of 64,000 to pass through the system. The maximum output of the system is the new bottleneck, which is 64,000 units per day.

Notice that now there is a new constraint—64,000 units per day. Remember that in a system there is always at least one constraint. TOC teaches us to manage the constraint using the following steps:

Identify the constraint. In the ASICS example, it was the DC's processing capability.

Exploit the constraint. Decisions must be made on how best to use the constraint and ensure that the constraint's time is not wasted doing things that it should not do.

Subordinate all other processes to the above decision. This means aligning the whole system around the constraint.

Elevate the constraint. If possible, increase the capacity of the constraint. ASICS bought more capacity by “bypassing” the DC.

When the constraint changes, return to Step 1. This means identifying the new constraint.

Engage in continuous improvement. Continue these steps, as this is a never-ending process.

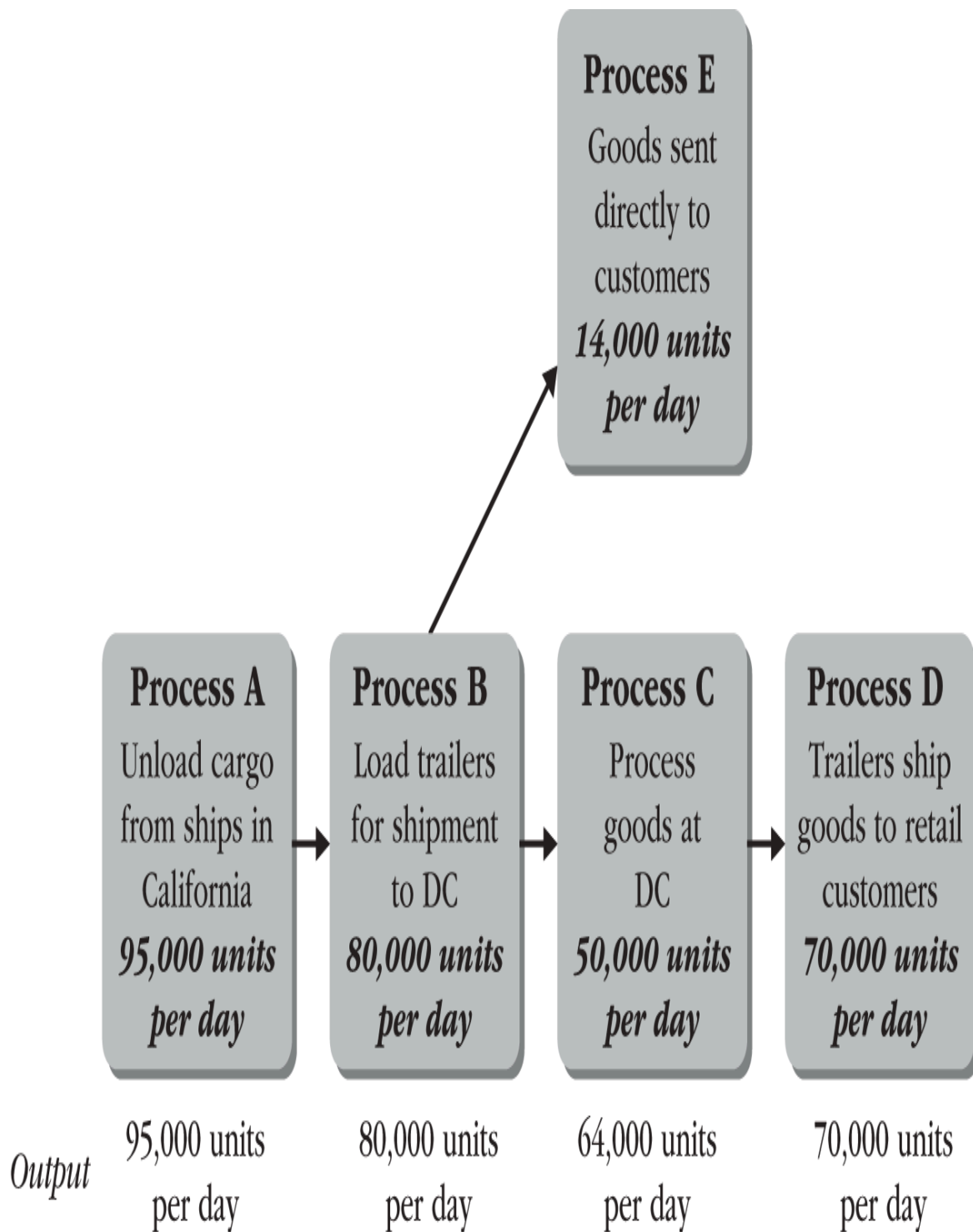


FIGURE 3.4 A parallel process: ASICS' redesigned distribution network.

Concept Check Questions

27. The basic principle of TOC is that every system has at least one constraint.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

28. The system cannot produce any more than the output of its bottleneck or constraining activity.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

29. A system has four workstations arranged in series. From the start of the line, their daily capacities are 40,000, 35,000, 65,000, and 50,000 respectively. What is the maximum number of units that this system can process in a day?

- ☐ a) 40,000
- ☐ b) 35,000
- ☐ c) 65,000
- ☐ d) 50,000
- ☐ e) 190,000

Correct or Incorrect?

Clear

Check Answer

30. A system has four workstations arranged in series. From the start of the line, their daily capacities are 57, 64, 28, and 92 respectively. What is the maximum number of units that this system can process in a day?

- ☐ a) 57
- ☐ b) 64
- ☐ c) 28
- ☐ d) 92
- ☐ e) 241

Correct or Incorrect?

Clear

Check Answer

31. A system has four workstations arranged in series. From the start of the line, their daily capacities are 40,000, 35,000, 65,000, and 50,000 respectively. What is the maximum number of units that this system can process in a day if the firm raises the capacity of the last workstation from 50,000 to 75,000?

- ☐ a) 40,000
- ☐ b) 35,000
- ☐ c) 65,000
- ☐ d) 75,000
- ☐ e) 215,000

Correct or Incorrect?

Clear

Check Answer

32. Increasing production capacity on a non-bottleneck workstation increases the overall capacity of the system.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

33. TOC has six steps for managing constraints. Which of the following is not one of those steps?

- ☐ a) Identify the constraint
- ☐ b) Exploit the constraint
- ☐ c) Subordinate all other processes to the above decision
- ☐ d) Deemphasize the constraint
- ☐ e) Engage in continuous improvement

Correct or Incorrect?

Clear

Check Answer

System Variation

Every system or process has variation. Variation is simply variability in the amount of output that is produced or processed. The activities of a process also exhibit variation. Think about your performance and how sometimes you are very productive and other times, no matter how hard you try, you are not. The same is true of workers in a factory, warehouse, restaurant, office environment, or medical facility. There is also variation in equipment and facilities. Sometimes, processes run smoothly, whereas other times there are breakdowns requiring unexpected repairs.

Variation is a problem as it consumes resources. This can be time—sometimes it takes more time to do an activity; space—such as needing extra storage; or labor—such as tasks having to be repeated. Variation also adds complexity and uncertainty. Consider the variation that occurs in consumer demand at a retail store, such as The Gap. The Gap makes forecasts of average demand for a given week or day but rarely is the forecast exactly equal to actual sales. Sometimes there are unexpected surges in demand, and other times there are slumps. These variations then propagate throughout the supply chain, as retailers either have to rush in more inventory or end up having to find storage for unsold goods. These variations in demand create variations in the production schedules of manufacturers and suppliers, which create coordination problems. Also, different activities may become constraints at different times adding to the complexity. The result may be not having enough inventory at certain times, missing component parts at the manufacturing facility, or simply carrying too much inventory.

One of the key reasons for Kodak's failure was its inability to deal with variation in customer demand. Kodak's business model was based on selling film and cameras. However, as digital photography became more popular, customers began to demand more convenience and affordability. Kodak tried to adapt to the changing landscape by offering its digital cameras, but it was too late. The company had already lost too much market share to competitors like Sony and Canon.

Kodak's failure to deal with variation in customer demand is another cautionary tale for other businesses. Companies need to be able to adapt to changing customer needs and preferences to survive and thrive. Process variation needs to be managed as it can create significant problems for a system. There are three ways this can be accomplished. First, attempts should be made to reduce or eliminate as much variation as possible. This requires identifying the source of variability in the system, such as workers or equipment, and correcting the problem. Quality control methods that are discussed later in this text are good tools to use for this purpose.

Second, it may be possible to create buffers to deal with the variation. Buffers, in the form of excess inventories, can be placed before and after highly variable activities. They can be placed before the constraint, ensuring that the constraint is never “starved.” They can also be placed behind the constraint to prevent downstream failure to block the constraint's output. Buffers used in this way protect the constraint from variations in the rest of the system. Third,

managers can deal with variation by designing more flexibility into the process to respond to the variation. This may be in the form of flexible technology or cross-training workers.

Tesla is an example of a company that uses flexibility to deal with variation in its supply chain. Tesla produces electric vehicles, which are a relatively new product category. As a result, Tesla's supply chain is still evolving. Tesla's flexibility allows the company to adapt to changes in its supply chain quickly. For example, Tesla vertically integrates its supply chain by manufacturing some of its component parts and materials. This gives Tesla more control over its supply chain and allows the company to respond to changes more quickly. Also, Tesla's manufacturing facilities are designed to be flexible. This allows Tesla to quickly change production lines to produce different models or to produce different volumes of vehicles.

Concept Check Questions

34. Every system or process has variation.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

35. Variation is not a problem.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

36. Variation adds complexity and uncertainty.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

37. One of the key reasons for Kodak's failure was its inability to deal with variation in customer demand.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

38. Process variation needs to be managed as it can create significant problems for a system. There are three ways this can be accomplished. Which of the following is not one of these?

- ☐ a) Attempts should be made to reduce or eliminate as much variation as possible
- ☐ b) By designing more flexibility into the process to respond to the variation
- ☐ c) It may be possible to create buffers to deal with the variation
- ☐ d) Improve the forecast

Correct or Incorrect?

Clear

Check Answer

Capacity Implications

Capacity refers to the maximum amount of output that can be achieved by a process over a specified period of time. Different businesses measure capacity in different ways, all trying to assess a measure of processing capability. For example, a healthcare clinic measures capacity in terms of patients seen per day, restaurants in terms of customers served, a delivery company in terms of the number of packages delivered, and an insurance company in terms of the number of claims processed. Capacity can also be measured in terms of size or storage limit. For example, a hospital may also measure capacity in terms of the number of hospital beds available, a restaurant in terms of the number of seats available, and a warehouse in terms of its square footage.

In supply chain network design, it is important to remember that different supply chain members have different levels of capacity. As we link organizations in the chain, we need to make sure that levels of capacity match. Otherwise, we will have bottlenecks or constraints, as not every organization can produce at the same level as the others. To understand the capacity of a facility, we need two types of information. The first is the amount of available capacity, which specifies exactly how much capacity a facility has. The second is the effectiveness of capacity use which specifies how effectively available capacity is being used.

Consider a bakery. Suppose that on average, the bakery can make 200 cupcakes per day. However, during peak periods—such as holidays—it can make 300 cupcakes per day. This is the maximum but cannot be sustained for any long period. Stating that the bakery has a capacity of 300 cupcakes per day would be misleading. On the contrary, saying that 200 cupcakes per day is the capacity does not indicate that the production can be increased to 300 per day. This example illustrates that different measures of capacity are useful, as they provide different kinds of information. The following are two of the most common measures of capacity.

Design capacity is the maximum output rate that can be achieved by a facility. A company achieves this output rate by using temporary measures, such as overtime, overstaffing, using equipment at the maximum rate, and subcontracting.

Starbucks often uses temporary measures to meet peak demand during the morning rush hour. Starbucks' temporary measures include hiring extra baristas. Starbucks hires extra baristas during the morning rush hour to help take orders and prepare drinks. Similarly, Starbucks opens additional registers during the morning rush hour to reduce customer wait times. Starbucks customers can also use the mobile ordering app to place orders ahead of time, which reduces wait times during the morning rush hour.

Effective capacity is the maximum output rate that can be sustained under normal conditions. These conditions include realistic work schedules and breaks, regular staff levels, scheduled machine maintenance, and none of the temporary measures that are used to achieve design capacity.

Regardless of how much capacity a company has, it needs to measure how well it is utilizing it. Capacity utilization is a metric that indicates how much capacity is being used and is computed as follows:

$$\text{Utilization} = \left[\frac{\text{Actual output rate}}{\text{Capacity}} \right] (100\%)$$

However, because there are two unique capacity measures, utilization should be measured relative to each of them:

$$\text{Utilization}_{\text{effective}} = \left[\frac{\text{Actual output}}{\text{Effective Capacity}} \right] (100\%)$$

$$\text{Utilization}_{\text{design}} = \left[\frac{\text{Actual output}}{\text{Design Capacity}} \right] (100\%)$$

EXAMPLE 1 Computing Capacity Utilization

Assume that a retail warehouse can process 100,000 orders in a single day, under maximum conditions, using overtime labor. However, the facility was designed to process 70,000 orders per day under normal conditions. During June, the facility was processing 80,000 orders per day. What is the warehouse's capacity utilization for both design and effective capacity?

SOLUTION:

$$\begin{aligned}\text{Utilization}_{\text{effective}} &= \left[\frac{\text{Actual output}}{\text{Effective capacity}} \right] (100\%) \\ &= \left[\frac{80,000}{70,000} \right] (100\%) = 114.3\% \\ \text{Utilization}_{\text{design}} &= \left[\frac{\text{Actual output}}{\text{Design capacity}} \right] (100\%) \\ &= \left[\frac{80,000}{100,000} \right] (100\%) = 80\%\end{aligned}$$

The utilization rates show that the current output of the warehouse is higher than the effective capacity. It can likely operate at this level for only a short period.



Concept Check Questions

39. Capacity refers to the maximum instantaneous amount of output that can be achieved by a process.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

40. All businesses measure capacity the same ways, either dollars of output or units of output.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

41. Different supply chain members have different levels of capacity.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

42. _____ is the maximum output rate that can be achieved by a facility.

- ☐ a) Capacity utilization
- ☐ b) Effective capacity
- ☐ c) Effective utilization
- ☐ d) Design capacity
- ☐ e) Utilization

Correct or Incorrect?

Clear

Check Answer

43. _____ is the maximum output rate that can be sustained under normal conditions.

- ☐ a) Capacity utilization
- ☐ b) Effective capacity
- ☐ c) Effective utilization
- ☐ d) Design capacity
- ☐ e) Utilization

Correct or Incorrect?

Clear

Check Answer

44. This is calculated as $[\text{Actual output rate} / \text{Capacity}] \times 100\%$.

- ☐ a) Utilization Capacity
- ☐ b) Utilization Effective
- ☐ c) Utilization Design
- ☐ d) Utilization

Correct or Incorrect?

Clear

Check Answer

45. This is calculated as $[\text{Actual output rate} / \text{Effective capacity}] \times 100\%$.

- ☐ a) Utilization Capacity
- ☐ b) Utilization Effective
- ☐ c) Utilization Design
- ☐ d) Utilization

Correct or Incorrect?

Clear

Check Answer

46. This is calculated as $[\text{Actual output rate} / \text{Design capacity}] \times 100\%$.

- ☐ a) Utilization Capacity
- ☐ b) Utilization Effective
- ☐ c) Utilization Design
- ☐ d) Utilization

Correct or Incorrect?

Integration of Supply Chain Processes

Stages of Integration

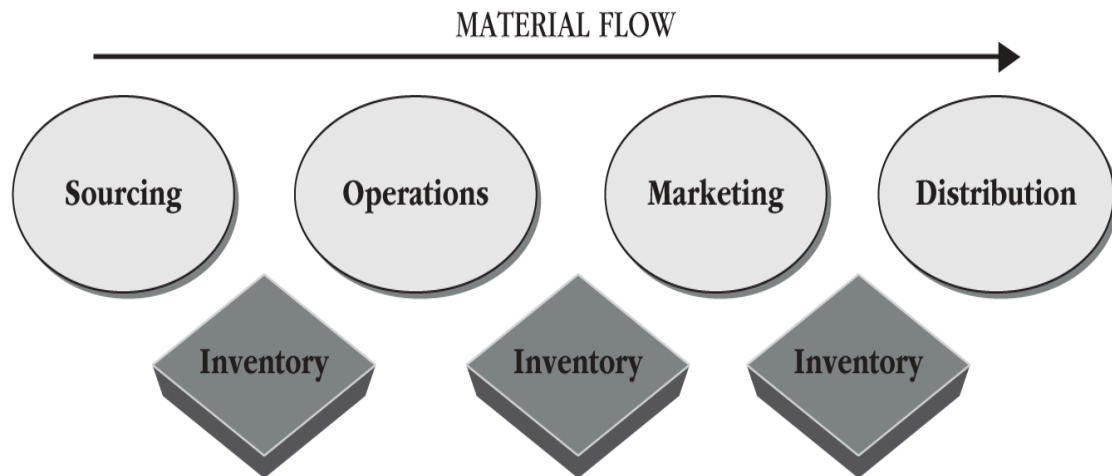
Traditionally organizations have viewed themselves as independent entities that exist separately from other firms with which they compete. They have a “survival of the fittest” mentality, rather than one of cooperation. However, as companies evolve in their supply chain strategy, they typically move through a set of integration stages—from little or no integration to complete integration of supply chain processes. First, this involves internal integration where organizational functions, such as operations, marketing, and purchasing, work in unison. Next, integration involves progressively more cohesion with other members of the supply chain. This evolution of integration is illustrated in [Figure 3.5](#).

There are three stages of integration. Stage 1 represents complete functional independence, whereas Stage 3 represents complete process integration. In Stage 1, the functions in the company operate in complete isolation of one another, sometimes called the “silo” mentality. Here, operations, for example, may focus on maximizing the production of products being produced without regard to sales or the buildup of finished goods inventories, or the impact on working capital. Similarly, marketing may promote products without consideration of whether operations can reasonably produce them. Large amounts of inventory are carried out to compensate for the lack of coordination and communication. Gap is a clothing retailer that has struggled in recent years. One of the challenges that Gap has faced is a misalignment between its marketing and operations teams. Gap's marketing team has often promoted products without consideration of whether operations can reasonably produce them. As a result, Gap has often faced stockouts, which has led to customer dissatisfaction.

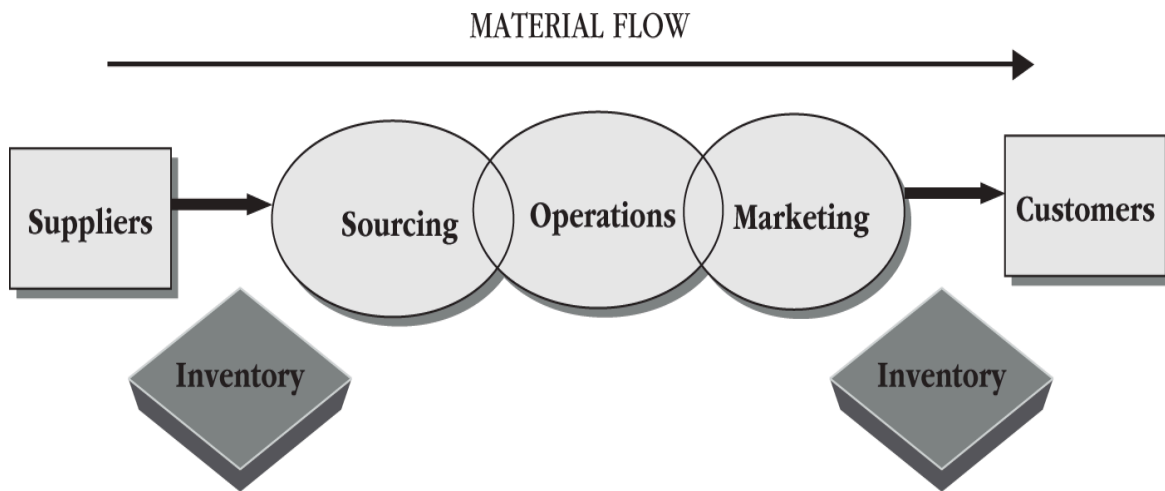
Companies that are in Stage 2 have internal functional cooperation and coordination, but not across the supply chain. Stage 3 companies, however, represent true supply chain integration. Here the concept of linkages and coordination extends beyond the boundaries of the firm to supply chain partners.

As companies evolve, they move from one stage to the next, progressively becoming more integrated with other members of the supply chain and carrying less inventory. However, companies often do not go through this evolution willingly, as it requires significant organizational change and restructuring. Rather, they typically evolve in response to competitive pressures and threats.

1. Organizational functions are independent.



2. Functions are integrated within the organization.



3. Functions are integrated across the supply chain.

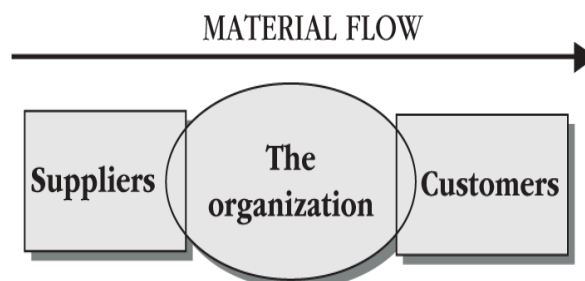


FIGURE 3.5 Stages of supply chain integration.

Concept Check Questions

47. There are three stages of supply chain integration. In this stage, the functions in the company operate in complete isolation of one another, sometimes called the “silo” mentality.

- ☐ a) Stage 1
- ☐ b) Stage 2
- ☐ c) Stage 3

Correct or Incorrect?

Clear

Check Answer

48. There are three stages of supply chain integration. In this stage, internal functional cooperation and coordination, but not across the supply chain.

- ☐ a) Stage 1
- ☐ b) Stage 2
- ☐ c) Stage 3

Correct or Incorrect?

Clear

Check Answer

49. There are three stages of supply chain integration. This stage represents true supply chain integration.

- ☐ a) Stage 1
- ☐ b) Stage 2
- ☐ c) Stage 3

Correct or Incorrect?

Clear

Check Answer

Vertical Integration vs Coordination

Each organization in the supply chain network is dependent on the other. Consider a shirt retailer who depends on the shirt manufacturer who depends on the weavers of fabrics, who all depend on the web of various distributors and warehouses. It may seem that coordination between supply chain members may be easiest through [vertical integration](#), which involves ownership of upstream suppliers and downstream customers. This was once thought to be a desirable competitive strategy, which some companies still use. For example, the Dole Corporation owns pineapple farms in Hawaii as well as all the production facilities. Increasingly, however, organizations have focused on “core competencies,” namely, the activities that are essential to their business. By focusing on core competencies, a company can learn to do these activities exceptionally well and is not encumbered by activities considered less important. These less important activities are increasingly being outsourced.

Recall that [outsourcing](#) is hiring an outside company to do certain tasks for a fee. Common examples of activities that are often outsourced include data network management, human resources (HRs), records archiving, and management of maintenance, repair, and operating [material requirements planning (MRP)] inventory items. However, many companies, such as Nike in footwear and sportswear, outsource manufacturing. The trend is even toward “virtual” companies, where everything is outsourced, including product design and research and development (R&D). This trend has significant implications for strategic issues of SCM. The decision of whether to outsource has a great deal to do with identifying core competencies or what a company is good at, deciding what to outsource, who to partner with, how to manage suppliers, how to coordinate the flow of materials, and what items to treat as a

commodity. These are important strategic decisions. They also require coordinating processes between multiple entities. Apple was able to continue producing iPhones during the pandemic thanks to its strong supply chain in China. Apple's Chinese suppliers were able to continue operating and produce the components that Apple needed to make iPhones. As a result, Apple was able to avoid a shortage of iPhones and maintain its market share.

On the negative side, outsourcing to Chinese companies also made some companies more vulnerable to disruptions during the pandemic. For example, when the Chinese government-imposed lockdowns in Wuhan and other cities in early 2020, it caused disruptions to the supply chains of many companies that outsourced to China. This led to shortages of products and higher prices for consumers.

Historically, the relationships companies had with their suppliers and downstream customers (such as distributors and retailers) were adversarial rather than cooperative. Today, there are still a number of companies that try to achieve cost reductions at the expense of their suppliers. These companies, however, do not realize that transferring costs upstream or downstream does not make them any more competitive. All it does is merely shift the cost from one “column” to another, as these costs will ultimately make their way to the final marketplace in the form of the price paid by the end user. More efficient supply chains, by contrast, will deliver the same product at a lower price.



Concept Check Questions

50. Each organization in the supply chain network is dependent on the other.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

51. _____ involves ownership of upstream suppliers and downstream customers.

- ☐ a) Horizontal integration
- ☐ b) Full supply chain integration
- ☐ c) Vertical integration
- ☐ d) Outsourcing

Correct or Incorrect?

Clear

Check Answer

52. Dole Corporation outsources all of its pineapple farming.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

53. _____ is hiring an outside company to do certain tasks for a fee.

- ☐ a) Horizontal integration
- ☐ b) Full supply chain integration
- ☐ c) Vertical integration
- ☐ d) Outsourcing

Correct or Incorrect?

Clear

Check Answer

54. Outsourcing to Chinese companies also made some companies more vulnerable to disruptions during the pandemic.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

55. Historically, the relationships companies had with their suppliers and downstream customers has been very cooperative.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Designing Supply Chain Networks

Supply Chain Structure and Management

All firms belong to one or more supply chains that begin with the source of raw materials and end with consumption. Two aspects of the supply chain

network are important. First is the actual physical structure of the network itself. Second is the management of the network. These two aspects are completely intertwined, as not all aspects of the physical structure need to be managed equally. Let's look at the physical structure first.

Managerial Insights Box

■ COCA-COLA

Coca-Cola provides an example of an aligned and analytics-driven end-to-end supply chain. The Coca-Cola giant has an algorithm to engineer the taste of its orange juice. The company has developed a computer model that directs everything from picking schedules to the blend of ingredients needed to maintain a consistent taste. Coca-Cola has spent \$114 million to expand its technology-driven U.S. juice bottling plant and claims to be the world's largest. It is at this plant that the company uses an algorithm it calls Black Book. Black Book uses big data from more than 600 flavors that make up the “taste” of what customers perceive as an orange. The data are matched to a chemical profile that specifies the acidity, sweetness, and other attributes of each batch of raw juice. The algorithm then tells Coca-Cola how to blend batches to replicate a consistent taste, including the amount of pulp that should be added. However, the use of analytics does not end at the plant but is used to connect to the entire supply chain. The algorithm is linked to satellite imaging of fruit groves to ensure the fruit is picked at the optimal time. Every aspect of the supply chain is optimized and includes external factors such as crop yield, current prices, and weather patterns. The mathematical model can be quickly updated with new information to create new plans—in a matter of 5 or 10 minutes. The entire supply chain network has been standardized and optimized. According to Jim Horrisberger, Director of Procurement: “You take Mother Nature and standardize it.” Coca-Cola's Black Book is considered one of the most complex applications of business analytics.

Each supply chain network structure is defined by three elements:

The number of companies that are part of the supply chain. Some supply chains are complex and have many members; others have few.

The structural dimensions of the network. This is the number of tiers in the supply chain and how many members are in each tier. A supply chain can have many tiers but few members in each tier, or it can have few tiers but many members in each.

The number of process links across the supply chain. The more process links that must be managed across the supply chain, the more complex the management of the chain. Examples include any one of the processes discussed earlier, such as customer relationship management (CRM), demand management, order fulfillment, or manufacturing flow management.

There are countless network structure types, and the structure itself evolves based on many factors. One factor is product type and its characteristics. Perishable products, for example, typically have a shorter and more streamlined supply chain. Items requiring intricate work from many specialty suppliers result in a more complex network. Innovative products that must have quick access to production facilities may have a network with few tiers but many members in each tier to provide quick production options—such as Nike or Sony. Other factors that affect the structure are the number of available suppliers and availability of raw materials, as well as ease of access to customers.

Some firms are at the beginning, whereas others are at the very end of the network structure, such as Walmart. Others are in the middle of the supply chain, such as P&G, Hewlett-Packard, or Intel. Each firm considers itself to be the focal firm, and the supply chain structure will look different if you are at the beginning, middle, or end of the network. CarMax is a focal firm at the end of the supply chain for used cars. CarMax buys used cars from individuals and dealerships and then sells those cars to consumers at its dealerships. CarMax's supply chain is more complex than it may seem, as the company needs to inspect and appraise each used car before it can be sold. CarMax also needs to have a network of dealerships in place to sell used cars to consumers.

Most companies belong to more than one supply chain network, and the network itself may have many branches. Not all of the supply chain branches and links need to be managed equally. Management needs to decide on the type of relationship that is appropriate for each particular supply chain link. For example, sourcing a standard component part that is a commodity with many suppliers does not require relationship building. This link in the network can be managed contractually. By contrast, alliances and partnerships need to

be managed differently. It is especially important to identify and manage key process links across the chain and recognize that processes need to be managed across the entire supply chain. Managing these process links requires a change from managing individual functions to integrating activities into SCM processes. As we discussed earlier in this chapter, thinking of the organization and supply chain in functional terms impedes process thinking.

Concept Check Questions

56. All firms belong to one or more supply chains that begin with the source of raw materials and end with consumption.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

57. There are two aspects of the supply chain network that are important. Which of the following is *not* one of these?

- ☐ a) The actual physical structure of the network itself
- ☐ b) The logistics used to move products
- ☐ c) The management of the network

Correct or Incorrect?

Clear

Check Answer

58. Each supply chain network structure is defined by three elements. Which of the following is *not* one of these?

- ☐ a) The structural dimensions of the network
- ☐ b) The number of process links across the supply chain
- ☐ c) The volume of shipments across the supply chain
- ☐ d) The number of companies that are part of the supply chain

Correct or Incorrect?

Clear

Check Answer

59. Perishable products typically have a shorter and more streamlined supply chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

60. Some firms are at the beginning, whereas others at the very end of the network structure.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

61. Most companies belong to a single supply chain network.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Designing Segmented Structures

Designing supply chain networks that provide a competitive advantage has become increasingly difficult. The reason is that most companies operate in global markets with rapidly changing consumer expectations. Over the past decade, companies have seen complexity increase in every link of their supply chains, from consumers to retail channels to manufacturers to suppliers. One factor driving this complexity is an increase in demand by consumers for customized products, which has fueled the growth of mass customization. Numerous companies such as Timbuk2, Reebok, and Nike permit customers to design their products online.

The supply chain implications of such a large product proliferation are vast. First, this high level of product diversity makes forecasting demand more difficult and inevitably results in either excess inventory or stockout. At the same time, however, supply chains have reduced their buffer stocks of inventories due to financial pressures. Retailers have also contributed to the complexity. To be responsive to customers they have increased their service expectations. Today major retailers demand in-stock levels over 98%, placing higher delivery expectations on their suppliers. Adding to the complexity is that many companies have increased the number of routes, with many now offering both conventional and online channels. If we add to this transportation cost issues and environmental concerns, we can see how complex these decisions can become.

Traditional “one-size-fits-all” supply chain structures cannot accommodate these variations. For example, a company can work hard to build an effective supply chain structure designed to deliver high-volume items and minimize overall supply chain costs. This supply chain structure, however, will not permit the company to respond to peaks in demand from customers who want slower-moving items. If the company takes steps to avoid stockout in this case, it will likely incur additional costs, such as transportation. In one such example, an apparel manufacturer found itself making extensive use of courier deliveries from factory to retailer to meet unpredicted demand. At one point the company found that they were moving one-third of their shipments this way, at a 30% increase in transportation cost. One of the challenges that the Gap has faced over the recent years is the ability to accurately predict demand for its products. As a result, Gap has often had to rely on courier deliveries to meet demand. Gap's reliance on courier deliveries has increased its transportation costs and has made it more difficult for the company to compete with other retailers. For example, in 2020, Gap's shipping costs increased by 20%.

To effectively meet these challenges, an increasing number of companies are abandoning a “one-size-fits-all” supply chain structure for one that relies on a segmented network. The best way to structure supply chains to meet varying customer requirements and keep the network manageable is to create segmented supply chains. Segmentation offers an effective way to bring under control this growing complexity. It requires understanding which elements of a network matter most to certain customer segments and designing differentiated supply chain structures for those segments.

A good example of simple segmentation is offered by a mid-sized U.S.-based pharmaceutical company. To address problems of stockout and waste, the company created a few simple segments. One segment was for high-volume, low-volatility items, which it stocks in inventory using the make-to-stock approach. Another segment was for low-volume, high-volatility items, which it offers in a make-to-order approach to eliminate unnecessary inventory. These simple segments resulted in better performance for the company, shorter lead times, and less waste.

A three-step approach can be used to successfully segment a company's supply chain network:

Identify key drivers of operational complexity. This means identifying what matters most to a particular customer group or channel. For example, volume flexibility and supply chain responsiveness are much more important to outlets that attract customer traffic with large, temporary price cuts than they are to “everyday-low-price” outlets. Similarly, quick time-to-market matters much more to fashion-oriented, short-life-cycle merchandise than to long-lasting, core products. Also, not all customers need the same level of customer service. Traditional supply chains attempt to continuously deliver high service levels across the board, to where it is and is not needed. The result is that they often fall short due to profitability pressures. A segmented supply chain forces the company to identify where investment in customer service results in the largest gain. Gap is an American apparel retailer that has struggled in recent years. One of the challenges that Gap has faced is a failure to accurately predict demand for its products. As a result, Gap has often had to rely on courier deliveries to meet demand.

Gap's reliance on courier deliveries has increased its transportation costs and has made it more difficult for the company to compete with other retailers. For example, in 2020, Gap's shipping costs increased by 20%.

Design differentiated supply chain segments tailored to address these unique complexities. Once key drivers of each customer group are identified a supply chain segment must be created to operationalize each one of those characteristics. This will likely require designing multiple supply chain segments to meet the identified requirements. The number of segments, however, should not be too large and should remain reasonable to manage, such as five or six.

Create a customized end-to-end operational blueprint and performance metrics for each supply chain segment. Once the segments have been created, details of putting them into operation must be established, including aligning processes and metrics across the supply chain.

There are numerous ways that segmentation can be conducted. [Figure 3.6](#) shows some examples that can be used to segment supply chains. Notice that each segment will result in a different supply chain structure. For example, high-volume, low-variability demand will likely require a cost-efficient supply chain structure, with dedicated production facilities to drive the lowest cost. High-volume, high-variability demand, On the contrary, is less predictable. The segment may be further differentiated based on customer priority. High-

priority customers may be offered a responsive service, whereas less-profitable segments are offered more limited options, helping to reduce variability in that segment. Low-volume, low-variability products may be shipped to high-priority customers using responsive inventory systems while limiting choices for lower-priority customers. Walmart is known for its low prices. Walmart segments its supply chain based on product categories. For example, Walmart has a different supply chain for fresh food than it does for electronics.

By segmenting its supply chain, a company can offer increased responsiveness for fast-growing channels and product lines while providing better cost control in mature, stable segments.



Concept Check Questions

62. Designing supply chain networks that provide a competitive advantage is fairly easy.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

63. Over the past decade companies have seen complexity increase in every link of their supply chains.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

64. The increase in demand by consumers for customized products has not had much of an impact on supply chains since customization mainly uses the same components as the “standard” product.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

65. An increasing number of companies are abandoning a “one-size-fits-all” supply chain structure for one that relies on a segmented network.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

66. _____ offers an effective way to bring under control the growing complexity of supply chains.

- ☐ a) Consolidation
- ☐ b) Outsourcing

- ☐ c) Offshoring
- ☐ d) Diversification
- ☐ e) Segmentation

Correct or Incorrect?

Clear

Check Answer

67. A segmented supply chain forces the company to identify where investment in customer service results in the largest gain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

68. A three-step approach can be used to successfully segment a company's supply chain network. Which of the following is not one of these?

- ☐ a) Design differentiated supply chain segments tailored to address unique complexities
- ☐ b)
- ☐ c) Create a customized end-to-end operational blueprint and performance metrics for each supply chain segment
- ☐ d) Identify key drivers of operational complexity

Correct or Incorrect?

Clear

Check Answer

69. There are three ways that segmentation can be conducted.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Fast-moving vs slow-moving products
Fast-growth vs slow-growth products
Traditional vs innovation vs online channel
High-priority customers vs low-priority customers
Low volume/low variability vs low volume/high variability
High volume/low variability vs high volume/high variability

FIGURE 3.6 Ways to segment supply chains.

Big Data Analytics Box

■ SEGMENTATION IN RETAIL

Technology has enabled retailers to identify and track customers through their loyalty programs and credit card data. This big data is then analyzed to track customers, create segments, and personalize offerings. The personalized offerings may be based on simply extrapolating existing customer behavior patterns such as buying and returning products. As a result, retailers have been delivering targeted promotions through e-mail, Web pages, and in-store kiosks. Drugstore chain, CVS, tracks customer purchases through its ExtraCare card. Tesco, the UK-based retailer, tracks all sales through its ClubCard. Similarly, Hallmark uses its Gold Crown card to segment customers, customize direct-mail offers, and assess customer reactions to promotions. Virtually every retailer today has some type of loyalty program. These loyalty programs have proven invaluable in gathering customer data and using big data analytics to create segments of customers, which are then linked to supply chains.

Empowering Entrepreneurs Box

Small supply chains are especially vulnerable to the types of bottlenecks and capacity problems discussed in this chapter, and have challenges being able to quickly scale up production. Understanding process flow is critical. Entrepreneurs should map their supply chain processes and upstream suppliers, going as far back in the supply chain as possible, at least several tiers back. The good news is that it is easy to do for small supply chains. The process flow map should also include process capability and the tools discussed in the Table of Contents (TOC) section of this chapter. This will enable entrepreneurs to clearly understand where bottlenecks can create slowdowns and which supply chain processes are at greatest risk for disruption.

Understanding the critical vulnerabilities in the supply chain allows entrepreneurs to take action to spread the risk. When looking at the supply chain process flow, entrepreneurs should make sure they are not dependent on only one supplier or a single facility. This poses a danger even for large firms, as seen during the COVID-19 pandemic when Apple was not able to meet its deliveries of iPhones due to heavy dependence on its Chinese manufacturer Foxconn. Apple has been trying to diversify its supply chains away from China since 2022 when protests against China's COVID-19 zero lockdowns hit iPhone output. The company has moved some of its iPhone production to India, and it was exploring moving its iPad manufacturing there, too.

Enterprise Resource Planning (ERP)

IT as an Enabler of SCM

For a supply chain to function as a system all chain members must have access to the same information. IT enables communication, storage, and processing of data within and between firms. It is also used to organize information to help managers with decision making. IT is considered an enabler of SCM, as SCM depends on the sharing of information that makes possible the planning, coordination, and execution of all processes. IT enables the linking of

processes across the supply chain and provides visibility into supply chain activities occurring at other points across the network, often far removed from the final customer. This information is then used to help managers throughout the network make effective decisions and appropriately respond to situations, rather than reacting blindly based on educated guesses.

Consider a giant retailer such as Walmart that since 2023 has operated almost 11,000 retail units and employs approximately 2.3 million people around the globe, with 55% of Walmart's employees being women. The sheer scale of the data in Walmart's system is daunting. To manage its inventory Walmart uses an IT system called Retail Link, which enables suppliers to see the exact number of their products on every shelf of every store at that precise moment. The system shows the rate of sales by the hour, by the day, and over the past year. Retail Link gives suppliers a complete overview of when and how their products are selling and even provides information on other products consumers have placed in their shopping cart. This lets suppliers make better decisions, and better managing their inventory and deliveries. For this reason, companies such as Walmart are prepared to spend large amounts of money to develop and continually update their IT systems.

A wide variety of information is needed for a supply chain to perform as a coordinated system. This requires information that supports both long-range and day-to-day decision making. It includes information such as customer demand, customer orders, inventory levels, delivery status, and production plans. This information must also effectively flow within the organization and between members of the supply chain to ensure the timely flow of materials and funds in the system.

In [Chapter 1](#), we discussed many types of information technologies that enable SCM. They range from the Internet, which we are all familiar with, to RFID to global positioning systems (GPS). One of the most significant information technologies has been [enterprise resource planning \(ERP\)](#), which has enabled sharing of information and data across the enterprise for better decision making. Let's look at ERP systems next.

Concept Check Questions

70. For a supply chain to function as a system all chain members must have access to the same information.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

71. Limited information is needed for a supply chain to perform as a coordinated system.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

72. ERP enables sharing of information and data across the enterprise for better decision making.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

What Is ERP?

ERP systems are a fully integrated computer-based technology used by organizations to manage resources throughout the supply chain. The purpose of ERP is to facilitate the flow of information between all business functions inside the boundaries of the organization and manage the connections to other members of the supply chain. These systems integrate all functions of an enterprise and are used to manage materials, financial resources, and HRs and interface with customers and suppliers. ERP systems consolidate all business operations into an enterprise-wide system that operates in real time and uses a centralized database that is accessed by all applications. Through the use of a single database, ERP serves as a business support system across functions and processes.

ERP systems typically tie together all business processes, such as sales, production, inventory management, warehousing, delivery, accounting, billing, and HR management. ERP systems are cross-functional and enterprise-wide, connecting functions such as marketing, operations, sourcing, and logistics. An ERP system uses a central database that allows every department within a business, or even supply chain, to store and retrieve information in real time. The system is designed to have the data inputted in a standardized format, increasing reliability. The software is developed in components or modules, specific to each function or process. The components of these modules are shown in [Figure 3.7](#). This allows a business to select desired components for use, mix, and match components from multiple vendors. The global ERP software market grew 8% in 2022 to a market value of \$44 billion. The top-five global market share positions are SAP, Workday, Oracle, UKG, and Sage.

Concept Check Questions

73. Enterprise Resource Planning (ERP) systems are a fully integrated computer-based technology used by organizations to manage resources throughout the supply chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

74. ERP systems integrate all of the operations functions of an enterprise.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

75. ERP systems are cross-functional and enterprise-wide, connecting functions such as marketing, operations, sourcing, and logistics.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

76. ERP systems tend to be inexpensive and easy to customize.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

77. Which of the following is *not* typically included in the manufacturing module of an ERP system?

- ☐ a) Inventory
- ☐ b) Workflow
- ☐ c) Quality control
- ☐ d) Scheduling
- ☐ e) Bills of material

Correct or Incorrect?

Clear

Check Answer

78. Which of the following is *not* typically included in the supply chain management module of an ERP system?

- ☐ a) Inventory
- ☐ b) Supplier scheduling
- ☐ c) Cost management
- ☐ d) Product inspection
- ☐ e) Order entry

Correct or Incorrect?

Clear

Check Answer

79. Which of the following is *not* typically included in the finance module of an ERP system?

- ☐ a) Fixed assets
- ☐ b) Cash management
- ☐ c) Accounts receivable
- ☐ d) General ledger
- ☐ e) Payroll

Correct or Incorrect?

Clear

Check Answer

80. Which of the following is *not* typically included in the project management module of an ERP system?

- ☐ a) Cash management
- ☐ b) Costing
- ☐ c) Time expense
- ☐ d) Activity management
- ☐ e) Billing

Correct or Incorrect?

Clear

Check Answer

81. Which of the following is *not* typically included in the human resources module of an ERP system?

- ☐ a) Training
- ☐ b) Benefits
- ☐ c) Employee tracking
- ☐ d) Commission
- ☐ e) Payroll

Correct or Incorrect?

Clear

Check Answer

82. Which of the following is *not* typically included in the customer relationship management module of an ERP system?

- ☐ a) Service
- ☐ b) Commission
- ☐ c) Activity management
- ☐ d) Call Center support
- ☐ e) Sales and Marketing

Correct or Incorrect?

Clear

Check Answer

ERP Configuration

ERP systems can be configured in many ways. One option is for the configuration to be fully customized software. Another, and a very different option, is the use of standardized “off-the-shelf” software modules. Finally, ERP can be configured as a mix of these two options, where modules are mixed and customized.

Fully customizing an ERP package can be very expensive and complicated. It is also time consuming and can significantly delay the implementation of an integrated system. However, customized systems have the advantage of being designed around organizational processes currently in place, capturing the way the organization works. On the contrary, applying standardized modules may force changes in the processes of the organization to accommodate the modules themselves.

Manufacturing Bills of material Scheduling Capacity Workflow Quality control Cost management Manufacturing process	SCM Inventory Order entry Purchasing Supply chain planning Supplier scheduling Product inspection
Finance General ledger Cash management Accounts payable Accounts receivable Fixed assets	Project Management Costing Billing Time expense Activity management
HRs Payroll Training Hourly involvement Employee tracking Benefits	CRM Sales and Marketing Commissions Service Customer contact Customer information Call center support

FIGURE 3.7 ERP modules.

The advantage of modular design is flexibility, as it permits the implementation of some functions but not others. Different companies select different configurations based on their needs and resources. For example, modules such as finance and accounting are needed by almost all companies; other modules—such as HR management—may not be needed by everyone; a service company will likely not acquire a manufacturing module. Sometimes

companies will not adopt a module because they already have their own proprietary system in place. Similarly, a company with a well-established IT department, but limited funds for ERP implementation, may select to mix and match different components to satisfy their most pressing business needs. In this case “middleware” can be developed to connect existing applications with standard modules.

The advantage of ERP is that its modules can exist as a system or can be utilized in an ad hoc fashion, enabling businesses to create a configuration best suited to their needs. To further accommodate this, ERP vendors have made changes to the software to help businesses in the implementation process. One improvement in standardized software has been the creation of built-in “configuration” tools to help customers change how the “out-of-the-box” system works and adapt them more easily to their business. Another is the incorporation of “best practices” into most ERP software packages. This provides the organization with the option to modify their processes to line up with the “best practice” function delivered in the “out-of-the-box” version of the software.

ERP Implementation

ERP software systems are complex and usually impose significant changes in organizational processes. Implementing ERP software is typically too complex for in-house developers, who lack the required skills, and it is better to hire outside consultants who are knowledgeable in implementing these systems. Implementation time can be significant and depends on the size of the business, the number of modules being implemented, the degree of customization, and the scope of the changes. It is also affected by the flexibility of the organization to adapt to the change required. The advantage of ERP systems is that they are modular, so they do not all need to be implemented at once. Implementation can then be divided into various stages, which begin with consultation and end with ongoing support following implementation.

Although ERP vendors have designed their software modules around standard business processes, including best practices, these modules are all of a standardized nature. This means that implementation of a noncustomized ERP system requires the organization to adapt its processes to the existing ERP package. This can be very trying for the organization, and planning prior to implementation can greatly help. Four general steps should be followed. First,

develop a map of current business processes, conducting a thorough business process analysis. Second, evaluate ERP vendors, identifying which vendor's ERP modules most closely match the mapped organization's processes. Third, identify steps to unify the ERP modules with organizational processes in the most efficient manner possible. Fourth, plan during implementation to further refine the unity between these two.

ERP implementation is considerably more difficult than organizations anticipate and often requires outside consultants and change management professionals. The benefits of an ERP system are vast as it provides system-wide synchronization and a common vision. It enables the supply chain to function as a unified system. However, a number of potential problems must be addressed, including issues of security and sharing of proprietary information. To achieve the benefits of ERP, careful implementation and ongoing system support are necessary. According to Gartner Research, companies with integrated ERP software increase profits by 10%. The average return on investment (ROI) of ERP implementations is more than \$7 for every dollar spent. The average ROI time in a group of companies that implemented ERP was just over 2.5 years.



Concept Check Questions

83. ERP software systems are complex and usually impose significant changes in organizational processes.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

84. Implementing ERP software is typically easy enough for in-house developers to complete with minor training.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

85. Implementation of a non-customized ERP system requires the organization to adapt their processes to the existing ERP package.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

86. Which of the following is typically not a step in planning for implementation of a non-customized ERP system?

- ☐ a) Develop a map of current business processes
- ☐ b) Identify the bottleneck operation(s)
- ☐ c) Evaluate ERP vendors, identifying which vendor's ERP modules most closely match the mapped organization's processes
- ☐ d) Identify steps to unify the ERP modules with organizational processes in the most efficient manner possible
- ☐ e) Plan during implementation to further refine the unity between ERP modules and organizational processes

Correct or Incorrect?

Clear

Check Answer

87. ERP implementation is considerably more difficult than organizations anticipate.

☐ True

☐ False

Correct or Incorrect?

Clear

Check Answer

CHAPTER HIGHLIGHTS

- A supply chain can be viewed as a system of processes. SCM involves managing these processes.
- A business process is a structured set of activities or steps with specified outcomes.
- The transactional view of supply chains focuses on the efficiency and effectiveness of managing supply chain processes.
- The relationship view of supply chains focuses on managing relationships across the supply chain.
- TOC explains how to manage a system. According to TOC, every system has at least one constraint. A constraint is anything that prevents the system from being able to achieve its goal and is sometimes called the “bottleneck.” A system should be improved by managing the constraint.
- Design capacity is the maximum output rate that can be achieved by a facility. Effective capacity is the maximum output rate that can be sustained under normal conditions.
- ERP systems are a fully integrated computer-based technology used by organizations to manage resources throughout the supply chain.

KEY TERMS

[Supply chain network design](#)

[Information technology_\(IT\)_design](#)

[Business process](#)

[Transactional view](#)

[Relationship view](#)

[Theory of constraints \(TOC\)](#)

[Design capacity](#)

[Effective capacity](#)

Vertical integration

Outsourcing

Enterprise resource planning (ERP)

DISCUSSION QUESTIONS

Explain what a process is and how activities in a process function as a system. Find an example of a process, and identify the different activities involved. How would you improve this process? What would that involve?

Find an example of a business, and identify the processes needed to deliver the product to the final customer. What do you think is the bottleneck in this process? How would you suggest it be managed?

Explain how constraints in a system work. Find an example of a constraint you have encountered recently in your everyday life—whether at work or shopping. How did the constraint affect you? What would happen if the constraint was removed?

Explain vertical integration and how it is different from SCM. In what cases would it make sense for a company to vertically integrate?

PROBLEMS

Shex Hotel can accommodate 300 guests in a single day under maximum conditions. However, under normal conditions this hotel is designed to accommodate 200 guests per day. In September, the hotel accommodated 150 guests in one day. What is the hotel's capacity utilization?

Leopard Transportation Company is designed to process 80 orders per day but can process as many as 100 orders per day under extreme conditions. For the past month, it has processed 90 orders per day. What is the company's capacity utilization? What comments can you make regarding its processing rates? Can the company maintain this rate?

Papi Toys can produce 500 toys in a single day under maximum conditions. However, it is designed to produce 400 units per day under normal conditions. In February, it produced 480 units per day. What was Papi Toys' capacity

utilization for both design and effective capacity? What do these numbers tell you?

Case Study Boca Electronics, LLC

Boca Electronics, a manufacturer of semiconductor components, was established in Houston, Texas, in 2002 after spinning off from its parent company. Originally a branch of Vissay, Inc., Boca Electronics had a solid customer base and strong sales with some major firms such as IBM, Compaq, and Motorola. Semiconductors included a wide array of products that were broken down according to their application and material. Some of their main products include microprocessors, light-emitting diodes (LEDs), rectifiers, and suppressors. Boca Electronics operated on a mainframe system that it inherited from its parent company and used additional stand-alone systems to perform many of its other business functions. For the last four years, the company had performed well financially; so, little concern had been given to the business operations. However, recent slowdown in the economy and an increase in competition in the semiconductor industry have forced Boca Electronics to take another look at the way it operates its business.

Ron Butler, the purchasing manager at Boca Electronics, was responsible for ordering raw materials and ensuring that their delivery was on time and met production requirements. Ron used his forecasting software to determine purchasing needs based on past sales. Although this worked most of the time, Ron often found himself scrambling to meet large customer orders at the last minute and was forced to expedite a lot of orders to meet production needs. Ron felt this was due largely to the lack of communication between his department and the sales force. Although he received production forecasts and projected sales from the sales department, it occurred on an irregular basis, and the forecasts would often change by the time he had placed orders to the suppliers. In addition, Ron had a difficult time synchronizing with suppliers and determining factors such as lead times and product prices. He had previously recommended a new software system that would integrate with suppliers of key components but the proposal was turned down by senior management due to a “current lack of need for such an investment.”

Boca Electronics also faced issues regarding its cash flows. It took several weeks for the accounting department to process invoices and usually had to e-mail back and forth with the sales manager to make multiple corrections. Because both departments used different systems to manage

customer accounts, some of the data was redundant and inaccurate (customer accounts would be updated in the sales department, but not in accounting). Although this issue went largely unnoticed during thriving periods, the recent slowdown in the economy revealed potential repercussions of the current business operations, as Boca Electronics began to run short on its cash flows.

In the last month, one of Boca Electronics' largest customers began requiring all its suppliers to integrate their manufacturing operations to improve the sharing of information and further improve its supply chain. This company had recently implemented an ERP system from a major provider and was encouraging its suppliers to do the same. Suppliers had the option of implementing middleware software to integrate operations. Whether suppliers chose to keep their current systems and implement middleware, or implement an ERP system that would integrate with the company, they had one year to make the changes to continue doing business with this customer.

Paul Andrews, the CIO at Boca Electronics, was well aware of the issues facing the company. He knew that something had to be done to improve communication and information sharing within the company, and the current mainframe system was outdated and inefficient. He was also aware of the constraints that Ron was facing in Purchasing and how much it was costing the company. With the new request from one of its largest customers for further integration, the idea of implementing an ERP system for Boca Electronics seemed like a viable solution to Paul. However, recent economic downturns and a limited amount of capital made such a large capital outlay a risky investment for the company.

Case Questions

1. Determine the trade-offs of implementing an ERP system in the company vs buying best-of-breed software and using middleware to integrate.
2. What are the potential impacts of such an implementation on the company's suppliers and customers?
3. If the company chose to stay with the system that it currently has, what are some potential consequences that can occur in the future?

4. Based on the business nature of the company, the industry, and the current environment, what would you recommend doing?

Case Study Making Decisions with Data Analytics: J Consulting

Joseph manages his own consulting firm, J Consulting, located in Rio de Janeiro, Brazil. He has recently acquired a new client, Maria, who has asked for services to help her start a business in the city. Maria is currently operating a steel furniture manufacturing business just outside the city and is looking for a related business idea for expansion.

Joseph has gone through city council reports and found an alarming increase in bike theft cases in the city. He realizes that bike locks, which are made of metal alloys, offer a great opportunity for Maria. Linking the bike locks business with a service that would offer theft insurance to bike lock customers appears to be a natural opportunity.

Joseph wants to present this proposal to Maria with as much analytical detail of product and service design as he can. He knows that in his proposal, he needs to address the following:

Type/design of locks

Manufacturing process involved

Lock-related services that offer diversification opportunities, such as offering insurance

Case Questions

1. How should Joseph proceed with developing this proposal? Specify the steps and data needed.
2. What should he include in the proposal? What would be the difference in the process flow for lock manufacturing compared with the insurance business? (**Tip:** One is a service operation, and the other is manufacturing.)
3. What criteria should he consider beyond the analytical details? Will these criteria be the same for both businesses?
4. What type of analysis should Joseph conduct to evaluate vertical integration opportunities?

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Note

- ¹ Douglas M. Lambert, *SCM: Process, Partnership, Performance*, 4th ed. (Sarasota, FL: Supply Chain Management Institute, 2014).

4 Marketing

LEARNING OBJECTIVES

After completing this chapter, you should be able to:

Define marketing and explain its role in supply chain management (SCM).

Describe how market segmentation impacts supply chain design.

Describe the tools of customer relationship management (CRM).

Explain the voice of the customer (VOC) and quality function deployment (QFD).

Explain channels of distribution and their role in supply chain management.

Explain the impact of e-commerce on channels of distribution and the supply chain.

CHAPTER OUTLINE

- **What Is Marketing?**
 - The Marketing Function*
 - Evolution of Marketing*
 - Impact on the Organization*
 - Impact on the Supply Chain*
- **Customer-driven Supply Chains**
 - Who Is the Customer?*
 - Types of Customer Relationships*
 - Managing Customers Using CRM*
- **Delivering Value to Customers**
 - Voice of the Customer (VOC)*
 - What Is Customer Service?*
 - Impact on the Supply Chain*
 - Measuring Customer Service*
 - Global Customer Service Issues*
- **Channels of Distribution**
 - What Are Channels of Distribution?*
 - Designing a Distribution Channel*
 - Distribution vs Logistics Channel*
 - The Impact of e-Commerce*
 - The Omnichannel*
- **Chapter Highlights**
- **Key Terms**
- **Discussion Questions**
- **Case Study: Gizmo**

- [Case Study: Making Decisions with Data Analytics: Your Friend Mark](#)
- [Bibliography](#)



[Bloomberg Quicktake Video: Peloton's Turnaround Efforts Bears Fruit](#)

[Bloomberg Quicktake Video: Apple Unveils iPhone 16](#)

Marketing experts say that consumers do follow their noses. This began with real estate agents using the tactic of encouraging owners to fill their homes with the scent of freshly baked bread or coffee in advance of property viewings, creating a “homey” feel for potential buyers. Today technology is using scent to dramatically increase sales in all consumer areas. This includes gel cartridges that emit smells from the TV while watching a cooking program, to iPhone scent cartridges that release scents when certain apps are switched on, to gyms that are scented to increase performance. Welcome to the new age of marketing—a form of sensory branding known as “ambient scenting,” “scent marketing,” or “sensory marketing.”

Even before you enter an Abercrombie & Fitch store, you can smell the characteristic woody aroma that is associated with the brand. A combination of citrus, fir-tree resin, and Brazilian rosewood extract, “Fierce” creates a sense of excitement and pleasure. Since its rollout in stores across the country a few years ago, Abercrombie's cologne, which also pervades sidewalks outside the clothier's stores, has become an integral part of the shopping experience. A part of the ambiance, the scent is designed to enhance the feel of being at the store, create a brand association, and ultimately promote sales. Popular demand compelled the company to produce the trademark scent in bottle form. The brand association with the trademark scent has since become so strong that some customers even complain when store-bought T-shirts lose the smell after multiple washes.

No longer confined to lingerie and candy stores, ambient scenting is custom-designed to create brand association and a particular outcome. Studies show that ambient scents can increase sales by up to 20% and improve brand recall. For example, Westin Hotel & Resorts disperses white tea to provide the “Zen Retreat” experience. The Mandarin Oriental in Miami sprays “meeting scent” in conference rooms to enhance “productivity.” Omni Hotels uses the scent of sugar cookies in its coffee shops. Similarly, Starbucks uses the enticing aroma of freshly brewed coffee and scented candles in its stores to enhance the customer experience and drive sales. By strategically implementing scent marketing, Starbucks creates a welcoming atmosphere that encourages customers to linger and enjoy their coffee, reinforcing its position as a preferred destination for coffee lovers. Even Disney uses a variety of scents in its theme parks,

including scents that are designed to evoke the feeling of being on vacation. For example, the company uses the scent of popcorn in its Main Street area and the scent of cinnamon buns in its Fantasyland area.

Scent branding is becoming just as prevalent in retail, as researchers show that ambient scenting allows consumers to make a deeper brand connection. Recently, Samsung had a scent designed for its stores to create an association between the brand and concepts of innovation and excellence. The creators even claim that customers—under the subtle influence of the scent—spend an average of 20–30% more time mingling among the electronics. Major retailers such as Nike have found that scent marketing in retail stores can increase intent to purchase by 80%. The American Marketing Association reports that an attractive scent can entice customers to stay up to 44% longer in a business.

This new approach in reaching customers has also created a new supply chain. Worldwide, a growing industry of companies specializing in ambient scent marketing and dispersion technology has emerged. These enterprises typically pair with fragrance companies to design customized fragrances for businesses. There is also scenting equipment and technology for dispersion that must be designed, as well as equipment maintenance that can vary depending on the size of the space to be scented. Distributors, dealers, and agents are added to the network.

As marketing develops novel alternatives to reach customers, improve brand recognition, and enhance sales, supporting supply chains evolve. Marketing drives the development of the supply chain to meet what the customer wants.

Concept Check Questions

1. Marketing experts say that consumers do follow their noses.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

2. Ambient scenting is mostly confined to lingerie and candy stores.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

3. Studies show that ambient scents can increase sales by up to what percentage?

- ☐ a) 5%
- ☐ b) 10%
- ☐ c) 20%
- ☐ d) 25%
- ☐ e) 50%

Correct or Incorrect?

Clear

Check Answer

4. Scent branding has not yet penetrated retail.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

5. Scent branding has created a new supply chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

What Is Marketing?

The Marketing Function

Marketing is the function responsible for linking the organization to its customers and is concerned with the “downstream” part of the supply chain. This is highlighted in [Figure 4.1](#). The task of marketing is to identify what customers need and want, create demand for a company's current and new products, and continue to identify market opportunities. Marketing plays a critical role, as providing value to customers drives all actions of the organization and the supply chain.

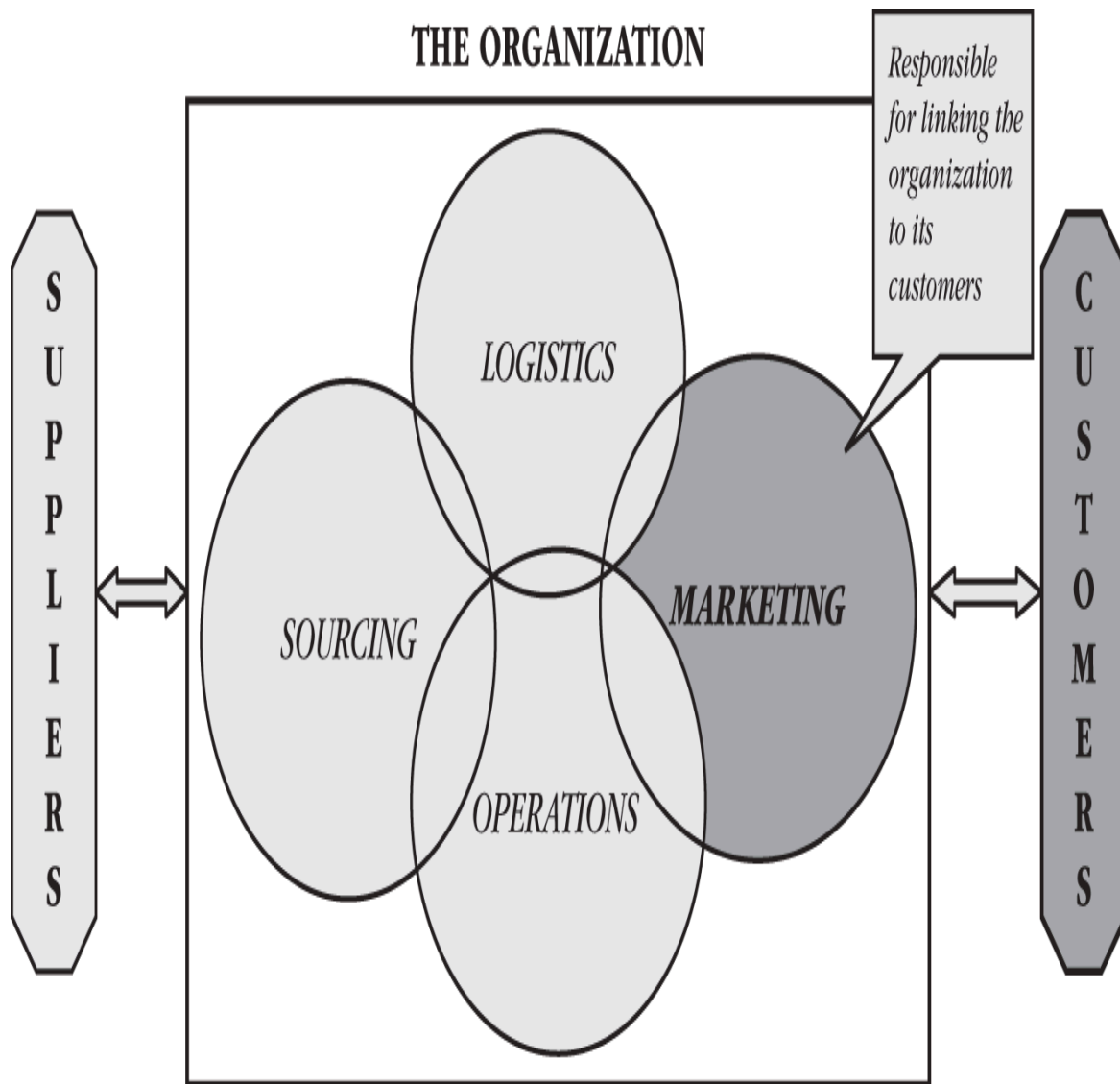


FIGURE 4.1 The marketing function.

For an organization and its supply chain to be competitive, they must be better than competitors at meeting customer needs. Marketing is the function responsible for identifying what these needs are, determining how to create value for customers, and building strong customer relationships.

Marketing is a far more complex function than it may appear, as customers are driven by much more than their basic needs for products and services. The key is to understand and develop the combination of products and services that precisely meet the expectations of a particular set of customers. For example, if most customers of athletic shoes only care for three different color choices, offering the product in five colors makes little sense. There would be little

benefit, and the supply chain implications—extra sourcing, manufacturing, distribution, and inventory—would be significant. It is critical to understand exactly what satisfies customers and to precisely match product and service offerings to their psychological needs or conscious preferences. A good example is In-N-Out Burger, a fast-food chain known for its small and focused menu, which includes burgers, fries, shakes, with just a few variations. This limited menu helps streamline operations, improve staff training, provide fast service, maintain food consistency, and support an efficient supply chain.

Marketing is further complicated by the fact that there is no single market for any given product or service. All markets can be broken down into multiple segments, each of which has somewhat different requirements. A critical challenge is to distinguish markets—called [market segmentation](#)—in a meaningful and effective way. At one end of the spectrum is [mass marketing](#), which refers to treating the entire market as a homogenous group and offering the same marketing mix to all customers. Mass marketing reduces costs through economies of scale but may miss large segments of the market with an offering that is too general. Segments that are too broad (e.g., all women in the world over the age of 30) do not permit the company to target a narrow enough group. On the contrary, segments that are too narrow (e.g., high school students who work part-time in Lima, Ohio) may not be cost effective. [Target marketing](#) recognizes the diversity of customers and does not try to please all of them with the same product offering. The challenge for marketing is to identify the most effective market segments and their needs. As we will see shortly, this must also take into account the supply chain requirements needed to service each segment.

Concept Check Questions

6. _____ is the function responsible for linking the organization to its customers and is concerned with the “downstream” part of the supply chain.

- ☐ a) Sales
- ☐ b) Marketing
- ☐ c) Operations
- ☐ d) Logistics
- ☐ e) Customer relationship management

Correct or Incorrect?

Clear

Check Answer

7. For an organization and its supply chain to be competitive, they must be better than competitors at meeting customer needs.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

8. Marketing is not a complex function.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

9. A critical challenge is to distinguish markets in a meaningful and effective way. What is this called?

- ☐ a) Mass marketing
- ☐ b) Internet marketing
- ☐ c) Target marketing

- ☐ d) Focused marketing
- ☐ e) Market segmentation

Correct or Incorrect?

Clear

Check Answer

10. This refers to treating the entire market as a homogenous group and offering the same marketing mix to all customers.

- ☐ a) Mass marketing
- ☐ b) Internet marketing
- ☐ c) Target marketing
- ☐ d) Focused marketing
- ☐ e) Market segmentation

Correct or Incorrect?

Clear

Check Answer

11. The recognizes the diversity of customers and does not try to please all of them with the same product offering.

- ☐ a) Mass marketing
- ☐ b) Internet marketing
- ☐ c) Target marketing
- ☐ d) Focused marketing
- ☐ e) Market segmentation

Correct or Incorrect?

Evolution of Marketing

The function of marketing has changed and evolved corresponding to changes in the general business environment. Three major perspectives dominated marketing over its history—the production concept, the selling concept, and the marketing concept, as shown in [Figure 4.2](#). This most recent perspective also ushered in an era that focused on creating relationships with customers, called relational marketing, which is different from merely focusing on making individual sales transactions. We now look at this in more detail.

The early part of the 20th century witnessed a large unfulfilled demand for products that met basic needs and gave rise to the production concept in marketing. At that time, virtually anything that could be produced was easily sold, and the primary challenge was to sell products at a price that exceeded the cost of production. Firms focused on products that could be made most efficiently, as offering low-cost products in the marketplace automatically created demand.

The 1930s, however, witnessed greater market competition and ushered in an era that now focused on selling. Mass production had become commonplace, competition had increased, and there was less unfulfilled demand. Unlike the time of the production concept, where mere product availability created demand, this new era required marketing to persuade customers to buy their products through tools such as advertising and personal selling. Marketing was a function that was performed after the product was developed and produced. The sales concept paid little attention to what the customer actually needed, and the goal was to simply beat competitors at the sale. As a result, marketing often involves hard selling, something that is still associated with marketing.

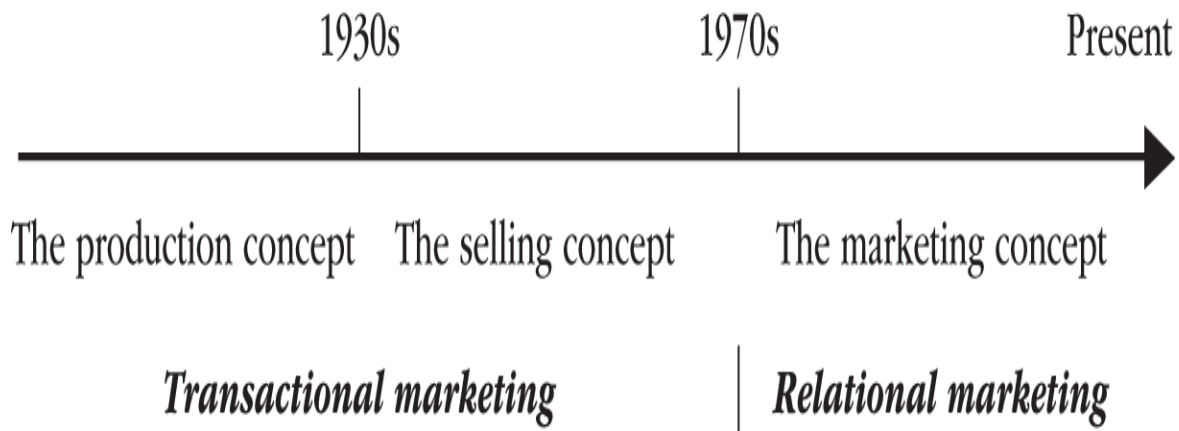


FIGURE 4.2 The evolution of marketing.

Supply Chain Leader's Box

■ GAP, INC.

Consider that Gap, Inc., one of the largest specialty retailers, owns seven brands: Banana Republic, Gap, Old Navy, Athleta, Intermix, Hill City, and Janie and Jack. The three largest—Gap, Banana Republic, and Old Navy—are similar but have very different target markets. Old Navy carries “great fashion at great prices” and is focused on offering a low price point for a target market that includes families and children. Gap offers a classic style at a slightly higher price point targeting college-aged students. Finally, Banana Republic focuses on offering “accessible luxury,” which has the highest price points, and targets fashion-conscious individuals.

The different brands have different supply chains to support the different target markets. Old Navy has the lowest price point and primarily sources from China, which is driven by a focus on cost. Gap sources from South America with slightly not only higher quality goods but also higher prices. Finally, Banana Republic primarily sources from Europe. It offers the highest-quality fashion of the three brands but at a higher price. The different supply chains are specifically geared to support each target market. This strategy also gives Gap, Inc.'s supply chain flexibility. When there are problems with any one supply chain the company can easily switch to one of the other chains to support its brands.

In addition to cost considerations, Gap's marketing strategy is also tailored to specific age groups and genders. Gap and Old Navy target families and individuals seeking trendy and affordable clothing for all ages.

Banana Republic targets working professionals and fashion-conscious individuals, while Athleta focuses on activewear and athleisure. Their marketing highlights women's empowerment, sustainability, and high-performance clothing. On the contrary, Hill City focuses on men's performance and active clothing. Their marketing highlights innovation, functionality, and style. Then, there is Janie and Jack, which targets parents and caregivers looking for high-quality and fashionable clothing for children.

The 1970s witnessed a proliferation of product variety and greater selectiveness on the part of customers. Hard selling no longer could be relied on to generate sales. Customers now had increased discretionary income and would buy only those products that precisely met their needs. In addition, in an increasingly global environment, their needs began changing rapidly and were not immediately obvious. The marketing concept developed in response, focusing on identifying what customers want and how to keep customers satisfied. Companies changed their focus to identify customer needs before developing the product and aligning all functions of the company to meet those needs.

The marketing perspectives prior to the 1970s were part of an era termed “[transactional marketing](#),” which focused on obtaining successful exchanges, or transactions, with customers. Companies focused on maximizing short-term transactions with their customers, as opposed to building long-term relationships. The focus was primarily on selling existing products and using promotional techniques to maximize sales, rather than developing insights into the future needs of customers. Then in the 1970s firms moved from a “selling” orientation to a “marketing” orientation. Here marketing research techniques are used to understand customer psychology and then to make decisions that satisfy customers better than the competition.

Transactional marketing as a marketing strategy is often associated with one-time or infrequent purchases. One example of transactional marketing is Black Friday sales at retail stores. Imagine a retail store that offers a special Black Friday promotion. They advertise heavily, offering deep discounts on various products for a limited time. Customers flock to the store on Black Friday with

the primary goal of taking advantage of these deals. They make their purchases, sometimes in a hurry, to secure the best discounts available that day. In this scenario, the store's marketing efforts are primarily geared toward driving sales on Black Friday. Customers are motivated by the prospect of getting items at significantly reduced prices. The focus is on the immediate transaction, and there may be limited efforts to establish a long-term relationship with the customers.

The store may not collect extensive customer information or engage in post-purchase follow-up. Transactional marketing in this context emphasizes the short-term sales opportunity presented by Black Friday, with less emphasis on building lasting customer relationships.

The growth of supply chain management (SCM) created a shift in philosophy regarding the nature of marketing strategy, termed “[relational marketing](#).” Relational marketing focuses on developing long-term relationships with key supply chain participants—customers and suppliers. The emphasis is to understand their long-term preferences, provide them with high customer service, and therefore engender loyalty. Relational marketing is based on the understanding that it is more cost effective to retain current customers than to work to attract new ones.

The focus on customers has further been magnified with the turn of the century. Today's business environment is characterized by an empowered customer who is the driving force of the supply chain. The single greatest factor that contributed to this shift was the Internet, a technological development that armed consumers with a wealth of information and provided them with bargaining power unseen before. Consumers today can gain information on the latest product choices, product characteristics, costs, and consumer reviews, and they perform global searches of companies and industries. This has enabled them to become knowledgeable buyers who can realistically demand choices in products and services. Trying to accommodate this new breed of customers has resulted in a major shift in business philosophy and has changed virtually every aspect of SCM.

Amazon, the multinational e-commerce and technology giant, has embraced a customer-centric approach to an exceptional degree. The company has harnessed the power of the internet to provide consumers with an unparalleled shopping experience. Amazon excels in customer-centricity by providing extensive product information, global product access, personalized

recommendations, efficient supply chain operations, and active customer feedback mechanisms.

Concept Check Questions

12. _____ major perspectives dominated marketing over its history

- ☐ a) Two
- ☐ b) Three
- ☐ c) Four
- ☐ d) Five
- ☐ e) Many

Correct or Incorrect?

Clear

Check Answer

13. Place these marketing perspectives in the correct order.

- I. The marketing concept
- II. The production concept
- III. The selling concept

- ☐ a) I, II, III
- ☐ b) II, I, III
- ☐ c) II, III, I
- ☐ d) III, II, I
- ☐ e) III, I, II

Correct or Incorrect?

Clear

Check Answer

14. The marketing perspectives prior to the 1970s were part of an era termed _____ marketing.

- ☐ a) transactional
- ☐ b) conceptional
- ☐ c) functional
- ☐ d) minimal
- ☐ e) relational

Correct or Incorrect?

Clear

Check Answer

15. The growth of supply chain management created a shift in philosophy regarding the nature of marketing strategy, termed _____ marketing.

- ☐ a) transactional
- ☐ b) conceptional
- ☐ c) functional
- ☐ d) minimal
- ☐ e) relational

Correct or Incorrect?

Clear

Check Answer

16 Today's business environment is characterized by an empowered customer that is the driving force of the supply chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Impact on the Organization

The knowledge and information that marketing provides has critical importance for the entire organization as it is used to guide the actions of all other functions within the firm. We can see this from the PepsiCo example, as provided in the Supply Chain Leader's Box section, where the entire organization is changing to accommodate new customer preferences. For marketing to be successful, it must be supported by the entire organization, and the products customers want must be made available.

As we have seen, it is common for marketing research techniques to determine that consumers desire a new type of product. Marketing then needs to work with operations to ensure production of the product with the exact characteristics needed; sourcing needs to ensure that supplies are available in a timely and cost-effective manner; logistics needs to ensure deliveries of exactly what is needed throughout the supply chain; also, finance needs to be involved in securing appropriate funding. All this coordination needs to happen simultaneously, while marketing is promoting and advertising the new product.

Notice that marketing brings the voice, the mind, and the heart of the customer into the decision-making process of the company. Collectively, the organization then translates customer desires into viable and profitable products. None of this organizational functioning could take place without marketing to drive it.

Supply Chain Leader's Box— Accommodating Changing Customer Preferences

■ PEPSICO

PepsiCo is a great example of a company making product changes to align with customer preferences. Initially, their products were carbonated beverages and snacks. In February 2007, when Derek Yach, a former executive director of the World Health Organization (WHO) and a nutrition expert, took a new job with PepsiCo, his mother worried. “You are aware they sell soda and chips, and these things cause you to get unhealthy and fat?” she asked him. Yach's former colleagues in public health had similar concerns. However, Yach said he knew what Pepsi made, but he wanted to help guide the snack food multinational toward a healthier product menu.

The company that made its reputation on junk food has changed its direction, under the leadership of the chief executive officer (CEO), Nooyi. Nooyi says she has no choice but to move toward healthier fare, as consumers become more health conscious. For over a decade, consumers have gradually defected from the carbonated soft drinks that once comprised 90% of PepsiCo's beverage business. Many have switched to bottled water and other healthier beverages. In addition, criticism grew steadily over Pepsi's largest business, Frito-Lay snacks, which are laden with oil and salt. In response to changing consumer demands, the company has decided to emphasize research to create truly healthy fare.

“Society, people, and lifestyles have changed,” Nooyi says. “The R&D needs for this new world are also different.” As a result, she has increased the research and development (R&D) budget to \$680 million, which is more than 1% of the company's \$65 billion net revenue. To do this, PepsiCo hired a dozen physicians and PhDs, many of whom built their reputations at the Mayo Clinic, WHO, and like-minded institutions. Some researched diabetes and heart disease, the sort of ailments that can result in part from eating too much of what PepsiCo sells. The goal is to continue creating healthy options while making the bad stuff less bad.

The researchers hunt for healthier ingredients that can go into multiple products. For example, technological improvements to an all-natural zero-calorie sweetener derived from a plant called “stevia” allowed PepsiCo to devise several new fast-growing brands. This included healthier beverages such as Pomegranate Blueberry, Pineapple, Mango, and Trop50, a variation on its Tropicana orange juice. PepsiCo has also launched an organic Gatorade.

In 2024, PepsiCo had about 45% of its net revenue from its so-called “guilt-free” products. These products include beverages with fewer than 70 calories per 12 ounces, snacks with lower amounts of salt and saturated fat, corn chips with 40% less sodium than regular corn chips, and potato chips with 25% less fat than regular potato chips.

PepsiCo's strategy to follow customer preferences is proving profitable. As preferences have changed PepsiCo has worked hard to respond to them.

Adapted from: <https://www.pepsico.com>.

Concept Check Questions

17. It is common for marketing research techniques to determine that consumers desire a new type of product.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

18. Marketing alone designs new products.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

19. Marketing and production alone combine to designs new products.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

20. marketing brings the voice, the mind, and the heart of the customer into the decision-making process of the company.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Impact on the Supply Chain

Just as marketing drives the decisions of the organization to produce and deliver exactly what customers want, it also drives supply chain decisions. Marketing decisions generally fall into four distinct categories known as the marketing mix or the 4Ps. These decisions are product, price, place

(distribution), and promotion. Although they are in the domain of marketing, these decisions directly involve SCM.

Product involves decisions that encompass the bundle of product characteristics that satisfy customer needs. They relate to brand name and functionality. They also address decisions of quality and packaging, which are directly supported by supplier standards and logistics packaging decisions. **Price** refers to the pricing strategy developed for the product. This includes volume and sales prices, seasonal pricing, as well as price flexibility. Although they are the domain of marketing, pricing strategies, and price flexibility are directly tied to supply chain costs. **Place** deals with having the product where it is needed and when it is needed. These decisions include a selection of distribution channels and market coverage. They also include traditional logistics, sourcing, and operations decisions such as inventory management, order processing, transportation, and reverse logistics. Finally, **promotion** deals with advertising and sales techniques to increase product visibility and desirability. Decisions involve promotional strategies and advertising, sales promotions, and public relations.

In the past, companies primarily focused on meeting the demands of the average customer. These companies supplied products to customers without trying to determine or satisfy the unique needs of each customer. Today, consumers are knowledgeable; they demand what they want at the highest quality, low price, and delivered at record speed. Also, today's customers expect a world-class organization to provide high levels of customer service. To compete in this new economy, companies are putting forth a great deal of effort and money to precisely understand their customers, to provide unprecedented levels of customer service, and to provide one-on-one customization. This has resulted in large changes in the SCM of companies and the relationships between supply chain members who aim to deliver what consumers want. We now look at key issues in designing customer-driven supply chains.

Netflix, as an example, has embraced a customer-centric approach by offering personalized content recommendations based on viewer behavior. They invest in producing tailored content to satisfy diverse audience preferences. The platform provides instant access to content, meeting the demand for rapid delivery. Netflix emphasizes customer service and continually enhances its user experience based on feedback. They also offer region-specific content catalogs, acknowledging cultural differences. Netflix's approach underscores

the transformation in SCM toward catering to the unique demands and preferences of informed and discerning consumers.



Concept Check Questions

21. _____ involves decisions that encompass the bundle of product characteristics that satisfies customer needs.

- ☐ a) Product
- ☐ b) Price
- ☐ c) Place
- ☐ d) Promotion
- ☐ e) Selling

Correct or Incorrect?

Clear

Check Answer

22. _____ refers to the pricing strategy developed for the product.

- ☐ a) Product
- ☐ b) Price
- ☐ c) Place
- ☐ d) Promotion
- ☐ e) Profits

Correct or Incorrect?

Clear

Check Answer

23. _____ deals with having the product where it is needed and when it is needed.

- ☐ a) Product
- ☐ b) Price
- ☐ c) Place
- ☐ d) Promotion
- ☐ e) Production

Correct or Incorrect?

Clear

Check Answer

24. _____ deals with advertising and sales techniques to increase product visibility and desirability.

- ☐ a) Product
- ☐ b) Price
- ☐ c) Place
- ☐ d) Promotion
- ☐ e) Advertising

Correct or Incorrect?

Clear

Check Answer

25. In the past companies primarily focused on meeting the demands of the wealthiest customers.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

26. Today, consumers are knowledgeable; they demand what they want at the highest quality, low price, delivered at record speed.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Customer-driven Supply Chains

Who Is the Customer?

Today's economy is characterized by a shift in power from companies to customers, where the customers are the dominant force. Customers now expect to receive the products they want, when they want them at a low price. As a result, companies are focused on capturing the individual customer, which requires a shift in focus from merely supplying goods and services to customers to actually capturing loyalty. The competition for customers has resulted in a proliferation of product choices and alternatives, which has had huge supply chain implications.

The focus on the customer has required supply chain companies to work together to provide customers with more value than competing supply chains.

As a result, companies are making large changes in their organizational structure and their supply chain relationships.

A company's supply chain contributes to its success because it provides more value to the customer than a competing supply chain. This may mean that it provides superior delivery and greater product availability. For supply chains to meet customer demands, they need to know exactly “who is the customer?” This also requires an understanding of the term “customer.” Most people assume that the term refers to the final customer or consumer. However, SCM as a concept requires a careful understanding of the term “customer.”

The “customer” can have many different meanings. Typically, there are two types of end users. The first is the [end consumer](#), which could be an individual or a household that purchases products and services to satisfy personal needs. The second type of customer is an [organizational end user](#). In this second case, purchases are made by an organization or institution for employees to perform their jobs in the organization. An SCM perspective requires that all firms in the supply chain focus on meeting the needs and requirements of customers, whether they are individual consumers or organizational end users. This is shown in [Figure 4.3](#).

From an SCM perspective, a customer is at any delivery location, not necessarily the last location in the supply chain. This includes a range of possible locations from consumers’ homes to retail, and wholesale businesses to the receiving docks of manufacturing plants and distribution centers. Often the customer is a different organization or individual than the one who is taking ownership of the product or service being delivered. Sometimes the customer is a different facility of the same firm or a business partner at other location in the supply chain. For example, the logistics manager of a Walmart warehouse would think of the Walmart retail location as its customer. They may be part of the same overall organization, but one serves the other as its customer.

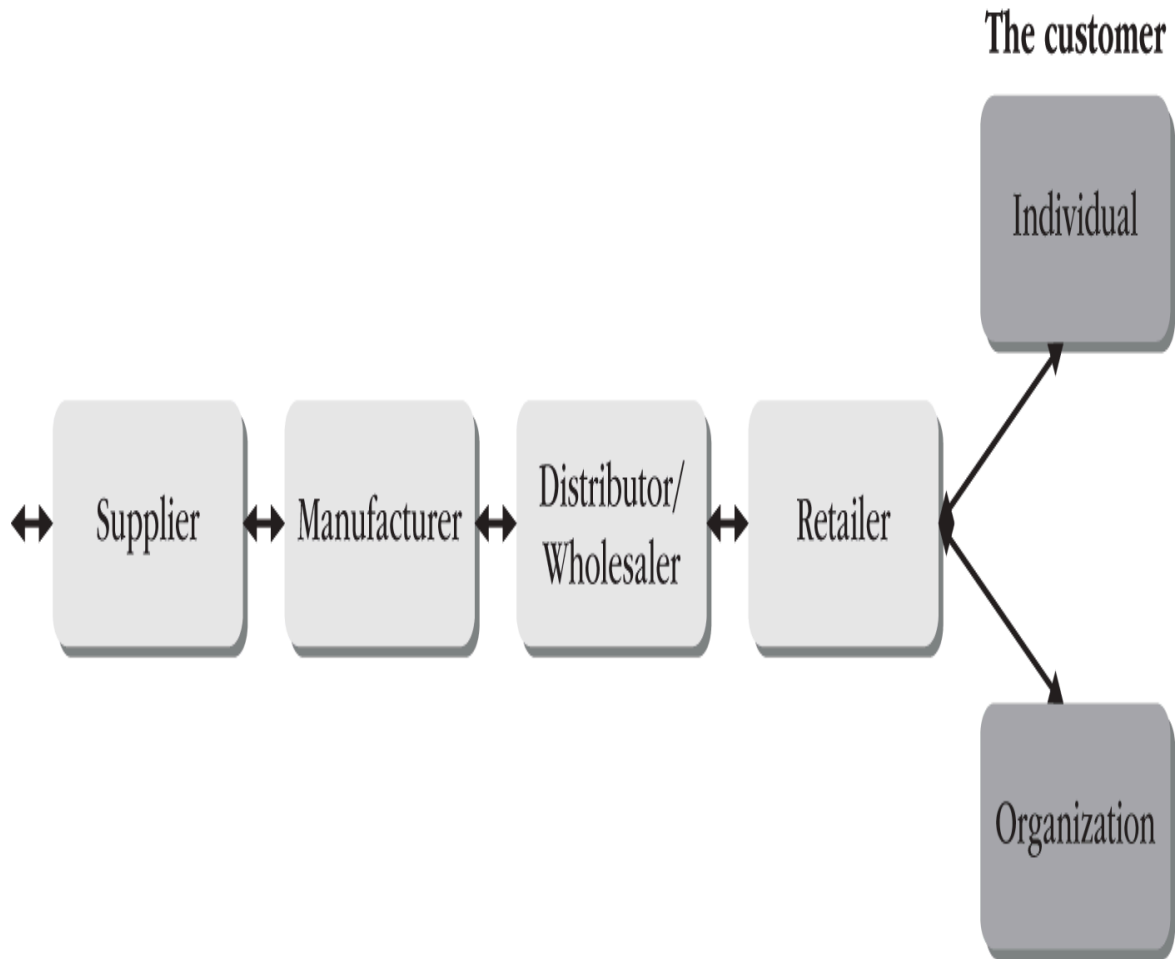


FIGURE 4.3 Traditional view of the “customer.”

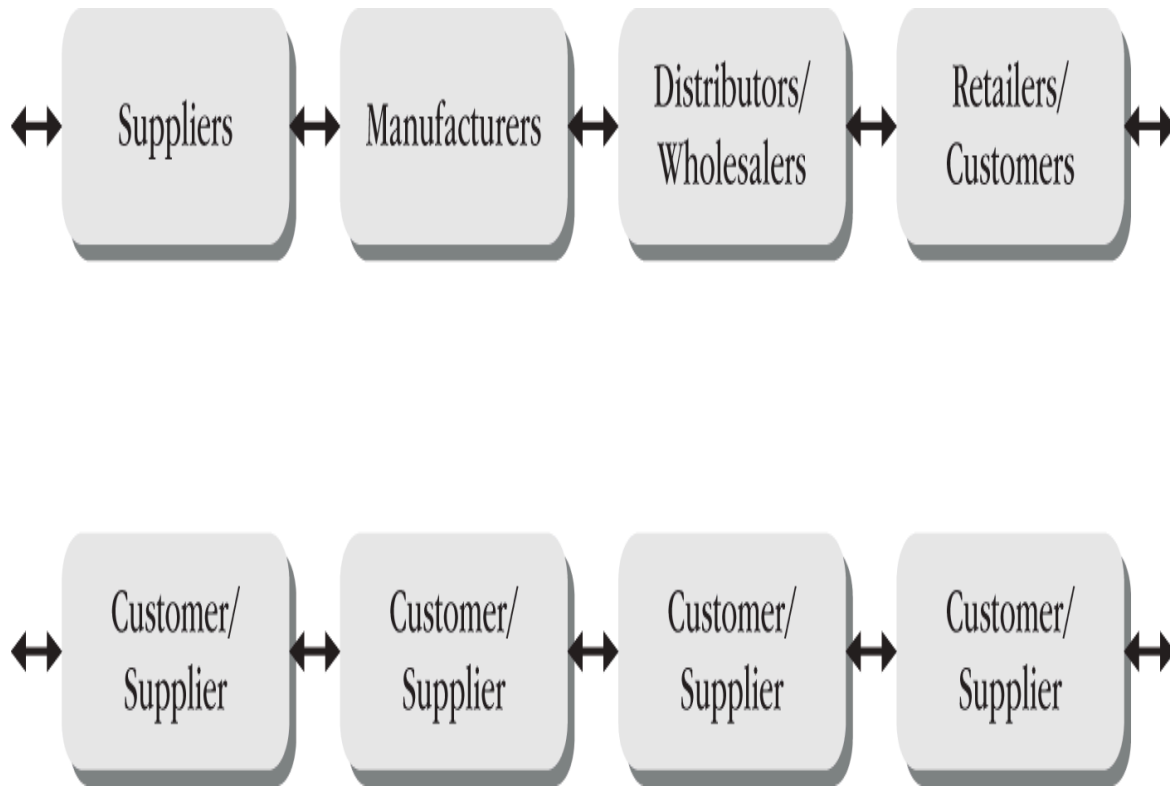


FIGURE 4.4 Every supply chain member is both a supplier and customer.

Within the supply chain context, there is a broad perspective of the term “customer.” The total supply chain looks at the end user of the product or service as the primary customer whose needs or requirements must be accommodated. The supply chain perspective, however, recognizes that the supply chain is made up of intermediate organizations, from raw material suppliers at the beginning of the chain to final consumers at the end of the chain. Each organization in the chain is dependent on the organization that immediately precedes it in the chain and serves as its supplier. Therefore, all organizations in the supply chain are both suppliers and customers to other members of the chain. For example, Walmart may sell Tide laundry detergent to the final customer in the supply chain. Procter & Gamble (P&G) provides Tide laundry detergent to Walmart and is therefore its supplier. However, P&G is a “customer” to their suppliers from which it receives supplies such as chemicals and plastics. Therefore, P&G is a “customer” of its suppliers and a “supplier” to retailers such as Walmart. Although each entity in the chain serves its immediate customer, it is ultimately driven by the demands of the final customer in the chain. This is shown in [Figure 4.4](#).

Concept Check Questions

27. Today's economy is characterized by a shift in power from customers to companies.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

28. Customers now expect to receive the products they want, when they want them at a low price.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

29. Typically, there are _____ type(s) of end users.

- ☐ a) one
- ☐ b) two
- ☐ c) three
- ☐ d) four

Correct or Incorrect?

Clear

Check Answer

30. The _____ consumer could be an individual or a household that purchases products and services to satisfy personal needs.

- ☐ a) individual
- ☐ b) organizational end
- ☐ c) end
- ☐ d) firm

Correct or Incorrect?

Clear

Check Answer

31. With a(n) _____ users, purchases are made by a firm or institution for employees to perform their jobs in the organization.

- ☐ a) individual
- ☐ b) organizational end
- ☐ c) end
- ☐ d) firm

Correct or Incorrect?

Clear

Check Answer

32. From an SCM perspective, a customer is the last location in the supply chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

33. Each organization in the supply chain is independent of the organization that immediately precedes it in the chain and serves as its supplier.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Types of Customer Relationships

The traditional marketing approach has been to pursue a strategy of increasing the number of customer transactions to increase revenues and profits. This is transactional marketing as it focuses primarily on increasing the number of customer transactions. This type of relationship does not consider the long-term impact that comes from building alliances. Rather, it is only a short-term view of the supplier–customer relationship. Often this strategy is used together with the marketing practice of developing target markets, such as grouping customers based on demographics or buying patterns. Usually, these groupings are very large, and specific customer needs are neglected. Three of the most common strategies used to satisfy customers in various target markets are the following: standardized strategy, customized strategy, and niche strategy.

Managerial Insights Box—Understanding the Customer

■ TARGET

Target uses sophisticated computer systems to understand its customers. The company tracks customer purchases, collects big data, and applies advanced analytics to the data set. The algorithm is even able to determine that a female shopper is pregnant based on a purchase assortment of 25 items that a woman buys. Some of the purchased items include vitamins, zinc, cocoa butter, and large clothing. Throw in a rocking chair, and the computer model says the purchaser is pregnant. Based on this assortment the algorithm even determines the timing of the pregnancy, identifying the purchaser as being in the second trimester. The algorithm has established that if it can lure mothers-to-be in their second trimester, they will maintain the highest customer loyalty rates.

The way this works is that Target assigns every customer an identification (ID) number that is tied to their name, e-mail address, and credit card number. The company then uses this information to track purchases and send coupons based on customer preferences.

Unfortunately, in the case of Target, an irate father scolded a Target manager because his teenage daughter received baby coupons in the mail. As it turned out, his daughter was indeed pregnant. The algorithm was correct.

In the [standardized strategy](#), all customers are viewed in the same way. It provides a minimal amount of product customization. When market segmentation is used, it ultimately averages out the needs of all the customers in the group. The company then develops products to satisfy the needs of the average of the customers in the group, rather than satisfying individual customer needs. This has large cost advantages in those processes from manufacturing, logistics, and marketing are streamlined and predictable. The advantage is that the customer receives a product at the lowest cost possible.

However, many customers may not be satisfied under this strategy, as they are unable to receive the products that meet their specific needs. There are many examples of “one-size-fits-all” products. For example, the pain reliever acetaminophen, sold under the brand name Tylenol, was historically available only as a standard pain reliever. However, it is now available in many versions, including sinus-relief Tylenol, Tylenol PM, and Tylenol tablets vs gelcaps. This has provided greater options but has also increased supply chain costs.

Customized strategy is a differentiated strategy that capitalizes on information that comes from market segmentation and target markets. The strategy enables the company to develop different versions of a product based on specific market needs. This results in higher-priced products due to the complexities involved in producing and coordinating multiple products being sent to multiple locations. Differences occur in the manufacturing process, distribution channel, logistics, and marketing. For example, Coca-Cola is an agile company that changes the features of its products to meet different markets. Product sizes are smaller in the Asian and European markets. Also, the company has moved to produce various juice drink alternatives and teas, particularly popular in the Asian market, as opposed to colas. A good example of customized marketing is Coca-Cola's “Share a Coke” campaign, where it replaced its logo on 20-ounce bottles with 250 of the most popular American names. Consumers were encouraged to find bottles with names they connected with and give them to a friend or family member. Capitalizing on the social media craze, Coca-Cola encouraged consumers to tweet about their experiences and post photos, using the hashtag, such as #ShareaCoke. Further expanding on this, Coca-Cola's online store now even lets consumers customize the names on bottles.

The **niche strategy** is a strategy that targets only one segment of the overall market by offering precise products that specifically meet customer needs. It is the opposite of the undifferentiated strategy. This is typically a strategy exploited by small firms or new companies. For example, there are many specialty retail stores that target niche markets, such as maternity clothes, or suits for tall men, or petite women. These companies are smaller and offer products at higher prices to compensate for the greater customer focus of their offering.

The ultimate in **customer relationship management (CRM)** is to focus on each individual customer and to design a product to meet their individual

needs. This approach is called micromarketing or one-to-one marketing, and recognizes that each customer may have their unique requirements. This could be an end customer such as an individual, or an intermediary customer such as a manufacturer or retailer. For example, large suppliers to Walmart are required to develop information systems that directly match those of Walmart to provide seamless information transfer. Starbucks' Rewards Program: Starbucks' mobile app and rewards program offer personalized promotions and rewards to individual customers based on their past purchases and preferences. For example, a customer who frequently buys lattes may receive a promotion for a discounted latte. This approach encourages repeat visits and customer loyalty. Another example is Netflix content recommendations where Netflix uses micromarketing to suggest TV shows and movies to individual viewers. Their recommendation engine analyzes the customer's viewing history and preferences to create a tailored homepage with content they are likely to enjoy. This personalized experience keeps viewers engaged and helps them discover new content.

One-on-one relationships may not be feasible with every customer. Also, many customers may not care for a customized relationship and may prefer a standardized product at a lower cost. However, one-to-one relationships can significantly reduce transaction costs between supply chain intermediaries by making transactions routine and ultimately lowering costs for the end customer. One-to-one relationships with the end customer can also be a significant factor in building brand loyalty.

Today, a high degree of one-to-one customization has been made possible with the development of CRM software that focuses on the interface between the firm and its customer. These systems collect customer-specific data which allow the firm to provide customer-specific solutions. We look at these systems in more detail next.

Concept Check Questions

34. The traditional marketing approach has been to pursue a strategy of increasing the number of customer transactions to increase revenues and profits.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

35. The _____ strategy is a strategy that targets only one segment of the overall market by offering very precise products that specifically meet customer needs.

- ☐ a) customized
- ☐ b) micro-marketing
- ☐ c) niche
- ☐ d) standardized
- ☐ e) individual

Correct or Incorrect?

Clear

Check Answer

36. The _____ strategy recognizes that each individual customer may have their own unique requirements.

- ☐ a) customized
- ☐ b) micro-marketing
- ☐ c) niche
- ☐ d) standardized
- ☐ e) individual

Correct or Incorrect?

Clear

Check Answer

37. In the _____ strategy all customers are viewed in the same way.

- ☐ a) customized
- ☐ b) micro-marketing
- ☐ c) niche
- ☐ d) standardized
- ☐ e) uniform

Correct or Incorrect?

Clear

Check Answer

38. The _____ strategy is a differentiated strategy that capitalizes on information that comes from market segmentation and target markets.

- ☐ a) customized
- ☐ b) micro-marketing
- ☐ c) niche
- ☐ d) standardized
- ☐ e) segmented

Correct or Incorrect?

Clear

Check Answer

39. The micro-marketing and one-to-one marketing strategies are the same thing.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

40. With the Internet, one-on-one relationships is feasible with every customer.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Managing Customers Using CRM

CRM involves managing long-term relationships between the company and its customers to improve profitability. It is a concept that has gained great popularity over the past few years given the advances in technology and the tremendous benefits it provides to the company and the supply chain.

To keep customers coming back, firms must offer distinct capabilities that provide value to customers. We know that in general terms customers perceive value through reliable, on-time delivery of high-quality products and services at competitive pricing. The problem, however, is that today's customers demand a greater amount of customization than ever before. Companies have to work hard to identify very precise needs of each customer group.

The ability to capture detailed customer information has become a reality with today's sophisticated technology. CRM uses automated customer transactions to gather data and customize communication. This data is captured through suites of software modules that are part of larger enterprise resource planning

(ERP) systems. They collect information through automated transactions to create large databases that, in turn, can be mined to design customer-specific solutions. For example, American Airlines uses CRM applications to precisely identify their most profitable customers. This information is then used to build strong customer relationships. One example of this might be sending a personalized text message to a highly valued customer that their planned flight is going to be delayed.

Another example is Tesla, a company that also uses CRM applications to build strong relationships with its most profitable customers. For example, Tesla customer service representatives may be trained to prioritize the needs of Tesla's most profitable customers and provide them with personalized support. Tesla may also invite its most profitable customers to participate in beta-testing programs or give them feedback on new products and services. By using CRM applications to precisely identify its most profitable customers and build strong relationships with them, Tesla can increase customer loyalty and drive sales.

The advantage of CRM is that it provides information that aids market segmentation as we can better create clusters of customers based on profitability and other factors. It also helps to predict customer behavior and create customized customer communication. Therefore, CRM plays a critical role in SCM.



Concept Check Questions

41. CRM involves managing long-term relationships between the company and its suppliers to improve profitability.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

42. To keep customers coming back, firms must offer distinct capabilities that provide value to customers.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

43. CRM uses automated customer transactions to gather data and customize communication.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

44. CRM plays a critical role in SCM.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Delivering Value to Customers

Voice of the Customer (VOC)

The central focus of SCM is to create value for the customer. However, how can we create value if we do not know exactly what the customer wants? The key issue is to understand exactly what it is the customer perceives as value. This is the responsibility of marketing and is not as easy as it sounds.

Understanding what the customer wants and perceives as value is a complex process. Most customers have a difficult time defining value, but they know it when they see it. For example, although you probably have an opinion on which cell phone provider provides the highest value, it may be difficult for you to define the specific standard of value in precise terms. Also, your friends may prefer a different cell phone provider, as they have a different opinion regarding what constitutes value.

Voice of the customer (VOC) is the process of capturing customer needs and preferences. Customer needs can be broken into three levels: basic needs, performance needs, and excitement needs. Basic needs are minimum customer expectations that are understood. If these needs are not met, the customer will be extremely dissatisfied. For example, brand-new rain boots that leak in wet weather would be considered unacceptable. Performance needs differentiate one product from another relative to the prices. An example here may be finding two pairs of rain boots at a comparative price, but one has a skid-proof sole. Excitement needs are normally not known by the customer in advance, but they elicit delight over the product. An example here may be purchasing the boots and finding that there is a free 10-year replacement guarantee for any dissatisfaction. Understanding different types of needs is critical information in designing products and services and their associated supply chains.

Tesla, the electric vehicle (EV) manufacturer, also exemplifies how understanding customer excitement needs can revolutionize an industry. While many EVs aim to meet performance and environmental needs, Tesla takes it a step further by addressing the excitement needs of its customers. One step is

an innovative technology, as Tesla's vehicles boast advanced tech features, appealing to tech enthusiasts. Another is “Ludicrous Mode” as Tesla's acceleration feature caters to thrill-seekers, offering an exhilarating driving experience. Yet another is the Tesla Roadster, a vehicle that showcases supercar-level performance, targeting niche excitement-seeking customers. Lastly, is continuous innovation, where Tesla's commitment to groundbreaking products keeps customers excited and loyal. Tesla's focus on excitement needs has set it apart in the EV market, capturing the imagination of customers and establishing a unique position in the industry. Understanding these diverse customer needs is pivotal in product and supply chain design.

The definition of value depends on the point of view of the customers defining it. In the rain boots example, the definition of value would be different if the customer was a parent buying rain boots for their child vs a firefighter buying waterproof boots for work. For this reason, VOC begins by dividing customers into their market segments. As we discussed earlier, we can segment customers by their demographic features or how, where, and when they use the product. This marketing information can help focus our attention on critical customer requirements in each market segment. After market segmentation, market research is used to gather information from customers in each segment using a variety of tools, such as interviews and focus groups. This enables marketing to identify key drivers of value in each market segment. Finally, the last step in translating the VOC is to use a tool called [quality function deployment \(QFD\)](#) to translate general customer requirements into specific product characteristics. These steps are shown in [Figure 4.5](#).

QFD is a tool for translating the VOC into specific technical requirements. Customers often speak in everyday language. For example, a product can be described as “attractive,” “strong,” or “safe.” To produce a product the customers actually want, these vague expressions need to be translated into specific technical requirements. This is the role of QFD. QFD is also used to enhance communication between different functions, such as marketing, operations, and engineering.

[Figure 4.6](#) shows a simplified example of a QFD matrix for a laptop computer bag. This matrix is sometimes called the “House of Quality,” as it resembles a picture of a house. The left side of the matrix lists general customer requirements that marketing gathers from customers using tools such as interviews or focus groups. The customers may say they want the computer

bag to be inexpensive, attractive, rugged, and roomy. Along the top of the matrix is a list of specific product characteristics. The main body of the matrix shows how each product characteristic supports the specific customer requirements. For example, “rugged” is supported by material strength and grade. Finally, the “roof” of the matrix shows the relationship between some of the features. The strength of the material and grade go together, whereas more compartments may take away from the bag's protective strength. The QFD matrix moves the organization from these general customer requirements to specific product characteristics. It can also show where conflict may exist between some of the features and where tradeoffs may have to be made.

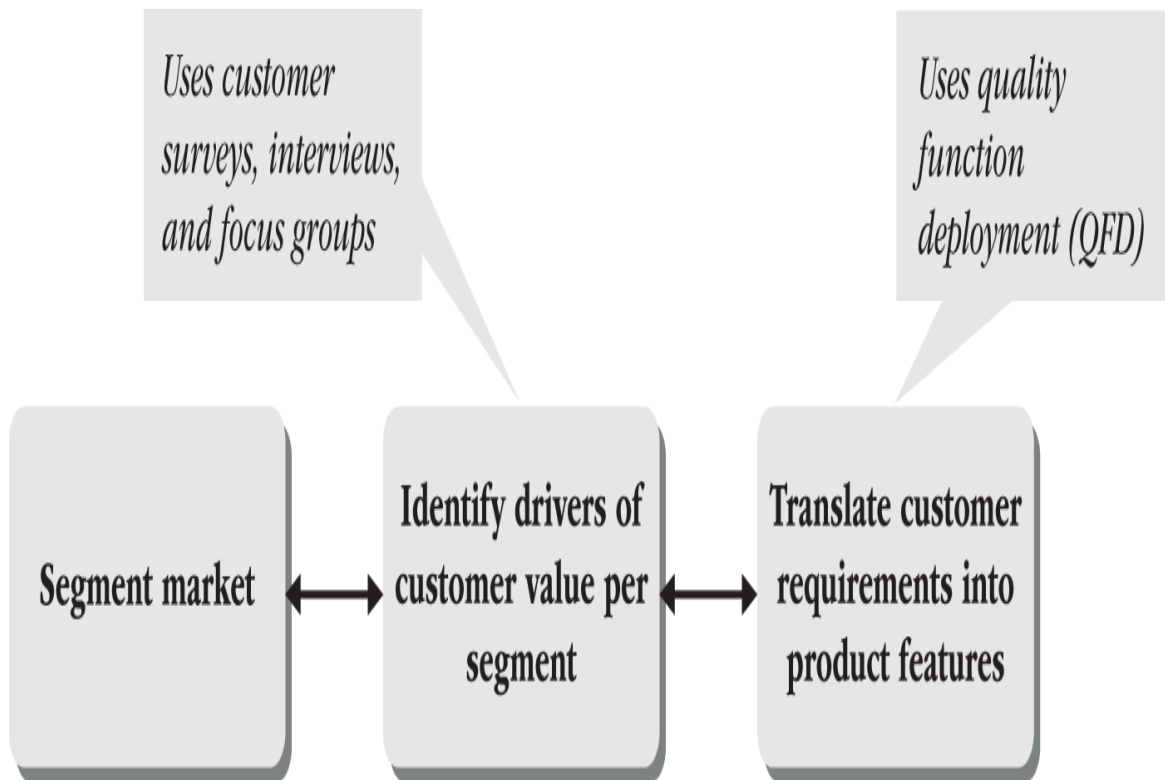


FIGURE 4.5 Translating the VOC.

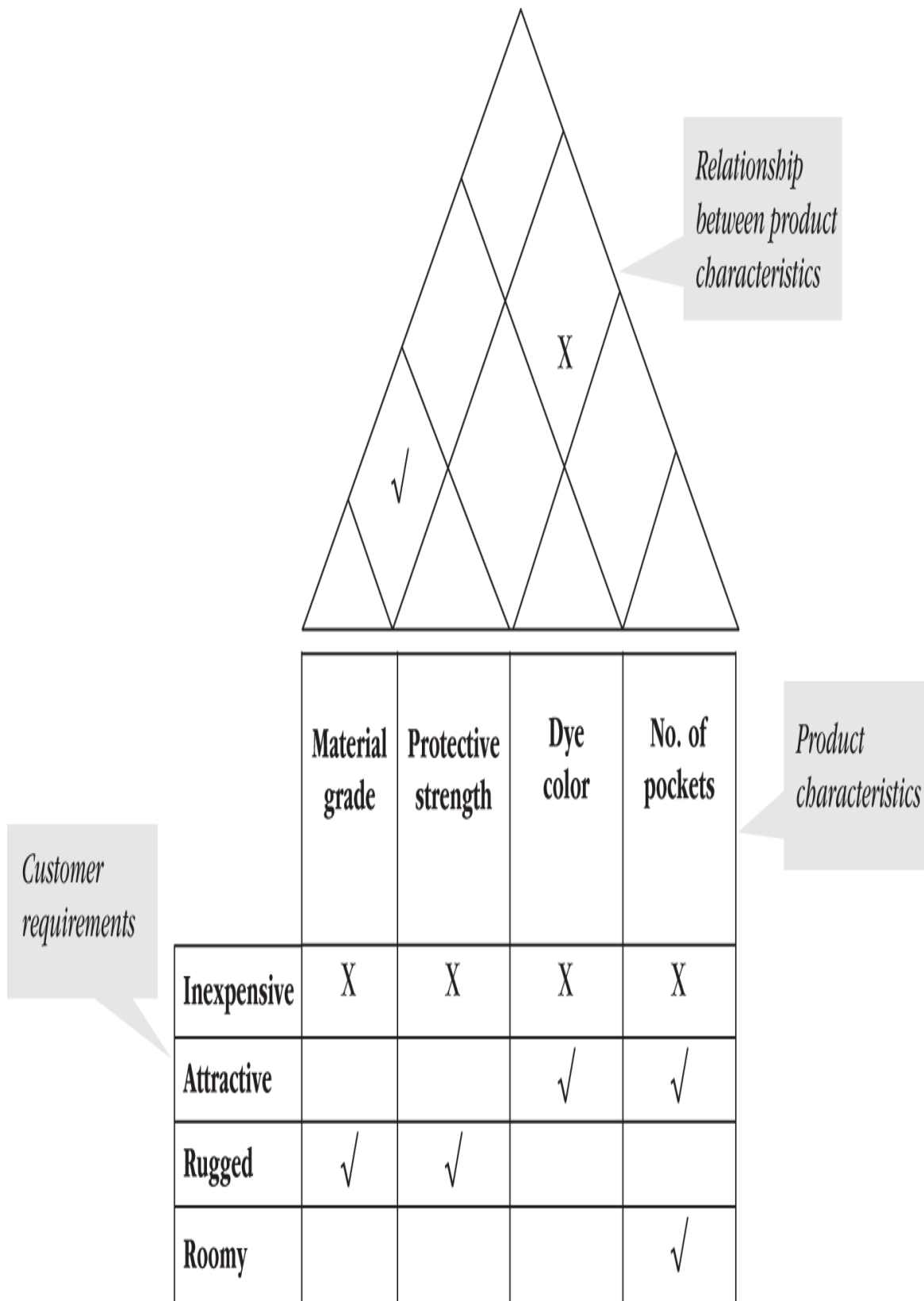


FIGURE 4.6 A simplified QFD matrix for a laptop case.

Let us look at Gap, Inc. discussed in the Supply Chain Leader's Box section of this chapter, to see how the company has utilized QFD for its segmentation. The first step would be identifying customer needs (VOC). Here, Gap, Inc. conducts market research and collects customer feedback to understand the needs and preferences of different customer segments. This involves gathering data on factors such as style, price sensitivity, age group, lifestyle, and values. Next is creating a “House of Quality” matrix where Gap creates a QFD matrix to link customer needs with specific product features and attributes. For example, in the “trendy and affordable” segment (e.g., Old Navy customers), the matrix might emphasize factors such as pricing, the latest fashion trends, and a wide range of styles for all ages. For the “working professionals” segment (e.g., Banana Republic customers), the matrix may focus on quality, professional styles, and materials suitable for office wear. For the “activewear” segment (e.g., Athleta and Hill City customers), the matrix might prioritize factors such as performance fabrics, sustainability, and functional design. Lastly, for the “parents looking for children's clothing” segment (e.g., Janie and Jack customers), the matrix could stress high-quality materials, fashionable designs, and durability.

Concept Check Questions

45. The central focus of supply chain management is to create value for the suppliers.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

46. Understanding what the customer wants and perceives as value is a fairly straightforward process.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

47. _____ is the process of capturing customer needs and preferences.

- ☐ a) CRM
- ☐ b) ERP
- ☐ c) QFD
- ☐ d) VOC

Correct or Incorrect?

Clear

Check Answer

48. the last step in translating the voice of the customer is to use a tool called _____.

- ☐ a) CRM
- ☐ b) ERP
- ☐ c) QFD
- ☐ d) VOC

Correct or Incorrect?

Clear

Check Answer

49. Customer needs can be broken into _____ levels.

- ☐ a) two
- ☐ b) three
- ☐ c) four
- ☐ d) five

Correct or Incorrect?

Clear

Check Answer

50. _____ are minimum customer expectations that are understood.

- ☐ a) Basic needs
- ☐ b) Performance needs
- ☐ c) Excitement needs
- ☐ d) Minimal needs

Correct or Incorrect?

Clear

Check Answer

51. _____ differentiate one product from another relative to the prices.

- ☐ a) Basic needs
- ☐ b) Performance needs
- ☐ c) Excitement needs
- ☐ d) Segmentation needs

Correct or Incorrect?

Clear

Check Answer

52. _____ are normally not known by the customer in advance, but they elicit delight over the product.

- ☐ a) Basic needs
- ☐ b) Performance needs
- ☐ c) Excitement needs
- ☐ d) Surprise needs
- ☐ e) Plus needs

Correct or Incorrect?

Clear

Check Answer

53. The definition of value is independent of the point of view of the customers defining it.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

54. _____ is a tool for translating the voice of the customer into specific technical requirements.

- ☐ a) CRM
- ☐ b) ERP

- ☐ c) QFD
- ☐ d) VOC

Correct or Incorrect?

Clear

Check Answer

55. The QFD matrix is sometimes called a “house of cards”.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

56. The left side of a QFD matrix lists _____.

- ☐ a) how each product characteristic supports the specific customer requirements
- ☐ b) correlations between various items
- ☐ c) general customer requirements
- ☐ d) a list of specific product characteristics
- ☐ e) the relationship between some of the features

Correct or Incorrect?

Clear

Check Answer

57. Along the top of the matrix shows _____.

- ☐ a) how each product characteristic supports the specific customer requirements
- ☐ b) correlations between various items
- ☐ c) general customer requirements
- ☐ d) a list of specific product characteristics
- ☐ e) the relationship between some of the features

Correct or Incorrect?

Clear

Check Answer

58. The “roof” of the matrix shows _____.

- ☐ a) how each product characteristic supports the specific customer requirements
- ☐ b) correlations between various items
- ☐ c) general customer requirements
- ☐ d) a list of specific product characteristics
- ☐ e) the relationship between some of the features

Correct or Incorrect?

Clear

Check Answer

59. The main body of the matrix shows _____.

- ☐ a) how each product characteristic supports the specific customer requirements
- ☐ b) correlations between various items
- ☐ c) general customer requirements
- ☐ d) a list of specific product characteristics
- ☐ e) the relationship between some of the features

Correct or Incorrect?

Clear

Check Answer

What Is Customer Service?

Today's customers are very different from those just a few years ago. They demand higher performance standards than ever before, and brand loyalty is not necessarily something that they routinely support. They expect high-quality and low-cost products delivered at their convenience. The problem is that these competitive dimensions can easily be copied by competitors. Excellence in these dimensions is expected but does not necessarily provide a competitive advantage. The one competitive dimension, however, that is difficult to copy and can provide a competitive advantage is customer service. As a result, many companies have made customer service their focal point and the driving force of their supply chains.

Customer service can be defined as a process of enhancing the level of customer satisfaction by meeting or exceeding customer expectations. It can provide a competitive advantage to the firm and the supply chain by maximizing the total value to the final customer. Within an organization customer service can be viewed in three distinct ways, each requiring progressively more commitment. They are

An Activity. This first view looks at customer service as an activity that a firm must do to satisfy customers. This includes activities such as billing and invoicing, product returns, and handling claims. Companies with this view believe they are meeting their obligations by having a customer service department responsible for handling customer problems and complaints.

A Set of Performance Measures. This second view looks at customer service in terms of specific performance measures that must be met. Examples would be the percentage of orders delivered on time or the number of orders processed within acceptable time limits. A company with this view would consider it has met its customer service requirements if the performance measures were being met.

A Philosophy. This last view looks at customer service as a firm-wide commitment to customers through superior customer service. It is a philosophy that permeates all decisions throughout the company. This view of customer service is consistent with the emphasis on today's quality management, which we discuss in [Chapter 10](#).

The first view of customer service looks at it as a mere activity and requires the least amount of involvement on the part of the company. From this perspective, customer service activities are at the transactional level. For example, accepting product returns from customers in a retail store adds no value to a product. Product returns are a cost to the company. In 2023, retail merchandise returned in the United States amounted to almost 744 billion U.S. dollars.

The activity is merely a transaction to please customers. Companies with this view of customer service have only a limited opportunity to add value to the customer.

The second view of customer service provides an objective way of measuring customer service performance and can serve as a benchmark to gauge improvement. However, it is not sufficient to create customer service excellence. Customer service needs to be an organizational philosophy to provide a competitive advantage.

Zappos, an online retailer, exemplifies the philosophy of superior customer service. They claim to “deliver happiness to soles and souls.” The company has cultivated a customer-centric culture, offering a 365-day return policy, 24/7 customer support, free shipping both ways and a commitment to employee engagement. Zappos views customer service as a firm-wide philosophy, permeating all aspects of its business. This dedication to delivering happiness through exceptional customer service sets them apart in the e-commerce industry and has become a hallmark of their brand. Amazon has become the parent company of Zappos but the tradition of customer service has continued.

Concept Check Questions

60. Today's customers are the same as those just a few years ago.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

61. Customer service can be defined as a process of enhancing the level of customer satisfaction by meeting or exceeding customer expectations.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

62. It is hard to get a competitive advantage from customer service.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

63. Within an organization customer service can be viewed in three distinct ways. The following describes which way? The view looks at customer service as an activity that a firm must do to satisfy customers.

- ☐ a) A philosophy
- ☐ b) A set of performance measures
- ☐ c) An activity
- ☐ d) A requirement

Correct or Incorrect?

Clear

Check Answer

64. Within an organization customer service can be viewed in three distinct ways. The following describes which way? This view looks at customer service as a firm-wide commitment to customers through superior customer service.

- ☐ a) A philosophy
- ☐ b) A set of performance measures
- ☐ c) An activity
- ☐ d) A total approach

Correct or Incorrect?

Clear

Check Answer

65. Within an organization customer service can be viewed in three distinct ways. The following describes which way? This view looks at customer service in terms of specific performance measures that must be met.

- ☐ a) A philosophy
- ☐ b) A set of performance measures
- ☐ c) An activity
- ☐ d) A metric

Correct or Incorrect?

Clear

Check Answer

66. The activity is merely a transaction to please customers.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

67. The second view of customer service provides an objective way of measuring customer service performance and can serve as a benchmark to gauge improvement. It is more than sufficient to create customer service excellence.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Impact on the Supply Chain

Customer service excellence can provide a competitive advantage. However, it requires a commitment to the entire supply chain and can be costly to implement. Supply chain managers have to balance the benefits attained from

increased customer service levels against the cost of providing that service. Consider, for example, a retail customer who can lower their inventories if their supplier uses air rather than truck transport. The customer can lower inventory costs as a result of shorter transit time. However, higher transportation costs are going to be incurred, as air transport is costlier than transport via truck. Supply chain managers have to find the optimum balance of these costs.

Apple exemplifies the delicate balance between transportation costs and inventory management across their supply chain. While utilizing air transport for speed and efficiency, the company incurs higher transportation costs. However, this approach allows Apple to maintain lower inventory levels, reducing warehousing expenses and enhancing its ability to respond swiftly to changing market demands. The supply chain team continually optimizes this balance based on factors such as product value and demand patterns to ensure cost-effectiveness and operational efficiency.

Customer service impacts the supply chain on four dimensions: time, dependability, communications, and convenience. Let us look at these in a little more detail.

Time. Time is concerned with the speed at which the company responds to its customers. From a supply chain perspective this refers to the time to complete an order and deliver it to the customer, called the order cycle time.

Competition based on time has been primarily enabled by the function of logistics, which today can guarantee a given level of order cycle time. Successful logistics operations have a high degree of time control over the elements of moving goods through the chain, such as order processing, order preparation, and order shipment. By effectively managing these activities, companies have ensured that order cycles will be responsive and of short duration.

Dependability. Dependability refers to consistently meeting promises made to customers, including order cycle time and level of quality. In fact, for some customers dependability can be more important than delivery time or other dimensions. For example, some customers might prefer a longer lead time, knowing with certainty the exact time of delivery. This allows customer firms to minimize their inventory levels if lead time is consistent. A company that knows with certainty that the lead time is 10 days can make better plans than being promised a shorter lead time with the possibility of fluctuation. This

level of dependability translates into carrying less inventory as safety stock and results in lower costs.

Communication. Communication is an aspect of customer service that involves providing real-time order status to all supply chain customers. Communication with customers is vital to monitoring customer service levels relating to dependability. It involves integrated information technology (IT) across the supply chain that tracks the order-filling process and is enabled by communication tools such as electronic data interchange (EDI) or the Internet. In addition to providing status updates, these communication tools can reduce errors in transferring order information as the order moves through the chain. The simplification of product ID is one strategy companies use to make this process more efficient. One example of this is using product codes to reduce order picker errors.

Convenience. Companies are offering more customer convenience as they move toward providing a greater amount of customization to their customers. In turn, this requires that the supply chain be more flexible to accommodate a range of requirements. The simplest option is to have one or a few standard service levels that apply to all customers. However, this is only possible when the requirements are the same for all customers. For example, one customer may require the supplier to place all products on pallets and ship everything by rail. Another customer may require truck delivery only, using no pallets. Some customers may require special delivery times that must be met. These place large demands on the supply chain, especially the logistics function. It also impacts decisions regarding packaging, mode of transportation, and routing.

One strategy to deal with this problem is to group customer requirements by factors such as customer size, market area, and the product line the customer is purchasing. This grouping, or market segmentation, makes it easier to meet customer expectations economically.

Coca-Cola, one of the world's largest beverage companies, provides a real-life example of market segmentation to meet customer requirements efficiently. The first is Product Line Segmentation, where Coca-Cola offers a range of products, from classic soda to diet options, tailored to different tastes and preferences. Another is Regional Market Segmentation where the company adapts its offerings to regional preferences, providing unique flavors and packaging in different markets.

Then there is Customer Size Segmentation where Coca-Cola serves individual consumers and large retailers, adjusting distribution and pricing strategies accordingly. Lastly, there is Promotional Segmentation where targeted marketing campaigns cater to specific customer segments, such as health-conscious consumers for diet soda products. In summary, market segmentation allows Coca-Cola to efficiently meet the diverse needs and preferences of its customers across demographics, regions, and product lines.

Concept Check Questions

68. Customer service excellence cannot provide a competitive advantage by itself.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

69. Customer service impacts the supply chain on four dimensions. The following describes which one? This is concerned with the speed at which the company responds to its customers.

- ☐ a) Communication
- ☐ b) Convenience
- ☐ c) Dependability
- ☐ d) Time
- ☐ e) Speed

Correct or Incorrect?

Clear

Check Answer

70. Customer service impacts the supply chain on four dimensions. The following describes which one? This to consistently meeting promises made to customers, including order cycle time and level of quality.

- ☐ a) Communication
- ☐ b) Convenience
- ☐ c) Dependability
- ☐ d) Time
- ☐ e) Consistency

Correct or Incorrect?

Clear

Check Answer

71. Customer service impacts the supply chain on four dimensions. The following describes which one? This is an aspect of customer service that involves providing real-time order status to all supply chain customers.

- ☐ a) Communication
- ☐ b) Convenience
- ☐ c) Dependability
- ☐ d) Time
- ☐ e) Updates

Correct or Incorrect?

Clear

Check Answer

72. Customer service impacts the supply chain on four dimensions. The following describes which one? This involves providing a greater amount of

customization to their customers.

- ☐ a) Communication
- ☐ b) Convenience
- ☐ c) Dependability
- ☐ d) Time
- ☐ e) Updates

Correct or Incorrect?

Clear

Check Answer

73. Coca-Cola provides a real-life example of market segmentation to meet customer requirements efficiently. The following describes which segmentation approach? This is where Coca-Cola offers a range of products, from classic soda to diet options, tailored to different tastes and preferences.

- ☐ a) Customer size segmentation
- ☐ b) Product line segmentation
- ☐ c) Promotional segmentation
- ☐ d) Regional market segmentation
- ☐ e) Flavor segmentation

Correct or Incorrect?

Clear

Check Answer

74. Coca-Cola provides a real-life example of market segmentation to meet customer requirements efficiently. The following describes which segmentation approach? This is where the company adapts their offerings to regional preferences, providing unique flavors and packaging in different markets.

- ☐ a) Customer size segmentation
- ☐ b) Product line segmentation
- ☐ c) Promotional segmentation
- ☐ d) Regional market segmentation
- ☐ e) National market segmentation

Correct or Incorrect?

Clear

Check Answer

75. Coca-Cola provides a real-life example of market segmentation to meet customer requirements efficiently. The following describes which segmentation approach? This is where targeted marketing campaigns cater to specific customer segments, such as health-conscious consumers for diet soda products.

- ☐ a) Customer size segmentation
- ☐ b) Product line segmentation
- ☐ c) Promotional segmentation
- ☐ d) Regional market segmentation
- ☐ e) Health segmentation

Correct or Incorrect?

Clear

Check Answer

76. Coca-Cola provides a real-life example of market segmentation to meet customer requirements efficiently. The following describes which segmentation approach? This is where Coca-Cola serves individual consumers and large retailers, adjusting distribution and pricing strategies accordingly.

- ☐ a) Customer size segmentation
- ☐ b) Product line segmentation
- ☐ c) Promotional segmentation
- ☐ d) Regional market segmentation
- ☐ e) Market segmentation

Correct or Incorrect?

Clear

Check Answer

Measuring Customer Service

Developing and measuring standards of customer service performance is essential, as it allows a company to monitor how it is doing in meeting set objectives. The company can also benchmark its performance against others in its industry.

Historically, companies used measures that viewed performance from the perspective of the supplier, solely focusing on customer service dimensions prior to shipping. This did not permit the supplier to know whether the customer was satisfied and if there were any problems with the delivery. Also, these measures did not enable the seller to identify whether there were any problems and whether its improvement efforts were successful.

Effective performance measures focus on customer service from the viewpoint of the customer rather than the supplier, as shown in [Figure 4.7](#). These measures provide the data to evaluate how successful the product delivery system is. They can also serve as an early warning system of potential problems as they develop. For example, monitoring customer service delivery may show that on-time delivery has slipped from 99 to 95%, triggering the company to evaluate the system for potential problems. The on-time delivery measure is particularly important in SCM, as it has become common practice for buying companies to give specific delivery appointment times for deliveries. The move to lean supply chain systems, which we discuss in [Chapter 10](#), requires a very narrow delivery time “window” for suppliers and has made achieving on-time deliveries much more difficult than in the past.

Supplier-Oriented Standards	Customer-Oriented Standards
Order shipped on time	Orders received on time
Orders shipped complete	Orders received complete
Orders shipped damage free	Orders received damage free
Order preparation time	Orders filled accurately

FIGURE 4.7 Supplier-oriented vs customer-oriented standards.

Most companies, however, do not rely on one, but multiple measures of customer service performance. Using multiple measures enables a company to address potential problems on many customer service dimensions. Having multiple performance measures, however, can make it even more difficult to achieve high levels of customer service.

Supply Chain Leader's Box

■ AMAZON

Amazon is a good example of a company that prioritizes on-time delivery as a customer-centric performance measure and measures its performance. The company monitors the percentage of orders delivered within promised timeframes, provides real-time tracking, and offers guaranteed delivery for Prime Members. Amazon's proactive approach to resolving delivery issues and continuous supply chain optimization ensures reliable and efficient delivery services, aligning with the importance of meeting customer expectations within narrow delivery windows in modern SCM. Here are some examples of metrics Amazon uses:

1. **Percentage of Orders Delivered on Time:** Amazon **consistently** delivers a high percentage of orders on time, with one report estimating that over 97% of Prime orders are delivered within two days.
 2. **Customer Satisfaction:** Amazon's commitment to on-time delivery has contributed to high levels of customer satisfaction. According to the American Customer Satisfaction Index, Amazon consistently ranks as one of the top retailers for customer satisfaction.
 3. **Prime Membership Growth:** Amazon Prime, which offers guaranteed two-day delivery among other benefits, has seen significant growth. As of 2023, there were over 200 million Amazon Prime members worldwide, indicating the appeal of Amazon's delivery services.
 4. **Supply Chain Efficiency:** Amazon's supply chain efficiency is reflected in its financial performance. The company's revenue has continued to grow, reaching \$386 billion in 2020, up from \$233 billion in 2018.
 5. **Market Dominance:** Amazon's focus on on-time delivery has helped it maintain its position as a market leader in e-commerce. The company's market share in the U.S. e-commerce market is estimated to be around 40%, far ahead of its closest competitors.
-

Concept Check Questions

77. Developing and measuring standards of customer service performance is essential.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

78. Effective performance measures focus on customer service from the viewpoint of the supplier rather than the customer.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

79. Which of the following is not a supplier-oriented customer service standard?

- ☐ a) Orders shipped damage free
- ☐ b) Orders filled accurately
- ☐ c) Orders shipped complete
- ☐ d) Order shipped on time
- ☐ e) Order preparation time

Correct or Incorrect?

Clear

Check Answer

80. Which of the following is not a customer-oriented customer service standard?

- ☐ a) Orders received damage free
- ☐ b) Orders received on time
- ☐ c) Orders filled accurately
- ☐ d) Orders received complete
- ☐ e) Orders shipped damage free

Correct or Incorrect?

Clear

Check Answer

81. Most companies rely on one measures of customer service performance.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Global Customer Service Issues

Companies that take a global view of customer service find that it adds even more complexities. Rather than dividing world markets into separate entities

with very different product needs, as might be expected, a better approach is searching for common market demands worldwide. Different parts of the world have different service needs that are related to issues such as information availability, order completeness, and expected lead times. Other factors that contribute to differences in customer service are the availability of a supporting infrastructure, such as roads, power, communication network, local congestion, and time differences. These factors may make it impossible to achieve the same levels of customer service globally.

Global customer service levels should be designed to match local customer needs and expectations to the greatest degree possible. A strong argument can be made for the implementation of a centrally coordinated global supply chain strategy. However, the one activity that should be conducted locally is setting the customer service standard.



Concept Check Questions

82. Companies that take a global view of customer service find that it adds even more complexities.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

83. Global customer service levels should be designed to meet the highest possible standards.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

84. It is always a good idea to offshore customer service.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Global Insights Box—Global Customer Service

■ COCA-COLA JAPAN

Most global companies typically provide different levels of customer service based on location. An example is Coca-Cola, which provides very different types of service in Japan than in the United States or Europe. For example, in Japan, the company provides a much higher level of service to its retail customers and merchants, but it meets local standards. The drivers of Coca-Cola delivery trucks are responsible for providing merchandising in supermarkets, helping in processing bills in small mom-and-pop operations, and responding to signals from communication systems in vending machines so that time is not wasted delivering to full machines. The Coca-Cola vending machines are equipped with efficient electronic money sensors and are stocked with product choices that include a variety of Japanese tea brands catering to local taste and focusing on healthy options. Developing the service to match the needs of the country creates the most efficient and effective customer service policy, rather than simply implementing the same strategy worldwide.

Global Insights Box—Global Adaptation

■ MCDONALD'S

McDonald's is another example of a company that exemplifies a global approach to customer service by customizing menus and service to cater to diverse regional preferences. The company adapt their offerings to align with local demands, respecting cultural norms and dietary restrictions. McDonald's also focuses on service speed, ensuring efficient drive-thru experiences where needed. Additionally, they prioritize local ingredient sourcing to maintain freshness and support local agriculture. This approach allows McDonald's to address variations in customer service expectations across different regions, meeting the diverse needs of their global customer base. Here are some examples of the global adaptation McDonald's uses:

1. **Menu Customization:** McDonald's customizes its menus to cater to regional preferences and dietary restrictions. For example, in India, McDonald's offers a range of vegetarian options, while in Japan, you can find items such as the Teriyaki Burger.
2. **Efficient Service:** McDonald's places a strong emphasis on speed and efficiency, particularly in drive-thru services. This focus on quick service ensures that customers receive their orders promptly, enhancing their overall experience.
3. **Local Sourcing:** McDonald's prioritizes local sourcing of ingredients, supporting local agriculture and ensuring the freshness of its products. This commitment to local sourcing also helps McDonald's adapt its menu to seasonal and regional availability.
4. **Cultural Sensitivity:** McDonald's respects cultural norms and traditions in its marketing and service approach. This includes offering limited-time items to celebrate local festivals and events, showing an understanding of and respect for local customs.
5. **Global Brand Consistency:** Despite these regional adaptations, McDonald's maintains a consistent global brand image. Customers can

expect a familiar experience and quality standards, regardless of the location.

6. Customer Satisfaction: McDonald's customer satisfaction scores reflect the success of its global approach. The company consistently ranks high in customer satisfaction surveys, demonstrating the effectiveness of its customer service strategies.
-

Channels of Distribution

What Are Channels of Distribution?

A [channel of distribution](#) is the way products and services are passed from the manufacturer to the final consumer. It is made up of the entities involved in getting products and services to final customers and can involve a variety of intermediary firms, including wholesalers, distributors, or retailers. Decisions regarding the distribution channel are critical to a company's success, as they are directly related to the ability of the organization to access the final customer.

Channels of distribution can be classified as either [direct](#) or [indirect](#). A direct channel structure is one where the transaction is directly from the producer to end user or final consumer. An example might be a farmer that sells directly to the final consumer, as at a farmers market. Another example is the sale of jet aircraft that are custom-designed and sold directly to the airline. This channel usually gives the company the greatest control on how the product is being designed for the final customer. However, distribution costs incurred by the manufacturer are higher, making it necessary for the firm to have substantial sales volume, market concentration, or higher product cost.

Tesla's direct-to-consumer sales model stands out in the automotive industry. The company sells EVs directly to customers through showrooms and an online platform, maintaining maximum control over the customer experience and branding. This approach also allows Tesla to educate customers about EVs. While it involves higher distribution costs, it aligns with their mission to drive EV adoption and has been a significant factor in their success.

Indirect channels are those that use intermediaries, such as wholesalers and retailers, to sell to final consumers. In this case, the external institutions or

agencies (e.g., carriers, warehouses, wholesalers, and retailers) assume much of the cost, burden, and risk. The manufacturer receives less revenue per unit than with the direct channel, but it also carries lower risk.

There is no “best” distribution structure. Rather the best distribution channel structure varies by the nature of the product and the market. The structure design depends on numerous factors, such as the buying patterns of end customers, competitors, and market saturation. Characteristics of the product itself are another important factor. Complex products, for example, may require a demonstration, which implies that they may need to be sold directly to the consumer. An example is the Kirby vacuum cleaner, which is sold by distributors directly to consumers with in-home demonstrations. Difficult-to-move products may be sold through an intermediary, such as automobiles that are shipped directly to dealers. Many products are shipped through wholesalers who may be better equipped to efficiently combine products from many different suppliers. Sometimes agents may be involved that negotiating between manufacturers, distributors, and retailers.

Most companies want to identify a “best” channel structure, but there is no “best” channel structure for all firms producing similar products. Management must determine the channel structure that is appropriate given the firm's corporate and marketing objectives. For example, if the firm has targeted multiple market segments, then management may have to develop multiple channels to service these markets efficiently. The distribution channel selected has important policy implications for the organization. Consider that direct-to-customer strategy is the model historically used by Dell. However, recently Michael Dell announced that Dell Computer Corporation would be changing its distribution channel to sell through retailers such as Best Buy. This change in Dell's distribution strategy is in response to changing markets and shows the importance of changing distribution channels based on the business environment.

Concept Check Questions

85. A/n _____ is the way products and services are passed from the manufacturer to the final consumer.

- ☐ a) supply chain
- ☐ b) channel of distribution
- ☐ c) logistics channel
- ☐ d) distribution network

Correct or Incorrect?

Clear

Check Answer

86. A _____ channel structure is one where the transaction is directly from the producer to end user or final consumer.

- ☐ a) handoff
- ☐ b) indirect
- ☐ c) custom
- ☐ d) direct
- ☐ e) hybrid

Correct or Incorrect?

Clear

Check Answer

87. _____ channels are those that use intermediaries, such as wholesalers and retailers, to sell to final consumers.

- ☐ a) Handoff
- ☐ b) Indirect
- ☐ c) Custom
- ☐ d) Direct
- ☐ e) Hybrid

Correct or Incorrect?

Clear

Check Answer

88. There is no “best” distribution structure.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Designing a Distribution Channel

The theory of channel structure was first developed by Louis P. Bucklin, who explained that the purpose of the distribution channel is to provide consumers with the desired products and services at minimal cost. The best channel structure forms when no other channel generates more profits or provides greater consumer satisfaction per dollar of product cost. According to Bucklin, to achieve the optimal channel structure, functions over time shift from one channel member to another to improve delivery and cost. As a result, channel structure is not static but is constantly changing to meet customer demands. Given a desired product and service combination by the consumer, channel members arrange their functional tasks in a way that minimizes total channel costs. As specific functions shift along the channel, there may be addition or deletion of channel members. Although organizations design channel structures taking into account many factors, it is consumers who ultimately determine the channel structure through their purchasing patterns.

Walmart's channel structure illustrates adaptability in response to consumer preferences. Beginning as a brick-and-mortar retailer, Walmart expanded into e-commerce to meet online shopping demand. Their channel structure caters to diverse product characteristics and offers flexibility with in-store shopping, pickup, and home delivery. They continuously evolve through acquisitions,

partnerships, and technology investments, reflecting a commitment to enhancing the customer experience. Walmart's ability to adjust their channel structure showcases the importance of staying attuned to consumer needs and trends, ensuring they can effectively serve a broad customer base across various shopping channels.

Three factors influence the structure of the distribution channel. These are market coverage objectives, product characteristics, and customer service objectives. The first of these, market coverage objectives, involves decisions regarding the size of specific market areas and the intensity of coverage of specific geographic regions. For example, this could be measured by the number of retail outlets in a particular region relative to the concentration of customers.

Three basic market coverage alternatives exist. The first alternative is [intensive distribution](#). This involves the placement of a product in as many outlets or locations as possible. An example of this would be a product, such as Tide laundry detergent, that is available at almost all supermarket locations. The second market alternative is [selective distribution](#). This involves the placement of a product or brand in a more limited number of outlets within a specific geographic area. Last is [exclusive distribution](#), which involves the placement of a brand in only one outlet in each geographic area. Exclusive distribution is an alternative that should be related to the types of customers the company wants to serve.

Product characteristics are another significant factor in the design of the distribution channel. For example, one important characteristic is the value of the product. High-value products typically require a shorter supply chain to minimize cost, whereas low-value products should have intensive distribution to maximize sales. Highly technical products usually require product demonstration and are better suited for a direct channel. Highly perishable products need to be delivered to markets faster due to their short life cycle.

Customer service objectives are another consideration in designing a channel structure. Customer service is used to differentiate the product or influence the market price, provided that customers are willing to pay more for better service. In addition, the supply chain structure determines the costs of providing a specified level of customer service. This means that customer service levels and the design of the appropriate distribution channel should carefully balance customer needs and costs.

Mars, Inc.'s distribution channel designed for highly perishable chocolate products emphasizes swift delivery and product freshness. They collaborate with distribution partners equipped for proper storage and transport to ensure customers receive fresh products. Mars, Inc. carefully balances the need for timely delivery with supply chain efficiency to manage costs effectively, recognizing the critical role of maintaining product quality in a highly perishable category like chocolate.

Concept Check Questions

89. The purpose of the _____ channel is to provide consumers with the desired products and services at minimal cost.

- ☐ a) handoff
- ☐ b) indirect
- ☐ c) custom
- ☐ d) distribution
- ☐ e) hybrid

Correct or Incorrect?

Clear

Check Answer

90. Channel structure is not static but is constantly changing to meet customer demands.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

91. Three factors influence the structure of the distribution channel. Which of the following is not one of these?

- ☐ a) Product characteristics
- ☐ b) Customer service objectives
- ☐ c) Product cost
- ☐ d) Market coverage objectives

Correct or Incorrect?

Clear

Check Answer

92. Three basic market coverage alternatives exist. This one involves the placement of a product in as many outlets or locations as possible.

- ☐ a) Exclusive distribution
- ☐ b) Intensive distribution
- ☐ c) Selective distribution
- ☐ d) Hybrid distribution
- ☐ e) Mass distribution

Correct or Incorrect?

Clear

Check Answer

93. Three basic market coverage alternatives exist. This one involves the placement of a product or brand in a more limited number of outlets within a specific geographic area.

- ☐ a) Exclusive distribution
- ☐ b) Intensive distribution
- ☐ c) Selective distribution
- ☐ d) Hybrid distribution
- ☐ e) Geographic distribution

Correct or Incorrect?

Clear

Check Answer

94. Three basic market coverage alternatives exist. This one involves placement of a brand in only one outlet in each geographic area.

- ☐ a) Exclusive distribution
- ☐ b) Intensive distribution
- ☐ c) Selective distribution
- ☐ d) Hybrid distribution
- ☐ e) Limited distribution

Correct or Incorrect?

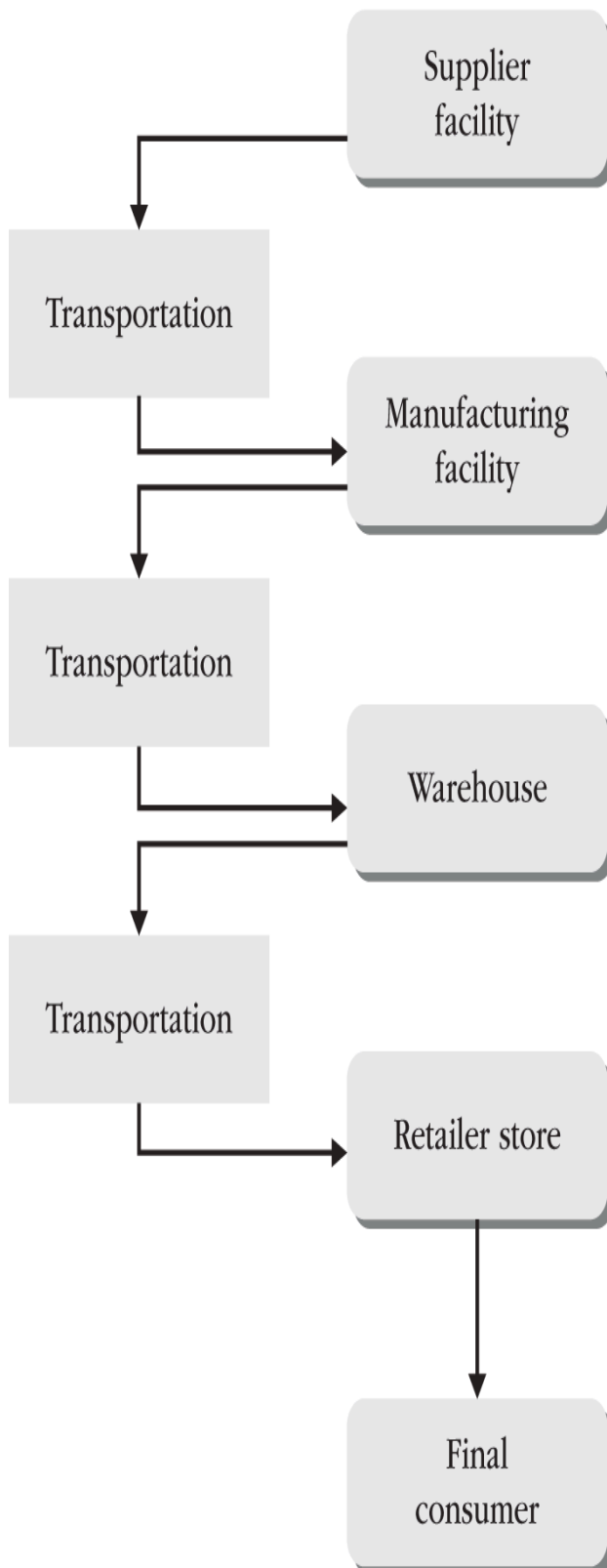
Clear

Check Answer

Distribution vs Logistics Channel

The distribution channel is different from the logistics channel. However, the logistics channel and the distribution channel are interrelated and are both part of the supply chain. These channels are illustrated and compared in [Figure 4.8](#).

Logistics Channel



Distribution Channel

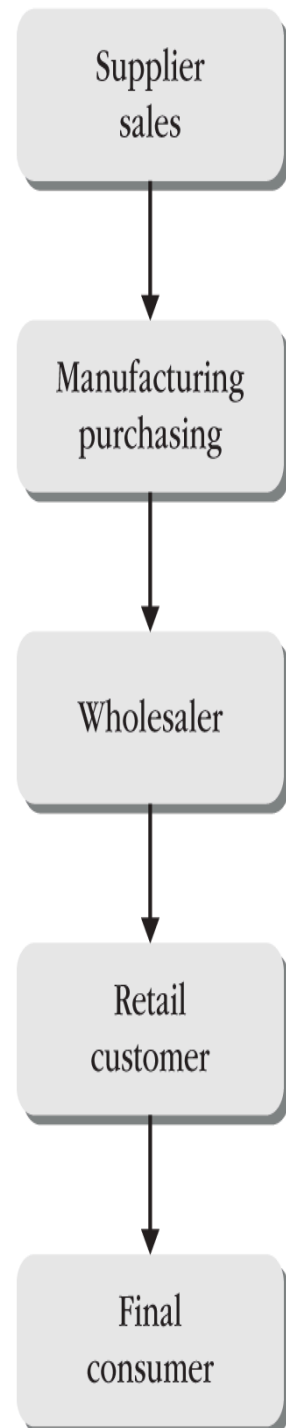


FIGURE 4.8 Logistics vs marketing distribution channel.

The logistics channel refers to the physical movement of products from where they are available to where they are needed. The distribution channel, on the contrary, refers to the transactional entities involved, such as dealers, distributors, and wholesalers. Consider that a “warehouse” is part of the logistics channel, whereas a “wholesaler” is part of the distribution channel. The wholesaler may not even hold the actual product in the warehouse but may simply serve as an agent between the manufacturer and retailer. Successful SCM requires proper management and integration of both types of channels.

Concept Check Questions

95. The distribution channel is the same as the logistics channel.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

96. The logistics channel refers to the physical movement of products from where they are available to where they are needed.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

97. The logistics channel refers to the transactional entities involved, such as dealers, distributors, and wholesalers.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

The Impact of e-Commerce

The Internet has provided unprecedented ability for companies to access massive numbers of customers across the globe. However, this broad reach must be coupled with a suitable distribution network to fulfill orders that are placed over the Internet. e-Commerce can provide success to a firm only if the firm can integrate the Internet with existing channels of distribution in a way that uses the strengths of each appropriately. There are numerous examples of companies that have created an online presence but subsequently failed due to the inability to integrate it with the physical channels. One example was Kozmo.com, a web-based home delivery company founded in 1997. Kozmo's mission was to deliver products to customers—everything from the latest video to ice cream—in less than an hour. Kozmo was technology enabled and rapidly became a huge success. However, the initial success gave rise to overly fast expansion. The company found it difficult to coordinate the physical distribution channel with the promises made on its website. The consequences were too much inventory, poor deliveries, and losses in profits, and they had to close their doors in April 2001.

Managerial Insights Box—Changing the Distribution Channel

■ STEINWAY PIANOS

When Bruce Stevens joined Steinway & Sons as CEO in 1985, the maker of legendary hand-crafted pianos found itself in the middle a slowdown crisis. Sales had slowed dramatically, and excess inventory was clogging the sales channel. The company had over four months' worth of finished goods inventory—over 900 unsold pianos—just sitting in inventory. Its 150 authorized dealers were complaining about low-profit margins and the costs associated with supplying concert pianos for Steinway Artist performers. The company was clearly in trouble.

The dealers were critical to Steinway & Sons's success. They were the ones who represented the company through trained salespeople, beautiful showrooms, and good displays. To understand their concerns, Stevens spent six months visiting the discontented dealers across the country and listening to their concerns. Based on what he heard, Stevens developed a relationship plan with dealers called the “Steinway Working Partnership.” At the core of this program was an offer to provide expanded and exclusive territories to dealers, as well as profit opportunities in exchange for their stepped-up commitment to display and promote Steinway products. Many dealers were reluctant to make the required investment. It required upgrading showrooms, increasing inventory, and adding salespeople, while sales were running at 20% below average.

The dealer network was slowly trimmed. The dealers that remained saw Steinway making good on its promises of expanding territories, and they signed on to the program. By 2009, only 63 dealers remained in Steinway's U.S. dealer network, less than half of the mid-1980s level. However, those remaining dealers were far more profitable. It took the company almost six years to gain the trust needed to fully implement the program, but it was a big success for Steinway and the dealers that remained. As a result, sales rebounded, and more dealers were selectively added on.

For Steinway, downsizing the distribution channel was the best way to increase dealer profitability and sales for the company. Rather than waiting and reactively managing its distribution channel, Steinway proactively pruned the channel to make it stronger. In 1985, Steinway & Sons had \$60 million in revenue and earned \$8 million. Between 2016 and 2022, Steinway piano sales increased from \$245 million to \$407 million. In 2023, Steinway & Sons had \$576 million in revenue. This all happened only after the company came out of the crisis.

The coupling of the virtual network with the physical network has been referred to as “clicks and mortar.” The success of an e-business is closely linked to the distribution capabilities of the existing supply chain. Separating them typically adds to inefficiencies.

A company needs to find ways to use its physical assets to satisfy both online orders and customers who want to shop through traditional routes for the most effective way to integrate e-business within its supply chain network.

e-Commerce has created other challenges for companies. For example, shipping small bundles of products to many different customers is very different than shipping in bulk to one location, such as a retail warehouse. Often companies underestimate and do not adequately calculate shipping costs. For example, it is not a good option for companies to charge standard shipping fees without consideration of size, weight, and destination. Otherwise, they will incur losses. Many e-businesses have incurred financial losses due to incomplete consideration of shipping costs. Companies must have an accurate assessment of the costs incurred to fulfill an order and reflect this cost in the prices they charge.

Etsy, the online marketplace, empowers sellers by offering tools for accurate shipping cost estimation and customization to accommodate diverse product needs. Sellers can create shipping profiles, set specific methods and rates, and even offer free shipping, simplifying the shopping experience for customers. Etsy also provides integrated shipping label printing and tracking, streamlining the shipping process while ensuring transparency and flexibility for sellers. This approach enhances the overall e-commerce experience and encourages seller success on the platform.

The e-commerce distribution system should also be modified to accommodate the shipping of small bundles. e-Business has required a change in distribution

from shipping large quantities to retail locations to shipping small packages to individual customers. For example, “brick-and-mortar” bookstores, such as Barnes & Noble, send all their merchandise in large quantities to replenish their stores. In contrast, online booksellers must send small packages to individual customers that may contain only one or two books. This can prove to be very expensive from a distribution point of view. Therefore, it becomes critical for companies to exploit every possible opportunity to consolidate shipments to lower costs. This may involve partnering with other firms to consolidate shipments. To increase consolidation and reduce transportation costs, e-businesses must try to bundle an entire customer order into a single package.

Recall that handling returns is a critical part of the supply chain. As a result, the distribution channel should be designed to efficiently handle returns. Customers purchasing products online are likely to have a higher rate of return than customers purchasing from a physical store due to their inability to physically handle the product beforehand. Regardless of how good a website is, it cannot match the customer experience of touching and seeing the product at a retail store, and the product purchased online is often different from the customer's expectation. Handling returns is a big challenge for e-businesses and can have a strong impact on customer satisfaction. Customers are more likely to shop from e-businesses that make returns easy.

A strategy that has worked well for successful e-businesses is to have the retail locations handle the returns by allowing customers to return unwanted merchandise at a store. Pure e-businesses that do not have a “brick-and-mortar” location, however, have no other choice but to allow customers to mail back unwanted merchandise. The easier the return process for customers, such as providing preprinted return labels, the higher the supply chain cost to the company. On the contrary, the more difficult the process, the less satisfied the customer will be and the more reluctant to purchase online in the future.

Amazon also demonstrates a successful approach to handling returns in the online retail landscape. With a vast online sales volume and the inherent challenge of customers unable to physically inspect products before purchase, Amazon prioritizes customer satisfaction.

The company implements a customer-centric returns policy, allowing hassle-free returns for dissatisfied customers or products that do not meet expectations. Amazon offers multiple return options, allowing customers to return items through the mail or at designated physical locations, catering to

diverse preferences. To simplify the process, Amazon provides preprinted return labels, enhancing convenience for customers. While prioritizing customer satisfaction, they carefully balance the cost of such convenience, recognizing that efficient returns handling contributes to future online purchases and maintains their prominence in e-commerce.

Concept Check Questions

98. E-commerce can provide success to a firm only if the firm can integrate the Internet with existing channels of distribution in a way that uses the strengths of each appropriately.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

99. Kozmo.com is an example of a company with a very successful distribution channel.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

100. The coupling of the virtual network with the physical network has been referred to as “clicks and mortar.”

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

101. It is a good option for companies to charge standard shipping fees without consideration of size, weight, and destination.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

102. Handling returns is a critical part of the supply chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

103. A strategy that has worked well for successful e-businesses is to have the retail locations handle the returns by allowing customers to return unwanted merchandise at a store.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

The Omnichannel

The [omnichannel](#) is an approach to sales that seeks to provide the customer with a seamless shopping experience across multiple channels. This is regardless of whether the customer is shopping online from a desktop or mobile device, by telephone, or in a brick-and-mortar store. It is essentially a seamless experience in real time across channels.

With a traditional multichannel the customer can use alternative shopping channels, such as a physical shopping environment or an online one. However, as technological capability evolves it has become more integrated in the lives of consumers. This means that the lines between what customers purchase online and in real life are blurred. Customers no longer think of a “desktop experience” separated from a “brick-and-mortar experience,” which is separated from a “mobile experience.” Rather, they want a shopping experience that is holistic and integrated. That is the omnichannel.

In an omnichannel, the customer experiences true integration between the different channels on the “back end.” All the information and history is completely transparent across channels. In an omnichannel environment, the customer can go online to the company's website to check inventory by store, purchase the item later on with a smartphone if they choose, and pick up the product at the customer's chosen location. At the retail location, this means that a customer service representative can immediately reference the customer's previous purchases—whether online or in-store—and preferences just as easily as the customer service representative on the phone or online. The key is that all channels are integrated. It is a technology that has enabled this to happen.

The omnichannel is rapidly becoming the norm in many industries such as retail, as customers demand a seamless interface among their various shopping

experiences. It has also helped the supply chain better coordinate inventory across the different channels.



Concept Check Questions

104. The _____-channel is an approach to sales that seeks to provide the customer with a seamless shopping experience across multiple channels.

- ☐ a) multi
- ☐ b) complete
- ☐ c) bi
- ☐ d) omni

Correct or Incorrect?

Clear

Check Answer

105. With a traditional multichannel the customer can use alternative shopping channels, such as a physical shopping environment or an online one.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

106. In an omni-channel the customer experiences true integration between the different channels on the “back end.”

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

107. The omni-channel has not yet gained much traction.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

108. The omni-channel model aligns with evolving customer expectations, especially in retail and hospitality.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Supply Chain Leader's Box: Omnichannel Experience

■ STARBUCKS

Starbucks exemplifies a successful omnichannel approach, integrating various channels for a seamless customer experience. Customers can check store inventory online, place orders via smartphones, and choose convenient pickup options.

This true integration extends to inventory coordination, ensuring product availability and personalized experiences. Starbucks leverages technology, primarily its mobile app, to facilitate ordering, payments, rewards, and customer engagement.

The omnichannel model aligns with evolving customer expectations, especially in retail and hospitality. It represents the norm as customers increasingly seek convenience, consistency, and personalization in their interactions with brands. Starbucks' commitment to technology-driven integration enhances customer satisfaction and optimizes inventory management throughout the supply chain.

Big Data Analytics Box

■ OASIS

Oasis is a UK fashion retailer that has embraced the omnichannel and, with state-of-the-art technology, has connected all shopping channels. This includes their e-commerce site, mobile app, and the brick-and-mortar stores. They have also fused these channels into a consistent presentation with matching displayed images across their site and social channels. They cover all popular social media channels, with image-led accounts on platforms including Pinterest, Instagram, and Facebook, and they have made them easy to navigate.

At their store locations, all shop floor assistants are equipped with an iPad. They have the most up-to-date stock information and can check stock levels on all products for customers. If the item is not in stock, they order it directly to the customer's house. The iPad also acts as a cash register, making it easy for associates to ring you up from anywhere in the store.

Oasis goes even further to connect the in-store and online experience. The technology enables the customer to book a personal shopping slot with their stylists, available in seven stores across the UK, seven days a week during regular store hours. They break down the different personal shopping occasion slots for events, such as “birthday,” “sun seeker,” and “wardrobe overhaul,” and they even allow the customer to read a bit about the personal stylist with whom they will be meeting.

This type of seamless experience across channels is increasingly becoming a customer expectation. Technology is making it a reality.

Adapted from: <https://www.oasis-stores.com/gb/my-personal-stylist.html>.

Empowering Entrepreneurs Box

In SCM, the reality is that power between suppliers and customers is asymmetrical. Large companies that have the most power and clout are often called “supply chain masters.” This discrepancy in supply chain power is felt the most by small companies that may be at the mercy of large customers. Large companies can place tremendous pressure on small supply chain partners, such as forcing terms of sales, negotiation deals, and technology requirements.

One strategy that can help small firms is to enlist the help of a big customer. This was a strategy used by the company called Collins Consulting, a small service provider of contingent staffing services from Chicago area. For almost a decade Collins Consulting provided almost exclusive service to IBM, doing IT-related work for its commercial and government business. However, an opportunity arose for Collins to expand its role at IBM to include a financial audit and accounting contract. Collins jumped at the opportunity to expand its capability. IBM then recommended Collins to KPMG, a competitor, to use the expanded Collins services. This enabled Collins to expand its offering and grow its customer base. The lesson here is that small companies can often leverage the success they have with a large customer to expand their capabilities and product offerings and grow their customer base. Being a small business does not necessarily mean being powerless in a supply chain context.

CHAPTER HIGHLIGHTS

Marketing is the function responsible for linking the organization to its customers and is concerned with the “downstream” part of the supply chain. It is responsible for identifying customer needs, determining how to create value for customers, and building strong customer relationships.

Marketing decisions drive all actions of the organization and the supply chain. These decisions fall into four distinct categories known as the marketing mix or the 4Ps. They are product, price, place (distribution), and promotion.

The traditional marketing approach has been to pursue a strategy of increasing the number of customer transactions to increase revenues and profits—transactional marketing. Today's approach to marketing is to develop long-term relationships with customers—relational marketing.

CRM is a sophisticated technology that gathers data and customizes communication from automated customer transactions. This data is captured through suites of software modules that are part of larger ERP systems.

Customer service is the process of enhancing the level of customer satisfaction by meeting or exceeding customer expectations. It can be viewed in three distinct ways: an activity, a set of performance measures, and an overarching philosophy.

A channel of distribution is the way products and services are passed from the manufacturer to the final consumer. It is made up of the entities involved in getting products and services to final customers and can involve a variety of intermediary firms, including wholesalers, distributors, or retailers.

Channels of distribution can be direct or indirect and are part of the overall supply chain.

e-Commerce requires changes in the channel of distribution through changes in the pricing structure, shipping small bundles, and handling returns.

KEY TERMS

[Market segmentation](#)

[Mass marketing](#)

Target marketing

Transactional marketing

Relational marketing

Product

Price

Place

Promotion

End consumer

Organizational end user

Standardized strategy.

Customized strategy.

Niche strategy.

Customer relationship management (CRM).

Micromarketing

One-to-one marketing

Voice of the customer (VOC).

Quality function deployment (QFD).

Customer service

Channel of distribution

Direct

Indirect

Intensive distribution

Selective distribution

Exclusive distribution

Omnichannel

DISCUSSION QUESTIONS

- Describe the differences between transactional and relational marketing. Provide an example from your own life where you have encountered them. How did each make you feel as a customer?
- Find an example of a product where you felt there were too many product choices. Explain the implications for the company and their supply chain.
- Identify a product market that is currently experiencing changes in customer preferences. How are the companies in that industry responding to the changing preferences? What are the supply chain implications?
- Identify a product currently marketed for household use. Imagine you were asked to market the product for commercial use. How might the product characteristics change, and what would be its impact on the supply chain?
- We all encounter CRM in our everyday lives—from our purchases at the grocery store to our online searches. Provide examples from your everyday life in which companies were able to gather information about your consumer preferences.

Case Study Gizmo

Orange company was based out of Southern California and was doing remarkably well considering that only 10 years earlier the company had been merely a hobby for Sam Wilkerson. Sam was fascinated by taking apart computers, adding memory, and then putting them back together. He never expected that his weekend hobby would turn into one of the highest-earning computer companies in the world. The company's relaxed atmosphere encouraged creativity and product innovation. The developers were never afraid to try something new. It was one of these highly experimental projects that led to their newest product: a smartphone that can do it all—simultaneously surf the Internet, text message, do voice recognition note-taking, and play music and movies, while still maintaining superior functioning for making telephone calls. With no buttons to get in the way, only a touch screen, it was unlike anything seen on the market.

Although the management at Orange felt that their new smartphone—named Gizmo—would be well received by consumers as innovative and cutting edge, they had concerns. They were not sure about their target market, the marketing strategy, and the resulting supply chain implications. These decisions were directly tied to their pricing strategy and had capacity and delivery implications. Who would be their target market, and how would they price the product given its abundant features? Should the product be targeted to business professionals or students or the public in general? If the Gizmo did significantly better than expected, could their supply chain handle the added demand?

Orange was considering partnering with the largest mobile service provider in the industry, Random Wireless, for exclusive distribution. This would mean that they could utilize an already established distribution channel for their first smartphone release. Orange believed that this would mean significant distribution savings and the ability to reach a wider market. They would also be able to provide service support at many locations. However, there were also disadvantages to going through one exclusive distributor.

Orange knew that they had a wonderful product, but the key to success would be good marketing, an excellent distribution network, and a reliable

supply chain. They had some decisions to make.

Case Questions

1. Identify at least two different possible target markets for the Gizmo. How would the marketing strategy differ for each target market? How would the pricing strategy and the volume sold change? Identify the supply chain implications for each target market.
2. If Orange decides to go after multiple market segments, identify the supply chain requirements. Should they have multiple supply chains?
3. Discuss the advantages and disadvantages of going with one exclusive distributor. How would this decision be affected by the selection of the target market? What would be the implications on the supply chain? What would you do if you were Orange?

Case Study Making Decisions with Data Analytics: Your Friend Mark

After completing your college degree, you took a position with an energy generation company. Two years ago, you were relocated to a remote town in the Midwest of the United States for a special project. Your entrepreneurial instincts have led you to notice problems faced by farmers in the region. One of the problems is the difficulty in finding replacements for farm equipment parts. Although most farmers can identify which equipment part has developed a problem, it is difficult for them to arrive at the technical specifications of the part to buy a replacement online.

To address this issue, you have developed an analytics app called “Your Friend Mark.” By using this app, farmers can simply take a photo of the faulty part and the app generates all the associated technical specifications. The app also generates pricing information from different websites and allows farmers to complete their purchases.

You have spent two months beta testing and, after analyzing the results, have noticed an interesting pattern. Over 60% of sales are generated by 50 equipment parts. This has given you a business idea to consider: if you could buy or rent a warehouse, you could stock these 50 parts by buying them from manufacturers in bulk. You could then sell these parts to end customers by taking advantage of the margin while still being competitive.

Due to your proximity to the end customers—the farmers—you are confident you can offer a better service compared to existing market players. Going ahead with this plan will allow you to expand your business beyond just the software application and to generate more revenue. This way, you will be able to quit your job and become a full-time entrepreneur.

Case Questions

1. Which parameters can you use to segment your end customers?
2. What marketing techniques can you apply to understand customer needs?
3. What distributions channels will be available to you once you buy/rent the warehouse?

4. What impact will the buy/rent decision have on your supply chain?

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5

Operations Management

LEARNING OBJECTIVES

After completing this chapter, you should be able to:

Define operations management (OM), and explain its role in the supply chain.

Describe operations decisions, and explain how they impact supply chain management (SCM).

Explain product and process design and their impact on supply chain operations.

Describe categories of facility layouts and their link to process design and the supply chain.

Describe the process of line balancing in designing product layouts.

Explain the role of process automation in layout design.

CHAPTER OUTLINE

- **What Is Operations Management (OM)?**
 - The OM Function*
 - OM Decisions*
 - Manufacturing vs Service Operations*
 - Evolution of the Operations Function*
 - Impact on the Organization*
 - Impact on SCM*
- **Product Design**
 - What Is Product Design?*
 - Design of Services*
 - The Product Design Process*
 - Break-even Analysis*
 - Factors Impacting Product Design Decisions*
- **Process Design**
 - What Is Process Design?*
 - Intermittent Processes*
 - Repetitive Processes*
 - The Continuum of Process Types*
- **Facility Layout**
 - Facility Layout Planning*
 - Types of Facility Layouts*
- **Line Balancing in Product Layouts**
 - Step 1. Identify Task Times and Precedence Relationships*
 - Step 2. Determine Cycle Time*
 - Step 3. Determine the Theoretical Minimum Number of Workstations*
 - Step 4. Assign Tasks to Workstations*

[Step 5. Compute Efficiency](#)

■

[Process Automation](#)

[Advantages and Disadvantages](#)

[Automation in Services](#)

■

[Chapter Highlights](#)

■

[Key Terms](#)

■

[Discussion Questions](#)

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[Problems](#)

■

[Case Study: Making Decisions with Data Analytics: Song's Mumbai Restaurant](#)

■

[Bibliography](#)



VIDEO
CONTENT

[Bloomberg Quicktake Video: Continental CFO Katja Duerrfeld Full Interview](#)

[Bloomberg Quicktake Video: Five Guys to Open 50 Stores](#)

There's a mystique about Tesla Motors, the electric automotive and energy storage company. Tesla's chief executive officer (CEO), Elon Musk, is one of the most dynamic figures in the world of science, technology, and innovation, and the company has developed an almost cult-like following. People believe that Tesla's vehicles are different from other cars. Just consider that its Model S can go from zero to 60 miles per hour in less than 2.3 seconds—what Tesla terms “Ludicrous Mode.” The company is indeed different, and one of the differences is Tesla's supply chain. Tesla has made unique operations decisions that are aligned with their goals and vision, and are supported by a vertically integrated digital supply chain. Let us look at this more closely.

The foundation of Tesla vehicles—the Model S sport sedan, the Model X crossover, and the Model 3 family sedan—is that these vehicles are designed and engineered to be electric vehicles from the start. Other automakers have moved into the electric car arena and have had to retrofit their facilities to produce these new products. Tesla, however, did not have to make these compromises. Rather, Tesla's entire system has been developed to focus precisely and solely on electric vehicles. Tesla has designed the vehicles from the ground up as a hybrid of mechanical and digital technology. It has also designed the facilities specifically to produce these products.

Unlike conventional wisdom to move manufacturing to low-cost labor locations, Tesla produces its cars in California. Tesla's plant in Palo Alto sits on some of the most expensive real estate in the world with a cost of living to match. However, Tesla's plant is also less than 18 miles away from company headquarters in an area with some of the best technical talent in the world the company can tap into. The company has selected its location to focus on proximity to innovative talent and corporate leadership rather than cost.

Tesla has invested an extraordinary amount in advanced robotics. These technological advancements in robotics are enabling Tesla to have state-of-the-art manufacturing. Tesla relies heavily on KUKA robots, the leading producer of industrial robots in the world. These robots are designed for flexibility and also interaction with thousands of workers on the shop floor. Tesla is also heavily vertically integrated. Their manufacturing facility is full-service with a plan for a supplier park in the immediate vicinity to focus on large parts. Also significant is the integration with its giant lithium-ion battery factory, called the Gigafactory, in nearby Nevada, which serves as its supplier. The factor covers over 15 million square feet of land, three times larger than Central Park, and is entirely powered by renewable energy sources. The factory was built to support projected annual vehicle demand and reduce the

costs associated with battery cells. Tesla's Gigafactory format is designed to achieve economies of scale, increase production efficiency, and drive down costs. As of 2024, Tesla's Gigafactory has reduced production costs and improved efficiency.

The Gigafactory's commitment to sustainability extends beyond its operations. Its 10-million-square-foot roof is covered with solar panels, capable of producing 850 MWh of solar power daily. This massive solar array is part of Tesla's broader goal to run the Gigafactory entirely on renewable energy.

Tesla's Gigafactory is a shining example of sustainable manufacturing practices. By harnessing the power of solar energy, the Gigafactory not only reduces its carbon footprint but also demonstrates the feasibility of large-scale renewable energy integration in industrial settings. This commitment to sustainability aligns with Tesla's broader mission to accelerate the world's transition to sustainable energy.

The success of the Gigafactory's solar initiative is not only measured in energy savings but also in its impact on the environment. By relying on renewable energy sources, the Gigafactory reduces its reliance on fossil fuels, contributing to cleaner air and a healthier planet. Additionally, the Gigafactory's solar array serves as a model for other industrial facilities looking to reduce their environmental impact and embrace sustainable practices.

Link: https://en.wikipedia.org/wiki/Gigafactory_Nevada#cite_note-4

Tesla is also continuing to invest in a network of supercharger stations around the country, to have a complete end-to-end supply chain. As of 2024, Tesla had 6,000 supercharger stations with 55,000 connectors. This is a 33% year-over-year growth. The network is primarily deployed in three regions: Asia Pacific (over 2,400 stations), North America (over 2,300), and Europe (over 1,100). This network will ensure that customers have a viable alternative to gas stations as they fuel their electric cars. Lastly, the Tesla supply chain is digitally controlled with end-to-end coordination using algorithms that automatically update over the cloud. Tesla clearly understands the importance of coordinating its supply chain and all its operations to produce the products it wants.

Concept Check Questions

1. Tesla produces its cars in Austin Texas.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

2. Tesla has a large battery factory, called the Gigafactory, in California.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

3. Tesla's Gigafactory format is designed to achieve economies of scale, increase production efficiency, and drive down costs.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

What Is Operations Management (OM)?

The OM Function

Operations management (OM)—or “operations”—is the business function responsible for producing a company's goods and services efficiently and cost-effectively. It is the function responsible for transforming a company's inputs, obtained by the sourcing function, into finished goods and services, which marketing sells to final customers. Without operations, there would be no products to sell, whether tangible goods or services. The functional position of operations in the organization is highlighted in [Figure 5.1](#).

OM is responsible for planning, organizing, and managing all the resources needed to produce a company's goods and services. This includes people, equipment, technology, materials, and information. It is a core function of every company, whether large or small, service or manufacturing, profit or nonprofit. Consider Gap, Inc., one of the largest specialty retailers, discussed in [Chapter 4](#). Gap's marketing function identifies characteristics of products desired by customers for each of its three largest brands, Banana Republic, Gap, and Old Navy. However, it is OM that must design and produce the merchandise, from T-shirts to jeans. It must also ensure that the right products—in terms of variety, colors, and styles—are available in the right quantities at various retail locations across the globe.

OM serves a [transformation role](#) in the organization by converting a company's inputs into finished goods and services, as shown in [Figure 5.2](#). These inputs include human resources, such as workers, staff, and managers; facilities and processes, such as buildings and equipment; it also includes materials, technology, and information. Outputs are the goods and services a company produces. At a manufacturing plant, the transformation is the physical change of raw materials into products—such as transforming leather and rubber into sneakers, denim into jeans, or plastic into toys. At a hospital, the transformation is organizing resources—such as doctors, medical equipment, and medications, to transform sick patients into healthy people.

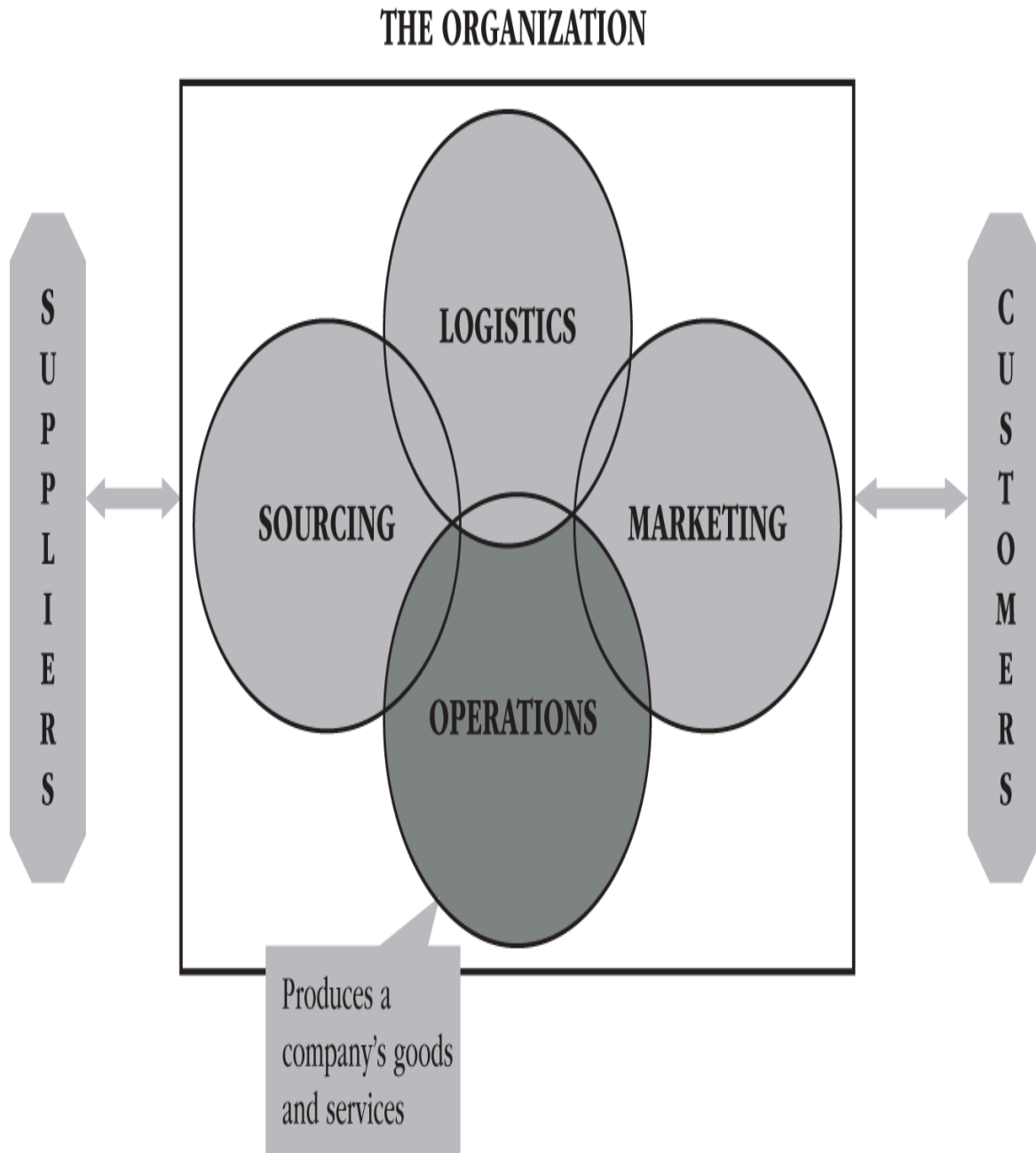


FIGURE 5.1 The operations function.

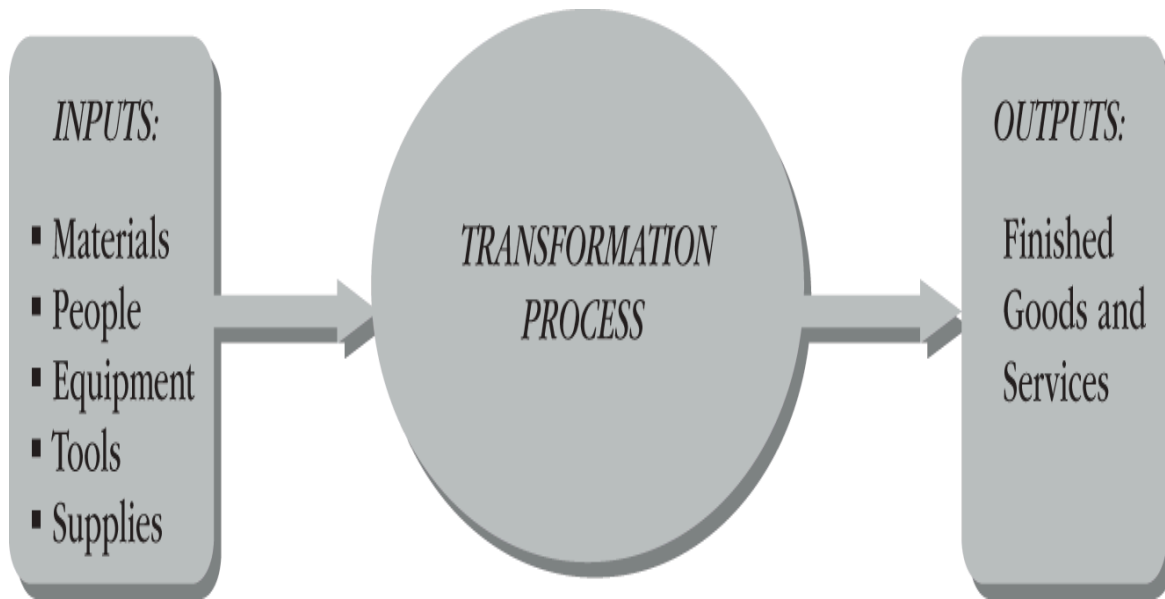


FIGURE 5.2 The transformation role of OM.

Consider the example of Ryanair in the Global Insights Box later in the chapter. Like traditional airlines, Ryanair transports passengers and their luggage from one location to another. However, the transformation process at Ryanair is organized very differently from traditional airlines, by involving the customer in aspects of the transformation process itself.

Another example is McDonald's. Here, the inputs include the workforce, facilities, materials, technology, and information. Outputs are the fast-food products and services, such as hamburgers and fries, that customers order and enjoy.

McDonald's excels in transforming these inputs into outputs efficiently and consistently by employing standardized processes, technology, and data analysis. This results in the quick and reliable delivery of food and services to its customers worldwide.

Concept Check Questions

4. Operations management (OM)—or “operations”—is the business function responsible for producing a company's goods and services in an efficient and cost-effective way.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

5. Logistics is responsible for planning, organizing, and managing all the resources needed to produce a company's goods and services.

☐ True

☐ False

Correct or Incorrect?

Clear

Check Answer

6. Organizations are made up of three major areas, logistics, marketing, and operations.

☐ True

☐ False

Correct or Incorrect?

Clear

Check Answer

7. OM serves a transformation role in the organization by converting a company's inputs into finished goods and services

☐ True

☐ False

Correct or Incorrect?

Clear

Check Answer

8. Ryanair manufactures airplanes.

☐ True

☐ False

Correct or Incorrect?

Clear

Check Answer

9. McDonald's excels in transforming inputs into outputs efficiently and consistently by employing standardized processes, technology, and data analysis.

☐ True

☐ False

Correct or Incorrect?

Clear

Check Answer

OM Decisions

OM is complex, as many different types of decisions are involved in transforming inputs into finished products. Some of these are listed in [Figure 5.3](#). For operations to be able to design and produce the products customers want, customer preferences—such as likes and dislikes—have to be translated into tangible product characteristics. It is then up to operations to decide on the exact type of process needed to produce the desired product. This includes equipment, level of technology, automation, skill levels, job requirements of workers, and capacity of facilities.

Consider your university and the transformation role it performs in educating students. Think about the location of the university and size and proximity of classrooms; consider the course offerings, capabilities of faculty and staff, and schedules provided; think about the resources—from cafeterias and conference rooms to computers and athletic facilities. These are all examples of OM decisions designed to create a transformation process.

Concept Check Questions

10. Designing unique product features.

- ☐ a) Product design
- ☐ b) Process design
- ☐ c) Quality management
- ☐ d) Inventory management
- ☐ e) Facility location

Correct or Incorrect?

Clear

Check Answer

11. Establishing and implementing quality standards.

- ☐ a) Product design
- ☐ b) Process design
- ☐ c) Quality management
- ☐ d) Inventory management
- ☐ e) Facility location

Correct or Incorrect?

Clear

Check Answer

12. Creating the production process to produce the designed products.

- ☐ a) Product design
- ☐ b) Process design
- ☐ c) Quality management
- ☐ d) Inventory management
- ☐ e) Facility location

Correct or Incorrect?

Clear

Check Answer

13. Decisions on amounts of inventory to carry and when to order.

- ☐ a) Scheduling
- ☐ b) Process design
- ☐ c) Quality management
- ☐ d) Inventory management
- ☐ e) Facility location

Correct or Incorrect?

Clear

Check Answer

14. Deciding the physical layout of the production facility.

- ☐ a) Scheduling
- ☐ b) Process design
- ☐ c) Quality management
- ☐ d) Inventory management
- ☐ e) Facility layout

Correct or Incorrect?

Clear

Check Answer

15. Deciding on the best location for facilities.

- ☐ a) Scheduling
- ☐ b) Process design
- ☐ c) Quality management
- ☐ d) Inventory management
- ☐ e) Facility location

Correct or Incorrect?

Clear

Check Answer

16. Creating schedules for workers, machines, and facilities.

- ☐ a) Scheduling
- ☐ b) Process design
- ☐ c) Quality management
- ☐ d) Inventory management
- ☐ e) Facility location

Correct or Incorrect?

Clear

Check Answer

Manufacturing vs Service Operations

Manufacturing and service organizations each pose unique challenges for the operations function. There are two primary distinctions between them. First, manufacturing organizations produce physical, tangible goods that can be stored in inventory before they are needed. In contrast, service organizations produce

intangible products that cannot be produced ahead of time. Second, in manufacturing organizations, most customers have no direct contact with the operation. For example, a customer buying a bottle of Pepsi never sees the bottling factory. However, in service organizations, the customer is typically present during the creation of the service, such as at hospitals, colleges, theaters, and barber shops.

OM Decision	What it means
Product design	Designing unique product features
Process design	Creating the production process to produce the designed products
Quality management	Establishing and implementing quality standards
Inventory management	Decisions on amounts of inventory to carry and when to order
Facility layout	Deciding the physical layout of the production facility
Facility location	Deciding on the best location for facilities
Scheduling	Creating schedules for workers, machines, and facilities

FIGURE 5.3 OM decisions.

The differences between manufacturing and service organizations are not as clear-cut as they might appear, and there is much overlap between them. Most manufacturers provide services as part of their business, and many service firms manufacture physical goods they use during service delivery. For example, a manufacturer of furniture may also provide shipment of goods and assembly of furniture. A barber shop may sell its line of hair care products. Even in pure service companies some segments of the operation may have high customer contact, whereas others have low customer contact. The latter can be thought of as “backroom” or “behind the scenes” segments. Examples would include the kitchen segment at a fast-food restaurant, such as Wendy's, or the laboratory for specimen analysis at a hospital.

Another example is Apple, known for manufacturing physical goods, including iPhones, MacBooks, and other hardware devices. However, Apple provides significant services such as technical support, product demonstrations, and repair services through its network of Apple Store and the AppleCare program. This demonstrates the overlap between manufacturing and service in a company's

operations. Apple manufactures hardware products while also offering a range of services to support its customers.

Concept Check Questions

17. There is/are _____ primary distinction(s) between manufacturing and services organizations.

- ☐ a) zero
- ☐ b) one
- ☐ c) two
- ☐ d) three
- ☐ e) many

Correct or Incorrect?

Clear

Check Answer

18. The differences between manufacturing and service organizations is clear-cut.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Apple is almost exclusively a manufacturing firm.

- ☐ True
- ☐ False

Correct or Incorrect?

Evolution of the Operations Function

OM has significantly evolved and changed over time, as shown in [Figure 5.4](#). As a result of global business trends and changes in competitive requirements, operations have evolved from being a “backroom” production function to taking on a strategic role and becoming a tool for competitive advantage. This is also reflected in the change of its name, which was formerly “production management,” indicating that it was just about “producing.” The term then evolved into “production and operations management” reflecting a broader organizational focus. The function was ultimately coined “operations management,” reflecting a broad and strategic organizational reach.

Prior to the 1950s, OM served merely a production role in the organization. The key opportunities at the time were in marketing, to develop markets for new products, and in finance, to support this growth. Operations were seen more as a “backroom” function that simply “made things.”

Although operations began taking on a broader organizational role in the 1950s and 1960s, its role changed abruptly in the 1980s. U.S. companies experienced large declines in productivity growth, and international competition began to challenge many U.S. markets, especially in the auto industry. While U.S. firms had neglected their operations processes, foreign firms from countries such as Germany and Japan were rebuilding their facilities and designing new production methods. Suddenly, many U.S. firms found themselves turning to operations to regain their competitiveness.

Today's global competition and focus on SCM have placed even greater importance on operations. Organizations within the supply chain network must operate at the highest level of efficiency and utilize the most current operations methods. Many inroads that are made in competitive markets come from innovations in operations, such as Tata Motors producing less-expensive vehicles due to new production techniques. Tata Motors has used distributed manufacturing, 3D printing, and meeting over 70% of the energy needs of its manufacturing sites through renewable energy.

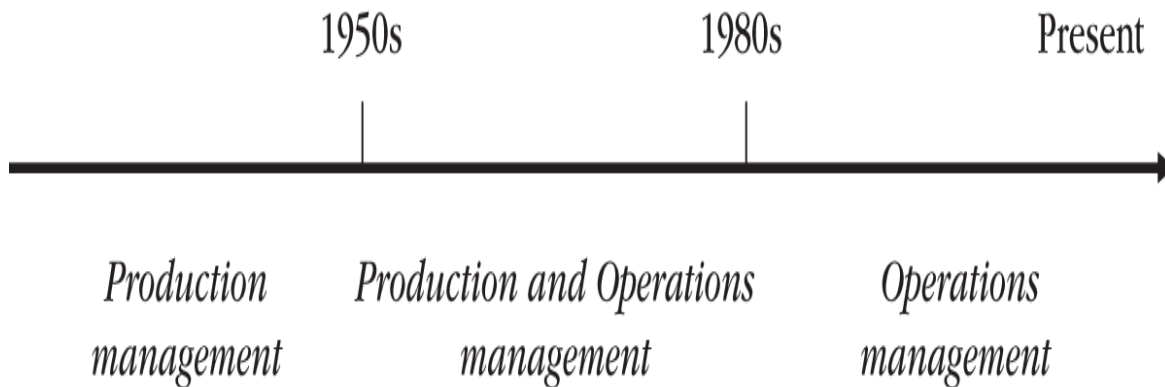


FIGURE 5.4 The evolution of OM.

Concept Check Questions

19. What was the timeframe for production management?

- ☐ a) 1800s
- ☐ b) Prior to the 1950s
- ☐ c) 1950s to 1980s
- ☐ d) 1980 to the present

Correct or Incorrect?

Clear

Check Answer

20. What was the timeframe for production and operations management?

- ☐ a) 1800s
- ☐ b) Prior to the 1950s
- ☐ c) 1950s to 1980s
- ☐ d) 1980 to the present

Correct or Incorrect?

Clear

Check Answer

21. What was the timeframe for operations management?

- ☐ a) 1800s
- ☐ b) Prior to the 1950s
- ☐ c) 1950s to 1980s
- ☐ d) 1980 to the present

Correct or Incorrect?

Clear

Check Answer

22. OM has significantly evolved and changed over time.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

23. The role of OM changed abruptly in the 1980s.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

24. Today's global competition has placed less importance on operations and more importance on logistics.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Impact on the Organization

Operations play a critical role in the organization, as without OM there would be no product to sell. However, operations cannot work in isolation from other business functions. For example, operations must work with marketing to understand and design the exact products customers want and to create the production processes that efficiently produce these products. Marketing, on the contrary, must understand operations' capabilities, such as the types of products it can/cannot produce. Otherwise, the company may find itself marketing products the company is not able to deliver. Consider a furniture manufacturer in North Carolina, where marketing pushed for the selling of laminated vs customized furniture, only to find that the operations requirements were completely different for one vs the other. Operations must also work with sourcing to understand material availability, such as sources of supply, quality standards, and availability of materials. Sourcing, in turn, must understand operational production requirements to develop and manage an appropriate supply base.

Supply Chain Leader's Box

■ WALMART

Companies often learn the hard way that operations decisions must be tied to customer expectations. Just consider what happened at Wal-Mart a few years ago. When the CEO of Walmart, Mike Duke, stepped into his position in 2009, he was faced with having to address a large operational change in the company that had already been underway. The company was in the process of implementing an overhaul of its U.S. retail stores called Project Impact. The goal was to make the stores more “target oriented,” putting in more space and making the stores look cleaner and less cluttered.

Duke immediately understood not only the marketing needs but also the operational challenges. Larger aisles and cleaner stores meant a significantly lower number of inventory items and stock-keeping units (SKUs). This was in direct contrast to the vision of Sam Walton, who favored a cluttered presentation; “Stack ’em high and let ’em fly!” was his philosophy. For decades the layout of the stores had included the so-called Action Alley, which is the long aisle shoppers face when entering the store. Action Alley was designed to be cluttered and display deeply discounted items. Under Project Impact, store managers were ordered to clear the Action Alleys completely. In addition, Walmart had to cut thousands of items that it carried in each store, deciding that it would be more efficient to focus on fewer brands. So, for example, a very popular laundry detergent—Wisk—was eliminated among the thousands of other SKUs.

The problem with Project Impact, however, was that customers were now buying less. Wal-Mart found that fewer products meant less clutter, but it also meant lower sales. Customers came to Walmart for the product variety and low prices and not having the variety meant customers were leaving. Duke quickly began to remedy the problem. By March 2010, he started to bring back many of the products that had been dropped, including Wisk laundry detergent. He understood that facility layout, inventory management, and all the other operations decisions were the lifeblood of ensuring the company met customer expectations.

Concept Check Questions

25. Operations play a critical role in the organization.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

26. Operations and marketing rarely work together.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

27. Operations must also work with sourcing to understand material availability.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Impact on SCM

It is not enough for a company to manage its own operations function. Each company depends on other members of its supply chain to be able to deliver the right products to its customers in a timely and cost-effective manner. Recall that in [Chapter 3](#) we learned how processes operate as a system and that every system has a constraint that must be managed as it creates a bottleneck. In the upstream part of its supply chain, a company depends on its suppliers for the delivery of raw materials and components in time to meet production needs. If deliveries of these materials are late or are of poor quality, production will be delayed, regardless of how efficient a company's operations process is. On the downstream side, a company depends on its distributors and retailers for the delivery of the product to the final customer. If these are not delivered on time, are damaged in the transportation process, or are poorly displayed at the retail location, sales will suffer. Also, if the operations function of other members of the supply chain is not managed properly, excess costs will result, which will be passed down to other members of the supply chain in the form of higher prices.

Consider the case of Amazon. Upstream, Amazon relies on suppliers for raw materials and components for products such as Kindle e-readers. Timely deliveries are crucial to meet customer demand. Downstream, Amazon depends on its logistics network for efficient warehousing and delivery services to ensure products reach customers promptly. Effective supply chain management (SCM) is vital for customer satisfaction. Amazon's success depends on managing its entire supply chain, from suppliers to last-mile delivery, to meet customer expectations efficiently.

The companies that comprise a supply chain need to coordinate and link their operations functions so that the entire chain is operating seamlessly and efficiently. Consider the fact that most of the components Dell uses are warehoused within a 15-minute radius of its assembly plant and Dell is in constant communication with its suppliers. Dell considers this essential to its ability to produce and deliver components quickly.



Concept Check Questions

28. Each company depends on other members of its supply chain to be able to deliver the right products to its customers in a timely and cost-effective manner.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

29. On the downstream side, a company depends on its distributors and retailers for the delivery of the product to the final customer.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

30. Operations has minimal impact on cost.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

31. Downstream, Amazon depends on an independent logistics network for efficient warehousing and delivery services to ensure products reach customers promptly.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

32. The companies that comprise a supply chain need to coordinate and link their operations functions so that the entire chain is operating in a seamless and efficient manner.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

33. Most of the components Dell uses are warehoused within a one-hour radius of its assembly plant and Dell is in constant communication with its suppliers.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Product Design

What Is Product Design?

Product design is the process of specifying the exact features and characteristics of a company's product. Features of every product—from a Starbucks' Café Latte to IKEA's kitchen chairs to Hewlett-Packard's (HP's) DeskJet printer—were determined during product design. This is also true for the design of services, ranging from in-room dining offerings at Marriott Hotels to shipping options at FedEx. All of a product's features are determined by product design. Ideas for which features to include are usually driven by marketing, which understands what customers want. Marketing understands that consumers respond to a product's appearance, color, texture, and performance. Marketing then works with operations to create a product that meets these consumer preferences.

Product design decisions are one of the most important in OM as they drive many other decisions. One of these is process design, which is the design of the production process needed to produce the desired product. Product design defines a product's characteristics and then translates them into measurable dimensions the process can use to produce the product.

Product and process design affect product quality, product cost, and customer satisfaction. Consider Apple's iPhone 4 manufactured in 2010. The product design specified white to be one of the color options. However, after white iPhone devices were produced, consumers found the white casing to “leak” too much light into the phone unit, washing out pictures and creating other problems. If the product is not well designed, or if the production process is not capable of producing the exact product design features, the quality of the product will suffer. Therefore, for a product to succeed in the marketplace it must have a good design and a good production process.

Consider the case of Tesla's Model 3. From a product design standpoint, the Model 3 aimed to be an affordable, stylish electric car with advanced features, broadening its appeal to a wider customer base. From a process design standpoint, Tesla utilized innovative manufacturing processes, including automation and advanced battery technology, at their Gigafactory to meet high demand. Although the Model 3 received praise for design and performance, initial quality concerns such as paint and panel issues arose due to rapid production scaling. Tesla adapted its processes to enhance product quality.

This example underscores that even innovative companies like Tesla can face quality challenges when product and process design are not seamlessly aligned. It

highlights the need for a well-integrated design-production approach to ensure high-quality products meet customer expectations.

Concept Check Questions

34. Product design is the process of specifying the exact features and characteristics of a company's product.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

35. Product design decisions are one of the least important in OM.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

36. Product and process design affect product quality, product cost, and customer satisfaction.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

37. In 2010, the white iPhone 4 was extremely well received.

☐ True

☐ False

Correct or Incorrect?

Clear

Check Answer

38. Although the Model 3 received praise for design and performance, initial quality concerns such as paint and panel issues arose due to rapid production scaling.

☐ True

☐ False

Correct or Incorrect?

Clear

Check Answer

Design of Services

Product design in the service industry has an added complication as the product is intangible and there is a high degree of customer interaction. Service design requires the design of the entire service concept. As with a tangible product, the service concept is based on satisfying customer needs. However, there are aesthetic and psychological benefits that the service provides that must be considered. Services are “experienced” by the customer, and details that enhance this experience are all part of the service concept. In [Chapter 4](#), we discussed the use of scents to enhance the service experience, such as Abercrombie & Fitch's use of their signature fragrance as part of the retail ambiance, or Omni Hotels &

Resorts scenting their coffee shop with the smell of sugar cookies. These are all attempts at enhancing the “service experience,” to improve customer satisfaction and promote sales.

The service concept has three elements, each of which must be designed. The first is the physical element of the service. This may be a haircut at the barber shop, an investment made by the financial planner, or the filling your dentist just put in your tooth. The second is the psychological benefits of the service, which are elements such as promptness and friendliness. Finally, there are sensual elements of the service, which are part of the experience, such as ambiance, image, and “feel good” elements of the service. Part of the service design is to specify all the elements of the service concept and to make sure that they work together. Consider the differences in service design between Hyatt Hotels, which provides upscale accommodations for travelers, and Hyatt Place, which provides lower-priced accommodations but ample amenities for the business traveler.

The concept of service design and differentiation can be seen by comparing Hyatt Hotels and Hyatt Place. Hyatt Hotels is known for providing upscale accommodations and services to travelers. Their service design includes:

Physical Element: Luxurious hotel rooms and facilities, high-end dining options, and spa services.

Psychological Benefits: Exceptional customer service, prompt check-ins and check-outs, and personalized concierge assistance.

Sensual Elements: A premium ambiance, elegant decor, and a focus on creating a “feel good” environment for guests.

In contrast, Hyatt Place is designed to cater to a different market segment, offering lower-priced accommodations while maintaining quality. The service design here includes:

Physical Element: Comfortable and modern rooms with essential amenities.

Psychological Benefits: Efficient and friendly service, convenient check-ins, and responsive staff.

Sensual Elements: A contemporary and practical ambiance, focused on providing a comfortable and no-frills experience.

This example demonstrates how service design can be adapted to meet the unique needs and expectations of different customer segments. While Hyatt Hotels target luxury travelers, Hyatt Place caters to business travelers seeking cost-effective yet quality accommodations. Service design plays a critical role in defining the customer experience in each case.

Big Data Analytics Box

■ HONDA

Honda is an excellent example of how companies can use big data to impact quality and customer service. The company has developed software to provide an “early warning system” that identifies major quality problems with their vehicles before they become catastrophic. The goal is to use analytics to make customers happy and save lives. The company uses analytical software to mine three sources of data—warranty service records categorizing quality problems (e.g., “brake system,” and “headlamps”), free text notes from mechanics, and transcripts of phone calls from customers to call centers—to identify trends or emerging problems. These are then forwarded to human analysts to make risk management judgment calls. This type of system illustrates how big data analytics can enhance and improve human decision making. It also shows how current analytics capability can incorporate unstructured data such as text notes. These types of quality improvements have been adopted by other automakers, all with the goal of using big data to improve quality.

Concept Check Questions

39. Product design in the service industry is much easier than in manufacturing since the products tend to be simpler.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

40. The service concept has three elements, each of which must be designed. Which one is a haircut at the barber shop, an investment made by the financial

planner, or the filling your dentist just put in your tooth?

- ☐ a) Cost and availability of the service
- ☐ b) Physical element of the service
- ☐ c) Psychological benefits
- ☐ d) Sensual elements

Correct or Incorrect?

Clear

Check Answer

41. The service concept has three elements, each of which must be designed. Which one is elements such as promptness and friendliness?

- ☐ a) Cost and availability of the service
- ☐ b) Physical element of the service
- ☐ c) Psychological benefits
- ☐ d) Sensual elements

Correct or Incorrect?

Clear

Check Answer

42. The service concept has three elements, each of which must be designed. Which one is part of the experience, such as ambiance, image, and “feel good” elements of the service?

- ☐ a) Cost and availability of the service
- ☐ b) Physical element of the service
- ☐ c) Psychological benefits
- ☐ d) Sensual elements

Correct or Incorrect?

Clear

Check Answer

43. Service design cannot be adapted to meet the unique needs and expectations of different customer segments.

☐ True

☐ False

Correct or Incorrect?

Clear

Check Answer

The Product Design Process

A significant challenge for today's companies is the need to regularly bring out new product designs. Some industries have a predictable cycle of new product development, such as new car models every year or new retail fashions every season. Some products come out seasonally, such as Starbucks specialty drinks during the holiday season, or Bath & Body Works floral scented soaps available in the spring.

The product design process follows a predictable set of steps:

Idea development.

Product ideas can come from many sources, such as marketing, which tries to determine what customers want, a company's research and development (R&D), engineering, or suppliers. Often, suppliers participate in a program called [early supplier involvement \(ESI\)](#) and get involved in the early stages of product design. Ideas can also come from competitors, by observing their products and success rate. Companies can also buy a competitor's product and then analyze its parts and features. This is a process called [reverse engineering](#) and was used by Ford in the design of its Ford Taurus.

Samsung Electronics provides examples of idea development from different sources. One source of idea development is from competitor observation. Samsung Electronics actively observes and analyzes its competitors in the

smartphone market, such as Apple and Google. By studying the features, functionalities, and designs of their competitors' devices, Samsung Electronics gains insights into what is working well in the market and what can be improved. This competitive intelligence helps Samsung enhance its product offerings and design innovative features to remain competitive. Another source is supplier involvement. Samsung engages in ESI where they collaborate closely with suppliers, especially in the development of new product components and technologies. For example, when Samsung Electronics wanted to improve the camera technology in its smartphones, they worked closely with camera module suppliers to develop cutting-edge camera systems that could be integrated into their devices.

This example demonstrates how Samsung Electronics leverages both competitor observation and supplier involvement to continuously innovate and develop new product ideas in the highly competitive smartphone industry.

Product Screening. All product ideas go through a screening stage, where they are evaluated to determine their likelihood of success. Product screening considers the viability of the product based on the needs of each of the business function. Each function has its concerns, which are shown in [Figure 5.5](#). Deciding which ideas should pass the screening stage involves managerial skill and experience. Roughly 80% of ideas not making it past the screening stage are due to the concerns illustrated in [Figure 5.5](#). One decision-making tool that can be especially helpful at this stage is break-even analysis, and we will look at its use later in this chapter.

Function	Product screening concerns
Marketing	What is the potential size of the market for the proposed product?
	How long will it take to capture the market?
	What is the long-term product potential?
Operations	What are the production process needs of the proposed product?
	Do we have the facilities, equipment, and labor skills needed?
	How easy would it be to acquire the needed production skills?
	Is there enough capacity to produce the new product?
Sourcing	What is the availability of sources of supply?
	What is the cost of materials for production?
	How easy is it to obtain available materials?
Finance	What are the financial requirements of the new product?
	What are the cost and the expected return on investment (ROI)?

FIGURE 5.5 Functional concerns at the product screening stage.

Preliminary Design and Testing. Following the screening stage, a product idea moves into preliminary design and testing. This is the stage where design engineers translate vague and general performance specifications (e.g., “pretty blue color” or “strong material”) into specific technical specifications. Prototypes are built and tested, and changes are made. In service organizations, this stage may entail pretesting the product on small groups of customers and then refining the service concept accordingly.

Final Design. Product testing results in the specification of the final product design. At this stage, specifications are translated into specific instructions used to manufacture the product, such as materials, equipment, and quality standards.

Global Insights Box

■ RYANAIR

Ryanair became famous for pioneering the rock-bottom budget airline. Just consider a situation that occurred in July 2002 when passengers in England were boarding a Ryanair flight bound for Dublin. The pilot announced that the baggage handlers loading the plane were short staffed. A major delay was imminent, the pilot said, unless people volunteered to move luggage. Soon after, a handful of passengers stepped out onto the tarmac to load bags onto the plane.

This is Ryanair—the largest low-cost airline in Europe, based in Dublin, Ireland. Michael O'Leary, CEO, says that someday he would like to see what happened in England happen on all Ryanair flights. “Airports are ludicrously complicated places only because we have this utterly useless transaction of taking your bag from you upon departure, just so we can give it back to you at arrival,” he says. “Get rid of all that crap. You take your own bag with you. You bring it down. You put it on.” O'Leary wants to completely change the operation of the airline industry. His dream is that someday all passengers will fly for free on Ryanair and that all of the company's income will come from ancillary revenue, such as baggage fees, in-flight sales, and commissions on travel insurance, hotels, and car rentals sold through the carrier's website.

O'Leary has a very different operation in mind from the way airlines currently run. “In exchange for cheap fares,” he says, “passengers will put up with just about anything.” On Ryanair, that can include high luggage fees, sales pitches for smokeless cigarettes, and scratch-off lottery games. Ryanair boasts of its minimal customer service, expensive food, and cramped seats. Eventually, O'Leary would like to eliminate two of the three toilets on all short flights, which would allow Ryanair to pack in more passengers at lower fares. He would charge passengers one euro to use the remaining toilet. Recently, he announced that he was planning to replace the last 10 rows of seats on his aircraft with 15 rows of upright “standing seats”—vertical benches with shoulder harnesses and arm rests, which would allow him to pack 30 more passengers into each plane. “The European consumer would crawl naked over broken glass for cheap fares,” O'Leary says.

This would all seem comical if Ryanair had not grown from a tiny regional airline into a legitimate powerhouse and has become the second-largest

European airline by passenger flights. “If you don't approach air travel with a radical point of view, then you get in the same bloody mindset as all the other morons in this industry,” O'Leary says.

Ryanair has organized its operation to increasingly involve the customer. Although this approach has been used in other industries, its success remains to be seen in the airline industry. Unlike many airlines, Ryanair runs on a tight schedule to keep their costs as low as they can fix. The system seems to be working. Ryanair has managed to keep a positive trajectory in terms of revenue, which was \$14.607B in 2023, a 151.89% increase year over year.

Concept Check Questions

44. Companies rarely need to bring out new products.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

45. Product ideas can come from many sources, such as marketing, which tries to determine what customers want, a company's R&D, engineering, or suppliers.

- ☐ a) Idea development
- ☐ b) Product screening
- ☐ c) Preliminary design and testing
- ☐ d) Final design
- ☐ e) Test market

Correct or Incorrect?

Clear

Check Answer

46. All product ideas go through a stage where they are evaluated to determine their likelihood of success.

- ☐ a) Idea development
- ☐ b) Product screening
- ☐ c) Preliminary design and testing
- ☐ d) Final design
- ☐ e) Test market

Correct or Incorrect?

Clear

Check Answer

47. This is the stage where design engineers translate vague and general performance specifications (e.g., “pretty blue color” or “strong material”) into specific technical specifications.

- ☐ a) Idea development
- ☐ b) Product screening
- ☐ c) Preliminary design and testing
- ☐ d) Final design
- ☐ e) Prototyping

Correct or Incorrect?

Clear

Check Answer

48. At this stage specifications are translated into specific instructions used to manufacture the product, such as materials, equipment, and quality standards.

- ☐ a) Idea development
- ☐ b) Product screening

- ☐ c) Preliminary design and testing
- ☐ d) Final design
- ☐ e) Prototyping

Correct or Incorrect?

Clear

Check Answer

Break-even Analysis

Break-even analysis is a tool that can be used to evaluate the success of a new product at the product screening stage. It is used to compute the product quantity that needs to be sold for a company to cover its costs, called the “break-even point.” Products with a high break-even point may be a risky choice, as the company must sell a large quantity before it can cover costs.

At the break-even point, total cost equals revenue, which is money made from sales. The total cost of producing a product or service is the sum of its fixed and variable costs. Fixed costs are those that do not vary with the quantity produced. They include overhead, taxes, and insurance and are incurred regardless of how much is produced. Variable costs, on the contrary, are costs that vary directly with the amount produced and include items such as direct materials and labor. Together, fixed and variable costs add up to the total cost:

$$\text{Total Cost} = F + V_C Q$$

where

F = fixed cost

V_C = variable cost per unit

Q = number of units sold

[Figure 5.6](#) shows a graphical representation of these costs and the break-even quantity. When $Q = 0$, the total cost and fixed cost are equal. However, as Q increases, so do variable cost and total cost. Revenue from sales is computed as

Revenue = $S_P Q$, where
 S_P = selling price per unit

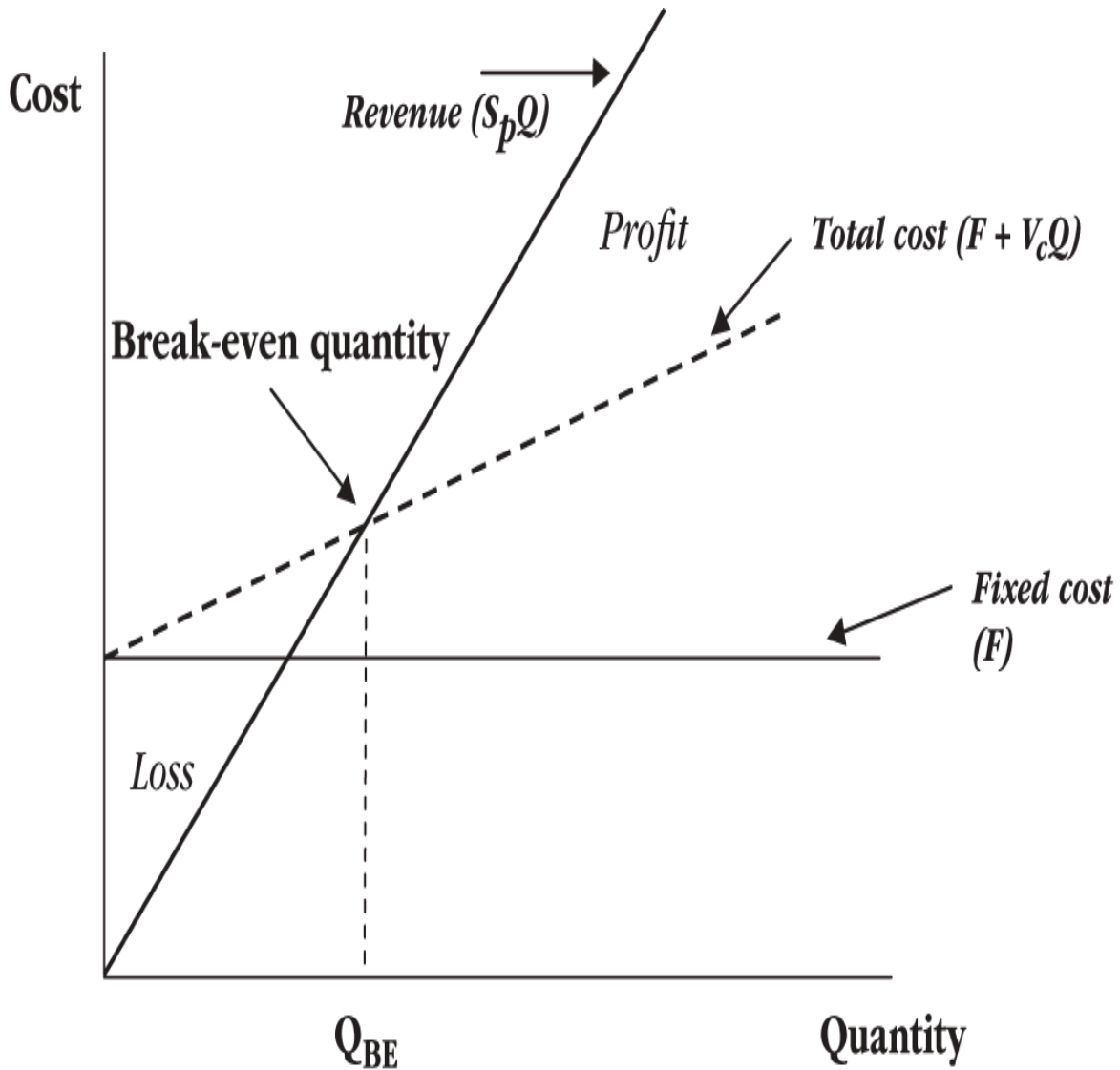


FIGURE 5.6 Graphical representation of the break-even quantity.

When $Q = 0$, revenue is zero, as there are no sales. As sales increase so does revenue, until the break-even point is reached when all costs are covered. Sales beyond the break-even point result in a profit for the company. At the break-even point, total cost is equal to revenue:

$$\begin{aligned}\text{Total Cost} &= \text{Revenue} \\ F + V_C Q &= S_P Q\end{aligned}$$

Solving for Q at the break-even point— Q_{BE} —we get the following equation:

$$Q_{BE} = \frac{F}{S_P - V_C}$$

Q_{BE} computes the break-even quantity, or the quantity needed to be sold for the company to break even. We could also find the break-even point by graphing total cost and revenue.

Break-even analysis can also be useful for conducting a sensitivity analysis to evaluate how changes in product price affect the break-even quantity. In addition, it can be used to make other product and process decisions, such as evaluating cost and benefits of different processes or deciding whether the company should make or buy a product.

EXAMPLE 1 Computing the Break-even Quantity

Shu Chen plans to produce a new line of children's scarves and is considering the scarves' processing needs and market potential. She estimates that the variable cost for each product is \$25 and the fixed cost per year is \$15,000. If Shu offers each scarf at a selling price of \$30, how many scarves must she sell to break even? If Shu sells 4,000 scarves at the \$30 price, what will be the contribution to profit?

SOLUTION:

To compute the break-even quantity:

$$Q_{BE} = \frac{F}{S_P - V_C}$$
$$Q_{BE} = \frac{\$15,000}{\$30 - \$25} = 3,000 \text{ scarves}$$

This means Shu needs to sell 3,000 scarves to cover her costs. To compute the contribution to profit with sales of 4,000 scarves, we look at the relationship between cost and revenue:

$$\begin{aligned}\text{Profit} &= \text{Total Revenue} - \text{Total Cost} \\ &= (S_P)Q - [F + (V_C)Q] \\ \text{Profit} &= \$30(4,000) - [\$15,000 + \$25(4,000)] \\ \text{Profit} &= \$5,000\end{aligned}$$

The contribution to profit is \$5,000 if Shu can sell 4,000 scarves from her new line.

Let us look at an example of this in practice. Netflix employed break-even analysis when transitioning from a digital versatile disc (DVD) rental service to an online streaming platform. They used this analysis to determine when their streaming venture would cover the costs of content licensing, technology, and infrastructure investments. It helped establish the subscription threshold needed to achieve a point where revenue equaled total streaming operation costs. For Netflix, fixed costs included infrastructure maintenance, content licensing, and employee salaries. Variable costs encompassed expenses tied to content delivery, customer support, and technology, which scaled with subscriber and streaming activity.

Break-even analysis empowered Netflix to make data-driven decisions about content investments and pricing. It allowed the company to set subscription rates and assess the risk associated with the transition to a streaming service. This example underscores how Netflix's use of break-even analysis played a pivotal role in its strategic shift to a successful streaming service, which revolutionized the entertainment industry.

Concept Check Questions

49. Break-even analysis is used to compute the product quantity that needs to be sold for a company to cover its depreciation.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

50. At the break-even point, total cost equals revenue.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

51. Fixed costs are those that do not vary with the quantity produced.

☐ True

☐ False

Correct or Incorrect?

Clear

Check Answer

52. The lower the fixed costs, the higher the break-even point.

☐ True

☐ False

Correct or Incorrect?

Clear

Check Answer

53. The lower the variable costs, the higher the break-even point.

☐ True

☐ False

Correct or Incorrect?

Clear

Check Answer

54. The lower the sales price, the higher the break-even point.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

55. Break-even analysis can also be useful for conducting a sensitivity analysis to evaluate how changes in product price affect the break-even quantity.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

56. Netflix employed break-even analysis when transitioning from a DVD rental service to an online streaming platform.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Factors Impacting Product Design Decisions

Some additional factors need to be considered during the product design process:

Design for manufacture (DFM).

DFM is a series of guidelines that should be followed to produce a product easily and profitably. Consider that product design processes are typically driven by the desire to create the exact product the customer wants. However, it is also important to consider how easy it is to manufacture. Otherwise, a product that is either difficult or too costly to manufacture may be created. DFM guidelines focus on two issues: design simplification and design standardization. Design simplification means reducing the number of parts and features of the product whenever possible.

A simpler product is easier to make, fewer mistakes are made, and it is less costly to produce. Design standardization, on the contrary, refers to the use of common and interchangeable parts. By using interchangeable parts, a greater variety of products can be made with less inventory, significantly lower cost, and greater flexibility. DFM includes rules such as minimizing parts, designing common parts for different products, using modular design, avoiding tools, and simplifying operations.

Product life cycle.

Another factor to consider is the stage of the product life cycle. Most products go through a series of stages of changing product demand called the [product life cycle](#). There are typically four stages: introduction, growth, maturity, and decline. In the introductory stage, neither the product nor the market are well defined, and all the “bugs” have not been worked out. In the growth stage, the product is more established, although both product and market continue to be refined. In the maturity stage, the product and market become fairly stable and predictable. Finally, in the decline stage the product experiences declining demand due to competing product designs or market saturation. In the first two stages of the product life cycle—called the early stages—the product and market are still being refined. Here product design involves product improvement and refinement based on market response. In the last two stages—called the later stages—the product and market are stable. The product, however, is approaching the end of its life cycle, and product design may involve major changes or reinventions to either revitalize an old product or create a new one for the market.

Let us look at an example of a product life cycle and the iPhone. The introduction of the first iPhone in 2007 marked the beginning of the product life cycle—the introduction stage. The product and smartphone market was not well-defined, and the initial iPhone required refinement and bug fixes. Subsequent iPhone models entered the growth stage with a growing customer base and product refinements. The iPhone became an established and popular product category with continuous

improvements. Then came the maturity stage as the iPhone matured with a stable product and market. Sales remained consistently strong, and the product's features and design reached a high level of maturity. The iPhone has not yet reached the decline stage, but it is a phase that all products eventually face if they do not reinvent. In the early stages, Apple focused on continuous product improvement based on market feedback, introducing new features and enhancements with each model. In the later stages, if the iPhone approaches decline, Apple may need to consider significant changes or reinventions to reinvigorate the product or introduce innovations. This example illustrates how the iPhone, a flagship product of Apple, has navigated through various phases of the product life cycle, highlighting the importance of ongoing product design and innovation in each stage.

Concurrent engineering. Historically, product design was made sequentially, where an idea was developed and then passed on to each function for evaluation. This was a time-consuming and inefficient process. Today, companies engage in concurrent engineering that requires all the functions to work together simultaneously to design and evaluate the product.

Remanufacturing. Remanufacturing uses components of old products in the production of new ones. It has enormous environmental and cost benefits, as the remanufactured products can be a fraction of the price of their new counterparts. Remanufacturing is especially popular in the electronics industry, such as the production of computers and televisions.



Concept Check Questions

57. This is a series of guidelines that should be followed to produce a product easily and profitably.

- ☐ a) Design for manufacture
- ☐ b) Product life cycle
- ☐ c) Concurrent engineering
- ☐ d) Remanufacturing.
- ☐ e) Production manual

Correct or Incorrect?

Clear

Check Answer

58. Most products go through a series of stages of changing product demand.

- ☐ a) Design for manufacture
- ☐ b) Product life cycle
- ☐ c) Concurrent engineering
- ☐ d) Remanufacturing.
- ☐ e) Product history

Correct or Incorrect?

Clear

Check Answer

59. This uses components of old products in the production of new ones.

- ☐ a) Design for manufacture
- ☐ b) Product life cycle
- ☐ c) Concurrent engineering
- ☐ d) Remanufacturing.
- ☐ e) Recycling

Correct or Incorrect?

Clear

Check Answer

60. This requires that requires all the functions to work together simultaneously to design and evaluate the product.

- ☐ a) Design for manufacture
- ☐ b) Product life cycle
- ☐ c) Concurrent engineering
- ☐ d) Remanufacturing.
- ☐ e) Rapid deployment

Correct or Incorrect?

Clear

Check Answer

61. A simpler product is easier to make, fewer mistakes are made, and it is less costly to produce.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

62. There are typically five product life cycle stages.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

63. Historically, product design was made sequentially, where an idea was developed and then passed on to each function for evaluation.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Process Design

What Is Process Design?

Process design involves developing a production process that can create the exact product that has been designed. Look at different products around you and consider the processes used to create them—from a box of chocolates to the software on your computer. Some processes produce standardized “off the shelf” products, like Totino's Pizza Rolls in your freezer, and some work with customers to customize their products, such as pizzas made to order at a local pizza shop.

Although there seem to be large differences between the processes of companies, many have certain characteristics in common. Based on common characteristics processes can be grouped into two broad categories: **intermittent** and **repetitive processes**. These two categories differ in almost every way. The most common difference, however, is along two dimensions: **product volume** and **degree of product standardization**. Product volume is the quantity produced and can range from making few one-of-a-kind customized products to producing large quantities of products in batches. Product standardization is the amount of product variety. Examples of standardized products are white undershirts, sugar, and postal service. Process requirements—including equipment and labor—are quite different for producing standardized vs customized products.

Characteristics of both intermittent and repetitive processes are shown in [Figure 5.7](#). Understanding these differences can help us match processes across the supply chain network, understand their strengths and weaknesses, and ensure optimal flow.

Concept Check Questions

64. Process design involves developing a production process that can create the exact product that has been designed.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

65. Based on common characteristics processes can be grouped into how many broad categories?

- ☐ a) Two
- ☐ b) Three
- ☐ c) Four
- ☐ d) Many

Correct or Incorrect?

Clear

Check Answer

66. Which of the following pairs is the most common difference between products?

- ☐ a) Product volume and intermittent process
- ☐ b) Intermittent and repetitive process
- ☐ c) Product volume and degree of product standardization
- ☐ d) Degree of product standardization and product volume
- ☐ e) None of these

Correct or Incorrect?

Clear

Check Answer

67. Process requirements are quite different for producing standardized versus customized products.

☐ True

☐ False

Correct or Incorrect?

Clear

Check Answer

Intermittent Processes

Intermittent processes are used to produce a large variety of products with different processing requirements in lower volumes. Examples are an auto body shop, a tool and die shop or a healthcare facility. As different products have different processing needs, there is no standard route that all products take through the facility. Instead, resources are grouped by function, and the product is routed to each resource as needed. Think about a healthcare facility. Each patient is routed to different departments as needed. One patient may need an X-ray, go to the lab for blood work, and then go to the examining room. Another patient may need to go to the examining room and then to physical therapy.

Decision	Intermittent processes	Repetitive processes
Product variety	Large	Small
Product standardization	Low	High
Product life cycle	Early stage	Later stage
Resources	Grouped by function	Line flow
Critical resources	Labor intensive	Capital intensive
Type of equipment	General purpose	Specialized
Throughput time	Longer	Shorter
Work-in-process inventory	High	Low

FIGURE 5.7 Differences between intermittent and repetitive processes.

Intermittent processes tend to produce products in the early stages of the product life cycle, where the product is still not well defined. They tend to be labor intensive, rather than capital intensive, to remain flexible. Workers need to be able to perform a variety of tasks, depending on the products' processing needs. These processes rely on highly skilled workers and give them discretion to perform their jobs. Equipment is more general-purpose to satisfy different processing requirements. Automation is less common because automation tends to be product specific, and it is not cost efficient to invest in automation for only one product type.

Concept Check Questions

68. Intermittent processes are used to produce a large variety of products with different processing requirements in lower volumes.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

69. With intermittent processes, there is one fixed path through the facility.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Repetitive Processes

Repetitive processes are used to produce one, or a few, standardized products in high volume. Examples include an automobile assembly line, a cafeteria, and an automatic car wash. Resources, such as machines and workers, are organized in a line flow to efficiently accommodate production of the product.

Repetitive processes tend to produce products in the later stages of the life cycle, and the larger volumes are justified by a well-established market. To produce a large volume of one type of product, these processes tend to be more capital intensive, rather than labor intensive. An example is “mass production,” where companies usually have much invested in their facilities and equipment to provide a high degree of product consistency. Often these facilities rely on automation and technology, rather than on labor skills, to improve efficiency and increase output. The volume produced is usually based on a forecast of future demands rather than on direct customer orders.

A good example of repetitive and intermittent processes can be seen in the automobile assembly. General Motors, for example, utilizes repetitive processes for mass-producing vehicles such as the Chevrolet Silverado. The Chevrolet Silverado is produced in large quantities in batches, catering to the mass market. The degree of standardization is high, with consistent features and options across different Silverado models. The assembly line approach ensures the efficient production of standardized vehicles. However, automobile assembly can also offer customization services utilizing intermittent processes. General Motors offers, for example, offers customization services, allowing customers to tailor their vehicles. An example is the Chevrolet Corvette, which offers various customization options. The Chevrolet Corvette, although a sports car with a limited market, offers customization options for individual buyers. The degree of standardization is lower as customers can choose unique features, colors, and other

customizations. Customization services for the Chevrolet Corvette are more intermittent and flexible to meet specific customer requests.

Concept Check Questions

70. Repetitive processes are used to produce one, or a few, standardized products in high volume.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

71. Repetitive processes are used to produce products to customer orders.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

72. Which of the following processes typically has a large product variety?

- ☐ a) Intermittent
- ☐ b) Repetitive
- ☐ c) Both
- ☐ d) Neither

Correct or Incorrect?

Clear

Check Answer

73. Which of the following processes typically has a low product variety?

- ☐ a) Intermittent
- ☐ b) Repetitive
- ☐ c) Both
- ☐ d) Neither

Correct or Incorrect?

Clear

Check Answer

74. Which of the following processes typically has low product standardization?

- ☐ a) Intermittent
- ☐ b) Repetitive
- ☐ c) Both
- ☐ d) Neither

Correct or Incorrect?

Clear

Check Answer

75. Which of the following processes typically has high product standardization?

- ☐ a) Intermittent
- ☐ b) Repetitive
- ☐ c) Both
- ☐ d) Neither

Correct or Incorrect?

Clear

Check Answer

76. Which of the following processes is typically used in the early stage of the product life cycle?

- ☐ a) Intermittent
- ☐ b) Repetitive
- ☐ c) Both
- ☐ d) Neither

Correct or Incorrect?

Clear

Check Answer

77. Which of the following processes is typically used in the later stage of the product life cycle?

- ☐ a) Intermittent
- ☐ b) Repetitive
- ☐ c) Both
- ☐ d) Neither

Correct or Incorrect?

Clear

Check Answer

78. Which of the following processes has resources grouped by function?

- ☐ a) Intermittent
- ☐ b) Repetitive

- ☐ c) Both
- ☐ d) Neither

Correct or Incorrect?

Clear

Check Answer

79. Which of the following processes has resources grouped by line flow?

- ☐ a) Intermittent
- ☐ b) Repetitive
- ☐ c) Both
- ☐ d) Neither

Correct or Incorrect?

Clear

Check Answer

80. Which of the following processes has labor as a critical resource?

- ☐ a) Intermittent
- ☐ b) Repetitive
- ☐ c) Both
- ☐ d) Neither

Correct or Incorrect?

Clear

Check Answer

81. Which of the following processes has capital as a critical resource?

- ☐ a) Intermittent
- ☐ b) Repetitive
- ☐ c) Both
- ☐ d) Neither

Correct or Incorrect?

Clear

Check Answer

82. Which of the following processes uses general purpose equipment?

- ☐ a) Intermittent
- ☐ b) Repetitive
- ☐ c) Both
- ☐ d) Neither

Correct or Incorrect?

Clear

Check Answer

83. Which of the following processes uses specialized equipment?

- ☐ a) Intermittent
- ☐ b) Repetitive
- ☐ c) Both
- ☐ d) Neither

Correct or Incorrect?

Clear

Check Answer

84. Which of the following processes has a longer throughput time?

- ☐ a) Intermittent
- ☐ b) Repetitive
- ☐ c) Both
- ☐ d) Neither

Correct or Incorrect?

Clear

Check Answer

85. Which of the following processes has a shorter throughput time?

- ☐ a) Intermittent
- ☐ b) Repetitive
- ☐ c) Both
- ☐ d) Neither

Correct or Incorrect?

Clear

Check Answer

86. Which of the following processes has high work-in-process inventory?

- ☐ a) Intermittent
- ☐ b) Repetitive
- ☐ c) Both
- ☐ d) Neither

Correct or Incorrect?

Clear

Check Answer

87. Which of the following processes has low work-in-process inventory?

- ☐ a) Intermittent
- ☐ b) Repetitive
- ☐ c) Both
- ☐ d) Neither

Correct or Incorrect?

Clear

Check Answer

The Continuum of Process Types

The two process categories—intermittent and repetitive—can be further divided to provide greater detail. Intermittent processes can be divided into [project processes](#) and [batch processes](#). Repetitive processes can be divided into [line processes](#) and [continuous processes](#). This provides a continuum of process types as shown in [Figure 5.8](#).

Project processes are used to make one-of-a-kind products exactly to customer specifications. These processes are used where there is high customization and low product volume, as each product is different. Examples include construction, shipbuilding, medical procedures, custom tailoring, and interior design.

Batch processes are used to produce small quantities of products in groups or batches based on customer orders or product specifications. They are also known as job shops. The volumes of each product produced are still small, and there can still be customization. Examples can be seen in bakeries, education, and printing shops. The classes you take at the university use a batch process.

Line processes are designed to produce a large volume of a standardized product for mass production. They are also known as flow shops, flow lines, or assembly lines. With line processes, the products are made in high volume with little or no customization. Think of typical assembly lines that produce everything from cars, computers, television sets, and shoes to candy bars, and even food items.

Continuous processes operate continually to produce a very high volume of a fully standardized product. Examples include oil refineries, water treatment plants, and certain paint facilities. The products produced by continuous processes are usually in continual rather than discrete units such as liquid or gas. They usually have a single input and a limited number of outputs. Also, these facilities are usually highly capital intensive and automated.

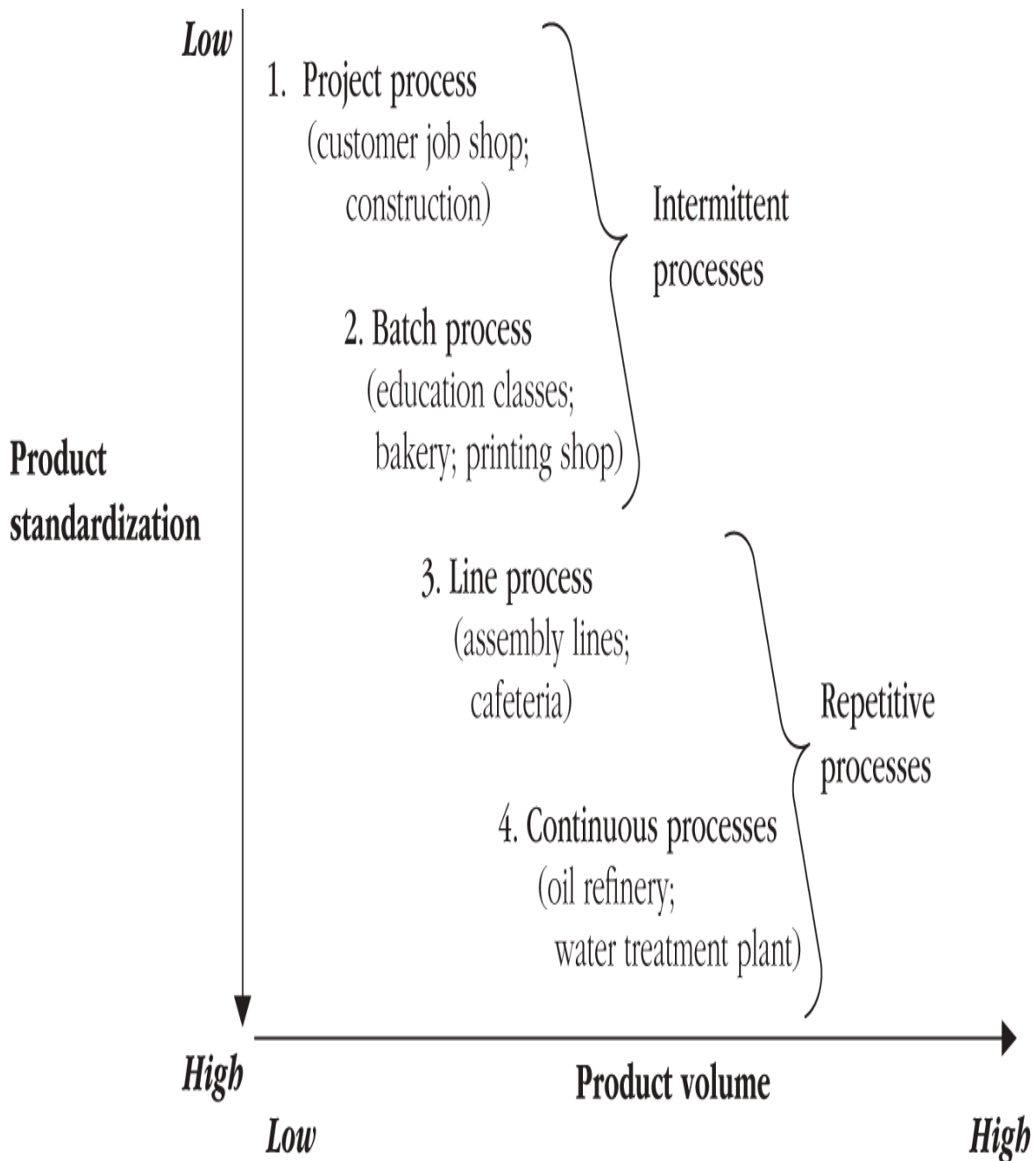


FIGURE 5.8 Continuum of process types.¹

ExxonMobil operates oil refineries that exemplify **continuous processes**. Oil refineries continuously process large volumes of crude oil into standardized petroleum products, such as gasoline, diesel fuel, and jet fuel. These refineries are capital intensive and highly automated, as they operate around the clock to meet the demands for these standardized products. The input is crude oil, and the outputs are various refined petroleum products in a continuous, uninterrupted flow. This example demonstrates how ExxonMobil's oil refineries embody

continuous processes by producing highly standardized products in large volumes through continual operations.

Note that both project and batch processes have low product volumes and offer customization. The difference is in the volume and degree of customization. Project processes are more extreme cases of intermittent processes, compared to batch processes. Also, note that both line and continuous processes primarily produce large volumes of standardized products. Similarly, continuous processes are more extreme cases of high volume and product standardization than line processes.

[Figure 5.8](#) positions these four process types along the diagonal to show the best process strategies relative to product volume and product customization.

Companies whose process strategies do not fall along this diagonal may not have made the best process decisions. Keep in mind, however, that not all processes fit into only one of these categories: a company may use both batch and project processing to good advantage. For example, a bakery that produces bread cakes, and pastries in batches may also bake and decorate cakes to order. Also, today's advances in technologies have created greater processing options. For example, many companies are moving toward mass customization, which provides increased variety while still getting the advantages of repetitive processes. Consider companies such as Dell which allows customers to design their customized computers online, or such as Nike which allows customers to design their customized footwear. Here customers can “design” a product by choosing from a range of options. Mass customization uses advanced technologies to customize products quickly and at a low cost. These companies store inventory in standard modules that are then configured to the exact product specification desired by the customer.



Concept Check Questions

88. These are used to make one-of-a-kind products exactly to customer specifications.

- ☐ a) Project processes
- ☐ b) Batch processes

- ☐ c) Line processes
- ☐ d) Continuous processes
- ☐ e) None of these

Correct or Incorrect?

Clear

Check Answer

89. These are used where there is high customization and low product volume, as each product is different.

- ☐ a) Project processes
- ☐ b) Batch processes
- ☐ c) Line processes
- ☐ d) Continuous processes
- ☐ e) None of these

Correct or Incorrect?

Clear

Check Answer

90. These are used to produce small quantities of products in groups or batches based on customer orders or product specifications.

- ☐ a) Project processes
- ☐ b) Batch processes
- ☐ c) Line processes
- ☐ d) Continuous processes
- ☐ e) None of these

Correct or Incorrect?

Clear

Check Answer

91. They are also known as job shops.

- ☐ a) Project processes
- ☐ b) Batch processes
- ☐ c) Line processes
- ☐ d) Continuous processes
- ☐ e) None of these

Correct or Incorrect?

Clear

Check Answer

92. These are designed to produce a large volume of a standardized product for mass production.

- ☐ a) Project processes
- ☐ b) Batch processes
- ☐ c) Line processes
- ☐ d) Continuous processes
- ☐ e) None of these

Correct or Incorrect?

Clear

Check Answer

93. They are also known as flow shops, flow lines, or assembly lines.

- ☐ a) Project processes
- ☐ b) Batch processes
- ☐ c) Line processes
- ☐ d) Continuous processes
- ☐ e) None of these

Correct or Incorrect?

Clear

Check Answer

94. These operate continually to produce a very high volume of a fully standardized product.

- ☐ a) Project processes
- ☐ b) Batch processes
- ☐ c) Line processes
- ☐ d) Continuous processes
- ☐ e) None of these

Correct or Incorrect?

Clear

Check Answer

95. The products are usually in continual rather than discrete units such as liquid or gas.

- ☐ a) Project processes
- ☐ b) Batch processes
- ☐ c) Line processes
- ☐ d) Continuous processes
- ☐ e) None of these

Correct or Incorrect?

Clear

Check Answer

96. ExxonMobil operates oil refineries that exemplify these

- ☐ a) Project processes
- ☐ b) Batch processes
- ☐ c) Line processes
- ☐ d) Continuous processes
- ☐ e) None of these

Correct or Incorrect?

Clear

Check Answer

Managerial Insights Box—A New Manufacturing Process

■ RAPID MANUFACTURING

Rapid manufacturing (RM) is a state-of-the-art process that is changing the way products are made. It is a technique used to quickly manufacture a prototype model from a computer-aided design (CAD) file and uses 3-D printing or additive manufacturing (AM). RM uses technology to make products to order when needed, exactly where they are needed and is considered to be one of the most important potential influences on the future of manufacturing. RM is an application of 3-D printing or AM, which we discussed in [Chapter 1](#).

RM involves the economic manufacture of low-volume products, or prototypes, on-demand at multiple locations near the point of consumption. It relies on new developments in three-dimensional (3-D) printing technologies or AM. AM consists of three basic steps. First, a 3-D computer representation is fed into a specially designed layer manufacturing machine, which can come from a variety of sources including CAD. Next, the image is digitally sliced up into hundreds of 2-D layers, each representing a profile of the part to be manufactured. Finally, the layers are rebuilt inside the AM machine one at a time, from the bottom up, until the part is complete.

There has been a rapid rise in the number of companies using RM. Companies such as Boeing, Airbus, BAE Systems, Renault, and Honda are all using RM for a variety of applications. Healthcare has many applications as well. For example, RM is being used to manufacture bone-replacement material for reconstructive surgeries and for creating customized prosthetics. RM is also used to design disposable surgical cutting guides, which are personalized to the individual patient. Dentistry is one of the best-known applications for RM; doctors are using the technology to manufacture customized dental caps, bridges, and crowns. Also, it is used in the production of personalized in-the-ear hearing aids, which are manufactured to fit exactly into each patient's ear. Another example is the manufacture of invisible dental braces. Invisalign Inc. is a company that uses RM to manufacture forming tools over which disposable, transparent dental braces are individually formed in sets for each patient.

Facility Layout

Facility Layout Planning

Product and process design directly impacts the organization of resources needed to produce the product. One aspect of the operation that is especially impacted is facility layout, which is the physical arrangement of all resources within a facility. These resources include everything that is part of the operation: a work center, a machine, an entire office, or just the location of a desk. Facility layout planning is made any time there is a change in the arrangement of resources. This could be a redesign of the operation to produce a new product. It can also be the change in resources being used, such as a new worker being added, a machine being moved, or a change in the process. Facility layout has a significant impact on performance, especially, production cost, time, and flexibility. Most people are surprised to learn that poor facility layouts are one of the most-significant contributors to inefficiency and increased production costs. For this reason, managers spend a great deal of effort ensuring that facility layouts are efficient and enhance workflow.

Amazon's fulfillment centers, key to their e-commerce operations, exemplify the direct influence of product and process design on facility layout. These centers are strategically organized to optimize the handling and shipping of various products, influenced by the specific processes involved in order fulfillment. Facility layout encompasses the arrangement of resources like storage shelves, conveyor systems, workstations, and packing stations. The layout is meticulously designed to facilitate efficient product flow and minimize time and effort in the order picking, packing, and shipping processes. This example illustrates how Amazon's fulfillment centers are a prime demonstration of how product and process design directly impacts facility layout, ensuring streamlined operations and quick, accurate order processing for a wide range of products and customer orders.

Concept Check Questions

97. One aspect of the operation that minimal impact is facility layout, which is the physical arrangement of all resources within a facility.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

98. Facility layout planning is made any time there is a change in the arrangement of resources.

☐ True

☐ False

Correct or Incorrect?

Clear

Check Answer

99. Facility layout has a significant impact on performance, especially production cost, time, and flexibility.

☐ True

☐ False

Correct or Incorrect?

Clear

Check Answer

Types of Facility Layouts

There are four distinct layout types: fixed position, process, product, and cellular. The type of process design selected influences the physical layout of the operation, including the arrangement of the equipment, employees, inventory, and aisles for movement. Different layouts lend themselves to producing different types of products, and it is important to match product designs with appropriate layouts.

Fixed-position Layout.

A fixed-position layout is used when a product cannot be moved during production, usually due to size. They are typically used for producing large products such as homes, buildings, bridges, large ships, airplanes, and spacecraft. The greatest supply chain challenge here is for all the resources to come together at the product's location in the right sequence at the right time. Consider the process of construction where different tasks must be performed in sequence, such as installing electrical wiring and plumbing, putting up drywall, and installing flooring. Each has different timing and sequence requirements. Due to the fixed nature of the product, the layout problem becomes a scheduling problem requiring timing and sequencing of different tasks.

An example of a fixed-position layout is the Boeing Aircraft Assembly. Boeing, a renowned aircraft manufacturer, uses fixed-position layouts for the assembly of large commercial airplanes like the Boeing 747. These airplanes are massive and complex, making it impossible to move them during the assembly process. As the aircraft assembly progresses, different tasks, such as installing electrical systems, plumbing, wings, and engines, need to be completed in a specific sequence. Given the fixed nature of the product, all required resources and components must converge at the aircraft's location, and each task must be executed with precise timing and sequencing. The supply chain challenge lies in efficiently orchestrating these tasks within the constraints of a fixed-position layout, transforming the layout challenge into a scheduling puzzle.

This example illustrates how Boeing successfully addresses the challenge of assembling large commercial airplanes by utilizing a fixed-position layout and applying meticulous timing and sequencing to ensure efficient aircraft production.

Process Layout.

Process layouts are best suited when producing different types of products in low volume, as seen in intermittent processes. Here products have different processing needs, and it would be almost impossible to create a sequence of departments to accommodate each one. As a result, resources are grouped by process—hence the term “process” layout. Here the product is moved between groupings based on need. Consider a hospital where functional groupings are created, such as maternity, pharmacy, laboratory, and X-ray. The patient—the product in this case—is moved between departments based on their need. A grocery store is another example, where food items are grouped based on their use, with sections for dairy, meat, bakery, canned goods, and produce. Retailers also use process layouts, with departments for shoes, children's clothing, cosmetics, and jewelry. [Figure 5.9](#) shows a process layout for a small clinic.

In process layouts, each product or customer takes a different route through the operation. This results in several disadvantages. First, material handling costs are high as products have to be moved from one department to another. Second, processing times and work-in-process inventory tend to be high as products or customers wait to be processed in different departments. Finally, there is also time lost to switching equipment from working on one product to another.

Process layouts provide the ability to produce a large variety of products. However, scheduling, planning, and control of the operation are difficult. It is very easy for these layouts to become inefficient if they are not designed properly. When designing process layouts, the objective is to arrange the departments so that the time and cost of moving materials and people are minimized.

Mayo Clinic, a prominent healthcare organization, adopts a process layout in its medical facilities. Healthcare services encompass a wide variety of medical conditions and patient needs, each with unique processing requirements. Mayo Clinic's medical facilities are organized into functional groupings, including maternity wards, pharmacies, laboratories, and X-ray departments. Rather than adhering to a fixed sequence of departments, patients are directed to the specific functional grouping that suits their medical needs. This process layout allows Mayo Clinic to efficiently accommodate diverse medical services and patient requirements, ensuring that patients move between different service areas based on their specific healthcare needs.

Product Layout.

A product layout arranges resources in sequence to enable efficient production of the products. It is a layout most suited for producing a high volume of one, or a few similar, products. An automotive assembly line, an automatic car wash, or a buffet table are perfect examples. Every product going through the line is almost the same. Product layouts minimize processing times, and planning, scheduling, and control are simplified. An example of flow through a product layout is shown in [Figure 5.10](#).

Waiting room	Examining room	Surgical room
Office	Laboratory	Recovery

FIGURE 5.9 Process layout.

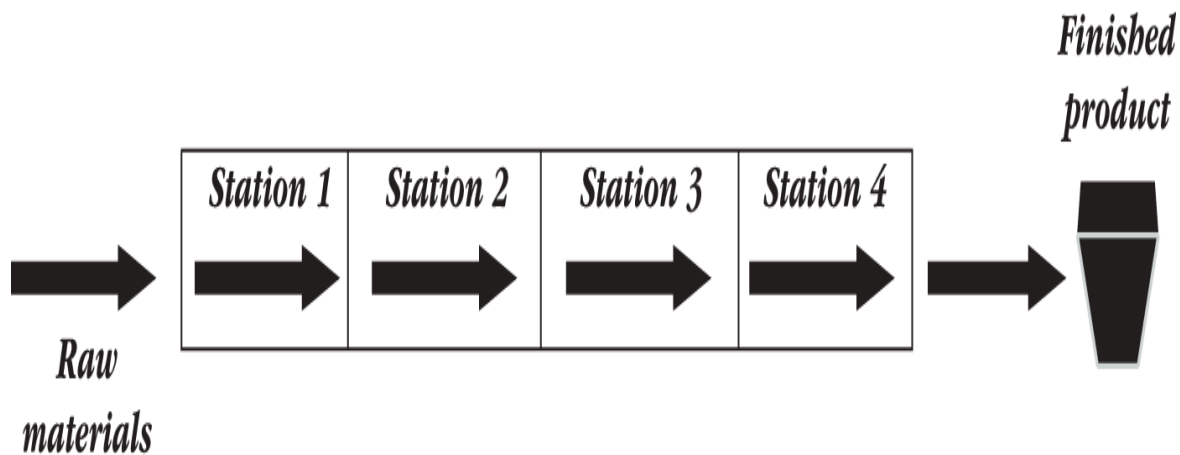


FIGURE 5.10 Product layout.

Product layouts are highly efficient and minimize the cost of producing high-volume products. However, they also have several disadvantages. First, they lack flexibility found with process layouts and are unable to produce variations of products. Second, because workstations are highly dependent on one another, a stoppage at a single workstation can cause the entire line to stop producing. Similarly, quality problems or delays in shipments from suppliers can have the same effect as product layout design extends to the supply chain.

Cellular Layouts.

Cellular layouts attempt to combine the efficiency and repetition of product layouts with the flexibility of process layouts. Cellular layouts group items based on similar processing characteristics and arrange workstations to form several small assembly lines called work cells. Then workstations within each work cell are arranged using product layout principles. The first step in designing a cellular layout is to use group technology to identify products that have similar processing requirements, called product families. These product families may have similar shapes, sizes, process flows, or demands. Then each work cell can be dedicated to making a product family.

An example of cellular layouts in the Toyota Production System (TPS). Toyota, a pioneer in lean manufacturing and efficient production, employs cellular layouts as part of the TPS. The TPS focuses on combining the efficiency and repeatability of product layouts with the adaptability of process layouts. Toyota's production

process involves grouping items based on similar processing characteristics and forming small assembly lines known as work cells. Workstations within each work cell are organized using product layout principles, optimizing the efficiency of assembly for specific product families. In TPS, the initial step is to apply group technology to identify product families with similar processing requirements, considering factors like shape, size, process flows, and demand. Each work cell is then dedicated to producing a specific product family, allowing for streamlined and efficient production processes. Toyota's application of cellular layouts within the TPS is a prime example of how this approach enhances production efficiency by grouping products with similar processing characteristics into dedicated work cells.

Managerial Insights Box

■ MAZZI'S VS TOTINO'S PIZZA

Consider two companies that both make the same type of product—pizza—but in a very different operations setting. One uses a process layout; the other, a product layout. Totino's makes frozen pizza that you can purchase in your local grocer's freezer. The pizzas are made in an assembly line format en masse with strict ingredients and predictable quality standards. The production output is set, and the sequence of operations is repetitive and predictable. It uses a make-to-stock strategy, with defined versions of the product, limiting product variety. It also sources large quantities of ingredients from its standard suppliers.

In contrast, Mazzi's—a family-owned Italian restaurant—makes everything from scratch. It uses a process layout format and custom makes many of its entrees and pizzas to order. The bread and dough are baked on the premises in the bakery. The produce is obtained locally. It has its own farm and also sources locally from a variety of independent farmers. As a result, the menu might change depending on availability of fresh vegetables and what is in season. This offers greater product variety and more customization.

The layouts of both facilities are tied to each company's business strategy and their target markets. Each layout enables the company to achieve its set goals and meet the expectations of its respective customers.

Concept Check Questions

There are how many distinct layout types?

- ☐ a) One
- ☐ b) Two
- ☐ c) Three
- ☐ d) Four
- ☐ e) Many

Correct or Incorrect?

Clear

Check Answer

100. This layout is used when a product cannot be moved during production, usually due to size.

- ☐ a) Fixed position layout
- ☐ b) Process layout
- ☐ c) Product layout
- ☐ d) Cellular layout

Correct or Incorrect?

Clear

Check Answer

101. This is typically used for producing large products such as homes, buildings, bridges, large ships, airplanes, and spacecraft.

- ☐ a) Fixed position layout
- ☐ b) Process layout
- ☐ c) Product layout
- ☐ d) Cellular layout

Correct or Incorrect?

Clear

Check Answer

102. This is best suited when producing many different types of products in low volume, as seen in intermittent processes.

- ☐ a) Fixed position layout
- ☐ b) Process layout
- ☐ c) Product layout
- ☐ d) Cellular layout

Correct or Incorrect?

Clear

Check Answer

103. This layout arranges resources in sequence to enable efficient production of the product.

- ☐ a) Fixed position layout
- ☐ b) Process layout
- ☐ c) Product layout
- ☐ d) Cellular layout

Correct or Incorrect?

Clear

Check Answer

104. Here products have different processing needs, and it would be almost impossible to create a sequence of departments to accommodate each one.

- ☐ a) Fixed position layout
- ☐ b) Process layout
- ☐ c) Product layout
- ☐ d) Cellular layout

Correct or Incorrect?

Clear

Check Answer

105. Mayo Clinic, a prominent healthcare organization, adopts this layout in its medical facilities.

- ☐ a) Fixed position layout
- ☐ b) Process layout
- ☐ c) Product layout
- ☐ d) Cellular layout

Correct or Incorrect?

Clear

Check Answer

106. This layout is highly efficient and minimizes cost of producing high-volume products.

- ☐ a) Fixed position layout
- ☐ b) Process layout
- ☐ c) Product layout
- ☐ d) Cellular layout

Correct or Incorrect?

Clear

Check Answer

107. It is a layout most suited for producing a high volume of one, or a few similar, products.

- ☐ a) Fixed position layout
- ☐ b) Process layout
- ☐ c) Product layout
- ☐ d) Cellular layout

Correct or Incorrect?

Clear

Check Answer

108. This groups items based on similar processing characteristics and arrange workstations to form a number of small assembly lines called work cells.

- ☐ a) Fixed position layout
- ☐ b) Process layout
- ☐ c) Product layout
- ☐ d) Cellular layout

Correct or Incorrect?

Clear

Check Answer

109. An example of this layout is the Toyota Production System.

- ☐ a) Fixed position layout
- ☐ b) Process layout
- ☐ c) Product layout
- ☐ d) Cellular layout

Correct or Incorrect?

Clear

Check Answer

Line Balancing in Product Layouts

Product layouts arrange resources in sequence so the product can be made as efficiently as possible. This type of layout is used when producing a large volume of one standardized product and there is repetition of the process. In product layouts, the material moves continuously and uniformly through a sequence of operations until the work is completed.

Look at [Figure 5.10](#) and notice that there is simultaneous work going on at each workstation. This is different from having one person do all the work beginning to end. This type of process allows a large volume to be produced. When designing product layouts, the objective is to decide on the sequence of tasks to be performed by each workstation. To accomplish this, we need to consider the logical order of the tasks to be performed and the time required to perform each task. Also, we need to consider the speed of the production process, which specifies how much time each workstation has to perform the assigned tasks. This entire process is called **line balancing**. Below are the steps that must be followed in designing product layouts:

Ford, a global automaker, is renowned for its assembly line production methods, which involve line balancing in product layouts.

Ford's assembly lines are designed to produce a large volume of standardized vehicles efficiently with repetitive processes.

As vehicles move along the assembly line, there's simultaneous work happening at each workstation, ensuring high-volume production.

In product layouts like these, the objective is to determine the sequence of tasks to be executed at each workstation.

Ford accomplishes this through careful consideration of the logical order of tasks, the time required for each task, and the speed of the production process. Ford's adoption of line balancing in its assembly line production exemplifies how careful planning and optimization of tasks at each workstation are key to efficiently manufacturing a large volume of standardized products.

Concept Check Questions

110. Product layouts arrange resources in sequence so the product can be made as efficiently as possible.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

111. Ford, a global automaker, is renowned for its assembly line production methods, which involve line balancing in process layouts.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Step 1. Identify Task Times and Precedence Relationships

The first step in line balancing is to identify the tasks that must be performed to produce the product, their duration, and the sequence in which they need to be performed. This is called a precedence relationship.

[Figure 5.11](#) illustrates tasks, task times, and the immediately preceding task for a pizza assembly. Notice that some tasks cannot be performed until other tasks are completed. For example, the dough must be rolled before the sauce can be added. However, sausage, pepperoni, or mushrooms are added only after the cheese. This precedence relationship is shown in diagrammatic form in [Figure 5.12](#).

Task	Description	Task time (s)	Preceding task
A	Roll dough	60	-
B	Add pizza sauce	40	A
C	Sprinkle cheese	35	B
D	Add sausage	25	C
E	Add pepperoni	35	C
F	Add mushrooms	25	C
G	Shrinkwrap pizza	15	D, E, F
H	Add label	10	G
Total time		245 s	

FIGURE 5.11 Precedence relationships for pizza assembly.

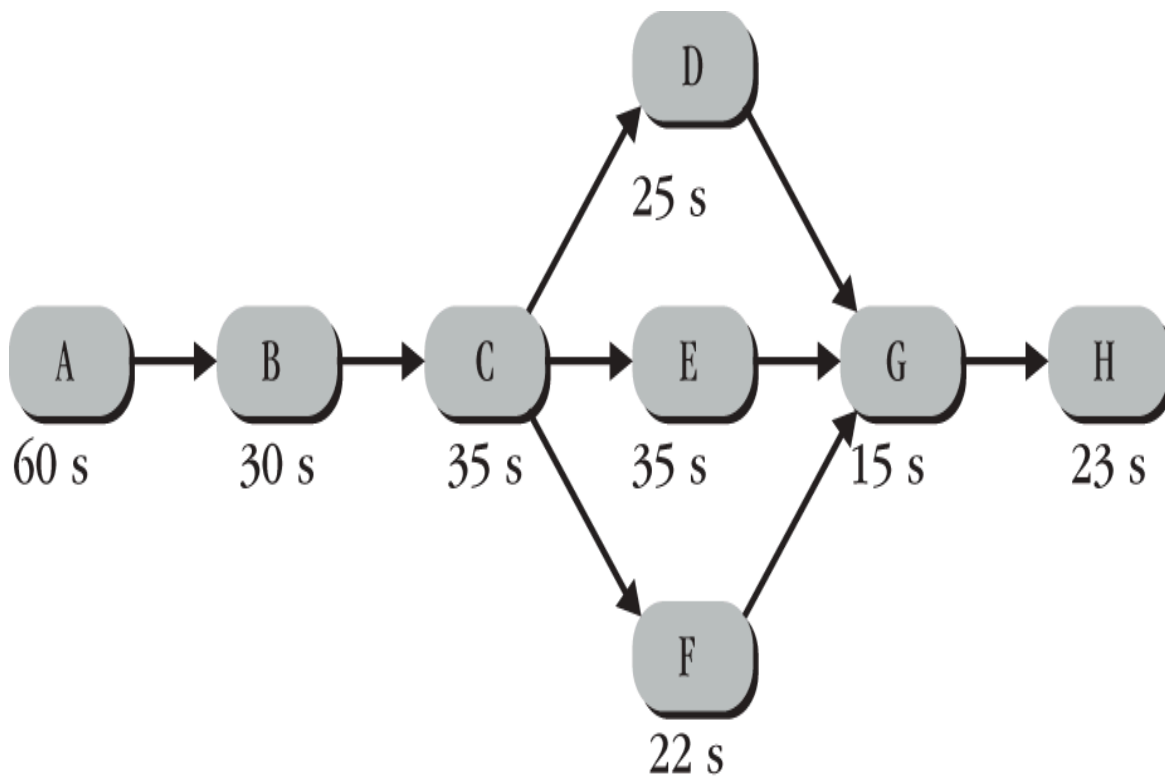


FIGURE 5.12 Precedence diagram of pizza assembly.

Concept Check Questions

112. Which of the following is the first step in line balancing?

- ☐ a) Assign Tasks to Workstations
- ☐ b) Determine Cycle Time
- ☐ c) Identify Task Times and Precedence Relationships
- ☐ d) Compute Efficiency
- ☐ e) Determine the Theoretical Minimum Number of Workstations

Correct or Incorrect?

Clear

Check Answer

113. A list of tasks, task times, and preceding task is called a precedence relationship.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Step 2. Determine Cycle Time

Recall that the product being produced on the assembly line moves in a continuous fashion. This means that each workstation has the same amount of time to complete their assigned tasks. The maximum amount of time each station on the assembly line has to complete its assigned tasks is called **cycle time** or **takt time**. The actual work time assigned to each station cannot exceed the assigned time, or cycle time. Otherwise, there would not be enough time to complete the work. This is also the frequency with which each unit is produced. Therefore, cycle time is directly related to the number of units produced.

The total task time to produce one pizza is 245 seconds, if a single person singlehandedly carries out all the tasks from beginning to end without a break. In such a case, the maximum output in one hour would be

$$\text{Maximum output} = \frac{3,600 \text{ s/h}}{245 \text{ s/h}} = 14.7 \text{ pizzas/h}$$

However, if we want to produce more pizzas than that, we will have to divide the work among several people working simultaneously at workstations to achieve the desired output rate. The first thing to compute is the cycle time:

Cycle time = Amount of time allowed to complete work at each station

$$\text{Cycle time} = \frac{\text{Available production time per day}}{\text{Desired number of units per day}}$$

Notice that the periods given to compute cycle time are per day, but they can also be given per hour or another period, as long as the periods are consistent.

Remember that operations run continuously for eight hours per day. This means that the numerator—available production time per day—can be assumed to be 480 minutes per day or 28,800 seconds per day.

The denominator—the desired number of units—is the amount we wish to produce in a certain period. Let us say we want to produce 300 pizzas per day. We can then compute the cycle time needed.

$$\text{Cycle time} = \frac{28,800 \text{ s/day}}{300 \text{ pizzas/day}} = 96 \text{ s/workstation}$$

An interesting fact is that as of 2024, the Yichang Factory of GAC Motor has the fastest automotive assembly line in the world, assembling a car every 46 seconds, which is their cycle time. On the contrary, the average assembly line takes 60 to 90 seconds per car.

Concept Check Questions

114. Which of the following is the second step in line balancing?

- ☐ a) Assign Tasks to Workstations
- ☐ b) Determine Cycle Time
- ☐ c) Identify Task Times and Precedence Relationships
- ☐ d) Compute Efficiency
- ☐ e) Determine the Theoretical Minimum Number of Workstations

Correct or Incorrect?

Clear

Check Answer

115. Cycle time and takt time are the same thing.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

116. Cycle time can only be computed using seconds.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

117. As of 2024, the Yichang Factory of GAC Motor has the slowest automotive assembly line in the world.

☐ True

☐ False

Correct or Incorrect?

Clear

Check Answer

Step 3. Determine the Theoretical Minimum Number of Workstations

The goal of line balancing is to assign tasks to workstations to achieve the best efficiency. It is usually helpful to have a baseline of what is theoretically the minimum possible number of stations we will need, although the balanced line may have more stations. The theoretical minimum number of stations computes the number of stations needed if we were 100% efficient. Remember that when determining the number of stations, round up to the next whole number, as you can never have a partial station.

$$\text{Theoretical minimum no. of stations } (N) = \frac{\text{Sum of the task times}}{\text{Cycle time}}$$

The numerator—the sum of the task times—is the total task time if one person is doing all the tasks. In our case, it is 245 seconds. The denominator is the cycle time we wish to produce. In our case, it is 96 seconds per workstation.

$$N = \frac{245 \text{ s}}{96 \text{ s/station}} = 2.55 \text{ stations} = 3 \text{ stations}$$

Concept Check Questions

118. Which of the following is the third step in line balancing?

- ☐ a) Assign Tasks to Workstations
- ☐ b) Determine Cycle Time
- ☐ c) Identify Task Times and Precedence Relationships
- ☐ d) Compute Efficiency
- ☐ e) Determine the Theoretical Minimum Number of Workstations

Correct or Incorrect?

Clear

Check Answer

119. The goal in line balancing is to assign tasks to workstations to achieve the fastest production.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

120. The theoretical minimum number of stations computes the number of stations needed if we were 100% efficient.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Step 4. Assign Tasks to Workstations

We can now proceed to assign tasks to workstations. Notice that we have to follow our precedence relationships to ensure the right sequence. For example, this means that you cannot put the cheese on before adding the sauce.

As we assign tasks to workstations, following the precedence, we have to make sure that the sum of the task times at any station does not exceed the cycle time. Otherwise, the person working at that station will not have time to complete his or her task. Also, sometimes we have a choice of tasks to assign to a station. For example, we can decide whether to put pepperoni or mushrooms or sausage next in the sequence. There are two rules we can follow here to make it easier:

Select the task with the longest task time (**longest task time rule**).

Select the task with the greatest number of followers (**Number of Followers Rule**).

These are just rules of thumb, or what we call “heuristics.” They will not necessarily result in the optimal solution but will give us a good solution. In our examples, we will use the longest task time rule. However, when assigning tasks in large and complex processes, multiple rules are used to balance the line, all to provide the highest efficiency.

[Figure 5.13](#) shows the assignment of tasks to workstations using the longest task time rule. Notice that the line is not balanced well, as the last station has much idle time—73 seconds—compared to the other stations. Once we have made these initial assignments we can go back and modify the tasks or the sequence to balance out the workload at each station. Many strategies can be used. For example, the last task, placing the label, may be modified and simplified to cut down on time. Another option might be to give additional tasks to that station that were not originally included, such as doing a quality check.

<i>Station</i>	<i>Eligible task</i>	<i>Assigned task</i>	<i>Time</i>	<i>Cumulative time</i>	<i>Idle time</i>
1	A	A	60	60	36
	B	B	30	90	6
2	C	C	35	35	61
	D, E, F	E	35	96	0
3	D, F	D	25	25	71
	F	F	22	47	24
	G	G	15	62	9
4	H	H	23	23	73

There isn't enough time remaining to add more tasks to this station. Start another station.

Selection of tasks is made using the longest task time rule.

FIGURE 5.13 Assigning tasks to workstations.

Note: Cycle time is 96 seconds/station.

Domino's pizza, a global pizza chain, exemplifies the assignment of tasks to workstations with a focus on the correct pizza assembly sequence. Precedence relationships dictate the order in which tasks are carried out; for example, sauce must be added before the cheese. When assigning tasks, it is essential to ensure that the total task time at any workstation does not exceed the available cycle time to avoid delays. Domino's carefully considers which toppings to add to pizzas and their order, such as pepperoni, mushrooms, or sausage, to maintain efficiency and meet customer expectations. This practice in the pizza-making process demonstrates how precision in task assignment is vital for ensuring efficiency and consistency in food preparation within a fast-food environment.

Concept Check Questions

121. Which of the following is the fourth step in line balancing?

- ☐ a) Assign Tasks to Workstations
- ☐ b) Determine Cycle Time
- ☐ c) Identify Task Times and Precedence Relationships
- ☐ d) Compute Efficiency
- ☐ e) Determine the Theoretical Minimum Number of Workstations

Correct or Incorrect?

Clear

Check Answer

122. When assigning tasks, you must follow the precedence relationships.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

123. When assigning tasks, all firms use the same assignment rule, the longest task time rule.

- ☐ True
- ☐ False

Correct or Incorrect?

[Clear](#)[Check Answer](#)

124. When assigning tasks, the longest task time rule optimizes the results.

- ☐ True
☐ False

Correct or Incorrect?

[Clear](#)[Check Answer](#)

Step 5. Compute Efficiency

Once we have assigned tasks to workstations on the line we need to compute our efficiency:

$$\begin{aligned}\text{Efficiency} &= \frac{\text{Sum of task times}}{\text{Number of workstations} \times \text{Cycle time}} \\ &= \frac{245 \text{ s}}{4 \text{ stations} \times 96 \text{ s/station}} = 63.8\%\end{aligned}$$

Our efficiency could be improved with better utilization of the line. One option may be to split tasks into smaller work elements or change technology to reduce the time required. More workers also can be assigned to the bottleneck tasks, which is task A in our case. This could reduce the time it takes and allow us to balance the line more efficiently.



Concept Check Questions

125. Which of the following is the fifth step in line balancing?

- ☐ a) Assign Tasks to Workstations
- ☐ b) Determine Cycle Time
- ☐ c) Identify Task Times and Precedence Relationships
- ☐ d) Compute Efficiency
- ☐ e) Determine the Theoretical Minimum Number of Workstations

Correct or Incorrect?

Clear

Check Answer

126. Efficiency is always rounded to a whole number.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Process Automation

An important operations design decision concerns the use of automation in operations processes. Technological advancements have significantly changed and enhanced the ways in which we can produce products. We are able to use technology to do much of the work for us, such as using robotics. This enhances processing speed through mechanization, provides greater accuracy, and enables the handling of dangerous and difficult tasks. Automation also reduces the need for human involvement and decision making. Consider UPS, which sorts millions of packages per day for various destinations. UPS does this through a completely automated process that uses bar codes and readers to sort packages efficiently and accurately. Repetitive assembly line processes, such as the types we just discussed, rely heavily on automation. Automation enables repetition to occur without worker fatigue, such as for tasks that need repetition of picking and sorting. It improves the consistency and accuracy of processes. Automation also

enables the use of robots for hazardous tasks, such as welding. UPS and supply chain solutions provider Softeon created the Warehouse Execution System (WES) which allows UPS to define specific customer requirements to ensure the highest priority orders are worked first without manual intervention, resulting in more than 50% productivity gains for some customers.

Concept Check Questions

127. Technological advancements have significantly changed and enhanced the ways in which we can produce products.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

128. Process automation enhances processing speed through mechanization, provides greater accuracy, and enables handling of dangerous and difficult tasks.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

129. UPS uses minimal automation.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Advantages and Disadvantages

As we can see from the KUKA example, automation has transformed today's operations. However, there are both advantages and disadvantages to using automation. One of the main advantages of automation is the replacement of human workers with automated processes for tasks that are physically dangerous, such as involving jobs in dangerous environments, such as extreme heat, fire, or nuclear facilities. Automation can take workers out of physically difficult jobs or monotonous jobs, which can result in higher error rates due to fatigue when using human workers. It also enables the handling of jobs that are beyond human capabilities, such as carrying heavy loads, working with substances that are either too hot or too cold for human contact, or at speeds that exceed human capability.

Other advantages of automation relate to economic improvements. Automation enables production to continue without stoppage around the clock, literally 24 hours a day, seven days a week. Automation brings product consistency and improved quality, due to a much lower error rate. Finally, automation improves security, as many of these jobs are risky for humans.

Global Insights Box

■ KUKA ROBOTICS CORP.

The German company KUKA Robotics Corp. is a leading producer of industrial robots for a variety of industries, from automotive and fabrication to food processing. Their industrial robots are used in production processes by companies in the auto industry (e.g., General Motors, Chrysler, Ford, Audi, and Volkswagen), aircraft production (Boeing), electronics (Siemens), furniture (IKEA), jewelry (Swarovski), retail (Walmart), food processing (Budweiser, Coca-Cola), and numerous other industrial applications. These industrial robots are used in material handling, loading and unloading of machines, palletizing, and welding. They cut steel, carry glass, and repetitively sort items without ever having to worry about danger or fatigue. They are used to cut stone kitchen counters to precision, cut steel in the manufacture of steel bridges, or weld metal parts together with heat that humans could not survive.

To design their robots, KUKA works closely with client companies to develop specific robots and control technologies for what is needed. For example, KUKA has designed robots for assembly lines where several robots work together to machine the same parts at the same time, reducing cycle times. They can also be designed to jointly handle heavy parts to share the weight or “payload.” KUKA is also working on new concepts focusing on improving the cooperation between robots and human operators with overlapping workspaces to achieve an optimal degree of automation. This would enable maximizing the advantages of both humans and robot and enable cooperative work.

More recently, KUKA has designed “collaborative robots,” also known as “cobots.” These are robots meant to operate in conjunction with humans to jointly perform tasks. Cobots are intentionally built to physically interact with humans in a shared workspace and be coworkers with humans. KUKA has pioneered robotics and has been leading the way with cobot design.

For most of us, robots are part of science fiction. KUKA robots have been seen in many Hollywood movies, from James Bond to Harry Potter. However, we may not realize their use in everyday life, which is in almost all of today's large-scale production processes.

There are, however, disadvantages to automation. First, the initial cost of automation can be very high for companies. For this reason, automation makes more sense for mature products that have an established demand and are produced in high volume. This enables the recouping of the initial financial investment, which can be very high. Second, there are limits to technology, and there are many tasks that simply cannot be automated. This can be a problem when designing assembly lines and adding automation to one part of the process, as the automated tasks may have considerably faster processing speeds than the tasks performed by humans. The human processing may create a bottleneck and not enable taking full advantage of the processing capability of the automation. Enabling the two to work in unison in the right balance is a major challenge and is precisely what KUKA is currently working on.

These disadvantages of automation can also be seen at SpaceX. SpaceX, known for its ambitious goals and advancements in space exploration, faces substantial initial costs in automating complex spaceflight missions. The development and deployment of automated systems in rocket production, spacecraft assembly, and launch operations entail significant financial investments. In addition, while SpaceX has achieved remarkable progress in reusable rocket technology and automation, there remain tasks that cannot be fully automated due to the inherent complexity of space missions. Critical decisions, emergency responses, and certain tasks require human intervention and decision making. SpaceX's efforts to automate space exploration, while groundbreaking, demonstrate the challenges associated with the high initial costs of automation and the technological limits that necessitate human involvement in certain aspects of the aerospace industry.

Concept Check Questions

130. There are no disadvantages to process automation.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

131. One of the main advantages of automation is the replacement of human workers with automated processes for tasks that are physically dangerous.

☐ True

☐ False

Correct or Incorrect?

Clear

Check Answer

132. Automation enables production to continue without stoppage around the clock.

☐ True

☐ False

Correct or Incorrect?

Clear

Check Answer

133. Automation provides less product consistency than human production.

☐ True

☐ False

Correct or Incorrect?

Clear

Check Answer

134. The cost of process automation has become very low.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

135. There are many tasks that simply cannot be automated.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

136. Any task can be automated.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Automation in Services

Automation goes well beyond manufacturing. Service organizations do not have the buffering mechanisms of inventory typically found in manufacturing. Therefore, managing operations is much more difficult. To address this issue,

services have turned to technology. Consider that telephone operators of yesteryear were replaced by a completely automated process. Other service processes, such as banking and much of purchasing, have become automated and online. Also, today, many medical screens, such as screening of genes or tissue samples, are automated.

The decision for service organizations to automate must be strategic, in addition to considering costs. Automation in services provides consistency and requires fewer employees, lowering labor costs. However, automation of service processes can impact the customer's perception of service quality. It must also relate to the target market. For example, several banks have extensive online banking services with brick-and-mortar facilities staffed with only a skeleton crew. However, in geographic markets with an older and wealthier clientele that expects traditional levels of customer service, banks have placed larger and well-staffed facilities. Therefore, automation in services needs to also be tied to the target market and their expectations.

Bank of America, a major financial services provider, strategically integrates automation into its operations and is an example of automation in services. The company offers a comprehensive suite of automated services, including online banking, mobile apps, and ATMs. Online banking allows customers to manage their accounts and perform transactions remotely, reducing the need for in-person visits. The bank's network of ATMs provides 24/7-automated banking services. Bank of America customizes its automation strategy based on the demographics of its target market. In areas with a tech-savvy customer base, online and automated services are emphasized. In regions with an older, wealthier clientele seeking traditional customer service, the bank maintains larger, well-staffed facilities. This strategic approach to automation optimizes efficiency and convenience while meeting the diverse preferences of its customer segments.



Concept Check Questions

137. Services rarely use automation.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

138. Since they are typically smaller, managing operations in a service is much easier than in manufacturing.

☐ True

☐ False

Correct or Incorrect?

Clear

Check Answer

139. The decision for service organizations to automate must be strategic.

☐ True

☐ False

Correct or Incorrect?

Clear

Check Answer

Empowering Entrepreneurs Box

For entrepreneurs there are very few things more important than OM. Most entrepreneurs have an idea of their product and their customers. It is their great idea that has inspired them. However, most entrepreneurs may not understand all the detailed decisions required to make that idea a reality. OM is about making the decisions to transform that idea into a product that is delivered to a customer. One of the big challenges is that for a small business there are a lot of moving pieces. In a large company, people usually work in a single area of operations or SCM. Some may be in product design, others in inventory management or quality management. For a small business owner, they are responsible for all of it and need to understand how the pieces interact. This means one person needs to understand all the issues discussed in this chapter and some of the other chapters in this book—including product design, quality control, break-even analysis, purchasing, and inventory management.

For a small business, it is important to develop an OM plan. That plan is a blueprint that will specify the exact product features, quality specifications, how you will source your supplies, where you will store your inventory, and all other operations and supply chain decisions. This plan can also serve as a visual map that specifies how these decisions are made and linked together. It can then dovetail into the broader supply chain process flow we discussed in earlier chapters. An entrepreneur can then see the end-to-end progression of how their product or service is made and delivered. They can then better understand bottlenecks and flow constraints, and use that knowledge to better manage the entire operations and supply chain process.

CHAPTER HIGHLIGHTS

OM, or “operations,” is the business function responsible for producing a company's goods and services, in an efficient and cost-effective way. It is the function responsible for transforming a company's inputs, obtained by the sourcing function, into the finished goods or services, which marketing sells to final customers.

The operations function performs the transformational role of the organization. It has evolved from being a strictly production function to having a strategic organizational role.

OM involves making many varied decisions. These include product and process design, quality management, inventory management, facility layout and location, and scheduling. Competitive bidding and negotiation are two different methods used to reach agreement and develop contracts with potential suppliers.

Product design is the process of deciding on the specific characteristics and features of each of the company's products. Process design is developing the process needed to produce the exact product designed.

Layout planning is deciding on the best physical arrangement of centers of economic activity. There are four types of layouts: fixed position, process, product, and cellular.

Line balancing is the process of designing product layouts. It involves assigning tasks to workstations considering their precedence relationships, cycle time, and task times.

KEY TERMS

[Transformation role](#)

[Physical element of the service](#)

[Psychological benefits](#)

[Sensual elements](#)

[Early supplier involvement \(ESI\)](#)

[Reverse engineering](#)

[Product life cycle](#)

Intermittent process

Repetitive process

Product volume

Degree of product standardization

Project processes

Batch processes

Line processes

Continuous processes

Fixed position

Process

Product

Cellular

Line balancing

Cycle time

Takt time

DISCUSSION QUESTIONS

Identify major differences between a service and manufacturing operation. Find an example of a service and manufacturing company you are familiar with, and compare them.

Find a company you are familiar with, and explain how it uses operations. How is its operations function tied to its supply chain? Do you have any suggestions for their improvement?

Find an example of a process layout of a local business. Draw a diagram, and try to find a way to improve it.

Explain the concept of cycle time, and explain how it affects layout. How does it affect suppliers?

PROBLEMS

“Green-GO Monitors” is ready to release their new intelligent monitors. The variable cost for each product is \$2,000. Fixed cost per year is estimated to be \$100,000. If the company sells each product at a price of \$2,500, how many products must be sold to break even? If the company sells 1,000 products at the price of \$2,500, what will be the contribution to profit?

James Pens has designed a new lawn care product called the mini-mower and is now considering its processing needs. The variable cost for each mini-mower manufactured is \$30. Fixed cost per year is estimated to be \$20,000. James is planning to sell each mini-mower at a price of \$40. How many products must be sold to break even? If James sells 5,000 products at the price of \$40, what will be the contribution to profit?

A company's break-even quantity for a product is 1,000. What is the selling price for each product assuming \$10,000 fixed cost per year and \$20 variable cost per product? If the company sells 2,000 products at the selling price, what will be the contribution to profit?

Given the following manufacturing precedence relationships, compute the cycle time per day and the minimum number of workstations assuming eight working hours a day and 400 products need to be produced per day.

Task	Description	Task Time (s)	Preceding Task
A	Punching	30	
B	Bending	20	A
C	Combining	30	B
D	Painting	40	C
E	Polishing	60	D

Lewis Noodles has the following cooking procedures. You will need to compute the cycle time per day and the minimum number of workstations assuming eight working hours a day and 500 units need to be made per day.

Task	Description	Task Time (min)	Preceding Task
A	Cook vegetables	2	
B	Cut noodles	1	A
C	Cook noodles	5	B
D	Cook meat	3	C

Task	Description	Task Time (min)	Preceding Task
E	Mix ingredients	1	D

Case Study Making Decisions with Data Analytics: Song's Mumbai Restaurant

Song is about to complete her master's degree in hospitality management and is planning to open her Indian restaurant on a busy street in Mumbai, India. After weeks of searching and negotiation, she has finalized the location and is now busy hiring chefs and other restaurant staff.

Song understands that running a successful restaurant requires a consistent quality experience every single time. She recognizes that such an experience would be a combination of services offered by support staff and consistent quality of dishes prepared by chefs. To ensure such an experience, Song is making a list of OM decisions that she should consider and supporting analytical tools.

Case Questions

1. List the operations management decisions she needs to make for services offered to customers and for preparation of food items.
2. What types of quality measures should Song have to take to ensure that she is using the best ingredients for food preparation in her restaurant? Are there analytical tools that can help?
3. How can Song ensure that required hygiene levels are adhered to by her employees?
4. Once the restaurant is operational, what should Song's response be if a customer has a quality complaint? How much do you estimate such a complaint may cost Song beyond analytical measures?
5. What aspects of process design and facility layout should Song consider as she is planning her restaurant?

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Note

- ¹ Based on Robert H. Hayes, and Stephen C. Wheelwright, “Link Manufacturing Process and Product Life Cycles.” *Harvard Business Review*, January–February 1979: 133–140.

6

Sourcing

LEARNING OBJECTIVES

After completing this chapter, you should be able to:

Define sourcing, and explain the differences between purchasing, strategic sourcing, and supply management.

Explain the impact of the sourcing function on the organization and the supply chain.

Describe the sourcing process.

Explain the characteristics of different types of sourcing engagements.

Explain how to measure sourcing performance.

CHAPTER OUTLINE

- **What Is Sourcing?**
 - Purchasing, Sourcing, and Supply Management*
 - Evolution of the Sourcing Function*
 - Commercial vs Consumer Sourcing*
 - Impact on the Organization and the Supply Chain*
- **The Sourcing Function**
 - The Sourcing Process*
 - Cost vs Price*
 - Bidding or Negotiation?*
- **Sourcing and SCM**
 - Functional vs Innovative Products*
 - Single vs Multiple Sourcing*
 - Domestic vs Global Sourcing*
 - Outsourcing*
 - Electronic Auctions (E-Auctions)*
- **Measuring Sourcing Performance**
- **Chapter Highlights**
- **Key Terms**
- **Discussion Questions**
- **Problems**
- **Class Exercise: Toyota**
- **Case Study: Snedeker Global Cruises**
- **Case Study: Making Decisions with Data Analytics: J&G**
- **Bibliography**



VIDEO CONTENT

[Bloomberg Quicktake Video: Terms of Trade: Navigating Supply Chain Challenges](#)

[Bloomberg Quicktake Video: GM in Talks to Buy Chinese Batteries Made in US by TDK](#)

In early 2010, all major headlines clamored over the news that Toyota was recalling more than eight million vehicles in the United States, Europe, and China for problems with sticking accelerator pedals. Production in the United States had been suspended for eight car models, including the Camry, America's top-selling car, and sales at most Toyota dealers had come to a screeching halt. For a company known for zero defects, this was devastating. Toyota Motor Corporation has been the icon of the quality movement and is considered a leader in the automotive industry. Toyota placed blame on one of its suppliers, a company that manufactures accelerator pedals. Given the close relationship Toyota has with its suppliers, how could such a major fault get past them?

Supplying to Toyota is highly coveted among car parts and accessories suppliers, and Toyota is known for making it difficult for suppliers to get contracts. Suppliers that are selected are typically monitored very carefully and are rewarded with loyalty. Toyota is known for playing a large role in engineering the parts made by outside firms. Suppliers make parts to Toyota's exact specifications but are often not involved in product testing. Between 2000 and 2008, Toyota doubled its sales, and the ability to maintain quality during such rapid growth was challenging. To keep up with costs the company demanded that suppliers make parts more cheaply. An executive at a major U.S. supplier said that Toyota had insisted his firm make each generation of parts 10% cheaper. Rapid growth in such a competitive industry may have shown up in the quality of Toyota's cars.

The close relationship between supplier and buyer, as seen between Toyota and its suppliers, makes it difficult to identify the true source of quality problems when they occur. The fault could be with the supplier in manufacturing the part, or with the component parts the supplier sources from their supplier. The latter situation occurred a few years earlier when the toy manufacturer Mattel had to recall toys due to the use of lead paint by its supplier's supplier in China. Another source of the quality problem could be the specifications defined by the manufacturer. Yet another could be the treatment that supplier parts may go through after receipt by the manufacturer.

Although the close relationship between supplier and buyer is necessary to achieve rapid response in today's competitive marketplace, it illustrates the importance and complexity of the sourcing function. Purchasing parts is

not merely about the lowest price. It is about building lasting long-term relationships and helping each other through challenging times.

Concept Check Questions

1. In early 2010, _____ recalled more than eight million vehicles in the United States, Europe, and China for problems with sticking accelerator pedals.

- ☐ a) Ford
- ☐ b) Honda
- ☐ c) BMW
- ☐ d) Toyota
- ☐ e) Chevrolet

Correct or Incorrect?

Clear

Check Answer

2. In early 2010, the best-selling car in the United States was the _____.

- ☐ a) Mustang
- ☐ b) Civic
- ☐ c) Camry
- ☐ d) Model 3
- ☐ e) Accord

Correct or Incorrect?

Clear

Check Answer

3. Toyota is known for making it difficult for suppliers to get contracts.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

4. The close relationship between supplier and buyer, as seen between Toyota and its suppliers, makes it easy to identify the true source of quality problems when they occur.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

What Is Sourcing?

Purchasing, Sourcing, and Supply Management

Sourcing is the business function responsible for all activities and processes required to purchase goods and services from suppliers. Every organization has customers and suppliers. The sourcing function has primary responsibility for the supply side of the organization, whereas marketing has primary responsibility for the customer side of the organization. We can also say that sourcing addresses the “upstream” part of the supply chain. [Figure 6.1](#) highlights the functional position of sourcing within the organizational framework.

The sourcing function is often referred to by a number of different terms, and there is some confusion regarding its name. These names include

“purchasing,” “procurement,” “sourcing,” “strategic sourcing,” and “supply management.” Although they are often used interchangeably they do not necessarily mean the same thing. In this text, we use the term “sourcing” to refer to the overall management of the supplier base, encompassing all the terms and the range of activities, from tactical to strategic. However, let us clarify the differences in these terms.

Purchasing is a term that defines the process of buying goods and services. It is a narrow functional activity with duties that include supplier identification and selection, buying, negotiating contracts, and measuring supplier performance. The term “purchasing” is also frequently used as the title of the business function within organizations.

Over the years the purchasing function has evolved to include a much broader and more strategic responsibility, which is termed “strategic sourcing” or “supply management.” Strategic sourcing is not the same as purchasing and involves a much more progressive approach to the sourcing function. **Strategic sourcing** goes beyond focusing on just the price of goods to looking at the sourcing function from a strategic and future-oriented perspective. It considers sourcing opportunities that will solve greater problems for the buying firm and give it a competitive advantage. This requires expanding the role of sourcing from mere buying to building close and longer-term working relationships with specially selected suppliers and partners. Therefore, it is important to remember that purchasing and strategic sourcing are not the same, as illustrated in [Figure 6.2](#).

SpaceX is a great example of a company that takes a highly strategic approach to sourcing. They not only seek cost-effectiveness but also focus on innovation and performance. For instance, SpaceX's partnership with Tesla to develop the Hyperloop transportation system demonstrates their commitment to sourcing cutting-edge technologies. They also invest in research and development to improve components, such as the Merlin rocket engines, in-house. Also, SpaceX's groundbreaking approach to reusability in rocketry impacts sourcing. They've developed the Falcon 9, a reusable rocket, which reduces the need for manufacturing new components for every launch. This strategy not only saves costs but also affects how they source and manage their supply chain.

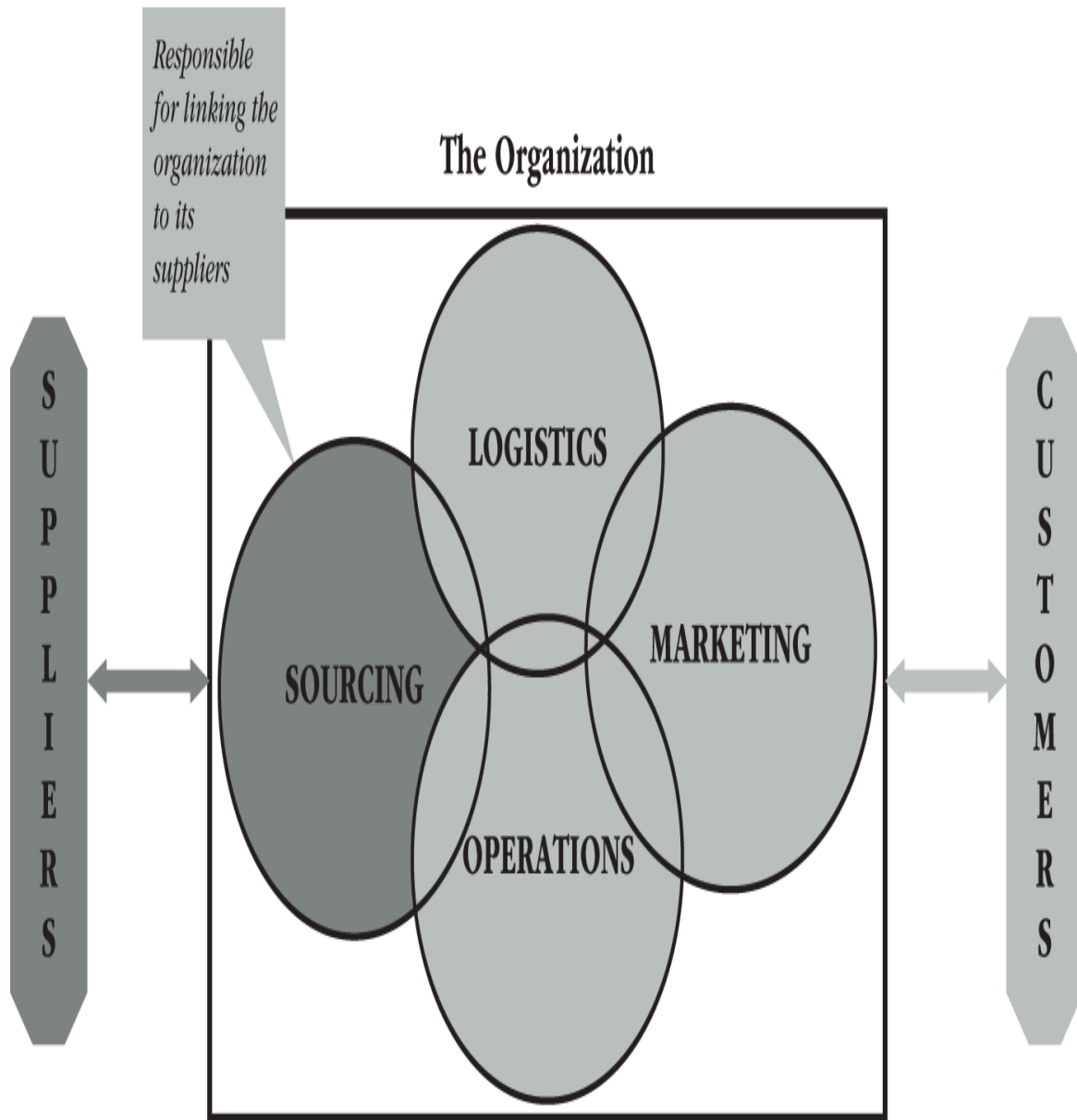


FIGURE 6.1 The sourcing function.

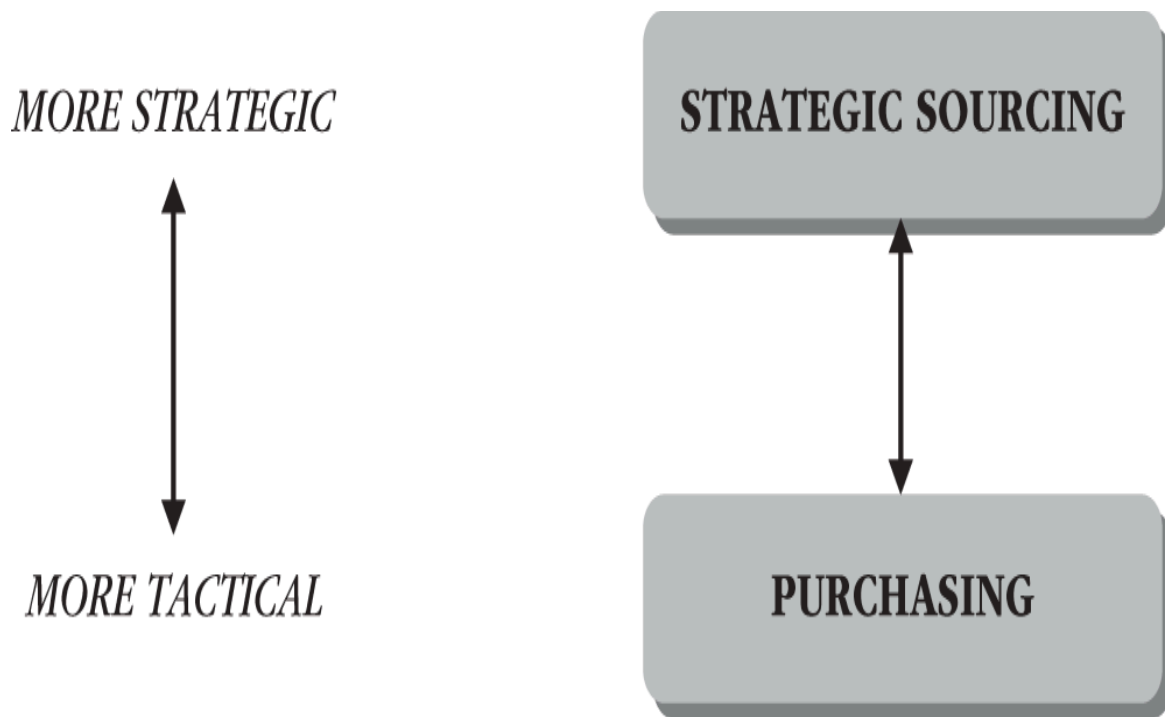


FIGURE 6.2 Hierarchy of terms.

Concept Check Questions

5. _____ is the business function responsible for all activities and processes required to purchase goods and services from suppliers.

- ☐ a) Purchasing
- ☐ b) Strategic sourcing
- ☐ c) Buying
- ☐ d) Sourcing
- ☐ e) Logistics

Correct or Incorrect?

Clear

Check Answer

6. _____ is a term that defines the process of buying goods and services.

- ☐ a) Purchasing
- ☐ b) Strategic sourcing
- ☐ c) Buying
- ☐ d) Sourcing
- ☐ e) Logistics

Correct or Incorrect?

Clear

Check Answer

7. _____ goes beyond focusing on just the price of goods to looking at the sourcing function from a strategic and future-oriented perspective.

- ☐ a) Purchasing
- ☐ b) Strategic sourcing
- ☐ c) Buying
- ☐ d) Sourcing
- ☐ e) Logistics

Correct or Incorrect?

Clear

Check Answer

8. SpaceX is a great example of a company that takes a highly strategic approach to sourcing.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Evolution of the Sourcing Function

Historically sourcing, or purchasing, was regarded primarily as a clerical activity. This involved managing the buying transactions and filling out required forms. However, during the mid-1900s, particularly during World War II, the ability to acquire raw materials when needed became critical. The scarcity of many materials resulted in price increases, and finding affordable sources of supply became a managerial challenge. As a result, sourcing slowly moved from being a mere buying function to one responsible for cultivating suppliers and ensuring a large and continuous supply base.

The importance of sourcing has continued as companies now compete globally for sources of supply. In the late 1900s, supply chain competition became the norm, and companies found that they were increasingly dependent on the performance of their suppliers. Further, technological developments in the early part of the 21st century created high expectations for supply chain integration, lower transaction costs, and faster response times. The Internet and business-to-business (B2B) e-commerce changed the way sourcing of goods was conducted. As a result, the role of the sourcing function within the organization had become elevated, moving to the highest ranks of the organization, such as vice president of purchasing and vice president of supply. This evolution of the sourcing function is shown in [Figure 6.3](#).

Concept Check Questions

9. Historically sourcing, or purchasing, was regarded primarily as a strategic activity.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

10. During World War II, scarcity of many materials resulted in price increases, and finding affordable sources of supply became a managerial challenge.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

11. As firms compete globally for sources of supply, sourcing has become less important.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Commercial vs Consumer Sourcing

Most people assume that they understand and have expertise in sourcing as they are familiar with personal buying. However, commercial sourcing is very different from personal buying, or consumer buying. One difference relates to the number of buyers vs suppliers. In consumer buying, there are many suppliers of common items, and the buyers are typically final consumers of the items they purchase. Also, each buyer comprises a relatively small portion of the supplier's total business and has little ability to negotiate purchase prices. Just consider the large number of shoppers at Home Depot purchasing everything from lightbulbs to refrigerators. Compare the number of these

transactions to those that take place between Home Depot and, say, the lightbulb manufacturer, which is much smaller in comparison.

Clerical and tactical	Strategic orientation
Focus on policies and procedures	Global supply chains
Focus on product and availability and cost	Executive-level leadership
	Focus on long-term supplier relationships
	
Early 1900s	Early 21st Century

FIGURE 6.3 The evolution of the sourcing function.

In commercial buying, the volumes purchased are on a much larger scale, and organizations typically have very specialized purchasing needs. Unlike in personal buying, where there tend to be many choices of suppliers, in commercial buying the number of potential suppliers may be limited. Given the large volumes that are typically purchased, buyers in commercial sourcing spend large sums of money, and suppliers may have a large stake in the individual customer. The stakes are high, sums of money are very large, and often there is an imbalance in power based on the size of the buyer vs supplier. As a result, companies may go to great lengths to secure buying contracts.

Many retail suppliers compete for a contract with a retailer such as Walmart or Target, where they can get wide access to the market and each company provides unique opportunities to suppliers. For example, Amazon reaches over 310 million customers and has millions of product searches daily. On the contrary, Walmart has over 11,000 physical stores and lower supplier fees that are between 12–20% compared with Amazon's 15–45%. On the contrary, Target, a retail corporation, has around 1,900 physical stores, over 30 million loyal shoppers, and a curated selection of around 125,000 products. The massive reach of Amazon's marketplace, the extensive physical presence and lower fees of Walmart, and the brand-loyal audience and comarketing opportunities of Target's curated approach each offer unique benefits for suppliers. The best fit depends on the supplier's specific products, brand maturity, and business goals.

The primary function of commercial buying is acquiring the right materials and services, and making sure they are available to all parts of the organization in the right quantities, at the right price, and at the right time. Remember that many different items are sourced that fulfill the needs of all parts of the organization, everything from materials directly used in manufacturing, to support services and office supplies. Sourcing must also make sure that it follows all legal and ethical procedures and abides by environmental and security regulations. As a result, commercial buying is much more complex than that of personal buying.

Concept Check Questions

12. Commercial sourcing is very similar to personal buying, or consumer buying.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

13. In commercial buying the volumes purchased are on a much larger scale, and organizations typically have very specialized purchasing needs.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

14. Relatively few retail suppliers compete for a contract with a retailer such as Wal-Mart or Target.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

15. The primary function of commercial buying is acquiring the right materials and services, and making sure they are available to all parts of the organization in the right quantities, at the right price, at the right time.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Impact on the Organization and the Supply Chain

The sourcing function provides a number of critical roles for the organization and the supply chain. The first is [operational impact](#). The operational performance of an organization and its supply chain is dependent on an efficient and effective sourcing function. It is sourcing that ensures that the right materials are available throughout the organization and supply chain, in the right quantities, and at the right places exactly when needed. Sourcing must also do this while striking an optimal balance between having enough inventory and not too much. Shortages of materials can stop an organization from functioning. Too much inventory, on the contrary, can mean tied-up capital and financial losses. Finding the right balance is an enormous task. For

example, Toyota Motor Corporation's sourcing function is essential for its just-in-time (JIT) manufacturing system. It ensures the timely delivery of components, nurtures long-term supplier relationships, maintains quality standards, focuses on cost efficiency, and mitigates supply chain risks. This approach is integral to Toyota's operational success, cost-effectiveness, and quality reputation in the automotive industry.

Sourcing also has a critical [financial impact](#) on the organization. Companies spend large sums of money on sourcing goods from their suppliers, and the savings that result from proper management of this function can have a huge impact on the organization. Consider that in most manufacturing organizations the sourcing function represents the largest single category of spend for the company, ranging from 50 to 90% of revenue. Almost 80% of the cost of an automobile is purchased cost, where the manufacturing facility merely assembles purchased items. The large financial impact of sourcing is precisely the reason this function has been elevated to such a prominent role in the organization.

For example, Ford Motor Company's sourcing function is integral to managing their costs and financial performance. The company negotiates competitive prices, fosters supplier relationships for innovation and cost reduction, upholds quality standards, drives efficiency and innovation, and mitigates supply chain risks. The significant financial impact of sourcing, given its share of costs in manufacturing, underscores its crucial role in Ford's profitability and competitiveness.

Sourcing also has a significant “strategic impact” on the organization. Let us recall from [Chapter 2](#) that all organizational decisions need to support the business strategy of the organization. This means that sourcing must find suppliers that support the company's competitive priorities. For example, companies that compete on cost will have different criteria for supplier selection than those competing on quality or other dimensions. Poor supplier quality may result in higher levels of scrap or returned items that slow down manufacturing. On the contrary, poor supplier management may result in paying significantly more for supplies than competitors. It is up to the sourcing function to ensure that the source of supply supports the strategic direction of the organization.

Another impact on the organization is [risk mitigation](#), by minimizing risks of supply disruptions and erosion of image that can result from improper sourcing selection. Consider that sourcing is not a one-time event but occurs

continually. As such, it is important to ensure a continuous source of supply rather than taking risks that may cause supply disruptions. This means evaluating suppliers not only on a one-time purchase basis but as a long-term source of supply. Also, sourcing must ensure that suppliers meet a range of performance standards, including legal and ethical. Sourcing from unethical suppliers, regardless of how low the cost, will erode a company's image.

Nike, the global athletic apparel and footwear leader, places a significant emphasis on ethical sourcing and risk mitigation. Their supply chain transparency extends to auditing 97% of footwear and apparel factories, helping to reduce supply chain risks. This ethical approach aligns with their commitment to sustainability, which includes a target to source 100% renewable energy in company-owned or operated facilities by 2025. This focus on responsible sourcing not only reduces the risk of supply disruptions but also reinforces Nike's brand image.

Sourcing also has an [information impact](#) on the organization. Sourcing is continually gathering information on availability of suppliers and goods, and prices, as well as new products and technology. It brings new knowledge to the organization and its supply chain. This helps companies in many ways, from having clear product cost expectations to understanding available technologies that can be used in product design.



Concept Check Questions

16. The operational performance of an organization and its supply chain is dependent on an efficient and effective sourcing function.

- ☐ a) Financial impact
- ☐ b) Risk mitigation
- ☐ c) Information impact
- ☐ d) Strategic impact
- ☐ e) Operational impact

Correct or Incorrect?

Clear

Check Answer

17. It is logistics that ensures that the right materials are available throughout the organization and supply chain, in the right quantities, and at the right places exactly when needed.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

18. Large amounts of inventory are good for business.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

19. Toyota Motor Corporation's sourcing function is essential for its just-in-time (JIT) manufacturing system.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

20. Companies spend large sums of money on sourcing goods from their suppliers, and the savings that can result from proper management of this function can have a huge _____ on the organization.

- ☐ a) financial impact
- ☐ b) risk mitigation
- ☐ c) information impact
- ☐ d) strategic impact
- ☐ e) operational impact

Correct or Incorrect?

Clear

Check Answer

21. In most manufacturing organizations the sourcing function represents the largest single category of spend for the company, ranging from 20% to 40% of revenue.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

22. Ford Motor Company's sourcing function is integral to managing their costs and financial performance.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

23. Sourcing must find suppliers that support the company's competitive priorities.

- ☐ a) Financial impact
- ☐ b) Risk mitigation
- ☐ c) Information impact
- ☐ d) Strategic impact
- ☐ e) Operational impact

Correct or Incorrect?

Clear

Check Answer

24. Another impact on the organization is _____, by minimizing risks of supply disruptions and erosion of image that can result from improper sourcing selection.

- ☐ a) financial impact
- ☐ b) risk mitigation
- ☐ c) information impact
- ☐ d) strategic impact
- ☐ e) operational impact

Correct or Incorrect?

Clear

Check Answer

Supply Chain Leader's Box—Cocreation

■ THE AUTO INDUSTRY

Companies such as Toyota, Honda, Fiat, and Nissan are reducing new-model development time by more than 50% as they engage in co-creation with their suppliers. [Cocreation](#) is a process of product development in which manufacturers and suppliers work together to create the product. Current technological capability enables integrating and sharing sets of big data, applications, and platforms that allow manufacturers and suppliers to work together in “cocreation.” Just consider industries such as automotive and aerospace, where a new product is often assembled with hundreds of thousands of components supplied by hundreds of suppliers globally. Designers and manufacturing engineers can share data, and quickly and cheaply create simulations to test different designs, select choice of parts and suppliers, and compute associated manufacturing costs. This is co-creation, and it significantly speeds up development time. It also creates cost savings as decisions made in the design stage typically drive 80% of manufacturing costs. Toyota claims to have eliminated 80% of defects prior to building the first physical prototype through this process. This is all due to co-creation.

The Sourcing Function

The Sourcing Process

The sourcing function is responsible for every aspect of acquiring goods and services, ranging from identifying potential suppliers to negotiating and awarding contracts and ensuring contract standards are met. The purchasing

process begins when a purchase need within the organization is identified and specified. The job of the sourcing function is to select appropriate suppliers, negotiate contracts, and manage the process of acquisition. Sourcing must first decide if the need can be met with existing suppliers or whether new suppliers must be identified. Sourcing typically maintains an acceptable list of suppliers for ongoing purchases but also evaluates suppliers for new needs that occur on an ongoing basis.

Supplier selection is an important part of the sourcing function and involves identifying potential suppliers and soliciting business from them either in the form of a [request for quotation \(RFQ\)](#), a [request for proposal \(RFP\)](#), or a [request or invitation for bid \(RFB\)](#).

It is important for the sourcing function to be in charge of the supplier base and that supplier management and selection are directed through the sourcing function. “Maverick buying,” a practice where internal users attempt to buy directly from suppliers and bypass the sourcing function, often occurs in companies. It is acceptable for such practices to occur occasionally, such as a restaurant employee running out to buy bread or an office worker buying paper. However, this should not be done on a routine basis as it bypasses sourcing and erodes all the benefits sourcing brings to the organization, such as economies of scale when dealing with a large supply base.

The sourcing function must act as the primary contact with suppliers, but other functions should also be able to interact with suppliers as needed. Involving members from multiple functions improves the communication process with suppliers, especially when identifying needs and evaluating supplier capabilities. This may involve the function of engineering, to assess tolerance specification requirements for purchased items; operations, in deciding which sourcing choice is better given the current production process; or even marketing, to decide if product changes influenced by sourcing selection will impact sales. Companies often have sourcing teams and must consider inputs from all other organizational functions.

Procter & Gamble (P&G), a global consumer goods corporation, places strong emphasis on cross-functional collaboration in its sourcing practices. By engaging members from various functions, including engineering, operations, and marketing, they streamline communication with suppliers. P&G's sourcing teams assess material requirements rigorously, ensuring that materials meet set performance standards. This approach has resulted in impressive cost savings—P&G saved \$350 million in 2020 through cost-reduction initiatives. This

highlights the significance of efficient sourcing and cross-functional collaboration in achieving both cost-efficiency and product quality.

Sourcing personnel are responsible for understanding a range of material requirements and whether they can meet organizational needs. For example, it is the responsibility of sourcing to review material specifications and question whether a supplier's lower-cost material can meet the performance standards that may have been set by operations or engineering. Sourcing also needs to be able to review a number of different requisitions and identify whether different users require the same material, allowing it to combine purchase requirements and lower costs.

Concept Check Questions

25. The sourcing function is responsible for every aspect of acquiring goods and services.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

26. Supplier selection is an important part of the sourcing function and involves identifying potential suppliers and soliciting business from them. Which of the following is not a form that is typically used?

- ☐ a) Request for purchase
- ☐ b) Request or invitation for bid
- ☐ c) Request for quotation
- ☐ d) Request for proposal

Correct or Incorrect?

Clear

Check Answer

27. This is a practice where internal users attempt to buy directly from suppliers and bypass the sourcing function.

- ☐ a) Direct purchasing
- ☐ b) One-on-one purchasing
- ☐ c) Maverick buying
- ☐ d) Just-in-time purchasing

Correct or Incorrect?

Clear

Check Answer

28. Maverick buying often occurs in companies.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

29. Procter & Gamble (P&G), a global consumer goods corporation, places strong emphasis on cross-functional collaboration in its sourcing practices.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

30. Operations personnel are solely responsible for understanding a range of material requirements and whether they can meet organizational needs.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Cost vs Price

Sourcing managers are responsible for buying goods and services and determining fair prices. For that reason they must understand the relationship between cost and price, remembering that cost and price are not the same. They must also understand what constitutes a fair price under a range of circumstances.

Cost is the sum of all costs incurred to produce the product. The total cost of producing a product, or service is the sum of its fixed and variable costs. Recall from [Chapter 5](#) that fixed costs are those the company incurs regardless of how much it produces, such as overhead, taxes, and insurance. For example, a company must pay for overhead and real estate taxes regardless of whether it produces 1 unit or 1,000 units. Variable costs, on the contrary, are costs that vary directly with the amount of units that are produced. They include items such as direct materials and direct labor. Together, fixed and variable costs add up to the total cost:

$$\text{Total Cost} = F + V_C Q$$

where

F = fixed cost

V_C = variable cost per unit

Q = number of units sold

The price of an item is the amount at which it is being sold in the marketplace. Buyers understand that a supplier must cover total costs, including overhead, and make a profit to stay in business. The profit also needs to reflect the risks the supplier is taking. The goal in developing purchasing contracts and negotiation is to find a [fair price](#), which is the lowest price that can be paid while ensuring a continuous supply of quality goods. This is illustrated in the following example:

<i>Variable cost</i>	
Materials	\$ 5,000
Labor	\$ 2,000
+	
<i>Fixed cost</i>	
Facility overhead	\$ 3,500
Total cost	\$10,500
+	
Profit	\$ 1,000
Selling price	\$11,500

A better way to evaluate price in purchasing is to estimate the [total cost of ownership \(TCO\)](#) before selecting a supplier. The reason is that there may be additional costs that are incurred when acquiring the item in addition to the selling price. The TCO is the purchase price plus “all” other costs associated with acquiring the item. This includes transportation, administrative costs, follow-up, expediting, storage, inspection and testing, warranty, customer

service, and handling returns. In the preceding example these additional costs need to be added to the selling price to get a more accurate assessment.

Walmart is renowned for its rigorous evaluation of the TCO in sourcing. This focus on TCO has contributed to impressive cost savings. For instance, Walmart reported a TCO-driven cost reduction of \$1.3 billion in 2023, reflecting the effectiveness of its approach in optimizing supply chain efficiency, reducing returns, and enhancing the customer experience. This highlights the significance of TCO in achieving both cost-efficiency and customer satisfaction.

Concept Check Questions

31. Operations managers are responsible for buying goods and services and determining a fair price.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

32. The total cost of producing a product or service is the sum of its fixed and variable costs.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

33. The lowest price that can be paid while ensuring a continuous supply of quality goods.

- ☐ a) Minimum price
- ☐ b) Fair price
- ☐ c) Strategic price
- ☐ d) Contract price

Correct or Incorrect?

Clear

Check Answer

34. Total cost of ownership is the purchase price plus all other costs associated with acquiring the item.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Bidding or Negotiation?

Another important role of the sourcing function is determining how to award buying contracts. Once suppliers have been identified, competitive bidding and negotiation are two different methods used to reach an agreement and develop contracts with potential suppliers. Competitive bidding has the objective of awarding the business to the most qualified bidder, once specific criteria have been identified, and can pit suppliers against one another. Negotiation, on the contrary, is a communication process between two parties that attempts to reach a mutual agreement.

Both bidding and negotiation achieve the goal of reaching an agreement and awarding a contract to a supplier; however, they do so under different circumstances. A significant factor to consider is the type of relationship needed between buyers and suppliers. For purchasing standard items that are a commodity and that have standard specifications, such as stationary or cement, competitive bidding is the most efficient and effective method. However, when there are many factors to consider in awarding a contract, and when it is important to work with suppliers in product development, it is best to rely on cooperative negotiation. Consider [Figure 6.4](#).

Boeing is a company that exemplifies the strategic use of sourcing methods. Competitive bidding, for standardized items, has significantly improved cost efficiency. In 2020, Boeing reported a 10% reduction in procurement costs due to competitive bidding. For complex projects, negotiation with suppliers fosters innovation and product development. This approach was pivotal in Boeing's development of the 787 Dreamliner, which features advanced materials and technologies and has received over 1,000 orders from airlines worldwide. This highlights the importance of choosing the right sourcing method to meet specific procurement needs.



Concept Check Questions

35. Bidding and negotiation are basically the same thing.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

36. _____ has the objective of awarding the business to the most qualified bidder, once specific criteria have been identified, and can pit suppliers against one another.

- ☐ a) Negotiation
- ☐ b) Strategic bidding
- ☐ c) Partnering
- ☐ d) Competitive bidding

Correct or Incorrect?

Clear

Check Answer

37. Which of the following is **not** a characteristic of competitive bidding?

- ☐ a) Performance criteria and specifications can be clearly defined
- ☐ b) Product being purchased is new or technically complex
- ☐ c) Volume purchased is high
- ☐ d) Many qualified suppliers exist in the marketplace
- ☐ e) Volume purchased is high

Correct or Incorrect?

Clear

Check Answer

38. Which of the following is **not** a characteristic of negotiation?

- ☐ a) Performance criteria and specifications cannot be clearly defined
- ☐ b) Product being purchased is new or technically complex
- ☐ c) Suppliers customize the product to buyer
- ☐ d) Many criteria exist for supplier selection
- ☐ e) Many qualified suppliers exist in the marketplace

Correct or Incorrect?

Clear

Check Answer

39. _____ is a communication process between two parties that attempts to reach a mutual agreement.

- ☐ a) Negotiation
- ☐ b) Strategic bidding
- ☐ c) Partnering
- ☐ d) Competitive bidding

Correct or Incorrect?

Clear

Check Answer

Sourcing and SCM

Functional vs Innovative Products

Supply chains have uncertainty on both the demand and supply side. Demand uncertainty occurs when product demand is unstable and difficult to predict. Supply uncertainty occurs when there is uncertainty regarding sources of supply and their capabilities. Demand and supply uncertainties are related to the type of product and their supply chains. Understanding these uncertainties makes it easier to manage the supply chain.

COMPETITIVE BIDDING

Performance criteria and specifications can be clearly defined

Volume purchased is high

Products being purchased are standardized

Many qualified suppliers exist in the marketplace

Time is available for bid evaluation

NEGOTIATION

Performance criteria and specifications cannot be clearly defined

Many criteria exist for supplier selection (e.g., cost, quality, delivery, and service)

The product being purchased is new or technically complex

Few qualified suppliers exist in the marketplace

Suppliers customize the product to the buyer

FIGURE 6.4 Criteria for using competitive bidding vs negotiation.

Two broad categories of products result in very different supply chains and have differing levels of demand uncertainty. Products can be classified as either primarily **functional** or primarily **innovative**.¹ Depending on their classification, they will be sourced differently and will require different types of supply chains. Functional products are those that satisfy basic functions or needs. They include items such as food purchased in grocery stores, gas and oil for transportation and heating, and household items—from batteries to lightbulbs. In contrast, innovative products are purchased for other reasons, such as innovation or status, and include high-fashion items or technology products, such as those seen in the computer industry.

Samsung, a global leader in consumer electronics, adeptly manages both functional and innovative product categories. For **functional products**, the supply chain emphasizes efficiency, cost control, and reliability, examples include refrigerators, washing machines, and basic mobile phones. In contrast, for **innovative products**, the focus is on research and development, marketing, and design to create a sense of innovation and desirability examples include the Galaxy series of smartphones, high-end televisions, and cutting-edge

electronics. This flexibility highlights the importance of aligning supply chain strategies with the specific characteristics of each product type.

Global Insights Box—Outsourcing Analytics

■ ACCENTURE

Companies outsource many activities that are not their core competency. Analytics is such an activity as it is not part of the core competency of most companies. To tap into the full potential of analytics, firms need to somehow acquire this skill. The most common way is by [outsourcing analytics](#). Like third-party logistics (3PL) firms that have specialized skills in logistics, analytics firms have specialized skills in data and software and are on the technology frontier. Their expertise in key data sources and analytical techniques makes them uniquely qualified to help with analytics. Further, many external providers specialize in certain industry segments and can bridge the gap between industry and technical knowledge.

There are numerous examples of such outsourcing arrangements. Accenture provides consulting and outsourcing services to many companies, including Best Buy. Accenture helps companies with analytical strategy, and selection of appropriate applications, and manages the major components of a firm's IT function. Software firm Teradata works closely with Hudson's Bay Company to implement an approach to reducing fraud in the merchandise returns process. Alliance Data works with retailers, such as Bath & Body Works, Inc and Pottery Barn, to establish and manage their loyalty programs. Walmart has outsourced the development of blockchain technologies to IBM. Given the deep knowledge analytics requires, even leading analytics companies outsource at least some aspect of their analytics capability.

Functional products typically have stable and predictable demand and long life cycles. It is easier to source for functional products due to this stability. Their supply chains are easier to manage; however, they typically have low-profit margins. Innovative products, on the contrary, have highly unpredictable demand and short life cycles. New and innovative products are introduced

quickly, and their demand is difficult to forecast. Although they have higher profit margins, their supply chains are much more difficult to manage.

Just as there are uncertainties on the demand side, there are also uncertainties on the sourcing side. The supply side of the supply chain can be classified as either a [stable](#) or an [evolving supply process](#). A stable supply process is where sources of supply are well established, manufacturing processes used are mature, and the underlying technology is stable. Consider sourcing apples, lumber, or undershirts. In contrast, an evolving supply process is where sources of supply are rapidly changing, the manufacturing process is in an early stage, and the underlying technology is quickly evolving. Examples would include alternative energy sources, certain organic food items, or high-end computer technology. It is challenging to manage supply chains with either demand or supply uncertainty. It is especially challenging to manage supply chains with both uncertainties as shown in [Figure 6.5](#).

Tesla operates in an industry characterized by both demand and supply uncertainties. In 2023, the company delivered approximately 1.81 million electric vehicles despite fluctuations in demand influenced by consumer sentiment and government incentives. Their supply chain for Electric vehicle (EV) components and batteries involves rapidly evolving technologies. Tesla addresses these uncertainties through substantial investments in research and development, maintaining strong supplier relationships, and monitoring market dynamics and government policies. This exemplifies the need for adaptability and innovation in supply chain management (SCM), especially in rapidly evolving industries like electric vehicles and alternative energy solutions.

Efficiency-focused supply chains have both low demand and supply uncertainty and are easiest to manage. These supply chains typically do not have high-profit margins. However, their operations are highly predictable, and the gains in these supply chains come from efficiency and elimination of waste.

Responsive supply chains are used for innovative products that have a stable supply base. The primary challenge here is to ensure to be able to quickly respond to customer demands. Mass-customization strategies such as [postponement](#), where the supply chain is designed to delay product differentiation as late in the supply chain as possible, are effective here. A good example is the case of Hewlett-Packard (HP) printers that are kept in generic form as long as possible. They are differentiated with country- and language-specific labels that are added at the last point in the system.

Risk-hedging supply chains are those with high uncertainty on the supply side. These supply chains must do everything possible to minimize risks of supply disruptions and inventory shortages. These supply chains typically rely on higher inventory safety stocks and engage in a practice where resources are pooled and shared between different companies. Cisco, a global information technology (IT) solutions leader, adopts a risk-hedging supply chain approach. Their supply chain strategy involves maintaining higher inventory safety stocks and collaborating with suppliers. This approach helps them manage uncertainties on the supply side, ensuring a stable supply of critical components.

		<i>Demand uncertainty</i>	
		Low (functional products)	High (innovative products)
<i>Supply uncertainty</i>	Low (stable process)	Efficiency-focused SC <i>Least challenging</i>	Responsive SC
	High (evolving process)	Risk-hedging SC	Agile SC <i>Most challenging</i>

FIGURE 6.5 Demand vs supply uncertainty.

Supply Chain Leader's Box—Risk Management

■ IBM

A decade ago IBM used analytics to move from a regional procurement process that was globally dispersed to a single integrated global supply chain. Today the tech giant continues to use analytics to manage every aspect of their supply chain, especially the supplier network. The company relies on analytics to manage cost containment and risk and uses software to model the impact of potential scenarios of suppliers.

Analytics helped IBM respond in a timely and effective manner when a natural disaster threatened to disrupt the company's supply chain. In April 2010, a volcano in Iceland halted flights throughout most of Europe. IBM relied on its algorithm to identify what to do. The software algorithm told IBM to focus on Asia rather than Europe, indicating that the critical link in IBM's supply chain was Hong Kong. To management, this did not make sense at first. Then the reason became clear.

The algorithm predicted that if IBM did not take steps to secure sufficient air capacity once the volcanic eruption stopped and flights resumed, it would encounter a bottleneck in Hong Kong. This would occur as a result of the company having to quickly move a backlog of products from Asian manufacturers to European customers. IBM followed the recommendation of the algorithm. The company booked space on commercial and charter aircraft from Hong Kong to Europe in plenty of time. “We didn't sit and watch what was going on with the disaster,” said Timothy E. Carroll vice president of supply chain operations. “We prepared ourselves for what to do once the disaster lifted.” This turned out to be the best decision. Now, a dedicated team within IBM regularly reviews various scenarios to prepare a response to any disaster or crisis anywhere in the world.

Agile supply chains are used in cases of both high demand and supply uncertainty. They are the most difficult to manage as they simultaneously must be responsive to an uncertain demand while using strategies to hedge risks to ensure there are no supply disruptions. These supply chains use mass customization strategies on the demand side while carrying higher safety stock and engaging in resource pooling on the supply side.

Concept Check Questions

40. Supply chains have uncertainty on both the demand and supply side.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

41. Products can be classified as either primarily _____ or _____.

- ☐ a) innovative, standard
- ☐ b) functional, innovative
- ☐ c) functional, evolving
- ☐ d) strategic, tactical

Correct or Incorrect?

Clear

Check Answer

42. _____ products are those that satisfy basic needs.

- ☐ a) Innovative
- ☐ b) Strategic
- ☐ c) Standard
- ☐ d) Functional
- ☐ e) Tactical

Correct or Incorrect?

Clear

Check Answer

43. _____ products are purchased for other reasons, such as status, and include high-fashion items or technology products, such as those seen in the computer industry.

- ☐ a) Innovative
- ☐ b) Strategic

- ☐ c) Standard
- ☐ d) Functional
- ☐ e) Tactical

Correct or Incorrect?

Clear

Check Answer

44. The supply side of the supply chain can be classified as either a/n _____ or a/n _____ supply process.

- ☐ a) stable, innovative
- ☐ b) evolving, devolving
- ☐ c) stable, evolving
- ☐ d) growth, shrinking
- ☐ e) innovative, strategic

Correct or Incorrect?

Clear

Check Answer

45. _____ is where the supply chain is designed to delay product differentiation as late in the supply chain as possible,

- ☐ a) Delayed production
- ☐ b) Customization
- ☐ c) Delayed customization
- ☐ d) Postponement

Correct or Incorrect?

Clear

Check Answer

46. A supply chain with low supply uncertainty and low demand uncertainty is called what?

- ☐ a) Efficiency-focused
- ☐ b) Responsive
- ☐ c) Agile
- ☐ d) Risk-hedging
- ☐ e) Strategic

Correct or Incorrect?

Clear

Check Answer

47. A supply chain with low supply uncertainty and high demand uncertainty is called what?

- ☐ a) Efficiency-focused
- ☐ b) Responsive
- ☐ c) Agile
- ☐ d) Risk-hedging
- ☐ e) Strategic

Correct or Incorrect?

Clear

Check Answer

48. A supply chain with high supply uncertainty and high demand uncertainty is called what?

- ☐ a) Efficiency-focused
- ☐ b) Responsive
- ☐ c) Agile
- ☐ d) Risk-hedging
- ☐ e) Strategic

Correct or Incorrect?

Clear

Check Answer

49. A supply chain with high supply uncertainty and low demand uncertainty is called what?

- ☐ a) Efficiency-focused
- ☐ b) Responsive
- ☐ c) Agile
- ☐ d) Risk-hedging
- ☐ e) Strategic

Correct or Incorrect?

Clear

Check Answer

Single vs Multiple Sourcing

Traditionally companies held the view that multiple sources of supply were best to increase cost competition and ensure supply security. This view has been challenged for quite some time, and the notion of single sourcing is becoming the acceptable norm. Single sourcing focuses on building closer supplier relationships and cooperation between buyers and suppliers and moves away from arm's-length relationships. It focuses on moving away from competitive bidding, using cooperative negotiation, and building long-term relationships.

Single sourcing has many benefits. Splitting the order among multiple suppliers can be costly as it does not permit consolidating purchase power. Splitting the order also has an impact on quality as there will be natural variations between different sources, even if minimal. Single sourcing also lowers freight costs, it enables easier scheduling of deliveries, and the supplier may be more cooperative in addressing special needs knowing they are the only source. Apple has increasingly embraced a single-sourcing approach for critical components. Single sourcing enables Apple to consolidate purchasing power, reduce freight costs, and maintain quality standards. However, it also makes the company vulnerable to supply disruptions, as exemplified by their reliance on single sources for advanced microprocessors. This approach underscores the importance of managing the trade-offs between the benefits and risks of single sourcing in the supply chain.

In some cases, there may not be a choice but to go with a single source. This may occur, for example, when a supplier is the only source of a particular material. They may be the only one that has the needed process or they are the sole owner of the patent for the product. Having a single source of supply, however, is risky in practice. When a supplier is small the buyer's business may utilize most of the supplier's capacity. This makes the supplier highly vulnerable if there is a discontinuity of purchase from the buyer. At the same time, the buyer may not wish to be tied to a source that is so highly dependent on them. Similarly, by relying on one supplier, the buyer is vulnerable if there is a disruption in the supplier's production process, such as a fire at a plant, a labor strike, or a work stoppage, as the supplier's supplier has a problem.

One strategy companies should consider is to use a “portfolio” of a small number of multiple suppliers. Similar to a financial portfolio, these suppliers can be selected to create a balance of requirements. Some can be local for rapid deliveries; others may be global but less expensive. This strategy can help balance the risks of relying on a single supplier in case of supply chain disruptions. Another rule to consider is that one buyer should not make up more than 20 or 30% of the total supplier's business, otherwise making the supplier highly vulnerable. General Motors (GM) strategically employs a portfolio of multiple suppliers for key components. In 2023, GM reported a total revenue of approximately \$171.8 billion. This approach helps GM balance the requirements of its complex supply chain by selecting suppliers based on criteria like quality, cost, and location. By mitigating supply chain risks through supplier diversification, GM ensures production continuity and avoids overburdening individual suppliers, fostering mutually beneficial

relationships. This highlights the significance of managing supplier portfolios in industries with intricate supply chain requirements.

Concept Check Questions

50. Traditionally companies held the view that multiple sources of supply were best to increase cost competition and ensure supply security.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

51. _____ sourcing focuses on building closer supplier relationships and cooperation between buyers and suppliers and moves away from arm's-length relationships.

- ☐ a) Strategic
- ☐ b) Partner
- ☐ c) Multiple
- ☐ d) Just-in-time
- ☐ e) Single

Correct or Incorrect?

Clear

Check Answer

52. Splitting orders between multiple suppliers saves money.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

53. Apple has increasingly embraced a multiple-sourcing approach for critical components.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

54. In some cases, there may not be a choice but to go with a single source.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

55. Using a single source of supply is less risky.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Domestic vs Global Sourcing

Another challenge to consider is whether to use domestic or global sourcing, also called [offshoring](#). Global sourcing has been on the rise as companies have been attracted to cheaper labor costs in other parts of the world. It has been most prominent for sourcing products with easily defined standards, such as in the retail industry. It is also used heavily in the service industry, such as running call centers, processing claim forms, or in software development. Even in medicine the reading of diagnostic tests, such as X-rays, is often off-shored. However, with a rise in fuel prices, the labor savings are often negated, or even outweighed, by high transportation costs. This is called [reshoring](#). Therefore, several companies are turning toward domestic sources to reduce transportation costs, monitor quality more closely, and have closer buyer–supplier relationships. Also, with an emphasis on sustainability and “green” there has been a push toward sourcing local vs global goods.

Ford is an example of a company that has grappled with the choice between domestic and global sourcing for automotive components. In 2023, Ford reported a total revenue of approximately \$176.2 billion. They traditionally source from various regions worldwide to access cost-effective manufacturing capabilities. While considering the benefits of reshoring for supply chain resilience, Ford navigates the complexities of balancing cost efficiency and global supply chain logistics. Their experience underscores the ongoing strategic considerations in the automotive industry and the need for flexibility in managing supplier networks.

Companies that engage in global sourcing must possess a certain amount of multinational experience. This can be especially problematic for small- to medium-sized firms that are more likely to lack this expertise. Global sourcing, by definition, requires work groups of individuals from different companies, cultures, and languages to work together effectively. This concept, known as virtual teaming, poses special challenges due to the significant potential for cultural clashes and misunderstandings. These differences in culture and

business practice can put offshore source initiatives at risk, particularly for enterprises with limited international experience.

Concept Check Questions

56. Global sourcing is also called _____.

- ☐ a) off-shoring
- ☐ b) out sourcing
- ☐ c) globally sourcing
- ☐ d) strategic sourcing
- ☐ e) re-shoring

Correct or Incorrect?

Clear

Check Answer

57. Returning globally sourcing to domestic sourcing is called _____.

- ☐ a) off-shoring
- ☐ b) out sourcing
- ☐ c) return sourcing
- ☐ d) local sourcing
- ☐ e) re-shoring

Correct or Incorrect?

Clear

Check Answer

58. Companies that engage in global sourcing need to possess a certain amount of multinational experience.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Outsourcing

An important sourcing decision is whether to “outsource” certain aspects of the sourcing function. Recall that outsourcing involves choosing a third party, such as an outside supplier or vendor, to perform a task, function, or process to incur business benefits. Companies may choose to outsource activities or tasks for many reasons, rather than performing them internally. These include lower costs, access to technical skills, and the ability to free themselves from doing noncore activities. Outsourcing is big business. The global market size for outsourced services was estimated at almost \$93 billion in 2019.

Outsourcing has become a mega trend in many industries and is continuing to grow, as companies focus on their core competencies and shed tasks perceived as noncore competencies. A good example has been the growth in outsourcing of transportation of goods to 3PL providers, such as UPS and FedEx.

Transportation and movement of goods require an investment of specialized resources, such as fleets of trucks, aircraft, and state-of-the-art information systems for product tracking. Outsourcing this activity to specialty companies is a much more cost-effective decision for most firms. Good outsourcing decisions can result in lowered costs and a competitive advantage, whereas poorly made decisions can increase costs, disrupt service, and even lead to business failure. Although the financial aspects of outsourcing are important, outsourcing has increasingly taken on a broader strategic organizational focus.

Apple, for example, strategically outsources transportation and logistics to 3PL providers such as UPS and FedEx. In 2021, Apple spent approximately 3% of its total revenue on transportation, which amounted to about \$11.8 billion.

Outsourcing non-core activities in transportation ensures cost efficiency, scalability, and reliability in product distribution, enabling Apple to focus on core competencies in innovation and customer experience. The scope and

criticality of outsourced tasks necessitate robust supplier management for efficient product delivery. Apple's outsourcing approach highlights the significance of cost-effective decisions and strategic focus in SCM.

Two key dimensions that help define outsourcing are the [scope](#) and [criticality](#) of the outsourced task. The scope is the degree of responsibility assigned to the supplier. Criticality, on the contrary, is the importance of the outsourced activities or tasks to the organization. The greater the scope of the outsourced task, the larger the relinquishing of control by the buyer. Similarly, the greater the criticality of the outsourced task the greater the consequences of poor performance to the buying firm and the greater the requirement for supplier management. It is important to understand these dimensions when considering outsourcing. Companies should be especially careful when outsourcing activities with large scope and criticality and should especially monitor such outsourcing engagement to ensure a successful outcome as illustrated in [Figure 6.6](#). We discuss the importance of scope and criticality in more detail in [Chapter 13](#).

Concept Check Questions

59. Outsourcing and off-shoring are the same thing.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

60. Outsourcing is big business.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

61. 3PL is an example of outsourcing.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

62. Good outsourcing decisions can result in lowered costs and a competitive advantage.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

63. Outsourcing is not a strategic decision.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

64. Two key dimensions that help define outsourcing are the _____ and _____ of the outsourced task.

- ☐ a) cost, volume
- ☐ b) cost, difficulty
- ☐ c) volume, difficulty
- ☐ d) scope, criticality
- ☐ e) speed, complexity

Correct or Incorrect?

Clear

Check Answer

65. The greater the scope of the outsourced task, the larger the relinquishing of control by the buyer.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Electronic Auctions (e-Auctions)

e-Auctions are the use of Internet technology to conduct auctions as a means of selecting suppliers and determining aspects of the purchase contract. This includes determination of price, product quality, volume allocation to different suppliers, as well as supplier delivery schedules. Auctions have been used throughout history as a means of providing competition between suppliers. It is

Internet technology, however, that has given sourcing managers an important tool for supplier selection to conduct this process online in an efficient and effective manner. e-Auctions have enabled increasing the pool of potential suppliers for any one item and to more efficiently and accurately compare sources of supply.

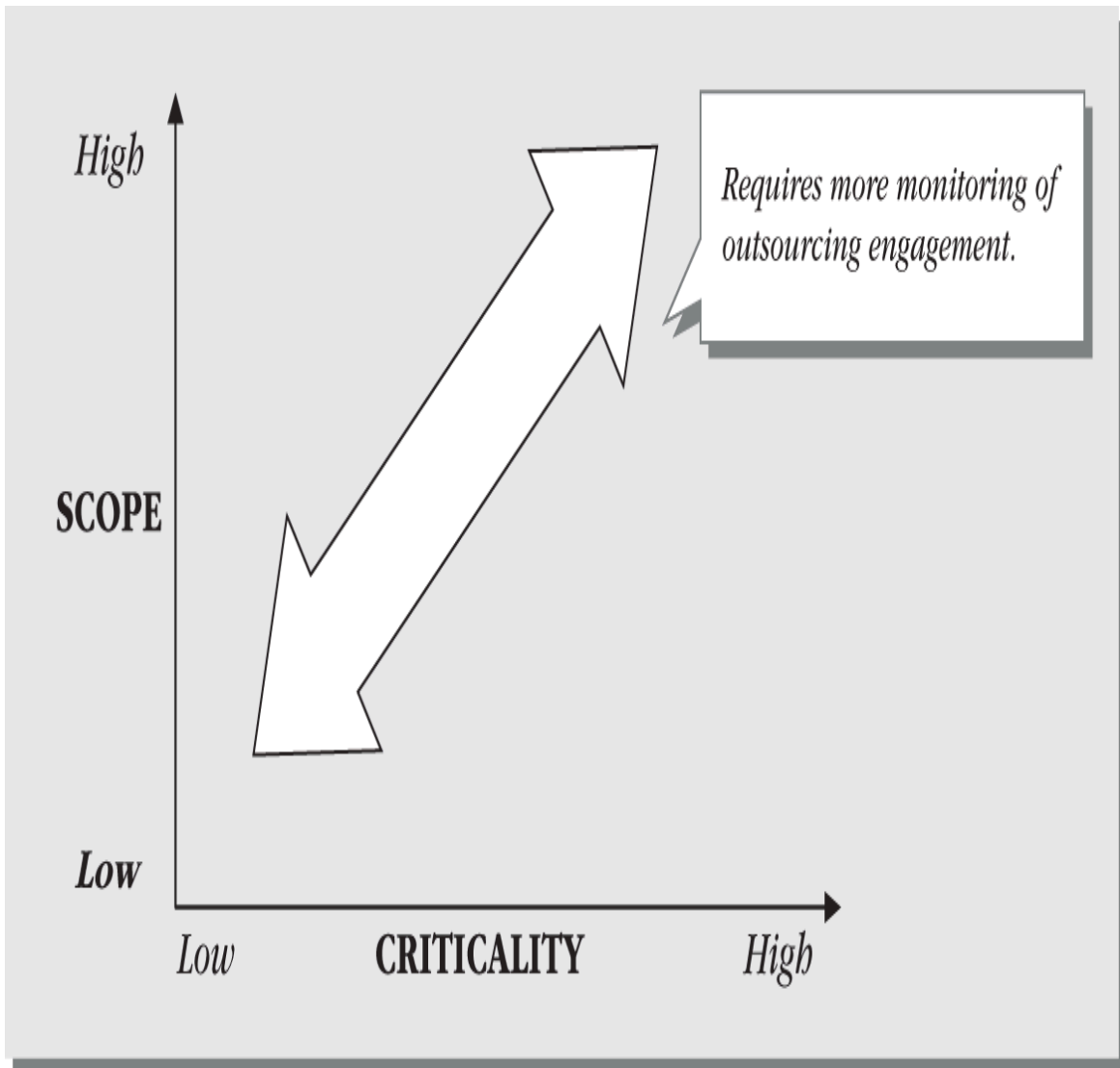


FIGURE 6.6 Dimensions of outsourcing.

There are many benefits to using e-auctions. They include market transparency, decreased error rate, and simplified comparison of sources of supply. They also include increased buying reach, as companies can tap into a much broader source of supply through the use of the Internet. There is also a reduction in ordering cycle time as the process is automated and more efficient than the traditional method of sourcing, such as issuing an RFP or RFQ.

There are, however, potential problems with e-auctions that must be considered. One problem is that suppliers can bid unrealistically low prices during the e-auction process, with the idea of renegotiating after the contract has been awarded. As a result, potentially better and more realistic sources of supply may be eliminated. Another problem is the inclusion of suppliers in the e-auction who do not plan on participating, but merely want to gather market intelligence. There are also risks to interrupting a good supplier relationship. Putting products on an e-auction sends a signal to current suppliers that the company is considering switching to a new source of supply and that price may be the determining factor in source selection. This may potentially damage good supplier relationships and may not be the best strategy when building long-term relationships.

Supply Chain Leader's Box: e-Auctions

■ PROCTER & GAMBLE (P&G)

Procter & Gamble (P&G), a global consumer goods corporation, effectively utilizes e-auctions in its SCM. While specific statistics related to P&G's e-auction spending are not publicly disclosed, the company's strategic approach is evident. The key areas of benefit of e-auctions include the following:

1. **e-Auctions for Supplier Selection:** P&G integrates e-auctions for selecting suppliers and negotiating various aspects of purchase contracts, including pricing, quality, volume allocation, and delivery schedules.
2. **Market Transparency:** E-auctions enhance market transparency, minimizing errors in supplier selection and enabling efficient comparisons of potential sources of supply.
3. **Efficiency and Reduced Ordering Cycle Time:** By embracing e-auctions, P&G streamlines its sourcing process, resulting in reduced ordering cycle times. The automated nature of e-auctions enhances efficiency compared to traditional sourcing methods.

P&G is aware of the challenges of e-auctions and addresses these potential challenges through various measures. For example, P&G counters the risk of suppliers bidding unrealistically low prices with intentions to renegotiate after contract award. P&G also considers the inclusion of suppliers in the process of seeking market intelligence, so that they engage in collective intelligence.

Managerial Insights Box—Outsourcing Alliances

■ ROOTS

The Canadian apparel manufacturer and retailer Roots is an example of a company that succeeded as a result of shifting its sourcing strategy to involve collaboration with its supplier and demonstrates the benefits that can be attained from supplier collaboration. Roots, a company with a stellar reputation, was given the task of handling licensed U.S. logo Olympic wear during the 2002 Winter Games in Salt Lake City. The forecast called for 100 calls per day into the Roots customer service center, which was well below the actual 1,500-per-day peak. However, the 2002 Winter Games experienced a surge of patriotism, following the 9/11 attacks. The result was an unexpected flood of demand that Roots was initially unable to meet. Roots found itself unable to handle the 50,000 orders per month for the U.S. Olympic gear from its Canadian operation. At the last minute, the company was forced to revamp its entire distribution strategy, opening a separate Web-based ordering channel. With the help of a third-party call center and fulfillment provider, it added two U.S.-based call centers, moved distribution to Memphis, and changed delivery carriers. The company did this almost overnight while orders were still flooding in.

The company's forecast of expected demand was based on two of the prior Olympic events. Based on this forecast of demand, raw materials were ordered, production was scheduled, and a third-party relationship for a call center and fulfillment operation was set up. However, the surge in demand in the post-9/11 climate was not anticipated. Further, Roots manufactures locally in Canada, so it has a short supply chain for finished products resulting in lower inventory levels. Roots quickly realized that it could not succeed alone and needed a partner. Roots turned to its 3PL provider. Together they quickly set up a system that involved reporting, checkpoints, and audits throughout the fulfillment chain. The systems were scalable and well planned, rules and procedures were in place, and it was clear who had what authority regarding issues such as customer service, manufacturing, or distribution. The system turned out to be a success, allowing Roots to

meet its orders. Building a close relationship with its 3PL has helped Roots showcase its brand and serve the market as a first-class retailer.

This level of responsiveness helped Roots establish itself. The company continues its success and was the provider of team uniforms for the Canadian team for the Olympic Games in Rio 2016.

See: www.roots.com.

There are many types of e-auctions that are classified based on the way competition between sellers or buyers is conducted. For example, in an [open auction](#), suppliers can select the items they want to place offers on, see the most competitive offers from other suppliers, and enter as many offers as they want until a specified closing time. In a [sealed bid auction](#), sellers have a certain amount of time to submit one best and final bid, with bidders never having knowledge of what the other sellers are bidding. With forward auctions, bids increase in value, whereas in reverse auctions they decrease in value.

The most common type of e-auction is the [reverse auction](#), which involves one buyer with many sellers. Sellers place decreasing bids on a set of goods or services and follow a specified set of rules that governs the auction. A reverse auction is an online, real-time declining price auction involving one buyer and many prequalified suppliers. The bidding process is dynamic. Suppliers compete for the business by bidding against each other online using specialized software. Suppliers are given information concerning the status of their bids in real time, and the supplier with the lowest bid is usually awarded the business.

e-Auctions are one of many methods for sourcing goods and services. To use e-auctions for sourcing a few criteria need to be in place. First, the specification for goods or services needs to be well defined. Buyer expectations must be clear, including product characteristics, quality standards, and technological requirements, as well as delivery expectations. Second, there must be a competitive market in place and a sufficient number of qualified suppliers. Too few suppliers may not provide enough competition, whereas too many may create confusion. A rule of thumb suggests that the number of suppliers participating in an e-auction should be between three and six. Third, there must be a clear understanding of market standards to set appropriate expectations. Fourth, the buyer believes the cost of the e-auction is justified by the savings in price. This item is often overlooked, as running an e-auction, including software and training, can be proved to be more expensive than most

companies anticipate. Fifth, clear rules for running the e-auction are specified, such as extending the auction and selection criteria.

The e-auction process involves three stages: preparation, the auction event, and follow-up. Preparation is often the determining factor of an e-auction's success or failure. In the preparation stage, the buyer must identify and prequalify suppliers who will participate. The buyer must also set the product requirements—such as quality, quantity, delivery, service, and the length of contract. In addition, they must train everyone involved in the technology that will be used to run the auction and pretest the auction technology to ensure functionality. They must also specify how the auction will be conducted. For example, suppliers must understand how long the auction will run and the rules if the targeted closing time will be extended. Some e-auctions have a “hard” closing time, which permits no extension of time, whereas other auctions permit time extension. Typically, an e-auction will experience a surge of activity in the last few minutes of the auction, and it is important for suppliers to understand these types of rules governing the auction to adjust their behavior accordingly.

Today's technology allows the buyer a variety of alternative approaches in terms of conducting auctions. For example, price visibility can be viewed in many ways, such as a rank order, by percentages, or by proportional differences. The technology also allows the ranks to be adjusted for nonprice factors, such as differences in transportation costs, quality, or delivery time. Most auction software allows suppliers and the buyers to communicate with each other during the auction, and the software options can specify whether messages may be visible to other suppliers participating in the auction. In addition, technical assistance must be made available during the auction in case problems arise.

Conducting e-auctions is much more complicated, and often more expensive than companies realize. It also automates the buyer–supplier relationship, diminishing the potential of building a long-term relationship. Although e-auctions can provide large benefits in sourcing, companies should be selective when using this sourcing approach.



Concept Check Questions

66. There are relatively few benefits to using e-auctions.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

67. E-auctions can lead to unrealistically low prices during the e-auction process.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

68. Putting products on an e-auction sends a signal to current suppliers that the company is considering switching to a new source of supply and that price may be the determining factor in source selection.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

69. E-auctions are a good way to motivate existing suppliers.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

70. In a/n _____ auction, suppliers can select the items they want to place offers on, see the most competitive offers from other suppliers, and enter as many offers as they want until a specified closing time.

- ☐ a) open
- ☐ b) closed
- ☐ c) sealed bid
- ☐ d) open bid
- ☐ e) reverse

Correct or Incorrect?

Clear

Check Answer

71. In a/n _____ auction, sellers have a certain amount of time to submit one best and final bid, with bidders never having knowledge of what the other sellers are bidding.

- ☐ a) open
- ☐ b) forward

- ☐ c) sealed bid
- ☐ d) open bid
- ☐ e) reverse

Correct or Incorrect?

Clear

Check Answer

72. The most common type of e-auction is the _____ auction.

- ☐ a) open
- ☐ b) forward
- ☐ c) sealed bid
- ☐ d) open bid
- ☐ e) reverse

Correct or Incorrect?

Clear

Check Answer

73. A _____ auction is an online, real-time declining price auction involving one buyer and a number of prequalified suppliers.

- ☐ a) open
- ☐ b) forward
- ☐ c) sealed bid
- ☐ d) open bid
- ☐ e) reverse

Correct or Incorrect?

Clear

Check Answer

74. Conducting e-auctions is much more complicated, and often more expensive, than companies realize.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

AI & Analytics Box

■ FEDEX

Security is essential for companies such as FedEx. In 2023, FedEx Ground delivered around 2.8 billion packages, or about 9.2 million packages per day. FedEx Express's average daily packages were about 5.64 million in the second quarter of 2023, which is a 2% decrease from the previous year. Recently, the company decided to harness the power of its large stores of data to address security needs. To do this FedEx decided to link its stores of big data to physical items. It created a next-generation, first-of-its-kind information service called SenseAware that combines a global positioning system (GPS) sensor device and a Web-based collaboration platform. This technology was originally used by the healthcare and life sciences industries to track high-value or extremely time-sensitive shipments but is now available to all industries. SenseAware attaches digital information to packages, providing information such as precise temperature readings, information about a shipment's exact location, and notification when a shipment is opened or if the contents have been exposed to light. It then shares real-time alerts and analytics between authorized parties regarding the shipment. The device is equipped with a radio that constantly broadcasts this information back to FedEx. This results in an enormous amount of data being generated that must be acted on in real time. This has provided top-level security and efficiency for FedEx, while generating even more data for large-scale analysis.

Measuring Sourcing Performance

As we can see, the sourcing function has a large responsibility over supply chain inventory. Sourcing must ensure that there are enough inventory items needed at the right locations, but not too much inventory given large inventory costs. There are two common performance measures that can be used to measure the performance of the sourcing function relative to its utilization of inventory. These are [inventory turnover](#) and [weeks of supply](#).

Inventory turnover measures how quickly inventory moves. It is computed as:

$$\text{Inventory turnover} = \frac{\text{Cost of goods sold}}{\text{Average inventory value}}$$

Concept Check Questions

75. Inventory turnover and weeks-of-supply are the same thing.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

76. _____ measures how quickly inventory moves.

- ☐ a) Inventory speed
- ☐ b) Weeks-of-supply
- ☐ c) Supply remaining
- ☐ d) Inventory turnover
- ☐ e) Inventory coverage

Correct or Incorrect?

Clear

Check Answer

77. _____ provides the length of time demand can be met with on-hand inventory.

- ☐ a) Inventory speed
- ☐ b) Weeks-of-supply
- ☐ c) Supply remaining
- ☐ d) Inventory turnover
- ☐ e) Inventory coverage

Correct or Incorrect?

Clear

Check Answer

78. In general, the higher the inventory turnover rate the better the company utilizes its inventory.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

79. There are well-known benchmarks for inventory turnover.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

80. A large weeks of supply value means too much inventory is being held.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

EXAMPLE 1 Inventory Turnover

Jenco Incorporated is a producer of children's dolls for the toy industry. It has high inventory costs and is concerned that its inventory is selling at an appropriate rate. It has an annual cost of goods sold of \$8,000,000 and an average inventory in dollars is \$2,000,000. What is the annual inventory turnover?

SOLUTION:

$$\text{Inventory turnover} = \frac{\$8,000,000}{\$2,000,000} = 4 \text{ inventory turns per year}$$

In general, the higher the inventory turnover rate the better the company utilizes its inventory. However, there is no one number that is considered correct. Some companies need to turn their inventories over faster than others. For example, perishable items such as food or medicine need to turn over faster than machinery or commodity items. Also, certain industries have much higher inventory turns than others. For example, innovative products with short life cycles need to turn over very quickly or they may become obsolete. To get good guidelines on acceptable inventory turns it is important for companies to consider their industry standards as a benchmark of performance.

The second performance measure, weeks of supply, provides the length of time demand can be met with on-hand inventory. It is computed as follows:

$$\text{Weeks of supply} = \frac{\text{Average on-hand inventory}}{\text{Average weekly usage}}$$

EXAMPLE 2 Weeks of Supply

Jenco, Inc. is concerned about having enough inventory in stock and wants to compute its weeks of supply. Recall that we already know that Jenco has an \$8,000,000 annual cost of goods sold.

SOLUTION:

The weekly cost of goods sold can be computed by dividing the annual cost of goods sold by 52 weeks per year. Weeks of supply can then be computed as follows:

$$\begin{aligned}\text{Weeks of supply} &= \frac{2,000,000}{\$8,000,000/52} \\ \text{Weeks of supply} &= \frac{2,000,000}{\$153,846.15} \\ \text{Weeks of supply} &= 13 \text{ weeks of supply}\end{aligned}$$

Weeks of a supply tells the manager how long the current on-hand inventory will last based on current demand. A large “weeks of supply” value means too much inventory is being held, whereas a value that is too low increases the chances of a stock-out or lost sales. Notice that the value of this metric depends on demand. Given that product demand often changes due to factors such as seasonality, managers need to consider that the best value of this metric will likely change throughout the year. As with inventory turnover, companies should benchmark this metric against industry best practices.

Empowering Entrepreneurs Box

Sourcing and procurement are of special importance for small business owners. The reason is that their supply chains are smaller compared to those of large firms and the number of sourcing options are more limited. Another reason is the large amount of spend involved in procurement. Remember that procurement controls roughly 80% of spend for a company. Managing finances is of critical importance here and making sure that all sources of supply are at the lowest cost options possible. Equally important are the meeting of quality standards and providing on-time delivery. A shortage or product delivery delay can be perilous to a small business as they typically have fewer choices in supply.

There are two important elements here. First, even small companies should diversify their portfolio of suppliers so they are never dependent on any one entity. The number of alternative sources will likely be much smaller than for a large company. However, having at least some options in sourcing will ensure that a small business does not find itself in trouble if its single source of supply is not able to deliver. Second, developing personal relationships with suppliers is extremely important for small business owners and a developed trust is something they can leverage. While large organizations often build impersonal procurement policies, small companies can benefit from personal relationships. These are key for improved negotiation, getting better terms of sales, and simply being able to make a phone call to check on things. This is one area where small business owners excel compared to large impersonal organizations and need to take advantage of it.

CHAPTER HIGHLIGHTS

Sourcing is the business function responsible for all activities and processes required to purchase goods and services from suppliers.

Terms such as “purchasing,” “procurement,” “sourcing,” “strategic sourcing,” and “supply management” are used interchangeably but are not the same.

Purchasing defines the process of buying goods and services, whereas strategic sourcing, or supply management, involves looking at sourcing from a strategic and future-oriented perspective.

The sourcing function provides several critical roles for the organization.

These are operational impact, financial impact, strategic impact, risk mitigation impact, and information impact.

The sourcing process involves every aspect of acquiring goods and services, ranging from identifying potential suppliers to negotiating and awarding contracts, and ensuring contract standards are met.

Competitive bidding and negotiation are two different methods used to reach agreement and develop contracts with potential suppliers.

Products can be classified as either primarily functional or primarily innovative. Depending on their classification, they will be sourced differently and will require different types of supply chains.

Outsourcing engagements can be classified based on scope and criticality of outsourced tasks.

e-Auctions are the use of Internet technology to conduct auctions as a means of selecting suppliers and determining aspects of the purchase contract.

Inventory turnover and weeks of supply are two metrics that can be used to measure the performance of the sourcing function.

KEY TERMS

[Sourcing](#)

[Purchasing](#)

[Strategic sourcing](#)

Operational impact

Financial impact

Risk mitigation

Information Impact

Cocreation

Request for quotation (RFQ)

Request for proposal (RFP)

Request or invitation for bid (RFB)

Fair price

Total cost of ownership (TCO)

Outsourcing analytics

Functional

Innovative

functional products

innovative products

Stable

Evolving supply process

Postponement

Off-shoring

Re-shoring

Scope

Criticality

Open auction

Sealed bid auction

Reverse auction

Inventory turnover

Weeks-of-supply

DISCUSSION QUESTIONS

- Identify the primary ways in which the sourcing function impacts supply chain management (SCM). Find an industry example where sourcing has significantly benefited the firm and where it has significantly hurt the firm.
- Think of a recent purchase you made in your everyday life. Explain how this purchasing process would be different if you were buying the same product for a firm regularly vs purchasing it for yourself.
- Find at least one business example of outsourcing. Explain the risks and benefits.
- There has been a push in many communities to source locally. Identify the risks and benefits of sourcing globally vs locally.
- Explain the differences between sourcing manufactured products vs services. Identify some key challenges that would occur in defining service specifications vs manufacturing specifications. Provide an example of each.

PROBLEMS

- Jerry's Auto Repair is concerned about the effective use of parts inventory. His average inventory in dollars is \$300,000, and the cost of goods sold is \$1,500,000.
 - What is the inventory turnover for Jerry's Auto Repair?
 - Assuming 52 weeks per year, what are the weeks of supply?
 - What do these numbers tell you about Jerry's inventory utilization?
- Urbanite Hip is a clothing store catering to college students and young professionals. It carries fashion merchandise and wants to ensure that it is using inventory effectively. The cost of goods sold is \$5,000,000, and the average inventory in dollars is \$250,000.
 - What is their inventory turnover?
 - What are the weeks of supply, assuming 52 weeks per year?
 - Urbanite Hip is expecting to increase sales by 10% next year while maintaining the same level of average inventory. How will their inventory turnover and weeks of supply change?

Phoenix & Chow is a family-owned restaurant with an annual cost of goods sold of \$520,000 and an average inventory of \$50,000. What is the value of weeks of supply assuming 52 weeks per year?

H & H store is a retailer of stationery and paper products. It has an annual cost of goods sold of \$100,000 and an average inventory of \$50,000. What is the annual inventory turnover? If the industry average is three turns per year, how does H & H compare?

Climb and Fly Sports has an annual cost of goods sold of \$1 million. What is the average inventory assuming 52 weeks per year and weeks of supply equal to 5?

CLASS EXERCISE: TOYOTA

You are the manager of strategic sourcing at Toyota Motor Corporation and have just been called in by the vice president (VP) of global sourcing, to whom you report. There has been a problem with at least eight vehicles exhibiting sticking accelerator pedals, and your boss is very upset. Strong evidence points to a problem with CTS, an electronics supplier, which has been recognized for high-quality standards by Toyota. You have been asked to provide your boss with the following:

Identify the exact sequence of steps—a “project plan”—on how to handle this problem, from dealing with customers to identifying causes. Explain what should be done and why.

What should be said to your customers? How should you explain the problem?

What information do you want to collect and from whom to identify causes?

What should you say to your supplier? How should you say it (e.g., in public or private; in a meeting or writing)? What action do you expect them to take?

Do you continue long-term contracting with this supplier? Do you penalize this supplier?

What are the risk trade-offs in your decision (e.g., placing blame vs accumulating evidence; dropping a supplier vs standing by a supplier)?

Case Study Snedeker Global Cruises

It was 7 August, and Brandt Womack had just been given his first assignment by his purchasing manager at Miami-based Snedeker Global Cruises, Inc. It was the “e-Auction Development Program” (EDP). The purpose of EDP was to identify potential products that could be purchased through e-auctions, determine the necessary steps to conduct a successful e-auction and assess the impact of e-auctions on supplier relationships. As a newly hired supply chain manager, Brandt wondered how to proceed.

Snedeker Global Cruises, Inc. incorporated in 1986 and is a cruise company with 35 cruise ships and over 70,000 berths. Snedeker Global Cruises, Inc. serves the contemporary and premium segments of the cruise vacation industry and offers a variety of itineraries to destinations worldwide, including Alaska, Asia, Australia, the Caribbean, Europe, Hawaii, Latin America, and New Zealand.

In 2005, Snedeker incurred its highest-ever procurement costs in sourcing the products and services needed for cruise ship operations and wanted to combat this trend. To that end, Snedeker had been working on changing its buying practices. In the past, each cruise ship made all its purchases for the upcoming season. Purchasing was decentralized, with each ship making purchasing decisions based on its needs alone. The company began moving away from this practice and put into place a centralized purchasing department in charge of making purchases for the entire cruise line. The centralized purchasing strategy provided many cost-saving opportunities for the company and greatly reduced the overall order costs of the company. The company wanted to continue to pursue ways in which the centralized purchasing practice could reduce costs, and e-auctions became a viable option. However, senior management at Snedeker was concerned about the impact on quality and the effect e-auctions might have on suppliers.

At Snedeker, the purchasing cycle began with a master forecast for the upcoming year with orders being placed 8–10 months prior to need. This master forecast included everything from replacement engine parts to chocolate mints placed on pillows in cabins. When the forecast was generated it was given to the Senior Purchasing Manager, Kasey Davis. Kasey scheduled a meeting with Brandt to discuss the EDP, giving Brandt

the master list of all the products that need to be purchased for the next year. Kasey instructed Brandt to determine which products would be best to purchase through e-auctions and wanted to know how the e-auction process would work. In addition, Kasey wanted Brandt to determine the effect that e-auctions would have on relationships with current suppliers.

Brandt walked out of Kasey's office overwhelmed. It was his first assignment, and he did not know where to begin the EDP.

Case Questions

1. Suggest steps Brandt should follow to begin the EDP process.
2. Identify differences between traditional purchasing and use of e-auctions. How can Brandt use these differences to make his selection? What types of items would be best suited for purchase through e-auctions?
3. Assume Brandt has identified products to purchase through e-auctions. What steps does he need to take to conduct a successful e-auction?
4. What negative impact can e-auctions have on supplier relationships, and how can Brandt ensure that they do not occur?

Case Study Making Decisions with Data Analytics: J&G

You are a procurement manager for packing materials at the consumer goods company J&G. You are responsible for ensuring efficient procurement of packing materials with high quality for hair care-related products, including shampoos and conditioners. J&G markets a set of shampoo and conditioner packed in two different bottles, under 5 different brands. Each brand is positioned at different price points and produced in 4 different pack sizes. Thus, there are a total of 40 packing material Stock keeping unit (SKUs) ($5 \text{ shampoo brands} \times 4 \text{ pack sizes} + 5 \text{ conditioner brands} \times 4 \text{ pack sizes}$). Packing material design for each brand is distinctly different to resonate with its positioning in the market and has tight specifications. Each brand has a separate filling line, and all filling lines are operated continuously.

J&G has been working toward a lean inventory system and does not hold inventory of more than 4 shifts. The system necessitates receiving supplies for each packing material SKU from vendors each day. The average number of packing materials received for each SKU equates to 10,000 bottles per day.

With increasing cost pressure from its retail channel, J&G has been working toward a lean organization. As a result, your team's size has been reduced from 6 people to 3 people. You are wondering how to continue working toward your team's quality performance measures with such a small team.

Case Questions

1. Specify what you need to do to ensure quality standards are met for the procured material.
2. What factors do you need to consider to form a sourcing strategy for the packing materials? Specify the factors.

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Note

- [1](#) H. L. Lee, “Aligning Supply Chain Strategies with Product Uncertainties,” *California Management Review*, 44(3), Spring 2002: 105–119 .

7

Logistics

LEARNING OBJECTIVES

After completing this chapter, you should be able to:

Define logistics and explain its impact on supply chain management.

Identify and describe key logistics tasks.

Explain reverse logistics and its challenges.

Explain the differences between modes of transportation.

Explain the role of warehousing in logistics and describe cross-docking.

Explain the role of third-party-logistics (3PL) providers.

CHAPTER OUTLINE

- **What Is Logistics?**
The Logistics Function
Evolution of Logistics
Impact on the Organization
Impact on the Supply Chain
Reverse Logistics
- **Logistics Tasks**
Transportation
Storage
Material Handling
Packaging
Inventory Control
Order Fulfillment
Facility Location
- **Transportation**
Truck
Water
Air
Rail
Pipeline
Multimode
- **Warehousing**
Role of Warehouses in the Supply Chain
Cross-docking
Facility Location

- [Third-party Logistics \(3PL\) Providers](#)
- [Chapter Highlights](#)
- [Key Terms](#)
- [Discussion Questions](#)
- [Problems](#)
- [Case Study: Strategic Solutions, Inc.](#)
- [Case Study: Making Decisions with Data Analytics: Morning Foods, Inc.](#)
- [Bibliography](#)



[Bloomberg Quicktake Video: Waymo Hits 100,000 Weekly Paid Rides](#)

[Bloomberg Quicktake Video: The Impact of EV Tariffs](#)

The arrival of *Harry Potter and the Deathly Hollows* was full of heightened anticipation for fans of the Harry Potter series of books. The 12 million copies of books were scheduled to hit the shelves of thousands of retail stores all over the United States in synchronized fashion on July 21, 2007, and be available through online bookstores. This was a record for the first printing in publishing. Strict security had to be implemented at all stages to minimize the risk of someone leaking the book's ending. Marketing was pushing a big publicity launch, and the mystery of the ending added to the excitement. For the executives at Scholastic, however, this was a major headache. Achieving synchronized deliveries of millions of books at thousands of different locations and meeting deadlines all depended on logistics.

Accomplishing the goal required everyone in the supply chain to work in tight coordination. This included executives from Scholastic's manufacturing and logistics divisions, printers, distributors, and trucking companies, all working to make sure the deliveries, tight schedules, and turnarounds were met. The author, J. K. Rowling, delivered the manuscript just in time (JIT) to the publisher, who then sent it to printers R. R. Donnelley & Sons and Quebecor World, which worked around the clock to guarantee books would be ready by the release date. To reduce time, Scholastic bypassed its warehouses, using hired trucks to ship from six printing sites directly to large retailers such as Barnes & Noble and Amazon.com, as well as numerous distributors of independent booksellers. To expedite loading and unloading, trucking companies such as Yellow Transportation and J. B. Hunt Transport Services used same-size trailers and pallets. To ensure security, every trailer shipping the Harry Potter books had a global positioning system (GPS) transponder that would alert Scholastic if the driver of the trailer veered off designated routes.

The timing was especially tricky for e-tailers, which had to ship in advance for the books to hit customer doorsteps precisely on July 21. barnesandnoble.com even developed special algorithms that enabled its shipping team to figure out when to release books to the U.S. Postal Service or UPS to ensure a simultaneous arrival around the country on that day. Who could have imagined that printing and delivering books could be such a logistical nightmare?

Concept Check Questions

1. Scholastic shipped five million copies of *Harry Potter and the Deathly Hollows* in preparation for its sale starting on July 21, 2007.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

2. For the launch of *Harry Potter and the Deathly Hollows*, achieving synchronized deliveries of millions of books at thousands of different locations and meeting deadlines all depended on logistics.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

3. Logistics security for the launch of *Harry Potter and the Deathly Hollows* was not needed.

- ☐ True
- ☐ False

Correct or Incorrect?

What Is Logistics?

The Logistics Function

Logistics is the business function responsible for transporting and delivering products to the right place at the right time throughout the supply chain. In essence, it is about the movement and storage of product inventories throughout the chain. Logistics has a critical responsibility for the functioning of both the organization and the supply chain because without it, materials would not arrive when and where they are needed. To achieve its goals, logistics must plan and coordinate all material flows from the source of supply to all users in the chain. As we can see by the logistics requirements to deliver Harry Potter books, this task is more complicated than it appears.

Unlike marketing, which focuses on the “downstream” part of the supply chain, and sourcing, which focuses on the “upstream” part, logistics connects the organization to both its customers and suppliers. Logistics works with sourcing to link the organization to its external suppliers and to ensure that materials are delivered inbound to the organization when needed. This is critical for the operations function, which is responsible for transforming sourced materials into finished products. Logistics also works with marketing to connect the organization to the final customer by ensuring the distribution and delivery of outbound products to external customers. This is shown in [Figure 7.1](#).

The function of logistics is complex and requires a great deal of coordination. Consider that Amazon operates an extensive global logistics network, delivering approximately 18.5 orders every second. Just in the first half of 2023, Amazon fulfilled over 1.8 billion U.S. Prime orders with same or next-day delivery. Amazon's market capitalization is significant, reflecting its diverse business segments, including e-commerce, cloud services, and the complexity of its logistics.

As we will see in this chapter, many important decisions have to work together to enable proper logistics functioning. This includes organizing and managing the entire distribution network, including the location of warehouses,

distribution centers, and plants, and coordinating the modes of transportation between them. It also includes the design and management of operations throughout the network for efficient storage and quick movement of goods. Recall that in the Harry Potter example, pallets of the same size were used to expedite movement, and even seemingly small decisions were found to be significant, such as the size of trailers used.

Logistics must also have access to information in real time to be able to track product movement and plan the exact timing and location of deliveries. It must ensure the security of goods from theft or tampering while the products are moved. For example, in the case of Harry Potter, all trailers that carried the books had GPS transponders to enable the company to monitor product location at all times. Adding to the challenge is that all of this must be accomplished while meeting exact customer delivery dates and at the lowest cost possible. It is a challenge of high magnitude.

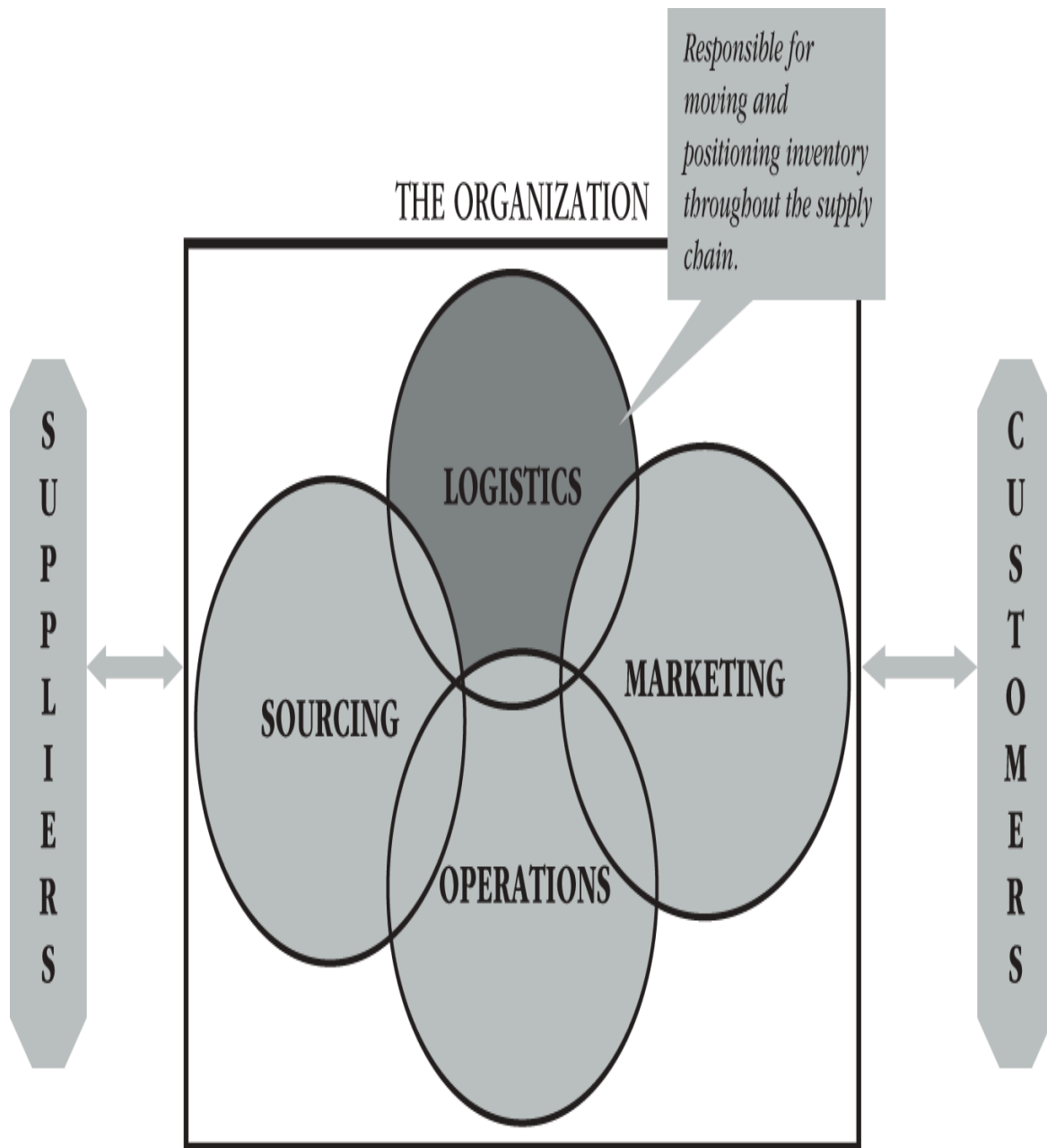


FIGURE 7.1 The logistics function.

Logistics is a function that requires large investments in infrastructure, such as transportation vehicles, material handling equipment, and information technology. For this reason, many companies outsource this function to outside firms. Companies such as United Parcel Service (UPS), Federal Express (FedEx), and DHL have made it their business to provide logistics services to their clients. As of 2024, UPS is considered the biggest delivery service company with the highest revenue of \$91.0 billion, followed by FedEx at \$90.155 billion, and DHL at \$81.8 billion. These companies have invested

in the needed infrastructure, such as their fleet of airplanes and trucks, and the latest technology to track packages from point of origin to destination using barcode technology and scanners. In addition to moving products, these companies can be contracted to perform a range of logistics functions, including designing an entire distribution network for their clients. They can also provide services such as management of inventory, warehouse management, and even customer interface.

Supply Chain Leader's Box

■ UNITED PARCEL SERVICE (UPS)

UPS is the world's largest package delivery company, both in terms of revenue and volume, and a global leader in supply chain solutions. It is known as a third-party logistics (3PL) provider, as it provides logistics services to companies. Although the primary business of UPS is the time-definite delivery of packages and documents, they have extended their capabilities in recent years to encompass the broader spectrum of services known as supply chain solutions. This includes designing a distribution network, freight forwarding, customs brokerage, fulfillment, returns, financial transactions, and even repairs.

UPS also maintains the highest quality and efficiency standards, implementing JIT and lean systems throughout its facilities. It uses state-of-the-art technology for tracking packages, and shipments, as well as real-time location identification of any of its carriers using GPS technology.

One can discern the full logistics capability of UPS just from its sheer size. UPS services more than 220 countries and territories and operates 1,801 facilities. It has a delivery fleet of 321,000 package cars, vans, tractors, and motorcycles, including more than 10,000 alternative fuel and advanced technology vehicles. It even has its own UPS fleet of over 500 aircraft is considered the ninth-largest airline in the world. This enables UPS to design optimal multimodal transportation for quick speed and lowest cost, delivering more than 15 million packages per day to almost 8 million customers.

UPS relies on technology and is an analytically driven company, optimizing every aspect of its logistics network. It uses GPS-enabled big data telematics and route optimization for maximum efficiency in transportation. Transport analytics can improve productivity by optimizing fuel efficiency, preventive maintenance, driver behavior, and vehicle routing. Tracking of weather and other disruptive events can continually optimize routes. UPS, for example, started gathering data more than 20 years ago. Today, the company uses a “data-drenched” tool called on-road

integrated optimization and navigation (ORION) to help drivers find the most efficient path through their delivery areas.

The immense infrastructure and capability offered by UPS are the reason why companies use them for their logistics and supply chain solutions. Logistics is a highly capital-intensive industry, and the coordination is complex. In addition, most companies do not consider transportation and logistics to be their core competency and do not have the resources to perform this function. For this reason, there has been a high growth in 3PL providers such as UPS and an increased demand for their services.

Adapted from: <https://ups.com>.

Concept Check Questions

4. _____ is the business function responsible for transporting and delivering products to the right place at the right time throughout the supply chain.

- ☐ a) Distribution
- ☐ b) Marketing
- ☐ c) Logistics
- ☐ d) Shipping
- ☐ e) Order fulfillment

Correct or Incorrect?

Clear

Check Answer

5. Logistics has a critical responsibility for the functioning of both the organization and the supply chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

6. Logistics focuses on the “downstream” part of the supply chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

7. Logistics connects the organization to both its customers and suppliers.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

8. The function of logistics is complex and requires a great deal of coordination.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

9. In the first half of 2023, Amazon fulfilled over 1.8 million U.S. Prime orders with same or next-day delivery.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

10. Logistics must also have access to information in real time.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

11. Logistics does not require much investment in infrastructure.

- ☐ True
- ☐ False

Correct or Incorrect?

[Clear](#)[Check Answer](#)

Evolution of Logistics

Today's business logistics is rooted in military logistics. Logistics has always been a critical part of national defense. Consider all the issues involved in moving military troops and convoys, planning optimal locations of depots, and delivery of supply items such as food, fuel, and spare parts. Logistics in the military is the function responsible for these activities. In addition, logistics in the military is also responsible for all issues related to equipment maintenance, reliability, and parts sourcing.

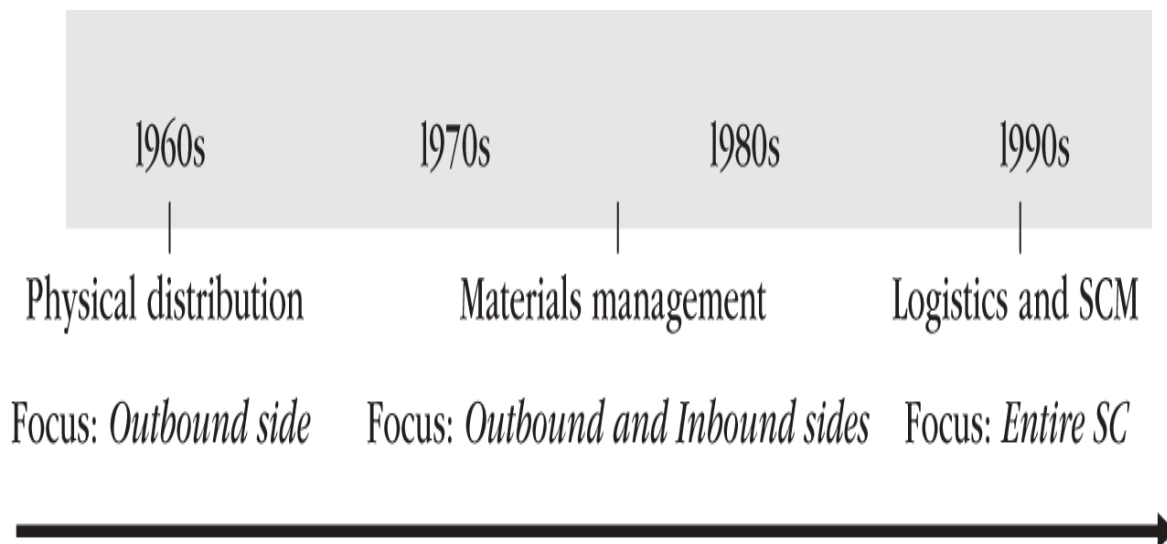


FIGURE 7.2 Evolution of the logistics function.

In the business arena logistics was introduced under the name of “[physical distribution](#)” in the 1960s and was primarily focused on shipping goods on the outbound side of the organization. The initial interest was in getting the product from the manufacturer to the final customer using the best arrangement of warehouses and distribution centers, and optimal modes of transportation. As a result, logistics developed a strong tie with the marketing function and focused on the “downstream” part of the supply chain ([Figure 7.2](#)).

In the 1970s and 1980s, the use of logistics concepts was extended to the “upstream” part of the supply chain. There was an increased focus on strengthening manufacturing and a greater awareness of the need to deliver

materials to manufacturing facilities in an accurate and timely fashion. This was termed “materials management,” which now looked at logistics for serving the inbound side of the organization in addition to the outbound.

The 1990s witnessed the growth of supply chain management (SCM) and the holistic understanding of the importance of managing the entire supply chain. As a result, logistics in the business sector was extended to include the movement of goods through the entire supply chain, both upstream and downstream, serving both the inbound and outbound side of the organization.

Today there are three different types of logistics. The first is [business logistics](#), which is focused on the movement and storage of goods throughout the entire supply chain. The second is [military logistics](#), which is focused on supporting military needs. Finally, there is [event logistics](#), which involves organizing and deploying resources in preparation for an event. Examples of this would be logistics involved in setting up the Olympic Games or deploying resources to provide disaster relief anywhere across the globe when needed.

Managerial Insights Box: Super Bowl Logistics

The Super Bowl is an iconic sporting event involving intricate logistics to ensure success. The complex logistics involved encompasses venue preparation, fan transportation, security, media coverage, halftime shows, ticketing, concessions, sponsorships, and postevent cleanup. Most people do not realize that the event represents the peak of logistics performance. Super Bowl's logistical intricacies contribute to its memorable and smoothly run experience for fans and viewers. Let us look at some of the issues involved in Super Bowl Logistics:

Venue Transformation: The host stadium undergoes a massive transformation to accommodate media, entertainment, and sports elements. For example, the 2020 Super Bowl at Hard Rock Stadium required 160,000 square feet of tents for various operations.

Temporary Structures: Temporary facilities such as media centers and hospitality tents are constructed. For Super Bowl XLVIII, held at MetLife Stadium, over 21,000 temporary seats were added to accommodate the event.

Broadcasting: Complex logistics are involved in broadcasting the event to millions of viewers worldwide. The 2021 Super Bowl had an estimated television audience of over 96 million viewers.

Security: Extensive security measures are in place, involving thousands of personnel. Super Bowl LV in 2021 had over 1,000 security cameras and approximately 700 security personnel.

Fan Experience: Logistics include transportation, fan zones, and merchandise sales. The 2020 Super Bowl saw over 1.3 million attendees at various events and activities leading up to the game.

Food and Beverage: Logistics for procuring, storing, and distributing food and beverages. It's estimated that over 1.3 billion chicken wings were consumed during the 2021 Super Bowl weekend.

Halftime Show: Logistics for stage setup and performer accommodations. The halftime show for Super Bowl LIV in 2020 featured over 1,000

performers.

Clean-Up: A large-scale clean-up operation is conducted after the event. It is estimated that over 40 tons of waste were generated during Super Bowl XLIX in 2015.

Economic Impact: Hosting the Super Bowl has a significant economic impact on the host city. Super Bowl LIV in 2020 generated an estimated \$572 million in economic impact for the Miami area.

Concept Check Questions

12. Which of the following phases of logistics came first?

- ☐ a) Electronic distribution
- ☐ b) Logistics and SCM
- ☐ c) Distribution
- ☐ d) Physical distribution
- ☐ e) Materials management

Correct or Incorrect?

Clear

Check Answer

13. Which of the following phases of logistics came second?

- ☐ a) Electronic distribution
- ☐ b) Logistics and SCM
- ☐ c) Distribution
- ☐ d) Physical distribution
- ☐ e) Materials management

Correct or Incorrect?

Clear

Check Answer

14. Which of the following phases of logistics came third?

- ☐ a) Electronic distribution
- ☐ b) Logistics and SCM
- ☐ c) Distribution
- ☐ d) Physical distribution
- ☐ e) Materials management

Correct or Incorrect?

Clear

Check Answer

15. Logistics has always been a critical part of national defense.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

16. logistics concepts have always included the “upstream” part of the supply chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

17. Today there are four different types of logistics.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

18. _____ logistics is focused on the movement and storage of goods throughout the entire supply chain.

- ☐ a) Business
- ☐ b) Marketing
- ☐ c) Event
- ☐ d) Defense
- ☐ e) Military

Correct or Incorrect?

Clear

Check Answer

19. _____ logistics is focused on supporting military needs.

- ☐ a) Business
- ☐ b) Marketing

- ☐ c) Event
- ☐ d) Defense
- ☐ e) Military

Correct or Incorrect?

Clear

Check Answer

20. _____ logistics involves organizing and deploying resources in preparation for an event.

- ☐ a) Business
- ☐ b) Promotional
- ☐ c) Event
- ☐ d) Defense
- ☐ e) Military

Correct or Incorrect?

Clear

Check Answer

Impact on the Organization

Logistics has a significant impact on the organization by the mere fact that its role is to support all organizational functions by ensuring timely availability of products. On the inbound side of the organization, logistics works with sourcing to ensure that materials needed for operations are delivered when required. On the outbound side, logistics works with marketing to ensure that products are delivered to various customers when needed. Let us look at this process a bit more closely.

Impact on Operations. Logistics interfaces closely with operations through the planning of the amounts of inventory that must be received at various

points throughout the supply chain and the timing of those receipts. Logistics must understand the exact delivery schedule requirements. It must also decide on the best balance between bringing extra inventory and arranging for storage or risking not having enough inventory. This is directly related to operations scheduling and production run time, which is the amount of time required for a batch of goods to be produced before a “setup” or changeover is incurred. Historically companies used long production runs to incur economies of scale and stored the excess goods in inventory. The production process was then stopped to “set up” or change equipment for the production of another product. This practice required logistics to deliver large amounts of inventory less frequently.

As more manufacturers have switched to JIT or lean manufacturing, production run times have become significantly shorter. JIT or lean, which we discuss in detail in [Chapter 10](#), is known as a “pull” system, where demand “pulls” the product through the supply chain. This is different from traditional systems that “push” the product through the supply chain in anticipation of demand. JIT systems are characterized by short production runs to respond to demand. They require frequent deliveries of smaller quantities of inventories and carry little excess inventory as safety stock. As a result, precise timing of deliveries of inbound materials is essential.

It is up to logistics to work with operations to arrange for the precise timing of deliveries of the exact materials that are needed based on production schedules. If too much inventory is delivered too soon, inventory costs become high, and storage becomes an issue. If too little inventory is delivered, manufacturing processes will not be able to operate without the needed materials. Therefore, it is critical that logistics understands production schedules and strikes a balance between inventory holding costs and shortages.

This is especially difficult if we consider that demand patterns and production schedules are not necessarily fixed. Consider holiday demand or seasonal demand, such as sales of ice cream in the summer or shovels in the winter. In these cases, most companies produce larger quantities of products in advance of production. It is up to logistics to ensure that these products are stored at the optimal location for quick delivery and that they work with operations to ensure that just the right amount of inventory is available.

The logistics function has an impact on all operations, whether they are manufacturing or service. Consider a large restaurant that specializes in

seafood. It is up to logistics to ensure that the right quantities of fresh seafood are delivered at the right time. Seafood is highly perishable, so transportation time should be minimal. Also, logistics must ensure that the right packaging, handling, and temperature controls are correct at all times. It must also ensure that the seafood is delivered at just the right time in the right quantities. If seafood deliveries are late the chefs may not have enough time to prepare the planned menu. If the delivered quantities are low the restaurant may not have enough to serve its customers. In both cases, customer service suffers. Similarly, if the seafood arrives too early, it must be stored, losing its freshness and risking loss due to its perishable nature. This can result in high inventory costs for the restaurant.

Impact on Marketing. On the outbound side, logistics provides key support for marketing and order fulfillment. Logistics must work with marketing to understand customer requirements, as well as storage and delivery needs. A key element in sales is ensuring that the product is available when needed. Consider sales of orange and black M&M's during the Halloween season. Marketing arranges for color designs that are in keeping with the event to promote sales. However, if enough colored M&M's are not on the retail shelves at the right time, sales will not occur. It is up to logistics to ensure the right timing of the shipment of M&M's. If the shipment arrives too late or if the quantities delivered are small, sales and marketing will suffer. On the contrary, if too much inventory arrives, the company will incur losses through markdowns of the colored M&M's after Halloween passes.

The impact is significant when we consider that Halloween candy sales in the United States reached approximately \$3.6 billion in 2023, according to the National Confectioners Association. This reflects the holiday's significant economic impact and the popularity of candy during Halloween festivities. The diverse range of treats available, along with efforts from retailers, manufacturers, and marketers, contributes to the growth and resilience of the confectionery industry. Overall, Halloween is a key event for the industry, driving innovation and consumer demand for candy products and availability depends on logistics.

Some statistics further highlight the importance of logistics in marketing in a different industry. In 2023, Apple sold over 235 million iPhones worldwide (20.1% of market share), demonstrating the scale of logistics operations required to deliver products to customers on a global scale. However, delays in product availability can result in substantial losses. For example, the estimated

cost of a one-week delay in the iPhone 12 launch was around \$4.5 billion in potential sales.

Efficient logistics contributed to Apple's market capitalization exceeding \$3 trillion in 2022, highlighting the connection between SCM and the company's success in marketing and sales.

Impact on Packaging. Another logistics decision is the packaging of goods as they are being transported. This has a significant impact on the ability to move and handle the material. This decision also protects the items from damage and affects both operations and marketing. Consider the seafood restaurant example mentioned earlier. If logistics does not make proper decisions on packaging, including insulation and temperature monitoring, the product will lose its freshness. In the example of M&M's, if proper packaging is not used, the candy can get crushed, broken, or damaged. In both cases, it is up to logistics to arrange for proper packaging that ensures product integrity which has a significant impact on cost. Just consider that the market value of global packaging is approximately \$1,015 billion, calculated on the value of finished products and has an estimated annual growth rate of +4% for the period 2021–2026.

Impact on Finance. Logistics has an especially important impact on the financial picture of the organization, as it is responsible for large capital expenditures, such as transportation, warehousing, and inventory. Its performance can be seen directly in financial measures such as return on assets (ROA) and return on investment (ROI). Consider that ROA is computed as follows:

$$\begin{aligned}\text{ROA} &= \frac{(\text{Revenue} - \text{Expenses})}{\text{Assets}} \\ \text{ROA} &= \frac{\text{Gross revenue}}{\text{Assets}}\end{aligned}$$

Notice in the equation that we can increase ROA in three ways. One is by increasing revenue, another by reducing expenses, and another by reducing assets. All three are directly impacted by logistics. First, inventory is considered an asset on the balance sheet and an expense on the income statement. This means that by reducing inventory, both expenses and assets are

reduced, and ROA is affected positively. In addition, investments in transportation and warehousing are also considered assets. By reducing these assets ROA is significantly affected. This is also another reason why some companies choose to outsource logistics. It is an asset-heavy function, and by using a third party these assets can be eliminated. Finally, notice that ROA increases with an increase in revenue. Revenue can be increased through customer service and, as we already explained, logistics can play a key role in ensuring deliveries of the right quantities of goods to the right customers.

Concept Check Questions

21. Logistics has a significant impact on the organization by the mere fact that its role is to support all organizational functions by ensuring timely availability of products.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

22. Logistics does not work with sourcing because that is the responsibility of marketing.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

23. Logistics interfaces closely with operations through the planning of the amounts of inventory that must be received at various points throughout the supply chain and the timing of those receipts.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

24. Historically companies used short production runs to incur economies of scale and stored the excess goods in inventory.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

25. JIT production systems imply longer production runs.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

26. JIT production systems require frequent deliveries of smaller quantities of inventories and carry little excess inventory as safety stock.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

27. The logistics function has an impact on all manufacturing operations, but it has minimal impact on service operations.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

28. Logistics must work with marketing.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

29. Halloween candy sales in the U.S. reached approximately \$1.6 billion in 2023, according to the National Confectioners Association.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

30. In 2023, Apple sold over one billion iPhones worldwide.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

31. Another logistics decision is packaging of goods as they are being transported.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

32. Gross revenue divided by assets calculates what?

- ☐ a) ROI
- ☐ b) ROA
- ☐ c) Inventory turnover
- ☐ d) Weeks of supply

Correct or Incorrect?

Clear

Check Answer

Impact on the Supply Chain

We discussed in [Chapter 1](#) that logistics, in contrast to SCM, consists of the tasks involved in moving and positioning inventory throughout the supply chain. Logistics is a function that supports SCM by being responsible for one of the flows in SCM, namely, the moving of goods or inventory. Logistics manages the movement of goods both downstream and upstream and is responsible for making all the decisions that enable this to happen efficiently and effectively. This includes order processing and tracking, inventory management, transportation, warehousing, material handling, and packaging. SCM could not function without logistics as there would be inventory stock-outs at some locations and too much inventory at others.

Walmart's success is directly tied to its logistics efficiency which emphasizes the critical role logistics plays in providing place, quantity, and time utilities to customers, reinforcing its competitiveness and service excellence in the retail industry. Walmart operates over 150 distribution centers in the United States alone. The company's SCM has contributed to its position as the world's largest retailer, with revenues exceeding \$550 billion in 2023. Walmart's inventory turnover ratio, a measure of inventory efficiency, is significantly higher than industry averages, reflecting its effective logistics system.

It can be said that logistics provides SCM with three utilities: place, quantity, and time, as shown in [Figure 7.3](#). Logistics provides place utility by ensuring that goods arrive at the right place in the supply chain. It is the function that extends the geographic region by effectively utilizing transportation. It is

because of logistics that SCM has a broad place utility and can reach a wide geographic region. Similarly, logistics provides quantity utility by ensuring that the correct quantities are delivered at the right location. Once again, the trade-off here is between delivering too many goods and incurring inventory holding costs or not delivering enough and having shortages. Finally, logistics provides time utility by delivering the goods at precisely the right time needed. Recall that this is especially critical for JIT inventory systems and promotional items.

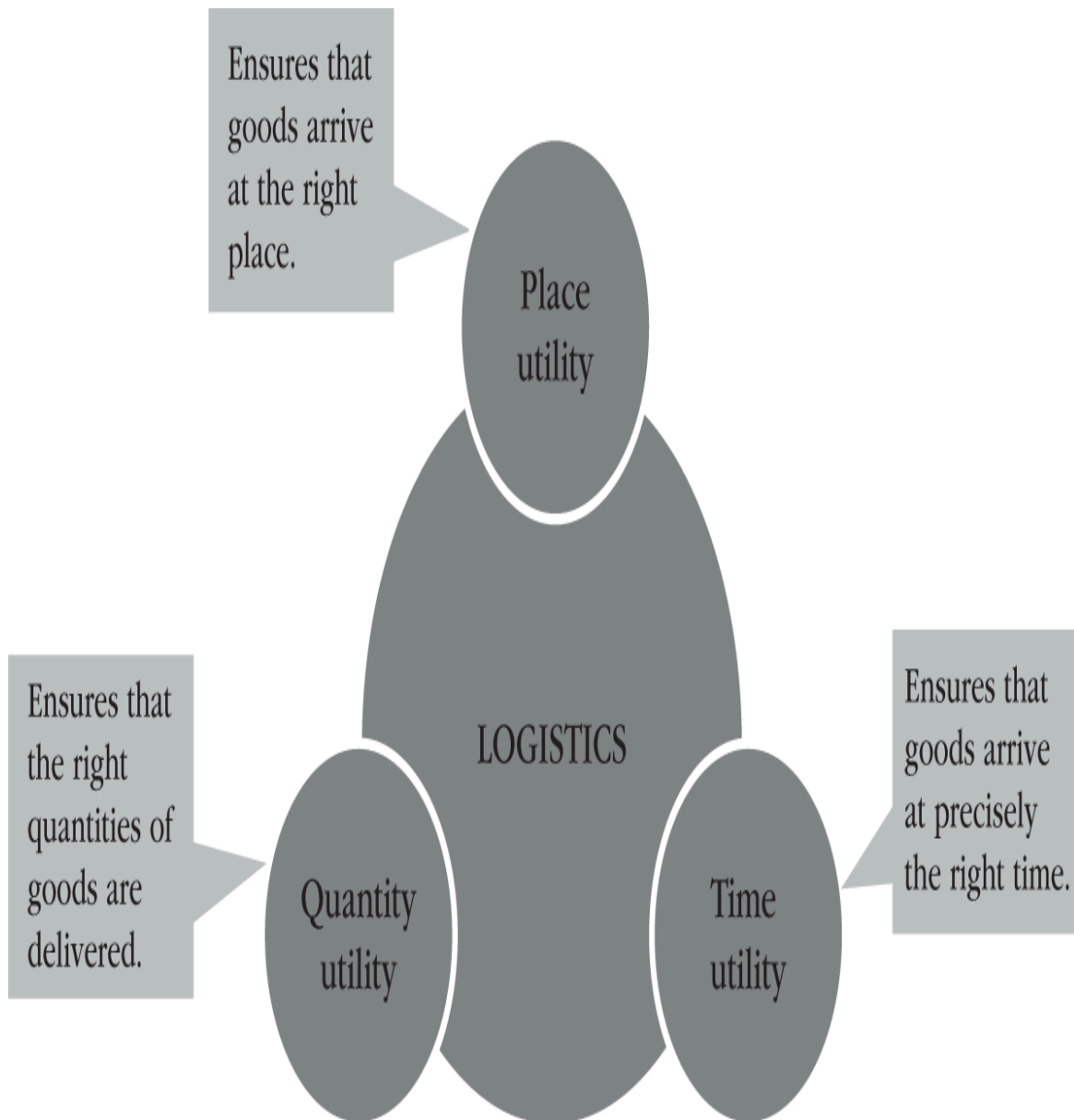


FIGURE 7.3 Impact of logistics on SCM.

Concept Check Questions

33. Logistics and supply chain management are the same thing.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

34. Logistics is a function that supports SCM by being responsible for one of the flows in SCM.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

35. Walmart's success is directly tied to their logistics efficiency that emphasizes the critical role logistics plays in providing place, quantity, and time utilities to customers, reinforcing its competitiveness and service excellence in the retail industry.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

36. It can be said that logistics provides SCM with three utilities. Which of the following is not one of these?

- ☐ a) Price
- ☐ b) Place
- ☐ c) Quantity
- ☐ d) Time

Correct or Incorrect?

Clear

Check Answer

Reverse Logistics

[Reverse logistics](#) is the process of moving products upstream from the customer back toward manufacturers and suppliers. This is the reverse direction from the way materials typically flow in a supply chain. This occurs for a variety of reasons, such as returns of damaged products or items the customer did not want. As with products that flow downstream, to move products upstream logistics has to organize transporting, storage, receiving, inspecting, sorting, and all other activities, to ensure efficient flow. Sometimes the items are returned directly to the manufacturer from the customer, as shown in [Figure 7.4](#). Other times, a 3PL provider may be used to handle returned items and arrange for repairs bypassing the manufacturer as shown in [Figure 7.5](#).

Reverse logistics is especially challenging to design as this flow does not directly add value. Consider that many different types of items are being returned to many different locations. For example, the returned item may be a damaged product being returned for repairs, an overstock item that can be sold elsewhere, or an item that has been recalled or has failed and needs to be disposed of in an environmentally safe manner. If we think about the different types of items returned, we can see that there are many different paths returned items can take, and it is up to logistics to arrange for this in a cost-effective manner.

Other issues add complexity to reverse logistics. One is handling the financials and the cash flows once items are returned. Another is arranging for warehouse and storage space in reverse order that does not confuse or take away from the flow of the usual downstream process. Another consideration is

abiding by “green laws” in countries that have them that may require returning packaging materials for proper disposal.

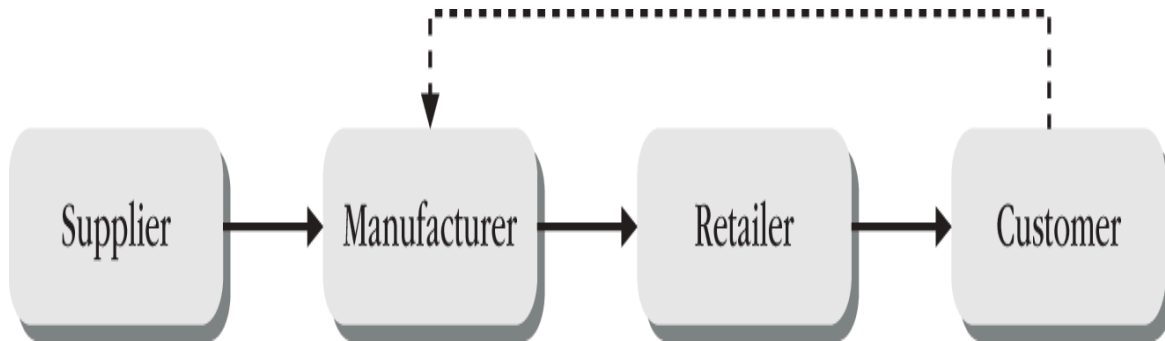


FIGURE 7.4 Reverse logistics with returns to the manufacturer.

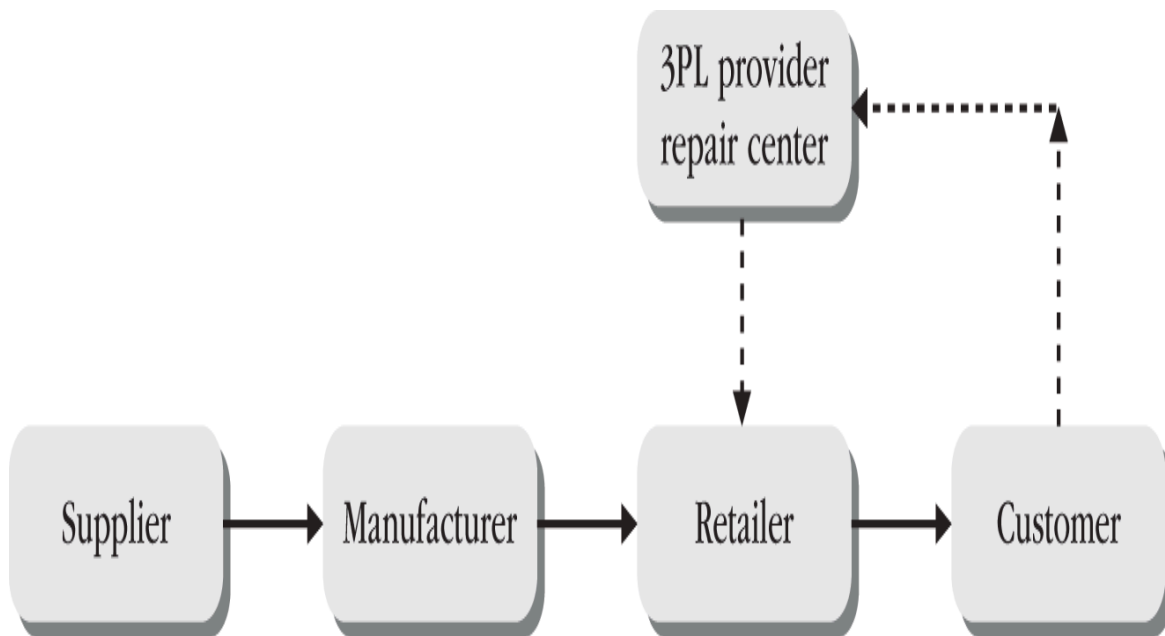


FIGURE 7.5 Reverse logistics with returns to a 3PL provider for repairs.

As we can see, reverse logistics is complex and is especially challenging, as it does not directly add value. Further, the role of reverse logistics has become especially important in recent years. The reason is that companies are under increasing pressure to improve customer service and have made it even easier for customers to return goods. This is especially prevalent in retail and Internet sales, where ease of returns is a major selling feature. The ability to easily return goods is becoming an “order qualifier” in much of retail, and it is up to logistics to continue to design ways for a cost-efficient process. For example, the success of the online retailer Zappos is in large part attributed to making

returns convenient for customers. Zappos's return policy is one of the highlights of their customer service strategy. The company offers free shipping and returns within 365 days of purchase. Customers can return items from anywhere in the United States. It is interesting to note that 75% of Zappos sales come from repeat customers and Zappos has a 97% customer satisfaction score.



Concept Check Questions

37. _____ logistics is the process of moving products upstream from the customer back toward manufacturers and suppliers.

- ☐ a) Business
- ☐ b) Promotional
- ☐ c) Reverse
- ☐ d) Defense
- ☐ e) Military

Correct or Incorrect?

Clear

Check Answer

38. Reverse logistics always transports returns to the manufacturer.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

39. Reverse logistics is especially easy to design.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

40. Which of the following is not an issue with reverse logistics?

- ☐ a) Arranging for warehouse and storage space in the reverse order that does not confuse or take away from flow of the usual downstream process
- ☐ b) Expediting shipment in the reverse order
- ☐ c) Abiding by “green laws” in countries that have them
- ☐ d) Handling the financials and the cash flows once items are returned

Correct or Incorrect?

Clear

Check Answer

41. Reverse logistics directly adds value to an organization.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

42. The ability to easily return goods is becoming an “order qualifier” in much of retail.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Logistics Tasks

As we already discussed, there are many tasks that logistics must do to perform the needed coordination for accurate and timely product deliveries. Here, we describe the requirements of some of these tasks.

Transportation

Transportation is probably the most important task logistics performs as it moves products throughout the supply chain. It is also a costly task that results in the high cost of transportation and distribution network design. Consider that some modes of transportation are less expensive than others, such as rail, but others are faster, such as air. The decision of which mode of transportation to use is directly tied to the consideration of the distance a product has to be moved. This is dependent on the span and complexity of the company's supply chain network. There are also other factors to consider, such as product characteristics. Perishable products, such as bananas, may need climate-controlled transportation. Highly innovative products, such as Apple's iPad, may need rapid delivery to areas with high demand. Products of very high value, such as diamonds, may need high security.

Pharmaceutical products are another example of a transportation challenge as these items are often highly regulated and need to be transported in a safe and

secure manner. Pharmaceutical companies typically use specialized transportation companies that have experience handling and transporting pharmaceutical products. These companies use a variety of security measures, such as temperature-controlled vehicles, secure storage facilities, and GPS tracking, to ensure that pharmaceutical products are transported safely and securely. It is interesting to note that over 80% of pharmaceutical companies use specialized transportation companies to transport their products and that 70% of all pharmaceutical shipments are temperature controlled. The global pharmaceutical logistics market is huge and expected to reach \$173.6 billion by 2030.

Big Data Analytics Box—Autonomous Vehicles

■ UBER

Autonomous vehicles—or driverless cars—are vehicles capable of sensing their environment and navigating without human input. They are also referred to as self-driving vehicles or robotic cars. Regardless of the name, this is a disruptive technology that will change transportation. These cars use technology, sensors, GPS, radar, computer vision, and analytics to detect surroundings. Advanced control systems interpret sensory information to identify appropriate navigation paths and relevant signage. They also have control systems that are capable of analyzing sensory data to distinguish between obstacles, such as different cars on the road.

Although autonomous vehicles were part of science fiction just a few years ago, Merrill Lynch predicted in a 2015 report that driverless taxis such as Uber will make up 43% of new car sales by 2040. Similarly, the Boston Consulting Group wrote in a 2015 report that driverless taxi sales are going to rapidly rise and that 23% of global new car sales will come from driverless taxis by 2040.

Uber, the company with the largest ride-share in the world, released its self-driving car to the public. As part of its pilot program, select Uber users in cities such as Pittsburgh can hail and ride in a driverless car. Initially, the trips will be free but eventually, there will be charges. Uber is now testing their third generation of self-driving cars. Several other companies are following in the autonomous vehicle industry. Ford, for example, initially planned to launch a commercial self-driving vehicle business in 2021 but delayed it until 2022 due to the COVID-19 pandemic.

In March 2023, Ford established Latitude AI, a wholly owned subsidiary focused on developing a hands-free, eyes-off-the-road automated driving system for millions of vehicles. Ford and Argo AI, an autonomous vehicle technology startup, are planning to launch at least 1,000 self-driving vehicles on Lyft's ride-hailing network. The plan is to start in Miami and Austin, and then expand to other cities over the next five years.

Autonomous vehicles are a rapidly evolving mode of transportation with every automotive company preparing for their future.

Concept Check Questions

43. _____ is probably the most important task logistics performs as it moves products throughout the supply chain.

- ☐ a) Transportation
- ☐ b) Packaging
- ☐ c) Insuring
- ☐ d) Securing
- ☐ e) Storage

Correct or Incorrect?

Clear

Check Answer

44. Highly innovative products, such as Apple's iPad, may need rapid delivery to areas with high demand.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

45. Pharmaceutical products are another example of transportation that can use standard channels.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Storage

Directly related to transportation is the [storage](#) of goods. This involves deciding where goods will be stored, such as the number of warehouses and distribution centers, and the amounts of inventory held in each center. We can see that the greater the number of storage areas and the wider their distribution, the lower transportation costs. The key is finding an optimal balance that minimizes costs but maximizes responsiveness to customers. This decision is directly related to warehouse management, inventory management, and material handling. It is also associated with how the products will be handled in the storage area, from order picking to order tracking, to a degree of automation.

Concept Check Questions

46. _____ involves deciding where goods will be stored, such as the number of warehouses and distribution centers, and the amounts of inventory that will be held at each center.

- ☐ a) Transportation
- ☐ b) Packaging
- ☐ c) Insuring
- ☐ d) Securing
- ☐ e) Storage

Correct or Incorrect?

Clear

Check Answer

47. The greater the number of storage areas and the wider their distribution, the higher transportation costs.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Material Handling

Material handling is concerned with the physical handling of the product. This includes loading and unloading of goods from vehicles, placement and order picking of goods in the warehouse, and movement throughout the facility, such as warehouse staging and dock areas. Efficient material handling saves cost, cuts down on time, and minimizes product damage in the process of movement. On the contrary, poor material handling can result in damaged products and excess processing costs.

Another issue of concern is the degree of automation used vs manual labor. There is a wide range of material handling equipment, from conveyors to forklift trucks, overhead cranes, and automated storage and retrieval systems (ASRS). Unlike years ago, when material handling was performed using manual labor, today many warehouses are completely automated and use very sophisticated ASRS.

Concept Check Questions

48. _____ is concerned with the physical handling of the product.

- ☐ a) Transportation
- ☐ b) Packaging
- ☐ c) Material handling
- ☐ d) Securing
- ☐ e) Storage

Correct or Incorrect?

Clear

Check Answer

49. There is a wide range of material handling equipment,

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Packaging

Packaging of products is an important issue that directly relates to material handling. In addition to protecting the product during transportation and storage, packaging must be compatible with material handling equipment and material handling requirements of the warehouse. Packaging is also directly related to the modes of transportation being used. Some modes of transportation require additional packaging, such as rail or water to prevent water damage. Other modes, such as air, typically require less packaging. Although one mode of transportation may cost less than the other, the cost of packaging must also be factored into the decision. For example, water transport is much cheaper than air, but requires packaging that may prevent water damage.

Concept Check Questions

50. Packaging of products is not an important issue.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

51. Packaging is not related to modes of transportation being used.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Inventory Control

All the logistics tasks we discussed so far are directly tied to [inventory control](#). This involves maintaining needed amounts of inventory, arranging for timely replenishments, and maintaining accurate counts of all inventories.

Logistics is the function responsible for managing the quantities of inventory in warehouses and storage areas. This includes using inventory control systems to maintain an adequate level of inventory and replenishing the stock once shipments are made. Managing inventory is directly tied to transportation as arrangements must be made for timely inbound shipments of materials once stock is depleted. Logistics must also ensure the accuracy of the inventory amounts. Inventory is typically monitored using electronic tracking systems.

However, a process called “cycle counting” is used periodically where inventory is physically counted, and any discrepancies with the electronic system are reconciled. This is all done to ensure high levels of inventory control.

Concept Check Questions

52. _____ involves maintaining needed amounts of inventory, arranging for timely replenishments, and maintaining accurate counts of all inventories.

- ☐ a) Logistics
- ☐ b) Packaging
- ☐ c) Material handling
- ☐ d) Inventory control
- ☐ e) Storage

Correct or Incorrect?

Clear

Check Answer

53. Logistics is the function responsible for managing the quantities of inventory in warehouses and storage areas.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

54. Managing inventory is directly tied to transportation as arrangements must be made for timely inbound shipments of materials once stock is depleted.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Order Fulfillment

Logistics is often responsible for [order fulfillment](#), which is completing, shipping, and delivering a customer order. Order fulfillment typically occurs from a warehouse or distribution center location, where orders are directly placed from retailers or manufacturers. Logistics must ensure that the specified lead time, the time from when the order is placed until it is received, is not exceeded. This means picking and packing the order, arranging for proper transportation, and shipping it out. This is an important role for logistics, as it involves directly dealing with the customer. In 2023, Amazon shipped over 7.7 billion packages worldwide. This is an average of over 51 million packages per day. Amazon is able to achieve this high volume of shipments by using a sophisticated logistics system that is tightly integrated with its e-commerce platform.

Concept Check Questions

55. Marketing is often responsible for order fulfillment.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

56. _____ is completing, shipping, and delivering a customer order.

- ☐ a) Logistics
- ☐ b) Packaging
- ☐ c) Material handling
- ☐ d) Inventory control
- ☐ e) Order fulfillment

Correct or Incorrect?

Clear

Check Answer

57. In 2023, Amazon shipped over seven billion packages worldwide.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Facility Location

Logistics is also involved in determining best location of warehouses, distribution centers, and other storage areas in relation to manufacturing facilities, customers, and suppliers. Decisions on [facility location](#) have a direct impact on the movement of products, distances traveled, cost of transportation, the ability to quickly respond to markets, and ultimately customer satisfaction. Optimal locations of distribution centers, for example,

can have a dramatic impact on how quickly deliveries can be received at retail locations. Location decisions also have a huge impact on transportation costs and inventory levels. It is up to logistics to determine the best locations of these facilities, considering modes of transportation to move goods between them and to the final customer. Walmart is a leading example of a company that uses logistics to determine the best location of warehouses and distribution centers. Walmart has a network of over 4,616 stores in the United States and over 10,500 stores worldwide. Walmart's logistics system is designed to deliver products to its stores as quickly and efficiently as possible.



Concept Check Questions

58. Logistics is also involved in determining best location of warehouses, distribution centers, and other storage areas in relation to manufacturing facilities, customers, and suppliers.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

59. Decisions on facility location only have an indirect impact on the movement of products, distances traveled, cost of transportation, the ability to quickly respond to markets, and ultimately customer satisfaction.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

60. It is up to marketing to determine the best locations of these facilities, considering modes of transportation to move goods between them and to the final customer.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Transportation

Transportation is one of the most important logistics tasks as it enables logistics to provide [place utility](#). For this reason, we want to look at this task more closely. Transportation deals with moving products and arranging for optimal modes of transportation. As we discussed earlier, transportation decisions are related to the span and complexity of the company's supply chain network. In developing optimal schedules, transportation must deal with both [economies of scale](#) (the larger the amount shipped at one time the lower the per-unit cost) and [economies of distance](#) (the longer the distance moved at one time the lower the per-unit cost). Let us look at these in a bit more detail.

Economies of scale is a term used to describe the fact that the larger the size of a shipment, the smaller the per-unit cost of the freight moved. Due to this, shipping a partly filled vehicle—such as a partly filled truck—is very costly. This is called a less-than-truck-load (LTL) shipment, and companies try to avoid it whenever possible. The reason for this is that certain fixed costs have to be incurred regardless of how much is shipped. This includes equipment,

labor, fuel, scheduling, and administrative costs. The larger the load over which these costs can be spread, the lower the per-unit cost, and this is true of all modes of transportation.

Economies of distance is a term used to describe the fact that the longer the distance shipped at one time, the smaller the per-unit cost of freight moved. Consider that sending one shipment of 500 miles is cheaper than sending two shipments of 250 miles each. Similarly, in your everyday life, consider that taking a taxi 10 miles is cheaper than taking two taxis 5 miles each. The reason is that the longer distance allows fixed costs to be spread over the larger number of miles.

The challenge for logistics managers is to find an optimal balance between the economies of scale and distance while maintaining customer service levels. The decision becomes one of selecting the right mode of transportation or combination of modes, considering all the costs and benefits.

Supply Chain Leader's Box

■ SYSCO

Sysco is a Houston-based food distributor, which each year ships 21.5 million tons of produce, meats, prepared meals, and other food-related products to U.S. restaurants and cafeterias. To accomplish the significant task of getting such a large volume of food safely to the right place at the right time, Sysco operates a fleet of 17,000 delivery vehicles, which is one of the largest in the food industry. This fleet plays a crucial role in Sysco's logistics and supply chain operations, enabling the company to deliver food and related products efficiently to its customers. Operating its fleet gives Sysco greater control over its supply chain, allowing for quick responses to customer demands and ensuring high service levels. Overall, Sysco's fleet demonstrates its commitment to efficient and reliable food distribution.

In 2000, Sysco revamped its logistics operations to ensure it was being as efficient as possible. The redesign created a centralized supply chain group in Houston, with the help of the software firm Manhattan Associates, to direct shipments from suppliers to one of two new redistribution centers. Once shipments are received at the redistribution centers, Sysco workers consolidate and pack large quantities of products onto trucks. They are then sent out to appropriate operating companies where they are assembled on pallets and sent out for delivery. In addition to redesigning the logistics network, Sysco also revamped its truck routes. To determine the most efficient routes for its trucks, Sysco uses Roadnet, a software program developed by UPS. The company felt this was necessary to address the problem of increasing fuel prices.

The result of the redesign of Sysco's logistics system has been fewer trucks on the road and each one fuller. The redesign has resulted in improvements in key performance metrics such as efficiency and cost of fuel usage. This example illustrates the kinds of savings that can be achieved through efficient logistics design.

Let us now look at common modes of transportation and their characteristics.

Concept Check Questions

61. Transportation is one of the most important logistics tasks as it enables logistics to provide _____.

- ☐ a) economies of scale
- ☐ b) economies of distance
- ☐ c) economies of storage
- ☐ d) place utility
- ☐ e) economies of shipping

Correct or Incorrect?

Clear

Check Answer

62. The larger the amount shipped at one time the lower the per unit cost.

- ☐ a) economies of scale
- ☐ b) economies of distance
- ☐ c) economies of storage
- ☐ d) place utility
- ☐ e) economies of shipping

Correct or Incorrect?

Clear

Check Answer

63. The longer the distance moved at one time the lower the per unit cost.

- ☐ a) economies of scale
- ☐ b) economies of distance
- ☐ c) economies of storage
- ☐ d) place utility
- ☐ e) economies of shipping

Correct or Incorrect?

Clear

Check Answer

64. _____ is a term used to describe the fact that the larger the size of a shipment, the smaller the per unit cost of freight moved.

- ☐ a) Economies of scale
- ☐ b) Economies of distance
- ☐ c) Economies of storage
- ☐ d) Place utility
- ☐ e) Economies of shipping

Correct or Incorrect?

Clear

Check Answer

65. The challenge for logistics managers is to find an optimal balance between the economies of scale and distance, while maintaining customer service levels.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Truck

Trucks are the most flexible mode of transportation given today's expansive highway system, and they pose few restrictions on weight or content. Also, trucks can go on a variety of roads typically maintained by the government, resulting in a relatively small fixed investment in vehicles. Given their easy access, they are utilized to some extent in almost all logistics movements. One challenge for this mode of transportation is stringent driver safety regulations, which can make labor requirements high. This has created a capacity constraint for some transportation companies who simply cannot find enough qualified drivers.

Concept Check Questions

66. Trucks are the most flexible mode of transportation.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

67. Using trucks has low labor costs.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Water

Water transportation has an advantage in its ability to transport very large and heavy shipments. It is the mode of choice for moving large bulk items, such as oil or coal. It is also a very affordable mode of transport. The disadvantage, however, is that it is an extremely slow mode of shipment and is restricted to water access.

Concept Check Questions

68. Water transportation is very speedy.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

69. Water transportation has an advantage in its ability to transport very large and heavy shipments.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

70. Water transportation is very expensive.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Air

In contrast to water transportation, air is the fastest mode of transportation. However, it is also the most expensive given the high fixed and variable costs. Not only are aircraft and fuel expensive, but also air transport requires an airport location. Given the high cost, it is most appropriate for lighter, smaller, and higher priority items.

Concept Check Questions

71. Air is the fastest mode of transportation.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

72. Air is the second most expensive mode of transportation.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Rail

Rail is the mode of transportation designed for moving heavy loads very long distances. The advantages are the same as with water: ability to handle large and heavy items at a low cost. The disadvantage is the long transit time. Also, rail is restricted to a particular infrastructure, such as railroad tracks. For this reason, rail typically has to be combined with another mode of transportation for final delivery to customers.

Concept Check Questions

73. Rail is the mode of transportation designed for moving heavy loads very long distances.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

74. Rail and water have the same advantages.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

75. Rail is very speedy.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

76. Rail typically has to be combined with another mode of transportation for final delivery to customers.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Pipeline

Pipeline transportation is limited to liquids and gases, such as petroleum and natural gas. It is a highly specialized mode and requires a specific

infrastructure, such as a pipeline.

Concept Check Questions

77. Pipeline transportation is limited to liquids and gases, such as petroleum and natural gas.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

78. Pipeline transportation is a highly specialized mode and requires a specific infrastructure, such as a pipeline.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Multimode

Multimode is the combined use of multiple modes of transportation for product delivery. Given the constraints of each mode of transportation, as shown in [Figure 7.6](#), it is almost impossible to exclusively rely on one mode. Often, a combination of a few modes provides optimal cost and customer service. However, the coordination effort can be a challenge for companies. This is one of the reasons many use a 3PL provider to handle shipments. Most

3PL providers, such as UPS, use multimode solutions to provide services to customers.

	FIXED COST	VARIABLE COST
RAIL	High	Low
	(e.g., equipment, terminals, and tracks)	(e.g., can transport large tonnage)
TRUCK	Low	Medium
	(e.g., highways publicly supported)	(e.g., fuel, maintenance, and labor)
WATER	Medium	Low
	(e.g., ships and equipment)	(e.g., can transport large tonnage)
PIPELINE	High	Low
	(e.g., right-of-way and construction)	(e.g., no labor cost)
AIR	High	High
	(e.g., aircraft, handling, and cargo)	(e.g., fuel, labor, and maintenance)

FIGURE 7.6 Cost structure by mode of transportation.

Let us consider how UPS uses multimode transportation. To ship a package from Los Angeles to New York City, UPS may use a combination of trucks and trains. UPS would pick up the package from the customer's location using a truck. The truck would then transport the package to a UPS distribution center. At the distribution center, the package would be transferred to a train. The train would then transport the package to a UPS distribution center in New York City. Finally, a UPS truck would deliver the package to the customer's location.

To ship a package from the United States to China, UPS may use a combination of trucks, airplanes, and ships. UPS would pick up the package from the customer's location using a truck. The truck would then transport the package to a UPS distribution center. At the distribution center, the package would be transferred to an airplane. The airplane would then transport the

package to a UPS distribution center in China. Finally, a UPS truck would deliver the package to the customer's location.



Concept Check Questions

79. Multimode is the combined use of multiple modes of transportation for product delivery.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

80. Most firms rely exclusively on one mode of transportation.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

81. Most 3PL providers, such as UPS, use multimode solutions to provide services to customers.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Global Insights Box—Rail Service Between China and Europe

■ NORTHEAST PASSAGE

In today's jet-setting world, we forget that challenges still exist with moving large and heavy cargo across the globe. For that reason, there has been much excitement over the new rail freight service that is now running between China and Europe. In 2008, Germany launched an experimental service between China and Germany by way of Russia. Since then, the International Union of Railways (UIC) and rail infrastructure providers in Finland and Sweden have started promoting the so-called “Northern East–West Freight Corridor” for intermodal container service from the Far East to Scandinavia.

The new rail service promises to dramatically reduce transit times of containers being shipped from the Far East to Europe. Currently, these shipments take well over six weeks by sea. With the new rail service, the time should be just two weeks. This is a dramatic reduction in time and significantly improves access to markets. In addition, there may be benefits for regions beyond Europe, as some of the containers could then be moved across the Atlantic Ocean. The new rail service expands logistics possibilities for importers and connects the rapidly growing Far East to other parts of the globe.

As with any new transportation service, there are still challenges that have to be worked out. Recall that rail service is dependent on the tracks it runs on, and in this case the rail equipment will have to navigate tracks with different gauges across two continents. Some trains in Europe are equipped with changeable gauges so they can cross different tracks. However, many freight cars do not have this capability. In addition, trains currently run on an irregular basis and often do not depart until the operator has accumulated enough freight to justify the cost of the trip.

These snags will quickly be ironed out as demand for the new service increases. A rail service from China's interior to Europe is a significant option for inland manufacturers, for which transportation using water is time consuming and expensive. China's booming industry is rapidly

shifting from the coast to inland, and this type of rail service offers a logistics opportunity to move Chinese goods to Western markets.

Warehousing

Role of Warehouses in the Supply Chain

Traditionally the role of warehouses has been to provide storage space for goods, as well as inbound and outbound transport. Goods that arrived at the warehouse via truck or rail were unloaded and then placed in storage bins in the warehouse. When customer orders arrived, goods were picked from their storage location, known as “order picking,” then staged for transport, loaded onto trucks or rail, and shipped.

In addition to providing storage, contemporary warehouses are increasingly places for mixing inventory assortments to meet customer needs. They are driven by enhancing and expediting movement rather than lengthy storage. Lengthy storage is discouraged, as it does not add value and just contributes to cost and obsolescence. Warehouses provide a centralized location that stores and organizes inventories of products before they get distributed to customers. For that reason, they are often called distribution centers.

Warehouses or distribution centers play a critical role in the supply chain enabling efficient movement of goods on both the inbound and outbound side of the organization. For example, in JIT and lean manufacturing warehouses can be located close to the manufacturing facility enabling frequent deliveries of materials on a JIT basis. At the same time, warehouses can be utilized to create product assortments for customer shipments. For example, a strategically located centralized warehouse can take advantage of consolidated shipments. The products can then be sorted and arranged for a particular customer and then shipped. In addition to these benefits, many warehouses are increasingly performing tasks traditionally done at manufacturing or retail sites. This may include repairs of items, putting garments on hangers and sequencing them to be rolled straight onto the retail floor, and adding labels and price tags.

An example of an efficient distribution network is that of Walmart, which has strategically positioned warehouses and distribution centers to maintain a smooth and efficient supply chain, catering to both inbound and outbound

logistics. Walmart operates over 210 distribution centers in the United States alone. Walmart's distribution network is crucial in supporting its JIT inventory model. The company's extensive distribution network allows it to restock its retail stores efficiently. These distribution centers are strategically located across the country to ensure that the goods are swiftly transported from the centers to the stores, offering a continuous and efficient supply chain.

Concept Check Questions

82. Traditionally the role of warehouses has been to provide storage space for goods, as well as inbound and outbound transport.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

83. Contemporary warehouses are increasingly places for mixing inventory assortments to meet customer needs.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

84. Warehouses do not perform repairs.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Cross-docking

Warehouses perform several functions that essentially reconfigure flows from origin to destination in the supply chain to improve the speed and accuracy of delivery. Two basic functions performed are breaking up of larger shipments on the inbound side, which results in lower transportation costs, and consolidation of orders for customers on the outbound side. The first is called a “[break-bulk](#)” operation, where a large shipment is received and then needs to be broken into smaller quantities for deliveries at multiple locations. The function of the warehouse in this case is to split the single order into multiple orders and arrange for deliveries.

Sorting of goods is yet another function performed by warehouses, enabling consolidation and mixing of orders to take place. One type of sorting that has gained popularity is called [cross-docking](#). Cross-docking is an approach used to reconfigure bundles of products where, rather than making larger shipments, larger shipments are broken down into small shipments for local delivery in an area. This is shown in [Figure 7.7](#). Cross-docking is often done in a highly coordinated manner so that the products are never stored in inventory. The term implies that the products literally “cross the dock” to be loaded onto the truck for final destination and are never stored.

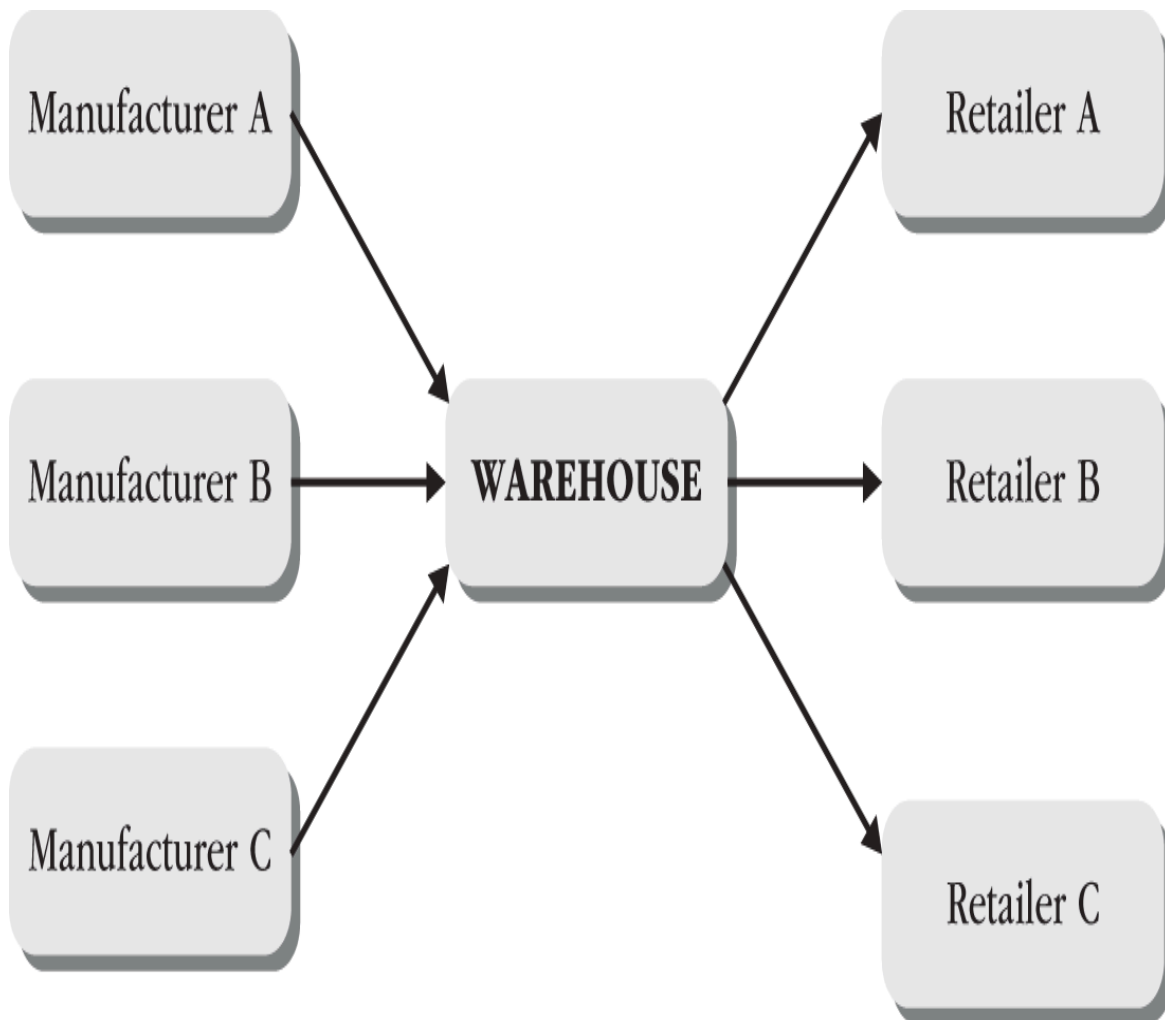


FIGURE 7.7 Cross-docking.

Walmart is an excellent example of achieving a high volume of shipments by using a sophisticated cross-docking system. Consider that Walmart's distribution centers cross-dock over 90% of all inbound shipments and over 95% of all outbound shipments. The speed at which this happens shows tremendous efficiency. Walmart's distribution centers can cross-dock a shipment in less than 24 hours helping to reduce inventory costs and improve delivery speed.

Walmart also uses cross-docking to replenish inventory at its stores. For example, a Walmart store in Los Angeles places an order for milk from a dairy farm in Wisconsin. The dairy farm ships the milk to a Walmart distribution center in Chicago. The distribution center cross-docks the milk shipment, meaning that the milk is unloaded from the dairy farm's truck and immediately loaded onto a truck that is dedicated to delivering milk to Walmart stores in

Los Angeles. The truck then delivers the milk to the Walmart store in Los Angeles—all within 24 hours of the store placing the order.

Cross-docking requires precision in timing and coordination and uses state-of-the-art information technology to track inventories. Inventory must be received at precisely the right time from each manufacturer, unloaded at the warehouse, and sorted by customer and destination. Computerized systems track the exact quantities of goods requested by each customer at each location, and this is factored into the sorting process. Products are then moved across the dock and loaded onto trucks that are dedicated to a particular destination. This method is very effective for replenishing fast-moving inventory items at the store level. For this reason, cross-docking is especially used in the retail industry, where shipments are sorted at distribution centers or centralized warehouses and then directly shipped to individual stores.

Concept Check Questions

85. _____ is where a large shipment is received and then needs to be broken into smaller quantities for deliveries at multiple locations.

- ☐ a) Break-bulk
- ☐ b) Splitting
- ☐ c) Cross-docking
- ☐ d) Bulk-dividing
- ☐ e) Dock-splitting

Correct or Incorrect?

Clear

Check Answer

86. _____ is an approach used to reconfigure bundles of product where, rather than making larger shipments, larger shipments are broken down into small shipments for local delivery in an area.

- ☐ a) Break-bulk
- ☐ b) Splitting
- ☐ c) Cross-docking
- ☐ d) Bulk-dividing
- ☐ e) Dock-splitting

Correct or Incorrect?

Clear

Check Answer

87. Warehouses simply take items in and ship them out. They never break up large shipments.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

88. Walmart tried cross-docking but did not find it useful.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

89. Cross-docking requires precision in timing and coordination and uses state-of-the-art information technology to track inventories.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Facility Location

The location of warehouses and distribution centers are important decisions logistics have to make. An optimal location will ease the distribution of goods in a timely manner, whereas a poor location will make distribution more difficult. A number of factors must be considered.

The first factor to consider is proximity to customers or manufacturing facilities. The location must be selected to be able to serve the largest geographic market size on the same or next-day basis. Directly related to this is the availability of infrastructure and access to transportation. This includes convenient access to highway or rail, the presence of a major airport, and proximity to inland or ocean port facilities. Ease of access and use of transportation coupled with customer proximity are key factors that must work together.

For labor-intensive operations, as is the case with most warehouses and distribution centers, the cost and availability of labor are another important factor. This includes considering levels of unemployment in the area, labor skills levels, productivity, work ethic, and degree of unionization. These are all important factors that must be considered carefully. Other considerations are business and personal taxes, as they have a significant impact on the cost of doing business. Also important is the overall business climate and whether it is welcoming to new business.

Several techniques can be used to help determine where to locate warehouses and distribution centers. Some of these use quantitative models that compute

distances between locations and try to find the optimal balance between costs and geographic coverage. Other methods are qualitative and help the decision maker evaluate the benefits of each location. One of the more popular techniques is called [Factor rating](#) and involves evaluating multiple alternatives based on several selected factors. It is a helpful procedure, as it can give structure to a seemingly chaotic process when many location factors need to be considered simultaneously. For example, Walmart's factor rating system has been very successful in helping the company choose warehouse locations that are efficient and cost effective.



Concept Check Questions

90. Location of warehouses and distribution centers are important decisions that are typically made by operations.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

91. Location of warehouses and distribution centers are important decisions that are typically made by marketing.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

92. The first factor to consider in locating warehouses and distribution centers is proximity to labor.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

93. Taxes do not have an impact on locating warehouses and distribution centers.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

94. Most warehouses and distribution centers are not labor intensive.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Next, let us look at how “factor rating” can be used to make a location decision.

STEPS IN FACTOR RATING

Step 1: Identify key decision factors (e.g., proximity to customers, transportation, infrastructure, taxes).

Step 2: Assign weights to each factor based on its importance; factor weights must add to 100.

Step 3: Establish a scale for evaluating each location relative to each factor. The most common scale is a five-point scale, with 1 being poor and 5 being excellent.

Step 4: Evaluate each location based on the factors selected, using the scale setup in Step 3.

Step 5: Compute a score for each location by multiplying the weight of the factor by the score for that factor and summing the results of each alternative.

Step 6: Select the location with the highest score.

Concept Check Questions

95. In factor rating, you want to select the location with the lowest score.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

96. In factor rating, you want to select the location with the average score.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

97. In factor rating, the weights must sum to one.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

98. Which of the following is the first step in factor rating?

- ☐ a) Establish a scale for evaluating each location relative to each factor
- ☐ b) Identify key decision factors
- ☐ c) Compute a score for each location
- ☐ d) Evaluate each location based on the factors selected
- ☐ e) Assign weights to each factor based on its importance

Correct or Incorrect?

Clear

Check Answer

99. Which of the following is the second step in factor rating?

- ☐ a) Establish a scale for evaluating each location relative to each factor
- ☐ b) Identify key decision factors
- ☐ c) Compute a score for each location
- ☐ d) Evaluate each location based on the factors selected
- ☐ e) Assign weights to each factor based on its importance

Correct or Incorrect?

Clear

Check Answer

100. Which of the following is the third step in factor rating?

- ☐ a) Establish a scale for evaluating each location relative to each factor
- ☐ b) Identify key decision factors
- ☐ c) Compute a score for each location
- ☐ d) Evaluate each location based on the factors selected
- ☐ e) Assign weights to each factor based on its importance

Correct or Incorrect?

Clear

Check Answer

101. Which of the following is the fourth step in factor rating?

- ☐ a) Establish a scale for evaluating each location relative to each factor
- ☐ b) Identify key decision factors
- ☐ c) Compute a score for each location
- ☐ d) Evaluate each location based on the factors selected
- ☐ e) Assign weights to each factor based on its importance

Correct or Incorrect?

Clear

Check Answer

102. Which of the following is the fifth step in factor rating?

- ☐ a) Establish a scale for evaluating each location relative to each factor
- ☐ b) Identify key decision factors
- ☐ c) Compute a score for each location
- ☐ d) Evaluate each location based on the factors selected
- ☐ e) Assign weights to each factor based on its importance

Correct or Incorrect?

Clear

Check Answer

EXAMPLE 1 Factor Rating

Urban Apparel is deciding on where to locate its distribution center to serve its northeast retail stores. It has identified six factors it considers most important and has decided to use “factor rating” to evaluate the two location alternatives based on a five-point scale, with 1 being poor and 5 excellent. The weights assigned to each factor for each location are shown in [Figure 7.8](#), as well as the factor score for each site. We can see that location 2 has a higher total score than location 1 and, therefore, appears to be a better location based on the set factors.

		Factor score at each location		Weight score for each location (Factor weight × Factor score)	
Factor	Factor weight	Location 1	Location 2	Location 1	Location 2
Proximity to stores	30	2	5	60	150
Access to highway	30	5	3	150	90
Labor availability	20	4	3	80	60
Taxes	10	4	3	40	30
Building cost	10	3	4	30	40
Total	100			360	370

FIGURE 7.8 Factor rating for urban apparel's two DC location alternatives.

Third-Party Logistics (3PL) Providers

3PL providers, or 3PLs, are companies that provide logistics and

transportation services to other firms. They have had an increasingly important and prominent role in the supply chain as numerous companies have outsourced their logistics functions. Traditional logistics management activities, such as transportation, warehousing, order processing, and related information technology support, are deemed as noncore activities for many firms. In addition, as we discussed earlier, logistics activities have significant asset requirements, making logistics a primary candidate for outsourcing. Finally, outsourcing logistics can offer the potential for large cost savings given its impact on ROA.

In the 1980s services offered by 3PL providers were relatively limited in scope. At that time 3PL providers provided traditional logistics services, such as transportation and warehouse management. However, as outsourcing logistics services grew in the 1990s, the role of the 3PL provider within the supply chain began changing accordingly. The role changed from initially offering transportation services to offering a broad array of bundled services that also include warehousing, inventory management, packaging, cross-docking, and technology management. More recently, however, the 3PL provider has taken on a more comprehensive strategic role as supply chain activities become more critical to the business.

Today, 3PL providers are engaged in strategic coordination of their customers' supply chain activities. Consider that UPS evolved from a provider of simple delivery services to offering complete distribution management and network design. UPS claims that for their customers they will "act as eyes and ears around the world" (www.ups.com). The global 3PL market was valued at \$1.1 trillion in 2022 and is expected to reach over \$2.3 trillion by 2031. This growth is driven by factors such as the globalization of supply chains, the rise of e-commerce, and the adoption of advanced technologies. Businesses are increasingly relying on 3PL providers to streamline logistics operations and focus on core competencies.

As entities that connect members of the supply chain, 3PL providers serve a critical role responsible for achieving effective logistics integration by which inter- and intrafirm activities are integrated to enhance customer satisfaction and provide a competitive advantage. As a result, 3PL providers have gained a prominent role in the coordination of the supply chain.



Concept Check Questions

103. 3PL providers that provide logistics and transportation services to other firms.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

104. 3PL is another name for the internal logistics department.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

105. Outsourcing logistics can offer the potential for large cost savings.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

106. 3PL providers are engaged in strategic coordination of their customers' supply chain activities.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

107. The 3PL market is fairly small.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Empowering Entrepreneurs Box

At first glance, logistics looks like we are moving products from point A to point B. On a small scale, it seems like something a small business owner should be able to do on their own. However, this is one of those areas where small business owners should consider using the services of a 3PL. As noted in this chapter, logistics is much more than moving products. The function is asset intensive, requiring a significant investment in assets like vehicles or property, and requires sophisticated analytics to optimize the flow of goods. A small business owner can save a considerable amount of time and money using a 3PL service, which can also help a small business scale logistics services up and down as needed. For example, this would allow shipments of more orders during busy seasons and scaling down storage and labor during slow periods.

Small business owners know their business and should focus on doing what they know best. Logistics is highly specialized and is best given to a 3PL to manage, especially if good negotiations of terms can be made.

CHAPTER HIGHLIGHTS

- Logistics is the business function responsible for transporting and delivering products to the right place at the right time throughout the supply chain.
- There are three different types of logistics: business logistics, which is focused on the movement and storage of goods throughout the entire supply chain; military logistics, which is focused on supporting military needs; and event logistics, which involves organizing and deploying resources in preparation for an event.
- Logistics impacts the organization on both the inbound and outbound side. On the inbound side, it ensures that materials needed for operations are delivered when required. On the outbound side, it ensures delivery of products to various customers when needed.
- Logistics is a function that supports SCM by being responsible for the flow of products. It provides SCM with three utilities: place, quantity, and time.
- Logistics tasks include transportation, storage, material handling, packaging, inventory control, order fulfillment, and facility layout.
- Reverse logistics is the process of moving products upstream from the customer back toward manufacturers and suppliers.
- Transportation is the primary function of logistics that enables logistics to provide place utility. There are five primary modes of transportation: truck, water, air, rail, and pipeline.
- Cross-docking is a warehouse sorting approach used to reconfigure bundles of products, where, rather than making larger shipments, larger shipments are broken down into small shipments for local delivery in an area.
- Factor rating is one tool that can be used to make location decisions.

KEY TERMS

[Logistics](#)

[Physical distribution](#)

[Business logistics](#)

[Military logistics](#)

[Event logistics](#)

[Reverse logistics](#)

[Transportation](#)

[Autonomous vehicles](#)

[Storage](#)

[Material handling](#)

[Automated storage and retrieval systems \(ASRS\)](#)

[Packaging](#)

[Inventory control](#)

[Order fulfillment](#)

[Facility location](#)

[Place utility](#)

[Economies of scale](#)

[Economies of distance](#)

[Break-bulk](#)

[Cross-docking](#)

[Factor rating](#)

DISCUSSION QUESTIONS

Find an example of a product you have recently purchased. Identify the logistics tasks that would have to take place for the product to be available for you to have the ability to purchase it.

Explain logistics tasks involved in one service supply chain, say, involving a hospital or restaurant. How different are these tasks vs those involved in a manufacturing supply chain?

Consider an event you are familiar with, such as a baseball game, a rock concert, or delivering aid to an underdeveloped country in need. Map out the logistics tasks needed and their sequence in organizing this particular event.

Consider an item you have recently returned. Identify the steps the company would have to go through to return the product back up the supply chain from where you have returned it. What costs do you think would be involved in this process? Is there a way the company can design this reverse logistics process to add value and make a profit?

PROBLEMS

Quick transport logistics (QTL) is considering where to locate its warehouse to serve its northeast region. The search has been narrowed to two competing locations, and QTL has decided to use “factor rating” to make their decision. They have listed the factors they consider important and assigned a factor score to each location based on a five-point scale. The information is shown below. Use the procedure for factor rating to decide which location is better.

Factor	Factor weight	Location 1 Factor score	Location 2 Factor score
Facility cost	10	3	5
Taxes	15	2	4
Proximity to airport	30	4	1
Labor source	25	2	4
Facility size	20	3	3

DJ Bank is deciding on where to locate its new branch. It has identified three factors it considers most important and has decided to use factor rating to evaluate the two candidate locations based on a five-point scale, with 1 being poor and 5 excellent. The factors are population, average area salary, and cost of land, with weights of 30, 20, and 50%, respectively. Location A has the following scores for the factors: 4, 3, and 3, whereas B has 3, 5, and 3. Evaluate the two candidates based on factor rating.

An electronic company is deciding which of two new products should be put into production. It has identified three factors it considers most important and has decided to use factor rating to evaluate the two products based on a five-point scale, with 1 being poor and 5 being excellent. The weights assigned to each factor are shown below in the table, as well as the factor score. Evaluate the two products.

Factor	Factor weight	Product 1 Factor score	Product 2 Factor score
Cost	30	4	5
Price	30	4	2
Demand	40	3	4

Case Study Strategic Solutions, Inc.

Strategic Solutions (SS) is a small 3PL provider that was started by Scott Crash in 1992. Scott began his career working in the logistics division of a large trucking company. He worked with fleet scheduling, customer support, and route scheduling before he saw the opportunity to start his own business offering similar services. SS provides logistics services to small businesses in Columbus, Ohio, and has recently acquired major accounts with two well-known grocery store chains. Their core competency is specializing in the movement of cold and frozen food products. Refrigerated trailers can be expensive, and if not transported using reliable equipment, it can prove to be very costly for all parties. Scott started his company by strategically combining LTL shipments for small stores such as gas stations, pharmacies, and small grocery stores. He found his niche in climate-controlled trailer movements. The business has been growing since.

The Business

SS operates by arranging customer shipments with the best for-hire transportation service they can find. Two of their main transporters are Frigid Movements and Problem Solved Shipments. SS has long-term contracts with most of its customers, but it also accepts one-time shipments and business from random customers on a regular basis. Customers can either call or e-mail SS with the details, such as identifying the products that need to be shipped, the destination, and the required time of delivery. Once SS has this information they can then arrange for the outbound shipments from the customer's distribution centers to the desired location. The customer base has increased substantially as a result of the company's success in the cold food movement area, and they have acquired new contracts with major grocery store chains.

The Problem

Scott's company has begun to struggle with the business growth due to information technology constraints. Their current method of telephone and e-mail information exchange has become outdated, and customers have found it hard to communicate with SS. Customer satisfaction has dropped in the recent past, and Scott fears the loss of some of his top business

clients. Something must be done so that Strategic Solution's reputation is not damaged and no customers are lost.

The Need for EDI or TMS

Scott understands that logistics depends on accurate real-time information, but is not sure what type of system would be best suited for his operation and has decided to take a customer-oriented approach. He personally spoke with each of his customers to find out what would be the best system for them and how the two companies could best work together. He also spoke with his transportation providers to see what type of information exchange and transportation scheduling arrangements would best work for them. It seems that the ideal system would be a single point of contact for customer orders where information is updated in real time. It is inconvenient and time consuming for a customer to call and deal with busy phone lines and unanswered phone calls, or wait for an e-mail reply. There could also be clerical errors when transferring the information between different parties.

The EDI vs TMS Expansion

Scott is not sure which system to implement and what would be the best investment. He assumes that electronic data interchange (EDI) can accomplish real-time information sharing with all of their customers as well as potential carriers. For customers, information can be available online with proper access codes so that scheduling arrangements involving shipments, equipment, and time schedules can be made with a single point of contact. The downside of an EDI system is the expense. Also, system failure could halt the business, potentially resulting in significant financial losses.

Another option is a transportation management system (TMS), which is a software system designed to manage transportation operations. TMS would enable SS to directly link to their transporters' systems to more efficiently identify and find potential routes. They would not have to arrange shipments through telephone or e-mail, but could simply schedule them using the TMS. A downside to TMS is that it would leave out noncontracted carriers. If a certain time or route was not available through Frigid Movements or Problem Solved Shipments, SS would have to find other ways to schedule the transportation of their customers' goods.

Scott has estimated the following costs for both systems as well as customer preferences:

Systems considered	Cost	Customer rank (1–3)
EDI (for real-time information and a single point of contact)	\$15,000	3
TMS (to link into the transporters system and find routes and lanes)	\$20,000	2
Both systems	\$35,000	3

Case Questions

1. Identify the characteristics of an ideal information system for this logistics environment. Gather information on both EDI and TMS and compare their suitability for this environment.
2. Help Scott decide if he should invest in either EDI or TMS, or both. Is there another type of system that you would believe would be better? What kind of benefits, including performance and customer satisfaction, can Scott expect by making these proposed changes to the business process?
3. What are the key considerations for Scott when deciding on the best possible systems to implement?

Case Study Making Decisions with Data Analytics: Morning Foods, Inc.

David is in charge of the packing floor for Morning Foods, Inc., a Swiss company producing breakfast cereals for kids. He has an office next to the packing line floor, where he can supervise all 10 packing lines easily. Morning Foods, Inc. is a small player in the Swiss market, otherwise dominated by multinationals. However, it is well known for its frugal marketing strategies, which include avoiding expensive mainstream media for product promotions. The company introduced a new flavor of kids' cereals this month, and the marketing team decided to insert a cookie of a famous animated character, "Doggo," in each cereal box. The cookie is to be inserted in each box on the packing floor.

Since this is a short-term promotion, the addition of Doggo is being handled manually. Marketing handed over an allotment of 10,000 cookies to be added to the first batch and asked David to coordinate with the cookie vendor for subsequent lots until further notice. David immediately issued 10,000 cookies to the packing floor.

David's team packs 1,000 cookies each day and David is told that the vendor needs a three-day notice before she can deliver the next lot of cookies. The cookies need to be transported in such a way that they do not break during either inbound or outbound transportation. When David received the next consignment of cookies, he found that all of the cookies were already broken. He immediately placed an order with the cookie vendor and asked for the earliest delivery. However, the vendor informed him that it would take three days to deliver the next batch of cookies.

As David walked into the office today, he received a call from the Operations Director's office asking him to meet with the director immediately. David is now dreading a conversation with his difficult boss.

Case Questions

1. What should have David done differently? What can he do now?
2. How can short-term changes to a lean production line be implemented, as described in the case?

3. Suggest strategies on working with a supplier in this type of situation that go beyond those specified by analytics analysis.
4. What other aspects related to packaging should David consider for the logistics of the cookies?

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8

Forecasting and Demand Planning

LEARNING OBJECTIVES

After completing this chapter, you should be able to:

Explain the impact of forecasting on supply chain management.

Describe the forecasting process.

Identify key qualitative and quantitative forecasting models.

Generate forecasts using quantitative models.

Explain how to measure forecast accuracy.

Describe methods of collaborative forecasting and demand planning.

CHAPTER OUTLINE

- [**What Is Forecasting?**](#)
 - [Forecasting vs Planning](#)
 - [Impact on the Organization](#)
 - [Impact on Supply Chain Management](#)
- [**The Forecasting Process**](#)
 - [Principles of Forecasting](#)
 - [Steps in the Forecasting Process](#)
 - [Factors in Method Selection](#)
- [**Types of Forecasting Methods**](#)
 - [Qualitative Forecasting Methods](#)
 - [Quantitative Forecasting Methods](#)
- [**Time Series Forecasting Models**](#)
 - [The Mean](#)
 - [Moving Averages](#)
 - [Exponential Smoothing](#)
 - [Trend-adjusted Exponential Smoothing](#)
 - [Seasonality Adjustment](#)
- [**Causal Models**](#)
 - [Linear Regression](#)
 - [Multiple Regression](#)
- [**Measuring Forecast Accuracy**](#)
- [**Collaborative Forecasting and Demand Planning**](#)
 - [Collaborative Planning, Forecasting, and Replenishment \(CPFR\)](#)
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[Bloomberg Quicktake Video: Top NYC Chef Shares Sustainability in Food](#)

[Bloomberg Quicktake Video: Eberly: The Past is not Always a Great Guide to The Present](#)

Nike sells sportswear for men, women, and children, carrying everything from shoes to clothing, gear, accessories. Have you ever walked into one of Nike's stores and considered the massive variety of products available on the retail shelves? There are numerous products in each category and an assortment of sizes and color variations. Imagine that you are looking for a pair of men's athletic shoe and have your heart set on an Air Jordan in black and Varsity Red. Suppose you wear size 11 and find the size is out of stock; chances are that you will go elsewhere and may select to buy from a competitor, say, Reebok Zig Pulse in black and red instead. Nike may have underestimated the demand for the Air Jordan in red but maybe overestimated the demand for the Nike Revolution in red. The company may be surprised to find that the Nike Revolution in blue is the big seller and may have to discount the shoes in red as there are too many of them.

So how does Nike decide how much to have of each one of the different products? What should be the quantity of an Air Jordan in black and red vs an Air Jordan 1 Retro in high silver? How much should they order of Nike Air Maxim 1 in pink vs in blue? These decisions are based on a forecast of demand for each product and location. Now, consider the range of product variety that must be stocked at various Nike locations around the globe, and you can understand the complexity of the forecasting task. Forecasting is extremely important to Nike. Forecasts drive the decisions regarding how much to carry of each individual product at each location, how much to produce, and what supplies to order for production, from leather to shoelaces. The entire supply chain is dependent on these forecasts.

In June 2000, Nike made headlines after going live with a highly touted i2 demand forecasting software intended to solve their forecasting challenges. Nine months later, its executives acknowledged that they would be taking a major inventory write-off because the forecasts from the automated system had been so inaccurate. The total cost to Nike was estimated at \$400 million as the forecasts themselves were way off. Relying exclusively on the automated projections, Nike ended up ordering \$90 million worth of shoes, such as the Air Garnett II, that turned out to be very poor sellers. The company also came up with an \$80 million to \$100 million shortfall on popular models, such as the Air Force 1.

Nike has since bounced back as an innovation leader and today uses sophisticated forecasting artificial intelligence (AI) and analytics algorithms for forecasting. The lessons learned, however, are the importance of forecasting, the cost of forecast errors, and the limitations of even the best demand forecasting software.

Concept Check Questions

1. Forecasting is extremely important to Nike.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

2. Nike's i2 demand forecasting software was very successful. It reduced inventory by 30 percent.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

What Is Forecasting?

Forecasting vs Planning

Forecasting is the process of predicting future events. This can range from forecasting product demand, such as the demand for purple-colored ketchup in October, to forecasting the passage of a healthcare bill in Congress. Any time, we try to predict future events we are forecasting. **Planning**, on the contrary, is the process of selecting actions in anticipation of the forecast. The forecast drives the plan, and the plan is made in response to the forecast. This is shown in [Figure 8.1](#).

Forecasting is one of the most important business activities because it drives all other business decisions. Decisions such as which markets to pursue, which products to produce, how much inventory to carry, and how many people to hire are all based on a forecast. Consider the example of Nike in the chapter opener. The company continuously makes forecasts of demand for its many products and, as a result, generates plans regarding which products to produce and how much inventory to carry. Nike's poor forecasting, as a result of overreliance on forecasting software, resulted in incorrect business decisions. A similar situation occurred with the Goodyear Tire & Rubber Company a few years earlier. After investing in state-of-the-art forecasting software, the company did not achieve the anticipated forecast accuracy, resulting in high safety stock and too much inventory. As we can see, forecasting is a challenge. Also, poor forecasts result in poor planning and can leave the company unprepared to meet future demands. The consequences can be costly in terms of lost sales or excess inventory that cannot be sold.

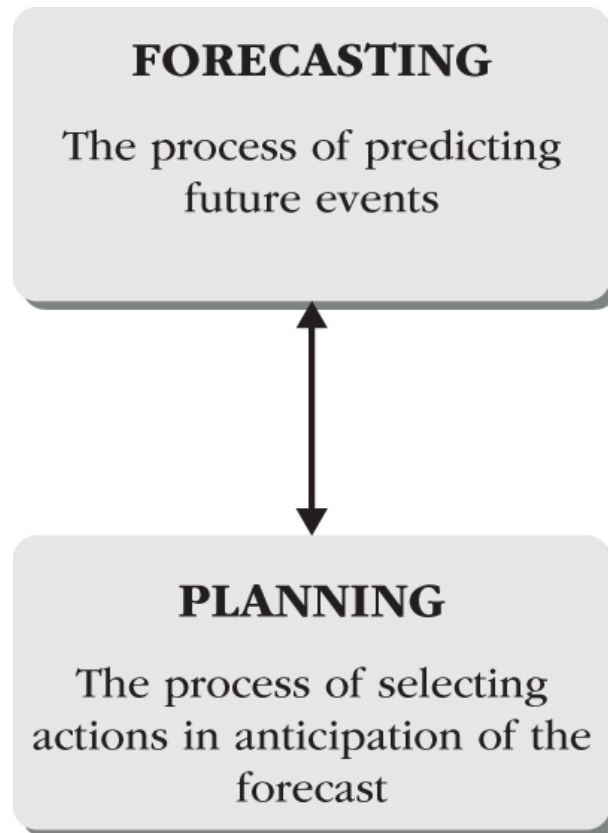


FIGURE 8.1 Forecasting drives planning.

Another example occurred in 2013 when Walmart faced significant issues with its inventory management due to inaccurate demand forecasts. The company heavily relies on demand forecasting to ensure the right products are in stock at the right stores and times. However, a forecasting error led to a substantial inventory surplus of \$3 billion worth of unsold merchandise. This situation occurred due to inaccurate predictions regarding customer demand. The surplus inventory led to significant losses in sales revenue as the products could not be sold at their expected rate, contributing to a decrease in profits. Walmart's overstocking issue highlighted the importance of accurate demand forecasting to avoid excessive inventory, which can lead to substantial financial losses and missed sales opportunities. This incident emphasizes the impact of poor forecasting on sales and financial outcomes, and how forecasting drives planning. Next, let us consider planning.

Planning is the process of taking action to be prepared for the future. It requires organizing resources in anticipation of the forecast and being prepared for future events. As organizations attempt to decrease their vulnerability to chance, they need to forecast and plan their resources accordingly. Forecasting and planning have become especially important as the lag time between awareness of an impending event and the need to respond have become increasingly short. The shorter this lag time, the more critical forecasting and planning become.

Planning involves the following decisions:

Scheduling existing resource. For a business and its supply chain to be competitive, it must use its current resources in the most efficient way possible. This includes the production process, transportation, labor, facilities, and capital. An important aspect of planning is deciding how to best utilize existing resources.

Determining future resource needs. In addition to efficiently utilizing current resources, organizations must determine what resources are going to be needed in the future. These decisions depend on forecasts of emerging market opportunities, new technology, new products, and competition.

Acquiring new resources. It takes time for companies to acquire new facilities, new technologies, and new equipment or expand to new locations. Plans must be made well in advance, and procedures to acquire new resources and capabilities put in place well ahead of time.

Companies often confuse forecasting and planning. The reason is that companies too affect demand. This can be done through promotional campaigns and advertisements, offering incentives to sales staff and personnel, and cutting prices. This is called [demand management](#) and is the process of influencing demand.

Notice that demand management cannot occur without first having a forecast or a prediction of what future demand is going to be. Once a forecast and a resulting plan have been made, the organization may decide to influence demand to better utilize its resources and the plan to reconfigure accordingly. This is shown in [Figure 8.2](#).

McDonald's is a prime example of a company that effectively uses forecasting and planning in its operations, particularly demonstrated in its strategic decisions around menu items such as the McRib sandwich. Here's how the process works and some related success metrics.

For forecasting **and planning**, McDonald's relies on sales data and local trends to anticipate demand for menu items. For the McRib sandwich, the decision to reintroduce it was based on predicted customer interest, and was analyzed through historical sales data, customer feedback, and market research. Then the company moved to **demand management tactics**.

Upon the return of the McRib sandwich, McDonald's employed demand management tactics, such as marketing campaigns, to stimulate customer interest and drive sales. These campaigns were strategically designed to create excitement and drive demand for the product.

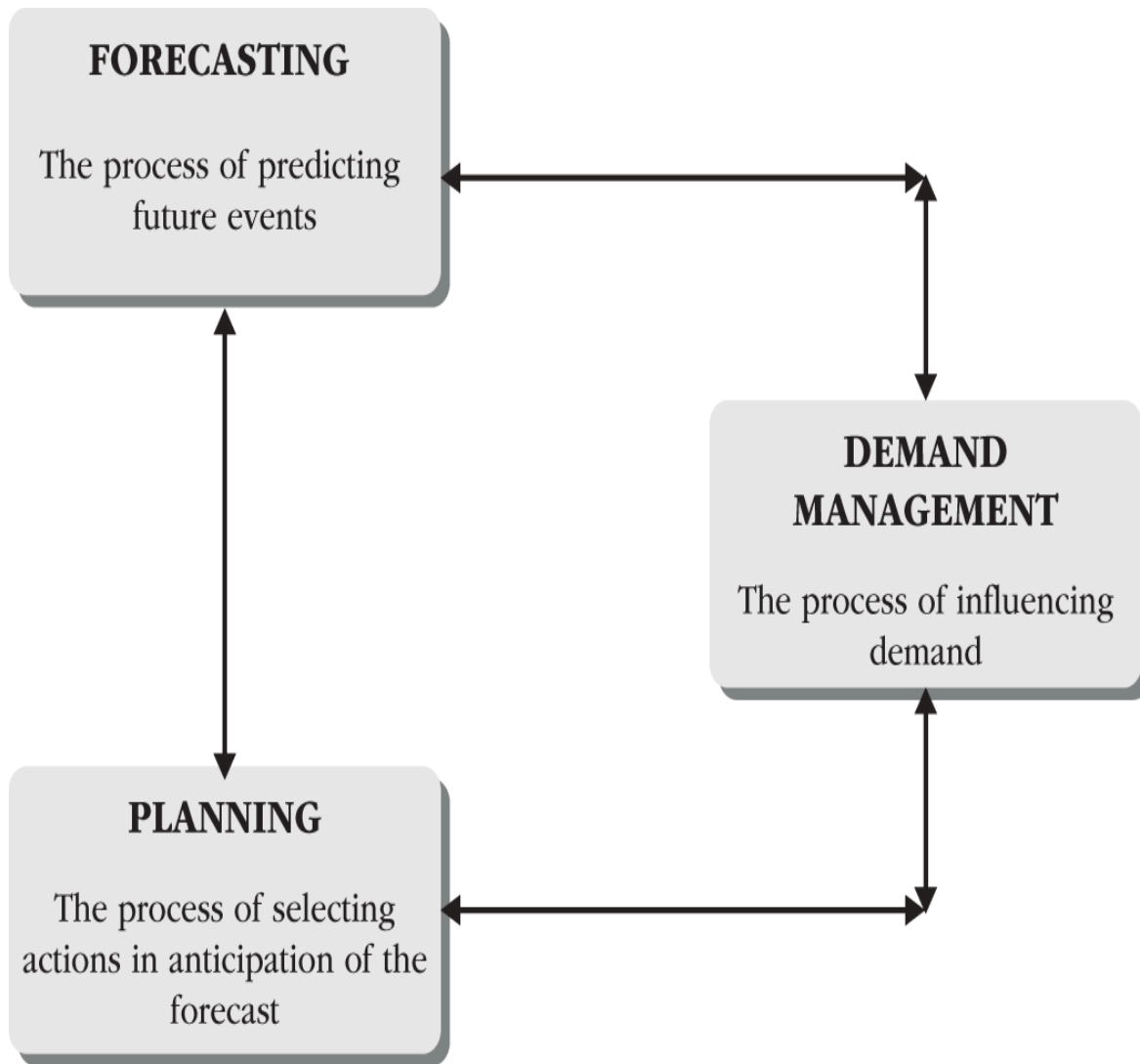


FIGURE 8.2 Forecasting, planning, and demand management.

The success of McDonald's forecasting and planning strategies were then measured by the sales figures of the McRib sandwich and other products. A significant increase in sales during the launch period indicated effective demand forecasting and management. McDonald's then further used AI and analytics to gather customer engagement metrics, such as social media interactions, customer feedback, and repeat purchases. Higher customer engagement levels suggested that customers are interested and satisfied with the product offerings and helped confirm McDonald's strategies and guide the future.

Managerial Insights Box

■ FORECASTING BEYOND WIDGETS

Planning for any event requires a forecast of the future. Whether in business or in our own lives, we make forecasts of future events. Based on these forecasts we make plans and take action. As in the example of Nike, most of us think of forecasting in terms of estimating demand for tangible products and what it means for inventories and sourcing. However, it is important to expand our concept of forecasting beyond that. Remember that all plans are based on a forecast. Let us consider some forecasting examples that go beyond the traditional and see how they impact planning.

1. **Crime Forecasting.** Crime forecasting is an area of forecasting that has gained quite a bit of interest. Consider that police departments must forecast different types of crimes by location and as a result schedule police officers and patrols, acquire resources, and provide training.
2. **Climate Change.** Numerous forecasting techniques are used to scientifically predict the effects of climate change. These forecasts impact the plans that are made by policymakers and how money and resources are allocated to mitigate catastrophic risk. These forecasts can have an enormous impact on preparedness in case these events materialize (see www.publicpolicyforecasting.com).
3. **Health Forecasting.** Health and healthcare forecasting is important for policymakers and researchers. This involves projecting demographic changes, health resources needed, future impact of disease, health risk factor distributions, trends in population health, and healthcare spending. These forecasts are used to make decisions regarding allocating resources and planning for future resources, such as training of physicians and acquiring new capabilities.
4. **Political Forecasting.** You may not think that forecasting political elections has a huge impact on supply chain management, but it does. Consider all the resources required to run a political campaign and the resources that must be immediately in place once an election is won. Also, a political forecast has a significant impact on current business decisions, especially considering how favorable it is toward business (see www.politicalforecasting.com).
5. **Forecasting Decisions in Conflicts.** Forecasting decisions of parties in conflict is concerned with forecasting industrial disputes, corporate takeovers, intercommunal conflicts, political negotiations, diplomatic and military confrontations, and even counterterrorism. The planning that is done based on these forecasts requires training and mobilization of personnel, resources, and allocation of money. Let us consider, for example, the operational and supply chain requirements that are involved when governments decide on increasing airport security or security at ports of entry (see www.conflictforecasting.com and www.terrorismforecasting.com).
6. **Tourism Forecasting.** This is a special area of forecasting concerned with forecasting trends and growth patterns in tourism. The large size of the hospitality industry—including hotels, cruises, and resorts—makes this an important forecasting area. These forecasts translate into supply chain decisions such as whether Marriot Hotels will open a new facility in Cairo or how many cruise ships and staff size will be needed to travel the Adriatic Sea during May.

In addition to these examples, consider planning to mobilize resources to an area of need, such as an earthquake in Turkey, or supporting an event such as the Olympic Games. These plans are

based on forecasts, and they require decisions regarding how best to manage resources in their respective supply chains (see www.forecastingprinciples.com).

Concept Check Questions

3. _____ is the process of predicting future events.

- ☐ a) Predicting
- ☐ b) Demand management
- ☐ c) Forecasting
- ☐ d) Planning
- ☐ e) Estimating

Correct or Incorrect?

Clear

Check Answer

4. _____ is the process of selecting actions in anticipation of the forecast.

- ☐ a) Scheduling
- ☐ b) Demand management
- ☐ c) Forecasting
- ☐ d) Planning
- ☐ e) Estimating

Correct or Incorrect?

Clear

Check Answer

5. The plan drives the forecast.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

6. In 2013, Walmart developed a very accurate forecasting method.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

7. _____ is the process of taking action to be prepared for the future.

- ☐ a) Scheduling
- ☐ b) Demand management
- ☐ c) Forecasting
- ☐ d) Planning
- ☐ e) Estimating

Correct or Incorrect?

Clear

Check Answer

8. Planning involves all of the following decisions except for which one?

- ☐ a) Determining future resource needs
- ☐ b) Determining the correct prices for products and services
- ☐ c) Acquiring new resources
- ☐ d) Scheduling existing resource

Correct or Incorrect?

Clear

Check Answer

9. _____ is done through promotional campaigns and advertisements, offering incentives to sales staff and personnel, and cutting prices.

- ☐ a) Scheduling
- ☐ b) Demand management
- ☐ c) Forecasting
- ☐ d) Planning
- ☐ e) Estimating

Correct or Incorrect?

Clear

Check Answer

10. Demand management comes before the forecast.

☐ True

☐ False

Correct or Incorrect?

Clear

Check Answer

11. McDonald's is a prime example of a company that effectively uses forecasting and planning in its operations.

☐ True

☐ False

Correct or Incorrect?

Clear

Check Answer

Impact on the Organization

Plans at all levels of the organization, from the strategic level, where long-range plans are made, to the tactical, where day-to-day scheduling is made, are based on forecasting. Also, forecasting drives the decisions of every organizational function. Marketing relies on forecasting to develop estimates of demand and future sales. Marketing also forecasts the sizes of markets, new competition, future trends, emerging markets, and changes in consumer preferences. Finance, in turn, uses forecasting to assess financial performance and capital investment needs, predict stock prices and investment portfolio returns, and set budgets. Operations makes decisions regarding production and inventory levels, and conducts capacity planning and scheduling, all based on a forecast. Sourcing uses forecasts to make purchasing decisions and select suppliers. None of these organizational functions could do their job without a forecast of the future. Whether in business, industry, government, or other fields such as medicine, engineering, and science, proper planning for the future starts with a forecast.

A good example is Nike which experienced a 1% decline in revenue in North America in 2018. This was attributed to several factors, including increased competition, changes in consumer behavior, and the ongoing trade war between the United States and China. However, analysts also pointed to the political climate in the United States as a contributing factor. The U.S. administration's policies, such as tariffs on goods imported from China, created uncertainty for businesses and consumers alike. This uncertainty led to a decrease in consumer spending, which negatively impacted Nike's sales.

The political climate in the United States also had a direct impact on Nike's supply chain. The tariffs imposed on goods imported from China made it more expensive for Nike to manufacture its products. This increased cost was passed on to consumers in the form of higher prices. As a result, some consumers were less likely to purchase Nike products.

So, how could Nike use political forecasting to improve its supply chain management? Nike could use political forecasting to better understand the potential impact of political events on its business. This would allow Nike to make more informed decisions about its supply chain, such as where to source its materials and how to price its products.

Concept Check Questions

12. Plans at all levels of the organization, from the strategic level, where long-range plans are made, to the tactical, where day-to-day scheduling is made, are based on forecasting.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

13. Only marketing and operations use the forecast.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

14. _____ relies on forecasting to develop estimates of demand and future sales.

- ☐ a) Accounting
- ☐ b) Finance
- ☐ c) Marketing
- ☐ d) Operations
- ☐ e) Sourcing

Correct or Incorrect?

Clear

Check Answer

15. _____ uses forecasting to assess financial performance and capital investment needs, predict stock prices and investment portfolio returns, and set budgets.

- ☐ a) Accounting
- ☐ b) Finance
- ☐ c) Marketing
- ☐ d) Operations
- ☐ e) Sourcing

Correct or Incorrect?

Clear

Check Answer

16. _____ makes decisions regarding production and inventory levels, conducts capacity planning and scheduling, all based on a forecast.

- ☐ a) Accounting
- ☐ b) Finance
- ☐ c) Marketing
- ☐ d) Operations
- ☐ e) Sourcing

Correct or Incorrect?

Clear

Check Answer

17. _____ uses forecasts to make purchasing decisions and select suppliers.

- ☐ a) Accounting
- ☐ b) Finance
- ☐ c) Marketing
- ☐ d) Operations
- ☐ e) Sourcing

Correct or Incorrect?

Clear

Check Answer

Impact on Supply Chain Management

The forecast of demand is critical not only to the organization but to the entire supply chain, as it affects all the plans made by each company in the chain. When members of the supply chain make their forecasts independent of one another, they are only looking at the demand of their immediate buyer not the final customer in the chain. The consequences are a mismatch between supply and demand because each member of the chain is working to fulfill a different level of demand.

Consider the forecasting and planning process of Dell and Intel, one of Dell's suppliers. Dell starts its planning process with a forecast of future demand that is used to determine order quantities. At the same time, Intel, which supplies Dell with microprocessors, must determine its production and inventory schedules. If Dell and Intel were to make their forecasts independent of one another, their forecasts would differ, and Intel would not be able to supply Dell with the exact quantities of microprocessors it needs. The best alternative is for Dell and Intel to collaborate. When there is collaboration between suppliers and manufacturers in generating the forecast, all entities are responding to the same level of demand.

Independent forecasting by members of the supply chain gives rise to the bullwhip effect, which we discussed in [Chapter 1](#). The bullwhip effect refers to the increased volatility in orders as they propagate through the supply chain. The bullwhip effect occurs when each individual company in the supply chain forecasts its own demand, plans its stocking levels, and makes its replenishment decisions independent of other companies in the chain. This creates volatility in orders, which makes forecasting more difficult, leads to increases in inventory throughout the supply chain, has a higher stockout risk, and results in inefficient use of working capital and production capacity.

As we can see, forecasting has an impact on all organizations in the supply chain. The answer to good forecasting, and mitigating the bullwhip effect, is the sharing of data with supply chain partners and jointly generating forecasts.



Concept Check Questions

18. The forecast is important to the firm but not its supply chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

19. When members of the supply chain make their forecasts independent of one another, they are only looking at the demand of their immediate buyer not the final customer in the chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

20. Independent forecasting by members of the supply chain gives rise to the bullwhip effect.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

21. Forecasting by each member of the supply chain reduces volatility.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Managerial Insights Box—Forecasting is Predicting Any Future Event

There is no better example of forecasting challenges than the attempts to forecast the propagation of the COVID-19 pandemic. The COVID-19 pandemic had a major impact on the world and global supply chains in large part because the world could not forecast it. Despite the availability of sophisticated forecasting models and AI, it was impossible to accurately predict the pandemic's onset, magnitude, and duration. Based on different assumptions, numerous forecasting models were used, from the Johns Hopkins University model to the Washington University (WashU) model (<https://covidforecast.wustl.edu>). Ultimately, however, experts and epidemiologists interpreted the forecasts and adjusted them based on their knowledge. As of 2023, there were over 697 million confirmed cases of COVID-19 worldwide, with over 6.9 million deaths. The virus has spread to every country in the world and has a significant impact on global health, economies, and societies.

A similar situation was observed for post-COVID-19 forecasting challenges. Initially, the pandemic resulted in widespread shortages and stockouts of all items, from food to computers and automobiles. Although supply chain disruptions were partly to blame, a fundamental problem was the inability of companies to forecast how a new work-from-home lifestyle would impact consumer buying patterns.

Subsequently, many retailers—from Target to Walmart—found themselves holding mountains of excess inventory. There were too many wrong items and not enough of those consumers wanted. Items ordered by retailers that were popular during the days of the pandemic were pouring in—only to be met with customers whose preferences and shopping habits have changed again. Similarly, airlines—from American Airlines to Southwest—did a dismal job in forecasting, with a continued inability to meet consumer demand for travel. Collectively, these examples illustrate the challenges of forecasting methods.

Why were old forecasting approaches inadequate after the first wave of COVID-19? Although quantitative methods are objective and consistent, they require good data to generate forecasts. In addition, data used for forecasting should represent the future, which becomes an issue under changing conditions and for rare events with low probability. Current quantitative forecasting models are often based on sophisticated machine-learning methods. Despite tremendous advancements in analytics and AI and the availability of vast data, these technologies are still incredibly narrow in what they can do. In an interview, John Sicard, chief executive officer (CEO) of Kinaxis, explained it well by saying that during COVID-19 *“Every math-based model collapsed. None of the assumptive parameters could be trusted. It is not an indictment on the science ... But an indictment on the belief that those technologies eliminate the need to be agile.”*¹

This does not mean that forecasting does not work. Despite these challenges, forecasting models have been able to provide many valuable insights into the COVID-19 pandemic. For example, forecasting models were used to predict the number of cases and deaths, the impact of different interventions, such as social distancing and mask-wearing, and the need for healthcare resources. Forecasting models were also used to help develop and distribute COVID-19 vaccines. The lesson is that in addition to excellent forecasting methods, companies also need agile supply chains that can respond quickly to changing environmental conditions.

The Forecasting Process

Principles of Forecasting

Some principles of forecasting hold true regardless of what is being forecast. Let us look at these briefly.

Forecasts are rarely perfect. A perfect forecast is rare as there are too many factors in the business environment that cannot be predicted with certainty. Forecasting the future involves uncertainty and forecasters know that they have to live with a certain amount of error, which is the difference between the forecast and what happened. It is easy then to wonder why we should bother with forecasting. Although we may not achieve a perfect forecast, we can maintain overall good forecast accuracy.

Forecasts are more accurate for groups than for individual items. When items are grouped, such as in product groups or families of items, their individual high and low values cancel each other out. The data for a group of items can be stable even when individual items in the group are unstable. The result is that higher degrees of accuracy can be obtained when forecasting for a group rather than for individual items. Consider FritoLay, a division owned by PepsiCo, Inc., which owns brands such as Lay's potato chips, Fritos, Doritos, Ruffles, SunChips, and other brands. FritoLay can expect to have much lower forecast accuracy when forecasting demand for one specific product line, such as Lay's Baked potato chips, vs forecasting demand for all chips combined.

Forecasts are more accurate for shorter than longer time horizons. The shorter the time horizon of the forecast, the lower the degree of uncertainty. Data do not change much in the short run. As the time horizon increases, however, there is a much greater likelihood that changes in established patterns and relationships will occur. For that reason, long-range forecasting tends to be less accurate than short range. For example, it is more difficult to forecast the size of an emerging market in Europe two years from now, than the size of the mobile phone market in Europe next month.

One example is that Walmart's forecasting accuracy for its weekly sales is 99%. However, its forecasting accuracy for its annual sales is only 95%.

This difference in accuracy is because it is easier to predict sales for a shorter time horizon. In the short term, fewer factors can affect sales, such as new products, changes in consumer preferences, and economic conditions. In the long term, more factors can affect sales, and it is more difficult to predict how these factors will interact.

Similarly, Amazon's forecasting accuracy for its quarterly revenue is 97%. However, its forecasting accuracy for its five-year revenue is only 90%.

Once again, the difference in accuracy is because it is easier to predict revenue for a shorter time horizon. In the short term, Amazon has a better understanding of its demand and its supply chain. In the long term, Amazon is more exposed to factors such as new competition, changes in technology, and economic conditions.

Forecasting is an important tool for businesses of all sizes. By forecasting demand, businesses can make better decisions about pricing, inventory, marketing, and other areas of their operations. However, it is important to remember that forecasts are more accurate for shorter than longer time horizons. When making decisions based on forecasts, it is important to consider the time horizon and the degree of uncertainty.

Concept Check Questions

22. Forecasts are rarely perfect.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

23. Forecasts are more accurate for individual items than for groups of items.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

24. Forecasts are more accurate for longer than shorter time horizons.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

25. Forecasting is an important tool mainly for large businesses.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

26. To ensure credibility, some basic steps should be followed when making a forecast, regardless of what is being forecast or the model used. Which of the following is the first step.

- ☐ a) Analyze appropriate data
- ☐ b) Decide what to forecast
- ☐ c) Generate the forecast
- ☐ d) Monitor forecast accuracy
- ☐ e) Select the forecasting model

Correct or Incorrect?

Clear

Check Answer

27. To ensure credibility, some basic steps should be followed when making a forecast, regardless of what is being forecast or the model used. Which of the following is the second step.

- ☐ a) Analyze appropriate data
- ☐ b) Decide what to forecast
- ☐ c) Generate the forecast
- ☐ d) Monitor forecast accuracy
- ☐ e) Select the forecasting model

Correct or Incorrect?

Clear

Check Answer

28. To ensure credibility, some basic steps should be followed when making a forecast, regardless of what is being forecast or the model used. Which of the following is the third step.

- ☐ a) Analyze appropriate data
- ☐ b) Decide what to forecast
- ☐ c) Generate the forecast
- ☐ d) Monitor forecast accuracy
- ☐ e) Select the forecasting model

Correct or Incorrect?

Clear

Check Answer

29. To ensure credibility, some basic steps should be followed when making a forecast, regardless of what is being forecast or the model used. Which of the following is the fourth step.

- ☐ a) Analyze appropriate data
- ☐ b) Decide what to forecast
- ☐ c) Generate the forecast
- ☐ d) Monitor forecast accuracy
- ☐ e) Select the forecasting model

Correct or Incorrect?

Clear

Check Answer

30. To ensure credibility, some basic steps should be followed when making a forecast, regardless of what is being forecast or the model used. Which of the following is the fifth step.

- ☐ a) Analyze appropriate data
- ☐ b) Decide what to forecast
- ☐ c) Generate the forecast
- ☐ d) Monitor forecast accuracy
- ☐ e) Select the forecasting model

Correct or Incorrect?

Clear

Check Answer

31. In forecasting, level and horizontal are the same thing.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

32. This is the simplest pattern and exists when data fluctuate around a constant mean.

- ☐ a) Cycles
- ☐ b) Trend
- ☐ c) Seasonality
- ☐ d) Random
- ☐ e) Level

Correct or Incorrect?

Clear

Check Answer

33. This is present when data exhibit an increasing or decreasing pattern over time.

- ☐ a) Cycles
- ☐ b) Trend
- ☐ c) Seasonality
- ☐ d) Random
- ☐ e) Level

Correct or Incorrect?

Clear

Check Answer

34. This is any pattern that regularly repeats itself.

- ☐ a) Cycles
- ☐ b) Trend
- ☐ c) Seasonality
- ☐ d) Random
- ☐ e) Level

Correct or Incorrect?

Clear

Check Answer

35. Seasonality is a factor that businesses need to consider when forecasting demand and making other business decisions.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

36. These are patterns created by economic fluctuations.

- ☐ a) Cycles
- ☐ b) Trend
- ☐ c) Seasonality
- ☐ d) Random
- ☐ e) Level

Correct or Incorrect?

Clear

Check Answer

Steps in the Forecasting Process

Forecasts need to be credible to be accepted by others. To ensure credibility, some basic steps should be followed when making a forecast, regardless of what is being forecast or the model used. The steps are as follows:

Decide what to forecast. This step may seem overly simple but it requires a bit of thought. For example, do we want to forecast actual sales vs total demand? Remember that forecasts are made to help plan for the future. To do so, we have to decide what forecasts are needed to guide the plan.

Analyze appropriate data. This step involves analyzing available data and identifying patterns present. Some patterns can be observed in the data, although not every set of data has every pattern. It is important to identify which patterns are present and—in the next step—select the forecasting model most appropriate for that pattern. The most common data patterns are

Level or horizontal. This is the simplest pattern and exists when data fluctuate around a constant mean. It is the easiest to predict and is common for commodity products in the mature stage of the life cycle, such as table salt or toothpaste.

Trend. The trend is present when data exhibit an increasing or decreasing pattern over time. The simplest type of trend is a straight line or linear trend. However, a trend can take other forms, such as an exponential trend.

Seasonality. Seasonality is any pattern that regularly repeats itself. Most of us think of ice cream sales in the summer or snow shovels in the winter. However, any pattern that regularly repeats itself is a seasonal pattern, such as restaurant sales that peak on the weekend.

One example is Home Depot's sales peaks in the spring and summer, as consumers are more likely to do home improvement projects during these months. This is due to the warmer weather and the longer days, which make it easier to work on outdoor projects.

Another example is Starbucks's sales peak during the holiday season, with December being its busiest month. This is due to a number of factors, including increased demand for coffee and tea as gifts, increased social gatherings during the holidays, and people looking for a warm drink to get them through the cold winter weather.

Seasonality is a factor that businesses need to consider when forecasting demand and making other business decisions. For example, Starbucks's needs to ensure that it has enough inventory in hand to meet the increased demand during the holiday season. Home Depot needs to ensure that it has enough staff in hand to assist customers during the spring and summer months.

Cycles. Cycles are patterns created by economic fluctuations. Examples include recessions, inflation, or even the life cycle of a product. The major distinction between seasonality and cycles is that cycles do not have a predictable or repeating length or magnitude. As a result, they are most difficult to predict.

In addition to these patterns, data contain random variation that cannot be predicted. The more random variation in the data, the harder it is to forecast. Forecasting focuses on the patterns in the data, knowing that the random variation will be present. This is shown below:

$$\text{Data} = \text{Pattern} + \text{Random variation}$$



$$\text{Data} = \text{level} + \text{trend} + \text{seasonality} + \text{cycles} + \text{Random variation}$$

Select the forecasting model. Once data patterns have been identified, the next step is to select an appropriate forecasting model. It is important to select the forecasting model best suited for the identified data pattern. Often, we narrow the choice to two or three different forecasting models, then test them on historical data to see which one is most accurate. We will look at specific models later in this chapter.

Generate the forecast. Once a model has been selected, the forecast is generated.

Monitor forecast accuracy. After the forecast has been made and actual events occur, it is critical to evaluate forecast performance by measuring forecast error. This information should be used to improve the forecasting process. Remember that forecasting is an ongoing process that is always changing as new information and data become available.

Factors in Method Selection

Someone new to forecasting might be overwhelmed by the choices in available forecasting methods. However, not all methods are appropriate for all forecasts. A few factors should be considered in method selection:

Amount and type of available data. Different forecasting methods require different types and quantities of data. Sophisticated quantitative models, for example, may require large amounts of data, whereas simpler methods may not. In some cases—such as when forecasting new products—no historical data may be available. This factor plays a key role in the forecasting method that can be selected.

Degree of accuracy required. Sophisticated quantitative models may generate good forecasts, but they may be costly to develop. The costs of the forecasting method need to justify the importance of the forecast. For example, forecasting paper clips or rubber washers doesn't justify a costly method of forecasting.

Length of forecast horizon. Some forecasting methods are better suited for short-term forecasts, whereas others are better suited for the long term. It is important to select the method most appropriate for the horizon being forecast. For example, forecasting emergency room visits at a hospital during December is going to require a very different forecasting method than forecasting demand for natural gas over the next 10 years.

Patterns in the data. As we already mentioned, it is critical to select a forecasting model that is appropriate for the identified patterns in the data. Otherwise, we can be guaranteed a poor forecast. For example, trying to forecast a product with a known trend pattern using a forecasting method that cannot capture trends will ensure errors.



Concept Check Questions

37. However, not all methods are appropriate for all forecasts. Which of the following is not a major consideration when selecting a forecasting method?

- ☐ a) Degree of accuracy required
- ☐ b) Amount and type of available data
- ☐ c) Length of forecast horizon
- ☐ d) Cost of data collection
- ☐ e) Patterns in the data

Correct or Incorrect?

Clear

Check Answer

38. AI is having an impact on forecasting. The following describes which of the items listed? These use real-time data to improve short-term demand forecasting.

- ☐ a) Collaborative Planning
- ☐ b) Demand Sensing
- ☐ c) Demand Segmentation
- ☐ d) Integrated Business Planning
- ☐ e) Supply Chain Visibility

Correct or Incorrect?

Clear

Check Answer

39. AI is having an impact on forecasting. The following describes which of the items listed? Enhanced visibility enables better forecasting accuracy by considering external factors such as weather, geopolitical events, and market trends.

- ☐ a) Collaborative Planning
- ☐ b) Demand Sensing
- ☐ c) Demand Segmentation
- ☐ d) Integrated Business Planning
- ☐ e) Supply Chain Visibility

Correct or Incorrect?

Clear

Check Answer

40. AI is having an impact on forecasting. The following describes which of the items listed? Doing this with suppliers and partners improves forecast accuracy and reduces lead times.

- ☐ a) Collaborative Planning
- ☐ b) Demand Sensing
- ☐ c) Demand Segmentation
- ☐ d) Integrated Business Planning
- ☐ e) Supply Chain Visibility

Correct or Incorrect?

Clear

Check Answer

41. AI is having an impact on forecasting. The following describes which of the items listed? This is dividing demand based on customer behavior, demographics, and buying patterns allows for more accurate forecasts and targeted marketing strategies.

- ☐ a) Collaborative Planning
- ☐ b) Demand Sensing
- ☐ c) Demand Segmentation
- ☐ d) Integrated Business Planning
- ☐ e) Supply Chain Visibility

Correct or Incorrect?

Clear

Check Answer

42. AI is having an impact on forecasting. The following describes which of the items listed? This aligns demand, supply, and financial plans across the organization, enabling more effective decision-making.

- ☐ a) Collaborative Planning
- ☐ b) Demand Sensing
- ☐ c) Demand Segmentation
- ☐ d) Integrated Business Planning
- ☐ e) Supply Chain Visibility

Correct or Incorrect?

Clear

Check Answer

43. Procter & Gamble uses this to reduce forecast error by 30% and improve product availability.

- ☐ a) Collaborative Planning
- ☐ b) Demand Sensing
- ☐ c) Demand Segmentation
- ☐ d) Integrated Business Planning
- ☐ e) Supply Chain Visibility

Correct or Incorrect?

Clear

Check Answer

44. Nestlé improved forecast accuracy by 35% by integrating weather data into its demand planning processes.

- ☐ a) Collaborative Planning
- ☐ b) Demand Sensing
- ☐ c) Demand Segmentation
- ☐ d) Integrated Business Planning
- ☐ e) Supply Chain Visibility

Correct or Incorrect?

Clear

Check Answer

45. Coca-Cola reduced forecast error by 25% through this with its bottlers.

- ☐ a) Collaborative Planning
- ☐ b) Demand Sensing
- ☐ c) Demand Segmentation

- ☐ d) Integrated Business Planning
- ☐ e) Supply Chain Visibility

Correct or Incorrect?

Clear

Check Answer

46. Amazon uses this to personalize recommendations and improve sales forecasting accuracy.

- ☐ a) Collaborative Planning
- ☐ b) Demand Sensing
- ☐ c) Demand Segmentation
- ☐ d) Integrated Business Planning
- ☐ e) Supply Chain Visibility

Correct or Incorrect?

Clear

Check Answer

47. Intel achieved a 30% reduction in finished goods inventory and a 20% increase in inventory turns through this.

- ☐ a) Collaborative Planning
- ☐ b) Demand Sensing
- ☐ c) Demand Segmentation
- ☐ d) Integrated Business Planning
- ☐ e) Supply Chain Visibility

Correct or Incorrect?

Clear

Check Answer

48. Unilever reduced waste by 28% and increased forecast accuracy by 50% by integrating this into its demand planning.

- ☐ a) Collaborative Planning
- ☐ b) Demand Sensing
- ☐ c) Demand Segmentation
- ☐ d) Integrated Business Planning
- ☐ e) Sustainability Considerations

Correct or Incorrect?

Clear

Check Answer

Managerial Insights Box

■ GENERATIVE AI AND FORECASTING

One of the most significant impacts on forecasting has been the development of Generative AI and large language models (LLMs). Companies are increasingly using Generative AI and advanced analytics, to improve forecast accuracy. AI and LLMs have changed the ability to predict and by 2025, the global market for AI in forecasting and supply chain management is expected to reach \$10.1 billion. Walmart, for example, was able to reduce out-of-stock items by 16% after implementing machine learning algorithms for demand forecasting. Netflix uses AI to predict content its customers are most likely to want to watch, with an accuracy of over 90%. This allows Netflix to personalize its recommendations for each customer, which keeps customers engaged and reduces churn. In 2023, Netflix had over 260.28 million subscribers worldwide, and it generated over \$33.7 billion in revenue and attributed a large part of its success to AI and analytics.

Let us look at some specific areas of forecasting where AI is having an impact:

1. **Demand Sensing:** Demand sensing techniques, which use real-time data to improve short-term demand forecasting, are gaining popularity. This helps companies react quickly to changes in demand patterns.

Success: Procter & Gamble (P&G) uses demand sensing to reduce forecast error by 30% and improve product availability.

2. **Supply Chain Visibility:** Enhanced visibility across the supply chain enables better forecasting accuracy by considering external factors such as weather, geopolitical events, and market trends.

Success: Nestlé improved forecast accuracy by 35% by integrating weather data into its demand planning processes.

3. **Collaborative Planning:** Collaborative planning with suppliers and partners improves forecast accuracy and reduces lead times.

Success: Coca-Cola reduced forecast error by 25% through collaborative demand planning with its bottlers.

4. **Demand Segmentation:** Segmenting demand based on customer behavior, demographics, and buying patterns allows for more accurate forecasts and targeted marketing strategies.

Success: Amazon uses demand segmentation to personalize recommendations and improve sales forecasting accuracy.

5. **Integrated Business Planning (IBP):** IBP aligns demand, supply, and financial plans across the organization, enabling more effective decision making.

Success: Intel achieved a 30% reduction in finished goods inventory and a 20% increase in inventory turns through IBP.

6. **Sustainability Considerations:** Forecasting and demand planning are increasingly incorporating sustainability factors, such as environmental impact and ethical sourcing, into decision-making processes.

Success: Unilever reduced waste by 28% and increased forecast accuracy by 50% by integrating sustainability into its demand planning.

These trends and examples demonstrate the evolving nature of forecasting and demand planning, highlighting the importance of leveraging advanced analytics, improving visibility, and adopting collaborative and sustainable practices to drive success in supply chain management.

Types of Forecasting Methods

Forecasting methods can be classified into two broad groups: qualitative and quantitative. They are shown in [Figure 8.3](#).

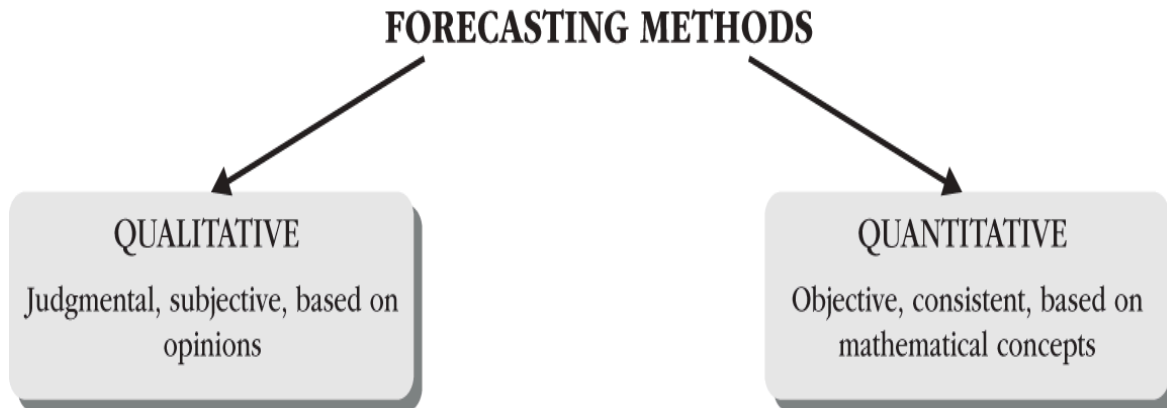


FIGURE 8.3 Categories of forecasting methods.

STRENGTHS	WEAKNESSES
I. Qualitative forecasting methods	
Highly responsive to latest changes in the environment. Can include “inside” and “soft” information difficult to quantify. Can compensate for “one-time” or unusual events. Provide users with a sense of “ownership.”	Cannot consider many variables. Influenced by short-term memory. Difficulty in understanding relationships. Biased (optimism, wishful thinking, political manipulation, and lack of consistency).
II. Quantitative forecasting methods	
Can consider many variables and complex relationships. Objective. Consistent. Can process large amounts of information.	Only as good as the data and model. Slow to react to changing environments. Costly and time-consuming to model “soft” information. Requires technical understanding.

FIGURE 8.4 Qualitative vs quantitative forecasting methods.

[Qualitative forecasting methods](#), often called judgmental methods, are methods based on subjective opinions and judgment of individuals, such as managers, sales staff, or customers. Asking customers whether they would buy a particular product, called “intention surveys,” is a type of qualitative forecasting method. Another one is called “sales force composite” and occurs when the sales staff

make a group forecast of upcoming sales. Qualitative methods are made by people and, as a result, are subject to human biases.

[Quantitative forecasting methods](#), on the contrary, are based on mathematical modeling. These methods are objective and consistent, are capable of handling large amounts of data, and can uncover complex relationships. Provided that good data are available, these methods are generally more accurate than qualitative methods.

Both qualitative and quantitative forecasting methods have their strengths and weaknesses, as shown in [Figure 8.4](#). Although quantitative methods are objective and consistent, they require data in quantifiable form to generate a forecast. Often, such data is not available, such as in new product forecasting or making long-range strategic forecasts. Also, quantitative methods are only as good as the data on which they are based. Qualitative methods, on the contrary, have the advantage of being able to incorporate last-minute “inside information.” This may be last-minute notice of a competitor's advertising campaign, a snowstorm delaying a shipment, or a heat wave increasing ice cream sales. Each method has its role in the forecasting process, and a good forecaster learns to rely on both.

Concept Check Questions

49. _____ forecasting methods are often called judgmental methods.

- ☐ a) Time series
- ☐ b) Mathematical
- ☐ c) Qualitative
- ☐ d) Quantitative

Correct or Incorrect?

Clear

Check Answer

50. _____ are methods based on subjective opinions and judgment of individuals, such as managers, sales staff, or customers.

- ☐ a) Time series
- ☐ b) Mathematical
- ☐ c) Qualitative
- ☐ d) Quantitative

Correct or Incorrect?

Clear

Check Answer

51. _____ forecasting methods based on mathematical modeling.

- ☐ a) Time series
- ☐ b) Mathematical
- ☐ c) Qualitative
- ☐ d) Quantitative

Correct or Incorrect?

Clear

Check Answer

Qualitative Forecasting Methods

There are numerous qualitative forecasting methods, ranging in degree of formality and structure. These methods are especially useful when identifying customer buying patterns and expectations and providing sales estimates of new products.

Supply Chain Leader's Box

■ TESLA MOTORS

Tesla's approach to forecasting demand for its new products, such as the Model 3 electric car and the Model Y crossover sports utility vehicle (SUV), highlights the importance of qualitative forecasting methods in its strategy. Qualitative forecasting relies on subjective factors and expert opinions to predict future demand, making it particularly useful for new or innovative products where historical data may be limited or unreliable.

For the Model 3, Tesla conducted surveys among potential customers to gauge their interest in the car model and gather feedback on its features and pricing. This qualitative data helped Tesla understand consumer preferences and anticipate demand for the Model 3 before its launch. Similarly, for the Model Y, Tesla used similar qualitative methods to assess customer interest and gather feedback to inform its production and marketing strategies.

Tesla's use of qualitative forecasting methods underscores its customer-centric approach to product development and marketing. By actively engaging with potential customers and gathering their input, Tesla can tailor its products to better meet market demand and increase the likelihood of a successful launch. Additionally, qualitative forecasting allows Tesla to be more agile in its decision making, as it can quickly adjust its strategies based on changing market conditions and customer preferences.

Overall, Tesla's use of qualitative forecasting methods for predicting demand for its new products demonstrates its commitment to innovation and customer engagement, helping it maintain its position as a leader in the electric vehicle market.

Executive opinion is a type of qualitative forecasting method where a group of managers, executives, or sales staff meet and collectively develop a forecast. This method is often used to forecast sales, market trends, make strategic forecasts, or forecast new products. Also, it can be used to modify existing forecasts to account for special events, such as slowed spending during a recession or a special promotional campaign.

The advantage of this method is the ability to include the latest information in the forecast. The disadvantage, however, is that it is subject to many human biases, such as optimism, inconsistency, and political manipulation. Also, because it is a group decision-making process, often the opinion of one member can dominate the forecast.

Market research uses surveys and interviews to determine customer likes, dislikes, and preferences and to identify new product ideas. Conducting market research requires an understanding of how to conduct reliable surveys. Therefore, companies usually hire an outside marketing firm to conduct market research studies.

Market research can be a good determinant of customer preferences. However, it has several shortcomings. A common one is the potential inadequacy of the survey questionnaire design. For example, a market research firm may ask participants to identify a favorite hobby providing them with the following choices: gardening, fishing, cooking, or sports. The problem in this example is that the list is not exhaustive, as a participant may prefer music—an option not included. This questionnaire forces participants to select a category. As a result, the findings will incorrectly portray customer preferences and lead to misinterpretation of the market.

An example of this was faced by Coca-Cola in 1985. At the time Coca-Cola launched a new product called New Coke, which was intended to replace the original Coca-Cola formula. Coca-Cola conducted market research to gauge customer interest in the New Coke formula, and the results were overwhelmingly positive. However, when New Coke was launched, it was met with a wave of consumer backlash. Many consumers said that they preferred the original Coca-Cola formula, and they refused to buy New Coke. Coca-Cola's market research study failed to accurately predict consumer preferences because it used a poorly designed questionnaire. The questionnaire asked consumers to rate the New Coke formula on a scale of 1 to 5, with 5 being the highest rating. However, the questionnaire did not provide consumers with an option to indicate that they preferred the original Coca-Cola formula. This caused the results of the market research study to be skewed, as it overstated the level of consumer support for New Coke.

Coca-Cola's failure to accurately predict consumer preferences resulted in a major financial loss for the company. Coca-Cola was forced to discontinue New Coke just three months after it was launched, and the company lost millions of dollars in the process.

The **Delphi method** is another qualitative forecasting technique designed to reach a consensus among a group of experts on a particular topic. Examples may include forecasting propagation of a disease, climate changes, or technological innovation. The process involves choosing experts in the field of inquiry, who maintain anonymity. Questionnaires are sent to the experts, the findings are summarized, and the process is repeated with updated questionnaires that incorporate the initial findings. This process continues until a consensus between the experts is reached.

Delphi is based on the assumption that although experts in a field typically do not agree on many things, what they do agree on will likely happen. The researcher's job is to extract this information. Although it is time consuming, Delphi is an excellent method for forecasting long-range product demand, technological change, and scientific advances in medicine.

Concept Check Questions

52. Which of the following is not a strength of qualitative forecasting methods.

- ☐ a) Can consider many variables and complex relationships
- ☐ b) Provide user with a sense of “ownership”

- ☐ c) Can include “inside” and “soft” information difficult to quantify
- ☐ d) Can compensate for “one-time” or unusual events
- ☐ e) Highly responsive to latest changes in environment

Correct or Incorrect?

Clear

Check Answer

53. Which of the following is not a weakness of qualitative forecasting methods.

- ☐ a) Influenced by short-term memory
- ☐ b) Biased (optimism, wishful thinking, political manipulation, lack of consistency)
- ☐ c) Difficulty in understanding relationships
- ☐ d) Slow to react to changing environments
- ☐ e) Cannot consider many variables

Correct or Incorrect?

Clear

Check Answer

54. _____ is a type of qualitative forecasting method where a group of managers, executives, or sales staff meet and collectively develop a forecast.

- ☐ a) The Delphi method
- ☐ b) Causal models
- ☐ c) Market research
- ☐ d) Time series models
- ☐ e) Executive opinion

Correct or Incorrect?

Clear

Check Answer

55. _____ uses surveys and interviews to determine customer likes, dislikes, and preferences and to identify new product ideas.

- ☐ a) The Delphi method
- ☐ b) Causal models
- ☐ c) Market research
- ☐ d) Time series models
- ☐ e) Executive opinion

Correct or Incorrect?

Clear

Check Answer

56. _____ is designed to reach a consensus among a group of experts on a particular topic.

- ☐ a) The Delphi method
- ☐ b) Causal models
- ☐ c) Market research
- ☐ d) Time series models
- ☐ e) Executive opinion

Correct or Incorrect?

Clear

Check Answer

Quantitative Forecasting Methods

Unlike qualitative methods that are based on opinions, quantitative methods are based on mathematical concepts. Quantitative methods can be divided into two broad categories: time series and causal models, as shown in [Figure 8.5](#). Although both are mathematical, the two categories differ in their assumptions and how the forecast is generated.

Time series models generate the forecast from an analysis of a “time series” of the data. A time series is simply a listing of data points of the variable being forecast over time taken at regular intervals. For example, data on student enrollment per semester at a university over the past five years is an example of a time series. Time series models assume that forecasts can be made by identifying and modeling the patterns present in the data.

Causal models assume that the variable being forecast is related to other variables in the environment. For example, university enrollment may be related to unemployment rates, recession levels, or salary levels. In this case, the forecasting process involves identifying these relationships, expressing them in mathematical form, and using that information to generate a forecast.

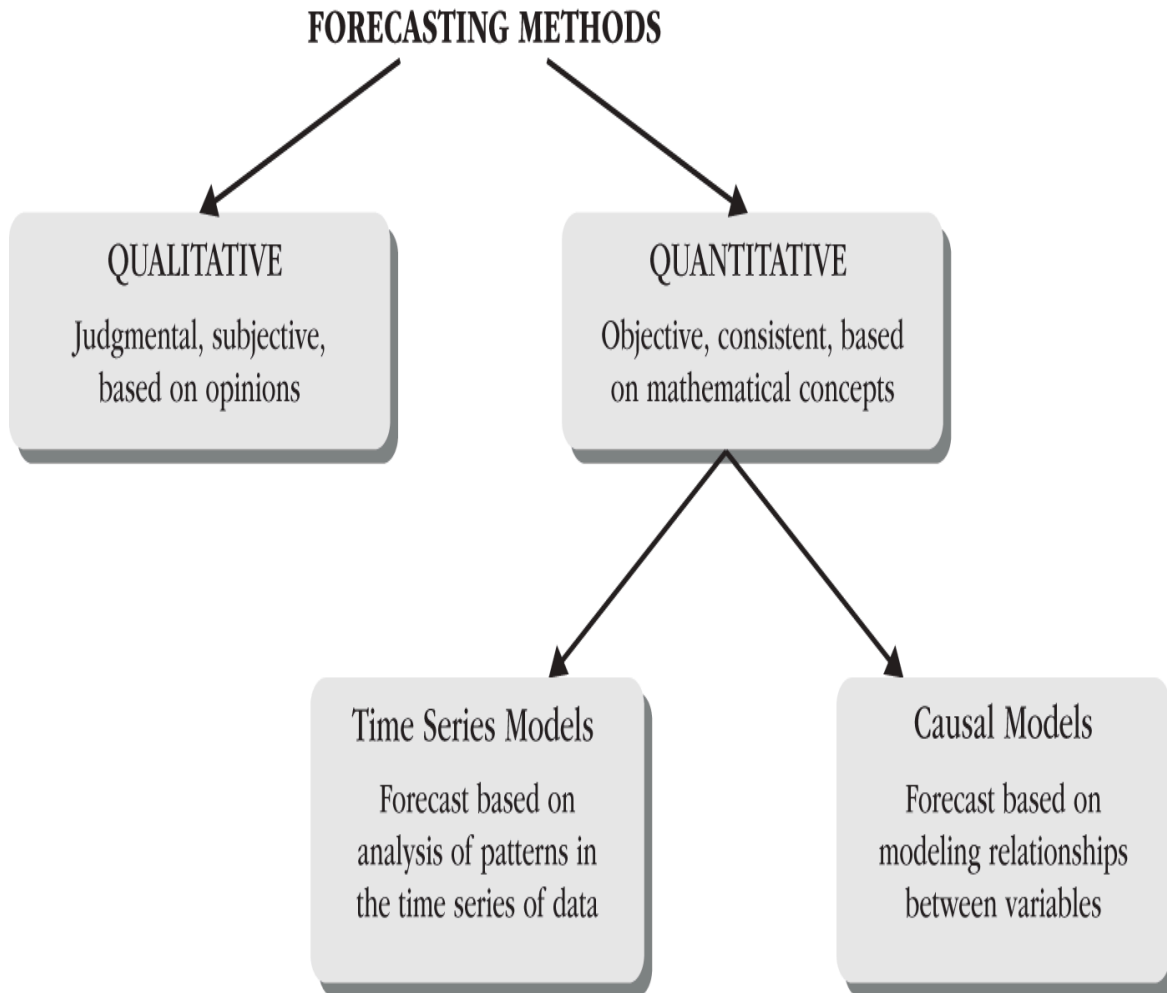


FIGURE 8.5 Categories of quantitative forecasting methods.

Nike uses time series models to forecast demand for its products, with an accuracy of over 95%. This allows Nike to optimize its inventory levels and ensure that it has the products that customers want in stock when they want them. Nike collects a massive amount of data about its sales, including historical sales data, seasonal trends, and promotional activity. This data is then used to train time series models to predict demand for each product. The models are constantly being updated with new data, which makes them more accurate over time. Nike's use of time series models has been a major success factor for the company. In 2023, Nike generated over \$51.542 billion in revenue.

Time series models are generally easier to use than causal models. They are also more readily available in forecasting software. Causal models, on the contrary, can be more complex, especially if relationships between multiple variables are being considered. However, time series models can often be just as accurate and have the advantage of simplicity. They are easy to use and can generate a forecast more quickly than causal models, which require model building. For this reason, time series models are used more frequently in environments where large numbers of items must be forecast regularly, such as retail. Recall the many different products that must be forecast at Nike. Time series analysis would likely be best for that large variety of items.



Concept Check Questions

57. Which of the following is not a strength of qualitative forecasting methods.

- ☐ a) Can consider many variables and complex relationships
- ☐ b) Highly responsive to latest changes in environment
- ☐ c) Consistent
- ☐ d) Objective
- ☐ e) Can process large amounts of information

Correct or Incorrect?

Clear

Check Answer

58. Which of the following is not a weakness of qualitative forecasting methods.

- ☐ a) Only as good as the data and model
- ☐ b) Costly and time consuming to model “soft” information
- ☐ c) Difficulty in understanding relationships
- ☐ d) Requires technical understanding
- ☐ e) Slow to react to changing environments

Correct or Incorrect?

Clear

Check Answer

59. _____ generate the forecast from an analysis of a “time series” of the data.

- ☐ a) The Delphi method
- ☐ b) Causal models
- ☐ c) Market research
- ☐ d) Time series models
- ☐ e) Executive opinion

Correct or Incorrect?

Clear

Check Answer

60. _____ assume that the variable being forecast is related to other variables in the environment.

- ☐ a) The Delphi method
- ☐ b) Causal models
- ☐ c) Market research
- ☐ d) Time series models
- ☐ e) Executive opinion

Correct or Incorrect?

Clear

Check Answer

61. Time series models are used more frequently in environments where large numbers of items must be forecast on a regular basis.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

AI and Analytics Box—Improving Weather Forecasting

■ NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)

The current technological capabilities have not just improved business forecasting. They have affected every type of forecast—or prediction—generated. A great example is weather forecasting. Climate change is resulting in stronger and more frequent weather extremes being predicted, such as more intense downpours and stronger hurricane winds. Improving weather prediction is critical to give communities more time to prepare for dangerous storms. These forecasts can save lives and minimize damage to property and infrastructure.

The key to better predicting the weather lies in the use of big data gathered by new radar technologies and satellites. Today, these new radar and satellite technologies combine with new computer models that run on more powerful supercomputers to allow forecasters to better “see” extreme weather. These technologies can process large amounts of data within minutes and create warnings of tornadoes, hurricanes, and other extreme weather events.

Weather forecasting models are based on physical laws governing atmospheric motion, chemical reactions, and other relationships. They need to be able to crunch millions of numbers that represent current weather and environmental conditions, such as temperature, pressure, and wind, to predict the future state of the atmosphere. To accomplish this NOAA has invested in what is termed as **brainware**. This is a combination of all these technologies that capture different types of data in huge amounts and make massive and quick computations. Today scientists know that many additional factors affect weather, including solar radiation, geological upheaval, plate tectonics, and even pollutants. These technologies can track and take all these factors into account.

With this new technology, NOAA predicts that forecasters will not have to wait for a radar image to detect an actual storm before issuing a warning with 14 or 18 minutes of lead time. Instead, they will be able to issue warnings well in advance. For example, highly accurate models can issue warnings for tornados, severe thunderstorms, and flashfloods 30–60 minutes in advance, giving the public time to take safety precautions. These forecasting models based on large data sets can provide warnings well ahead of time so that people can prepare and respond. Now, a tornado warning is typically issued for a portion of counties at a time and usually lasts no more than 45 minutes. If the thunderstorm which is causing the tornado is also producing torrential rains, this warning may also be combined with a flashflood warning.

Time Series Forecasting Models

The Mean

One of the simplest forecasting models is the mean, where the forecast is made by simply taking an average of all the data:

$$F_{t+1} = \frac{\sum D_t}{n}$$

$$F_{t+1} = \frac{[D_t + D_{t-1} + \dots + D_{t-n}]}{n}$$

where

F_{t+1} = forecast of demand for next period, $t + 1$

D_t = demand for the current period, t

n = number of data points

This method is only appropriate for a level data pattern. It is, however, a reasonable forecasting model to use for forecasting stable and mature products. One advantage of this method is that as more data is collected over time, and the average becomes based on a larger data set, the forecasts become more stable.

EXAMPLE 1 Forecasting with the Mean

Handy Power Tools is forecasting sales of its most popular drill. The company has been selling the drill for the past 15 years, and sales have been steady. The company uses a simple mean to forecast weekly sales. Sales over the past five weeks are available, and the company will use them to make a forecast for week six.

Week	Drill Sales	Forecast
1	8	
2	10	
3	9	
4	12	
5	10	
6	—	10

The forecast is simply an average of the past five weeks:

$$F_6 = \frac{[8 + 10 + 9 + 12 + 10]}{5} = \frac{49}{5}$$

$$F_6 = 9.8 \approx 10 \text{ drills}$$

Concept Check Questions

62. One of the simplest forecasting models.

- ☐ a) Exponential smoothing
- ☐ b) Trend adjusted exponential smoothing
- ☐ c) Mean
- ☐ d) Linear regression
- ☐ e) Moving averages

Correct or Incorrect?

Clear

Check Answer

63. This method is only appropriate for a level data pattern.

- ☐ a) Exponential smoothing
- ☐ b) Trend adjusted exponential smoothing
- ☐ c) Mean
- ☐ d) Linear regression
- ☐ e) Moving averages

Correct or Incorrect?

Clear

Check Answer

Moving Averages

The [simple moving average](#) is a method that generates a forecast by averaging a specified number, n , of the most recent data rather than the entire data set. As new data become available, the oldest are dropped, and the number of observations used to compute the average is kept constant. In this manner, the simple moving average “moves” through time. Like the mean, this model is only appropriate for level data patterns. However, it does have the advantage of being responsive by averaging only the most recent observations.

The formula is as follows:

$$F_{t+1} = \frac{\sum D_t}{n}$$

$$F_{t+1} = \frac{[D_t + D_{t-1} + \dots + D_{t-n+1}]}{n}$$

where

F_{t+1} = forecast of demand for next period, $t + 1$

D_t = demand for current period, t

n = number of data points in the moving average.

Notice that n is not the entire data set but only a subset of the data used in the average. For example, if $n = 3$ the average would include only the latest three data points. If $n = 5$ the average would include only the latest five data points, and so on. In general, the more data points that are used in the average, the more stable the forecast as more data is being averaged. On the contrary, the fewer the data points in the average, the more responsive the forecast.

EXAMPLE 2 Forecasting with the Simple Moving Average

La Petite Tableau forecasts sales of kitchen aprons using a three-period moving average. How many aprons should they expect to sell in April given the following sales figures for January, February, and March?

Month	Actual sales
January	38
February	27
March	42

To find the forecast for April, we take an average of the last three observations:

$$\begin{aligned} F_{t+1} &= \frac{\sum D_t}{n} \\ F_{\text{April}} &= \frac{[D_{\text{January}} + D_{\text{February}} + D_{\text{March}}]}{3} = \frac{[38 + 27 + 42]}{3} = 35.7 \approx 36 \text{ aprons} \end{aligned}$$

If La Petite Tableau sells 42 aprons in April, let us make a forecast for May continuing to use a three-period moving average.

$$F_{\text{May}} = \frac{[D_{\text{February}} + D_{\text{March}} + D_{\text{April}}]}{3} = \frac{[27 + 42 + 42]}{3} = 37.$$

Notice that in a simple moving average, all the data are weighed equally, that is $1/n$. Sometimes we may want to give more or less weight to certain data points, such as giving more weight to recent observations. This is called a [weighted moving average](#). The computation is the same except that managers have the option of specifying the weights assigned to the data point.

Concept Check Questions

64. This is a method that generates a forecast by averaging a specified number, n , of the most recent data rather than the entire data set.

- ☐ a) Exponential smoothing
- ☐ b) Trend adjusted exponential smoothing
- ☐ c) Mean
- ☐ d) Linear regression
- ☐ e) Moving averages

Correct or Incorrect?

Clear

Check Answer

65. As new data become available, the oldest are dropped, and the number of observations used to compute the average is kept constant.

- ☐ a) Exponential smoothing
- ☐ b) Trend adjusted exponential smoothing
- ☐ c) Mean
- ☐ d) Linear regression
- ☐ e) Moving averages

Correct or Incorrect?

Clear

Check Answer

66. Sometimes we may want to give more or less weight to certain data points, such as giving more weight to recent observations.

- ☐ a) Exponential smoothing
- ☐ b) Trend adjusted exponential smoothing
- ☐ c) Weighted moving average
- ☐ d) Linear regression
- ☐ e) Moving averages

Correct or Incorrect?

Clear

Check Answer

Exponential Smoothing

Exponential smoothing is a forecasting model that uses a special weighted average procedure to obtain a forecast. It is easy to use and understand and provides good forecast results. To make a forecast just three items are needed:

- Current period's forecast
- Current period's actual value
- Value of a smoothing coefficient, α , which varies between 0 and 1

The equation for the forecast is

$$F_{t+1} = \alpha D_t + (1 - \alpha)F_t$$

where

F_{t+1} = forecast of demand for next period, $t + 1$

D_t = actual value for current period, t

F_t = forecast for current period t

α = smoothing coefficient

EXAMPLE 3 Forecasting with Exponential Smoothing

Café Nervosa uses exponential smoothing to forecast the monthly usage of coffee cream. Its forecast for May was 24 gallons, but the actual usage turned out to be 28 gallons of coffee cream. The manager has chosen to use an α of 0.70. What is her forecast for June?

Using the exponential smoothing equation

$$\begin{aligned} F_{\text{June}} &= \alpha D_{\text{May}} + (1 - \alpha) F_{\text{May}} \\ &= (0.70)(28) + (0.30)24 \\ &= 26.8 \text{ gallons} \end{aligned}$$

The critical aspect of exponential smoothing is selecting the correct value for α . High values of α place more weight on the current period's actual demand, whereas low values place more weight on the current period's forecast. Values of α that are low, say, 0.1 or 0.2, generate forecasts that are stable as more weight is placed in historical data and less on the current period's actual demand. However, these forecasts are less responsive to recent changes in demand. Values of α that are high, say, 0.7 or 0.8, place a large weight on the current period's actual demand. As a result, they generate forecasts that are responsive to the latest changes in demand but can be less stable.

When using exponential smoothing for the first time, we may not have a forecast for the current period. The most common way to handle this is to use what is called “the naive method,” which uses the last period's actual value to generate an initial forecast. Another option is to average the last few periods—say the last three or four—just to get a starting point.

Concept Check Questions

67. This is a forecasting model that uses a special weighted average procedure to obtain a forecast.

- ☐ a) Exponential smoothing
- ☐ b) Trend adjusted exponential smoothing
- ☐ c) Weighted moving average
- ☐ d) Linear regression
- ☐ e) Moving averages

Correct or Incorrect?

Clear

Check Answer

68. How many items are needed for an exponential smoothing forecast?

- ☐ a) One
- ☐ b) Two
- ☐ c) Three
- ☐ d) Four
- ☐ e) It increases as you go further into the future

Correct or Incorrect?

Clear

Check Answer

69. Value of a smoothing coefficient, α , vary between ____.

- ☐ a) $-\infty$ and $+\infty$
- ☐ b) $-\infty$ and 0
- ☐ c) 0 and $+\infty$
- ☐ d) -1 to +1
- ☐ e) 0 to +1

Correct or Incorrect?

Clear

Check Answer

70. With exponential smoothing, high values of α place more weight on the earlier period's actual demand.

- ☐ True
☐ False

Correct or Incorrect?

Clear

Check Answer

Trend-adjusted Exponential Smoothing

The models discussed so far work only for a level pattern. If there is a trend in the data the models need to be modified, otherwise the forecasts will “lag” the trend. One of the more common ways to forecast trends is to use trend-adjusted exponential smoothing. It is a simple modification of the exponential smoothing model we just discussed. The model takes the basic exponential smoothing equation and just adds a trend component to compensate for the additional pattern:

$$FIT_{t+1} = F_{t+1} + T_{t+1}$$

FIT_{t+1} = forecast including trend for next period, $t + 1$

F_{t+1} = unadjusted forecast for the next period = $\alpha D_t + (1 - \alpha)F_t$

T_{t+1} = trend factor for next period = $\beta(F_{t+1} - F_t) + (1 - \beta)T_t$

T_t = trend factor for the current period, t

β = smoothing constant for the trend adjustment factor

Notice that F_t and F_{t+1} feed into the trend equation

To generate a forecast including trend, FIT_{t+1} , we need to follow these steps:

Step 1 Generate an unadjusted forecast F_{t+1}

Step 2 Generate trend T_{t+1} (notice that F_t feeds into the trend equation)

Step 3 Add F_{t+1} and T_{t+1}

EXAMPLE 4 Forecasting with Trend-adjusted Exponential Smoothing

Looking at the following data, assume that we are at the end of January and want to forecast one period using trend-adjusted exponential smoothing. We have decided to use an $\alpha = 0.3$ and a $\beta = 0.4$. Assume that we are rolling through time knowing the actual demand after we have made the forecast and using the information to forecast the subsequent period.

Month	Demand	Unadjusted forecast F_{t+1}	Trend T_{t+1}	Adjusted forecast FIT_{t+1}
January	20	18	0	
February	21	18.6	.24	18.84
March	24	19.32	.43	19.75
April	25	20.72	.82	21.54
May	26	22.00	1.00	23.00

How did we get the above numbers? Let us follow the steps to generate the forecast for February.

Step 1 Generate an unadjusted forecast F_{t+1}

$$\begin{aligned}F_{\text{February}} &= \alpha D_{\text{January}} + (1 - \alpha)F_{\text{January}} \\F_{\text{February}} &= F_{\text{January}} + \alpha (D_{\text{January}} - F_{\text{January}}) \\&= 18 + (0.3)(20 - 18) \\&= 18.6\end{aligned}$$

Step 2 Generate trend T_{t+1} (notice once again that F_t feeds into the trend equation)

$$\begin{aligned}T_{\text{February}} &= \beta(F_{\text{February}} - F_{\text{January}}) + (1 - \beta)T_{\text{January}} \\T_{\text{February}} &= 0.4(18.6 - 18) + 0.6(0) \\&= 0.24\end{aligned}$$

Step 3 Add F_{t+1} and T_{t+1}

$$\begin{aligned} FIT_{\text{February}} &= F_{\text{February}} + T_{\text{February}} \\ FIT_{\text{February}} &= 18.6 + 0.24 = 18.84 \end{aligned}$$

The other numbers in the table are obtained in the same manner. Notice the difference in the unadjusted vs adjusted forecast. How different do you think the adjusted values would be with a different value of β ?

Concept Check Questions

71. Exponential smoothing works well when there is a trend to the data.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

72. This model takes the basic exponential smoothing equation and just adds a trend component to compensate for the additional trend pattern.

- ☐ a) Exponential smoothing
- ☐ b) Trend adjusted exponential smoothing
- ☐ c) Weighted moving average
- ☐ d) Linear regression
- ☐ e) Moving averages

Correct or Incorrect?

Clear

Check Answer

Seasonality Adjustment

Seasonality is any regularly repeating pattern. Consider sales of ice cream in the summer or snow shovels in the winter, university enrollment in the fall, amusement park attendance in the summer, or sales of turkeys at Thanksgiving.

When seasonality is present, we need to adjust our forecast to reflect the amount by which the particular “season” is above or below the average. This is estimated as a percentage, such as saying that amusement park attendance is 140% of the average during June, whereas it is 70% of the average

in March. This percentage is called the [seasonal index](#). Adjusting for seasonality simply involves computing the seasonal index—or percentage—and using it to adjust the forecast.

Target is an example of a company that uses seasonal indexes to adjust its forecasts for Christmas trees. Target knows that Christmas tree sales peak in the weeks leading up to Christmas and decline sharply after Christmas. To account for this seasonality, Target calculates a seasonal index for each week of the year. The seasonal index for each week is the ratio of the average sales for that week to the average sales for the entire year.

For example, the seasonal index for the week of 18 December to 24 December might be 1.50. This means that Target expects sales for that week to be 50% higher than the average for the entire year. Target uses seasonal indexes to adjust its forecasts for Christmas tree sales. Then if Target forecasts that it will sell 100 Christmas trees in a typical week, it would adjust its forecast to 150 Christmas trees for the week of 18 December to 24 December. By adjusting its forecasts for seasonality, Target is able to ensure that it has enough Christmas trees in stock to meet demand and avoid overstocking. This is detailed in the following steps:

Step 1 Compute the average demand for each “season.” Total annual demand is divided by the number of “seasons” per year. For quarterly data, the number of “seasons” would be 4, whereas for monthly data it would be 12.

Step 2 Compute a seasonal index for each season. A seasonal index is obtained by dividing the **actual** demand for each season by the average demand for each year. An average seasonal index is then obtained by averaging across the number of years available.

Step 3 Adjust the average forecast for next year by the seasonal index. Generate a forecast for next year using any of the methods we discussed and calculate the average demand per season. Use seasonal indexes to generate seasonally adjusted forecasts.

EXAMPLE 5 Generating Seasonally Adjusted Forecasts

Coco's Ice Cream shop experiences high seasonality in customer sales. It sells ice cream throughout the year, with most sales occurring in the summer; it also sells hot chocolate, with most sales occurring in the winter. Coco's Ice Cream has generated a forecast for next year to be 98,000 customers. Use the data below to create a seasonally adjusted forecast per quarter.

SOLUTION:

Number of customers (in thousands)		
Quarter	Year 1	Year 2
Fall	14	15
Winter	25	26
Spring	20	20
Summer	33	35
Total	92	96

Step 1 Compute the average demand for each “season.”

$$\text{Year 1 : } \frac{92}{4} = 23$$

$$\text{Year 2 : } \frac{96}{4} = 24$$

Step 2 Compute a seasonal index for each season.

Quarter	Seasonal indexes		Average seasonal index
	Year 1	Year 2	
Fall	$\frac{14}{23} = 0.61$	$\frac{15}{24} = 0.63$	0.620
Winter	$\frac{25}{23} = 1.09$	$\frac{26}{24} = 1.08$	1.085
Spring	$\frac{20}{23} = 0.87$	$\frac{20}{24} = 0.83$	0.850
Summer	$\frac{33}{23} = 1.43$	$\frac{35}{24} = 1.445$	1.445

Step 3 Seasonally adjust the average forecast for next year.

The forecast for next year is 98,000, so the average demand is 24,500.

Number of customers			
Quarter	Seasonally	Adjusted	Forecast
Fall	24,500	(0.620)	= 15,190
Winter	24,500	(1.085)	= 26,583
Spring	24,500	(0.850)	= 20,825

Number of customers			
Quarter	Seasonally	Adjusted	Forecast
Summer	24,500	(1.445)	= 35,403

Concept Check Questions

73. Seasonality is any regularly repeating pattern.

- ☐ True
☐ False

Correct or Incorrect?

Clear

Check Answer

74. When seasonality is present we need to adjust our forecast to reflect the amount by which the particular “season” is above or below the average.

- ☐ True
☐ False

Correct or Incorrect?

Clear

Check Answer

Causal Models

Linear Regression

Linear regression is a forecasting model that assumes a linear, or straight line, relationship between two variables. It assumes that the variable being forecast, called the dependent variable, is linearly related to another variable, called the independent variable. For example, if we assume that a person's weight and height are linearly related, we can create a linear regression model of this relationship. We can then use the model to forecast weight based on a person's height. It is also possible to use time as the independent variable if we want to see how a variable changes over time. In this case, it could be used to forecast trends.

Linear regression is a method that fits a straight line through a set of data, as shown in [Figure 8.6](#). You can see that the dependent variable is linearly related to the independent variable. The relationship between two variables is the equation of a straight line as follows:

$$Y = a + bX$$

where

Y = dependent variable

X = independent variable

a = Y intercept of the straight line

b = slope of the straight line

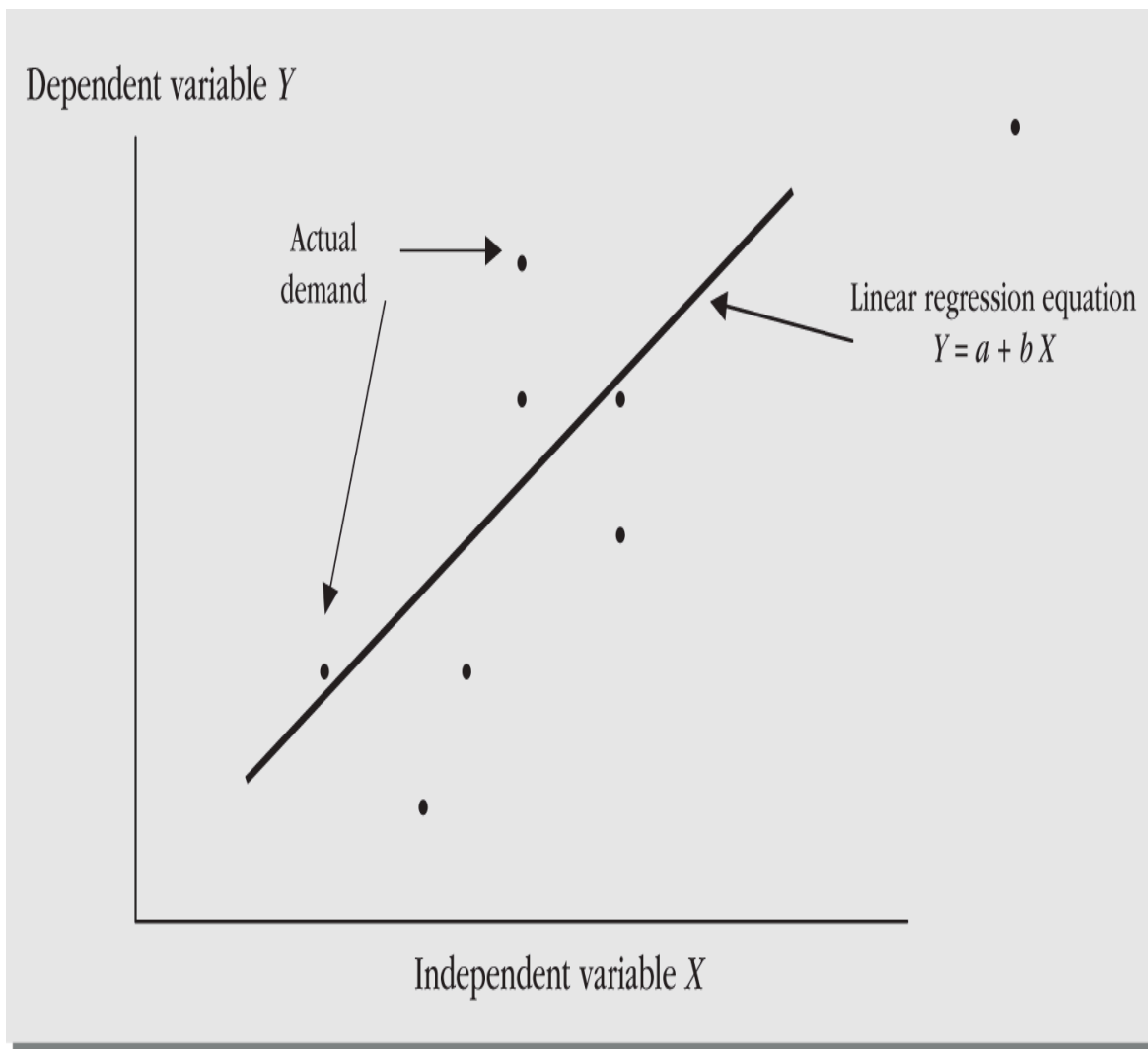


FIGURE 8.6 Linear regression line.

Using linear regression requires first developing the linear regression equation. Then for any value of the independent variable, we can compute the value of the dependent variable, which is the variable being forecast. The steps involved are as follows:

Step 1 **Compute parameter b**

$$b = \frac{\sum XY - n\bar{X}\bar{Y}}{\sum X^2 - n\bar{X}^2}$$

where

$\bar{Y}$ = average of the Y values

X = independent variable

n = number of data points

Step 2 Compute parameter a

$$a = \bar{Y} - b\bar{X}$$

Step 3 Substitute values for a and b in the equation

$$\hat{Y} = a + bX$$

Step 4 Generate a forecast for the dependent variable (Y)

Substitute the appropriate value for the independent variable (X).

EXAMPLE 6 Forecasting with Linear Regression

Pizza Boy is trying to forecast the volume of pizza sold based on the amount of money it has put into advertising in the local newspaper. It has been tracking the relationship between pizza sales and advertising over the past four months. The results are as follows:

Pizza Sales	Advertising Dollars
58	135
43	90
62	145
68	145

What would happen to pizza sales if Pizza Boy invested \$150 in advertising for next month?

In this example, pizza sales are the dependent variable (Y) and advertising dollars are the independent variable (X). Following the outlined steps we formulate the following table:

	Y	X	XY	X^2	Y^2
	58	135	7,830	18,225	3,364
	43	90	3,870	8,100	1,849
	62	145	8,990	21,025	3,844
	68	145	9,860	21,025	4,624
Total	231	515	30,550	68,375	13,681

From the aforementioned steps, we compute as $\bar{X} = \frac{515}{4} = 128.75$ and $\bar{Y} = \frac{231}{4} = 57.75$

Step 1 Compute parameter b

$$\begin{aligned}b &= \frac{\sum XY - n\bar{X}\bar{Y}}{\sum X^2 - n\bar{X}^2} \\b &= \frac{30,550 - 4(128.75)(57.75)}{68,375 - 4(128.75)^2} \\b &= 0.391\end{aligned}$$

Step 2 Compute parameter a

$$\begin{aligned}a &= \bar{Y} - b\bar{X} \\a &= 57.75 - (0.391) 128.75 = 7.41\end{aligned}$$

Step 3 Substitute values for a and b in the equation

$$Y = a + bX$$
$$Y = 7.41 + 0.391 X$$

Step 4 Generate a forecast for the dependent variable (Y).

Substitute the appropriate value for the independent variable (X).

$$Y = 7.41 + 0.391 (150) = 66 \text{ pizzas}$$

Concept Check Questions

75. This is a forecasting model that assumes a linear, or straight line, relationship between two variables.

- ☐ a) Exponential smoothing
- ☐ b) Trend adjusted exponential smoothing
- ☐ c) Weighted moving average
- ☐ d) Linear regression
- ☐ e) Moving averages

Correct or Incorrect?

Clear

Check Answer

76. Linear regression can be used to forecast trend.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

77. Linear regression uses how many variables?

- ☐ a) One
- ☐ b) Two
- ☐ c) Three
- ☐ d) Four
- ☐ e) It increases as you go further into the future

Correct or Incorrect?

Clear

Check Answer

Multiple Regression

Multiple regression extends linear regression by looking at a relationship between the independent variable and “multiple” dependent variables. The general formula for multiple regression is as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k$$

where

Y = dependent variable

β_0 = the Y intercept

$\beta_1 \dots \beta_k$ = coefficients that represent the influence of the independent variables on the dependent variable

$X_1 \dots X_k$ = independent variables

For example, the dependent variable might be university student enrollment per semester, and the independent variables might be unemployment rate and per capita income. Other variables that can be included are seasonality and trend, as well as special events such as promotions that can be included as separate variables. Multiple regression is a powerful tool for forecasting. The drawback, however, is that it has increased computational and data requirements.

Concept Check Questions

78. This extends linear regression by looking at a relationship between the independent variable and multiple dependent variables.

- ☐ a) Exponential smoothing
- ☐ b) Trend adjusted exponential smoothing
- ☐ c) Weighted moving average
- ☐ d) Multiple regression
- ☐ e) Moving averages

Correct or Incorrect?

Clear

Check Answer

79. Multiple regression uses how many variables?

- ☐ a) One
- ☐ b) Two
- ☐ c) Three
- ☐ d) Three or more

Correct or Incorrect?

Clear

Check Answer

Measuring Forecast Accuracy

Measuring forecast accuracy is a critical aspect of forecasting. This tells us how our forecasting methods are performing and enables us to improve performance over time. Data can change over time, and models that once provided good results may no longer be adequate. The model's accuracy can be assessed only if forecast performance is measured over time.

The first step in measuring forecast accuracy is to measure the forecast error. Forecast error is the difference between actual demand and the forecast for a given period:

$$e_t = D_t - F_t$$

where

e_t = forecast error for period t

D_t = actual demand for period t

F_t = forecast for period t

However, computing error for one time period does not provide enough information. We need to measure forecast accuracy over time. Two of the most commonly used error measures are the mean absolute deviation (MAD) and the mean square error (MSE). MAD is the average of the sum of the absolute errors:

$$\text{MAD} = \frac{\sum \text{Actual} - \text{Forecast}}{n}$$

MSE is the average of the squared error:

$$\text{MSE} = \frac{\sum (\text{Actual} - \text{Forecast})^2}{n}$$

Both of these measures are useful and provide the forecaster with different information. An advantage of MAD is that it is based on absolute values. As a result, errors of opposite signs do not cancel each other out when they are added, providing a total sum of the average error. When comparing different forecasting methods, we would select the method with the lowest MAD.

MSE has an additional advantage. Due to the squaring of the error term, large errors are magnified, giving them greater penalty. This can be a useful error measure in environments where large errors are particularly destructive. As with MAD, when comparing the forecast performance of different methods, we would select the method with the lowest MSE. Both error measures provide different information, and a good forecaster learns to rely on multiple measures.

EXAMPLE 7 Measuring Forecast Accuracy

Harry Thurber (HT) Apparel is comparing the accuracy of two methods that it has used to forecast monthly sales of its popular jeans. Forecasts of monthly sales from January through May for method A and method B are shown in the following against the actual sales. Which method provided better forecast accuracy?

		Method A				Method B			
Month	Sales	Forecast	Error	Error	Error ²	Forecast	Error	Error	Error ²
Jan	40	42	-2	2	4	44	-4	4	16
Feb	28	29	1	1	1	31	-3	3	9
Mar	41	39	2	2	4	38	3	3	9
Apr	41	38	3	3	9	42	-1	1	1
May	39	41	-2	2	4	40	-1	1	1
Total			2	10	22		-6	12	36

Accuracy for method A

$$\begin{aligned}\text{MAD} &= \frac{\sum \text{Actual} - \text{Forecast}}{n} \\ \text{MAD} &= \frac{\sum 10}{5} \\ \text{MAD} &= 2\end{aligned}$$

$$\begin{aligned}\text{MSE} &= \frac{\sum (\text{Actual} - \text{Forecast})^2}{n} \\ \text{MSE} &= \frac{22}{5} \\ \text{MSE} &= 4.4\end{aligned}$$

Accuracy for method B

$$\begin{aligned}\text{MAD} &= \frac{\sum \text{Actual} - \text{Forecast}}{n} \\ \text{MAD} &= \frac{12}{5} \\ \text{MAD} &= 2.4\end{aligned}$$

$$\begin{aligned}\text{MSE} &= \frac{\sum (\text{Actual} - \text{Forecast})^2}{n} \\ \text{MSE} &= \frac{36}{5} \\ \text{MSE} &= 7.2\end{aligned}$$

Of the two methods, method A produced both a lower MAD and a lower MSE, which means that it provided better forecast accuracy.

Concept Check Questions

80. Measuring forecast accuracy is a fairly minor aspect of forecasting.

- ☐ True
☐ False

Correct or Incorrect?

Clear

Check Answer

81. The first step in measuring forecast accuracy is to measure the forecast error.

- ☐ True
☐ False

Correct or Incorrect?

Clear

Check Answer

82. Which of the following is not a common measure of forecast error?

- ☐ a) MSE
- ☐ b) MAD
- ☐ c) Mean error

Correct or Incorrect?

Clear

Check Answer

83. The average of the sum of the absolute errors.

- ☐ a) MSE
- ☐ b) MAD
- ☐ c) Mean error

Correct or Incorrect?

Clear

Check Answer

Collaborative Forecasting and Demand Planning

Forecasting is most effective when it is done in collaboration with supply chain partners. In this section, we discuss two of the most common processes for collaborative forecasting and demand planning.

Concept Check Questions

84. This is a collaborative process of developing joint forecasts and plans with supply chain partners, rather than doing them independently.

- ☐ a) Collect forecasting
- ☐ b) Pooled forecasting
- ☐ c) Sales and operations planning
- ☐ d) Collaborative planning, forecasting, and replenishment

Correct or Incorrect?

Clear

Check Answer

85. The distinguishing feature of CPFR is that members of the supply chain collaborate on business plans, and jointly execute the processes of forecasting and replenishment.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

86. CPFR has very few benefits except for very large companies.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Collaborative Planning, Forecasting, and Replenishment (CPFR)

[Collaborative planning, forecasting, and replenishment \(CPFR\)](#) is a collaborative process of developing joint forecasts and plans with supply chain partners, rather than doing them independently. It is based on the premise that companies can be more successful if they work together to bring value to their customers, share risks of the marketplace, and improve their performance. CPFR was developed by the voluntary interindustry commerce standards (VICS) association, a nonprofit organization formed in 1986 to develop standards and guidelines for improving supply chain efficiency. CPFR is one such set of guidelines and provides a process to be followed in achieving coordination for both forecasting and inventory replenishment.

VICS membership includes major corporations such as Walmart and P&G. These companies have demonstrated the benefits that can be achieved with CPFR. The organization has a specific “CPFR committee,” which offers detailed guidelines on how supply chain members can collaborate to improve efficiency. The guidelines are based on standard technologies and are scalable, enabling ready implementation across different industries.

The distinguishing feature of CPFR is that members of the supply chain collaborate on business plans, and jointly execute the processes of forecasting and replenishment. Trading partners jointly set forecasts, plan production, replenish inventories, and evaluate their success in the marketplace.

The benefits of CPFR are impressive, and it has been implemented by many companies, including Walmart, Target, Black & Decker, and Ace Hardware. In 2001, an Advanced Market Research (AMR) Research study found that by implementing CPFR retailers and suppliers jointly achieved higher sales, decreased inventory, and improved stock levels while lowering their logistics costs. Similarly, years later Kurt Salmon Associates estimated the benefits from CPFR on the apparel industry as roughly being \$8.3 billion annually (www.vics.org).

VICS offers a five-step process for adoption of CPFR:

Step 1 Create joint objectives.

Step 2 Develop a business plan (e.g., forecasting needs, production schedules, key performance metrics, or “KPIs”).

Step 3 Create a joint forecast.

Step 4 Agree on replenishment strategies.

Step 5 Agree on a technology partner to bring CPFR to fruition.

Although these steps seem simple, they can often be difficult to implement as they require companies to trust each other and be flexible and willing to work together. It should also be pointed out that CPFR is not a one-time event. Rather, it is an ongoing process where the outlined steps are performed on a weekly or a monthly basis, and the agreement between parties is evaluated annually.

Sales and Operations Planning (S&OP)

In [Chapter 2](#) we discussed that sometimes organizational functions—such as marketing and operations—operate independent of one another, resulting in the overall poor performance. An organization can have several functional forecasts for the same products over the same time period, such as a financial forecast, an operations forecast, a marketing forecast, and a distribution forecast. As these functional forecasts are made independent of one another they typically do not agree. For example, marketing may forecast demand for products that neither manufacturing nor distribution can meet. For an organization to develop efficient and realistic plans for the future, it must generate forecasts that all functional areas agree on and can execute.

In the early 2000s, Ford Motor Company had independent functional forecasts for its marketing, sales, and production departments. The marketing department forecast that Ford would sell 1 million vehicles in 2003, the sales department forecast that Ford would sell 900,000 vehicles, and the production department forecast that Ford could only produce 800,000 vehicles. As a result of these independent forecasts, Ford overproduced vehicles in 2003. This led to a large inventory of unsold vehicles, which Ford had to sell at a discount, resulting in significant financial losses for the company. Ford learned from this experience and implemented a new forecasting process that involved all functional departments. The new process resulted in more accurate forecasts and improved alignment between the different departments. This helped Ford to avoid overproduction and improve its financial performance.

Supply Chain Leader's Box—Using Collaborative Technology

■ LI & FUNG

Li & Fung is an example of a company that relies on collaborative technology and real-time information flows to forecast future trends and engage in collaborative planning. Li & Fung is one of the world's biggest supply chain operators, serving as an orchestrator of a network of 15,000 suppliers across the globe. Their clients include large retailers, such as Walmart, Target, and Disney World. Serving as an intermediary between customers and suppliers, collaborative planning is critical for this company.

Li & Fung used to deal with clients mostly by phone and fax, with e-mail counting as high technology. However, the company has found the most important technology for collaborative planning to be videoconferencing. It allows buyers and manufacturers to jointly examine product details, such as the color of a material or the stitching on a garment. “Before, we were not able to send a 500 MB image—we would post a digital video disk (DVD). Now we can stream it to show vendors in our offices. With real-time images we can make changes quicker,” says Manuel Fernandez, Li & Fung's chief technology officer. This enables quick product changes in response to the market.

The information system has also enabled Li & Fung to look across its operations to identify trends. For example, a shortage of workers and new legislation in southern China raised labor costs, so production moved north. “We saw that before it actually happened,” says Mr. Fernandez. The company also got warning of the economic crisis from retailers’ orders before these trends became apparent.

Adapted from: <https://www.lifung.com>.

Sales and operations planning (S&OP) is an organizational process intended to match supply and demand through functional collaboration. S&OP requires teamwork among sales, distribution and logistics, operations, finance, and product development. This enables firms to provide better customer service, lower inventory, reduce customer lead times, and stabilize production schedules. The process is designed to coordinate activities between marketing and sales, with those of operations and sourcing, to ensure that supply meets demand requirements.

The S & OP process consists of a series of meetings to reach an agreement between various departments on the course of action to achieve the optimal balance between supply and demand. It consists of a five-step process that needs to be followed to arrive at a consensus forecast:

Step 1: Generate a quantitative sales forecast. This process is done using one or more of the forecasting techniques discussed in the previous section.

Step 2: Marketing adjusts the forecast. These adjustments include promotions of existing products, introduction of new products, or the elimination of products. This revised forecast is usually stated in terms of both units and dollars.

Step 3: Operations checks forecast against existing capability. This includes an evaluation of whether existing capacity is adequate to handle the forecasted volumes. Operations must analyze the availability of resources, such as inventory, production capacity, scheduling, and labor, to meet overall

demand and “spike” demand. This may signal the need for extra resources to support special promotions.

Step 4: Marketing, operations, and finance jointly review forecast and resource issues. This is a joint meeting of the key business functions to review the forecast and any capacity issue that might have emerged during step 3. During this phase attempts are made to solve capacity issues and balance supply and demand. Alternative scenarios are usually developed and considered, identifying potential lost sales and costs associated with each scenario. At this stage the forecast is converted to dollars to assess whether the scenarios meet the financial plan of the organization.

Step 5: Executives meet to finalize forecast and capacity decisions. At this meeting executives from each functional area meet to make final decisions regarding sales forecasts and capacity issues. Executives reach an agreement on the forecast and convert it into the operating plan for the organization.

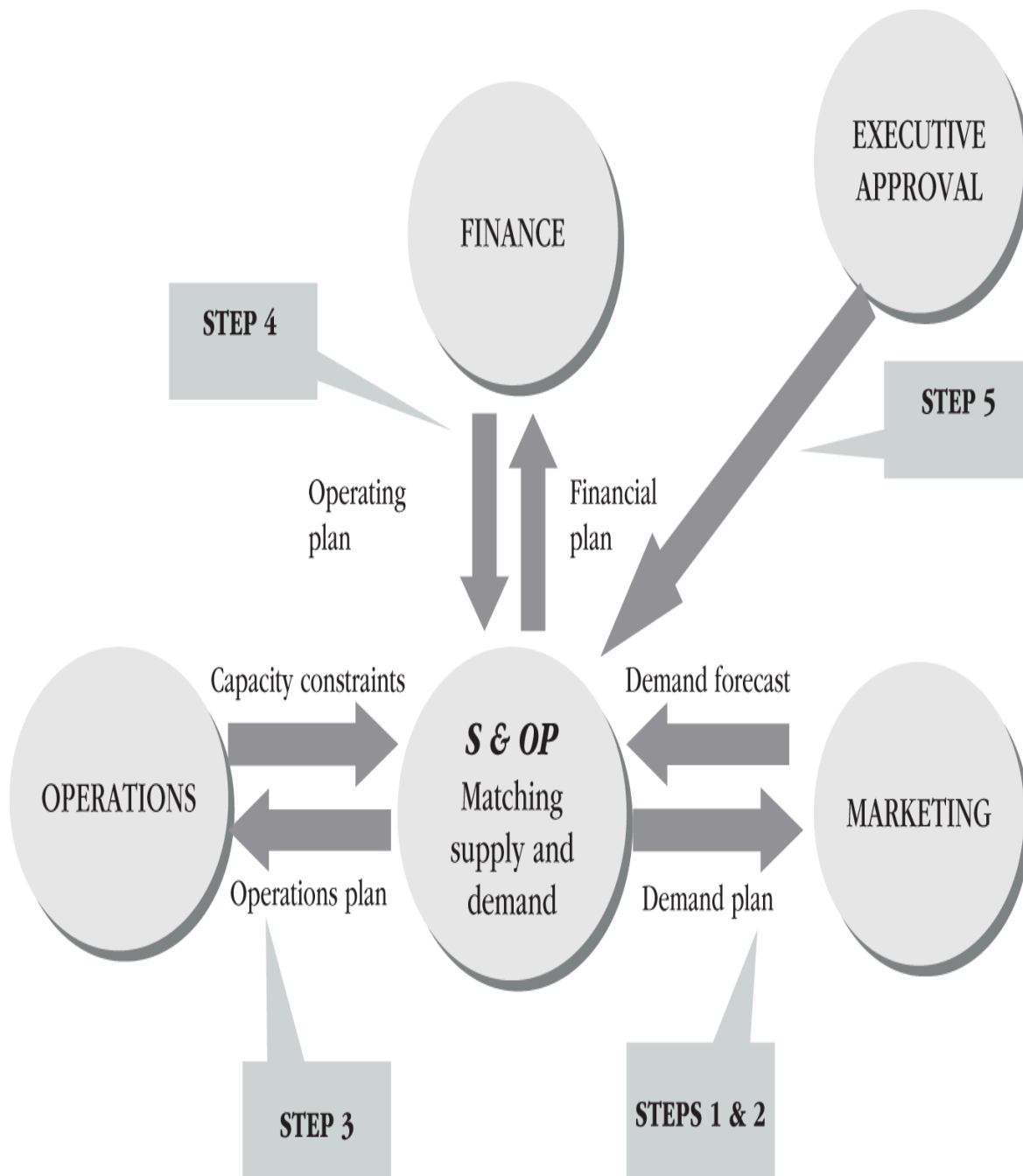


FIGURE 8.7 The S&OP process.

This process is illustrated in [Figure 8.7](#).

S&OP is an important process as it forces functional agreement and creates an understanding of revenue and cost trade-offs. It also forces the joint plan to measure functional performance in terms of metrics appropriate for each functional area, enabling it to support the overall business plan. For example, let us say that the performance of the operations function is measured on “cost per unit.” This metric encourages operations to keep costs low. A promotional campaign by marketing may mean higher per-unit costs for operations, as it needs to extend its resources. These metrics for operations discourage it from supporting marketing. A better solution is to revise the metric for operations to

something such as “compliance to schedule.” This new metric would reward operations for making the planned quantities at the planned times. This is an example of what could be achieved through S&OP. S&OP encourages functions to jointly work together to achieve goals of the business plan.



Concept Check Questions

87. This is an organizational process intended to match supply and demand through functional collaboration.

- ☐ a) Collect forecasting
- ☐ b) Pooled forecasting
- ☐ c) Sales and operations planning
- ☐ d) Collaborative planning, forecasting, and replenishment

Correct or Incorrect?

Clear

Check Answer

88. The S&OP process consists of a series of meetings with the goal of reaching an agreement between various departments on the course of action to achieve the optimal balance between supply and demand.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Empowering Entrepreneurs Box

Predicting the future is one of the most important functions for small companies. All decisions the founders make will be based on forecasts. Although they need forecasts for the medium and long term to predict their markets, they need good forecasts for the short term to manage their operations and inventories. Most small business owners do not have access to sophisticated algorithms large companies can afford. The good news is that they do not necessarily need them to get good forecast results. More sophisticated and more expensive is not necessarily better. Numerous studies over many decades repeatedly show that simpler forecasting models work better than more complex ones. The key is to have good data, understand what is being forecast, and select a simple model appropriate for that data set.

The principles of forecasting outlined in this book are especially important here. Small business owners should remember that forecasts are rarely perfect and this means that it is important to use a measure of expected error to get a sense of how much the forecasts may be “off.” This will allow a better estimate of how much extra inventory to carry. The collaborative forecasting methods discussed in this chapter may be especially useful to small business owners. Relationship building is an important aspect of entrepreneurship and communicating with suppliers or customers to jointly generate forecasts can be a very useful strategy.

CHAPTER HIGHLIGHTS

Forecasting is the process of attempting to predict future events. Planning is the process of selecting actions with the hope that they will result in the attainment of goals and objectives given the forecast.

There are three principles of forecasting: (a) forecasts are rarely perfect; (b) forecasts are more accurate for aggregated items than for individual items; and (c) forecasts are more accurate for shorter than longer time horizons.

Data are composed of patterns and randomness. Four of the most common patterns are level, trend, seasonality, and cycle.

Forecasting methods can be divided into qualitative and quantitative. Qualitative methods are subjective and based on opinions. Quantitative methods are mathematically based, objective, and consistent.

Quantitative forecasting methods can be divided into two categories: time series and causal models.

Time series models generate the forecast by identifying and analyzing patterns in a “time series” of the data. Causal models assume that the variable being forecast is related to other variables in the environment and develop a model identifying these relationships, expressing them in mathematical terms, and using that information to forecast the future.

CPFR is a collaborative process of developing joint forecasts and plans with supply chain partners, rather than doing them independently.

S&OP is an organizational process intended to match supply and demand through functional collaboration between marketing, operations, and finance, to ensure that supply can meet demand requirements.

KEY TERMS

[Forecasting](#)

[Planning](#)

[Demand management](#)

[Qualitative forecasting methods](#)

[Quantitative forecasting methods](#)

[Executive opinion](#)

[Market research](#)

[Delphi method](#)

[Time series models](#)

[Causal models](#)

[Simple moving average](#)

[Weighted moving average](#)

[Seasonal index](#)

[Linear regression](#)

Multiple regression

Collaborative planning, forecasting, and replenishment (CPFR)

Sales and operations planning (S&OP)

DISCUSSION QUESTIONS

Identify a nontraditional business event, such as forecasting demand for T-shirts following the Super Bowl, or the amount of relief aid needed following an earthquake. What do you think would be the best way to forecast such an event—qualitative or quantitative—and why? What are the implications of forecast error on supply chain management?

Think of a product you have recently purchased. How many different forecasts do you think the retailer had to make to decide how much product to stock? What are the consequences for that particular retailer if they had overforecast vs underforecast?

Imagine that you are starting a business. What type of forecasting model would you use to decide how many products you will be selling? Would you use the same forecasting model after you have been in business for five years? Why or why not?

Identify an example where large errors would be extremely costly. Which forecast error metric would be best for this environment?

Identify the differences between the two methods of collaboration discussed in the chapter: CPFR and S&OP. How are they similar, and how are they different? Explain the differences in the organizational objectives they are trying to achieve.

PROBLEMS

Beyond Tea, Inc. wants to forecast sales of its menthol green tea. The company is considering either using a simple mean or a three-period moving average to forecast monthly sales. Given here is the sales data for the past 10 months use both forecasting methods to forecast periods 7–10 and then evaluate each. Which method should they use? Use the selected method to make a forecast for month 11.

Month	Sales (lbs)
1	5
2	8
3	15
4	18
5	20
6	19
7	17
8	18
9	19
10	21

Safe Spirit sells novelty hats in New York City. The company uses a simple mean to forecast monthly sales. The forecast of sales for month six was \$5,000 obtained by averaging the past 5 months' sales.

Sales from months one to four were \$6,000, \$7,000, \$4,000, and \$5,000. However, the sales assistant accidentally deleted the sale data for month five in the system. Now, the sales manager wants to determine sales for month five from the remaining data. How would she do that?

Mr. Zhou repairs computers. He had 45 customers for January, 50 customers for February, and 70 for March. He now wants to forecast his customers for April by using a two-period simple moving average. Compute the forecast.

Smile Cucumber Corp records its sales in a database system. The company wants to forecast monthly sales based on the records of the past three months. The value of the forecast is 10 million if the company uses the simple mean. What is the forecast if the company uses a three-period moving average? Explain.

Green Water Park uses exponential smoothing to forecast monthly visits of customers. Its forecast for June was 1 million, but the actual number of customers turned out to be 2 million. The forecaster decided to use an α of 0.8. What is the forecast for July?

Katherine is a forecast manager. She used exponential smoothing to forecast her sales of coffee cakes for next week, and this number is 200. Her forecast for this week was 180 but the actual number is 220. What is her choice for α ?

The past two years sales at ACSR Inc. were 2 million and 4 million. Their forecast team used a two-period moving average to forecast its sales this year. However, the actual sales for this year were 4 million. Now, the forecast team wants to forecast its sales for next year by using exponential smoothing with α equals 0.7. What is the forecast?

Gold Roof Hut is trying to forecast its number of customers based on the average price of food. It has been tracking the relationship between several customers and food's average price over the past five weeks. The results are as follows:

Number of customers (K)	Average price (dollars)
1	16
1.2	15
1.4	14
1.8	12
1.8	11

What would be the number of customers if Gold Roof Hut set the average price to 10?

Alexandra is forecasting sales based on the salesperson's salary. She collected the following data and would like to forecast sales if the salary is 6K:

Sales (10 K)	Salary (K)
1	2
1.5	3
2	3.5
3	4
3.2	5

Mixo, Inc. is forecasting its product's quality on a scale of 0–100-based on how many hours are spent on each product. Data are listed in the following table:

Quality	Hours spent
50	10

Quality	Hours spent
60	15
70	20
80	24
90	30

How many hours should be spent if the company wants its product quality to be 95?

John Taylor Salons wants to forecast monthly customer demand from June through August using trend-adjusted exponential smoothing. Given that $\alpha = 0.2$, $\beta = 0.4$, $F_{\text{May}} = 45$, and a $T_{\text{May}} = 0$, forecast a *FIT* for the months of June through August.

Month	Actual sales
May	50
June	61
July	73
August	80

Henry Lo Manufacturing is comparing the accuracy of two methods that it has used to forecast monthly production. Forecasts of monthly productions from May through August are shown below against the actual productions. Which method provided better forecast accuracy?

Month	Actual sales	Method A forecast	Method B forecast
May	50	48	47
June	60	55	56
July	60	62	57
August	40	41	35

Samuel Bridge Company wants to compare the accuracy of two methods that it has used to forecast yearly profits. Forecasts of yearly profits from 2013 through 2017 are shown below against the actual productions. Comment on their forecast accuracy

Year	Actual profits (million)	Method A forecasts (million)	Method B forecast (million)
2013	10	12	11
2014	12	15	14
2015	6	16	18
2016	5	7	5
2017	8	10	7

Jay Sharp Guard wants to compare the accuracy of two methods that it has used to forecast monthly expenses. Forecasts of monthly expenses from September to November are shown below against the actual expenses. Which method provided best forecast accuracy?

Month	Expenses (million)	Method A forecasts (million)	Method B forecasts (million)
September	3	3.5	3.1
October	4	4.1	3.8
November	5	5.3	5.1

Case Study Speedy Automotive

It is August 2020, and Speedy Automotive is one of four car dealerships located in rural Wyoming. The residents in the area replace their vehicles roughly every eight years. When they replace their vehicles, they tend to visit the same dealership that sold them the first one, building a relationship with the dealership. This has kept sales relatively stable for all the dealerships in the area. Recently, however, customers have begun expanding their shopping options. Speedy Automotive believes this is due to the Internet and online shopping. Customers have started coming to the dealership with an exact idea of what car they would like and have a price in mind. When Speedy Automotive does not have the model available or cannot meet the price, customers have started going to competitors.

This trend has the general manager of Speedy Automotive, Mike Leavy, worried. Mike runs the dealership like a small business and relies on repeat customers. Speedy Automotive is not a chain and has little access to outside capital, so cash flow is critical. If sales are low, Mike has to take out a loan to pay the manufacturer for the vehicles. If sales are high, Speedy Automotive loses potential customers due to lack of inventory. Mike has decided that he needs to be able to forecast this new variability to keep the business healthy.

Bill Goodson is the inventory manager at Speedy Automotive and has historically prepared the forecasts. Bill usually just takes the sales numbers from last year and adjusts them upward or downward based on his “gut feeling.” This has worked well in the past, but Mike has told him to look into other forecasting methods. Bill is preparing the September 2020 sales forecast for Speedy Automotive and is not sure where to start. For the August forecast, Bill used the sales numbers from the same time of the previous year—August 2019. The August 2019 forecast was off by 10 cars and Bill hoped the 2020 version would fare better. Bill assumed the sales representatives would always work a little harder if sales were low and they could always take vacation time if they were above target.

Mike has told Bill to look into both time series and causal forecasting models, but Bill is not sure of the difference. Mike also wants Bill to determine the amount of profit being lost due to poor forecasting. Bill has access to sales and forecast data from the past 18 months and has already calculated various measures of error in Excel.

Speedy Automotive Sales Forecast History

Month	Sales	Forecast	Error	Mean error	Mean absolute error	Sum of squared error	Absolute percentage error	Mean squared error
March 2019	100.00	103.00	3	3.00	3.00	9	3.00	9.00
April 2019	119.00	120.00	1	2.00	2.00	10	0.84	5.00
May 2019	478.00	441.00	-37	-11.00	13.67	1379	7.74	459.67
June 2019	98.00	118.00	20	-3.25	15.25	1779	20.41	444.75
July 2019	110.00	104.00	-6	-3.80	13.40	1815	5.45	363.00
August 2019	93.00	103.00	10	-1.50	12.83	1915	10.75	319.17
September 2019	104.00	105.00	1	-1.14	11.14	1916	0.96	273.71

Speedy Automotive Sales Forecast History

Month	Sales	Forecast	Error	Mean error	Mean absolute error	Sum of squared error	Absolute percentage error	Mean squared error
October 2019	96.00	101.00	5	-0.38	10.38	1941	5.21	242.63
November 2019	96.00	98.00	2	-0.11	9.44	1945	2.08	216.11
December 2019	103.00	109.00	6	0.50	9.10	1981	5.83	198.10
January 2020	94.00	99.00	5	0.91	8.73	2006	5.32	182.36
February 2020	102.00	105.00	3	1.08	8.25	2015	2.94	167.92
March 2020	98.00	101.00	3	1.23	7.85	2024	3.06	155.69
April 2020	120.00	119.00	-1	1.07	7.36	2025	0.83	144.64
May 2020	469.00	453.00	-16	-0.07	7.93	2281	3.41	152.07
June 2020	99.00	115.00	16	0.94	8.44	2537	16.16	158.56
July 2020	99.00	106.00	7	1.29	8.35	2586	7.07	152.12

Case Questions

- Speedy Automotive currently using a time series or causal forecasting? Explain the difference and how you can identify each.
- Is this type of forecast appropriate, or would an alternative method produce a more accurate result? Why or why not?
- Which measure should Bill use to assess forecast error rates? Why?
- If Bill's forecasts are consistently too high or consistently too low, which measure is most useful to remedy the situation? Why?
- If the average sale price for one car is \$20,000 and the average car costs \$15,000 to acquire, how much profit is being lost each month as a result of poor forecasting? *Note:* For ease of calculation, assume all cars arrive on the 1st and all cars remaining on the 31st are disposed of with a 50% markdown.
- What can Bill do to improve his forecasting based on your observations?

Case Study Making Decisions with Data Analytics: TechGiant

As a new business graduate, you were excited to start a job at TechGiant's Cupertino, CA, United States office on a team that is working on finalizing a forecast for the company's flagship smart watches, myWatch 3 and myWatch Pro. myWatch 3 is an incremental improvement over an earlier version called myWatch 2, but the company has projected myWatch Pro as a torch bearer for the next decade. myWatch 3 is slated to start at \$400 while myWatch Pro is expected to start at \$550 (an untested price point for a TechGiant watch).

Both watches are going to be unveiled in September of this year. Preorders of myWatch 3 will begin in October and preorders of myWatch Pro will start in November. TechGiant is known for its lean supply chain. Smart watches constitute 30% of revenues and the new watches, myWatch 3 and myWatch Pro, are the most expensive watches in the company's history so far. Therefore, forecasts that are far off the mark can significantly affect TechGiant's bottom line.

It is July, and your team is expected to share forecasts with the outsourced producer by the end of this month. Although TechGiant has ensured that the outsourced producer will have the flexibility to cater to volatile demand as much as possible, if the forecast is significantly off, the outsourced producer would not be able to help TechGiant.

Case Questions

1. How will you develop this forecasting process?
2. Which methods will you use? What variables should be considered?
3. Are there conditions under which the analytics models should be adjusted by your judgment?

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Note

[1](#) Interview with John Sicard, CEO of Kinaxis, January 2023.

9

Inventory Management

LEARNING OBJECTIVES

After completing this chapter, you should be able to:

Describe different types of inventories, their uses, and their costs.

Explain inventory systems and ordering policies.

Understand how to compute order quantities, reorder points (ROPs), and safety stock.

Differentiate between independent and dependent demand.

Understand practical issues of managing supply chain inventories.

Explain ABC inventory classification and vendor-managed inventory (VMI).

CHAPTER OUTLINE

Basics of Inventory Management

What Is Inventory?

Reasons for Carrying Inventory

Types of Inventories

Inventory Costs

Inventory Systems

Fixed-order Quantity System

Fixed-time Period System

Comparing Fixed-order Quantity vs Fixed-time Period Systems

Fixed-Order Quantity Systems

Economic Order Quantity (EOQ).

Reorder Point (ROP).

Safety Stock

Economic Production Quantity (EPQ).

Fixed-time Period Systems

Computing Target Inventory

Independent vs Dependent Demand

Managing Supply Chain Inventory

ABC Inventory Classification

Practical Considerations of EOQ

Measuring Inventory Performance

Vendor-managed Inventory (VMI).

Chapter Highlights

Key Terms

Discussion Questions

Problems

Case Study: Making Decisions with Data Analytics: ColorWorld

Bibliography



[Bloomberg Quicktake Video: Qualcomm CEO Sees No Chip Inventory Issue](#)

[Bloomberg Quicktake Video: Two Chinese AI Chipmakers](#)

On an early July morning, a crowd gathered for the opening of Trader Joe's newest store location, in Manhattan's Chelsea neighborhood. As shoppers stand in line for the store's opening, they chat about their favorite Trader Joe's foods and discuss the benefits the store opening will bring to the area. Why the excitement? Trader Joe's is no ordinary grocery chain. It is offbeat and hip, having elevated food shopping to a cultural experience.

Trader Joe's has developed an almost cult following and is one of the hottest retailers in the United States. As of 2023, Trader Joe's had 564 stores in 42 states plus the District of Columbia. They see themselves as a national chain of neighborhood grocery stores, stocking shelves with a winning combination of low-cost, yuppie-friendly goods. This includes staples such as cage-free eggs and organic blue agave sweetener. They also carry the exotic, such as Belgian butter waffle cookies and Thai lime-and-chili cashews—items difficult to find anywhere else.

What is most remarkable about Trader Joe's is that they have found a unique way of addressing the problem that has traditionally plagued grocery stores: carrying large numbers of highly perishable food items in large varieties. A typical grocery store carries about 50,000 stock-keeping units (SKUs), while Trader Joe's carries about 4,000 SKUs. As a result, its stores sell an estimated \$2,030 in merchandise per square foot, compared to Whole Foods' \$1,200 per square foot. The company does not carry much inventory and has little backroom space for storage. However, the inventory that it does carry is carefully selected.

Trader Joe's pursues a limited-selection, high-turnover inventory model. One example is peanut butter. Trader Joe's sells 10 varieties, compared to most supermarkets that sell about 40 varieties. This has huge implications for inventory turnover. Imagine that both a typical supermarket and a Trader Joe's store sell 40 jars of peanut butter a week. Trader Joe's would sell an average of four of each type, while the supermarket might sell only one. With the greater turnover on a smaller number of items, Trader Joe's can buy large quantities with deep discounts. It also has lower losses due to shelf life. This makes operations—from stocking shelves to checking out customers—much simpler.

Customers accept Trade Joe's limited variety trusting that the company will stock only the best. For example, there are only two kinds of pudding or one kind of polenta. As one former employee puts it, "If they're going to get behind only one jar of Greek olives, then they are sure as heck going to make sure it is the most fabulous jar of Greek olives they can find for the price."

Management has sought to minimize the number of hands that touch a product throughout the supply chain. Whenever possible, Trader Joe's buys directly from the manufacturer, which then ships the items straight to Trader Joe's distribution centers. For example, a U.S.-made cheese is sent to distribution centers nationwide, where it is cut and wrapped. At a traditional supermarket, that same cheese would typically go through a distributor first, adding another inventory cost to the supply chain. Trucks leave the distribution centers daily for the stores, which keep low inventory levels. Trader Joe's small stores do not have much of a back room, so ordering from the distribution centers has to be precise. All this has kept costs low, enabling Trader Joe's to be in an enviable financial position: having no debt and self-funding their growth. Despite its low-tech, small-town vibe, Trader Joe's makes big money.

Concept Check Questions

1. Trader Joe's has developed an almost cult following and is one of the hottest retailers in the United States.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

2. Trader Joe's carries a large quantity of inventory.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

3. A typical grocery store carries about 250,000 stock-keeping units (SKUs).

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

4. Trader Joe's pursues a limited-selection, high-turnover inventory model.

- ☐ True
- ☐ False

Correct or Incorrect?

[Clear](#)[Check Answer](#)

Basics of Inventory Management

What Is Inventory?

Simply put, inventory is quantities of goods in stock. This is true for any product, material, or good. Consider the books or CDs on your bookshelf. They comprise your inventory. They provide you with a certain value, such as enjoyment or the ability to share them with friends. They also have a certain financial cost. They cost money to purchase—money that cannot be used for something else. For Trader Joe's, inventory comprises all the items on their store shelves, in their distribution center, and even in transit. When we talk about inventory, we are simply talking about quantities of materials or “stuff” we have in storage. As we will see, this material serves many purposes, but it also ties up a great deal of funds. As a result, managing inventory throughout the entire supply chain is extremely important. The benefits, however, can be significant as demonstrated by Trader Joe's financial success.

Both manufacturing and service organizations carry inventory. A great deal of inventory must be carried to support basic processes of product creation. In manufacturing inventory can take a variety of forms, such as [raw materials](#) and [component parts](#), which are delivered from suppliers. Once these items enter the production process they become [work-in-process \(WIP\)](#) “inventory.” Finally, when the production process is completed, inventory becomes classified as [finished goods](#). Inventory also includes supplies and equipment.

As inventory moves through the supply chain it takes on different classifications. Consider the packaging supplier for Tide laundry detergent for Procter & Gamble (P&G). The supplier takes plastic material and creates the packaging. Their finished product then becomes a part of the production of Tide at the P&G facility.

In services, inventory includes the tangible goods that support delivery of the service, such as medical tools in an operating room or soaps in a hotel chain. It also includes items that are sold as part of the service, such as hair products sold at a beauty salon. In addition, service personnel can be considered part of the inventory, as their skills define the type of services that can be offered. An example might be physicians on staff and their specialties—such as internal medicine or neurology, or attorneys on staff—such as specialty in tort law vs family law.

Services produce an intangible product, and finished services cannot be placed in inventory. However, this does not mean that some steps in the delivery process cannot be performed before the customer arrives. This stored work is also part of [service inventory](#). Service inventory involves all activities that are carried out in advance of the customer's arrival. One strategy service organizations can use to improve their responsiveness is to create a service inventory of tasks they can do before customers arrive. As with physical inventories, service inventories allow firms to create a buffer against variability of demand, while providing customers with faster response times. Managing service inventory improves service response time and quality and reduces costs.

McDonald's is a leading example of a company that uses service inventory to improve its responsiveness and provide customers with faster service times. McDonald's has several service inventory practices in place. One is precooking food. McDonald's precooks many of its food items, such as hamburgers and chicken nuggets. This allows McDonald's to serve customers

quickly, even when demand is high. Another is premade sandwiches and salads. McDonald's also prepares sandwiches and salads in advance. These are essentially inventory items that allow customers to order and receive their food quickly, without having to wait for it to be prepared. Yet another practice are self-service kiosks that allow customers to place their own orders. This helps to reduce the wait time for customers and improve the efficiency of McDonald's operations.

Inventory decisions relate to when to replenish stock and how large orders should be. This is called an **inventory policy** and addresses the basic questions of “when” and “how much” to order. Later in this chapter, we will look at different types of inventory policies that help address these two questions. Let us first look at some reasons for carrying inventory.

Managerial Insights Box—Service Inventory

■ ZOOTS

A good example of how service inventories can be created is provided by Zoot, a dry cleaner that has transformed the task of dry cleaning into a highly efficient, streamlined workflow that results in a higher level of customer service. Consider that at many dry cleaners laundered shirts are stored separately from dry-cleaned items, and a customer must wait for both to be picked up from the back room. The retailer could save time if the work was performed before the customer arrived. Even more time would be saved if the customer's items were waiting at the front of the store. Zoot does this.

Zoot charges orders to the customer's credit card on file and then places the completed orders in lockers that are available 24 hours a day. Customers can simply arrive at the store at their convenience to pick up their clothes. They spend no time standing in line and waiting. Zoot has reduced the pickup time to a minimum by building up its service inventory.

The customers, however, are not the only ones to benefit. Zoot's employees can work at a more constant rate as opposed to responding to minute-by-minute fluctuations in demand. This enables Zoot to plan employee schedules more efficiently, improving productivity for the company and lowering production costs.

Concept Check Questions

5. A type of inventory that is delivered from suppliers.

- ☐ a) Work-in-process
- ☐ b) Raw materials
- ☐ c) Finished goods
- ☐ d) Service inventory

Correct or Incorrect?

Clear

Check Answer

6. A type of inventory that is delivered from suppliers.

- ☐ a) Work-in-process
- ☐ b) Component parts
- ☐ c) Finished goods
- ☐ d) Service inventory

Correct or Incorrect?

Clear

Check Answer

7. Once inventory enters the production process, it becomes this.

- ☐ a) Work-in-process
- ☐ b) Component parts
- ☐ c) Finished goods
- ☐ d) Service inventory

Correct or Incorrect?

Clear

Check Answer

8. When the production process is completed, inventory becomes classified as this.

- ☐ a) Work-in-process
- ☐ b) Component parts
- ☐ c) Finished goods
- ☐ d) Service inventory

Correct or Incorrect?

Clear

Check Answer

9. _____ is when a service company, like McDonald's, performs part of the delivery process before the customer arrives. For example, McDonald's precooking the patties.

- ☐ a) Work-in-process
- ☐ b) Component parts
- ☐ c) Finished goods
- ☐ d) Service-in-process
- ☐ e) Service inventory

Correct or Incorrect?

Clear

Check Answer

10. Services produce an intangible product, and finished services cannot be placed in inventory.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

11. Inventory decisions relate to when to replenish stock and how large orders should be. This is called an inventory strategy.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Reasons for Carrying Inventory

We have all heard about problems of high inventory costs and the benefits of lean systems that minimize inventory levels. However, inventory is carried for many reasons, and all companies—even those that practice lean—carry inventory. Organizations cannot function without a certain amount of inventory. There are different types of inventories that meet different organizational objectives.

Protect Against Lead Time Demand. One reason for carrying inventory is that goods cannot arrive immediately when we run out of stock. There is a certain amount of lead time that is needed for goods to be produced and delivered. There is also a normal amount of variation in this lead

time. This may result from shipping delays, production problems at the supplier site, lost orders, defective materials, and numerous other problems. Even in lean systems, discussed in [Chapter 10](#), where inventory is delivered in predicted intervals, there is still a certain amount of inventory that must be held in stock.

Also, consider that sources of supply are rarely at the same location as demand, and we cannot locate a production facility everywhere there is demand. As a result, inventory has to be transported from one location to another, and sometimes held in a distribution center to be distributed when needed at the various locations.

Amazon, for example, strategically maintains a substantial inventory across its fulfillment centers to minimize the impact of lead time variations. For instance, during peak shopping seasons, such as Black Friday or the holiday season, the demand for products surges. Amazon prestocks popular items in anticipation of increased demand, protecting against potential delays caused by shipping congestion or unexpected variations in lead time. This strategic approach ensures that products can be promptly shipped to customers even during periods of heightened demand.

According to industry reports, Amazon's proactive inventory management practices have contributed to a consistent delivery performance, with a reported 99% on-time delivery rate. By effectively managing lead time demand and maintaining an optimized inventory level, Amazon not only meets customer expectations but also mitigates the risks associated with potential disruptions in the supply chain.

Maintain Independence of Operations. Recall our discussion in [Chapter 3](#) regarding how processes function and the challenge of balancing different processing capabilities. Inventory at different points in the system serves this purpose by evening out differences in processing capability and providing a cushion between operations. Extra stores of inventory can be placed at various points in the supply chain network, or at work centers within a facility, to give it flexibility.

Consider the high interdependence of workstations on an assembly line, as discussed in [Chapter 5](#). Inventory is typically placed between workstations to decrease their interdependence so that a work stoppage at one station does not shut down the entire assembly line. In addition, there is natural variation in processing times between identical operations, and it is desirable to create a cushion of inventory so that output can occur at a constant rate.

Balance Supply and Demand. Demand is never known with certainty, and holding extra inventory enables an organization to meet unexpected surges in demand. Also, consider that demand occurs intermittently, rather than continuously. An example might be retail sales that are slower on weekday mornings but high over the weekends. Not having extra inventory may mean missed sales. Carrying inventory helps to address these natural variations in demand.

Another important factor is seasonal demand patterns. This may result in high and low periods of demand, such as ice cream sales in the summer or demand for snow shovels in the winter. It would be very costly for production facilities to produce products in unison with the seasonality of demand. This might mean closed facilities and unemployed workers during low seasons and overtime production during high seasons. Switching production rates to large facilities can be extremely costly. A more common strategy is for companies, and their supply chains, to produce at a more uniform rate during the year. In this case, extra products are stored in inventory and used during peak seasons. This is shown in [Figure 9.1](#), where A represents inventory stored to be used up during segment B.

Coca-Cola exemplifies effective inventory management in response to seasonal demand patterns. Instead of adjusting production rates drastically, the company maintains a consistent rate throughout the year, building up surplus inventory during low-demand periods. This strategy enables Coca-Cola to meet customer demands seamlessly during peak seasons without incurring the costs of facility closures or overtime production. Reports indicate that Coca-Cola's approach has resulted in a 15% reduction in production-related costs and a 10% improvement in supply chain efficiency. By strategically leveraging inventory, Coca-Cola not only navigates seasonal fluctuations successfully but also enhances cost-effectiveness and overall operational resilience.

Buffer Uncertainty. Companies know that many unexpected events may occur that impact both supply and demand. This could be a batch of damaged goods being received, an unexpected delay due to weather, or a strike at a supplier's plant. Companies carry extra inventory in stock to protect themselves or “buffer” against these uncertainties. Think about yourself going to the movies with friends. The movie ticket might cost \$8.00 but you will likely carry with you a bit more money. Why? Just in case something comes up. That is the same logic.

Economic Purchase Orders. Buying larger quantities means incurring a higher inventory holding cost. However, there are several reasons why this may be advantageous. For example, suppliers sometimes offer price discounts to encourage customers to purchase larger quantities at one time. Similarly, buying in large quantities may result in savings associated with transporting larger quantities at one time. Also, anticipating some type of price increase or disruption, which may lead to quantity shortages, leads companies to buy larger quantities. An example might be a drought in Africa, leading to an anticipated price increase in coffee.

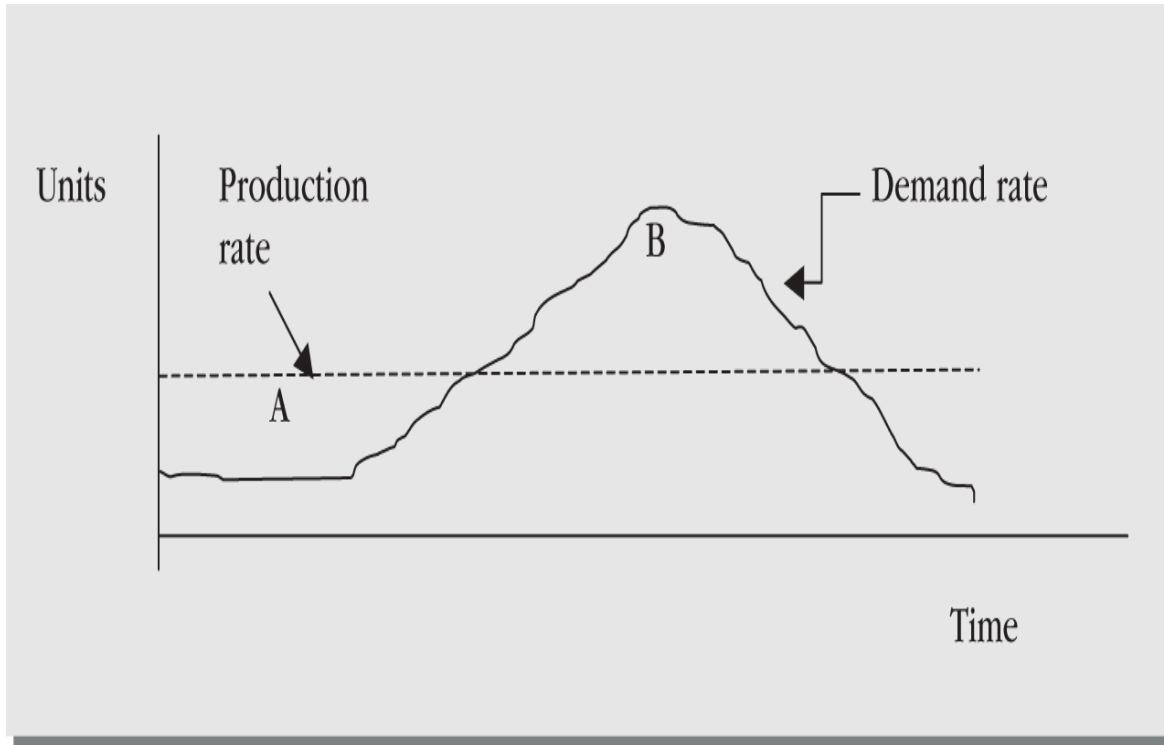


FIGURE 9.1 Differences in production and demand rates.

Concept Check Questions

12. Companies can function very well without inventory.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

13. One reason for carrying inventory is that goods cannot arrive immediately when we run out of stock.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

14. There is rarely any variation in lead time.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

15. We cannot locate a production facility everywhere there is demand.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

16. Extra stores of inventory can be placed at various work centers within a facility to give it flexibility.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

17. Demand is usually known with certainty.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

18. Companies know that many unexpected events may occur that impact both supply and demand.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

19. Buying larger quantities means incurring a higher cost per item.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

20. Buying in large quantities may result in savings associated with transporting larger quantities at one time.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Types of Inventory

There are different types, or categories, of inventory designed to meet the different purposes for carrying inventory, and their quantities are computed differently. We look at these here.

Cycle Stock. These are also called lot-size inventories. This is inventory for immediate use and is computed based on expected demand over a certain period. It assumes demand is known with certainty and computes how much stock is needed over a set period. It also accounts for the fact that products are typically produced in batches. This is the quantity, or the size, of the batch that is produced during the production cycle. Therefore, it is called “cycle stock.”

Safety Stock. Safety stock, also called buffer stock, is the extra inventory we carry to serve as a cushion for uncertainties in supply and demand. It can be in the form of finished goods to cover unexpected demand. It can also be in the form of raw materials to guard against supply problems, or in the form of WIP inventories, to guard against production stoppages.

Anticipation inventory. As the name states, these inventories are carried in anticipation of certain events. Their one purpose is to compensate for differences in the timing of supply and demand and to smooth out the flow of products throughout the supply chain. They are also used when demand fluctuations are significant, but predictable, such as with seasonal variation. This is where companies carry extra inventory during a low season in anticipation of higher demands during the high season. For this reason, they are sometimes called [seasonal inventory](#). Finally, these are inventories that are carried out in anticipation of a price increase or a shortage of products—sometimes called [hedge inventory](#).

Pipeline inventory. Also called [transportation inventory](#), this is inventory that is simply in transit. It exists because the points of demand and supply are not the same. At any one time, a global supply network has a large percentage of its inventory in transit—say, on a barge, truck, or rail—being moved from one location to another or waiting to be loaded or unloaded.

Apple is a notable example of a company with an efficient inventory pipeline within its global supply chain. With components sourced globally, Apple strategically utilizes pipeline inventory to facilitate the seamless movement of materials and finished products across different regions. A significant percentage of Apple's inventory is in transit at any given time, whether on trucks, ships, or railways. This strategy has contributed to Apple's remarkable supply chain efficiency, with reports indicating a 20% reduction in lead times and a 15% improvement in overall production responsiveness. By leveraging pipeline inventory, Apple ensures a continuous and timely supply of products, meeting customer demand and maintaining its reputation for successful product launches on a global scale.

Maintenance, Repair, and Operating (MRO) Items. In addition to inventories that directly support product creation, there are other inventories that are used indirectly. These are called MRO items (MRO). They include everything from office supplies and forms to toilet paper and cleaning supplies, to tools and parts needed to repair machines. Collectively, MRO items make up a significant amount of inventory and need to be managed like all other inventories. Consider the abundance of printing paper in an office, paper cups at Starbucks, or latex gloves in a hospital.

Concept Check Questions

21. These are also called lot size inventories.

- ☐ a) Anticipation inventory
- ☐ b) Seasonal inventory
- ☐ c) Cycle stock

- ☐ d) Safety stock
- ☐ e) Pipeline inventory

Correct or Incorrect?

Clear

Check Answer

22. This is inventory for immediate use and is computed based on expected demand over a certain time period.

- ☐ a) Anticipation inventory
- ☐ b) Seasonal inventory
- ☐ c) Cycle stock
- ☐ d) Safety stock
- ☐ e) Pipeline inventory

Correct or Incorrect?

Clear

Check Answer

23. Also called buffer stock.

- ☐ a) Anticipation inventory
- ☐ b) Seasonal inventory
- ☐ c) Cycle stock
- ☐ d) Safety stock
- ☐ e) Pipeline inventory

Correct or Incorrect?

Clear

Check Answer

24. The extra inventory we carry to serve as a cushion for uncertainties in supply and demand.

- ☐ a) Anticipation inventory
- ☐ b) Seasonal inventory
- ☐ c) Cycle stock
- ☐ d) Safety stock
- ☐ e) Pipeline inventory

Correct or Incorrect?

Clear

Check Answer

25. These inventories are carried in anticipation of certain events.

- ☐ a) Anticipation inventory
- ☐ b) Seasonal inventory
- ☐ c) Cycle stock
- ☐ d) Safety stock
- ☐ e) Pipeline inventory

Correct or Incorrect?

Clear

Check Answer

26. This is where companies carry extra inventory during a low season in anticipation of higher demands during the high season.

- ☐ a) Anticipation inventory
- ☐ b) Seasonal inventory
- ☐ c) Cycle stock
- ☐ d) Safety stock
- ☐ e) Pipeline inventory

Correct or Incorrect?

Clear

Check Answer

27. These are inventories that are carried in anticipation of a price increase or a shortage of products.

- ☐ a) Anticipation inventory
- ☐ b) Hedge inventory
- ☐ c) Maintenance, repair, and operating items
- ☐ d) Safety stock
- ☐ e) Pipeline inventory

Correct or Incorrect?

Clear

Check Answer

28. Also called transportation inventory.

- ☐ a) Anticipation inventory
- ☐ b) Hedge inventory
- ☐ c) Maintenance, repair, and operating items
- ☐ d) Safety stock
- ☐ e) Pipeline inventory

Correct or Incorrect?

Clear

Check Answer

29. This is inventory that is simply in transit.

- ☐ a) Anticipation inventory
- ☐ b) Hedge inventory
- ☐ c) Maintenance, repair, and operating items
- ☐ d) Safety stock
- ☐ e) Pipeline inventory

Correct or Incorrect?

Clear

Check Answer

30. Apple is a notable example of a company with an efficient inventory pipeline within its global supply chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

31. They include everything from office supplies and forms, to toilet paper and cleaning supplies, to tools and parts needed to repair machines.

- ☐ a) Anticipation inventory
- ☐ b) Hedge inventory
- ☐ c) Maintenance, repair, and operating items
- ☐ d) Safety stock
- ☐ e) Pipeline inventory

Correct or Incorrect?

Clear

Check Answer

Inventory Costs

Two of the most important inventory costs are [holding cost](#) and [ordering cost](#). These costs typically move in opposite directions, where reducing one means increasing the other. A third important cost is [shortage cost](#). We look at these next.

Holding Cost. Holding cost, sometimes called [carrying cost](#), includes all the costs that vary with the amount of inventory held in stock. This includes storage facilities, handling, insurance, pilferage, breakage, obsolescence, depreciation, taxes, and the opportunity cost of capital. Although we own the inventory, there are still costs associated with keeping it. Theft is not an uncommon occurrence; some damages can occur; highly innovative or seasonal items can easily become obsolete if not sold on time.

Inventory holding cost is typically described as a percentage of the value of the inventory that is held. It is generally denoted by H and is computed as follows:

$$H = I C$$

The diagram illustrates the formula $H = I C$. Three arrows point upwards from the terms below to the equation above. The first arrow points from 'Holding Cost (\$)' to 'H'. The second arrow points from 'Holding Cost (%)' to 'I'. The third arrow points from 'Item Cost (\$)' to 'C'.

Holding Cost (\$)

Holding Cost (%)

Item Cost (\$)

H is the [dollar value](#) to hold one unit in inventory over some time. I is holding cost as a [percentage of item cost](#), and C is the cost of the item. Therefore, inventory holding cost can be provided as a percentage, say, 30% of the cost of goods annually. It can also be provided as a dollar value, such as \$12 per unit per year. Notice that holding cost must be provided over some

time, whether a day or month, or year. The longer the time period the longer we are holding inventory in stock and the higher the inventory holding cost.

Inventory holding cost is generally underestimated and can roughly vary from 15% of the cost of goods per year to as much as 50% of the cost of goods. Reducing holding costs means a reduction in inventory levels and results in frequent replenishment. This, however, then results in a higher ordering cost.

Ordering Cost. This cost includes all the costs involved in placing an order and procuring the item. It involves deciding on order quantities, and clerical costs involved in placing the order, tracking the order, and receiving it. Ordering cost is sometimes called [setup cost](#) as it also includes the costs involved in preparing the production run when the items are made in-house. If there were no costs, or loss of time, when changing from producing one product to another, companies would produce many small quantities. They would quickly switch from producing one product to another, reducing inventory levels. However, this is not the case, and there is cost associated with switching production from one product type to another.

Notice that reducing ordering cost means ordering less frequently. This means that the quantities ordered have to be larger and will result in higher levels of inventory. This lower ordering cost, unfortunately, will result in a higher inventory cost as we then have to carry more in stock. Holding and ordering costs are the most common inventory costs, and the challenge is to find the right balance between them.

Shortage costs. Shortage costs occur when we run out of stock. This cost reflects the consequences of not having enough in inventory. Being out of stock means that the customer will have to wait for the item to arrive, or the order must be canceled. Potentially there is a loss of sale. Also, there can be a loss of goodwill and reputation with customers. There is a trade-off between carrying extra stock to ensure we can satisfy demand and the costs resulting from a stockout. This balance is sometimes difficult to obtain, as it is hard to estimate the true shortage cost and the impact of the shortage on customer behavior.



Concept Check Questions

32. Two of the most important inventory costs are _____ and _____.

- ☐ a) holding cost and shortage cost
- ☐ b) holding cost and ordering cost
- ☐ c) dollar value and ordering cost
- ☐ d) holding cost and dollar value
- ☐ e) shortage cost and ordering cost

Correct or Incorrect?

Clear

Check Answer

33. Holding cost and carrying cost are the same thing.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

34. All the costs that vary with the amount of inventory held in stock.

- ☐ a) Variable cost
- ☐ b) Ordering cost
- ☐ c) Holding cost
- ☐ d) Shortage cost
- ☐ e) Fixed cost

Correct or Incorrect?

Clear

Check Answer

35. This cost includes all the costs involved in procuring the item.

- ☐ a) Variable cost
- ☐ b) Ordering cost
- ☐ c) Holding cost
- ☐ d) Shortage cost
- ☐ e) Fixed cost

Correct or Incorrect?

Clear

Check Answer

36. Ordering cost is sometimes called setup cost.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

37. This occurs when we run out of inventory.

- ☐ a) Variable cost
- ☐ b) Ordering cost
- ☐ c) Holding cost
- ☐ d) Shortage cost
- ☐ e) Stoppage cost

Correct or Incorrect?

Clear

Check Answer

Supply Chain Leader's Box

■ JOHN DEERE & COMPANY

Excess inventory can hurt financial performance. However, companies need to have enough products in showrooms to generate sales. The trick is to maintain the bare minimum yet have enough products available to support sales. John Deere & Company had to tackle this problem in its \$4 billion worldwide commercial and consumer equipment (C&CE) division. The company restructured that division's supply chain to reduce inventory and freight costs. The result was a major improvement in the company's financial performance.

A few years ago, the company embarked on an effort to better manage their return on assets. A large part of the assets in the C&CE division was finished goods inventory, both in the factories and in dealers' hands. To free up capital John Deere & Company began an inventory-reduction initiative. About 70% of the finished-goods inventory was at dealers' locations, which had to be reduced. However, the dealers were uncomfortable with this decision. The reason was that many of the products sold—such as lawn mowing equipment, utility vehicles, and golf course maintenance equipment—are things that customers such as to sit on, touch, and try out before finalizing their purchase. This enhances sales. Also, the seasonal nature of the sales cycle complicated the inventory-reduction effort, as 65% of retail sales of lawn mowers occur between March and July.

John Deere & Company used advanced software to determine how to better align its production with demand to reduce inventory.

An analysis concluded that the division could reduce inventory by \$1 billion if it held the right amount at the right location at each point throughout the year. Due to concerns of dealers, they chose to reduce inventory by \$250 million each year over four years in a process dubbed “stair-stepping.” In addition, they decided to change their supply chain processes to ensure products were available to meet demand. They would react more swiftly to changes in demand as now there was less inventory to buffer demand swings. Processes had to be changed to become faster and more flexible to support a lower inventory level.

The division began by reducing target inventory levels, which required a change in the production schedule at its five factories throughout North America. In the past, these inventory targets had been set high to compensate for the inability of factories to quickly respond to changes in demand. Now production schedules had to be changed to adjust to demand. In addition, the factories changed their assembly practices, producing at a higher level rather than a seasonal rate.

Through this process of restructuring the supply chain, John Deere & Company cut inventory and reduced freight costs to better manage assets and enhance shareholder value. The company learned that operating a supply chain with less inventory means adjusting internal production and distribution processes. It also means significant financial rewards.

Inventory Systems

Every inventory system must answer the two basic questions: “when to order” and “how much to order.” Two basic categories of inventory systems accomplish this, and they work in slightly different ways. Let us look at these next.

Concept Check Questions

38. Every inventory system must answer the two basic questions: _____ and _____.

- ☐ a) when to order and how to ship
- ☐ b) when to order and how much to order
- ☐ c) how to ship and how much to order
- ☐ d) when to order and where to ship to
- ☐ e) where to ship to and price to pay

Correct or Incorrect?

Clear

Check Answer

39. There are _____ basic categories of inventory systems.

- ☐ a) two
- ☐ b) three
- ☐ c) four
- ☐ d) five or more

Correct or Incorrect?

Clear

Check Answer

Fixed-Order Quantity System

The first inventory system is called a [fixed-order quantity system](#). As the name suggests, the quantity that is ordered with this system is constant or fixed and is denoted by Q . An order is placed when the inventory position (IP) drops to a predetermined level, noted as the reorder point (ROP). Therefore, two variables define this system and answer the two basic questions of when to order and how much— Q and ROP. They specify when to place an order—when inventory reaches the ROP. They also specify how much to order—the quantity Q .

The fixed-order quantity model is shown in [Figure 9.2](#). Notice that the system assumes a constant demand rate of d by which the IP is reduced. When the IP reaches the ROP, an order is placed for

the quantity Q . When goods are received the inventory is replenished and the IP is increased by Q . However, inventory cannot arrive the moment an order is placed, as there is a certain amount of lead time, L , during which we have to wait for the order.

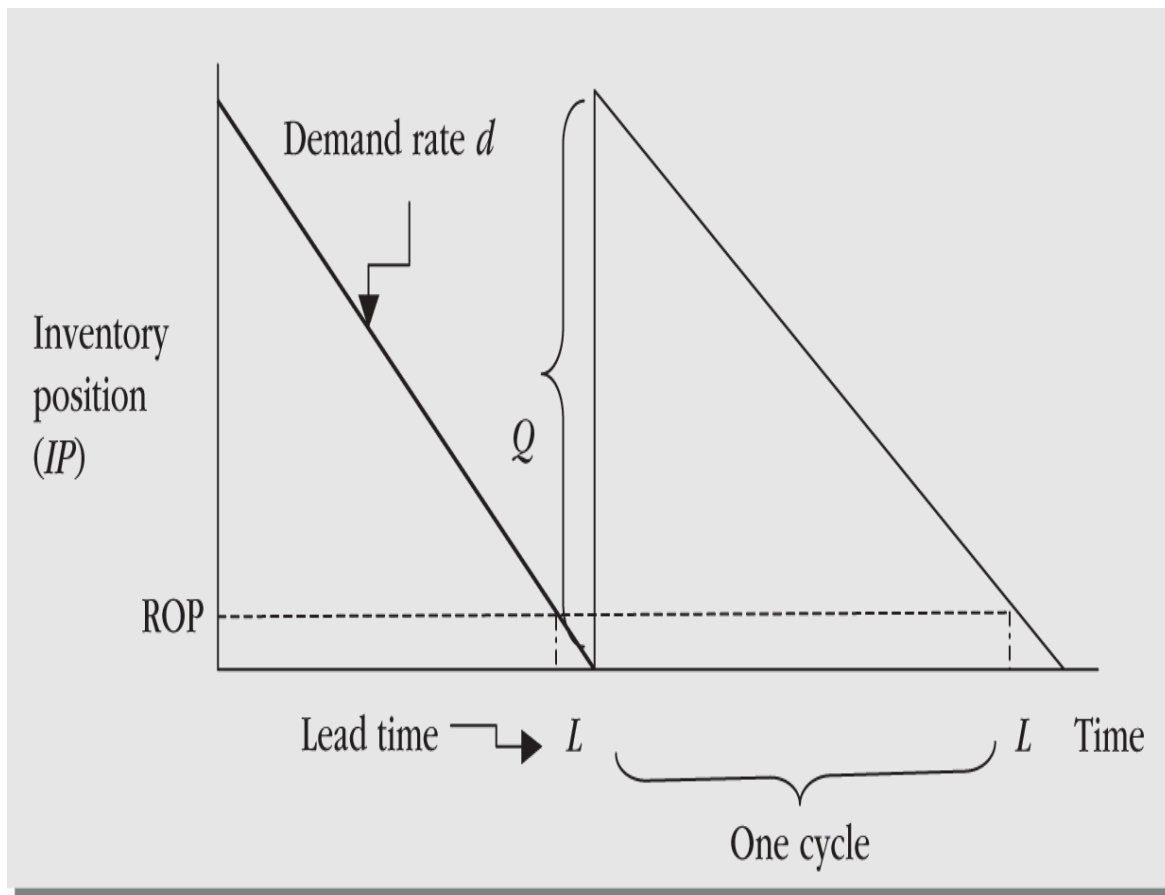


FIGURE 9.2 Fixed-order quantity system.

With this system, inventory is checked on a continual basis, and the assumption is that we always know the current level of inventory. When inventory levels reach the reorder point ROP, an order of quantity Q is placed. For example, let us assume that a hotel chain uses a fixed-order quantity system for its inventory of lavender bath soaps. Its policy is that it always orders 2,000 soaps, for which it gets a nice quantity discount, and the order is made when the number of soaps drops to 300. Therefore, $ROP = 300$, and the order quantity $Q = 2,000$.

In the basic version of this system the order quantity Q is computed as the economic order quantity (EOQ)—an economically optimal order quantity. For this reason, this system is sometimes called the [EOQ model](#). Other terms used to describe it are the [Q-model](#) as the quantity Q is constant. Sometimes it is called a [continuous review system](#), as the inventory levels are continuously monitored. The model has even been called a [sawtooth model](#), as the graph of inventory looks like a sawtooth. All these terms refer to the same type of inventory system, describing different features of the system itself. Later in this chapter, we will see how the EOQ value is computed.

Concept Check Questions

40. The quantity that is ordered with this system is constant or fixed and is denoted by Q.

- ☐ a) Fixed-time period system
- ☐ b) Vendor managed inventory
- ☐ c) Fixed-order quantity system
- ☐ d) Shipper managed inventory

Correct or Incorrect?

Clear

Check Answer

41. An order is placed when the inventory position drops to a predetermined level, noted as the reorder point, or ROP.

- ☐ a) Fixed-time period system
- ☐ b) Vendor managed inventory
- ☐ c) Fixed-order quantity system
- ☐ d) Shipper managed inventory

Correct or Incorrect?

Clear

Check Answer

42. With this system inventory is checked on a continual basis, and the assumption is that we always know the current level of inventory.

- ☐ a) Fixed-time period system
- ☐ b) Vendor managed inventory
- ☐ c) Fixed-order quantity system
- ☐ d) Shipper managed inventory

Correct or Incorrect?

Clear

Check Answer

43. The fixed-order quantity system is also known as the Q-model.

- ☐ True
- ☐ False

Correct or Incorrect?

44. The fixed-order quantity system is also known continuous review system.

- ☐ True
- ☐ False

Correct or Incorrect?

45. The fixed-order quantity system is also known as the ROP-model.

- ☐ True
- ☐ False

Correct or Incorrect?

Fixed-Time Period System

The second inventory system is called a [fixed-time period system](#), as shown in [Figure 9.3](#). Here inventory levels are checked in fixed periods, T , and the quantity that is ordered varies. The system sets a target inventory level, R , to be maintained. Inventory is checked every T intervals, say, every week or every 2 weeks, and an order is placed to restore the inventory level to R . Based on the inventory level at period T , the amount of inventory that needs to be ordered will be some quantity Q that varies from period to period. This quantity Q is the difference between the target inventory R and how much inventory is in stock, the IP at time T :

$$Q = R - IP$$

where

Q = order quantity

R = target inventory level

IP = inventory position

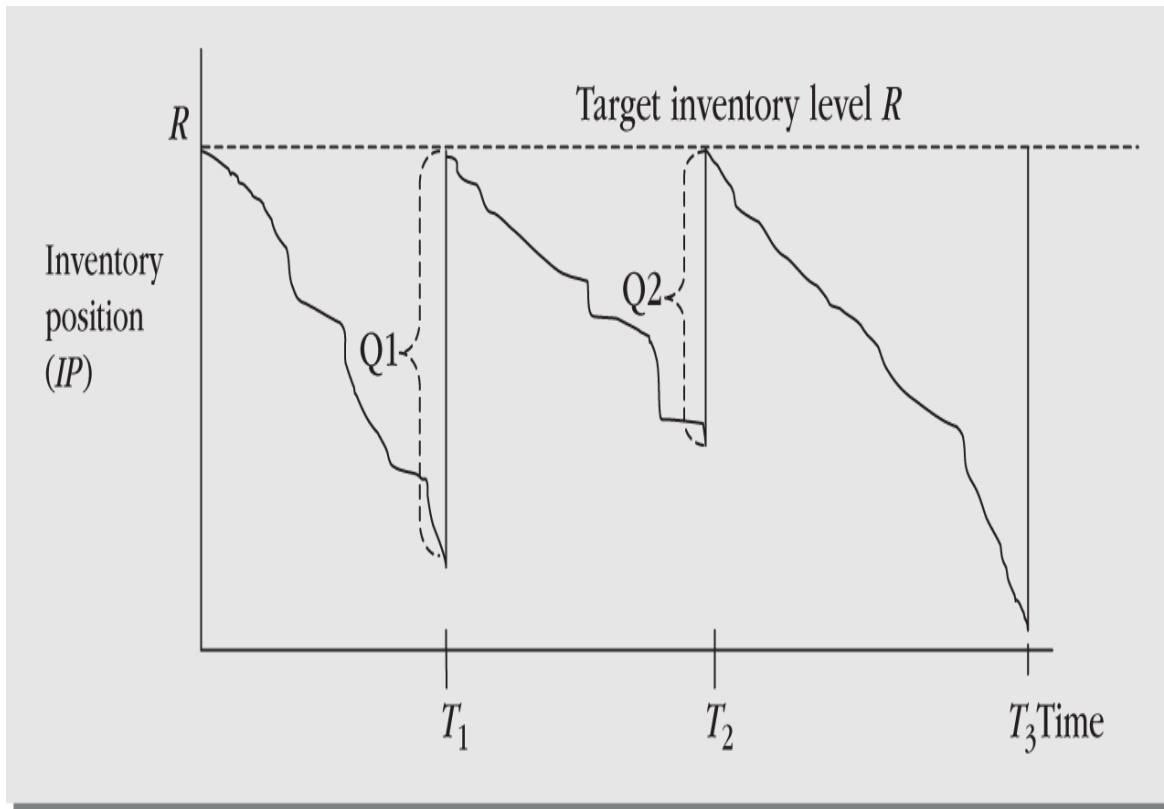


FIGURE 9.3 Fixed-time period system.

Two variables define this system and answer the two basic questions of when to order and how much are T and Q . They specify when to place an order—at a time interval, T . They also specify how much to order—quantity, Q , computed as the difference between the target inventory, R , and the IP . Sometimes this system is called the [periodic review system](#) to indicate that the inventory level is checked periodically, rather than continuously.

Let us assume a hotel chain uses a fixed-time period model for its inventory of lavender bath soaps. Also, let us consider its policy is to check inventory levels every 2 weeks, and that it has a target inventory level $R = 5,000$ soaps. If after 2 weeks the company checks its inventory level and finds its inventory position $IP = 2,800$ soaps, it would place an order for quantity $Q = R - IP = 5,000 - 2,800 = 2,200$ soaps.

Concept Check Questions

46. Here inventory levels are checked in fixed time periods, T , and the quantity that is ordered varies.

- ☐ a) Fixed-time period system
- ☐ b) Vendor managed inventory
- ☐ c) Fixed-order quantity system
- ☐ d) Shipper managed inventory

Correct or Incorrect?

Clear

Check Answer

47. The fixed-order quantity system is sometimes called the periodic review system.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Comparing Fixed-Order Quantity vs Fixed-Time Period Systems

Both inventory systems answer the question of when and how much to order, but they do it differently. [Figure 9.4](#) shows a comparison of the two systems.

The biggest difference between the two systems is the timing and quantities of the orders placed. With the fixed-order quantity system, inventory is checked continually, and the system is prepared to place orders multiple times per year on a random basis. This has the advantage of providing greater system responsiveness, but it also requires administrative processes to be in place continually. In addition, as different inventory items may reach their ROPs at different periods, it may be difficult to obtain quantity discounts that are based on a bundled order.

The fixed-period order system requires carrying more safety stock inventory. The reason is that with this system we do not check the IP regularly, and a sudden surge of demand could lead to a stockout. This system, however, allows more organized purchasing as inventory levels are checked in set time intervals. Orders can be bundled and quantity discounts obtained easier. Imagine in our hotel example if the company used a fixed-order quantity model to place orders for various items, such as soaps, shampoos, lotions, and conditions. These different items may reach ROPs at different times generating many orders at random intervals. On the other hand, a fixed-

period system could ensure that inventory levels are checked regularly for all items, say, every 2 weeks. Then the orders for all the items could be bundled.

In general, a fixed-order quantity system is more appropriate for high-value items as the average inventory carried is lower. Also, it is more appropriate when stockouts are less desirable, as inventory is monitored continually. However, this system is more costly to maintain as it requires technology to record all transactions and compute the IP in real time.



Concept Check Questions

48. The biggest difference between fixed-order quantity and fixed-time period systems is cost.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

49. The fixed-order quantity system requires carrying more safety stock inventory.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

50. In general, a fixed-order quantity system is more appropriate for high-value items.

- ☐ True
- ☐ False

Correct or Incorrect?

[Clear](#)[Check Answer](#)

Fixed-order Quantity Systems

A fixed-order quantity system is one of the most important in inventory management. For that reason we need to look at how to compute the two variables that define it: the order quantity (Q) and the ROP. Before we do that, however, we need look at the assumptions this system makes. Most importantly, the system assumes that all the variables occur at a constant rate and their values are known with certainty. For example, the system assumes that the demand, d , occurs at a constant rate and that there is no variability in demand. Also, the lead time L is constant, and the holding cost H is known and fixed, as are stockout cost S and unit price C . Although these assumptions are not realistic, the model is highly robust and provides excellent results despite these assumptions.

	Fixed-order quantity	Fixed-time period
How much to order?	Order quantity $Q = EOQ$	Order quantity $Q = R - IP$
When to order?	When inventory level drops to (ROP)	When the review period arrives— T
Order quantity	Fixed	Variable
Recordkeeping	Continual	Periodic—at review interval
Size of inventory	Lower	Higher
Time to maintain	Higher	Lower
Type of items	Higher valued items	Quantity discount options

FIGURE 9.4 Comparison of inventory systems.

Concept Check Questions

51. A fixed-order quantity system is one of the most important in inventory management.

- ☐ True
☐ False

Correct or Incorrect?

[Clear](#)[Check Answer](#)

52. A fixed-order quantity system assumes that demand is known with certainty.

- ☐ True
☐ False

Correct or Incorrect?

Clear

Check Answer

53. A fixed-order quantity system assumes that lead times are variable.

- ☐ True
☐ False

Correct or Incorrect?

Clear

Check Answer

Economic Order Quantity (EOQ)

The first decision in the fixed-order quantity model is to select the order quantity Q . Recall that there are a number of inventory costs, most notably inventory holding cost and ordering cost. We want to select the “best” order quantity that minimizes these costs. This is called the economic order quantity or EOQ. This is computed by looking at the total annual inventory cost and finding the order quantity that minimizes it. Consider that the total annual cost comprises annual purchase cost, annual ordering cost, and annual holding cost and looks as follows:

$$\begin{aligned}\text{Total cost} &= \text{Purchase cost} + \text{Ordering cost} + \text{Holding cost} \\ TC &= DC + \left(\frac{D}{Q}\right) S + \left(\frac{Q}{2}\right) H\end{aligned}$$

where

TC = Total cost

D = Annual demand

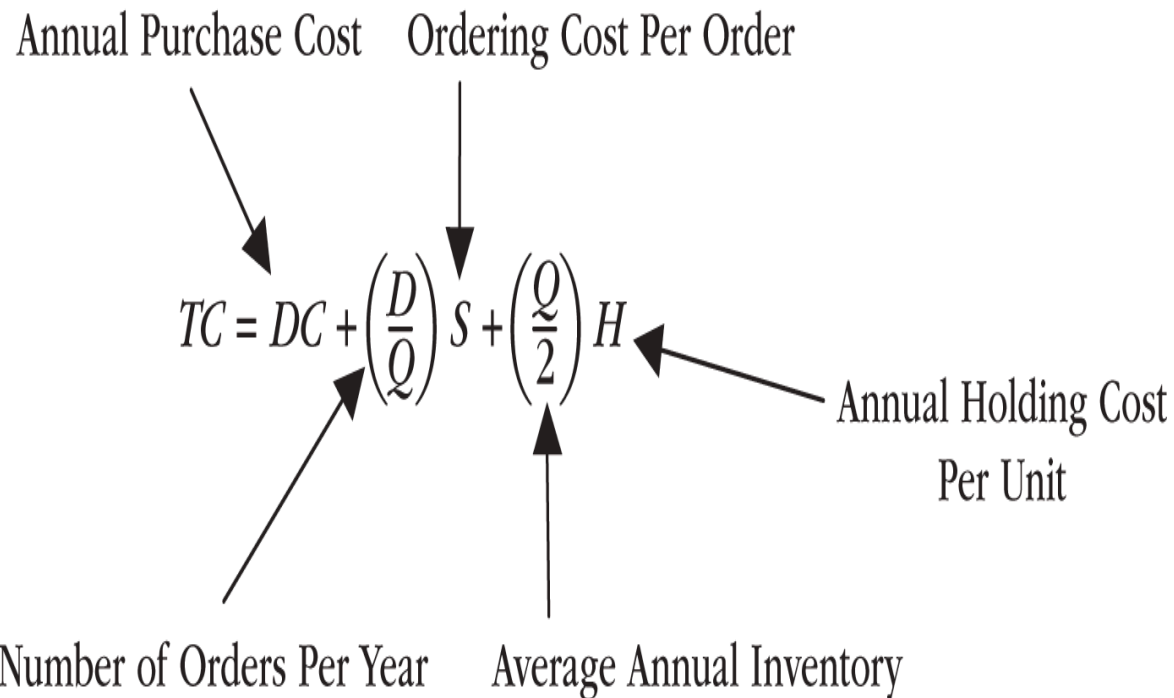
C = Unit cost

Q = Order quantity

S = Ordering cost

H = Holding cost

Let us discuss these terms in a bit more detail:



The first term in the equation, DC , is the annual purchase cost for items. It comprises annual demand (D) times the unit cost of each item (C). The second term $\left(\frac{D}{Q}\right) S$ is the annual ordering cost. It is computed as the number of orders placed per year $\left(\frac{D}{Q}\right)$ times the cost of each order, $\left(\frac{Q}{2}\right) S$. Finally, the third term is the annual holding cost $\left(\frac{Q}{2}\right) H$; where is the average inventory held? Remember that our maximum inventory is Q units when the order is received. When inventory is depleted, we have $\frac{Q}{2}$ zero. Therefore, on average we have units in inventory. H is the annual holding cost per unit of inventory. Recall that H is a percentage computed as $H = I \times C$.

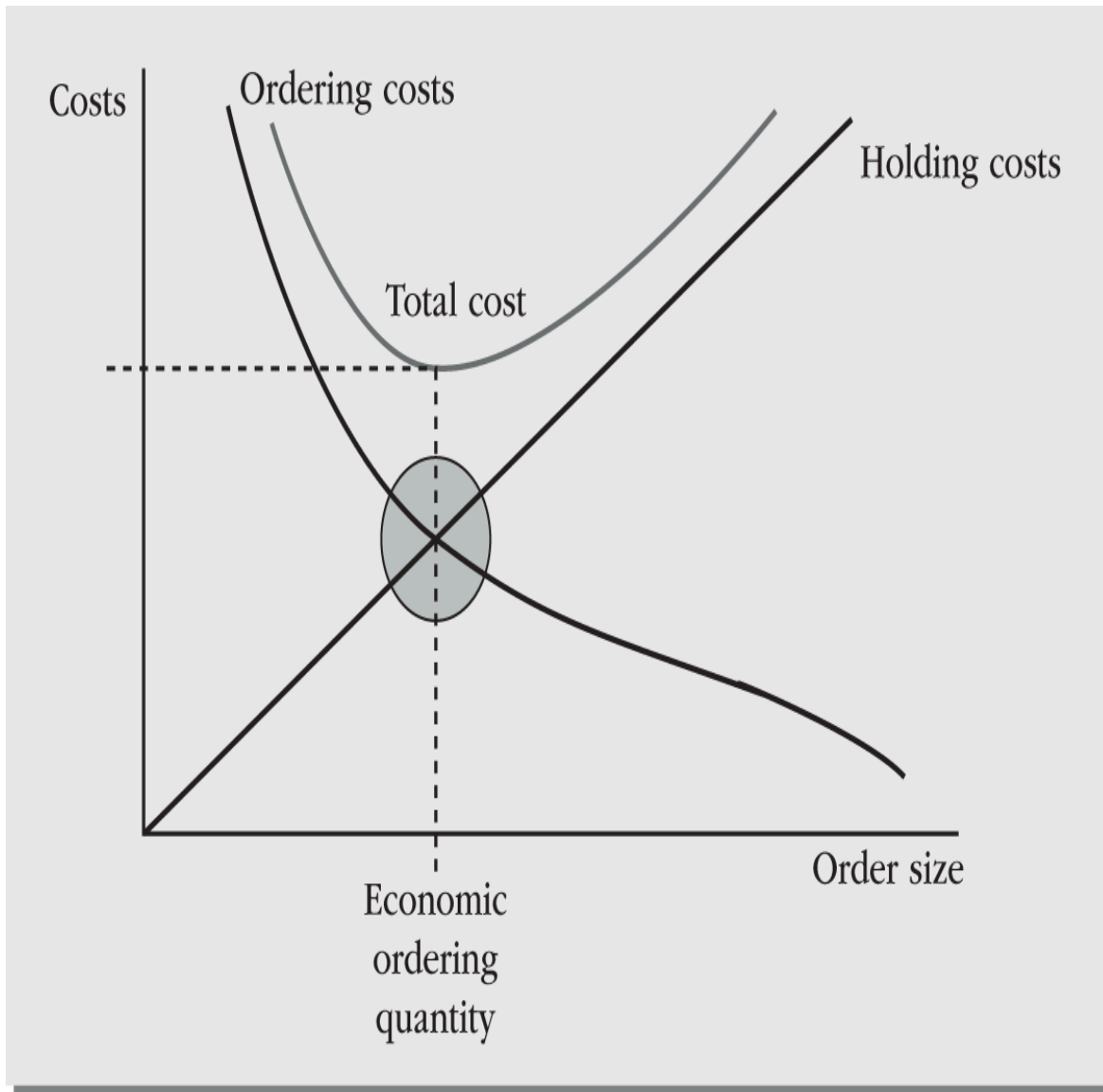


FIGURE 9.5 Total cost curve.

The behavior of the two costs is shown in [Figure 9.5](#). Notice that inventory holding cost increases with the order quantity, Q . The reason is that higher order quantities mean holding more inventory. However, this also means that we are ordering less frequently, so ordering cost decreases. The opposite is true as the order quantity Q is decreased. A smaller order quantity results in a lower holding cost, but a higher ordering cost, as we are ordering more frequently.

The objective is to pick an order quantity that minimizes the sum of both the holding and ordering costs, which is the minimum point on the total cost curve. This is the “best” or optimal order quantity, Q_{opt} , also called the EOQ. To find the minimum point on the total cost curve we use calculus. We take the derivative of total cost (TC) with respect to Q and set this equal to zero. For the basic model considered here, the calculations are as follows.

Total cost equation:

$$TC = DC + \frac{D}{Q} S + \frac{Q}{2} H$$

First derivative of total cost equation:

$$\frac{TC}{dQ} = 0 + \frac{-DS}{Q^2} + \frac{H}{2} = 0$$

Solving the above equation for Q we compute Q_{opt} , also called the EOQ:

$$Q_{\text{opt}} = \text{EOQ} = \sqrt{\frac{2DS}{H}}$$

This is the EOQ, or the “best” quantity to order in the fixed-order quantity system to minimize the sum of inventory cost and ordering cost.

EXAMPLE 1 Computing the EOQ at Georgia's Florists

You have taken over as inventory manager at Georgia's Florists. You would like to use EOQ to compute the best quantity of orchids to order. The previous manager in Georgia's ordered orchids once a month in quantities of 1,000 to simply match the monthly demand. Orchids are expensive to order with an ordering cost of \$300 per order. Holding cost is estimated at 15% of product cost annually, with a product cost of \$60 per unit.

What would be your order? What is the number of orders per year? What is the annual holding cost? Assuming 4 weeks/month and a lead time of 1 week, what is the ROP?

SOLUTION:

You were given the following information:

$$\begin{aligned}\text{Annual demand (D)} &= 1,000 \text{ orchids per month} \times 12 \text{ months} = 12,000 \text{ orchids} \\ \text{Holding cost (H)} &= (.15) \$60 \text{ per unit} \\ \text{Ordering cost (S)} &= \$300 \text{ per order}\end{aligned}$$

Computing the EOQ:

$$\begin{aligned}\text{EOQ} &= \sqrt{\frac{2DS}{H}} = \sqrt{2 \frac{(12,000 \text{ units})(\$300)}{(0.15) \$60}} = 894.5 \approx 895 \\ \text{Orders Per Year} &= \frac{D}{Q} = \frac{12,000}{895} = 13.4 \\ \text{Annual Holding Cost} &= \left(\frac{Q}{2}\right) H = \left(\frac{895}{2}\right) \$9 = \$4,028\end{aligned}$$

Concept Check Questions

54. The first decision in the fixed-order quantity model is to select the reorder point.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

55. Which of the following is not a component of the total cost formula?

- ☐ a) Ordering cost
- ☐ b) Purchase cost
- ☐ c) Holding cost
- ☐ d) Transportation cost

Correct or Incorrect?

Clear

Check Answer

56. Inventory holding cost decreases with the order quantity, Q .

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

57. The objective is to pick an order quantity that minimizes the purchase price.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Reorder Point (ROP)

The EOQ answers the question of how much to order, but we still need to determine when to order. Assume that the demand rate, d , and lead time (L) are constant and known with certainty. In

that case, the ROP would simply be enough inventory to ensure that demand is covered during the length of the lead time. In this simple case, the ROP would be computed as:

$$\begin{aligned}\text{ROP} &= \text{demand during lead time} \\ \text{ROP} &= d L\end{aligned}$$

Let us go back to the Georgia's Florists example. If lead time L is 1 week and the demand, d , is 250 units per week, the ROP would be as follows:

$$\text{Reorder Point} = \text{ROP} = d \times L = 1 \text{ week} \times 250 = 250 \text{ units}$$

The order policy for Georgia's Florists would be defined by the EOQ and ROP. This would mean ordering 895 orchids when inventory drops to 250 orchids.

Concept Check Questions

58. The EOQ answers the question of how much to order, but we still need to determine when to order.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

59. The reorder point is just annual demand times the lead time.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Safety Stock

Unfortunately, d and L are rarely fixed, and demand is often higher than expected. As a result, we have to carry a bit more inventory to address this uncertainty. This is called or **buffer stock** and is inventory we carry in addition to the demand during lead time. Safety stock is added to the ROP calculation and is computed as follows:

$$\text{ROP} = \text{demand during lead time} + \text{safety stock}$$

$$\text{ROP} = dL + SS$$

$$\text{ROP} = dL + Z_k \sigma_L$$

We can see that SS is equal to $Z_k \sigma_L$. Let us look at this second term in the equation to see what it means. Z_k is the value of the standard normal variable for a particular service level k . The service level, k , is simply the probability that we will “not” run out of stock. This is set by the company based on the level of service they wish to provide for a particular product and customer base. Higher service levels mean higher levels of inventory. For example, a service level k of 95% means a 95% probability of being in stock and a 5% probability (100–95%) of being out of stock. The value of Z is obtained from the standard normal table in the back of the text for a particular value of k .

The service level, k , can be set in two ways:

Direct way: This is a specified percentage, such as 95% service level.

Indirect way: This may be in terms of the number of stockouts tolerated, such as five stockouts per year. If we know the number of orders per year, we can then compute the value of k .

The second part of this term, σ_L , is the standard deviation of demand over the lead time L . The higher the variability, the higher the standard deviation (computed as the square root of variance), and the higher the safety stock.

EXAMPLE 2 Computing Safety Stock at Georgia's Florists

Earlier we computed an EOQ and ROP for Georgia's Florists, but assumed no safety stock. Let us now compute the amount of safety stock and the new ROP, assuming that you desire a 95% service level.

SOLUTION:

We know the following:

$$\begin{aligned}\text{Demand } (D) &= 1,000 \text{ orchids per month} \\ \text{Lead time } (L) &= 1 \text{ week} \\ \sigma_L^2 &= 64 \\ k &= 95\%\end{aligned}$$

We then compute the ROP:

$$\begin{aligned}\text{ROP} &= \text{demand during lead time} + \text{safety stock} \\ \text{ROP} &= dL + SS \\ \text{ROP} &= dL + Z_k \sigma_L \\ \text{ROP} &= (250 \text{ units})(1 \text{ week}) + 1.645\sqrt{64} = 263.16 @ 263 \text{ units}\end{aligned}$$

Therefore, the new order policy would be to order 895 orchids when inventory drops to 263 orchids.

Concept Check Questions

60. Usually, d and L are fixed.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

61. The service level is computed using an equation.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

62. The higher the variability, the higher the standard deviation.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

63. The higher the variability, the lower the safety stock.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Economic Production Quantity (EPQ)

The fixed-order quantity model assumes that the EOQ arrives in one lump sum after the order is placed. In Georgia's Florists example, all the ordered orchids arrived in one shipment. This meant that the company had to have physical space for the entire EOQ quantity. Sometimes, however, the products ordered are made in-house or nearby. In that case, the producing operation may not wait to produce all Q units before passing them on to the operation that ordered them. This is

called the [economic production quantity \(EPQ\)](#) and sometimes it is called the [production rate model](#). The variables that define this model are still Q and ROP, as these define how much to order and when. However, the computation of Q is a little bit different.

Consider Samba Chocolate Co., which produces a variety of chocolates and makes its packaging for its specialty chocolate: turtle truffles. The turtle truffle wrapping is made immediately next door to chocolate production. The chocolate production department orders the special wrapping from the packaging department. However, the packaging department does not wait to make all Q units of wrapping before they get it to chocolate production. Rather, they begin passing the wrapping to chocolate production as it is being produced. If the wrapping is made at a rate of 80 units per day and chocolate production uses it at a rate of 60 units per day, the inventory will build up at a rate of 20 units per day. This is shown in [Figure 9.6](#).

[Figure 9.7](#) illustrates the way the EPQ system works. As with the basic fixed-order quantity model, a quantity Q is ordered at the ROP. The production process starts at a rate of p . However, as the product is produced it is used at a rate of d , with $d \leq p$, and inventory builds up at rate of $p - d$. Production stops once the ordered quantity Q has been made. This is one cycle. The cycle begins again when the ROP is reached.

Notice that with this system we hold less inventory than with the basic EOQ system. The reason is that here we are using part of the inventory while it is being produced. The broken line in [Figure 9.7](#) shows the amount of inventory Q that we would hold if the inventory was received all at once. Instead, the maximum amount of inventory that we hold— $I_{\max}$ —is shown as the inventory peak.

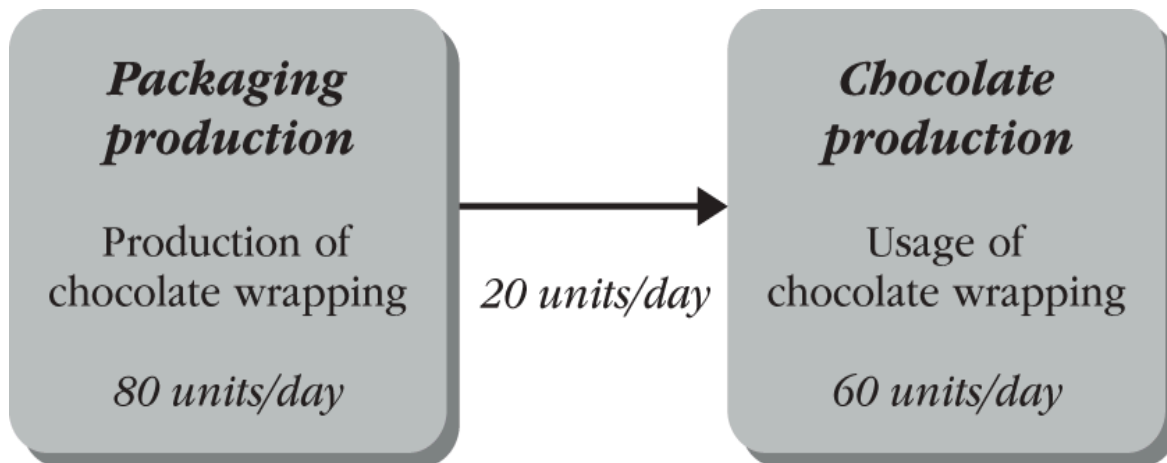


FIGURE 9.6 Production and demand at Samba Chocolate Co.

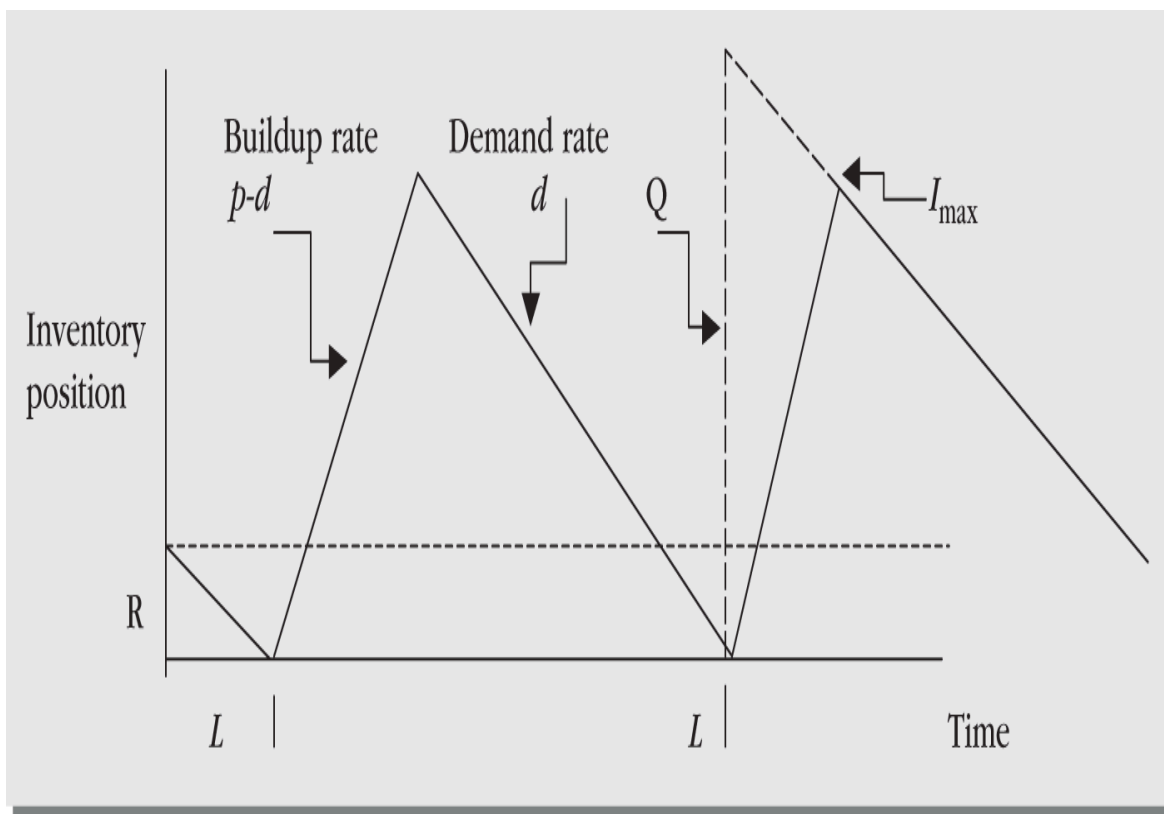


FIGURE 9.7 Economic production quantity system.

The optimal quantity that should be ordered in this situation is different from the traditional EOQ as the inventory holding cost is lower. As before, to compute the optimal order quantity Q_{opt} we begin with the total cost equation:

Annual Purchase Cost Ordering Cost Per Order

$$TC = DC + \left(\frac{D}{Q}\right)S + \left(\frac{I_{\max}}{2}\right)H$$

Annual Holding Cost Per Unit

Number of Orders Per Year Average Annual Inventory

Notice that in this equation the average annual inventory is $\frac{I_{\max}}{2}$ computed as rather than $\frac{Q}{2}$ as in the basic EOQ derivation. The reason is that the maximum inventory we hold is no longer Q , but is $I_{\max}$.

To compute the Q_{opt} consider the following. The time to produce Q units is $\frac{Q}{p}$. During this time, we lose to demand $d \left(\frac{Q}{p}\right)$ units. Therefore, the maximum held in inventory, $I_{\max}$, is computed as follows:

$$I_{\max} = Q - d \frac{Q}{p}$$

$$I_{\max} = Q \left(1 - \frac{d}{p}\right)$$

where

d = daily demand rate

p = daily production rate

Substituting this into the total cost equation we get the following:

$$TC = DC + \frac{D}{Q}S + \left(p - \frac{d}{2p}\right)QH$$

Using calculus, we solve for Q obtaining the equation for Q_{opt} :

$$Q_{\text{opt}} = \sqrt{\frac{2DS}{H} \frac{p}{(p-d)}} = \sqrt{\frac{2DS}{H \left(1 - \frac{d}{p}\right)}}$$

EXAMPLE 3 Calculating EPQ and I_{max}

A bicycle manufacturer uses 50,000 wheels per year for its popular children's cycle. The firm makes its wheels, which it can produce at a rate of 600 per day. The bicycles are assembled uniformly over the entire year. Carrying cost is \$1 per wheel a year, and setup cost for a production run of wheels is \$45. Considering that the plant operates 250 days per year, find the order quantity and I_{max} .

SOLUTION:

The order quantity here is the EPQ. We just need to substitute the values provided into the equation as follows:

$$Q_{\text{opt}} = \sqrt{\frac{2DS}{H} \frac{p}{(p-d)}} = \sqrt{\frac{2DS}{H \left(1 - \frac{d}{p}\right)}}$$

Be careful when substituting to make sure that the units of time are the same in each denominator. Demand is given to be 50,000 wheels “per year,” which we use in the first denominator as holding cost H is also given “per year.” However, the production rate p is given “per day,” and we must convert demand to a daily rate here.

$$\begin{aligned}
 D &= 50,000 \frac{\text{wheels}}{\text{year}} \\
 d &= \frac{50,000 \text{ wheels}}{250 \text{ days}} = 200 \frac{\text{wheels}}{\text{day}} \\
 Q_{\text{opt}} &= \text{EPQ} = \sqrt{\frac{2 \left(50,000 \frac{\text{wheels}}{\text{year}} \right) \$45/\text{order}}{\$1 \text{ per wheel/year}} \frac{600 \text{ wheels/day}}{600 \text{ wheels/day} - 200 \text{ wheels/day}}} \\
 Q_{\text{OPT}} &= \text{EPQ} = 2,598.07 \text{ wheels @ } 2,598 \text{ wheels} \\
 I_{\text{max}} &= Q \left(1 - \frac{d}{p} \right) = 2,598 \left(1 - \frac{200}{600} \right) = 1,732 \text{ wheels}
 \end{aligned}$$

Although the order is 2,598 wheels, there only needs to be space for 1,732 wheels.



Concept Check Questions

64. The fixed-order quantity model assumes that the EOQ arrives in one lump sum after the order is placed.

- ☐ True
☐ False

Correct or Incorrect?

Clear

Check Answer

65. Sometimes, the producing operation may not wait to produce all Q units before passing them on to the operation that ordered them. In that case, which model is used?

- ☐ a) Fixed-time period system
☐ b) Vendor managed inventory
☐ c) Fixed-order quantity system
☐ d) Shipper managed inventory
☐ e) Economic production quantity system

Correct or Incorrect?

Clear

Check Answer

66. The economic production quantity is sometimes called the production rate model.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

67. The economic production quantity computes Q and the ROP the same as the EOQ model.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

68. The economic production quantity causes the firm to hold more inventory than the EOQ system.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

69. The economic production quantity has the same maximum inventory as the EOQ model.

- ☐ True
- ☐ False

Correct or Incorrect?

[Clear](#)[Check Answer](#)

AI and Analytics Box—Analytics-driven Inventory

■ DELL

Just a few years ago, Dell customers could order customized computer configurations on the company's website using the company's configure-to-order model. Customers could design their computers choosing variations in models, software configurations, memory, screens, design, and numerous other features. These large options were great for customers. However, the combination of options created a huge challenge for Dell as this resulted in over seven septillion possible computer configurations—mathematically 10^{24} combinations. In practical terms, this created an inventory mess.

The company then turned to an analytically driven system to optimize inventory decisions. The goal was to satisfy the diverse needs of a broad set of customers but also keep costs as low as possible. The analytics team decided to use historical order data to run cluster analysis to determine the most common configurations customers were choosing. Cluster analysis revealed that there were a lot of commonalities in ordering. Going through the data, they were able to reduce the seven septillion options down to just a few million. They were then able to identify certain models so common that the company could stock them in preconfigured inventory just waiting to be shipped. These common configurations could then be built ahead of time with the lowest margins, kept in inventory and, if ordered today, the customer could have them tomorrow. The new analytically driven system increased customer service and reduced inventory cost and resulted in an additional \$40 million in revenue.

Fixed-time Period Systems

In a fixed-time period system, inventory levels are checked in regularly set time intervals. The goal is to place an order to restore the inventory position to the target inventory level R . Therefore, the quantity that is ordered at the time interval, T , is

$$Q = R - IP$$

where

Q = order quantity

R = target inventory level

IP = inventory position at time T

In this system, the questions of “when to order” and “how much” are set as follows. Orders are placed at time interval T . This time interval is typically set for organizational convenience. For example, it may be every week, every 2 weeks, or once a month. The ordering process requires administrative responsibility, and the organization decides what is most convenient. Also, sometimes suppliers make routine visits to customers, and this timing may be considered when setting T . Finally, T can even be set as the time interval that would allow for a certain quantity Q to be used up. This could be, for example, the optimal order quantity EOQ:

$$T = \frac{Q}{d}$$
$$T = \frac{\text{EOQ}}{d}$$

The quantity Q that is ordered is the amount that will restore inventory levels to R , the target inventory level. Therefore, the important decision is computing the target inventory level.

Concept Check Questions

70. In this system, inventory levels are checked in regularly set time intervals.

- ☐ a) Fixed-time period system
- ☐ b) Vendor managed inventory
- ☐ c) Fixed-order quantity system
- ☐ d) Shipper managed inventory
- ☐ e) Economic production quantity system

Correct or Incorrect?

Clear

Check Answer

71. The ordering process requires administrative responsibility, and the organization decides what is most convenient.

- ☐ a) Fixed-time period system
- ☐ b) Vendor managed inventory
- ☐ c) Fixed-order quantity system
- ☐ d) Shipper managed inventory
- ☐ e) Economic production quantity system

Correct or Incorrect?

Clear

Check Answer

72. Sometimes suppliers make routine visits to customers, and this timing may be considered when setting T .

☐ True

☐ False

Correct or Incorrect?

Clear

Check Answer

Computing Target Inventory

The target inventory level needs to be large enough to cover three types of demand:

$$T = \frac{Q}{d}$$
$$T = \frac{\text{EOQ}}{d}$$

Demand during the length of the lead time, L .

Demand during the length of the review period, T .

Safety stock, SS , to guard against uncertainty.

Therefore, the target inventory level can be computed as follows:

$$R = \text{demand during lead time} + \text{demand during review period} + \text{safety stock}$$

$$R = d L + d T + Z_k \sigma_{L+T}$$

As before, Z_k is the standard normal variable for the desired service level. However, the standard deviation of demand is now over both the length of the lead time, L , and the review period T . Sometimes the standard deviation is provided over another period, t , other than the specified $L + T$. It is easy to make a mathematical conversation using the following equation:

$$R = DL + DT + Z_k \sigma_t \sqrt{\frac{L + T}{t}}$$

where

t = interval over which standard deviation is given

L = lead time

T = review interval

Notice that the demand, lead time, and review period are over length of time, such as days, weeks, or years. Remember, however, that this length must be the same throughout the equation.

EXAMPLE 4 Computation of the Fixed-time Period System

Gordon's Potato Chips reviews inventory every 14 days, with demand and lead time given below:

$$\begin{aligned}T &= 14 \text{ days} \\D &= 30 \text{ units per days} \\L &= 7 \text{ days} \\\sigma_{\text{day}} &= 10 \text{ units}\end{aligned}$$

If the company tolerates no more than two stockouts per year, develop the ordering policy for a fixed-time period inventory system.

SOLUTION:

Remember that an ordering policy specifies when to order and how much. Here, we know that orders are placed every 14 days. To determine how much to order we must first compute the target inventory level R and substitute known values:

$$\begin{aligned}R &= dL + dT + SS \\R &= 30 \text{ units/day (7 days)} + 30 \text{ units/day (14 days)} + Z_k(10)\sqrt{\frac{7+14}{1}}\end{aligned}$$

Notice that we still have to compute k , the cycle service level. Let us look at what we know:

two stockouts per year

an order placed every 2 weeks

52 weeks/year means 26 orders per year (52/2)

Therefore, the service level

$$\begin{aligned}
 k &= \frac{26-2}{26} = .9231 \\
 Z_{92.3} &= 1.426 \\
 R &= 630 + 1.426 (10)\sqrt{21} = 692 \text{ units}
 \end{aligned}$$

Therefore, the ordering policy is to check inventory every 2 weeks and order the quantity that will restore inventory to 692 units.

Concept Check Questions

73. The target inventory level needs to be large enough to cover three types of demand. Which of the following is not one of these?

- ☐ a) Demand during the length of the review period
- ☐ b) Safety stock
- ☐ c) Demand during the restocking period
- ☐ d) Demand during the length of the lead time

Correct or Incorrect?

Clear

Check Answer

74. The standard deviation of demand is now over both the length of the lead time L and the review period T.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Independent vs Dependent Demand

One of the biggest differences in inventory is between dependent and independent demand. Understanding this difference is important, as the entire inventory policy for an item is based on

this. [Independent demand](#) is demand for a finished product, such as a computer, a bicycle, or a pizza. [Dependent demand](#), on the other hand, is demand for component parts or subassemblies. For example, this would be the microchips in the computer, the wheels on the bicycle, or the amount of cheese on the pizza.

The inventory systems we discussed thus far are for independent demand. Dependent demand is derived from its independent demand. We can forecast the number of bicycles we expect to sell, then we can derive the quantities needed for wheels, tires, frames, and other parts. For example, if a company plans to produce 200 bicycles in a day, it would need 400 wheels, 400 tires, and 200 frames. The number of wheels, tires, frames, and other parts is dependent on the quantity of the independent demand item from which it is derived.

The relationship between independent and dependent demand is shown in a [bill of materials \(BOMs\)](#), which can be in the form of a table or a visual diagram. An example is shown in [Figure 9.8](#). Item A is the independent demand item. All the other items are dependent on demand. The quantities that go into the final item are shown in parentheses. Notice that two units of C are combined with one unit of B to make the final product. Similarly, two units of D and one unit of E are combined to make one unit of B.

Dependent demand order quantities are computed using a system called [material requirements planning \(MRP\)](#), which considers not only the quantities of each of the parts needed but also the lead times needed to produce and receive the items. For example, 20 units of A means that 20 units of B are needed, as are 40 units of C. Similarly, 40 units of D and 20 units of E are needed. However, the system must also take into account differences in lead times, as receiving D may have different lead times than receiving E. This means that the orders should be placed at different times. This system can also be tied to costs of goods and can link internal and external members of the supply chain. This is called [enterprise resource planning \(ERP\)](#), discussed in [Chapter 3](#).



Concept Check Questions

75. This type of demand is demand for a finished product, such as a computer, a bicycle, or a pizza.

- ☐ a) Independent demand
- ☐ b) Induced demand
- ☐ c) Dependent demand
- ☐ d) Calculated demand

Correct or Incorrect?

Clear

Check Answer

76. This demand is demand for component parts or subassemblies.

- ☐ a) Independent demand
- ☐ b) Induced demand
- ☐ c) Dependent demand
- ☐ d) Calculated demand

Correct or Incorrect?

Clear

Check Answer

77. Dependent demand is derived from its independent demand.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

78. The relationship between independent and dependent demand is shown using what?

- ☐ a) Material requirements planning
- ☐ b) Enterprise resource planning
- ☐ c) A bill of materials
- ☐ d) A flow chart

Correct or Incorrect?

Clear

Check Answer

79. Dependent demand order quantities are computed using a system called what?

- ☐ a) Material requirements planning
- ☐ b) Enterprise resource planning
- ☐ c) A bill of materials
- ☐ d) A flow chart

Correct or Incorrect?

Clear

Check Answer

80. An MRP system can also be tied to costs of goods and can link internal and external members of the supply chain. This is called what?

- ☐ a) Material requirements planning
- ☐ b) Enterprise resource planning
- ☐ c) A bill of materials
- ☐ d) A flow chart

Correct or Incorrect?

Clear

Check Answer

Global Insights Box

■ INTEL CORPORATION

Companies that make component parts are highly dependent on the success of the final product—their independent demand item. An example of this is Intel Corporation, which has become famous for its microprocessors, or chips, that run personal computers (PCs). The problem for Intel has been the declining PC market, signaling a decline in demand for their chips and the famous “Intel inside” logo.

To leverage its dependent demand position, Intel has come up with a new strategy. The company understands that there is a limit to where their core business will take them. As a result, they have pushed to be inside more than just PCs. They understand that their growth depends on sales of their independent demand items and are counting on other markets to break their dependence on the slowing PC market. The company is pushing to promote the fact that they are now inside a range of “Intel-powered devices,” ranging from three-dimensional (3-D) printers and robot assembly lines to solar-powered cars and fitness trackers. Intel is also developing chips to power drones, sensors, and robot butlers, rather than just PCs. The company cannot change its dependent demand position but it can expand the range of independent demand items it supplies. Therefore, the strategy is to make Intel inside everything.

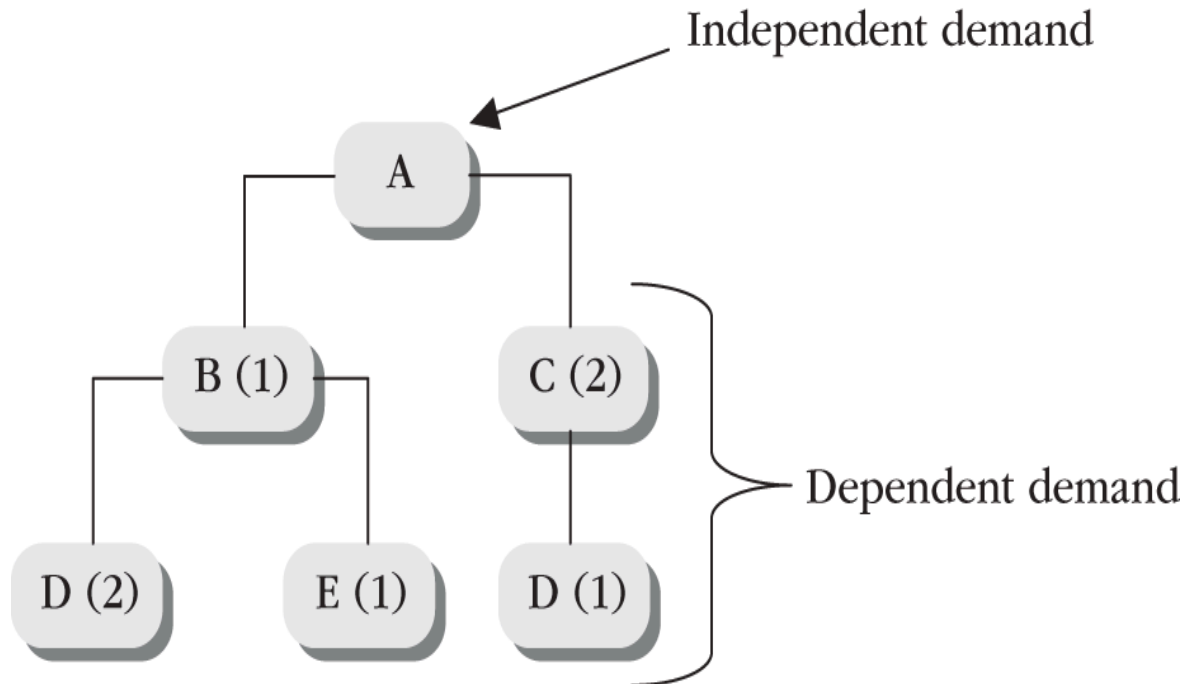


FIGURE 9.8 A simple bill of materials (BOMs).

Managing Supply Chain Inventory

The quantitative models we discussed help managers determine when and how much to order. However, managers should not just follow the models blindly. There are many practical implications to consider when managing supply chain inventories. We discuss these here.

Concept Check Questions

81. Quantitative inventory models help managers determine when and how much to order.

- ☐ True
- ☐ False

Correct or Incorrect?

82. There is no need to make adjustments to quantitative inventory models.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

ABC Inventory Classification

All items in the supply chain are not of equal importance. Some are very important, such as specialized surgical equipment. Others are less important, such as latex gloves in a hospital. The first step in managing inventory is to classify inventory based on its degree of importance in order to manage it properly. The tool for this is the ABC classification. Classifying inventory based on degree of importance allows us to give priority to important inventory items and manage those with care. It also prevents us from wasting precious resources on managing items that are of less importance.

ABC classification is based on Pareto's law, which states that a small percentage of items account for a large percentage of value. This value can be sales, profits, or other measure of importance. Roughly, 10–20% of inventory items account for 70–80% of inventory value. These highly valuable items are classified as “A” inventory items. Moderate-value items account for approximately 30% of inventory items and contribute to roughly 35% of the total. They are called “B” items. Finally, approximately 50% of the items only contribute to roughly 10% of the total inventory value. These are called “C” items and are of the least importance. [Figure 9.9](#) provides an example of ABC analysis.

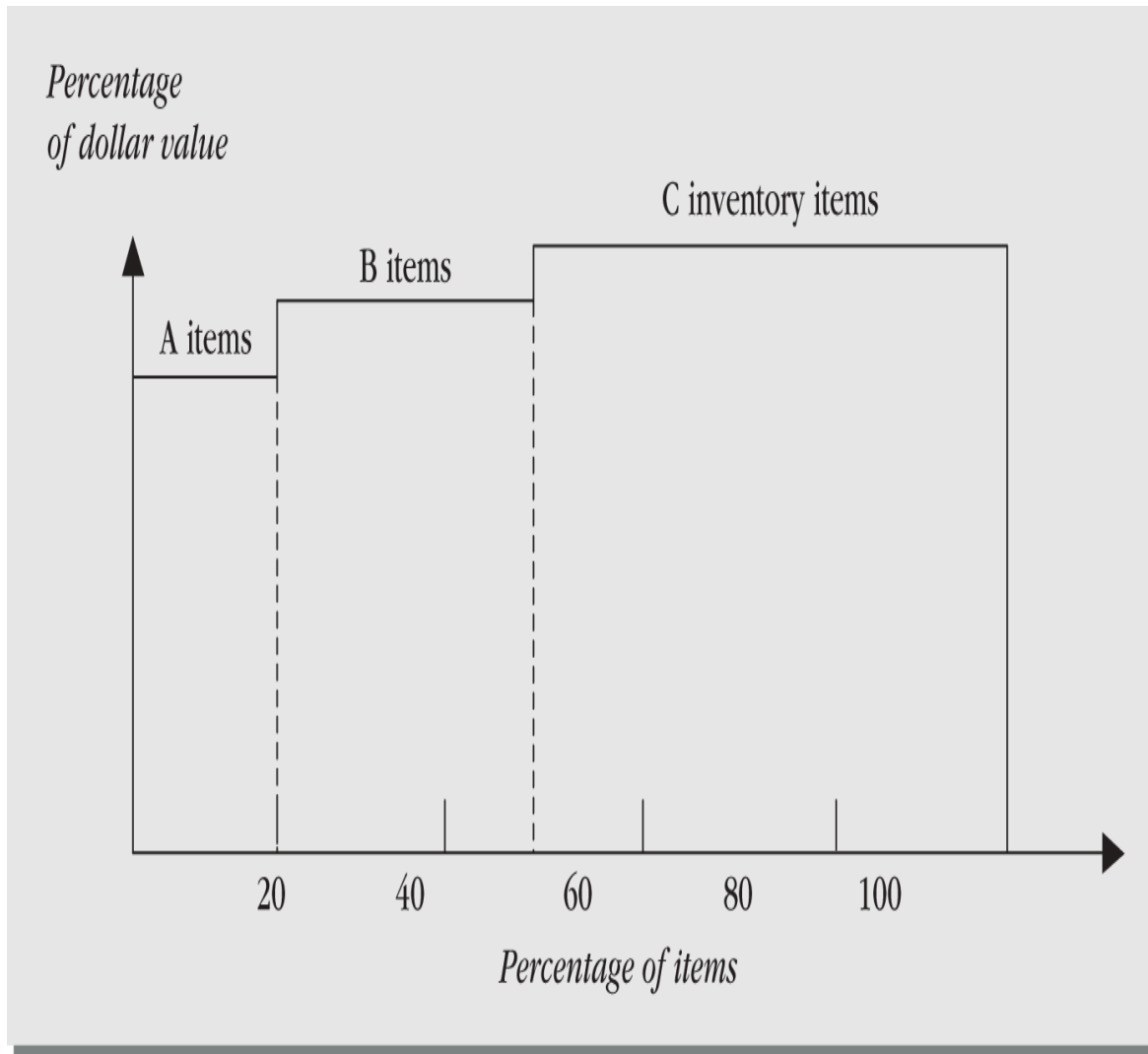


FIGURE 9.9 ABC classification of inventory.

McKesson Corporation, a major healthcare services and pharmaceutical distribution company, provides a real-life example of effectively implementing ABC classification for inventory management within the healthcare sector. Given the diverse range of medical supplies and equipment they handle, ABC classification is instrumental in prioritizing and managing inventory based on importance.

In the healthcare supply chain, critical and specialized surgical equipment (Category A) is crucial for patient care and requires meticulous management to ensure availability. Meanwhile, less critical items such as latex gloves (Category C) are essential but may not demand the same level of attention. By using ABC classification, McKesson can allocate resources more efficiently, ensuring that high-priority items receive the necessary focus and resources, while still maintaining an adequate stock of lower-priority items. McKesson's ABC classification strategy enables the company to consistently provide a wide range of healthcare products to various institutions underscoring the success of its inventory management practices. The application of ABC classification in the healthcare sector contributes to optimizing resource allocation and maintaining a balance between critical and less critical inventory items.

Conducting an ABC classification of inventory is quite easy. The steps are as follows:

Determine annual usage or sales for each item.

Determine the percentage of the total usage or sales by item.

Rank the items from highest to lowest percentage.

Classify the items.

After ranking the items from highest to lowest percentage, do not force groups to fit the preset percentages, as these are rough estimates. Rather, there are typically natural breaking points that will occur. The data will naturally group itself, and these are groupings that should be used.

ABC analysis is extremely important for determining order policies. The most sophisticated inventory systems should be used for A items. Many managers personally oversee these. By contrast, C items are typically left for automated ordering systems as they do not warrant the cost of managerial involvement.

ABC analysis is also important in establishing safety stock levels. Remember that safety stock is extra inventory held to guard against uncertainty of demand and prevent stockouts. All inventory items are not of equal importance, and the safety stock policy will be different based on ABC classification. The importance of not running out of stock of a particular item will enter the safety stock computation through the service level component, k . For example, a service level of 80% results in a significantly lower safety stock than a 98% service level. ABC classification is a critical part of the stocking decision given the costs of holding extra inventory, as well as the costs of stocking out.

Concept Check Questions

83. All items in the supply chain are not of equal importance.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

84. ABC classification is based on the standard normal distribution.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

85. Roughly 10% to 20% of inventory items.

- ☐ a) A inventory items
- ☐ b) B inventory items
- ☐ c) C inventory items
- ☐ d) D inventory items

Correct or Incorrect?

Clear

Check Answer

86. Roughly 70% to 80% of inventory value.

- ☐ a) A inventory items
- ☐ b) B inventory items
- ☐ c) C inventory items
- ☐ d) D inventory items

Correct or Incorrect?

Clear

Check Answer

87. Roughly 30% of inventory items.

- ☐ a) A inventory items
- ☐ b) B inventory items
- ☐ c) C inventory items
- ☐ d) D inventory items

Correct or Incorrect?

Clear

Check Answer

88. Roughly 35% of inventory value.

- ☐ a) A inventory items
- ☐ b) B inventory items
- ☐ c) C inventory items
- ☐ d) D inventory items

Correct or Incorrect?

Clear

Check Answer

89. Roughly 50% of inventory items.

- ☐ a) A inventory items
- ☐ b) B inventory items
- ☐ c) C inventory items
- ☐ d) D inventory items

Correct or Incorrect?

Clear

Check Answer

90. Roughly 10% of inventory value.

- ☐ a) A inventory items
- ☐ b) B inventory items
- ☐ c) C inventory items
- ☐ d) D inventory items

Correct or Incorrect?

Clear

Check Answer

91. ABC analysis is extremely important for determining order policies.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

92. ABC analysis does not impact safety stock.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Practical Considerations of EOQ

Several practical considerations must be taken into account when using the EOQ, rather than applying it blindly.

Lumpy Demand (POQ). EOQ assumes demand to be uniform. However, product demand can sometimes be “lumpy.” This means that it occurs in a discontinuous or nonuniform fashion, with some periods exhibiting high demand and then other periods having zero demand. Using EOQ in this case results in carrying too much inventory over periods with no demand. A more practical option here is to use something called a [periodic order quantity \(POQ\)](#).

P&G adeptly addresses lumpy demand in its inventory management through the implementation of POQ. As a consumer goods giant, P&G encounters varying demand patterns for its extensive product range, with some items experiencing sporadic bursts of high demand. In such scenarios, traditional EOQ models may result in inefficient inventory management. By adopting the POQ approach, P&G optimizes order quantities based on the fluctuating demand, preventing excessive inventory buildup during periods of no demand.

As with EOQ, the logic behind the POQ is to balance ordering and holding costs. The difference, however, is that ordering is done in whole periods of demand. To determine the number of periods to order, the first step is to compute the EOQ quantity. Next, we determine the average number of periods of demand covered by the EOQ, and then order that quantity rounding up. For example, let us consider that the weekly demand is 120 units with an EOQ of 350 units. This means the EOQ covers an average of $350/120 = 2.9$ weeks of demand. This rounds to an “economic order period” of three weeks, meaning that we always order 3 weeks of demand at a time. This is the POQ.

EOQ Adjustments. Recall that the EOQ was computed as the minimum point on the total cost curve. However, this total cost curve is pretty flat around the minimum point. It is a soft curve rather than a sharp minimum point. This means that ordering slightly above or below the minimum point does not substantially change the total cost. This allows managers to increase or decrease the EOQ—within reason, of course—to accommodate container sizes, truckloads, and various types of discounts.

Capacity Constraints. When computing anticipation inventory, we typically consider the balance between inventory holding cost and anticipated costs we are trying to avoid. One additional factor that needs to be considered is capacity or storage size. Ordering extra inventories to hedge against a price increase may result in unanticipated expenses if additional storage space needs to be leased.

Concept Check Questions

93. EOQ assumes demand to be uniform.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

94. A periodic order quantity is best when lead time is variable.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

95. With a POQ system, ordering is done in whole periods of demand.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

96. Ordering slightly above or below the minimum point (EOQ) substantially changes the total cost.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

97. When computing anticipation inventory we typically consider the balance between inventory holding cost and anticipated costs we are trying to avoid. One additional factor that needs to be considered is capacity or storage size.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Measuring Inventory Performance

Inventory impacts the supply chain both in terms of customer service and cost. Given its importance, the success of inventory policy must be measured and evaluated regularly. The most common metrics to measure inventory are

- Units
- Dollars
- Weeks of supply
- Inventory turns

The first two measures directly address the number of units available and the dollars tied up in inventory. The last two measures were discussed in [Chapter 7](#). Recall that “weeks of supply” is a measure of inventory quantity relative to usage, and “inventory turnover” gives us a sense of inventory movement. Their computations are as follows:

$$\begin{aligned}\text{Weeks of supply} &= \frac{\text{Average on-hand inventory}}{\text{Average weekly usage}} \\ \text{Inventory turnover} &= \frac{\text{Cost of goods sold}}{\text{Average inventory value}}\end{aligned}$$

In [Chapter 7](#), we were given average inventory value. Now that we know a bit about ordering policy, we can compute it as follows:

$$\text{Average inventory value} = \left(\frac{Q}{2} + SS \right) C$$

The inventory turnover for an individual item is then computed as follows:

$$\text{Inventory turnover} = \frac{DC}{\left(\frac{Q}{2} + SS\right) C} = \frac{D}{\frac{Q}{2} + SS}$$

EXAMPLE 5 Average Inventory Calculation

Suppose that an item is being managed using a fixed-order quantity model with safety stock. The following information is given:

$$\begin{aligned}\text{Annual Demand } (D) &= 1,000 \text{ units} \\ \text{Order quantity } (Q) &= 250 \text{ units} \\ \text{Safety stock } (SS) &= 50 \text{ units}\end{aligned}$$

What are the average inventory and inventory turn for the item?

SOLUTION:

$$\begin{aligned}\text{Average inventory} &= \frac{Q}{2} + SS = \frac{250}{2} + 50 = 175 \text{ units} \\ \text{Inventory turnover} &= \frac{D}{\left(\frac{Q}{2} + SS\right)} = \frac{1,000}{175} = 5.71 \text{ turns per year}\end{aligned}$$

Concept Check Questions

98. Inventory impacts the supply chain both in terms of customer service and cost.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

99. It is not necessary to measure and evaluate inventory policy on a regular basis.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

100. Average inventory value ignores cost.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

101. Inventory turnover can be computed without knowing the cost of the item.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Vendor-managed Inventory (VMI)

Historically companies owned and managed all of their inventories. They were responsible for the storing, controlling, replenishing, and overall management of the inventory. With supply chain management (SCM), most of this has changed. Today, many firms have implemented vendor-managed inventory (VMI) arrangements. Here, the vendor is responsible for managing the inventory located at a customer's facility. The vendor stocks the inventory, places replenishment orders, and arranges its display. The vendor typically owns the inventory until it is purchased by the customer.

VMI offers many important advantages to both the customer and the vendor. The vendor has greater control over their product. They are required to work much more closely with the customer, giving them better understanding of how to serve the market. The customer, in turn, has less responsibility and financial burden over the inventory items. VMI requires both the vendor and customer to work closely together. It represents one of the many partnership arrangements that have evolved in SCM.

Cisco Systems, a global technology company, is a noteworthy example of successful VMI implementation. Cisco, known for its networking and communication solutions, has embraced VMI to enhance efficiency in its supply chain.

In VMI arrangements, Cisco's suppliers take an active role in managing inventory levels at Cisco's distribution centers. This includes tasks such as inventory replenishment, order fulfillment, and ensuring optimal stock levels based on demand patterns. Vendors maintain ownership of the inventory until products are utilized by Cisco, allowing for a streamlined and collaborative supply chain process.

The adoption of VMI has enabled Cisco to focus on its core competencies while leveraging the expertise of its suppliers in inventory management. This collaborative approach fosters better communication, agility, and responsiveness in the supply chain. While specific statistics on Cisco's VMI strategy may not be publicly disclosed, the company's ability to consistently deliver cutting-edge technology products to a global market attests to the effectiveness of its collaborative supply chain practices, including VMI.



Concept Check Questions

102. Historically companies owned and managed all of their inventories.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

103. Today, many firms have implemented vendor managed inventory (VMI) arrangements.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

104. With vendor managed inventory (VMI), the vendor is responsible for managing the customer's inventory at the vendor's facility.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

105. With VMI, vendors are required to work much more closely with the customer, giving them better understanding of how to serve the market.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Empowering Entrepreneurs Box

For business owners, inventory can make up well over 50% of the business's current assets, and poor inventory tracking is a major factor in small business failure. Entrepreneurs usually start with a passion and an idea. Getting into the details of inventory management can seem like a mundane task. Even Howard Schultz, former founder and chief executive officer (CEO) of Starbucks, once complained that what had started with an inspiring café idea quickly turned into discussions of inventory levels and ordering policies. Entrepreneurs must remember, however, that without having the right inventories a business cannot satisfy its customers—and with too much inventory the company's capital can be tied up. Even worse the company could simply be stuck with excess inventory that is not selling.

Many entrepreneurs often begin by managing inventories informally, storing goods in a rented space or even their garage, and then occasionally taking a physical count. However, as the business grows this becomes untenable. An entrepreneur cannot grow their business without knowing exactly how much inventory they have of each item, where the inventory is located, and what it is costing the company. Inventories are directly tied to capital use and the financial picture.

The smart thing to do is have a formal inventory management process from the beginning. Many entrepreneurs are taken by surprise when their business starts to grow and they are not prepared. They find that they cannot accurately assess their ability to meet customer demand and don't know what to do. There are some simple things an entrepreneur can look for as red flags that things are not going well. First, pay attention to inventories climbing faster than sales and monitor inventory turns, as discussed in this chapter. These signal that you have too much inventory or that the market is changing, such as a decline in orders of certain items. Second is to check if backorders are piling up, as this may mean you do not have enough inventories. Perhaps there is a problem with supply or that production is interrupted because of a lack of material. An entrepreneur has to stay abreast of these measures at all times. Inventory management will keep an entrepreneur informed about the status of products and provide critical information helping them decide what to do.

CHAPTER HIGHLIGHTS

There are many reasons for carrying inventory. They include protecting against lead time demand, maintaining independence of operations, balancing supply and demand, buffering against uncertainty, and achieving economic purchase orders.

There are different types of inventories intended for different purposes. Inventory types are “cycle stock,” “safety stock,” “anticipation inventory,” “pipeline inventory,” and MRO.

The three inventory costs are “holding cost,” “ordering cost,” and “shortage cost.” Inventory holding cost includes all the costs involved with holding inventory in stock. Ordering cost is the cost of placing an order. Shortage cost is the cost associated with being out of stock, such as loss of customer goodwill and possible lost sales.

Inventory systems answer two basic questions: “when to order” and “how much to order.” Two of the most common types of inventory systems are “fixed-order quantity system,” and “fixed-time period system.”

In a fixed-order quantity system the order placed is constant or fixed. An order is placed when the IP drops to the ROP, noted as ROP. In the basic fixed-order quantity system the order quantity is computed as an economic order quantity or EOQ. When production directly feeds demand, then it is computed as an EPQ.

In a fixed-time period system orders are placed in regular time intervals denoted by T . The order that is placed varies and is the quantity that will return the IP to a target inventory level, denoted as R .

Independent demand is “demand for a finished product,” such as a computer, a bicycle, or a pizza. Dependent demand is “demand for component parts or subassemblies” that are a result of the independent demand item.

To manage inventory properly it must be classified based on its degree of importance. The tool for this is the ABC classification. This allows us to give priority to important inventory items and manage those with care, while not wasting resources on items that are of less importance. Inventory items are of the highest importance and must be monitored carefully. B items are classified as moderate importance, and C items are of least importance.

Inventory must be measured and evaluated regularly given its impact on cost and customer service. The most common ways to measure inventory are in units, dollars, weeks of supply, and inventory turns.

VMI is an arrangement where the vendor is responsible for managing the inventory located at a customer's facility. The vendor stocks the inventory, places replenishment orders, and arranges its display. The vendor typically own the inventory until it is purchased by the customer.

KEY TERMS

[Raw materials](#)

[Component parts](#)

[Work-in-process \(WIP\)](#)

Finished goods

Service inventory.

Inventory policy.

Seasonal inventory.

Hedge inventory.

Transportation inventory.

Holding cost

Ordering cost

Shortage cost

Carrying cost

Dollar value

Percentage of item cost

Setup cost

Fixed-order quantity system

EOQ model

Q-model

Continuous review system

Sawtooth model

Fixed-time period system

Periodic Review System

Safety stock

Safety stock

Buffer stock

Economic production quantity.(EPQ)

Production rate model

Independent demand

Dependent demand

Bill of materials (BOMs)

Material requirements planning.(MRP)

Enterprise resource planning.(ERP)

Periodic order quantity.(POQ)

DISCUSSION QUESTIONS

Identify an example of inventory in your own life. Estimate how much it costs you to hold this inventory. Estimate the “ordering cost.” How often do you replenish this inventory, and which of the inventory policies does this most closely resemble?

Think of a service you recently used. How might this service be restructured to create service inventory as in the example of Zoots? What would they have to do? What advantages would the company gain, and how would they better serve their customers?

Find at least one business example of a fixed-order quantity system vs a fixed-period quantity system. What are their differences? Which do you think is better, and why?

Provide an example of ABC classification in a business you are familiar with. What would be the A inventory items vs B and C? What ordering policies would you use for each of these?

Identify an example of VMI. Explain the benefits to both the vendor and retailer. Identify some of the risks for both parties.

PROBLEMS

Ricky Orange's annual demand is 12,500 units. The ordering cost is \$100 per order. Holding cost is estimated at 20% of product cost, which is \$50 per unit. What is the number of orders per year using EOQ to compute the best quantity to order? What is the annual holding cost? What is the ROP? Assume four weeks/month, lead time L is 1 week, and demand rate is 250 units per week.

You are the inventory manager of Diego Supplies, Inc. You computed the EOQ to be 500 units. Annual demand for the company is 5,000 units, and holding cost is \$4 per unit. What is the ordering cost?

G-Tech's monthly demand is 250 units. You are in charge of the inventory department. You know that the holding cost is \$60 per unit and the ordering cost is \$100 per order. What is the EOQ? What is the number of orders per year? What is the annual holding cost? If lead time L is 1 week and the demand rate is 60 units per week, what is the ROP?

We know that Blue Pad Company's lead time L is 1 week and the demand rate is 100 units per week. Compute the amount of Safety Stock and new ROP, assuming that the company desires a 98% service level. The standard deviation of demand over lead time is eight.

Bright Light computed their new ROP to be 116.45. Assume that lead time L is 1 week and demand rate is 100 units per week. What is the company's desired service level, assuming the standard deviation of demand over lead time is 10?

Basic Code Tech desires a 95% service level to compute its safety stock. The variance of demand over lead time is 64. We computed its new ROP to be 14.16. What is the demand rate per week if we assume its lead time, L , is 1 week?

The Yacht Company builds personal yachts. Its annual demand is 10 yachts. This company can build at a rate of one yacht per month. Carrying costs is very expensive and is about \$10,000 per year. The setup cost for a production run of yachts is \$2,000. Find the order quantity and $I_{\max}$.

Linden Jet's annual demand is 20. It can build at a rate of four jets per month. The setup cost for a production run of jets is \$1,000. Find the order quantity and $I_{\max}$, assuming carrying cost is \$1,000

per year.

Lugini Watch's annual demand is 100. It can produce at a rate of 10 watches per month with a \$100 setup cost for the production run. Find the order quantity and $I_{\max}$, assuming the carrying cost is \$100 per unit.

Apple Cakes reviews inventory every 2 weeks with a lead time of 7 days, a demand rate of 40 units per day, and a standard deviation of five units per day. If the company tolerates no more than one stockout per year, develop the ordering policy for a fixed-time period inventory system assuming 52 weeks per year.

Ice Ginger reviews inventory every 2 weeks. As the inventory manager of the company, you know that its lead time is 7 days and its demand rate is 40 units per day. Given variance is 25 units per day, you calculated the target inventory level to be 881 units. Now, how many stockouts per year are permitted by the company assuming 52 weeks per year? Show all calculations.

Pure Grapes reviews inventory every week. Lead time, L is 7 days, and the demand rate is 100 units per day. You know the company's standard deviation is 10 units per day and allows one stock-out per year. Develop the ordering policy for a fixed-time period inventory system assuming 52 weeks per year and 95% service level.

Case Study Making Decisions with Analytics: ColorWorld

In January, Vidhi started a business that produces colored pencils for elementary school children called ColorWorld. Her goal was to serve the Greater Boston regional market. She used a market intelligence algorithm that predicted an average monthly demand of 100,000 pens. The market requires that Vidhi supply the pens 1 month ahead of time (for example, to meet February 1 demand, she needs to supply them on January 1).

Anticipating a future increase in demand, Vidhi set up manufacturing capacity for producing 125,000 units per month with a regular shift operating 5 days a week. To test the production facility, in the first month they produced at full capacity. However, they only sold 10,000, 20,000, and 20,000 pens in the first 3 months. As a result, they are currently sitting on an inventory of 75,000 pens. At the end of March, working with sales and marketing, Vidhi's planning team came with a forecast of 20,000, 25,000, 30,000, 125,000, 225,000, and 200,000 for each month for the next 6 months.

Case Questions

What should Vidhi do? (Select one of the four options below and explain your answer.)

1. Ignore the new analytics forecast and use a conservative approach to reduce inventory.
2. Try and understand the planning team's reasoning for an illogical-looking forecast. Then apply your judgment and "correct" the forecast.
3. Believe the forecast is accurate and immediately start production at full capacity.
4. Believe the forecast may be accurate, but do not commit your entire production capacity immediately. Wait until the fourth month (July) to confirm uptake in demand. If actual demand is greater than the capacity, try to cover production using contract manufacturers.

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10

Lean Systems and Six Sigma Quality

LEARNING OBJECTIVES

After completing this chapter, you should be able to:

Describe Lean and Six Sigma, and explain the benefits of “Lean Six Sigma.”

Identify elements of the Lean philosophy.

Explain Lean production.

Explain total quality management (TQM).

Explain statistical process control (SPC).

Describe the Lean Six Sigma supply chain.

CHAPTER OUTLINE

- **What Is Lean?**
Lean Six Sigma
Lean Philosophy
Elements of Lean
- **Lean Production**
The Pull System
Visual Signals
Small Lot Production
Uniform Plant Loading
- **Respect for People**
Role of Workers
Role of Management
Role of Suppliers
- **Total Quality Management (TQM)**
Voice of the Customer
Costs of Quality
Quality Tools
ISO 9000
- **Statistical Quality Control (SQC)**
Sources of Variation
Process Capability
Process Control Charts
Control Charts for Attributes
- **Six Sigma Quality**
What Is Six Sigma?

Six Sigma Methodology

■

The Lean Six Sigma Supply Chain

Developing a Lean Six Sigma Supply Chain

Impact on Supply Chain Activities

Suppliers

Operations

Logistics

■

Chapter Highlights

■

Key Terms

■

Discussion Questions

■

Problems

■

Case Study: Buckeye Technologies

■

Case Study: Making Decisions with Data Analytics: Calloway, Inc.

■

Bibliography



VIDEO
CONTENT

[Bloomberg Quicktake Video: Impact of Geopolitics, US Election on Tech Sector](#)

[Bloomberg Quicktake Video: Target Tops Profits as Inventories Decline](#)

Orthopedic surgeon Doug Woolley was frustrated. A bottleneck in the recovery room at the Community Medical Center in Missoula limited the total number of joint replacements he could do each week. The system limited him to four procedures, although he had time to do at least one more. He turned for help to Cindy Jimmerson, who worked with the hospital to implement a management system called Lean. They began by conducting observations of the system and quickly noticed some key problems. They observed nurses working hard and automatically going “around” barriers without even considering that the barriers could be removed.

They identified a few big things that could be improved immediately. One was posting a physician's or nurse's beeper number in an obvious place where it could be immediately seen. Although it seems simple, this prevented a common bottleneck—having to call somebody to find the number. These types of changes were made immediately, and the results were astounding. Patient time in the recovery room went from 90 minutes to 62 minutes, and as a result, the patient's bill went down. The hospital's productivity increased, and now Dr. Woolley can perform more procedures per week.

Similar benefits are occurring across the country as hospitals and medical centers implement Lean. At Goshen Health System on-time start in the hospital's operating department went from 15 to 80% in only 8 weeks after implementing Lean. A team of employees examined the processes. They determined that the factor most responsible for the late start time was not having everything needed at the right place at the right time. This included supplies, staff, physicians, and the patient. As a result, the team developed process improvements so that everything was in place and worked to educate physicians and staff on the impact of late arrivals. As a result of these efforts, the system reduced its average operating room (OR) turnover time from 30 minutes to 15 minutes.

As these examples illustrate, we are seeing organizations in all industries, including hospitals and healthcare clinics, improve their efficiency by implementing Lean systems. Although originally developed for manufacturing, the key goals of Lean—eliminating waste, simplifying the system, and continually improving—can be applied to all organizations.

Concept Check Questions

1. Orthopedic surgeon Doug Woolley was frustrated. A bottleneck in patient check-in at the Community Medical Center in Missoula limited the total number of joint replacements he could do each week.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

2. Lean has applications in a hospital.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

3. Although originally developed for manufacturing, the key goals of Lean—eliminating waste, simplifying the system, and continually improving—can be applied to all organizations.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

4. Lean only has applications in manufacturing.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

What Is Lean?

Lean Six Sigma

Lean is a management approach for creating value for the end customer through the most efficient utilization of resources possible. Lean is about eliminating waste of every type and involves numerous organizational efforts that work in unison. One of the most significant is the focus on quality and the use of a stringent methodology to identify and eliminate root causes of quality problems called Six Sigma. For this reason, the two are often combined through the term Lean Six Sigma. Lean Six Sigma combines the benefits of both approaches, as shown in Figure 10.1, utilizing the tools from each. In this chapter, we will look at each one and see how they work to create an efficient Lean Six Sigma supply chain.

Concept Check Questions

5. _____ is a management approach for creating value for the end customer through the most efficient utilization of resources possible.

- ☐ a) Process control
- ☐ b) Lean
- ☐ c) Lean Six Sigma
- ☐ d) Six Sigma
- ☐ e)

Correct or Incorrect?

Clear

Check Answer

6. One of the most significant is the focus on quality and the use of a stringent methodology to identify and eliminate root causes of quality problems. This is called _____.

- ☐ a) Process control
- ☐ b) Lean
- ☐ c) Lean Six Sigma
- ☐ d) Six Sigma
- ☐ e)

Correct or Incorrect?

Clear

Check Answer

7. Six Sigma and Lean Six Sigma are the same thing.

- ☐ True
- ☐ False

Correct or Incorrect?

Lean Philosophy

Originally pioneered by Toyota in the 1970s, Lean has been widely adopted in numerous industries. Its implementation often results in large cost reductions, improved quality, and increased customer service. The benefits are so impressive that Lean has become a standard in many industries, such as auto, aerospace, and the computer industry. It is used by companies such as Honda, General Electric Company (GE), Boeing, Lockheed Martin, Hewlett-Packard, and IBM. Volkswagen strongly relies on Lean to coordinate processes designed down to the very smallest detail and keep production moving smoothly 24 hours a day. Companies in retail, such as Zara, Target, and Amazon, have also implemented Lean, and so have many hospitals and healthcare institutions, as we have seen in the chapter opener.

Lean is often thought of as just another type of production process, given its roots in manufacturing. However, Lean is an all-encompassing organizational philosophy founded on six tenets shown in [Figure 10.2](#). The most significant of these is eliminating [waste](#), where waste is defined as anything that does not add value. We look at these in more detail next.

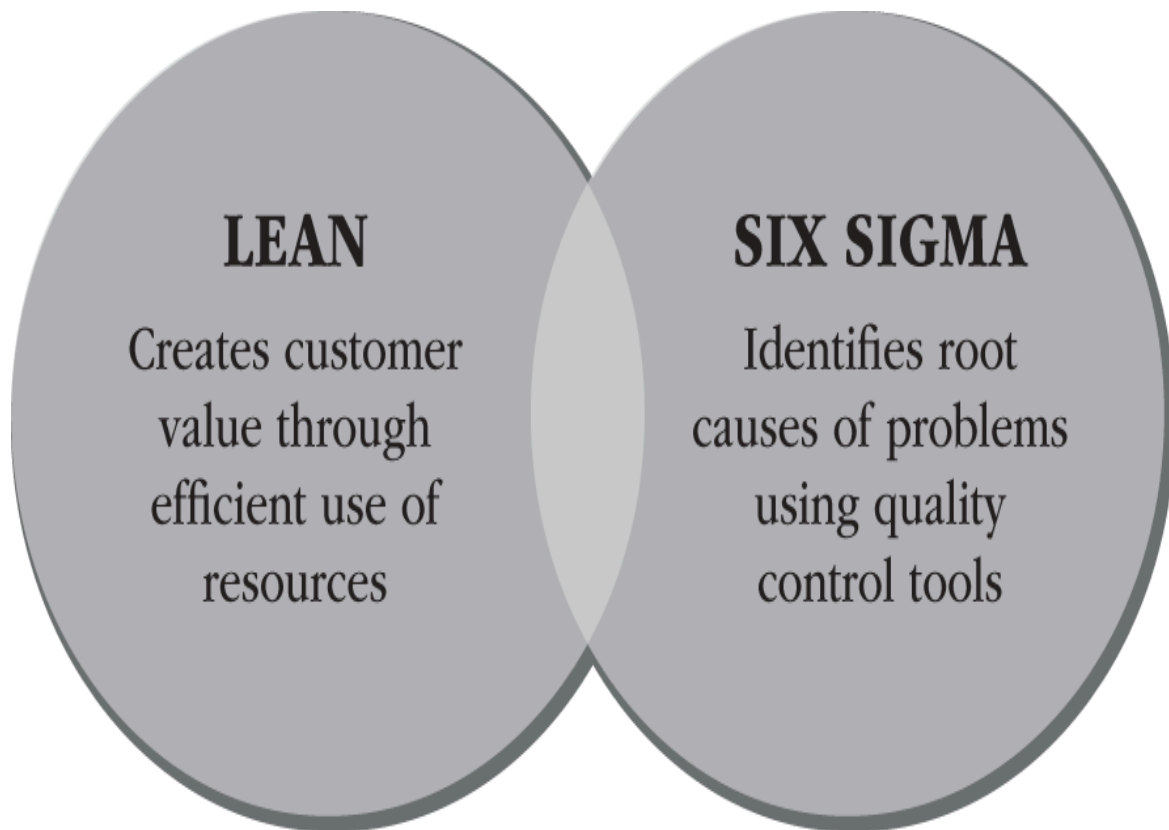


FIGURE 10.1 Lean Six Sigma.

1. Elimination of waste

- Eliminate all “non-value”-adding activities.

2. A broad view

- Overall goals should drive all tasks.

3. Simplicity

- The simpler the solution the better.

4. Continuous improvement

- Apply the idea of never-ending improvement.

5. Visibility

- Visible problems are identified and solved.

6. Flexibility

- Quickly adapt to changing customer needs.

FIGURE 10.2 Tenets of the Lean philosophy.

Elimination of Waste. Waste is anything that does not add value to the system. This includes excess material, equipment, time, energy, space, or human activity that does not contribute to the value of the product or service being produced. The concept of waste, however, has an even broader meaning. Waste can be found in the production process itself through waiting and excess stock. It is seen in the poor layout design of facilities that requires transporting goods from one part of the facility to another. Waste can exist in unneeded motion, such as searching for parts or supplies. Waste is poor quality resulting in scrap and rework, which is costly and adds no value.

Consider the healthcare facility discussed in the chapter opener. Value-adding activities include registering, triaging, and examining the patient. On the contrary, sitting in the waiting room, filling out duplicate forms, or waiting in an examining room are nonvalue adding. Eliminating this type of waste is the focus of Lean.

Novo Nordisk, a leading global healthcare company founded in Denmark, offers an example of the benefits of Lean. The company applied Lean to its production processes, aiming to streamline operations and reduce waste. One significant area targeted was the production of insulin pens, where they faced inefficiencies and delays. By adopting Lean principles, Novo Nordisk restructured its production layout, reducing unnecessary movement and optimizing the flow of materials and equipment. They also implemented just-in-time (JIT) principles to minimize inventory waste and ensure materials were available precisely when needed for production.

The results were impressive. Novo Nordisk managed to reduce its production lead time by over 50%. Additionally, their defect rate decreased significantly, leading to a substantial decrease in rework and waste of materials. This Lean transformation not only improved their production efficiency but also enhanced the quality of their insulin pens and reduced overall operational costs. The success of Lean implementation at Novo Nordisk demonstrates how applying these principles can yield tangible improvements in efficiency and waste reduction in pharmaceutical manufacturing, as well as any process.

A Broad View. All tasks and processes should be driven by one goal—to serve the customer. It is easy for a company to think of its own needs and not that of the entire supply chain. Similarly, it is easy for employees to focus exclusively on their jobs and view the organization solely from their assigned

tasks. A broad view involves understanding that all supply chain partners, and their employees, are ultimately responsible for providing value to the final customer. Decisions should be made for the success of the entire chain rather than their success.

Simplicity. Lean emphasizes simple solutions to problems. It is easy to solve an organizational problem using complex and expensive methods. Finding a simple solution that addresses the root cause of the problem is quite difficult. Just consider how, in the chapter opener, something as simple as posting a physician's beeper number where it could be immediately seen helped improve process efficiency in the recovery room.

Continuous Improvement. Emphasis on quality and continuous improvement—called [kaizen](#)—is an important element of Lean. Continuous improvement applies to everything from reducing costs to improving quality to eliminating waste. The premise is that organizations are never perfect and can always be improved in some way. Several companies utilize a continuous improvement approach called a “[kaizen blitz](#).” This is an improvement tool that utilizes cross-functional teams to plan and deliver improvements to specific processes during two- or three-day marathon sessions. The process allows a small team to intently concentrate on one problem for a short period. Companies find that a kaizen blitz can quickly deliver dramatic and low-cost improvements to processes.

Supply Chain Leader's Box—Kaizen

■ TOYOTA

Toyota, the pioneer of Lean principles, is a notable example of a company that heavily emphasizes continuous improvement through kaizen. Toyota regularly implements kaizen events or “blitzes” as part of its continuous improvement culture.

One such example was observed at Toyota's manufacturing plants, where the company conducted focused kaizen blitz sessions to enhance specific assembly line processes. During these intense two- or three-day sessions, cross-functional teams consisting of assembly line workers, engineers, and managers would concentrate on a particular area or process to identify inefficiencies and brainstorm solutions. For instance, they might target reducing assembly line downtime or improving the ergonomics of workstations. A notable result of these kaizen blitzes was the significant reduction in assembly line setup times. By scrutinizing and refining their processes, Toyota managed to slash the setup time for certain manufacturing tasks by up to 50%, allowing for quicker transitions between production runs and enhancing overall productivity.

Toyota's commitment to continuous improvement through kaizen blitzes illustrates how short, focused bursts of improvement efforts can yield substantial enhancements in processes and efficiency. These practices have influenced numerous companies worldwide to adopt similar continuous improvement strategies to enhance their operations.

Visibility. Lean tells us that waste can be eliminated only when it is seen and identified, and it cannot be identified if it is hidden. For this reason, Lean stresses visibility. Lean facilities are open and clean, with ample floor space. Problems are visible to everyone. The Lean philosophy stresses that a cluttered environment creates confusion and disrespect toward the workplace. In contrast, a clean environment creates order and improves performance.

Flexibility. Flexibility means adapting to changes in the environment. A company can be flexible in many ways. Flexibility can mean rapidly changing production volumes as demand changes. Flexibility is also the ability to

produce a wide variety of products. Lean systems are designed to easily switch from one product type to another, using flexible workers that perform many different tasks. Processes are designed to be highly efficient but flexible to accommodate changing customer demands.

One factor that enables flexibility is relying on general-purpose equipment capable of performing a variety of different functions. In manufacturing, this might be a drilling machine able to drill holes in an engine block and also perform milling and threading operations. This is different from having specialized equipment that can perform only one task. Just consider the benefits of having an all-in-one printer, copier, fax, and scanner.

Artificial Intelligence (AI) and Analytics Box

■ GENERAL ELECTRIC

GE is the icon of best management practices and management efficiency approaches such as “Lean” and “Six Sigma.” These were the hallmarks of GE under the leadership of chief executive officer (CEO), Jack Welch, in the 1980s and 1990s. However, as other companies adopted these best practices, they no longer provided a unique competitive advantage. For GE, Lean and Six Sigma continue to be the hallmarks of their culture. As the company has evolved, they have taken excellence in these practices as a foundation for other ventures. One such practice involves combining big data with lessons in Lean from entrepreneurship.

AI and digitization are speeding up all processes in every industry sector. Companies are now competing more like the software industry, which is characterized by short product life cycles and rapid decision making. GE has responded to this changing environment and has worked to apply an approach called “Lean Startup.” It is a Lean approach developed for entrepreneurs to develop new products with short cycles. It involves “sprints” (quick deliverables) and fast learning and applies Lean principles. GE has branded it “FastWorks” and believes that the rapid learning cycles with customers will reduce the risk of building products the customers do not want. GE has applied FastWorks to product development with excellent results. It has so far cut program costs and development speed in half.

Concept Check Questions

8. Lean was originally pioneered by _____.

- ☐ a) Toyota
- ☐ b) Honda
- ☐ c) Ford

- ☐ d) Kia
- ☐ e) Nissan

Correct or Incorrect?

Clear

Check Answer

9. Lean is not widely used.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

10. Lean has become a standard in many industries.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

11. Lean is just another type of production process.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

12. Remove all “non-value”-adding activities.

- ☐ a) Elimination of waste
- ☐ b) A broad view
- ☐ c) Simplicity
- ☐ d) Continuous improvement
- ☐ e) Visibility

Correct or Incorrect?

Clear

Check Answer

13. Overall goals should drive all tasks.

- ☐ a) Elimination of waste
- ☐ b) A broad view
- ☐ c) Simplicity
- ☐ d) Continuous improvement
- ☐ e) Visibility

Correct or Incorrect?

Clear

Check Answer

14. The more straightforward the solution the better.

- ☐ a) Elimination of waste
- ☐ b) A broad view
- ☐ c) Simplicity
- ☐ d) Continuous improvement
- ☐ e) Visibility

Correct or Incorrect?

Clear

Check Answer

15. Apply the idea of never-ending improvement.

- ☐ a) Elimination of waste
- ☐ b) A broad view
- ☐ c) Simplicity
- ☐ d) Continuous improvement
- ☐ e) Visibility

Correct or Incorrect?

Clear

Check Answer

16. Observable problems are identified and solved.

- ☐ a) Elimination of waste
- ☐ b) A broad view
- ☐ c) Simplicity
- ☐ d) Continuous improvement
- ☐ e) Visibility

Correct or Incorrect?

Clear

Check Answer

17. Quickly adapt to changing customer needs.

- ☐ a) Elimination of waste
- ☐ b) A broad view
- ☐ c) Simplicity
- ☐ d) Flexibility
- ☐ e) Visibility

Correct or Incorrect?

Clear

Check Answer

18. Waste is anything that does not add value to the system.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

19. Waste is anything that must be discarded.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

20. All tasks and processes should be driven by one goal—what is best for the stockholders.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

21. Lean emphasizes IT solutions to problems.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

22. Emphasis on quality and continuous improvement—called _____—is an important element of Lean.

- ☐ a) Agile
- ☐ b) Deming cycle
- ☐ c) muda
- ☐ d) kaizen
- ☐ e) baka-yoke

Correct or Incorrect?

Clear

Check Answer

23. A number of companies utilize a continuous improvement approach called a “kaizen blitz.”

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

24. Lean tells us that waste can be eliminated only when it is seen and identified, and it cannot be identified if it is hidden.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

25. Flexibility means adapting to changes in the production process.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Elements of Lean

Lean is composed of three elements that work in unison: [Lean production](#), [total quality management \(TQM\)](#), and [respect for people](#). They are shown in [Figure 10.3](#). Note that Lean production is just one element of Lean—a frequent misunderstanding. It is the three elements that work together to create a complete Lean system.

Lean production focuses on the operations and delivery system. It involves developing an efficiently coordinated system that makes it possible to produce the exact products desired and deliver them in the right quantities to where they are needed just in time. For this reason, it is often called “[just-in-time \(JIT\)](#)”. Lean Production is known as a [pull production](#) system that keeps minimal levels of inventory, relies on efficiencies gained by repetition, elimination of all unnecessary steps and motions, and use of visual signals.

The second element of Lean is the focus on quality through concepts such as TQM, which we discuss later in the chapter. TQM is integral to Lean as it identifies customer quality standards and serves to eliminate waste, such as defects, scrap, and rework. Quality is integrated into all functions and levels of the organization as the entire supply chain must be designed to provide the level of quality expected by the final customer. Consider that traditional quality control systems use the concept of acceptable quality level (AQL) to indicate the acceptable number of defective parts. In Lean there is no such measure—no level of defects other than zero is acceptable.

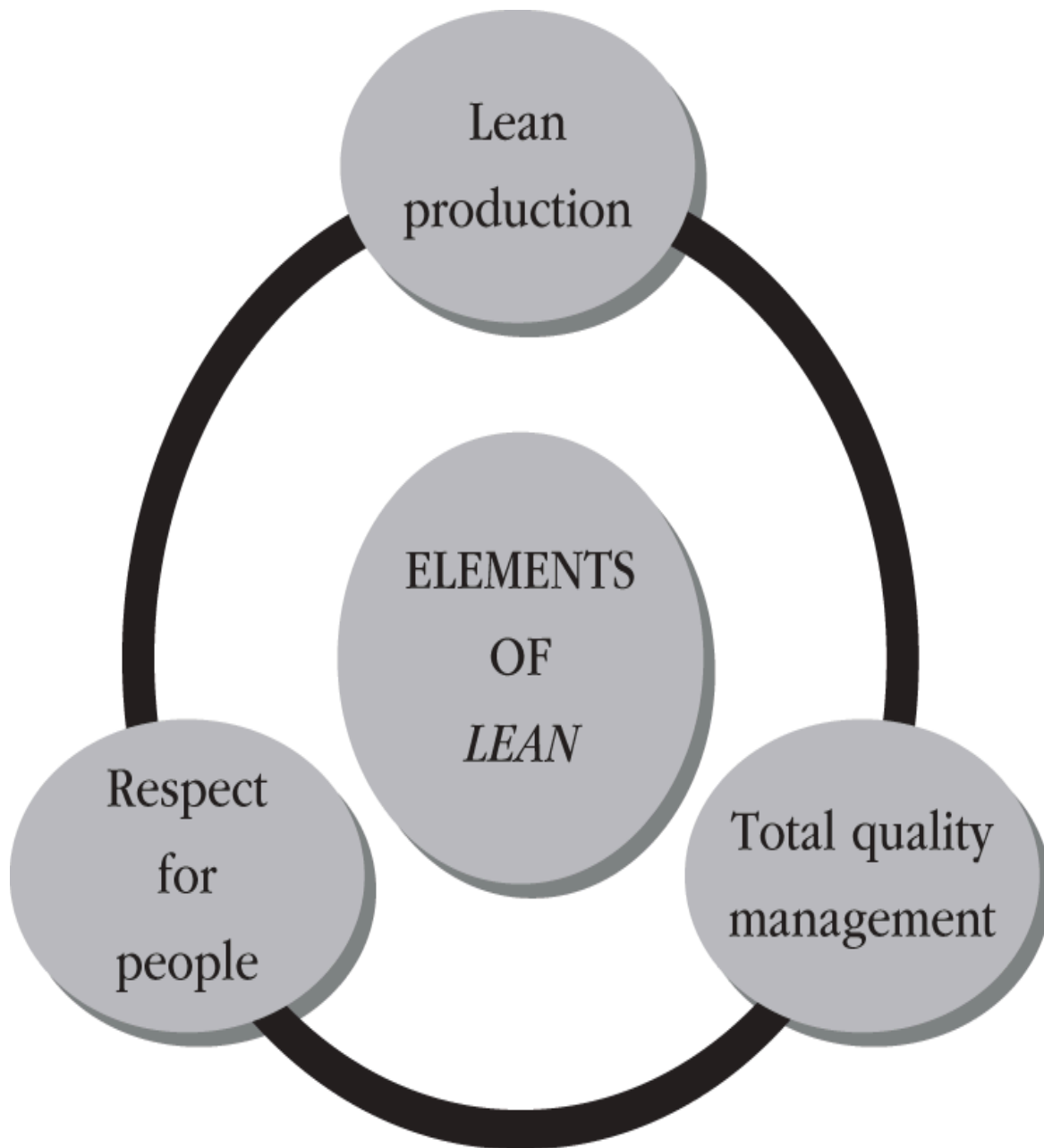


FIGURE 10.3 Elements of Lean.

“Respect for people” is the third element of Lean. Lean considers people the most important resource, and their involvement is central to the Lean philosophy. The Lean philosophy believes in treating all employees with respect and offering significant rewards for well-performed tasks. Lean requires total organizational reform, which cannot occur without everyone's participation. Lean relies on workers to perform multiple tasks and to work in teams, including management, labor, staff, and suppliers. Respect for People

extends to all members of the supply chain, where the focus is on developing long-term relationships.



Concept Check Questions

26. Lean is composed of three elements that work in unison. Which of the following is not one of these?

- ☐ a) Total quality management
- ☐ b) Respect for people
- ☐ c) Minimum inventory
- ☐ d) Lean production

Correct or Incorrect?

Clear

Check Answer

27. Lean Production is just one element of Lean.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

28. Lean Production is known as a pull production.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

29. TQM is not integral to Lean but rather serves as an enhancement.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

30. Lean considers inventory the most important resource.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Supply Chain Leader's Box

■ U.S. ARMY

In 2009, the Corpus Christi Army Depot (CCAD)—one of two U.S. Army Aviation depots—faced a dilemma. The depot was receiving a steady flow of battle-damaged helicopters for refurbishment and overhaul from Iraq and Afghanistan. In addition, it was being asked to carry out two major helicopter upgrades, with no additional resources. The problem for the leadership: how to do more with less.

The depot conducts the repair and overhaul of aircraft for the U.S. Army. It has many production capabilities that include machining, fabrication, and computer-aided design and manufacturing. It is the largest single industrial employer in the region with a workforce of more than 4,000 employees plus 1,000 contractors and occupies approximately 50 buildings. Such an extensive operation decided to turn to Lean and Six Sigma for help. Lean had been successful in manufacturing, and applying it to the military made sense.

As soon as the Depot began incorporating Lean principles, improvements were seen. One of the helicopter lines increased production by 40%. The other lines reduced their average cycle time by 25%. In addition, inventory was reduced. “We met our one-aircraft-per-week goal. We now can complete more Black Hawks per year than before the new procedures,” says George Kunke III, the depot's process optimization manager.

So how did they do this? The first step was to reduce work-in-process (WIP) inventory. The logic was to work on fewer aircraft at a time, devoting resources to only those aircraft. They admit that working on fewer aircraft simultaneously seemed “counterintuitive,” but it provided focus, and the depot saw immediate improvements in inventory. The second step was to instill broad or global thinking and break down the “silo” mentality. The depot division chiefs were asked to work cooperatively as members of the core team and were required to take a global view of the depot's operations, rather than just concentrating on their areas of responsibility.

Other changes were made, such as better management of bottlenecks. When a bottleneck was detected, an “issue resolution team” was immediately dispatched to direct all available resources to solve the problem. To enhance efficiency, they also started using “full kitting,” where a kit is an assembly of all items needed for a job. In this case, a kit is more than parts and manuals. Like in the healthcare example in the chapter opener, a kit includes “all” resources needed to complete an assembly on time—including personnel. This means that all the supporting entities are concentrated at the place where the task is being done. With the implementation of Lean and Six Sigma, the depot has exceeded its expectations and expects even better results in the future.

Lean Production

The Pull System

Traditional organizations and supply chains work as “push” systems, where goods are produced based on a forecast and then stored in anticipation of demand. Lean Production is based on a “pull,” rather than a push system, to produce and move products. In the operation of an organization, the process starts with the last workstation in the facility and works backward through the system. Each station requests the precise number of products needed from the previous workstation. The pull system works in the same way throughout the entire supply chain. Each stage in the supply chain requests quantities needed from the previous stage in the chain. If products are not requested, they are not produced, and no excess inventory is generated.

A major aspect of Lean is how it views inventory. In traditional systems, inventory is carried out to cover up problems—such as poor deliveries, inefficiency, lack of coordination, and demand uncertainty. Lean views inventory as a cost that provides no value and should be eliminated. Inventory also hurts the organization, as it does not permit visibility of problems. Eliminating inventory permits problems to be seen and corrected, rather than wasting resources to compensate for them. An often-used analogy to describe inventory is that of a river, with the rocks being problems and the water being inventory. The water covers the rocks, and they cannot be seen. However, as water is reduced the rocks emerge. Similarly, as inventory is reduced, problems are seen and can then be solved.

Zara's successful implementation of Lean principles, including the “pull” system and inventory management strategies, has yielded impressive results which include 12 inventory turns per year. Zara's inventory turnover rate is significantly better than the industry average, indicating that the company efficiently manages its inventory levels. Almost all of Zara's clothing items—over 85%—are sold at full price. This demonstrates Zara's high understanding of customer preferences and ability to respond quickly to changing trends. Further, only 10% of inventory is unsold. Zara's low unsold inventory rate reflects its effective demand-driven approach, minimizing the risk of excess stock and associated costs. By embracing Lean principles and adopting a demand-driven supply chain, Zara has cemented its position as a trendsetter and a leader in the fast-fashion industry.

Global Insights Box

■ UPS

Virtually all transportation carriers today use Global Positioning System (GPS) based telematics devices in their vehicles. These devices provide a wide variety of data about driving behavior, speeds under various conditions, and traffic. These types of systems have other sensing and monitoring capabilities as well. For example, they can alert drivers when vehicles need repairs or software updates. UPS has already employed telematics data to redesign its global logistical network.

UPS uses geolocation data for many aspects of its operation to be lean, be efficient, and eliminate waste. As a result, it optimizes every aspect of the operation from routes to labor management. Its vehicles are fitted with sensors, wireless modules, and GPS, all gathering data. These data are then fed to headquarters, which uses algorithms for predictions such as engine trouble and to schedule maintenance. The system lets the company track routes in real time and knows the location of every vehicle. The company can monitor drivers and scrutinize their scheduled deliveries to optimize routes. The system can also improve safety and efficiency, such as identifying routes with fewer turns that must cross traffic intersections.

Concept Check Questions

31. Traditional organizations and supply chains work as “pull” systems.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

32. Lean views inventory as a cost that provides no value and should be eliminated.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

33. With a pull system, each stage in the supply chain requests quantities needed from the previous stage in the chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

34. With a pull system, IF products are not requested, they are produced but put into inventory.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Visual Signals

For the pull system to work there must be communication between the work centers in a production facility and between supply chain partners. This communication is made possible by the use of a signaling system called a [kanban](#), which means “signal” or “card” in Japanese. A kanban card typically contains information such as product name, part number, and the quantity that needs to be produced, and it is attached to a container. When workers need products from the station before them, they pass an empty container with an attached kanban to that station and take a full container. The kanban authorizes the worker at that station to produce the amount of goods specified on the kanban and fill the empty container. In effect, the kanban authorizes production. Production cannot take place unless a container is empty and a kanban card has authorized production. This is shown in [Figure 10.4](#).

In many facilities, the kanban system has been modified so that actual cards do not exist but some other signaling mechanism is used to pull the goods through the system. This may be as simple as a square drawn on the floor that identifies where the material should be stored. An empty square indicates that more goods are needed and is called a “kanban square.” Another type of signal might be a flag that is raised to indicate it is time to produce the next container of goods and is called a “signal kanban.” When the inventory level is reduced to the point of reaching the signal, the signal is removed and placed on an

order post, indicating that it is time for production. These visual signals are shown in [Figure 10.5](#).

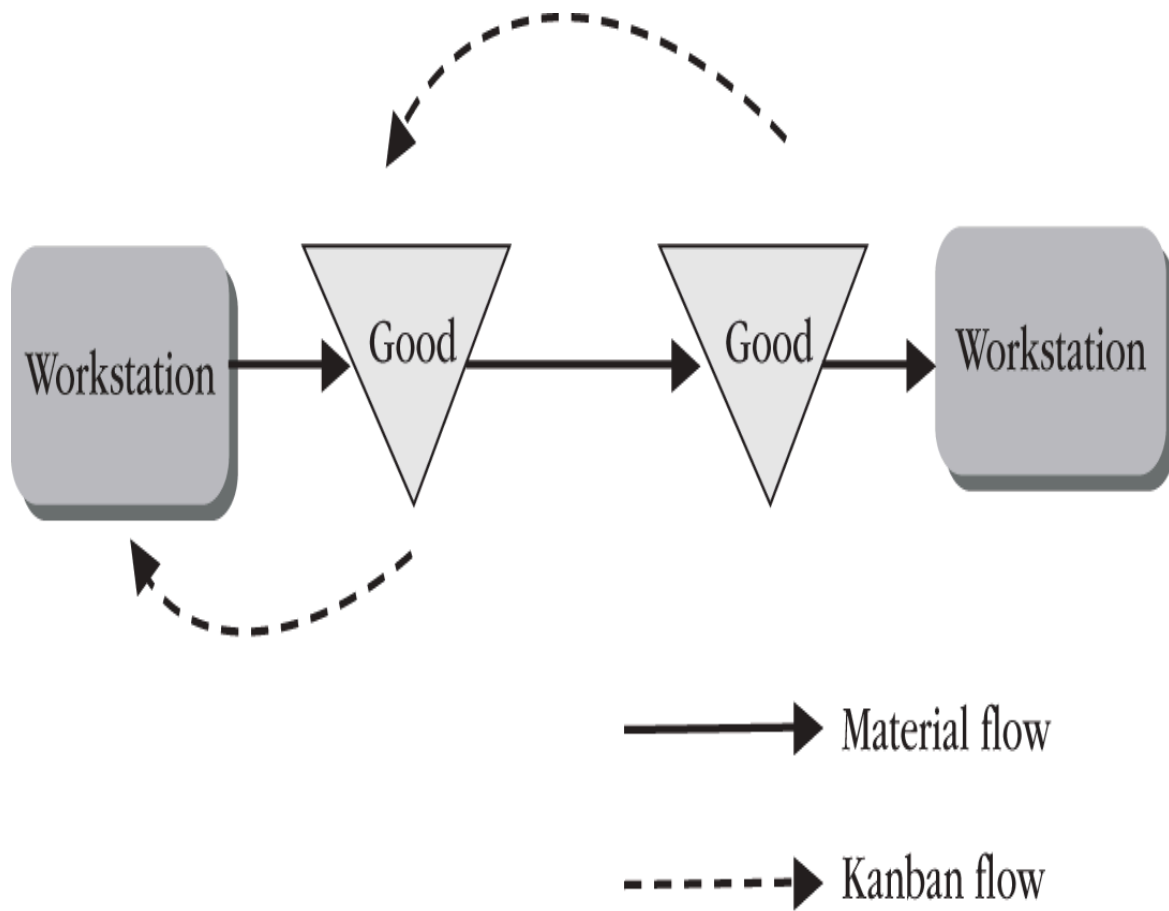


FIGURE 10.4 Flow of kanban cards between workstations.

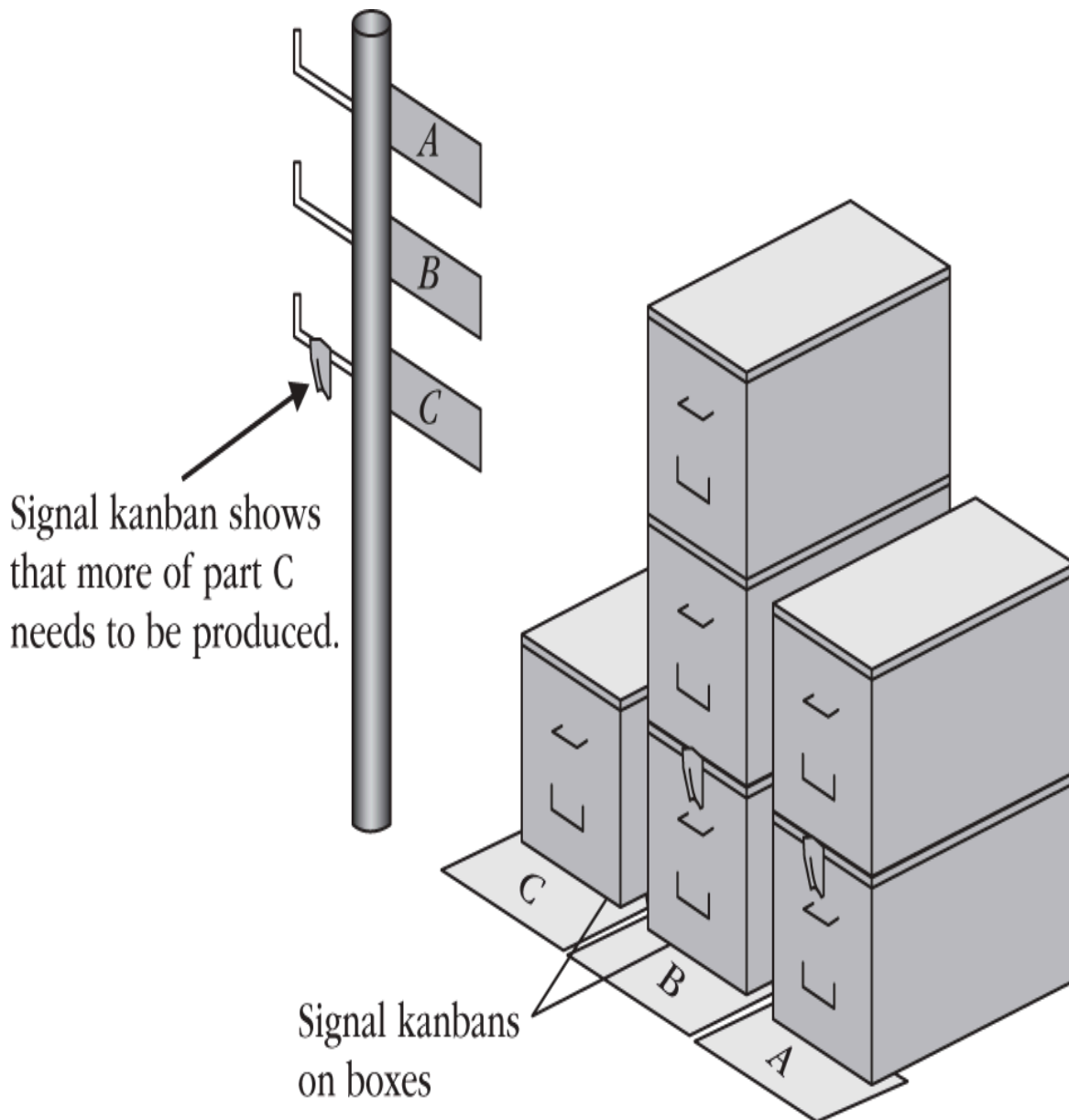


FIGURE 10.5 Visual signals.

In the supply chain, kanbans can be used to coordinate supplier deliveries and are called supplier kanbans. The suppliers bring the filled containers to the point of usage in the factory and at the same time pick up an empty container with a kanban to be filled later. Since a manufacturer may have multiple suppliers, “mailboxes” can be set up at a factory for each supplier. The suppliers can check their “mailboxes” to pick up their orders. Kanbans are usually made of plastic or metal, but there are also barcoded kanbans and electronic kanbans that further ease communication with suppliers.

Intel Corporation uses kanban in its chip manufacturing processes to streamline operations and manage inventory efficiently. Within their fabrication facilities, the kanban system is utilized to control the flow of materials and components needed for chip production.

Intel employs cards or signals to indicate the need for certain materials at different stages of the manufacturing process. When a workstation requires specific components or materials to continue production, it triggers the kanban signal. This signal prompts the preceding workstation to supply the needed materials, ensuring a smooth and demand-driven production flow. Intel's use of kanban has resulted in reducing excess inventory, preventing overproduction, and maintaining a synchronized flow of materials throughout its complex manufacturing operations. This approach optimizes Intel's production processes for efficiency and responsiveness to demand fluctuations in the semiconductor industry.

Global Insights Box: Supplier Kanbans

■ HEWLETT-PACKARD (HP)

Hewlett-Packard (HP) emerged as a pioneer in the utilization of supplier kanbans, a strategy that proved instrumental in shaping the company's quick response manufacturing (QRM) approach. This kanban-based system enabled HP to significantly reduce lead times, enhance customer satisfaction, and establish itself as a more formidable competitor within the industry.

At the heart of HP's kanban system lies a seamless process that involves the issuance of kanbans to suppliers, specifying the type, quantity, and delivery schedule of the required parts. Once suppliers fulfill these orders, they deliver the filled kanbans directly to HP's factories. Upon completion of parts usage, HP returns the empty kanbans to the suppliers, signaling the need for replenishment.

Several factors contribute to the remarkable success of HP's kanban system:

Strong Supplier Partnerships: Cultivating strong relationships with suppliers proved crucial for HP's kanban implementation. By working closely with its partners, HP ensured that suppliers fully grasped the system's intricacies and were committed to its effective execution.

System-wide Adoption: HP's commitment to supplier kanbans extended beyond a select few suppliers. The company embraced kanbans across its entire supply chain, ensuring consistency and effectiveness throughout the entire procurement process.

Technology Integration: HP seamlessly integrated technology into its kanban system, employing barcoded kanbans and electronic kanbans to streamline communication with suppliers. This technological advancement enhanced efficiency and minimized errors, further bolstering the system's overall success.

The adoption of supplier kanbans played a pivotal role in propelling HP's achievements during the 1980s and 1990s. This strategy transformed HP into a more efficient and competitive organization, paving the way for

other companies to embrace similar systems and reap the benefits of kanban-based supply chain management.

Concept Check Questions

35. For the pull system to work there must be communication between the work centers in a production facility and between supply chain partners. This communication is made possible by the use of a signaling system called a _____.

- ☐ a) kanban
- ☐ b) kaizen
- ☐ c) muda
- ☐ d) mura
- ☐ e) None of these

Correct or Incorrect?

Clear

Check Answer

36. _____ means “signal” or “card” in Japanese.

- ☐ a) Kanban
- ☐ b) Kaizen
- ☐ c) Muda
- ☐ d) Mura
- ☐ e) None of these

Correct or Incorrect?

Clear

Check Answer

37. Kanban cannot work without cards.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

38. In the supply chain kanbans can be used to coordinate supplier deliveries and are called supplier kanbans.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Small Lot Production

Small lot production means that the number of products produced at any one time is small, say 10 vs 1,000. Producing in small lots is the primary way of eliminating inventory and excess processing while increasing flexibility. The manufacturer can produce many lots of different types of products. It also shortens the manufacturing lead time, the actual time it takes to produce a product because it takes less time to produce 10 units than to produce 1,000.

Small lot production gives a company flexibility and allows it to respond to customer demands more quickly. However, to be able to achieve small lot production, companies have to reduce setup time. Recall from [Chapter 9](#) that

this is the time it takes to set up equipment for a production run. This includes cleaning and recalibrating equipment, changing blades and other tools, and all other activities necessary to switch production from one product to another.

To produce only the quantities needed, the setup time must be low so it is easy to switch from producing one type of product to another. This approach allows companies to respond quickly to changes in demand. Using Lean principles many large manufacturers have been able to reduce setup times from hours to only a few minutes, giving them tremendous flexibility. The ultimate goal of Lean is to be able to economically produce one item at a time as the customer wants it.

Concept Check Questions

39. Small lot production means that the amount of products produced at any one time is small, say one versus 100,000.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

40. Small lot production gives a company flexibility and allows it to respond to customer demands more quickly.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

41. To be able to achieve small lot production, companies have to reduce inventory.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

42. To produce only the quantities needed, the setup time must be low so it is easy to switch from producing one type of product to another.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Uniform Plant Loading

Demand for a product can exhibit sudden increases or decreases, which can mean disruptive changes in production schedules. These demand changes are typically magnified throughout the supply chain and contribute to inefficiency and waste. Lean reduces this problem by making adjustments as small as possible and setting a production plan that is frozen for the month. This is called uniform plant loading or “leveling” the production schedule. The term “leveling” comes from the fact that the schedule is uniform or “level” throughout the planning horizon. This helps suppliers better plan their own production and delivery schedules.

Procter & Gamble (P&G), a multinational corporation that produces a diverse range of consumer goods, employs uniform plant loading to manage demand fluctuations. Their production leveling system is founded on the concept of “demand-driven planning,” which entails aligning production plans with actual customer demand rather than forecasts. This approach enables P&G to promptly respond to demand changes and avoid accumulating excess inventory.

P&G's production leveling system functions as follows. P&G monitors customer demand for its products through point-of-sale data, customer surveys, and retailer feedback. Production plans are adapted based on demand data, increasing production for high-demand products and decreasing it for those in low demand. Production plans are communicated to suppliers to ensure they align their production and delivery schedules accordingly. Then the production progress is continuously monitored, and adjustments are made to production plans as needed.

P&G's production leveling system has proven to be highly beneficial, leading to reduced waste, improved efficiency, higher product quality, and lower costs. Their success in implementing uniform plant loading demonstrates its effectiveness in managing demand fluctuations and contributing to overall business growth.



Concept Check Questions

43. Lean reduces the problem of demand changing by making adjustments as small as possible and setting a production plan that is frozen for the next year.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

44. Uniform plant loading is called leveling the production schedule.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

45. Procter & Gamble (P&G), a multinational corporation that produces a diverse range of consumer goods, employs uniform plant loading to manage demand fluctuations.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Respect for People

According to Lean, respect for all people, including labor, management, and suppliers, must exist for an organization to be its best. It is up to company leadership to create such an organizational culture. Lean requires all supply chain members to work together in cross-functional teams to solve problems. Lean organizations have a hierarchy that is generally flatter compared to that of traditional organizations, and organizational layers are not strictly defined. Great responsibility and autonomy are given to ordinary workers, and their

input is highly valued. In this section, we look at some specific issues that relate to respect for people in the Lean environment.

Concept Check Questions

46. According to Lean, respect for all people, including labor, management, and suppliers, must exist for an organization to be its best.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

47. Lean requires respect for people. It is up to lower management to create such an organizational culture.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

48. Lean requires respect for people. It is up to the union to create such an organizational culture.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Role of Workers

In traditional organizations production workers often perform their jobs in an automatic manner. In Lean organizations, however, they are actively engaged in pursuing the goals of the company. Lean relies on cross-functional worker skills, which is the ability of workers to perform many different tasks on many different machines. Part of worker duties is to be actively engaged in improving the production process, monitor quality, and correct quality problems. Lean considers those closest to the problem best suited to make improvements in their jobs. They are given autonomy, and their opinions are highly valued.

Production workers are responsible for quality and are required to continually check and monitor the quality of the production process. They are responsible for inspecting their own work as well as the materials received from previous operations to detect quality problems. An example of worker responsibility can be seen through [jidoka](#), which is the authority of every worker to stop the production process and fix problems as they occur rather than pushing them down the line. Jidoka requires workers to take ownership of poor quality and have the confidence to take on the responsibility. Discovering quality problems is seen as a goal, not something that should be covered up or blamed on others.

Teams are an integral part of Lean. One of the most popular teams is the [quality circle](#). Quality circles are groups of about 5–12 employees who come together to solve quality problems. Although participation is usually voluntary, meetings take place during regular work hours. Quality circles usually meet weekly and attempt to develop solutions to problems and share them with management.

Concept Check Questions

49. Lean relies on cross-functional worker skills.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

50. With lean, production managers are responsible for quality and are required to continually check and monitor the quality of the production process.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

51. _____ is the authority of every worker to stop the production process and fix problems as they occur rather than pushing them down the line.

- ☐ a) Kanban
- ☐ b) Kaizen
- ☐ c) Muda
- ☐ d) Mura
- ☐ e) Jidoka

Correct or Incorrect?

Clear

Check Answer

52. Teams are an integral part of Lean.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Role of Management

The role of management is to create the cultural change in the organization needed for Lean to succeed. This is a difficult task as it involves creating an organizational culture that provides an atmosphere of close cooperation and mutual trust. Recall that Lean relies on production workers to independently solve production problems and take on many additional tasks. To be able to do this, employees must be problem solvers and be empowered to take action based on their ideas. Workers must feel secure in their jobs and know that they will not be reprimanded or lose their jobs for being proactive. They must also feel comfortable enough to discuss their ideas openly. It is up to management to develop an incentive system that rewards and motivates this type of behavior.

Concept Check Questions

53. The role of management is to create the cultural change in the organization needed for Lean to succeed.

- ☐ True
- ☐ False

Correct or Incorrect?

[Clear](#)[Check Answer](#)

54. It is easy for management to create the cultural change in the organization needed for Lean to succeed.

- ☐ True
☐ False

Correct or Incorrect?

[Clear](#)[Check Answer](#)

Role of Suppliers

Lean emphasizes building long-term supplier relationships. The traditional approach of competitive bidding and buying parts from the cheapest supplier runs counter to the Lean philosophy. Lean companies understand that they are in a partnership with their suppliers, who are viewed as the external factory. The number of suppliers is typically much smaller than in traditional systems, and the goal is to shift to single-source suppliers that provide an entire family of parts for one manufacturer. Together the supply chain partners focus on improving process quality. Having few suppliers makes it easier to develop stable and repetitive delivery schedules and eliminate paperwork.

With a long-term relationship, a supplier can act as a service provider rather than a one-time seller. An important part of such a relationship is information sharing. The manufacturer shares demand information and production schedules, allowing the supplier to “see” what is going to be ordered. The supplier, in turn, shares cost information and cost-cutting efforts with the manufacturer. Both parties help each other and together reap the benefits.



Concept Check Questions

55. Suppliers are not involved in Lean production.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

56. Lean emphasizes building short-term supplier relationships to get the lowest price on inputs.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

57. The number of suppliers is typically much smaller with Lean than in traditional systems, and the goal is to shift to single-source suppliers that provide an entire family of parts for one manufacturer.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

58. With Lean, the manufacturer must share information with their suppliers.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Total Quality Management (TQM)

TQM is an integrated organizational effort designed to improve quality at every level. Meeting quality expectations as defined by the customer and eliminating defects is an integral aspect of Lean. For this to succeed, every member of the supply chain must adopt the same quality standards. Poor quality anywhere in the supply chain will be passed down the chain, resulting in dissatisfied customers and higher costs for all members of the chain.

The meaning of quality has changed and evolved. In the early 20th century quality management meant inspecting products to ensure that they met specifications. Today it means meeting and exceeding customer expectations. Several individuals have contributed to our knowledge and understanding of quality and have made TQM what it is today. They are showcased in [Figure 10.6](#).

Supply Chain Leader's Box: General Electric Company (GE)

GE has been a leader in TQM with a strong emphasis on the Six Sigma methodology, which targets reducing defects to nearly zero levels. This approach has been pivotal in GE's success across diverse industries such as healthcare, energy, and aviation. Let us see how GE has used TQM in each of these areas.

In healthcare, Six Sigma has played a crucial role in improving patient care and operational efficiency. For example, GE Healthcare's implementation of Six Sigma resulted in a 60% reduction in patient wait times and a 20% increase in patient satisfaction scores.

In the energy sector, GE's use of Six Sigma has led to significant improvements in the reliability and performance of power generation equipment. For instance, GE Energy's implementation of Six Sigma helped reduce downtime in gas turbines by 50%, resulting in substantial cost savings.

In aviation, Six Sigma has been instrumental in enhancing the safety and efficiency of aircraft engines. GE Aviation's adoption of Six Sigma contributed to a 50% reduction in defects in engine components, leading to improved reliability and customer satisfaction.

Overall, GE's commitment to TQM and Six Sigma has translated into tangible successes, including improved quality, cost savings, and enhanced customer satisfaction. These achievements underscore the effectiveness of TQM as a strategic approach at GE.

Concept Check Questions

59. Total quality management (TQM) is an integrated organizational effort designed to improve quality at every level.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

60. Meeting quality expectations as defined by management and eliminating defects is an integral aspect of Lean.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

61. Quality management means inspecting products to ensure that they met specifications.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

62. Quality management means meeting and exceeding customer expectations.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

63. Which of the following is not something W. Edwards Deming was known for?

- ☐ a) Stressed management's responsibility for quality
- ☐ b) Focus on prevention and not inspection
- ☐ c) Developed “14 points” to guide companies in quality improvement
- ☐ d) Considered the “father” of TQM

Correct or Incorrect?

Clear

Check Answer

64. Which of the following is not something Philip Crosby was known for?

- ☐ a) Introduced concept of zero defects
- ☐ b) Focus on prevention and not inspection
- ☐ c) Stressed management's responsibility for quality
- ☐ d) Coined phrase “quality is free” as defects are costly

Correct or Incorrect?

Clear

Check Answer

65. Which of the following is not something Joseph M. Juran was known for?

- ☐ a) Introduced concept of zero defects
- ☐ b) Denied quality as “fitness for use”
- ☐ c) Developed concept of cost of quality

Correct or Incorrect?

Clear

Check Answer

Voice of the Customer

The overriding feature of TQM is the focus on customers. Therefore, quality is defined as meeting or exceeding customer expectations. This is called the **voice of the customer (VOC)**, as we discussed in [Chapter 4](#). The goal is to first identify, and then meet, customer expectations. TQM recognizes that a perfectly produced product has little value if it is not what the customer wants. Therefore, the ultimate definition of quality is customer driven.

Although this may sound simple, it is not always easy to determine what the customer wants, as consumer tastes and preferences are constantly changing. As we discussed in [Chapter 4](#), customers often do not know or cannot articulate what they want. Consider the retail industry, where fashion trends and tastes change rapidly. Companies often conduct focus groups, market surveys, and customer interviews just to determine what customers want at any one time.

W. Edwards Deming

- Considered the “father” of TQM
- Stressed management’s responsibility for quality
- Developed “14 points” to guide companies in quality improvement

Philip Crosby

- Coined phrase “quality is free” as defects are costly
- Introduced concept of zero defects
- Focus on prevention and not inspection

Joseph M. Juran

- Defined quality as “fitness for use”
- Developed concept of cost of quality

FIGURE 10.6 Quality gurus.

Concept Check Questions

66. The overriding feature of TQM is the focus on management.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

67. Quality is defined as meeting or exceeding customer expectations.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

68. It is easy to determine what the customer wants with regards to quality.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Costs of Quality

Companies understand the high cost of poor quality. The most obvious consequence is when poor quality creates dissatisfied customers leading to loss of business. Costs of quality are shown in [Figure 10.7](#). The first two costs—prevention and appraisal costs—are incurred with the hope of preventing the second two—internal and external failure.

Managerial Insights Box—Costs of Quality

■ BOEING AND THE 737 MAX AIRCRAFT

Boeing, the American multinational aerospace company, experienced significant financial and reputational damage due to quality issues with its 737 MAX aircraft. Two fatal crashes, Lion Air Flight 610 in 2018 and Ethiopian Airlines Flight 302 in 2019, were attributed to software flaws in the aircraft's Maneuvering Characteristics Augmentation System (MCAS).

The 737 MAX crisis resulted in several costs of poor quality for Boeing. Let us look at each of these.

Direct costs of grounding and remanufacturing: Boeing incurred significant costs to ground the 737 MAX fleet worldwide, modify the aircraft's software, and conduct additional testing before its eventual return to service.

Loss of revenue and market share: The 737 MAX crisis led to a decline in Boeing's aircraft orders and revenues, as airlines delayed or canceled orders due to safety concerns. This also allowed competitors like Airbus to gain market share.

Legal fees and settlements: Boeing faced lawsuits from families of the crash victims, airlines, and investors, leading to substantial legal expenses and settlements.

Damage to reputation and brand value: The 737 MAX crisis severely tarnished Boeing's reputation and brand value, as the company faced scrutiny for its quality control processes and safety culture.

Costs of regulatory scrutiny and investigations: Boeing was subjected to extensive investigations by the National Transportation Safety Board (NTSB) and other regulatory bodies, incurring additional costs and reputational damage.

Internal costs of crisis management: Boeing diverted significant resources and management time to address the 737 MAX crisis, impacting other business operations and decision making.

Loss of customer trust and confidence: The 737 MAX crisis eroded customer trust and confidence in Boeing, making it harder for the company to regain market share and secure future contracts.

The 737 MAX crisis serves as a stark reminder of the high costs of poor quality. Companies must prioritize quality throughout their operations to avoid similar financial, reputational, and human consequences.

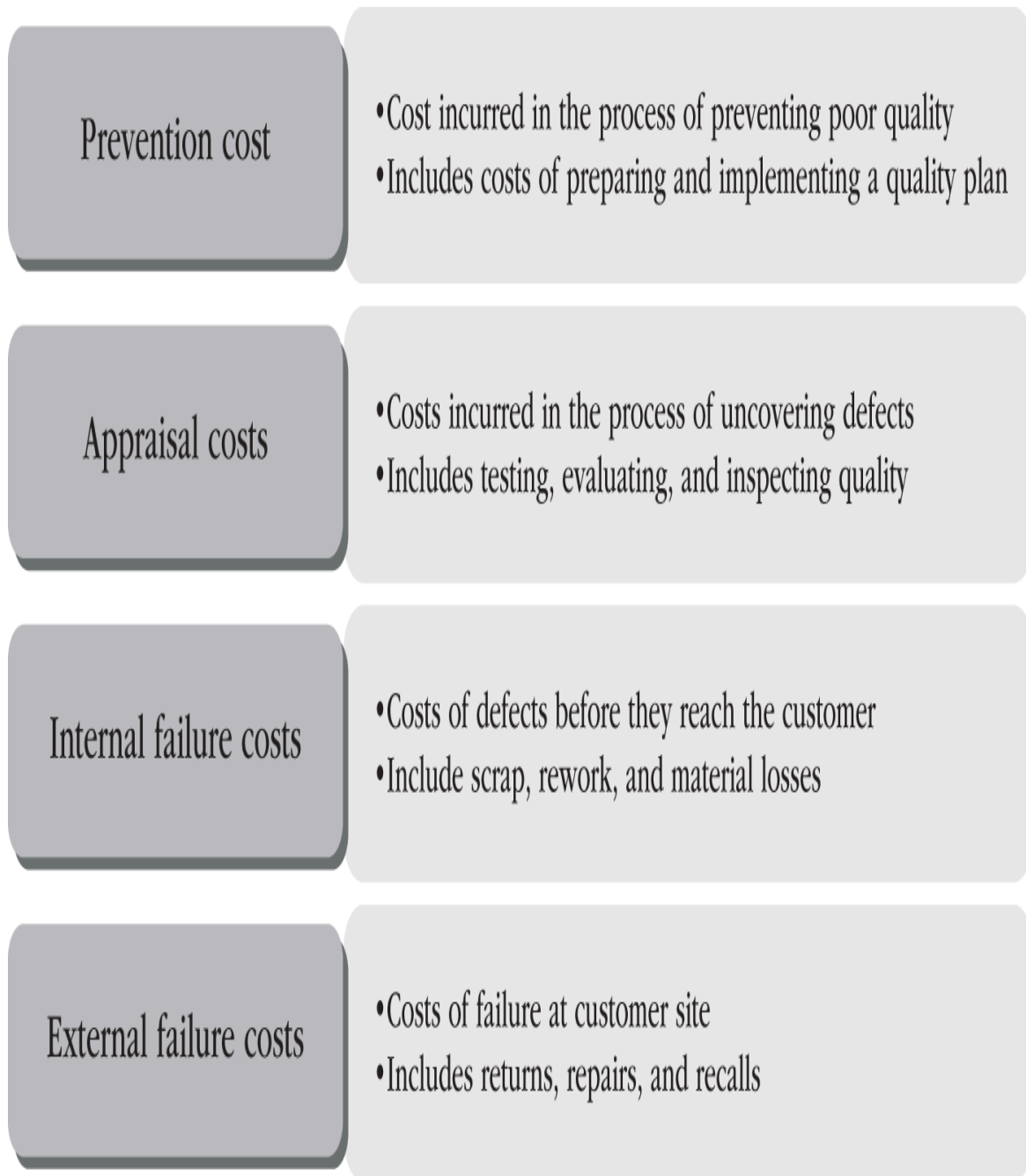


FIGURE 10.7 Costs of quality.

Concept Check Questions

69. Poor quality has a high cost.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

70. Cost incurred in the process of preventing poor quality.

- ☐ a) Appraisal costs
- ☐ b) External failure costs
- ☐ c) Internal failure costs
- ☐ d) Prevention cost

Correct or Incorrect?

Clear

Check Answer

71. Includes costs of preparing and implementing a quality plan.

- ☐ a) Appraisal costs
- ☐ b) External failure costs
- ☐ c) Internal failure costs
- ☐ d) Prevention cost

Correct or Incorrect?

Clear

Check Answer

72. Costs incurred in the process of uncovering defects.

- ☐ a) Appraisal costs
- ☐ b) External failure costs
- ☐ c) Internal failure costs
- ☐ d) Prevention cost

Correct or Incorrect?

Clear

Check Answer

73. Includes testing, evaluating, and inspecting quality.

- ☐ a) Appraisal costs
- ☐ b) External failure costs
- ☐ c) Internal failure costs
- ☐ d) Prevention cost

Correct or Incorrect?

Clear

Check Answer

74. Costs of defects before they reach the customer.

- ☐ a) Appraisal costs
- ☐ b) External failure costs
- ☐ c) Internal failure costs
- ☐ d) Prevention cost

Correct or Incorrect?

Clear

Check Answer

75. Include scrap, rework, and material losses.

- ☐ a) Appraisal costs
- ☐ b) External failure costs
- ☐ c) Internal failure costs
- ☐ d) Prevention cost

Correct or Incorrect?

Clear

Check Answer

76. Costs of failure at customer site.

- ☐ a) Appraisal costs
- ☐ b) External failure costs
- ☐ c) Internal failure costs
- ☐ d) Prevention cost

Correct or Incorrect?

Clear

Check Answer

77. Includes returns, repairs, and recalls.

- ☐ a) Appraisal costs
- ☐ b) External failure costs
- ☐ c) Internal failure costs
- ☐ d) Prevention cost

Correct or Incorrect?

[Clear](#)[Check Answer](#)

Quality Tools

Lean places great responsibility on all workers to identify and correct quality problems. To do this, workers need proper training. They need to understand how to assess quality using various quality control tools, interpret findings, and correct problems. In this section, we look at seven quality tools often called the “seven tools of quality control,” shown in [Figure 10.8](#). Although simple, they are extremely useful in identifying and analyzing quality problems. Workers can use only one tool at a time, but often a combination of tools is most helpful. These are the seven tools of quality control:

[Cause-and-effect diagrams](#)—sometimes called “[fishbone diagrams](#)”—are tools used to identify the causes of a particular quality problem. The causes may be machines, workers, measurements, suppliers, materials, and other aspects of the production process. Each of these individual causes is caused by more specific factors. For example, a problem with a machine could be due to a need for adjustment, old equipment, or tooling problems. Similarly, a problem with workers could be related to lack of training, poor supervision, or fatigue.

[Flowcharts](#) are schematic diagrams of the sequence of steps involved in an operation or process. They provide a visual tool that is easy to use and understand, and develop a clear picture of where problems could arise.

[Checklists](#) are lists of common defects and the number of occurrences of the defect observed. Although simple, checklists are a highly effective tool for identifying defects.

[Control charts](#) are charts used to determine whether a process is operating within expectations for a dimension of interest. This could be product weight or volume, or the number of customer complaints in a given week.

[Scatter diagrams](#) are graphs that visually show how two variables are related to one another. They are particularly useful in detecting a relationship between two variables.

[Pareto analysis](#) is a technique used to identify quality problems based on their degree of importance. Pareto analysis tells us that there are a small number of causes that create the majority of quality problems.

Histograms are charts that show the frequency distribution of observed values of a variable. The plot shows the distribution a particular variable, such as whether it has a normal distribution and whether it is symmetrical.

Concept Check Questions

78. Sometimes called “fishbone diagrams.”

- ☐ a) Cause-and-effect diagrams
- ☐ b) Flowcharts
- ☐ c) Checklists
- ☐ d) Control charts
- ☐ e) Scatter diagrams

Correct or Incorrect?

Clear

Check Answer

79. Tools used to identify causes of a particular quality problem.

- ☐ a) Cause-and-effect diagrams
- ☐ b) Flowcharts
- ☐ c) Checklists
- ☐ d) Control charts
- ☐ e) Scatter diagrams

Correct or Incorrect?

Clear

Check Answer

80. Schematic diagrams of the sequence of steps involved in an operation or process.

- ☐ a) Cause-and-effect diagrams
- ☐ b) Flowcharts
- ☐ c) Checklists
- ☐ d) Control charts
- ☐ e) Scatter diagrams

Correct or Incorrect?

Clear

Check Answer

81. Lists of common defects and the number of occurrences of the defect observed.

- ☐ a) Cause-and-effect diagrams
- ☐ b) Flowcharts
- ☐ c) Checklists
- ☐ d) Control charts
- ☐ e) Scatter diagrams

Correct or Incorrect?

Clear

Check Answer

82. Charts used to determine whether a process is operating within expectations for a dimension of interest.

- ☐ a) Cause-and-effect diagrams
- ☐ b) Flowcharts
- ☐ c) Checklists

- ☐ d) Control charts
- ☐ e) Scatter diagrams

Correct or Incorrect?

Clear

Check Answer

83. Graphs that visually show how two variables are related to one another.

- ☐ a) Cause-and-effect diagrams
- ☐ b) Flowcharts
- ☐ c) Checklists
- ☐ d) Control charts
- ☐ e) Scatter diagrams

Correct or Incorrect?

Clear

Check Answer

84. A technique used to identify quality problems based on their degree of importance.

- ☐ a) Pareto analysis
- ☐ b) Flowcharts
- ☐ c) Checklists
- ☐ d) Control charts
- ☐ e) Histograms

Correct or Incorrect?

Clear

Check Answer

85. Are charts that show the frequency distribution of observed values of a variable.

- ☐ a) Pareto analysis
- ☐ b) Flowcharts
- ☐ c) Checklists
- ☐ d) Control charts
- ☐ e) Histograms

Correct or Incorrect?

Clear

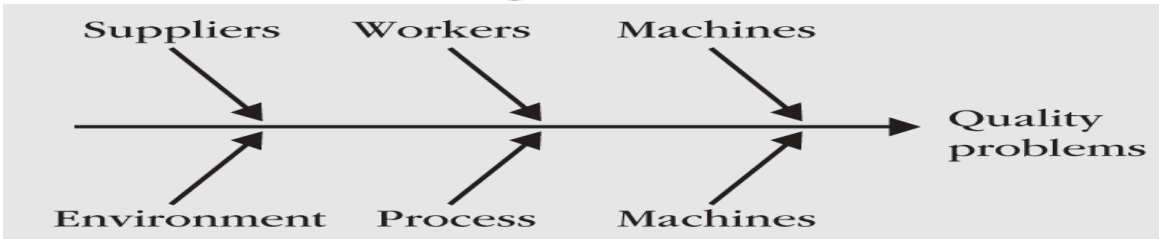
Check Answer

ISO 9000

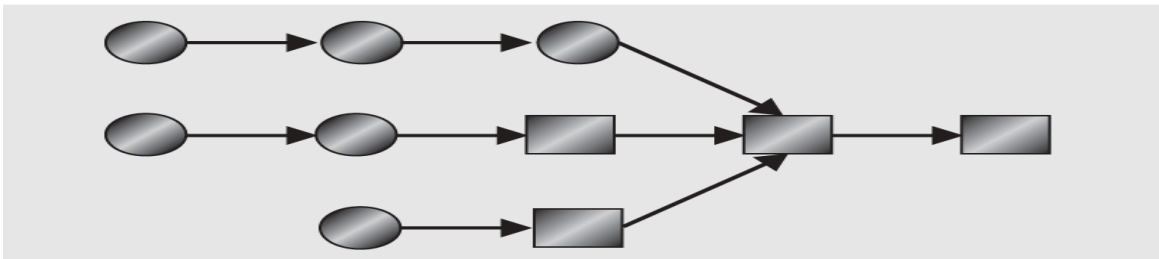
Increased international trade during the 1980s created a need for universal standards of quality. As a result, the International Organization for Standards (ISO) published its first set of standards for quality management, called ISO 9000, in 1987. These have become the internationally adopted standards of quality for all types of companies in a range of industries. Today, many industries consider ISO certification a requirement for doing business.

ISO 9000 consists of a “family” of standards that address various aspects of the quality management process. For example, ISO 9001 provides a set of standards for management systems. Collectively these standards document what the company is doing to fulfill the customer's quality requirements and meet applicable regulatory requirements. Note that ISO 9000 is process standards, not product quality standards. They verify that a company is meeting standards of measuring and documenting their quality processes, but says nothing about the actual product.

1. Cause-and-Effect Diagram



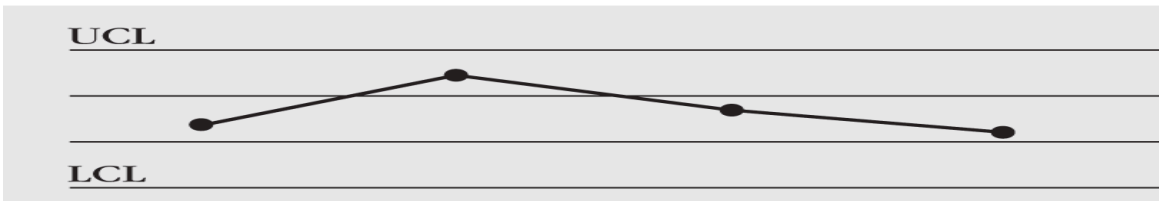
2. Flowchart



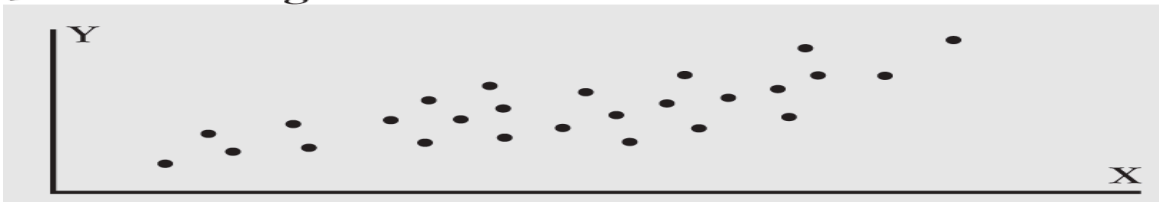
3. Checklist

Defect Type	No. of Defects	Total
Broken zipper	✓✓✓	3
Ripped material	✓✓✓✓✓✓✓	7
Missing buttons	✓✓✓	3
Faded color	✓✓	2

4. Control chart



5. Scatter diagram



6. Pareto chart



7. Histogram

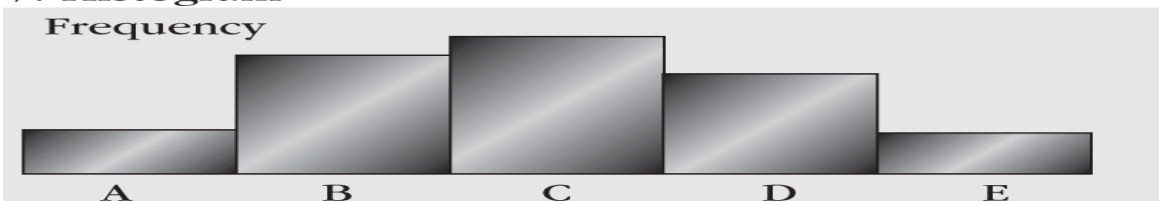


FIGURE 10.8 The seven tools of quality.

ISO provides a certification process for companies to follow to become ISO certified. ISO 9000 certification demonstrates that a company has met the standards and has appropriate quality processes in place. To receive ISO certification, a company must provide extensive documentation of its quality processes, including methods used to monitor quality, frequency of worker training, job descriptions, inspection programs, and statistical process control tools used. Detailed documentation of all processes is critical. The company is then audited by an ISO inspector, who visits the facility and verifies all documentation.

Implementing an ISO 9000 quality management system (QMS) can bring various financial benefits to companies, leading to cost savings and increased revenue. Here are some specific examples of how companies can profit from ISO 9000:

Reduced waste and rework: ISO 9000 emphasizes defect prevention and process improvement, leading to a reduction in product defects and rework costs. This can save companies significant amount of money in materials, labor, and production time.

Improved efficiency and productivity: ISO 9000 helps companies streamline their operations, eliminate unnecessary steps, and optimize resource utilization. This can lead to improved efficiency, increased productivity, and lower production costs.

Enhanced customer satisfaction: ISO 9000 promotes a focus on customer satisfaction and continuous improvement. Companies that implement ISO 9000 can produce higher quality products and services that meet or exceed customer expectations, leading to increased customer satisfaction, loyalty, and repeat business.

Reduced warranty claims and customer complaints: ISO 9000 helps companies identify and address potential quality issues before they reach customers, reducing the number of warranty claims, customer complaints, and product returns. This can save companies significant costs associated with product replacements, repairs, and customer service.

Improved supplier quality: ISO 9000 encourages companies to establish clear quality standards for their suppliers, leading to improved supplier

performance and reduced incoming defective materials. This can save companies money on rework, inventory costs, and supplier management.

Increased market access and opportunities: ISO 9000 certification is often a requirement for government contracts, industry certifications, and international business partnerships. Achieving ISO 9000 certification can open doors to new market opportunities and increase a company's competitive advantage.

Enhanced brand reputation and customer trust: ISO 9000 certification demonstrates a company's commitment to quality and continuous improvement, enhancing its reputation and gaining the trust of customers, investors, and partners. This can lead to increased brand value, better marketing opportunities, and a stronger competitive position.

Reduced insurance costs: ISO 9000 certification can lower insurance premiums for product liability, workers' compensation, and other forms of insurance. This is because ISO 9000 helps companies reduce the risk of accidents, product defects, and legal claims.

Reduced legal and regulatory risks: ISO 9000 helps companies comply with relevant product safety, environmental, and labor regulations, reducing the risk of legal disputes, fines, and penalties. This can save companies significant legal expenses and protect their reputation.

Managerial Insights Box

■ LEAN TOOLS IN THE POPULAR PRESS

Lean tools are so powerful they are even espoused in the popular press. An Amazon Best Book of the Month titled *The Checklist Manifesto: How to Get Things Right* focuses on the benefits of following simple checklists in the workplace—a hallmark of Lean.

The author explains how tragic errors can be dramatically reduced with just a piece of paper and a pencil. A range of disparate tasks is illustrated, from flying a plane to building a skyscraper, to show how checklists can improve outcomes. The logic behind checklists is that they help organize information rather than relying on the brain to reliably remember tasks. Using simple checklists is a reliable guide in fields that range from healthcare to finance to government.

One example of checklist success occurred in healthcare when a critical care specialist at Johns Hopkins, Dr. Peter Pronovost, devised an OR checklist. On a plain sheet of paper, he wrote out five steps doctors and nurses should follow in the OR. These were simple steps, such as washing hands with soap; sterilizing the patient's skin; putting sterile drapes over the entire patient; wearing a mask, gown, and gloves; and putting a sterile dressing over incisions. Within a year of implementing the checklist the rate of infections related to IV tubes at the hospital went from 11% to zero. Since then, Michigan mandated the inclusion of these five steps in every hospital in the state. Within 3 months infections related to intravenous (IV) tube insertions dropped 66%. Although they seem simple, it is easy to see how the steps can be overlooked repeatedly.

Another example is the famous U.S. Airways Flight 1549, which safely landed on the Hudson River in January 2009 after hitting a flock of geese near New York. It turns out that the pilot, Captain Sullenberger III, known as “Sully,” followed a detailed emergency checklist that multiplied their chances of success. He and his copilot had the experience to know the importance of discipline and teamwork and landed the plane safely.

The “checklist manifesto” provides guidelines, such as including all “stupid but critical” tasks on the list so they're not overlooked. It also

makes it mandatory to let others know when each task is completed and empowers subordinates to question their superiors about the checklist. This does sound like Lean in practice and shows the reach of Lean even on the mass market.

The second “family” of standards is ISO 14000, which addresses environmental management. They document what the company is doing to minimize harmful effects on the environment caused by its activities and to achieve continual improvement of its environmental performance. With greater interest in green manufacturing and more awareness of environmental concerns, ISO 14000 standards are becoming an important set of standards for documenting environmental responsibility. To see the latest developments in ISO standards, see www.iso.org.



Concept Check Questions

86. The International Standards Organization published ISO 9000 in 1987.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

87. ISO 9000 consists of a “family” of standards that address various aspects of the quality management process.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

88. ISO provides a certification process for companies to follow in order to become ISO certified.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

89. To become ISO certified, a firm simply pays for an ISO license.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

90. ISO 9000 emphasizes defect prevention and process improvement, leading to a reduction in product defects and rework costs.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

91. ISO 9000 helps companies streamline their operations, allowing them to lay off large numbers of workers.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

92. ISO 9000 promotes a focus on management satisfaction and continuous improvement.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

93. ISO 9000 helps companies identify and address potential quality issues before they reach customers, reducing the number

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

94. ISO 9000 encourages companies to establish clear quality standards for their suppliers, leading to improved supplier performance and reduced incoming defective materials.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

95. While helpful, ISO 9000 certification is rarely a requirement for government contracts, industry certifications, and international business partnerships.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

96. ISO 9000 certification demonstrates a company's commitment to quality and continuous improvement, enhancing its reputation and gaining the trust of customers, investors, and partners.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

97. ISO 9000 certification demonstrates a company's profitability.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

98. ISO 9000 certification can lower insurance premiums for product liability, workers' compensation, and other forms of insurance. This

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

99. ISO 9000 helps companies comply with relevant product safety, environmental, and labor regulations, reducing the risk of legal disputes, fines, and penalties.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

100. The second “family” of standards is ISO 14000, which address environmental management.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Statistical Quality Control (SQC)

Statistical quality control (SQC) is the use of statistical tools used to measure product and process quality. These tools provide quantifiable measures that verify quality standards are being met and can be divided into three broad categories:

Descriptive statistics are statistical tools used to describe quality characteristics. They include the mean, standard deviations, range, and a measure of the distribution of data. They can also be used to describe relationships, such as whether certain characteristics tend to occur together.

Statistical process control (SPC) is a statistical process used to verify that the production process is functioning as specified. It involves inspecting a random sample of the output from the process and deciding whether the process is producing products with characteristics that fall within the acceptable range.

Acceptance sampling is the process of randomly sampling a batch of goods and deciding whether to accept the entire batch based on the results.

Acceptance sampling determines whether a batch of goods should be accepted or rejected.

The tools in each category provide different information for evaluating product and process quality. Although descriptions of certain characteristics are helpful, they are not enough to help us evaluate whether there is a problem with quality. Acceptance sampling can help us decide whether to accept or reject the items produced. Although this information helps make the quality acceptance decision after the product has been produced, it does not help us identify and catch a quality problem during the production process. For this, we need tools in the SPC category.

Concept Check Questions

101. Statistical quality control (SQC) is the use of statistical tools used to measure product and process quality.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

102. _____ are statistical tools used to describe quality characteristics.

- ☐ a) Statistical process control
- ☐ b) Acceptance sampling
- ☐ c) Descriptive statistics
- ☐ d) Inferential statistics
- ☐ e) Analytical statistics

Correct or Incorrect?

Clear

Check Answer

103. _____ is a statistical process used to verify that the production process is functioning as specified.

- ☐ a) Statistical process control
- ☐ b) Acceptance sampling
- ☐ c) Descriptive statistics
- ☐ d) Inferential statistics
- ☐ e) Analytical process control

Correct or Incorrect?

Clear

Check Answer

104. _____ s the process of randomly sampling a batch of goods and deciding whether to accept the entire batch based on the results.

- ☐ a) Statistical process control
- ☐ b) Acceptance sampling
- ☐ c) Descriptive statistics
- ☐ d) Inferential statistics
- ☐ e) Analytical process control

Correct or Incorrect?

Clear

Check Answer

Sources of Variation

All processes have a certain amount of natural variation. This variation can be caused by many factors, some of which we can control and some which are inherent in the process. The variation that is caused by factors that can be identified and managed is called assignable variation. An example may be a variation in output caused by workers not being equally trained or by improper machine adjustment. Variation that is inherent in the process itself is called common or random variation.

Causes of assignable variation can be precisely identified and eliminated. Examples of this type of variation are poor supplier quality, poor worker performance, or a misaligned machine. In each of these examples, the problem can be identified and corrected. In contrast, common causes of variation are based on random causes we cannot identify. If you look at bottles of a soft drink, you will notice that no two bottles are filled to the same level. Similarly, if you look at blueberry muffins in a bakery you will notice that some have more blueberries than others. These types of differences are completely normal. No two products are exactly alike. This is due to slight differences in materials, workers, machines, tools, and other factors. An important task in quality control is to determine the amount of random variation in a process. We can then monitor the process to ensure that the amount of variation does not exceed it.

Concept Check Questions

105. All processes have a certain amount of natural variation.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

106. Machine/robotic processes do not have natural variation.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

107. Common and random variation are the same thing.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

108. Variation that is caused by factors that can be clearly identified and managed is called _____.

- ☐ a) assignable variation
- ☐ b) common variation
- ☐ c) controllable variation
- ☐ d) usual variation

Correct or Incorrect?

Clear

Check Answer

109. Variation that is inherent in the process itself is called _____.

- ☐ a) assignable variation
- ☐ b) common variation
- ☐ c) controllable variation
- ☐ d) usual variation

Correct or Incorrect?

Clear

Check Answer

110. Causes of assignable variation can be precisely identified and eliminated.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

111. Common causes of variation are based on random causes we cannot identify.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

112. You can always reduce common variation.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Process Capability

Process capability is the evaluation of a process on its ability to meet certain quality standards. Quality standards are useless if the production process is not able to achieve them. It would be akin to expecting every high school athlete to perform at Olympic standards or taking an old-family sports utility vehicle (SUV) and expecting it to perform in a National Association for Stock Car Auto Racing (NASCAR) race. They simply are not capable. The same holds true for business processes. Strict quality standards are useless if the system is not capable of producing products that meet those standards.

General Motors (GM), for example, extensively relies on process capability evaluations in their automotive manufacturing. These assessments ensure that their production systems consistently meet strict quality standards, especially during new vehicle introductions or process changes. By assessing process capability, GM identifies and rectifies any potential manufacturing issues early on, ensuring its ability to consistently deliver high-quality and safe vehicles to consumers worldwide.

Supply Chain Leader's Box

■ INTEL CORPORATION

Intel Corporation—the world's largest manufacturer of semiconductors—understands the problems with process variation. Process variation leads to quality defects and a lack of product consistency. To minimize process variation Intel has implemented a program it calls “copy-exactly” at all its manufacturing facilities. This means that each facility uses the same equipment, and the same materials, and performs the same tasks in the same order. Regardless of whether the chips are made in Arizona, New Mexico, Ireland, or any of its other plants, they are made in exactly the same way. The level of detail to which the “copy-exactly” concept goes is meticulous. For example, when a chip-making machine was found to be a few feet longer at one facility than another, Intel made them match. When water quality was found to be different at one facility, Intel instituted a purification system to eliminate any differences. Even when a worker was found polishing equipment in one direction, he was asked to do it in the approved circular pattern. Such attention to exactness of detail is to minimize all variation possible.

The first question to ask in the development of a quality program is whether the process is capable of achieving the desired product specifications. [Product specifications](#), also called tolerances, are set ranges of acceptable quality characteristics. These can be product dimensions, such as length or weight, or customer service standards, such as a number of customer complaints. These standards are typically set by design engineers taking into account how the product will be used and customer expectations. For a product to be considered acceptable, its characteristics must fall within the product specification range. For example, the specification width of a machined part may be set as 10 inches ± 0.5 . This specifies that the part should be 10 inches wide but can vary between 9.5 and 10.5 inches. Anything outside this range is unacceptable.

Apple is known for its precision in manufacturing and sets stringent product specifications and tolerances for its iPhone components. Consider the iPhone's dimensions, which must align precisely with Apple's specifications to meet

their quality standards. For instance, the product specification for the iPhone's thickness may be designated as 0.3 inches ± 0.02 . This means that the acceptable thickness ranges from 0.28 to 0.32 inches. Any device falling outside this tolerance range is considered unacceptable. These specifications are crucial as they ensure uniformity and consistency across all iPhones produced. If these dimensions are wrong then the iPhone could no longer be water proof and even dust proof. Apple's design engineers meticulously set these tolerances considering how the device will be used, ensuring that customers receive products meeting their expectations. The strict adherence to product specifications ensures that each iPhone produced falls within the defined tolerances, guaranteeing consistency and quality across the product line.

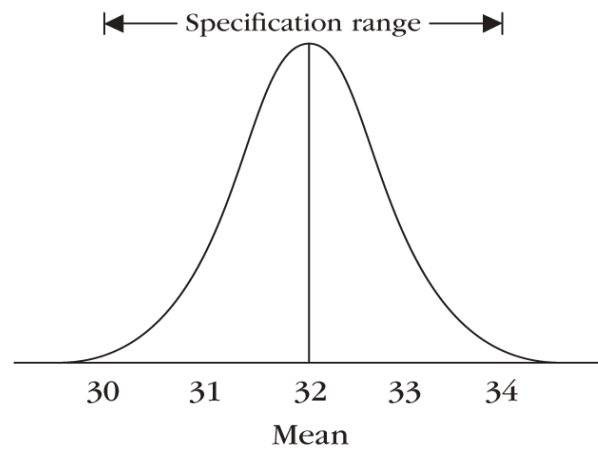
Recall that all production processes have a certain amount of natural variation. For a process to be considered “capable” of producing a product with set specifications, the variation of the process itself cannot exceed this set specification. Therefore, process capability involves evaluating the variation of the process and comparing it to product specifications.

To see how this works, let us look at the following three cases of process variation relative to product design specifications: (1) process variation “equals” specification range; (2) process variation “exceeds” specification range; and (3) process variation is “narrower” than specification range. Consider Pasta Mania, a company that produces pasta sauces in glass jars specified at 32 ounces ± 2 ounces. Therefore, the product specification range is between 30 and 34 ounces. [Figure 10.9\(a\)](#) shows a process (± 3 standard deviations) where product volumes fall between 30 and 34 ounces. Assuming a normal distribution, 99.74% of products fall in the range of ± 3 standard deviations. In this example, we can see that process variation matches product specifications. This means that the process is capable of producing products within the set specifications.

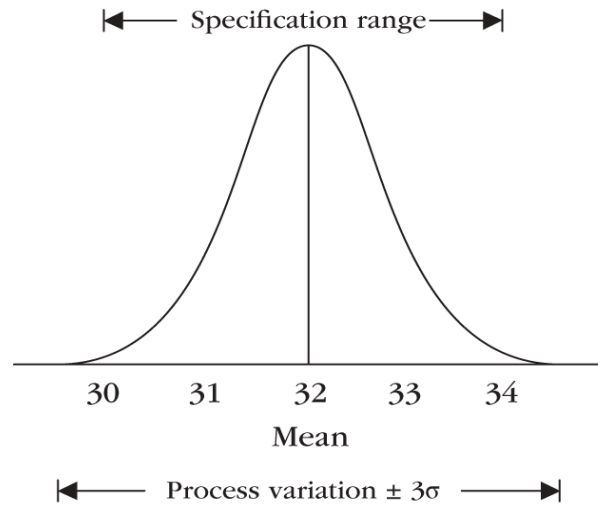
In [Figure 10.9\(b\)](#), however, 99.74% of products (± 3 standard deviations) have volumes between 29 and 35 ounces. Here the process variation is outside the product specifications, and a large percentage of products produced fall outside the permissible limits. Here the process is not capable of producing the product within the set specifications.

In [Figure 10.9\(c\)](#), 99.74% of the products produced are with volumes between 31 and 33 ounces. Here, the range of process variation is less than the set specification range, and the process exceeds minimal capability.

(a) Process variation and product specification range are equal



(b) Process variation exceeds product specification range



(c) Process variation is narrower than process specification range

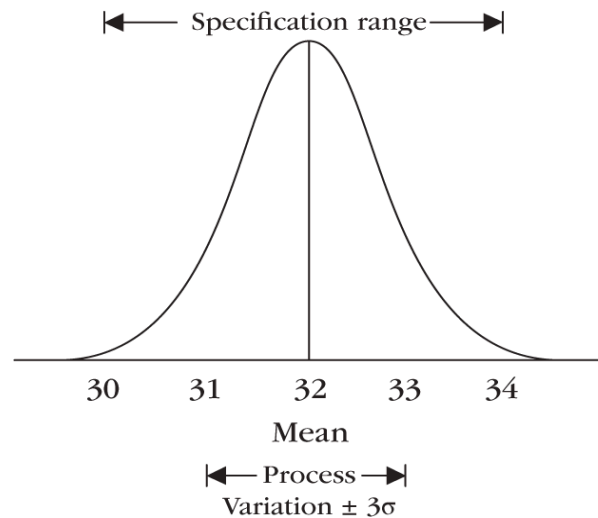


FIGURE 10.9 Process variation vs product specifications.

Process capability is measured using the process capability index C_p . It is computed as the ratio of the product specification range to the process variation range:

$$C_p = \frac{\text{Product specification range}}{\text{Process variation range}} = \frac{USL - LSL}{6\sigma}$$

The product specification range is the difference between the upper specification limit (USL) and the lower specification limit (LSL) of the process. The process variation range—the denominator—is computed as 6 standard deviations (6σ) of the process being monitored. We use 6σ because 99.74% of the products fall within ± 3 standard deviations of the distribution—a total of 6 standard deviations. C_p is easy to interpret:

$C_p = 1$: Process variation just meets specifications, as shown in [Figure 10.9\(a\)](#). The process is “minimally capable.”

$C_p \leq 1$: Process variation “exceeds” the specification range, as in [Figure 10.9\(b\)](#). The process is not capable of producing products within specification.

$C_p \geq 1$: Process variation is “narrower” than the specification range, as shown in [Figure 10.9\(c\)](#). The process exceeds minimal capability.

A C_p value of 1 means that 99.74% of products produced fall within the specification range. This also means that 0.26% ($100 - 99.74\%$) of the products do not fall within the range. This percentage may seem negligibly small. However, 0.26% corresponds to 2,600 parts per million (ppm) defective products ($0.0026 \times 1,000,000$). This translates into 2,600 wrong prescriptions out of a million, 2,600 incorrect medical procedures out of a million, or 2,600 malfunctioning aircraft out of a million. In these terms, we can see that this number of defects is high, and the way to reduce it is to increase process capability. This involves studying the process and improving it.

EXAMPLE 1 Computing C_p

Pasta Mania is evaluating three different machines for their capability in filling jars with its famous pasta sauce. The product specification range is set between 30 and 34 ounces. Given the standard deviations for each machine provided in the following table, determine which of the machines are capable of producing within specifications.

Machine	Standard Deviation
A	0.6
B	0.7
C	1.2

SOLUTION:

To determine the capability of each machine, we need to divide the specification width ($UCL - LCL = 34 - 30 = 4$) by 6σ for each machine:

Machine	σ	USL - LSL	6σ	$C_p = \frac{USL-LSL}{6\sigma}$
A	0.6	4	3.6	1.11
B	0.7	4	4.2	0.95
C	1.2	4	7.2	0.55

Looking at the C_p values, only machine A is capable of filling bottles within specifications because it is the only machine that has a C_p value at or above 1.

Although C_p is a valuable measure of process capability, it has one shortcoming: it assumes that process variability is centered on the specification range. Unfortunately, this is not always the case. [Figure 10.10](#) shows an example from Pasta Mania. Here the process is specified for a mean of 32 ounces, but the variation of the process itself has a mean of 31 ounces, even though both ranges are the same. The process is not centered, and a certain proportion of products will fall outside the specification range.

This problem is common and can lead to mistakes when computing C_p . For this reason, another measure for process capability is used more frequently:

$$C_p = \min \left(\frac{USL - \mu}{3\sigma}, \frac{\mu - LSL}{3\sigma} \right)$$

where

μ = the mean of the process

σ = the standard deviation of the process

C_{pk} is a measure of process capability that addresses a possible lack of centering of the process over the specification range. To use this measure, the process capability of each half of the normal distribution is computed, and the minimum of the two is used.

Looking at [Figure 10.10](#), the computed C_p would be 1.00 as both ranges are the same, leading us to conclude that the process is capable. Computing C_{pk} , however, leads to a different conclusion. Assuming that the process standard deviation, σ , is 0.6, we get the following:

$$\begin{aligned} C_{pk} &= \min \left(\frac{USL - \mu}{3\sigma}, \frac{\mu - LSL}{3\sigma} \right) \\ C_{pk} &= \min \left(\frac{34 - 31}{3(0.6)}, \frac{31 - 30}{3(0.6)} \right) \\ C_{pk} &= \min (1.66, 0.55) \\ C_{pk} &= 0.55 \end{aligned}$$

The computed C_{pk} value is less than 1, indicating that the process is not capable.

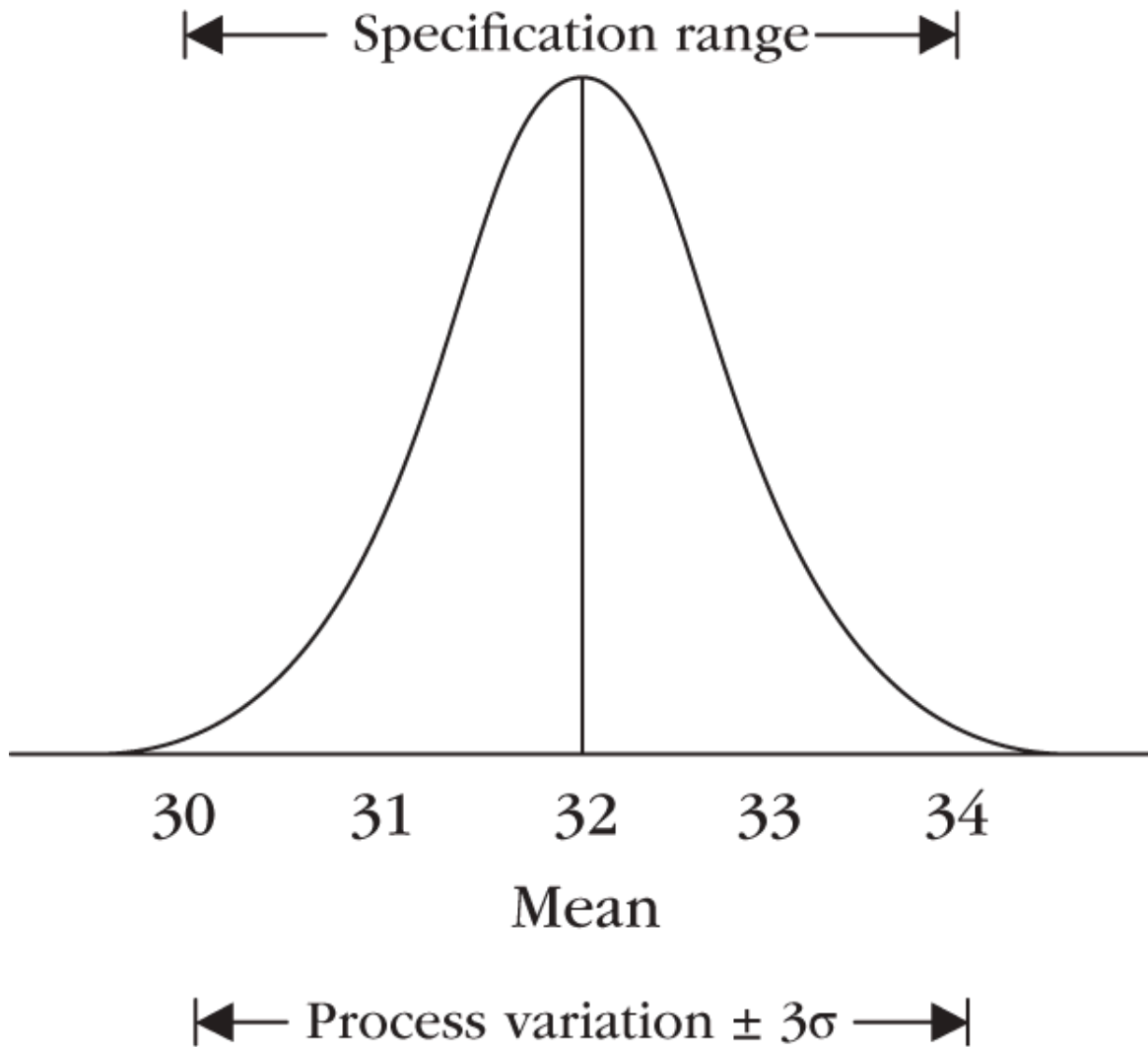


FIGURE 10.10 Actual process variation is not centered on the specification range.

EXAMPLE 2 Computing the C_{pk} Value

Compute and interpret the C_{pk} measure of process capability for the following process. What value would you have obtained with the C_p measure?

$$\begin{aligned}\text{USL} &= 22 \\ \text{LSL} &= 10 \\ \text{Process } \sigma &= 2 \\ \text{Process } \mu &= 14\end{aligned}$$

SOLUTION:

Compute the C_{pk} measure of process capability:

$$\begin{aligned}C_{pk} &= \min \left(\frac{22-14}{3(2)}, \frac{14-10}{3(2)} \right) \\ &= \min(1.33, 0.66) \\ &= 0.66\end{aligned}$$

The C_{pk} value is below 1.00, telling us that the process is not capable. The C_p measure, however, provides a different answer in this case:

$$C_p = \frac{\text{USL} - \text{LSL}}{6\sigma} = \frac{12}{12} = 1.00$$

This measure is misleading in this case. The reason for the difference is that the process is not centered on the specification range.

Concept Check Questions

113. Process capability is the evaluation of a process on its ability to meet certain quality standards.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

114. Strict quality standards are useless if the system is not capable of producing products that meet those standards.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

115. Process capability and product specifications are the same thing.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

116. Product specifications and tolerances are the same thing.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

117. For a process to be considered “capable” of producing a product with set specifications, the variation of the process itself cannot exceed this set specification.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

118. Process capability is measured using the process capability metric.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

119. A value of C_p below 1 indicates the process is capable.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

120. The lower the value of C_p the better.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

121. C_p works on all processes.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

122. C_{pk} is a measure of process capability that addresses a possible lack of centering of the process over the specification range.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Process Control Charts

Once we have ensured that the process is capable of producing products within the set limits, we need to make sure the process continues doing so. This requires regularly monitoring the process to make sure products are produced with characteristics that stay within the set limits. We say that we are ensuring that the process is “in a state of control.” The most commonly used tool for doing this is a [process control chart](#).

A control chart is a graph that shows whether a sample of data falls within the common or normal range of variation. The chart has upper and lower control limits that separate common from assignable causes of variation. We say that a process is out of control when a plot of data reveals that one or more samples fall outside the control limits. [Figure 10.11](#) shows examples of when the data falls outside the control limits and when we need to investigate causes of variation.

Control charts were pioneered by Walter A. Shewhart in the 1920s while working at Bell Telephone Laboratories. Shewhart developed these charts as a visual tool for assessing variation in manufacturing processes, laying the foundation for SQC methodologies. Control charts were designed to identify variations in processes as soon as they occur. By plotting data points over time, these charts swiftly signal when a process moves beyond its usual limits. This early detection enables prompt investigation and corrective actions, preventing the production of defective products.

To monitor the process using control charts, samples of the process output are taken at regular intervals and plotted on the control chart. When observed values go outside the control limits, the process is assumed not to be in control. Production is stopped, and employees attempt to identify the cause of the problem and correct it.

Control charts are one of the most commonly used tools in statistical process control and can be used to track the performance of any characteristic of a product, such as the weight of a cereal box, the number of chocolates in a box, or the volume in a bottle of water. Characteristics that can be monitored by control charts can be divided into two groups: [variables](#) and [attributes](#).

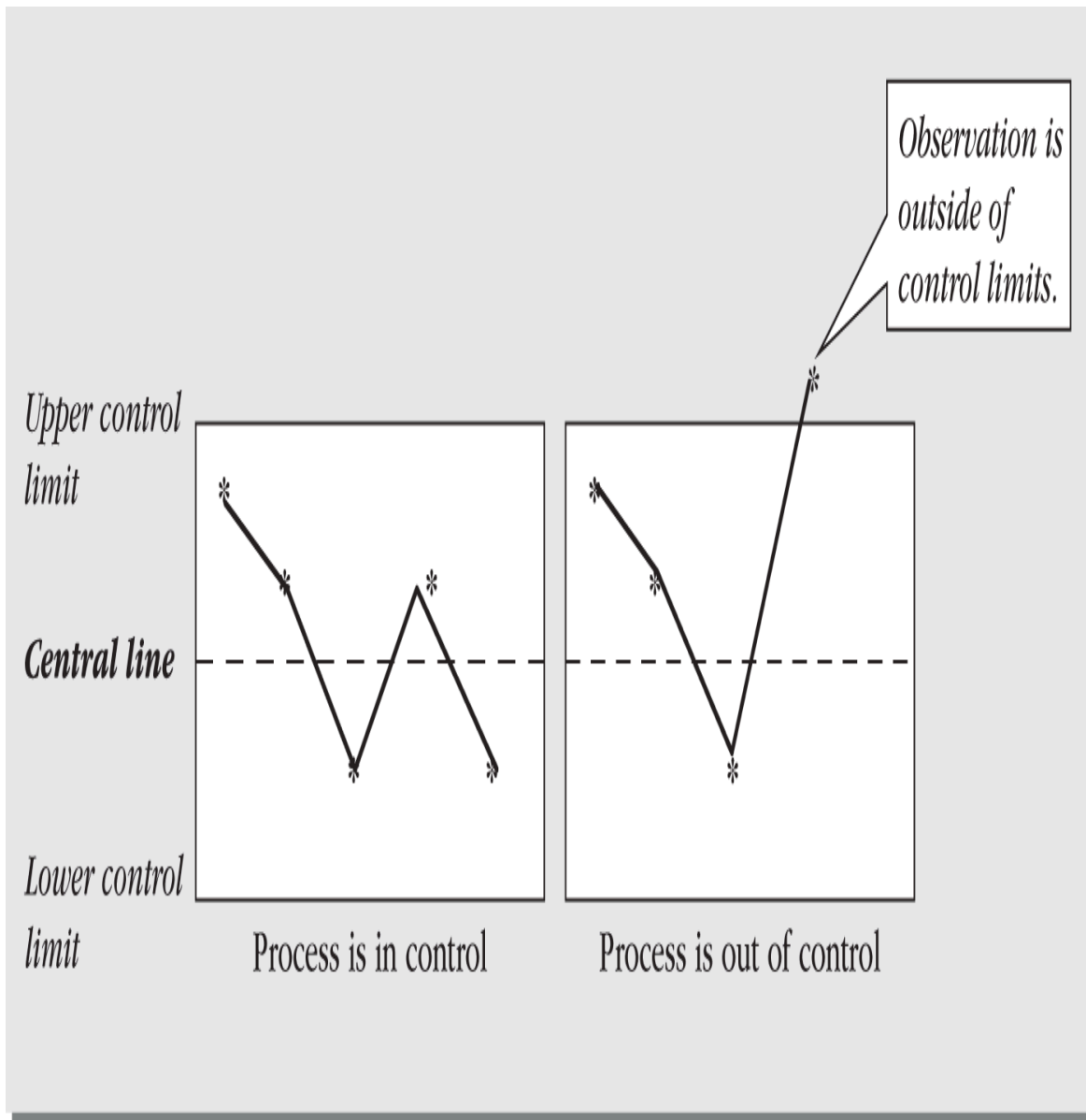


FIGURE 10.11 Process control charts.

Control charts for variables are used to monitor characteristics that can be *measured* and have a continuum of values, such as height, weight, or volume. A soft-drink bottling operation is an example of a variable measure because the amount of liquid in the bottles can be measured and can take on a number of different values. Other examples are the weight of a bag of sugar, the temperature of a baking oven, or the diameter of plastic tubing.

A control chart for attributes, on the contrary, is used to monitor characteristics that have discrete values and can be “counted.” Often, they can be evaluated with a simple yes-or-no decision. Examples include color, taste, or smell. An

attribute requires only a single decision, such as yes or no, good or bad, acceptable or unacceptable (e.g., the apple is good or rotten, the muffin is fresh or stale, the zipper is or is not broken, the lightbulb works or it does not work) or counting the number of defects (e.g., the number of broken cookies in the box, the number of dents on the car, the number of barnacles on the bottom of a boat). Control charts can be used to monitor both attributes and variables. Here we will look at the control charts for attributes.

Concept Check Questions

123. Process control charts measure to ensure that the process is capable of producing products within the set limits.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

124. A _____ is a graph that shows whether a sample of data falls within the common or normal range of variation.

- ☐ a) histogram
- ☐ b) Pareto diagram
- ☐ c) Ven diagram
- ☐ d) control chart

Correct or Incorrect?

Clear

Check Answer

125. Control charts were pioneered by Walter A. Shewhart in the 1920s

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

126. Control charts are one of the most commonly used tools in statistical process control.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

127. Control charts for attributes are used to monitor characteristics that can be measured and have a continuum of values.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

128. A control chart for attributes is used to monitor characteristics that have discrete values and can be counted.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Control Charts for Attributes

Control charts for attributes called a [*p*-chart](#), monitor the proportion of defective items in a sample. The center line of the chart is the average proportion defective in the population, or p . This is obtained by taking several sample observations at random and computing the average value of p across all samples. To construct the UCL and LCL for a p -chart we use the following formulas:

$$\begin{aligned} \text{UCL} &= p + z sp \\ \text{LCL} &= p - z sp \end{aligned}$$

where

z = standard normal variable

p = the sample proportion defective

sp = the standard deviation of the average proportion defective computed as

$$sp = \sqrt{\frac{p(1-p)}{n}}$$

where n is the sample size.

EXAMPLE 3 Designing p -Charts

Mercy Hospital wants to ensure all staff follow a common five-step process when discharging patients. The hospital has put a check sheet in place and is performing random inspections to ensure that the steps are being followed. Conducting random checks of 10 observations per sample the hospital collected the following data to use to develop control chart limits.

Sample	Number of incorrect procedures	Number inspected	Fraction defective
1	0	10	0.1
2	1	10	0.1
3	2	10	0.2
4	1	10	0.2
5	1	10	0.1
Total	5	50	

$$p = \frac{5}{50} = 0.10$$

$$sp = \sqrt{\frac{0.10(1-0.10)}{10}} = 0.095$$

$$UCL = p + z sp = 0.10 + 3(0.095) = 0.385$$

$$LCL = p - z sp = 0.10 - 3(0.095) = -0.185 \rightarrow 0$$

In this example, the lower control unit is negative, which sometimes occurs due to approximation of the binomial distribution. When it occurs, LCL is rounded to zero.



Concept Check Questions

129. Which of the following is a control chart for attributes?

- ☐ a) R-chart
- ☐ b) p -chart
- ☐ c) $\bar{x}$ -bar chart
- ☐ d) μ -chart

Correct or Incorrect?

Clear

Check Answer

130. A p -chart monitors the proportion of defective items in a sample.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

131. The lower control limit (LCL) for a p -chart can be negative.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Six Sigma Quality

What Is Six Sigma?

Six Sigma is a quality management process that uses rigorous measurement to reduce process variation and eliminate defects. It originated at Motorola in the 1970s, and the rigorous standards were later embraced by GE, Lockheed Martin, Allied Signal, American Express, Texas Instruments, and other companies. Today, the Six Sigma quality standard has become a benchmark in many industries.

Six Sigma defines quality as no more than 3.4 ppm defective. Sigma (σ) stands for the number of standard deviations of the process and measures how far a given process deviates from perfection. A process with ± 3 sigma (σ) means that 2,600 ppm are defective, whereas with Six Sigma they approximate 3.4 ppm, as shown in [Figure 10.12](#). The process achieves this by eliminating waste through strict improvements in quality and elimination of defects. The idea behind Six Sigma is to systematically identify and eliminate defects and get as close to “zero defects” as possible. The concept of quality is at the core of Lean, and the two go hand in hand eliminating waste and rooting out defects. Six Sigma relies on all the tools we have discussed so far to achieve this.

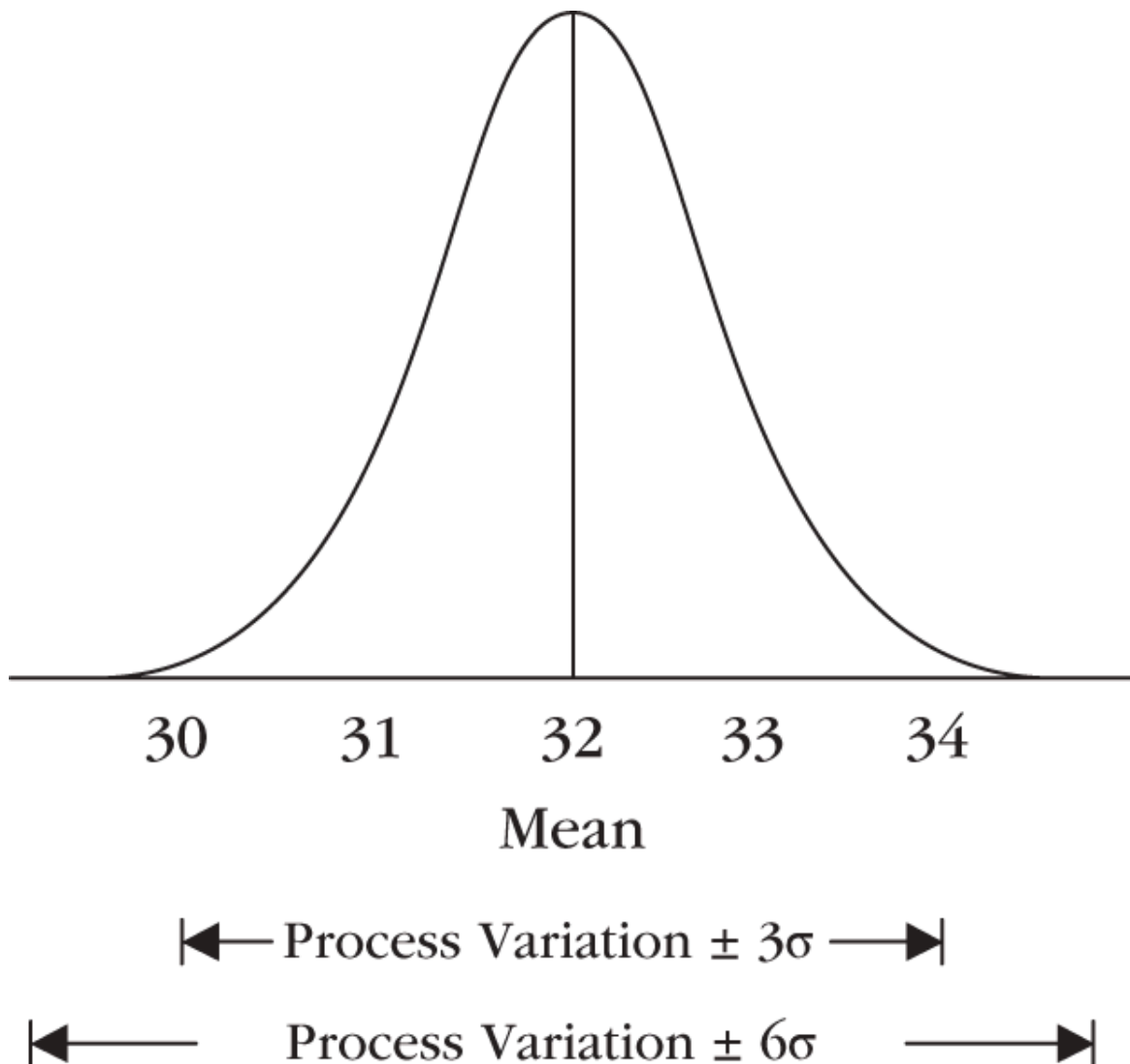


FIGURE 10.12 Six Sigma vs Three Sigma quality.

To achieve the goals of Six Sigma, companies typically institute a quality focus in every aspect of their organization. Before a product is designed, marketing ensures that product characteristics are exactly what customers want. Operations ensure that exact product characteristics can be achieved through product design, the manufacturing process, and the materials used. The Six Sigma concept is an integral part of other functions as well. It is used in the finance and accounting departments to reduce costing errors and the time required to close the books at the end of the month. Six Sigma requires the involvement of all parts of the organization as well as the entire supply chain.

GE exemplifies the successful implementation of Six Sigma methodologies across its operations. Led by CEO Jack Welch, GE embraced Six Sigma as a core strategy, achieving significant results. The company reported cost savings of around \$12 billion over five years due to reduced defects and increased efficiency. Six Sigma was not limited to manufacturing; it permeated all aspects, from product design to finance, fostering a culture of quality and continuous improvement. GE's commitment to Six Sigma led to a substantial cultural shift and served as a model for other companies seeking to enhance quality and operational effectiveness.

Concept Check Questions

132. Six Sigma is a quality management process that uses rigorous measurement to reduce process variation and eliminate defects.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

133. Six Sigma originated at Toyota in the 1970s, and the rigorous standards were later embraced by General Electric, Lockheed Martin, Allied Signal, American Express, Texas Instruments, and other companies.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

134. Six Sigma defines quality as no more than six parts per million defective.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

135. To achieve the goals of Six Sigma, companies typically institute a quality focus in every aspect of their organization.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

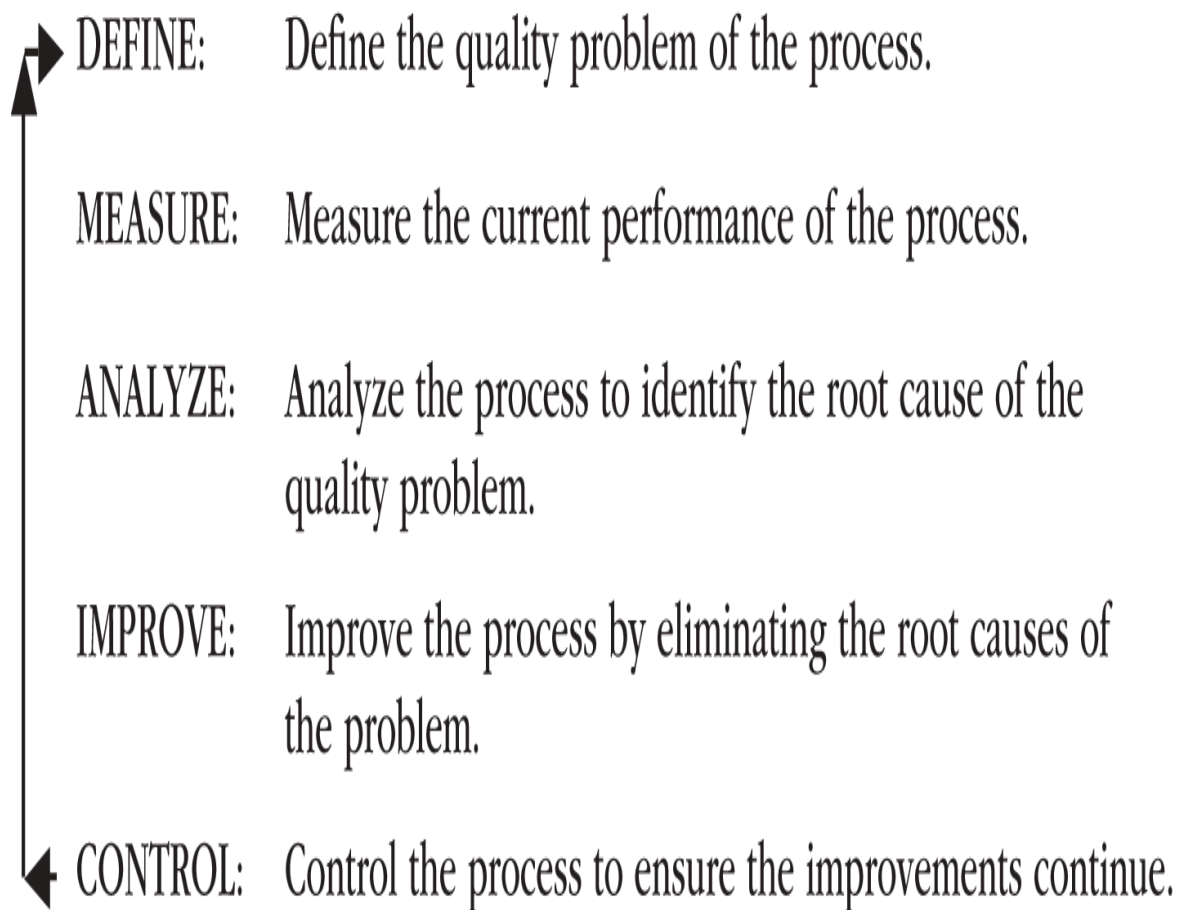
Six Sigma Methodology

There are two aspects to the Six Sigma methodology. First is the use of technical tools to identify and eliminate causes of quality problems. Six Sigma relies heavily on quantitative and data-driven technical tools. These technical tools include the SQC tools and the seven tools of quality discussed earlier in this chapter. Company use of these technical tools is integrated throughout the entire organization.

The second aspect of Six Sigma is people involvement, as with all other aspects of Lean. In Six Sigma all employees have the training to use technical tools and are responsible for rooting out quality problems. Employees are

given martial arts titles that reflect their skills in the Six Sigma process. Black belts and master black belts are individuals who have extensive training in the use of technical tools and are responsible for carrying out the implementation of Six Sigma. They have experienced individuals who oversee the measuring, analysis, process controlling, and improvement. They achieve this by acting as coaches, team leaders, and facilitators of the process of continuous improvement. Green belts are individuals who have sufficient training in technical tools to serve on teams or small, individual projects.

The Six Sigma approach is organized around a five-step plan known as DMAIC, which stands for the following:



The first three steps provide a study of the existing process, whereas the last two steps are involved in process change. All steps extensively utilize quantitative tools, such as measuring the current performance and analyzing the process for root causes of problems. This is a continuous process. Part of

Six Sigma is to continuously search for quality problems and improve them. In organizations, this effort is led by the black belts.

Successful Six Sigma implementation requires commitment from top company leaders. These individuals must promote the process, eliminate barriers to implementation, and ensure that proper resources are available. A key individual is the champion of Six Sigma. This is a person who comes from the top ranks of the organization and is responsible for providing direction and overseeing all aspects of the process.



Concept Check Questions

136. There are two aspects to the Six Sigma methodology. Which of the following is not one of these?

- ☐ a) People involvement
- ☐ b) The use of technical tools to identify and eliminate causes of quality problems
- ☐ c) Management involvement

Correct or Incorrect?

Clear

Check Answer

137. The Six Sigma approach is organized around a five-step plan. Which of the following is not a part of the plan?

- ☐ a) Analyze
- ☐ b) Control
- ☐ c) Define

- ☐ d) Improve
- ☐ e) Suppliers

Correct or Incorrect?

Clear

Check Answer

138. Successful Six Sigma implementation requires commitment from top company leaders.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

The Lean Six Sigma Supply Chain

In this chapter we have seen how Lean utilizes all its resources in the most efficient manner possible to create value for the end customer. We have also learned about Six Sigma, as a way to root out quality problems and reduce process variation. The two approaches together result in improved supply chains that can operate at lower relative costs and provide greater customer value than their competitors. They can even perform at levels exceeding customer expectations. As a result, Lean and Six Sigma create a “best-in-class” supply chain that provides a major competitive advantage over competitors. [Figure 10.13](#) shows the tools from each approach that work to create an efficient Lean Six Sigma supply chain.

Amazon's strategic adoption of Lean and Six Sigma methodologies in its supply chain management has been highly successful, leading to significant

improvements in efficiency, cost reduction, and customer satisfaction. Let us see what this has done for Amazon:

Cost Reduction: Amazon has reduced costs by an estimated 25% through the implementation of Lean and Six Sigma principles. This cost reduction has helped Amazon maintain competitive pricing and improve its profitability.

Efficiency Improvements: By integrating Lean's focus on eliminating waste and Six Sigma's emphasis on quality, Amazon has streamlined its operations. This has resulted in faster deliveries, improved service quality, and optimized inventory management.

Customer Satisfaction: The implementation of Lean and Six Sigma has led to enhanced customer satisfaction. Amazon's ability to deliver products quickly and accurately has helped it build a loyal customer base.

Overall, Amazon's integration of Lean and Six Sigma methodologies across its supply chain has not only improved its operational efficiency but also set industry standards for efficient, value-centric operations.

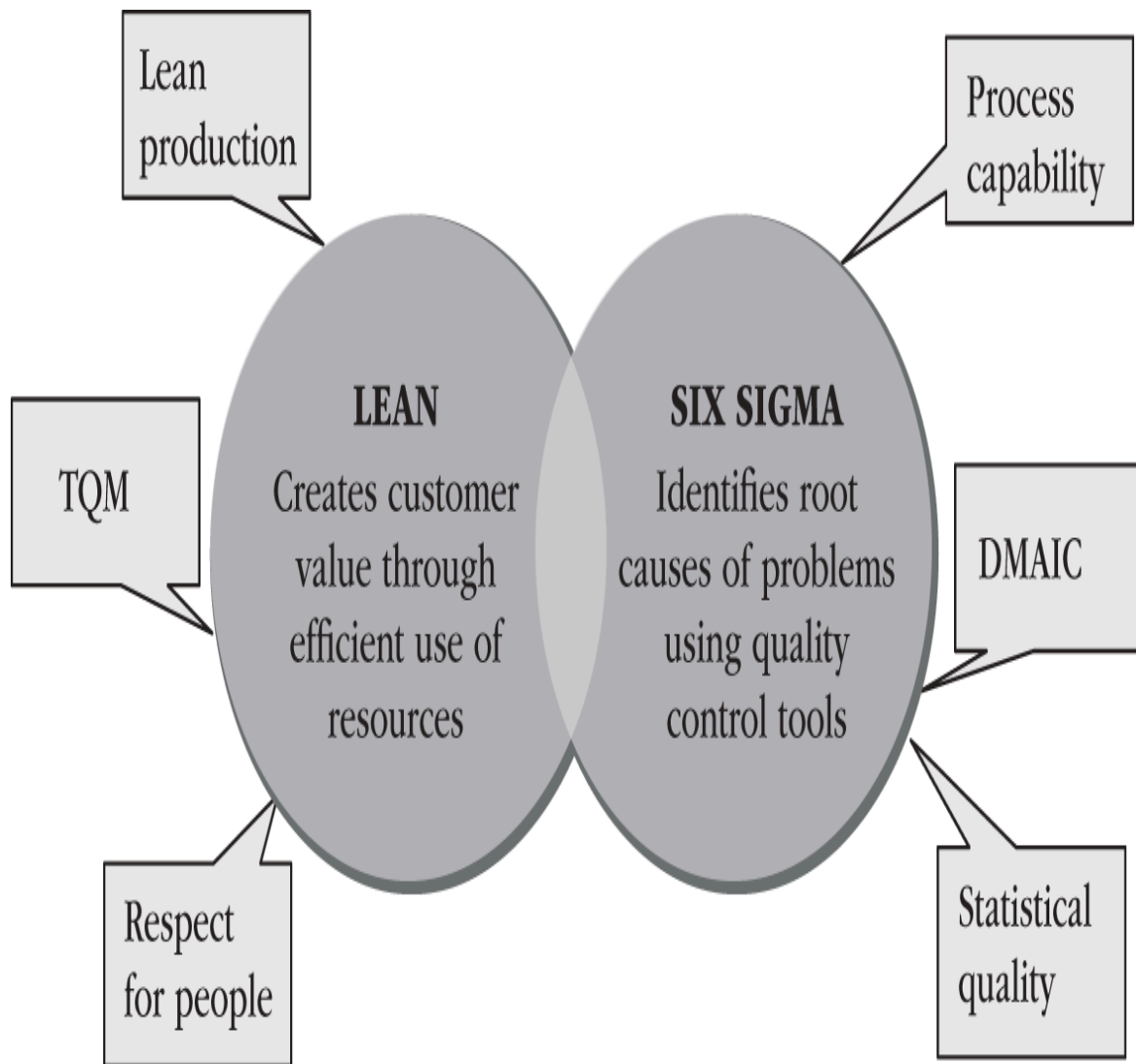


FIGURE 10.13 Lean Six Sigma.

These practices, however, cannot just be implemented within one stage of the supply chain. They must be implemented across all organizations in the chain to work. Otherwise, waste and inefficiencies incurred by even a few members of the chain will be passed down to the final customer. If a process in the chain does not create value, it should be removed. For this reason, the term “value chain” is often used to refer to a Lean supply chain.

A Lean Six Sigma supply chain is a cross-functional team effort comprising individuals across different supply chain processes. In many companies, it is the same team as the Sales and Operations Planning (S&OP) we discussed in [Chapter 8](#). S&OP is a process intended to match supply and demand through functional collaboration. The process is designed to coordinate activities

between marketing and sales, with those of operations and sourcing, across the supply chain to ensure that supply meets demand requirements. It requires teamwork among sales, distribution and logistics, operations, finance, and product development. This enables supply chains to provide better customer service, lower inventory, reduce customer lead times, and stabilize production schedules. The S&OP is a very good source for Lean Six Sigma, as S&OP must be strategically aligned with executive management objectives. As a result, this team understands the “big picture” and sees major process breakdowns and their impact on the supply chain.

Concept Check Questions

139. Which of the following is not part of Lean Six Sigma?

- ☐ a) Respect for management
- ☐ b) DMAIC
- ☐ c) Statistical quality
- ☐ d) Process capability
- ☐ e) TQM

Correct or Incorrect?

Clear

Check Answer

140. Lean Six Sigma can just be implemented within one stage of the supply chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

141. A Lean Six Sigma supply chain is a cross-functional team effort comprising individuals across different supply chain processes.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Developing a Lean Six Sigma Supply Chain

Let us look at the steps in developing a Lean Six Sigma supply chain:

Step 1—Jointly Define Value. The cross-functional team jointly defines value as perceived by the final customer. This creates a joint vision of critical attributes of the product and delivery process. This involves identifying the VOC, which we learned about in [Chapter 5](#), and the specific value propositions for each target market.

Step 2—Conduct Supply Chain Capability Analysis. This requires establishing how well the current supply chain meets customer requirements. This means conducting a capability analysis. Six Sigma concepts can be used here to characterize the ability of the supply chain to meet customer requirements. The supply chain is viewed as a system and is analyzed for capacity bottlenecks and system constraints.

Step 3—Develop Key Financial and Operational Metrics. Key financial and operational metrics for the supply chain are developed. Inventory metrics are an important barometer of supply chain efficiency at this stage. For example, inventory investments and inventory turns ratio are important supply chain metrics that measure the efficiency of supply chain asset utilization. Developing an understanding of the relationships between metrics is important as well. For example, metrics such as lead time, demand, and service levels,

impact key process outputs, such as cash flow, profitability, inventory investment, and inventory turns.

Step 4—Identify and Implement System Improvements. The partners then work together to identify and eliminate waste from the system and to meet target costs. They analyze supply chain work streams using tools such as [value stream mapping \(VSM\)](#). VSM is a flowcharting tool that is used to illustrate product and information flows through various processing steps. It is a valuable tool in identifying all value-adding and nonvalue adding processes.

In addition, Lean Six Sigma requires supply chain member transparency to share plans and information, such as forecasts, inventory usage requirements, and production plans. Information technology, as we discussed in [Chapter 3](#), has become a critical tool to enable this degree of information sharing. Often supply chain partners are linked online. They develop joint forecasts, joint production schedules, and joint delivery plans. This permits suppliers to deliver goods when they are needed by their customers in smaller quantities and not carry excess inventories. Also, suppliers have adopted stringent quality practices enabling customers to bypass the quality inspection process. All this serves to streamline the supply chain and eliminate steps.

Starbucks, for example, employs VSM to visualize and optimize its coffee production and supply chain processes. Utilizing this tool, Starbucks scrutinizes the flow of coffee beans from sourcing to store delivery, identifying inefficiencies and streamlining operations. Through VSM, Starbucks has achieved notable improvements, reportedly reducing supply chain costs by approximately 10% and minimizing waste in production. This systematic approach supports Starbucks' commitment to quality, ensuring a consistent supply of high-quality coffee to its stores while maintaining operational efficiency. VSM's strategic application underscores Starbucks' dedication to continuous improvement and efficiency across its supply chain.

Concept Check Questions

142. The cross-functional team jointly defines value as perceived by the final customer.

- ☐ a) Conduct Supply Chain Capability Analysis
- ☐ b) Identify and Implement System Improvements

- ☐ c) Develop Key Financial and Operational Metrics
- ☐ d) Jointly Define Value

Correct or Incorrect?

Clear

Check Answer

143. This requires establishing how well the current supply chain meets customer requirements.

- ☐ a) Conduct Supply Chain Capability Analysis
- ☐ b) Identify and Implement System Improvements
- ☐ c) Develop Key Financial and Operational Metrics
- ☐ d) Jointly Define Value

Correct or Incorrect?

Clear

Check Answer

144. This means conducting a capability analysis.

- ☐ a) Conduct Supply Chain Capability Analysis
- ☐ b) Identify and Implement System Improvements
- ☐ c) Develop Key Financial and Operational Metrics
- ☐ d) Jointly Define Value

Correct or Incorrect?

Clear

Check Answer

145. Key financial and operational standards for the supply chain are developed.

- ☐ a) Conduct Supply Chain Capability Analysis
- ☐ b) Identify and Implement System Improvements
- ☐ c) Develop Key Financial and Operational Metrics
- ☐ d) Jointly Define Value

Correct or Incorrect?

Clear

Check Answer

146. The partners work together to identify and eliminate waste from the system and to meet target cost.

- ☐ a) Conduct Supply Chain Capability Analysis
- ☐ b) Identify and Implement System Improvements
- ☐ c) Develop Key Financial and Operational Metrics
- ☐ d) Jointly Define Value

Correct or Incorrect?

Clear

Check Answer

147. Lean Six Sigma requires supply chain member transparency to share plans and information, such as forecasts, inventory usage requirements, and production plans.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Impact on Supply Chain Activities

Lean Six Sigma has a transformative impact on the supply chain. However, some activities are more impacted than others. Let us look at some supply chain activities to see how they are impacted by Lean Six Sigma.

Suppliers

Lean Six Sigma suppliers are a key element of an efficient supply chain. They are better able to respond to changes in customer demand, have lower costs due to efficient systems, and have improved quality that eliminates inbound inspection. They also tend to have shorter and more reliable lead times, which translate into lower safety stock and smoother workflow throughout the chain.

To quickly respond to demand, suppliers often locate their facilities close to their customers. For example, Dell requires its first-tier suppliers to be located within a 15-minute radius of its Austin facility. Also, Lean supply chains tend to rely on networks of small specialized plants that enable efficiency and permit focus. For example, Toyota has 12 separate plants located around Toyota City.

Concept Check Questions

148. Suppliers are not a key element of Lean Six Sigma.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

149. To quickly respond to demand, suppliers often locate their facilities close to their customers.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

150. Lean supply chains tend to rely on large plants that enable efficiency and permit focus.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Operations

Operations is one area where Lean Six Sigma improvements are most evident, from setting uniform workflow to pull production and changes in facility layout. One important aspect of operations is the calculation of the system's takt time, or cycle time, which we discussed in [Chapter 5](#). Proper cycle time calculation ensures that the process will produce according to actual customer demand. Also, cycle time calculations directly tie into inventory calculations, discussed in [Chapter 9](#), and ordering policies. Effective inventory utilization is a critical aspect of the Lean Six Sigma supply chain, as it is one of the most important assets. Metrics such as inventory turnover and utilization, discussed in [Chapter 7](#), are especially important here.

Consider that the Coca-Cola Company's adoption of Lean Six Sigma principles in operations and inventory management has significantly optimized its processes. By applying these methodologies, Coca-Cola achieved an approximate 20% reduction in excess inventory and a notable improvement in production cycle times. Lean Six Sigma's emphasis on cycle time optimization and strategic inventory management strategies has led to streamlined operations, reduced holding costs, and enhanced supply chain efficiency. Coca-Cola's commitment to continuous improvement, rooted in Lean Six Sigma practices, underscores the enduring impact of optimizing cycle times and efficiently managing inventory in achieving operational excellence and meeting customer demands effectively.

Concept Check Questions

151. Operations is one area where Lean Six Sigma improvements are most evident.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

152. One important aspect of operations is the calculation of the system's takt time.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

153. Takt time and cycle time are the same thing.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

154. Inventory efficiency is not a part of Lean Six Sigma.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Logistics

Lean Six Sigma requires substantial changes in logistics, as it is a key function that connects the links in the chain. The location of warehouses and modes of transportation can be selected to optimize the movement of materials and meet performance criteria. Optimization models can also be used to select routes and determine shipping quantities. In addition, changes in warehouse design are essential to eliminate waste, create efficiency improvements, and eliminate process variability from order picking to packing. As the logistics function is often outsourced to third-party logistics (3PL) providers, it is important to integrate the service provider into the supply chain planning process.



Concept Check Questions

155. Lean Six Sigma rarely impacts logistics.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

156. The logistics function is often outsourced to third-party logistics (3PL) providers

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Empowering Entrepreneurs Box

As you have learned in this chapter, Lean is not just a new type of process but is a broad business philosophy that affects every aspect of the organization. Lean has a special impact on small businesses and startups and was even popularized by a book titled *The Lean Startup*. Applying Lean to entrepreneurship is about taking the Lean philosophy and creating a different way of thinking about the business, emphasizing the business model vs the business plan. It uses the concept of continuous improvement, or kaizen, to create a process of learning iterations to achieve the right fit between the product and the market. This process means continuous customer discovery and being agile to adapt to the customer needs.

The traditional process for an entrepreneur is to go through a long period researching their idea, writing a business plan, developing a team and process to create the product, and then launching a marketing campaign. The concept of the Lean Startup is different. It starts with a minimum viable product—a version of the product with just enough features to attract early adopters—and suggests getting to the market quickly and cheaply. Then, using the concept of kaizen, the entrepreneur creates cycles of product improvement, learning from customers in real time and quickly adapting and improving the product. The quality control tools discussed in this chapter can be especially helpful. This process combines an active focus on the customer with quick adaptations to the market and continuous improvement for the business to evolve and become better.

Entrepreneurs are typically on a tight budget and need to adapt to the market quickly. This means they need to eliminate waste and be agile to respond to customer demand. The concepts of Lean are particularly useful for entrepreneurs.

CHAPTER HIGHLIGHTS

Lean is a management approach for creating value for the end customer through the most efficient utilization of resources possible. The most important tenet of Lean is eliminating waste, where waste is defined as anything that does not add value.

Lean consists of three elements that work together: Lean production, total quality management, and respect for people.

Lean relies on visual signals to pull products through the system.

Communication between work centers is made possible by the use of a signaling system called a kanban, which means “signal” or “card” in Japanese.

Jidoka is the authority of every worker to stop the production process and fix problems as they occur rather than pushing them down the line.

The “seven tools of quality control” are essential in identifying and analyzing quality problems. They include cause-and-effect diagrams, flowcharts, checklists, control charts, scatter diagrams, Pareto analysis, and histograms.

ISO 9000 consists of a “family” of standards established by the ISO that address various aspects of the quality management process. ISO 14000 are standard for environmental management.

SQCs are statistical tools used to measure quality and identify quality problems in both the product and process. These tools can be divided into three broad categories: descriptive statistics, SPC, and acceptance sampling.

All processes have a certain amount of normal variation. The variation that is caused by factors that can be identified and managed is called “assignable variation”. Variation that is inherent in the process itself is called “common or random variation.”

Process capability is the evaluation of the production process as to its ability to meet or exceed the set product specifications.

Process control charts are SQC tools used to monitor the process to make sure products are being produced with characteristics that are within the set limits. Process control charts ensure that the process is “in a state of control.”

Six Sigma is a quality management process that uses rigorous measurement to reduce process variation and eliminate defects. Six Sigma defines quality as no more than 3.4 ppm defective.

KEY TERMS

[Lean](#)

[Six Sigma](#)

[Lean Six Sigma](#)

[Waste](#)

[Kaizen](#)

[Kaizen blitz](#)

[Lean production](#)

[Total quality management \(TQM\)](#)

[Respect for people](#)

[just-in-time \(JIT\)](#)

[Pull production](#)

[Kanban](#)

[Setup time](#)

[Jidoka](#)

[Quality circle](#)

[Voice of the customer \(VOC\)](#)

[Cause-and-effect diagrams](#)

[Fishbone diagrams](#)

[Flowcharts](#)

[Checklists](#)

[Control charts](#)

[Scatter diagrams](#)

Pareto analysis

Histograms

Statistical quality control (SQC)

Descriptive statistics

Statistical process control (SPC)

Acceptance sampling

Assignable variation

Common or random variation

Process capability

Product specifications

Process control chart

Variables

Attributes

p-chart

Value stream mapping (VSM)

DISCUSSION QUESTIONS

- Describe the core beliefs of Lean and how they could be implemented in your own life.
- Identify the three elements of Lean, and explain how they work together.
- Find an example of a company that has high respect for people. How does this affect their performance?
- Find an example of a service organization, and explain how Lean could be implemented in this environment.
- Describe three recent situations in which you were directly affected by poor product or service quality.
- Discuss the key differences between common and assignable causes of variation. Give examples.

Describe the differences between process capability and process control charts. How should the two be used together?

PROBLEMS

Hawks Soccer is evaluating four different machines for their capability in manufacturing size 5 soccer balls. The specification range for the circumference is set between 68 and 71 cm. Given the standard deviations for each machine in the following table. You need to determine which of the machines are capable of producing within specifications.

A. Machine	B. Standard Deviation
A	0.4
B	0.8
C	0.7
D	1.0

Tommy suits are evaluating their two tailoring machines for their precision. The specification range is set between 0.2 and 0.5 mm with a mean of 0.3 mm. Given the standard deviation for each machine, determine the C_{pk} values and compare them to C_p values.

Machine	Standard Deviation
A	0.04
B	0.05

HOO-HA Karate Club is evaluating its three members for their strength in kicking. The specification range for the power is set between 300 and 350 kg. Given the standard deviation for each member, determine which of the members are capable of kicking within specification. Is this a reasonable measure here? Why or why not?

Member	Standard Deviation
A	40
B	50
C	60

Compute and interpret the C_{pk} measure of process capability for the following process. And also compute the C_p measure. Explain the differences.

$$USL = 20$$

$$LSL = 12$$

$$\text{Process } \sigma = 1$$

$$\text{Process } \mu = 14$$

The specification range for machine performance is set between 50 and 100, and the mean is 80. Given the information in the following table determine the C_{pk} and C_p values. Explain the differences.

Machine	Standard Deviation
A	10
B	8
C	12

New Land Power is conducting random inspections to check the quality of its batteries. Data collected are in the following table. Use the information to develop control chart limits with a 95% confidence interval desired.

Sample	Number Defective	Number Inspected	Fraction Defective
1	0	10	0
2	1	10	0.1
3	0	10	0
4	1	10	0.1
5	2	10	0.2

Doctor David Miller is conducting random inspections of the accuracy of his new specimen-reading machine. Data collected are shown in the following table. Use the data to develop control chart limits with a 99% confidence interval.

Sample	Number Incorrect	Number Inspected
1	0	100
2	1	100
3	1	100

Lucie Tire has conducted random inspections for defects in their new tires. Given the following data, develop control chart limits assuming a 95% confidence interval.

Sample	Number Defective	Number Inspected
1	2	50
2	1	50
3	2	50
4	3	50
5	1	50

Case Study Buckeye Technologies

Buckeye Technologies is a manufacturer of semiconductors for mobile consumer electronic devices, such as laptop computers, smartphones, and digital cameras. Ms. Sabina Norton has been working at Buckeye Technologies for about a year as a production manager. The volatile demand of the semiconductor industry has been an obstacle in designing an accurate production schedule. The unstable demand causes the company to carry high amounts of safety stock and incur other types of waste. Sabina is wondering if the operation can be modified to become more efficient.

Transistors are key components used in the manufacture of a semiconductor. One of the transistors of a cell phone semiconductor is sourced from Xiang, a supplier in China, with a lead time of 2 months. Buckeye Technologies usually carries enough of these transistors at the plant. When it runs out of them, however, they experience high levels of WIP) inventory and are unable to continue with production. Although this transistor can also be obtained from several suppliers in the United States, the cost is considerable higher compared to the cost of sourcing it from Xiang.

The semiconductors for laptop computers, smartphones, and digital cameras are produced differently, so every time the company needs to produce a different type of semiconductor, the operator is required to change the setting of the production machinery. This can be time consuming, and the company wants to be able to respond quickly to changes in demand. Sabina knows that there must be a way to reduce inventory, but at the same time, she wants to keep a flexible production schedule to keep up with the fast-paced environment and the volatility of the demand.

Sabina has also noticed that the current design of the facility is not very efficient. Currently, the facility production system is grouped by function, and components move from function to function. There are about 350 steps in producing a semiconductor chip. Some functions of the facility are located at one end of the facility, whereas other functions are at the other end of the facility. This results in long waiting times between procedures.

She is thinking about changing the design of the facility to one that will give more flow to the production process.

Sabina recognizes that several changes must be made. She has heard of Lean as a method to reduce waste but is not sure where to begin.

Case Questions

1. What suggestions do you have for Sabina about working with suppliers, and how would you address the sourcing issue from the Chinese supplier based on Lean principles?
2. What should Sabina do about reorganizing the work environment? Should any layout changes be made, and how do you think they should be implemented?
3. How would you address the issue of equipment setup? How would you proceed?
4. What other suggestions would you offer Sabina to improve the operation of this company? In what order should these changes be made?
5. Describe the organizational culture of Lean. How can Sabina promote this at Buckeye?

Case Study Making Decisions with Data Analytics: Calloway, Inc.

Lauren Calloway is a corporate production planner for Calloway, Inc., a paint manufacturing company. She has been using an SAP advanced planning and optimization (SAP APO) tool for production planning on her job. The tool generates forecasts based on historical sales trends. It then converts the forecast into a production plan that computes inventories for locations all over the country. For new or special focus products, there is a provision in the tool to manually load forecast numbers.

One special focus group of products is the category of Wood Finish paints. This group includes varnishes and paints formulated to be applied to wooden surfaces for both a better finish and protection. Calloway, Inc., first introduced Wood Finish paint a year back, but it did not receive a good response from the market. Therefore, most of the inventory from the initial production run is reflected in the system as a nonmoving inventory. However, the Wood Finish team developed an improved formulation and is trying to get Wood Finish products to the market again. Last week the team complained to the Chief Manager of Supply Chain (Lauren's boss) that, despite giving forecasts for Wood Finish products to Lauren, no production has taken place in the last month based on that forecast. Lauren's boss is upset with her.

Case Questions

1. What should Lauren do? What do you think is the root cause of nonproduction?
2. Offer suggestions on how Lauren can rectify the issue. Are there any tools discussed in the chapter that she can use?
3. Identify key problems that occur when automatically relying on this type of algorithm.

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11

Supply Chain Relationship Management

LEARNING OBJECTIVES

After completing this chapter, you should be able to:

Explain the importance of relationships to SCM.

Identify categories of supply chain relationships and their defining dimensions.

Explain the differences between transactional-based and relational-based relationships.

Describe the development and management of trust-based relationships.

Explain different causes of conflict between supply chain members.

Describe methods of dispute resolution and negotiation.

CHAPTER OUTLINE

- **Supply Chain Relationships**
 - Importance of Supply Chain Relationships*
 - Relationship Dimensions*
 - Scope
 - Criticality
 - Supply Chain Relationship Matrix*
- **The Role of Trust**
 - Trust-based vs Power-based Relationships*
 - Developing a Trust-based Relationship*
 - Assessing the Relationship
 - Identifying Operational Roles
 - Creating Effective Contracts
 - Designing Effective Conflict-resolution Mechanisms*
 - Managing a Trust-based Relationship*
 - Commitment
 - Clear Method of Communication
 - Performance Visibility
 - Fairness
- **Managing Conflict and Dispute Resolution**
 - Sources of Conflict*
 - Dispute Resolution Procedures*
 - Litigation
 - Arbitration
 - Mediation
 - Negotiation

- [**Negotiation Concepts, Styles, and Tactics**](#)
 - [*Leverage*](#)
 - [*“Position” vs “Interest”*](#)
 - [*Negotiator's Dilemma*](#)
 - [*Negotiation Styles*](#)
 - [*Adversarial Tactics*](#)
 - [*Problem-solving Tactics*](#)
- [**Relationship Management in Practice**](#)
 - [*The Keiretsu Supplier-partnering Model*](#)
 - [*Partnership Agreements*](#)
 - [*Diluting Power*](#)
- [**Chapter Highlights**](#)
- [**Key Terms**](#)
- [**Discussion Questions**](#)
- [**Case Study: Lucid v. Black Box**](#)
- [**Case Study: Making Decisions with Data Analytics: Buckeye Deliveries**](#)
- [**Bibliography**](#)



[Bloomberg Quicktake Video: J&J CFO Sees Value in Tech Partnership](#)

[Bloomberg Quicktake Video: The Impact of Geopolitical Risks on Supply Chains](#)

Verizon Wireless, Inc. is the wireless service provider that owns and operates one of the largest telecommunications networks in the United States. Apple, Inc. is a well-known multinational corporation that creates and markets personal computers and consumer electronics such as the iPhone multifunction cellular phone. Verizon made a name for itself for having a remarkably reliable network. Apple's iPhone revolutionized the cell phone market by including features that allow users to surf the Internet, send and receive photographs and videos, and download content. The two companies are members of the same supply chain.

Today we are accustomed to the partnerships Apple has with wireless giants such as Verizon and AT&T. However, how did these partnerships come about? A few years earlier, Verizon and Apple almost created their first partnership, but it fell through. Verizon, a reputable wireless service provider, would supply the network for Apple's fancy new phone. However, the two companies failed to reach agreement. Verizon feared relinquishing control over maintenance, retail fees, and service fees pursuant to Apple's demands. Apple feared creating a mobile phone device for Verizon's network because it did not operate globally. Despite their telecommunications expertise, Apple and Verizon ceased communicating for two years. As a result, Apple went with a different service provider.

Then Apple began receiving complaints that the wireless service for its iPhone was slow, choppy, and unreliable, given the tremendous amount of data transmitted over the wireless networks by millions of users. As a result of an overloaded service provider, many iPhone users suffered dropped calls. At the same time, Verizon was promising to develop an even faster global network. The chief executive officer (CEO) of Verizon Wireless, Inc. reached out to the CEO of Apple to say, "We really ought to talk about how we do business together. We weren't able to [reach an agreement] a couple of years before, but it is probably worth having another discussion to make sure we're not missing something." The CEO of Apple responded, "Yeah, you're probably right. We have missed something."

With excitement swelling on the part of cell phone users around the globe, Verizon and Apple had finally decided to work together. Utilizing Verizon's superb wireless service and Apple's highly sought-after phone,

the two companies decided to collaborate to produce something many have called the “dream phone” with superior service and capabilities.

The partnership between Verizon and Apple illustrates how supply chain companies can enter into a relationship to create value for the final customer. It also illustrates the importance of relationship building, importance of value provided by each party, and the role of negotiation in the process.

Another more recent partnership example is that between SpaceX and NASA, and reflects the evolution of a successful collaboration despite initial disagreements. SpaceX, led by Elon Musk, a private aerospace company, initially failed to reach an agreement with NASA due to differences in control and funding allocation. However, SpaceX continued to innovate, developing advanced rocket technology.

In parallel, NASA faced challenges with existing partners and sought cost-effective solutions for missions. SpaceX, with its technological advancements, offered potential solutions. After initial setbacks, SpaceX's CEO proposed reevaluation, acknowledging mutual benefits. Eventually, SpaceX and NASA forged a new partnership. As of 2023, SpaceX conducted over 100 launches, including successful crewed missions to the International Space Station (ISS). The collaboration reduced launch costs significantly—SpaceX's Falcon 9 costs approximately \$62 million per launch, considerably lower than competitors' prices.

This partnership illustrates how overcoming past hurdles through negotiation and acknowledging shared value led to groundbreaking missions and cost-efficient space exploration endeavors.

Concept Check Questions

1. _____ is the wireless service provider that owns and operates one of the largest telecommunications networks in the United States.

- ☐ a) T-Mobile
- ☐ b) Verizon Wireless
- ☐ c) US Cellular

- ☐ d) Mint Mobile
- ☐ e) Google LLC

Correct or Incorrect?

Clear

Check Answer

2. _____ made a name for itself for having a remarkably reliable network.

- ☐ a) T-Mobile
- ☐ b) Verizon Wireless
- ☐ c) US Cellular
- ☐ d) Mint Mobile
- ☐ e) Google LLC

Correct or Incorrect?

Clear

Check Answer

3. The iPhone was introduced using the Verizon network.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

4. Apple and Verizon are members of the same supply chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

5. SpaceX's Falcon 9 costs approximately \$100 million per launch, considerably lower than competitors' prices.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Supply Chain Relationships

Importance of Supply Chain Relationships

We have discussed the management and design of the physical network structure of the supply chain, the use of information technology to connect supply chain members, and the management of numerous processes across enterprises. In this chapter, we discuss one of the most important aspects of supply chain management (SCM)—the management of relationships between supply chain members. In essence, this involves the management of “people.” Management of people overlays the physical supply chain structure and the connecting information technology, as shown in [Figure 11.1](#).

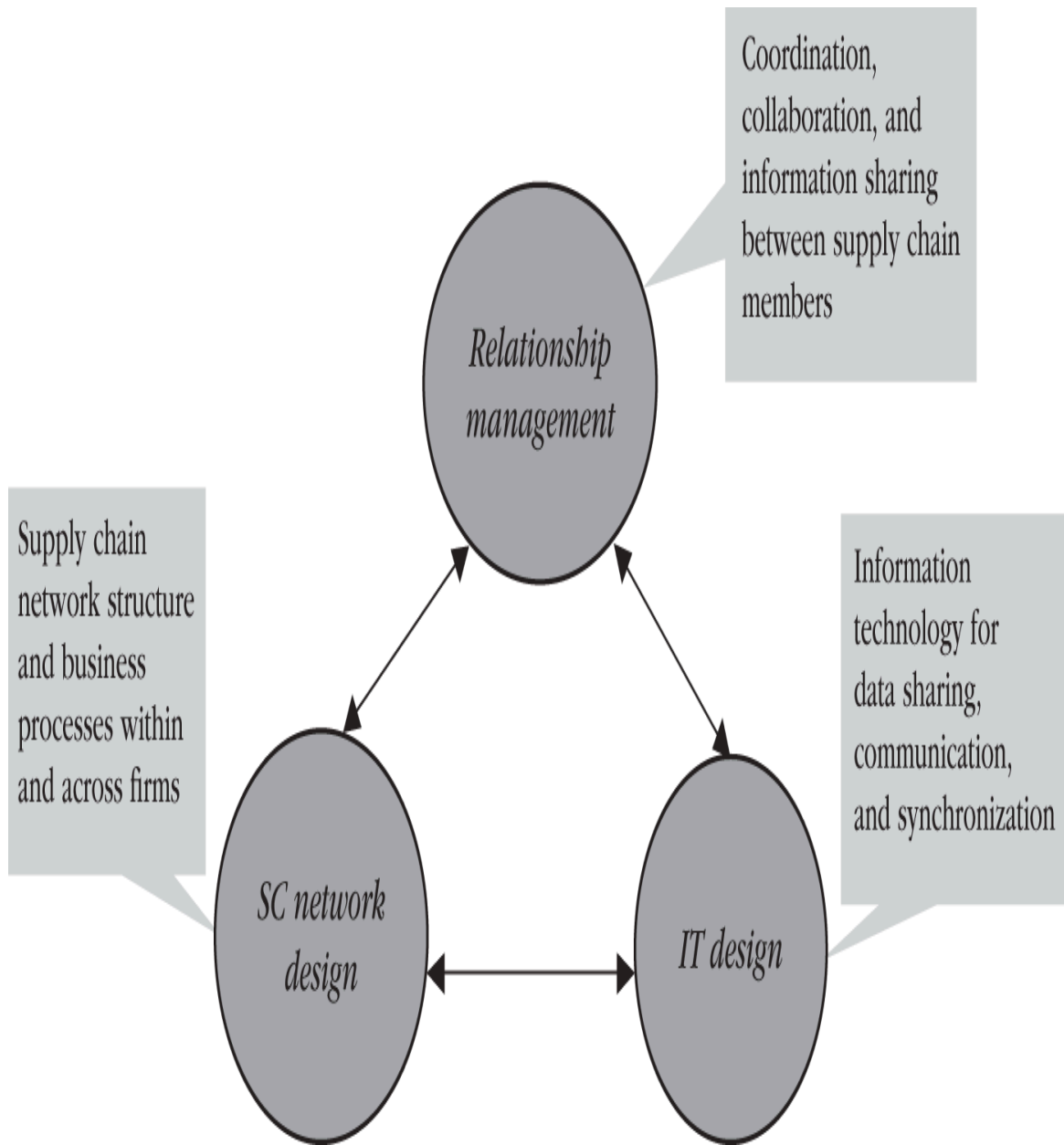


FIGURE 11.1 Relationship management as an element of SCM.

Recall that SCM involves coordination of activities, collaboration in planning, and sharing of information among members of the supply chain so that they jointly plan, operate, and execute business decisions. Notice that engaging in these activities relies on relationships between members of the supply chain. Relationship management is probably the most important aspect of SCM. It affects all areas of the supply chain and can have a dramatic impact on performance. Supply chain activities can be highly successful if there is trust and commitment between companies to work together. However, even if all

the structural elements of the supply chain are in place—information technology, facilities, distribution centers, transportation management systems, and inventory systems—SCM efforts can fail as a result of sabotage, mistrust, or just poor communication. Information technology only provides the capability for information sharing. It is supply chain relationships that make it happen.

Managing supply chain relationships involves managing relationships between people. It involves issues that include respect, trust, agreements, negotiation, joint ventures, contracting, and even conflict resolution. Therefore, SCM is primarily about the management of relationships across complex networks of companies. As a result, developing and managing relationships between supply chain partners may be the most important element of successful SCM.

While technology and automation have transformed supply chains, human-centric approaches remain essential. In the intricate web of supply chains, trust is the adhesive that binds partnerships. It enables stakeholders to rely on each other, fostering seamless collaboration and information exchange. Conflict management within this ecosystem is not merely about resolution; it is an opportunity for improvement. Effectively navigating conflicts, whether regarding resource allocation or strategic differences, fuels innovation and strengthens relationships.

Negotiations in supply chains demand finesse, balancing the interests of multiple parties for equitable agreements. Skilled negotiators navigate complexities, ensuring fair terms and fostering long-term cooperation. Robust relationships, cultivated on a foundation of trust and transparency, lead to resilient supply chains, enabling adaptability and agility in an ever-evolving market landscape.

Concept Check Questions

6. Supply chain network structure and business processes within and across firms.

- ☐ a) Blockchain usage
- ☐ b) SC network design
- ☐ c) Relationship management

- ☐ d) IT design
- ☐ e) Employee management

Correct or Incorrect?

Clear

Check Answer

7. Coordination, collaboration, and information sharing between supply chain members.

- ☐ a) Blockchain usage
- ☐ b) SC network design
- ☐ c) Relationship management
- ☐ d) IT design
- ☐ e) Employee management

Correct or Incorrect?

Clear

Check Answer

8. Information technology for data sharing, communication, and synchronization.

- ☐ a) Blockchain usage
- ☐ b) SC network design
- ☐ c) Relationship management
- ☐ d) IT design
- ☐ e) Employee management

Correct or Incorrect?

Clear

Check Answer

9. SCM involves coordination of activities, collaboration in planning, and sharing of information among members of the supply chain so that they jointly plan, operate, and execute business decisions.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

10. Relationship management is probably the least important aspect of SCM.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

11. Information technology only provides the capability for information sharing.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

12. Developing and managing relationships between supply chain partners may be the most important element of successful SCM.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

13. Technology and automation have transformed supply chains to the point that human-centric approaches are no longer essential.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

14. Negotiations in supply chains demand finesse, balancing the interests of multiple parties for equitable agreements.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Relationship Dimensions

Not all supply chain relationships need to be, or should be, treated the same. Most companies today have hundreds or even thousands of suppliers. Some provide tangible goods, such as component parts or raw materials, whereas others provide services, such as transportation and logistics. All these relationships are not of equal importance. Relationship management requires

time and effort and should not be wasted on relationships that are transactional. As we will see, supply chain relationships should be carefully segmented based on how much management is needed.

Consider that even a small bakery can have dozens of suppliers—from common items such as sugar and flour to specialty items such as hazelnut paste or truffle oil. Some suppliers provide commodity items or services where cost is the determining criterion. For example, companies have historically used suppliers for certain routine activities, such as package deliveries, records management, or uniform cleaning. These routine services are transactional and do not require relationship management. On the contrary, some companies use supply chain partners for almost all activities. This may include outsourcing virtually everything, including manufacturing, distribution, research and development (R&D), innovation, and even strategic planning. For example, Nike is a company that focuses on marketing and innovation and outsources manufacturing and distribution to other members of its supply chain. Similarly, Apple focuses on product innovation and marketing and outsources all manufacturing to the Chinese manufacturer Foxconn. In these cases, careful and ongoing relationship management is critical. Initially, Apple was heavily dependent on China, representing 48% of its top suppliers in 2019. However, Apple diversified its suppliers across Asia, reducing China's share to 30% by 2023.

Two dimensions help differentiate supply chain relationships. The first is the [scope](#), or degree of responsibility, assigned to the supplier. A greater scope means a greater dependence on the supplier. The second dimension is the [criticality](#) of a sourced item or task. Criticality is the extent to which the sourced item or task impacts the ability of the organization to perform its core competencies. The greater the criticality of the sourced item, the greater the consequences of poor performance to the company and the greater the requirement for relationship management. Let us look at these dimensions in a bit more detail.

Concept Check Questions

15. All supply chain relationships need to be treated the same.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

16. A company can have thousands of suppliers.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

17. Relationship management requires time and effort and should not be wasted on relationships that are transactional in nature.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

18. There are three dimensions that help differentiate supply chain relationships.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

19. _____ is the degree of responsibility assigned to the supplier.

- ☐ a) Range
- ☐ b) Criticality
- ☐ c) Linkage
- ☐ d) Scope
- ☐ e) Importance

Correct or Incorrect?

Clear

Check Answer

20. _____ is the extent to which the sourced item or task impacts the ability of the organization to perform its core competencies.

- ☐ a) Range
- ☐ b) Criticality
- ☐ c) Linkage
- ☐ d) Scope
- ☐ e) Importance

Correct or Incorrect?

Clear

Check Answer

21. The lesser the criticality of the sourced item, the greater the consequences of poor performance to the company and the greater the requirement for relationship management.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Scope

At one extreme the relationship can be narrow in scope where a supplier provides a limited number of items or provides one task from many possible tasks that make up an entire function. For example, this may be a supplier that is responsible for the replenishment of only maintenance, repair, and operating items (MROs) inventories (MROs discussed in [Chapter 9](#)). At another extreme the scope can be broad, where the bulk of items or services are provided by one supplier. An example would be complete manufacturing, as provided by Foxconn for Apple and Sony. Another example would be the comprehensive outsourcing of all aspects of the logistics function to a third-party logistics (3PL) provider, such as provided by UPS.

When the responsibility is relatively small, confined, and specific—such as handling a buyer's returned inventories, arranging for item disposal or restocking, or providing a commodity item such as sugar in the bakery—the risks of such a relationship are small. Such confined relationships are good for standardized products or repeatable tasks that are easily defined and have a limited choice of options.

As the scope of the relationship becomes more comprehensive, however, the degree of customization provided by the supplier progressively increases, as does the risk to the buyer. For example, this might be using a supplier to manage all inventories, including order management, or the complete management of a company's transportation system. The supplier may now be responsible for all aspects of the function, including equipment, facilities, staffing, software, implementation, management, and ongoing improvement. This is the level of outsourcing often seen with the services provided by 3PL providers.

A large scope of tasks provided by a supply chain partner can bring large benefits, as it allows the company to focus on its core competencies. The risks,

however, can also be great as both operational and strategic responsibility is now in the hands of an outside party, requiring close relationship management. An interesting fact about the evolution of such comprehensive supply chain partnerships is their correlation with the growing trend of “vertical integration” within industries. In some cases, companies opt to bring certain outsourced functions back in-house to regain control over critical aspects of their operations. This trend reflects a strategic shift, as organizations aim to balance the benefits of outsourcing with the need for control and oversight over core functions. For instance, companies might insource specific critical supply chain functions like logistics or manufacturing to ensure greater control, quality assurance, and flexibility in response to market changes. This demonstrates the ongoing strategic evaluation and adaptation of outsourcing strategies within industries.

Historically, Apple outsourced the manufacturing of its products, such as iPhones and iPads, to third-party manufacturers in locations such as China. However, over time, Apple started bringing some aspects of manufacturing closer to home. For instance, they built a plant in Austin, Texas, to produce the Mac Pro desktop computer. This move aimed to bring some manufacturing back to the United States, providing Apple with more control over quality, production processes, and supply chain responsiveness.

Apple's shift reflects the strategic decision to insource certain critical functions to maintain better control, enhance quality assurance, and have more flexibility in managing their supply chain, despite the complexities involved in such a transition.

Concept Check Questions

22. The relationship can be narrow in scope where a supplier provides a limited amount of items or provides one task from many possible tasks that make up an entire function.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

23. Which of the following would represent broad scope?

- ☐ a) A supplier providing MRO inventories
- ☐ b) A supplier providing donuts for meeting
- ☐ c) Foxconn for Apple
- ☐ d) A supplier who provides flour to a baker

Correct or Incorrect?

Clear

Check Answer

24. Confined relationships are good for standardized products or repeatable tasks that are easily defined and have a limited choice of options.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

25. As the scope of the relationship become more comprehensive the degree of customization provided by the supplier progressively increases, as does the risk to the buyer.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

26. A large scope of tasks provided by a supply chain partner tends to be risk free.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Criticality

The second differentiating dimension of supply chain relationships is the criticality of the tasks provided by a supplier. On the one hand, a supplier can provide commodity items, such as sugar in the bakery example, or a more tactical task, such as records management. On the other hand, a supplier may provide—and be the only source of—a critical component. Similarly, a firm may just outsource transportation, or it may outsource all aspects of the logistics function, such as the design, implementation, and ongoing management.

The higher the criticality of the outsourced task the greater the business risk to the buyer. As a result, this directly impacts the degree of relationship management required and the nature of the buyer–supplier relationship. When tasks with low criticality are outsourced, the relationship between buyer and supplier is primarily contractual. Relationship management is primarily focused on the transactional nature of the outsourced function. As criticality increases, the relationship moves from being contractual to becoming more relational. When there is low criticality, the supplier has responsibility over nonstrategic items or tasks. The relationship is contractual, and the buying firm continues to have operational and managerial responsibility over all internal functions and processes. As the supplier's role becomes more comprehensive, however, the supplier increasingly becomes responsible for

managerial and possibly the strategic aspects of the function. This moves the relationship from more transactional to more relational, as shown in [Figure 11.2](#).

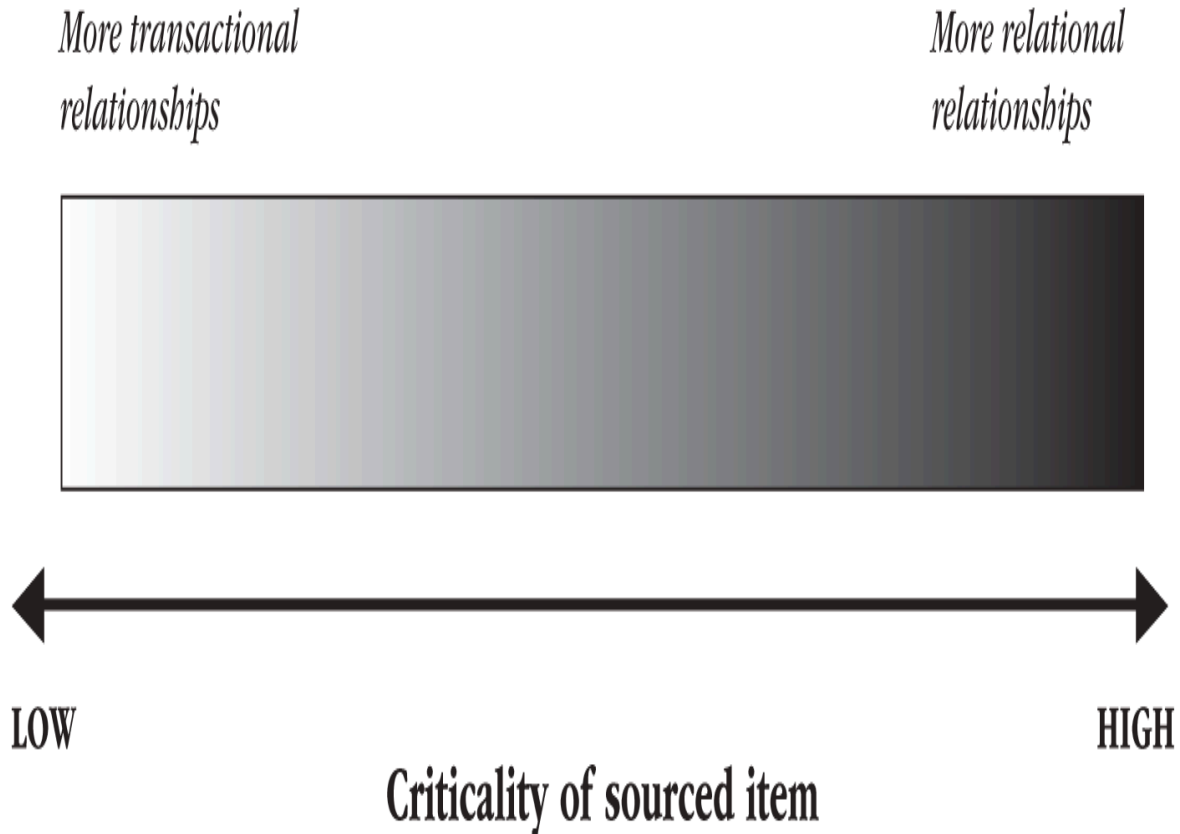


FIGURE 11.2 Nature of supply chain relationships.

Box Big Data Analytics Box—The Network Effect

■ AMAZON

Today's companies must rely on connections in addition to producing excellent products. Today's biggest companies rely on connections as much as their industrial products. This is different from the past.

Just consider that four U.S. companies—Apple, Facebook, Google, and Microsoft—can claim billion-customer global businesses. They have well over 1 billion users. These companies operate at breathtaking scale and dominate their categories. This dominance is possible because of a highly linked system of communication and data, coupled with the fact that today's users crave efficiency and speed. As more people engage in these social networks, they attract more people. It is what scientists call “The

Network Effect.” This is when a system becomes better, faster, and more efficient for everyone as more people use it.

We can see this working in retail. An excellent example is Amazon, a retailer that far outpaces even its closest competitors in e-commerce. This is in large part because Amazon applies “more-is-better network logic” to the back end of its business. The more Amazon sells, the more the algorithms learn about what customers want, and the more customers want to use Amazon. Every company wants this ability to shape its business. Unfortunately, market dynamics mean that those that are using the “network effect” will be even more effective than competitors.

Network effects, often overlooked, stand as the powerhouse driving success in the tech realm. While only 48% of top tech companies center on these effects, they generate a staggering 70% of the total tech value in 2022. This resilience offers an enduring advantage, with network effect businesses reaching valuations in the tens or hundreds of billions, far surpassing others that peak at \$1B–\$2B. Apple's iOS and App Store illustrate this, creating a formidable ecosystem nearly impervious to disruption. Strategically harnessing various network effects—be it personal utility, personal network, or market networks—becomes the linchpin for companies aiming for sustained growth. Understanding and integrating these effects into the core of a business can lead to unparalleled market dominance and substantial value creation.

Concept Check Questions

27. The higher the criticality of the outsourced task the smaller the business risk to the buyer.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

28. As criticality increases, the relationship moves from being relational to becoming more contractual.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

29. As the supplier's role becomes more comprehensive the supplier increasingly becomes responsible for managerial and possibly the strategic aspects of the function.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Supply Chain Relationship Matrix

To understand categories of supply chain relationships we need to consider both dimensions—scope and criticality. Together these dimensions create four categories of buyer–supplier relationships that differ in the level of relationship management required. For example, a large scope coupled with high criticality leads to more comprehensive buyer–supplier relationships and to different types of managerial requirements than are necessitated by the smaller scope and lower criticality. The four categories of relationships are nonstrategic transactions, contractual relationships, partnerships, and alliances, and they are shown in [Figure 11.3](#).

Nonstrategic Transactions. When both scope and criticality are low, we have relationships that are solely transaction oriented, such as a simple commodity exchange. The product provided by the supplier is typically standardized, and

alternative sources of supply or market access are readily available. There is little mutual dependence on which to base a relationship, and there is limited communication between supplier and buyer. Indeed, there is little reason for a relationship to evolve, and an arm's-length approach dominates the communication. From an organizational standpoint, nonstrategic relationships may form simply because there is no need for close interactions. The sourced items are typically standardized, and their low criticality does not necessitate close relationship management. The relationship, however, may evolve into a more encompassing relationship if the scope increases over time and involves multiple transactions. In that case, it might become a contractual relationship. For example, companies such as Walmart or Target often engage in nonstrategic transactions when purchasing standardized goods in large quantities. These transactions, often for everyday products, involve limited interaction and rely on numerous alternative suppliers.

Contractual Relationships. Contractual relationships occur when the scope is high, although the criticality of purchased items or tasks is low. This relationship is characterized by moderate levels of communication frequency, as there is a greater need for control over supplier activities. From an organizational standpoint, there is an awareness of the need for some management of the relationship due to the sheer size of the arrangement. Also, there is a higher level of trust and greater levels of interaction than in nonstrategic relationships. However, there is no desire to raise the commitment to a more personal relationship due to low criticality. The relationship is strictly based on formal contracts reducing the need for communication between boundary-spanning personnel.

For example, companies such as Coca-Cola or PepsiCo maintain contractual relationships for raw material procurement, such as sourcing sugar or packaging materials. They establish formal contracts with suppliers to maintain quality and pricing.

Partnerships. This relationship type is characterized by the sourcing of critical components or tasks, albeit low in scope. The term “partnership” is used to connote strong and enduring trust between supplier and buyer, as well as a strong commitment to the relationship although the parties may not interact frequently. An example of this relationship could be the sourcing of just-in-time (JIT) replenishments of a critical manufacturing component. Due to the high criticality, the supplier has a greater commitment to the relationship. However, given the higher level of trust and relatively small

scope, there is a limited frequency of interaction. The management of the relationship is not extensive, and the buyer may entrust the supplier with greater control.

In the automotive industry, for example, Toyota and its key suppliers often maintain partnerships for critical components used in their vehicles. Toyota relies on these suppliers for JIT inventory replenishment, fostering trust and commitment over time.

Alliances. The most comprehensive buyer–supplier relationships occur when both criticality and scope are high. These arrangements are defined as alliance relationships and reflect high interaction frequency and significant trust and commitment between supply chain partners. Alliances presume a high level of confidence in the capabilities and integrity of the other party and require significant resource investment in ongoing relationship management. In alliances, vendor products and services are highly customized and evolve with the business needs of the client. There is also great potential for flexibility given the typically large transaction volumes. In some cases, these alliances may even be legalized through incorporation. A case in point is an alliance between Texas Utilities and CapGemini, called CapGemini Energy, to outsourcing its entire information management organization. A notable example is the alliance between Boeing and General Electric (GE) for aircraft engine development. This collaboration involves high criticality and scope, with both companies deeply integrated for product customization, ongoing innovation, and significant resource investment.

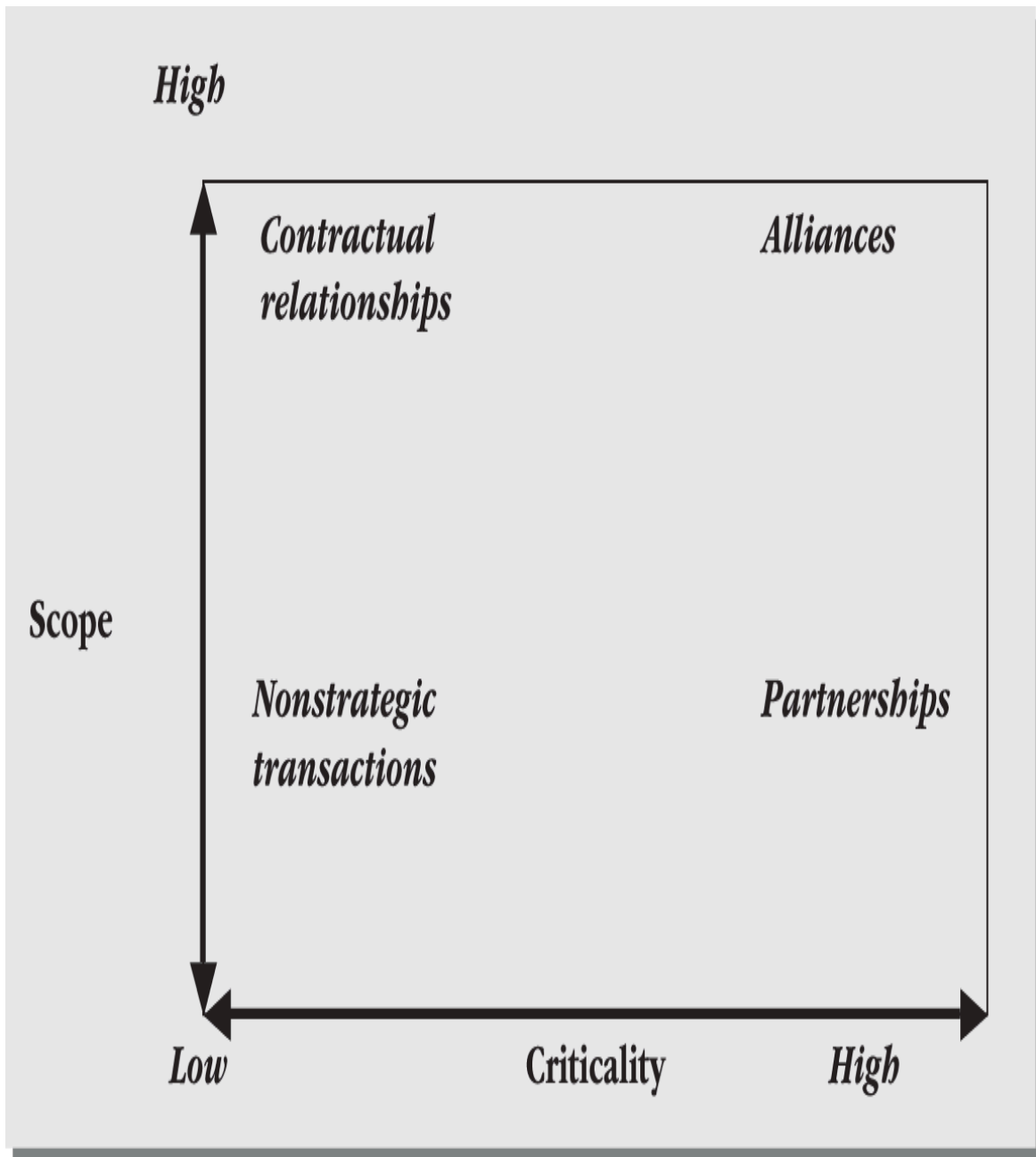


FIGURE 11.3 Supply chain relationship matrix.

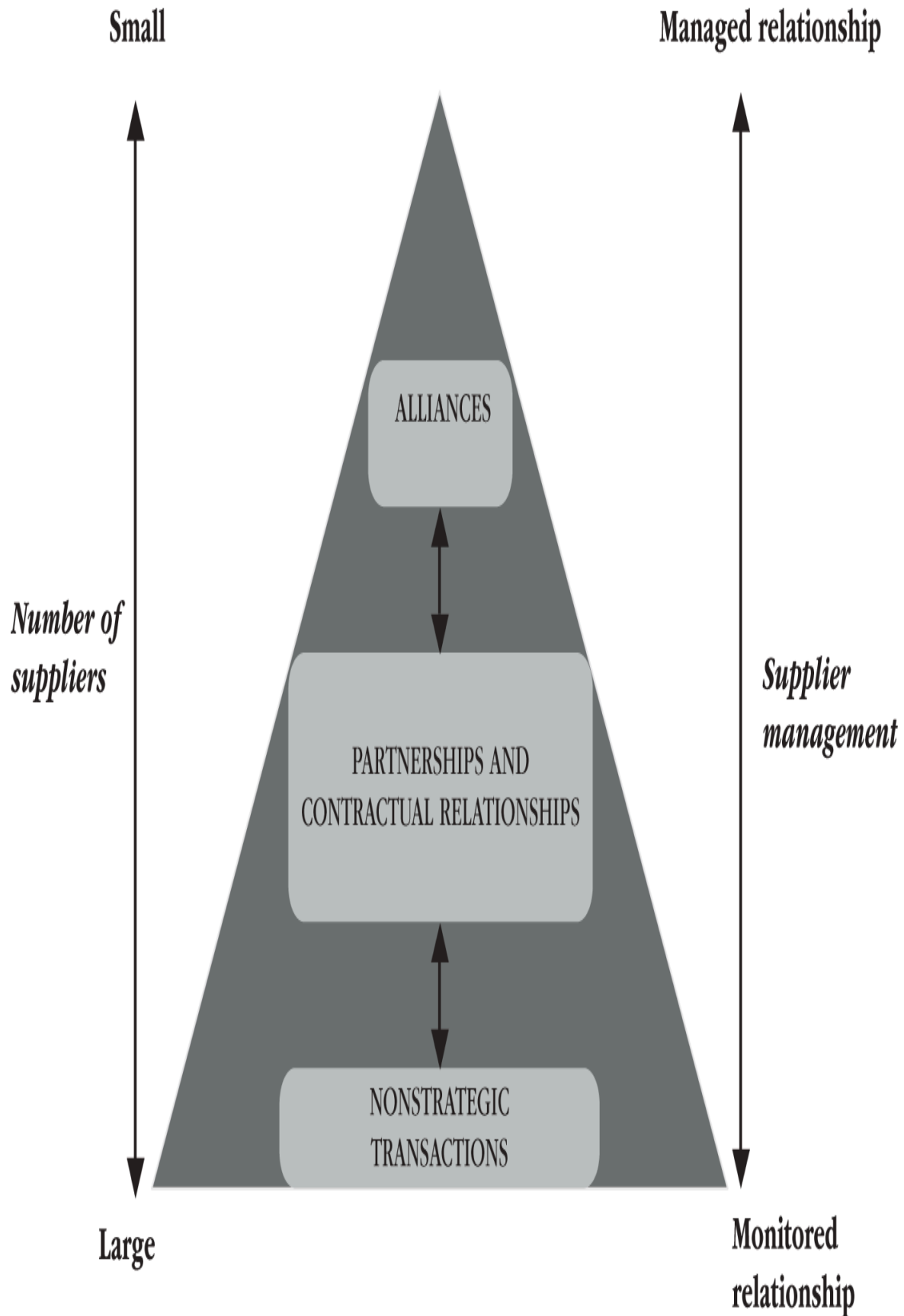


FIGURE 11.4 Managing supply chain relationships.

These different buyer–supplier relationships have different managerial requirements. More comprehensive relationships, such as alliances, have a greater requirement to manage the relationship. By contrast, less-comprehensive relationships, as exemplified by nonstrategic transactions and contractual, primarily require performance monitoring. This is shown in [Figure 11.4](#). Therefore, the number of comprehensive outsourcing engagements, such as alliance-type relationships, must be kept small due to the extensive relationship management requirement. Relationships such as nonstrategic transactions, on the other hand, can be numerous as only monitoring efforts are required.



Concept Check Questions

30. _____ is when both scope and criticality are low.

- ☐ a) Nonstrategic transactions
- ☐ b) Contractual relationships
- ☐ c) Mergers
- ☐ d) Partnerships
- ☐ e) Alliances

Correct or Incorrect?

Clear

Check Answer

31. Relationships that are solely transaction oriented, such as a simple commodity exchange.

- ☐ a) Nonstrategic transactions
- ☐ b) Contractual relationships

- ☐ c) Mergers
- ☐ d) Partnerships
- ☐ e) Alliances

Correct or Incorrect?

Clear

Check Answer

32. The product provided by the supplier is typically standardized, and alternative sources of supply or market access are readily available.

- ☐ a) Nonstrategic transactions
- ☐ b) Contractual relationships
- ☐ c) Mergers
- ☐ d) Partnerships
- ☐ e) Alliances

Correct or Incorrect?

Clear

Check Answer

33. _____ occur when the scope is high, although the criticality of purchased items or tasks is low.

- ☐ a) Nonstrategic transactions
- ☐ b) Contractual relationships
- ☐ c) Mergers
- ☐ d) Partnerships
- ☐ e) Alliances

Correct or Incorrect?

Clear

Check Answer

34. This relationship is characterized by a greater need for control over supplier activities.

- ☐ a) Nonstrategic transactions
- ☐ b) Contractual relationships
- ☐ c) Mergers
- ☐ d) Partnerships
- ☐ e) Alliances

Correct or Incorrect?

Clear

Check Answer

35. Companies like Coca-Cola or PepsiCo maintain these types of relationships for raw material procurement, like sourcing sugar or packaging materials.

- ☐ a) Nonstrategic transactions
- ☐ b) Contractual relationships
- ☐ c) Mergers
- ☐ d) Partnerships
- ☐ e) Alliances

Correct or Incorrect?

Clear

Check Answer

36. This relationship type is characterized by the sourcing of critical components or tasks, albeit low in scope.

- ☐ a) Nonstrategic transactions
- ☐ b) Contractual relationships
- ☐ c) Mergers
- ☐ d) Partnerships
- ☐ e) Alliances

Correct or Incorrect?

Clear

Check Answer

37. An example of this relationship could be the sourcing of just-in-time (JIT) replenishments of a critical manufacturing component.

- ☐ a) Nonstrategic transactions
- ☐ b) Contractual relationships
- ☐ c) Mergers
- ☐ d) Partnerships
- ☐ e) Alliances

Correct or Incorrect?

Clear

Check Answer

38. The most comprehensive buyer–supplier relationships occur when both criticality and scope are high.

- ☐ a) Nonstrategic transactions
- ☐ b) Contractual relationships
- ☐ c) Mergers
- ☐ d) Partnerships
- ☐ e) Alliances

Correct or Incorrect?

Clear

Check Answer

39. These arrangements reflect high interaction frequency and significant trust and commitment between supply chain partners.

- ☐ a) Nonstrategic transactions
- ☐ b) Contractual relationships
- ☐ c) Mergers
- ☐ d) Partnerships
- ☐ e) Alliances

Correct or Incorrect?

Clear

Check Answer

40. Different buyer–supplier relationships have different managerial requirements.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Supply Chain Leader's Box—Open Innovation

■ PROCTER & GAMBLE

Open innovation and strategic licensing are two developments in the business world that show the benefits of supply chain relationships, even with competitors. Open innovation means that, instead of relying exclusively on ideas created by intensive internal R&D efforts, organizations are willing to bring externally generated ideas to market. Strategic licensing means that, instead of guarding internally developed intellectual property jealously, companies are willing to license these innovations to outside companies.

Procter & Gamble (P&G) is a leading consumer-product developer that created many of its leading brands through costly scientific internal research, that is, until P&G adopted an alternative innovation strategy that seeks to obtain half of its product innovations from external sources. The highly popular SpinBrush marketed by P&G was invented by four outside entrepreneurs rather than from P&G's laboratories. Similar breakthrough products such as Tide Total Care, Olay Smooth Finish, Mr. Clean Magic Eraser, and Tide pods were all developed as part of its open innovation program called Connect+Develop. The program is designed to connect with suppliers, competitors, scientists, entrepreneurs, and others to actively look for proven technologies, packages, and products. P&G can then develop these further and market them as either their own or in partnership with other companies. Connect+Develop uses its web portal, through which innovators can submit their innovations directly to P&G. The company's development team then reviews submissions and provides feedback.

Open innovation can save money by reducing reliance on cost-intensive in-house scientific research. P&G is showing that collaboration accelerates innovation. The strategy has proven highly successful. As a result, P&G has put forth a strategic effort to systematize innovation and has formalized this strategy through Connect+Develop.

The Role of Trust

Trust-Based vs Power-Based Relationships

An important characteristic of competitive supply chains is the focus on relationship building and the move away from arm's-length adversarial relationships that had been dominant in the past. Underlying this idea is that the buyer–supplier relationship should be based on a partnership of trust, commitment, and fairness. There are numerous advantages to such relationships that can be long-term and mutually beneficial. The competitive advantage of companies such as Toyota and Honda over their competitors in the auto industry comes from the collaborative relationships they have developed with their suppliers. Successful supply chains will be those that are governed by a constant search for win–win relationships based on mutuality and trust.

A trust-based relationship between supply chain partners helps improve performance for the following reasons. First, a cooperative relationship results in the development and sharing of joint objectives. This means that each party is much more likely to consider the other party's objectives when making their decisions. Second, managerial strategies to achieve coordination become easier to implement. Sharing of information is easier between parties that trust each other. Also, it is easier to implement and design operational improvements, as both parties are aiming for a common goal. Third, cooperation and coordination result in the elimination of duplication of efforts between parties. Consequently, supply chain productivity is increased. An example may be that the manufacturing firm does not have to inspect the quality of materials it receives from its supplier. Finally, greater sharing of sales and production information results in enabling members of the supply chain to coordinate production and distribution decisions.

Historically, supply chain relationships have been based on power. In a power-based relationship, the stronger party dictates its view. Although exploiting power may be advantageous in the short term, its negative consequences are felt in the long term for three main reasons. First, exploiting power results in one supply chain partner maximizing its profits, often at the expense of other

partners. This decreases total supply chain profits. Second, exploiting power to extract unfair concessions can hurt a company once the balance of power changes. Third, when a member of a supply chain systematically exploits its power advantage, the other members find ways to resist. For example, when retailers tried to exploit their power, manufacturers sought ways to directly access the consumer. This included selling over the Internet and setting up company stores. The result can be a decrease in supply chain profits because different members are now competing rather than cooperating. [Figure 11.5](#) highlights the differences between trust- and power-based relationships.

TRUST-BASED RELATIONSHIPS	POWER-BASED RELATIONSHIPS
Development of joint objectives	One partner maximizes its profit at the expense of others
Greater sharing of information	Extracting unfair concessions hurts the company if the balance of power shifts
Elimination of duplication of efforts	Creates competition rather than cooperation
Coordination easier to implement	Results in decreased supply chain profitability

FIGURE 11.5 Characteristics of trust-based vs power-based relationships.

An example of this occurred when in 2015 it was discovered that Volkswagen (VW) had installed software in its diesel cars designed to cheat on emissions tests. The software could detect when a car was undergoing emissions testing and would alter the performance to comply with the standards. However, during regular driving conditions, these cars emitted pollutants far beyond the legal limits. This scandal, known as the “diesel dupe,” severely damaged VW's reputation and led to massive financial losses. The company faced hefty fines, legal battles, and a major decline in trust among consumers, regulators, and investors. VW had to recall millions of vehicles, pay billions in settlements and fines, and work extensively to rebuild its reputation and regain consumer trust.

This case underscores how exploiting power to deceive or manipulate regulations can result in severe consequences, not only in terms of financial

penalties but also in long-term damage to a company's brand and credibility.

Given the negative consequences of power-based relationships, cooperation and trust between supply chain members is highly valuable. However, these qualities are very hard to initiate and sustain. There are two views on how cooperation and trust can be brought into any supply chain relationship:

Contractual-based View. This view states that formal contracts should be used to ensure cooperation among supply chain members. With a contract in place, parties are assumed to behave in a trusting manner for reasons of self-interest, although actual trust has not been built.

Relationship-based View. Trust and cooperation are viewed as a result of a series of interactions between the partners built over time. Positive interactions strengthen the belief in the cooperation of the other party.

In practice, neither view holds exclusively. Initially in the relationship, the contractual-based view holds. Over time, however, the relationship evolves toward a relationship-based view, if it is a strong supply chain relationship. A contract is always the basis of a business partnership. Parties that may not trust each other yet have to rely on the building of trust to resolve issues that are not included in the contract. Conversely, parties that trust each other and have a long relationship still rely on contracts. In most effective partnerships, a combination of the two approaches is used. An example of this situation is when suppliers sign an initial contract with manufacturers containing contingencies, yet they never refer to the contract afterward. They hope that all contingencies can be resolved through negotiation in a way that is best for all parties.

There are two phases to any long-term supply chain relationship. First is the [design phase](#) of the relationship, where ground rules are established, and the relationship is initiated. Second is the [management phase](#), where the interactions based on the ground rules are managed. A manager seeking to build a supply chain relationship must consider how cooperation and trust can be encouraged during both phases of the relationship. Careful consideration is very important because in most supply chains, power tends to be concentrated in relatively few hands. The concentration of power often leads managers to ignore the effort required to build trust and cooperation, hurting supply chain performance in the long term. Next, we discuss how supply chain relationships can be designed to encourage cooperation and trust.

Concept Check Questions

41. An important characteristic of competitive supply chains is the focus on relationship building and the move away from arm's-length adversarial relationships.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

42. A trust-based relationship between supply chain partners helps improve performance for many reasons. Which of the following is not one of these?

- ☐ a) A cooperative relationship results a lower purchase price for the firm
- ☐ b) Managerial strategies to achieve coordination become easier to implement
- ☐ c) Greater sharing of sales and production information results in enabling members of the supply chain to coordinate production and distribution decisions
- ☐ d) Cooperation and coordination result in the elimination of duplication of efforts between parties
- ☐ e) A cooperative relationship results in the development and sharing of joint objectives

Correct or Incorrect?

Clear

Check Answer

43. Historically, supply chain relationships have been based on power.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

44. Which of the following is not a characteristic of trust-based relationships?

- ☐ a) Greater sharing of information
- ☐ b) Coordination easier to implement
- ☐ c) Results in decreased supply chain profitability
- ☐ d) Elimination of duplication of efforts
- ☐ e) Development of joint objectives

Correct or Incorrect?

Clear

Check Answer

45. Which of the following is not a characteristic of power-based relationships?

- ☐ a) Extracting unfair concessions hurts the company if balance of power shifts
- ☐ b) Elimination of duplication of efforts
- ☐ c) One partner maximizes its profit at expense of others
- ☐ d) Results in decreased supply chain profitability
- ☐ e) Creates competition rather than cooperation

Correct or Incorrect?

Clear

Check Answer

46. This view states that formal contracts should be used to ensure cooperation among supply chain members.

- ☐ a) Power-based view
- ☐ b) Trust-based view
- ☐ c) Contractual-based view
- ☐ d) Relationship-based view

Correct or Incorrect?

Clear

Check Answer

47. Trust and cooperation are viewed as a result of a series of interactions between the partners built over time.

- ☐ a) Power-based view
- ☐ b) Trust-based view
- ☐ c) Contractual-based view
- ☐ d) Relationship-based view

Correct or Incorrect?

Clear

Check Answer

48. There are three phases to any long-term supply chain relationship.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Developing a Trust-based Relationship

A trust-based relationship between two companies in the supply chain creates a sense that each company can depend on the other and has confidence in joint decisions. Trust creates the belief that each company is interested in the other's welfare and would not take action without considering the impact of those decisions on other companies as well, in addition to themselves. However, building a trust-based relationship can be difficult as it requires changing the nature of traditional relationships between suppliers and customers in the supply chain. Certain key steps can be followed in designing trust-based relationships. We look at these next.

Supply Chain Leader's Box: Toyota

Toyota's partnership prowess is not just about cars; it is about crafting an entire symphony within the supply chain. Their approach to forging trust-based relationships with suppliers is a standout performance. Data shows that Toyota's commitment to supplier relationships is not just a touchy-feely approach; it is a strategic superpower. Around 70% of their car parts come from their top 100 suppliers, demonstrating the depth and significance of these relationships. This close-knit collaboration is not just about buying parts; it is about cocreating excellence.

Their partnership model goes beyond the assembly line. Toyota actively involves suppliers in the design phase, tapping into their expertise. This collaboration is not just a conversation; it is a full-on jam session where ideas flow, innovations spark, and both sides bounce ideas off of each other.

Toyota's trust is not merely a handshake but a bond. They trust suppliers enough to let them optimize their processes, fostering an environment of shared innovation. This confidence translates into quality, with data revealing that Toyota's vehicles boast defect rates as low as one per 1,000 vehicles, showcasing the fruits of these trusted partnerships.

In their relationships with suppliers, Toyota employs a dual approach involving initial contracts and a culture of mutual trust. Their contracts are designed to accommodate future negotiations, recognizing the impossibility of accounting for all eventualities. However, the essence of their success lies in fostering trust that bridges gaps unforeseen in contracts. Over time, Toyota formalizes informal agreements, refining contracts based on evolving relationships and shared understandings between assigned representatives from both sides. This method has resulted in sustained, successful partnerships. Toyota's approach emphasizes the need for a blend of flexible contracts and relational trust, fostering enduring, mutually beneficial supply chain partnerships.

Concept Check Questions

49. A trust-based relationship between two companies in the supply chain creates a sense that each company can depend on the other and has confidence in joint decisions.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

50. Building a trust-based relationship is fairly easy.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Assessing the Relationship

The first step in designing a supply chain relationship is to clearly identify the mutual benefit that the relationship provides. In most supply chains, each member of the partnership brings distinct skills, all of which are needed to supply a customer order. For example, a manufacturer produces the product, a carrier transports it between firms, and a retailer makes the product available to the final customer. The contribution of each party to supply chain success and profitability must be made clear.

An important element of the relationship is equity. Fair dealing in the relationship—called equity—should be an important element when developing a relationship. Equity measures the fairness of the division of the total profits between the parties involved. Members of the supply chain are unlikely to

participate in true coordination unless they are confident that the resulting increase in profits will be shared equitably. For example, when suppliers make an effort to reduce replenishment lead times, the supply chain benefits because of reduced safety stock inventories at manufacturers and retailers. Suppliers are unlikely to put in the effort if the manufacturers and retailers are not willing to share the increase in profitability with them. Consequently, a supply chain relationship is likely to be sustainable only if it increases profitability, and this increase is shared equitably between the parties.

Concept Check Questions

51. The first step in designing a supply chain relationship is to clearly identify the appropriate supplier.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

52. Fair dealing in the relationship—called equity—should be an important element when developing a relationship.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

53. _____ measures the fairness of the division of the total profits between the parties involved.

- ☐ a) Fairness
- ☐ b) Scope
- ☐ c) Criticality
- ☐ d) Equity

Correct or Incorrect?

Clear

Check Answer

54. When suppliers make an effort to reduce replenishment lead times, the supply chain benefits because of reduced _____ at manufacturers and retailers.

- ☐ a) safety stock
- ☐ b) total inventory
- ☐ c) employees
- ☐ d) excess cash

Correct or Incorrect?

Clear

Check Answer

Identifying Operational Roles

When identifying the operational roles and rights of each party in a supply chain relationship, managers must consider the interdependence between the parties. One source of conflict occurs when the tasks are divided in a way that makes one party more dependent on the other. The dependence of one party on another often leads to frustration among supply chain firms. In many partnerships, an inefficient allocation of tasks results simply because neither party is willing to give the other a perceived upper hand based on the tasks assigned.

Traditionally, supply chain activities have been sequential, with one stage completing all its tasks and then handing them off to the next stage. This was called sequential interdependence, where the activities and information of one partner preceded the other. A different relationship is reciprocal interdependence, where parties come together and exchange information,

with information flowing in both directions. Such a relationship is the one between P&G and Walmart, where the companies have created reciprocal interdependence. An example of this is their use of Collaborative Planning and Forecasting for Replenishment (CPFR), discussed in [Chapter 8](#). The process relies on ongoing work teams with members from both Walmart and P&G. Walmart brings demand information to the process, as it is closest to the customer, and P&G brings information on available capacity. The teams then decide on the production and replenishment policy that is best for the supply chain.

Reciprocal interdependence requires a significant effort to manage and can increase transaction costs if it is not managed properly. However, reciprocal interdependence is more likely to result in supply chain profitability because all decisions take the objectives of both parties into account. Reciprocal interdependence increases the interactions between the two parties, increasing the likelihood of trust and cooperation if positive interactions occur. Reciprocal interdependence also makes it harder for one party to be opportunistic and take self-serving actions that hurt the other party. Therefore, greater reciprocal interdependence in decision making increases the chances of an effective relationship.

Concept Check Questions

55. One source of conflict occurs when the tasks are divided in a way that makes one party more dependent on the other.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

56. Almost all partnerships have an efficient allocation of tasks.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

57. _____ is where the activities and information of one partner preceded the other.

- ☐ a) Mutual interdependence
- ☐ b) Sequential interdependence
- ☐ c) Functional interdependence
- ☐ d) Reciprocal interdependence

Correct or Incorrect?

Clear

Check Answer

58. _____ is where parties come together and exchange information, with information flowing in both directions.

- ☐ a) Mutual interdependence
- ☐ b) Sequential interdependence
- ☐ c) Functional interdependence
- ☐ d) Reciprocal interdependence

Correct or Incorrect?

Clear

Check Answer

59. The relationship between P&G and Walmart.

- ☐ a) Mutual interdependence
- ☐ b) Sequential interdependence
- ☐ c) Functional interdependence
- ☐ d) Reciprocal interdependence

Correct or Incorrect?

Clear

Check Answer

60. This relationship requires a significant effort to manage and can increase transaction costs if it is not managed properly.

- ☐ a) Mutual interdependence
- ☐ b) Sequential interdependence
- ☐ c) Functional interdependence
- ☐ d) Reciprocal interdependence

Correct or Incorrect?

Clear

Check Answer

Creating Effective Contracts

Managers can help promote trust by creating contracts that encourage negotiation as unplanned events arise. Contracts are most effective when all future contingencies can be accounted for. Unfortunately, the practical realities of the business environment make it impossible to design a contract that includes provisions for all contingencies. Therefore, the parties must develop a relationship that allows trust to compensate for gaps in the contract. The relationship often develops between appropriate individuals that have been assigned from each side. Over time, the informal understandings and commitments between the individuals tend to be formalized when new contracts are drawn up. When designing the partnership and initial contract, it should be understood that informal understandings will operate side by side, and these will contribute to the development of the formal contract over time.

Thus, contracts that evolve are likely to be much more effective than contracts that are completely defined at the beginning of the partnership.

Over the long term, contracts can only play a partial role in maintaining supply chain partnerships. What is needed is a combination of a contract, the mutual benefit of the relationship, along with the trust that compensates for gaps in the contract.

Concept Check Questions

61. Managers can help promote trust by creating detailed contracts that spell out all possible contingencies.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

62. The practical realities of the business environment make it impossible to design a contract that includes provisions for all contingencies.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

63. Over the long term, contracts can only play a partial role in maintaining supply chain partnerships.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Designing Effective Conflict-resolution Mechanisms

Effective conflict-resolution mechanisms can strengthen supply chain relationships. Conflicts will inevitably arise. Unsatisfactory resolutions cause the partnership to worsen, whereas satisfactory resolutions strengthen the partnership. A good conflict-resolution mechanism should allow the parties to communicate and work through their differences. An initial formal specification of rules and guidelines for financial procedures and technological transactions can help build trust between partners. The specification of rules and guidelines facilitates the sharing of information among the partners in the supply chain.

Regular and frequent meetings between members of both organizations facilitate communication and are an important part of conflict management. These meetings allow issues to be raised and discussed before they turn into major conflicts. They also provide a basis for resolution at a higher level, should resolution at a lower level not take place. An important goal of these formal conflict-resolution mechanisms is to ensure that disputes over financial or technological issues do not turn into interpersonal squabbles.

Concept Check Questions

64. Conflict is not inevitable.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

65. Effective conflict resolution mechanisms can strengthen supply chain relationships.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

66. Regular and frequent meetings between members of both organizations facilitate communication and are an important part of conflict management.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Managing a Trust-based Relationship

Once a trust-based relationship is developed, it must be managed. Effectively managed supply chain relationships promote cooperation and trust, increasing supply chain coordination. In contrast, poorly managed relationships lead to each party being opportunistic, resulting in inefficiency and loss of profitability. One problem, however, is that management of the relationship is often seen by managers as a routine task with little reward. Often top management prefers to be involved in the design of a new partnership that often provides corporate visibility but is rarely involved in its management. This has led to a mixed record in running successful supply chain alliances and partnerships. The following factors are a part of managing a successful supply relationship.

The current trend in SCM is leaning heavily toward trust-based relationships. These relationships are instrumental in reducing cycle times and enhancing

supply chain responsiveness. They involve suppliers investing in specific assets while buyers use contracts to manage relationships based on their dependence levels. Trust-building measures play a pivotal role in improving supplier responsiveness, even when buyers have limited control over suppliers.

This shift toward trust-based relationships stems from the need for greater supply chain agility, faster responses to customer demands, and global market changes. However, sustaining these relationships remains challenging.

Examples such as the Office Max v. Ryder Integrated Logistics case highlight the complexity of maintaining long-term interorganizational relationships, emphasizing the need for a delicate balance between economic, legal, and social-psychological factors in SCM.

Concept Check Questions

67. Effectively managed supply chain relationships promote cooperation and trust, increasing supply chain coordination.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

68. Once a trust-based relationship is developed, little management is required.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

69. The current trend in supply chain management is leaning heavily against trust-based relationships because they are too difficult to manage.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

70. Trust-based relationships are instrumental in reducing cycle times and enhancing supply chain responsiveness.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

71. The shift toward trust-based relationships stems from the need for greater supply chain agility, faster responses to customer demands, and global market changes.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Commitment

The commitment of both parties helps a supply chain relationship succeed; in particular, the commitment of top management on both sides is crucial for success. The manager directly responsible for the partnership can also facilitate the development of the relationship by clearly identifying the value of the partnership for each party in terms of their expectations.

Concept Check Questions

72. Commitment of both parties helps a supply chain relationship succeed.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

73. Commitment of top management on both sides is not crucial for success as long as middle management is on board.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Clear Method of Communication

Having clear organizational arrangements in place significantly increases the chances of relationship success. This is especially important when it comes to information sharing and conflict resolution. Lack of information sharing and

the inability to resolve conflicts are the two major factors that lead to the breakdown of supply chain partnerships.

Concept Check Questions

74. Having clear organizational arrangements in place significantly increases the chances of relationship success.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

75. Lack of information sharing and the inability to resolve conflicts rarely impact supply chain partnerships.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Performance Visibility

Mechanisms that make the actions of each party and resulting outcomes visible help avoid conflicts and resolve disputes. Such mechanisms make it harder for either party to be opportunistic and help identify defective processes, increasing the value of the relationship for both parties.

Concept Check Questions

76. Mechanisms that make the actions of each party and resulting outcomes visible increase conflicts.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

77. Mechanisms that make the actions of each party and resulting outcomes visible make it more difficult to resolve disputes.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Fairness

The more fairly the stronger partner treats the weaker, vulnerable partner, the stronger the supply chain relationship tends to be. The issue of fairness is extremely important in the supply chain context because most relationships will involve parties with unequal power.

Unanticipated situations that hurt one party more than the other often arise. The more powerful party often has greater control over how the resolution occurs. The fairness of the resolution influences the strength of the relationship in the future. Fairness requires that the benefits and costs of the relationship be shared between the two parties in a way that makes both winners.



Global Insights Box—Growth Through Partnership

■ COCA-COLA IN AFRICA

The Coca-Cola Company is a beverage manufacturer, marketer, and retailer most famous for the sweet, brown, fizzy soda known by almost everyone as “Coke.” The red and white Coca-Cola circle may be one of the most recognizable brands the world over. However, how about drinks such as Sparletta Stoney Tangawizi? Or maybe a drink such as Krest Bitter Lemon? These are just 2 of 100 drinks that Coca-Cola produces in Africa, and many are tailored to local tastes.

Coke's presence in Africa dates back to 1929, but Africa has taken on a new role in the eyes of this major corporation. Growth has slowed down significantly for Coca-Cola products in Western markets such as Europe and the United States. The rate of growth in Africa is considerably higher, and the continent is increasingly becoming a larger part of Coca-Cola's revenue. Many experts predict Africa will grow in the next few decades much as India and China did in the last few decades. Currently, Coke is the African continent's largest employer, with business units in every African country, 145 bottling plants, 59 Coca-Cola bottling partners spread across the Sub-Saharan African countries, and 70,000 employees.

Coke's strategy for growth in Africa has been through partnerships. Coke has chosen to partner with small shop owners in alleyways in small villages. The business model needed to partner with these retailers is unique. Coca-Cola provides the refrigerators and even paints the storefronts with the brand logo. Rather than using delivery trucks to restock the retail stores, Coca-Cola ships cases of bottles from bottling plants to one of 3,000 manual distribution centers. Here, young men and women load the cases onto a trolley and deliver drinks by hand. This distribution model is apt for a region with relatively poor transportation infrastructure. Further, given little room for extra inventory, many store owners order just one case per day, which would render truck deliveries an overkill.

In return for helping establish the Coca-Cola brand throughout Africa, Coca-Cola educates its microdistributors in ways that include how to save resources by timing the icing of the bottles for the lunch rush and how to purchase real estate with the extra revenue earned by selling Coke. It is an example that win–win partnerships can occur despite differences in power or size.

Concept Check Questions

78. The more fairly the stronger partner treats the weaker, vulnerable partner, the stronger the supply chain relationship tends to be.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

79. Unanticipated situations that hurt one party more than the other rarely arise.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

80. Fairness requires that the benefits and costs of the relationship be shared between the two parties in a way that makes both winners.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Managing Conflict and Dispute Resolution

As we have seen, there are many types of supply chain relationships that serve many purposes. Even when there is trust and fairness, conflict can arise. In this section, we look at sources of conflict and procedures for dispute resolution.

Concept Check Questions

81. Even when there is trust and fairness, conflict can arise.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

82. There are only a handful of types of supply chain relationships.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Sources of Conflict

One of the most problematic issues in relationship management is how to manage conflict. To ward off conflicts before they turn into disputes, we should understand the sources of conflict.

Conflict is a common occurrence in supply chain relationships, often arising from differing interests and priorities among partners. A notable example of such conflict occurred between Walmart and P&G over the adoption of radio-frequency identification (RFID) technology. Walmart sought to improve inventory control and efficiency through the implementation of RFID technology. However, P&G was hesitant to adopt RFID due to the high implementation costs involved. This difference in priorities led to a conflict of interest between the two companies. To resolve the conflict, Walmart and P&G engaged in negotiations to find a mutually acceptable solution. They eventually agreed on a phased implementation of RFID, allowing both companies to achieve their objectives while maintaining their partnership. This compromise demonstrated the importance of balancing conflicting interests in supply chain relationships.

The conflict between Walmart and P&G highlights the challenges inherent in managing supply chain relationships. It underscores the need for effective communication, negotiation, and compromise to resolve conflicts and maintain productive partnerships in the supply chain.

Five potential sources of conflict may arise in supply chain relationships: relationship conflict, data conflict, interest conflict, structural conflict, and values conflict.¹

Relationship conflicts are a result of strong emotions, misperceptions or stereotypes, poor communication or miscommunication, and repetitive negative behavior. In intercultural communications, stereotypes are especially problematic. We attribute negative features to people or institutions we do not recognize or understand. When different languages are involved—as in multicultural negotiation—the risks of miscommunication increase.

Data conflicts are caused by a lack of information, misinformation, different views on what is relevant, different interpretations of data, and different data-assessment procedures. Information traveling between multiple supply chain members can be lost just as in the children's game of telephone. Even when all

relevant parties have the same spreadsheet before them, with the same data, differences in how the data is interpreted can cause conflicts.

Interest conflict can be caused by perceived or actual competition over substantive interest. An example might be the selected criteria used to determine whether a supplier meets a certain quality standard. Interest conflict can also arise from competition over procedural interests, such as a protocol for processing orders. It can also arise over psychological interests, such as how blame or praise is to be allocated. In SCM, for example, not equally sharing cost savings between members that result from process improvements can create interest conflict.

Structural conflicts are caused by factors such as destructive patterns of behavior or interaction; unequal control, ownership, or distribution of resources; unequal power or authority; geographical, physical, or environmental factors that hinder cooperation; and time constraints. Structural conflicts are among the most prominent sources of conflict in SCM relationships.

Values conflicts are caused by different criteria for evaluating ideas or behavior; mutually exclusive intrinsically valuable goals; and different ways of life, ideology, or religion. Values conflicts are to be expected in intercultural interactions. For example, Western companies operating in India have found it difficult to engage older workers in a participatory style of management because hierarchical roles are the cultural norm.

Concept Check Questions

83. One of the most problematic issues in relationship management is how to manage cost.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

84. Conflict is a common occurrence in supply chain relationships.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

85. These are a result of strong emotions, misperceptions or stereotypes, poor communication or miscommunication, and repetitive negative behavior.

- ☐ a) Data conflicts
- ☐ b) Interest conflicts
- ☐ c) Relationship conflicts
- ☐ d) Structural conflicts
- ☐ e) Values conflicts

Correct or Incorrect?

Clear

Check Answer

86. These are caused by lack of information, misinformation, different views on what is relevant, different interpretation of data, and different data-assessment procedures.

- ☐ a) Data conflicts
- ☐ b) Interest conflicts
- ☐ c) Relationship conflicts
- ☐ d) Structural conflicts
- ☐ e) Values conflicts

Correct or Incorrect?

Clear

Check Answer

87. Even when all relevant parties have the same spreadsheet before them, with the same data, differences in how the data is interpreted can cause conflicts.

- ☐ a) Data conflicts
- ☐ b) Interest conflicts
- ☐ c) Relationship conflicts
- ☐ d) Structural conflicts
- ☐ e) Values conflicts

Correct or Incorrect?

Clear

Check Answer

88. These can be caused by perceived or actual competition over substantive interest.

- ☐ a) Data conflicts
- ☐ b) Interest conflicts
- ☐ c) Relationship conflicts
- ☐ d) Structural conflicts
- ☐ e) Values conflicts

Correct or Incorrect?

Clear

Check Answer

89. An example might be the selected criteria used to determine whether a supplier meets a certain quality standard.

- ☐ a) Data conflicts
- ☐ b) Interest conflicts
- ☐ c) Relationship conflicts

- ☐ d) Structural conflicts
- ☐ e) Values conflicts

Correct or Incorrect?

Clear

Check Answer

90. These are caused by factors such as destructive patterns of behavior or interaction; unequal control, ownership, or distribution of resources; unequal power or authority; geographical, physical, or environmental factors that hinder cooperation; and time constraints.

- ☐ a) Data conflicts
- ☐ b) Interest conflicts
- ☐ c) Relationship conflicts
- ☐ d) Structural conflicts
- ☐ e) Values conflicts

Correct or Incorrect?

Clear

Check Answer

91. These are among the most prominent sources of conflict in supply chain management relationships.

- ☐ a) Data conflicts
- ☐ b) Interest conflicts
- ☐ c) Relationship conflicts
- ☐ d) Structural conflicts
- ☐ e) Values conflicts

Correct or Incorrect?

Clear

Check Answer

- ☐ a) Data conflicts
- ☐ b) Interest conflicts
- ☐ c) Relationship conflicts
- ☐ d) Structural conflicts
- ☐ e) Values conflicts

Clear

Dispute Resolution Procedures

More formal ←————→ *Less formal*



From left to right, the procedures transition from formal and adjudicative (where an independent party determines the outcome of the dispute) to informal and consensual (where the disputants themselves determine the outcome of the dispute). Also, the nature of third-party intervention is different, with litigation involving decisional assistance by a judge, and mediation involving procedural assistance by a mediator. Supply chain partners should decide ahead of time how they will resolve disputes, which will inevitably arise, considering the features unique to each dispute resolution procedure. [Figure 11.7](#) shows differences in dispute resolution procedures.

	Litigation	Arbitration	Mediation	Negotiation
1. Proceedings type	• Formal proceedings	• Informal proceedings	• Informal meetings with parties	• Informal meetings with parties
2. Decision maker	• Judge (law) and jury (facts)	• Party-appointed arbitrator	• Disputants	• Disputants
3. Third party role	• Issue judgment based on application of law to facts	• Determines award based on terms of agreement	• Facilitate negotiation between disputants	• Not applicable
4. Basis for decision	• Law, evidence, national policy	• Standards provided by the arbitration agreement	• Interests or positions of parties	• Interests or positions of parties
5. Confidentiality	• No	• Yes	• Yes	• Yes
6. Binding	• Yes, by court decree	• Yes, by court confirmation of arbitration award	• Yes, the settlement agreement is enforceable as a contract	• Yes, the settlement agreement enforced as a contract
7. Appeal	• Yes	• Usually no	• Not applicable	• Not applicable

FIGURE 11.7 Differences in dispute resolution procedures.²

Concept Check Questions

93. This type of dispute resolution procedure uses formal proceedings.

- ☐ a) Negotiation
- ☐ b) Arbitration

- ☐ c) Litigation
- ☐ d) Mediation

Correct or Incorrect?

Clear

Check Answer

94. This type of dispute resolution procedure uses a judge for law and a jury for facts.

- ☐ a) Negotiation
- ☐ b) Arbitration
- ☐ c) Litigation
- ☐ d) Mediation

Correct or Incorrect?

Clear

Check Answer

95. This type of dispute resolution procedure uses a party-appointed arbitrator.

- ☐ a) Negotiation
- ☐ b) Arbitration
- ☐ c) Litigation
- ☐ d) Mediation

Correct or Incorrect?

Clear

Check Answer

96. This type of dispute resolution procedure has a third party who issues judgment based on application of law to facts.

- ☐ a) Negotiation
- ☐ b) Arbitration
- ☐ c) Litigation
- ☐ d) Mediation

Correct or Incorrect?

Clear

Check Answer

97. This type of dispute resolution procedure has a third party who determines award based on terms of agreement.

- ☐ a) Negotiation
- ☐ b) Arbitration
- ☐ c) Litigation
- ☐ d) Mediation

Correct or Incorrect?

Clear

Check Answer

98. This type of dispute resolution procedure has a third party who facilitate negotiation between disputants.

- ☐ a) Negotiation
- ☐ b) Arbitration
- ☐ c) Litigation
- ☐ d) Mediation

Correct or Incorrect?

Clear

Check Answer

99. This type of dispute resolution procedure is not confidential.

- ☐ a) Negotiation
- ☐ b) Arbitration
- ☐ c) Litigation
- ☐ d) Mediation

Correct or Incorrect?

Clear

Check Answer

100. This type of dispute resolution procedure is appealable.

- ☐ a) Negotiation
- ☐ b) Arbitration
- ☐ c) Litigation
- ☐ d) Mediation

Correct or Incorrect?

Clear

Check Answer

Litigation

When a supply chain member breaches a contract or commits fraud, a legal wrong has been committed. This may be stealing inventory or using lesser grade materials than contracted. Consider the case of Mattel Toys from a few years ago that found its Chinese suppliers were using lead in their materials. The victim may choose to file a lawsuit to be made whole. A legal sanction should deter the wrongdoer from repeating such behavior. However, some companies will factor litigation costs into the overall costs of doing business and will only avoid breaching a contract when the costs exceed the benefits. Litigation costs can be excessive. They involve lawyer fees, court fees, producing sensitive data for evidence, depositions of responsible parties (which can impede productivity), the uncertainty of a jury verdict, and the potential for bad press (because lawsuits are usually public). Time-consuming, uncertain, and costly, litigation is viewed by some as the “nuclear option”: it should be used only as a last resort. Litigation is viewed by some as a

management failure because the resolution of the dispute is no longer within the management's control. Rather, factual controversies are resolved by a jury, and questions of rights and obligations are determined by an independent judge. Although trial court opinions can be appealed, the process is usually protracted and costly. Litigated outcomes are usually “all or nothing” for either the plaintiff or the defendant.

Concept Check Questions

101. When a supply chain member breaches a contract or commits fraud, a legal wrong has been committed.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

102. Some companies will factor litigation costs into the overall costs of doing business and will only avoid breaching a contract when the costs exceed the benefits.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

103. Litigation is fairly inexpensive.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

104. Litigation is viewed by some as a management failure because resolution of the dispute is no longer within the management's control.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Arbitration

When both parties can agree to procedures and norms for how their disputes should be resolved, they can create an arbitration agreement that stipulates how an arbitrator will be selected and which controversies will be subject to arbitration. This option is especially useful in international commercial contexts, where suing in the courts of another nation may not be desirable to either party. Further, arbitration may be desirable for businesses that specialize in highly technical fields and want to avoid having factual questions decided by a lay jury. Instead, the parties can choose a neutral arbitrator who is an expert in their field to determine the outcome. The parties can also stipulate by agreement that certain issues will be arbitrated, whereas other matters may be litigated. Arbitration allows the parties to customize the dispute resolution procedure. They may agree that the law is irrelevant and that industry norms or customs should govern the outcome. Like litigation, arbitration involves a neutral third party who issues a binding decision. Unlike litigation, however, arbitrators are not obligated to provide a reasoned opinion for their award. The choice to arbitrate a dispute should be made with care because courts usually enforce arbitration agreements, requiring parties to arbitrate disputes when they have agreed to in the contract. Further, the choice of arbitrator must be made with care because arbitration awards are rarely subject to review. Instead, they are enforced as mandatory and binding.

Concept Check Questions

105. When both parties can agree to procedures and norms for how their disputes should be resolved, they can create an arbitration agreement that stipulates how an arbitrator will be selected and which controversies will be subject to arbitration.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

106. It is fairly easy to sue in an international commercial context.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

107. Litigation is more desirable for businesses that specialize in highly technical fields.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

108. Arbitrators are obligated to provide a reasoned opinion for their award.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Mediation

Like litigation and arbitration, mediation relies on a neutral third party. Unlike the former two procedures, the mediator does not have the power to compel the disputants to accept any particular outcome. Mediators are more like facilitators than decision makers. The mediator acts as a “go-between” or conducts shuttle diplomacy, ferrying information, offers, and counteroffers between the disputants. Although some courts require the parties to attempt mediating their dispute before litigating, mediation is usually voluntary and is the dispute resolution procedure of choice when preserving the relationship between the parties is more important than seeking vindication. In SCM, where long-term relationships are important, this is a much more preferred method of dispute resolution than litigation and arbitration.

The structure of mediation and the issues that are subject to mediation are determined by the parties. The mediator must be impartial, creative, and patient. Mediators often help the parties devise creative solutions to their problems, but whether to agree to a mediated outcome is up to either party. In other words, mediation is a facilitated negotiation. The effectiveness of mediation depends not only on the attitude of the disputants but also on the talent and style of the mediator.

Concept Check Questions

109. Mediation relies on a neutral third party.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

110. The mediator has the power to compel the disputants to accept any particular outcome.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

111. Mediation is always voluntary.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

112. The structure of mediation and the issues that are subject to mediation are determined by the mediator.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Negotiation

Negotiation is the process of gaining concessions from another party.

Negotiation is the most informal of dispute resolution procedures and does not involve third-party assistance. The disputants agree to discuss or argue about a problem until they determine a resolution. Sometimes, parties will refuse to negotiate, and the only way to resolve the dispute is through a more formal mechanism. Sometimes, a party will agree to negotiate but will do so with such aggressive tactics that the initiating party is better off not negotiating. Usually, powerful or sophisticated parties do better in negotiations than weak or unsophisticated parties. Negotiated decisions can be enforced as a contract. Negotiations can be viewed as adversarial, where each party tries to extract as much value from the other as possible. Or, negotiations can be viewed as problem-solving opportunities, where each party helps brainstorm the conflict to determine whether mutually beneficial agreements are possible. In supply chain relationship management, negotiations should consider more collaborative, problem-solving orientations toward dispute resolution. Because negotiation is consensual and does not require third-party intervention, it can be the most inexpensive and swift method for resolving disputes.

Dispute resolution procedures encompass various methods, from formal litigation and arbitration to informal mediation and negotiation. For instance, in 2011, Apple and Samsung engaged in a high-profile legal battle over patent infringements, primarily related to smartphone technology. This conflict initially unfolded through litigation, leading to numerous lawsuits in multiple countries over several years. However, by 2014, the companies pivoted toward alternative dispute resolution methods, transitioning to mediation and negotiation. Ultimately, in 2018, they settled their patent disputes, bringing an end to the prolonged legal confrontations.

This shift exemplifies the flexibility and range of dispute resolution mechanisms employed by firms to address conflicts effectively. While the litigation route incurred substantial costs and prolonged disputes, the transition to mediation and negotiation allowed Apple and Samsung to find common ground. Through these alternative methods, they reached agreements and

cross-licensing deals, fostering a more cooperative approach that enabled them to maintain their business relationships and redirect their focus toward innovation and market growth. This strategic shift highlights the significance of utilizing consensual and cooperative approaches in resolving conflicts within the business landscape.



Concept Check Questions

113. Negotiation is basically the process of gaining concessions from another party.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

114. Negotiation is the most formal of dispute resolution procedures.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

115. Sometimes, parties will refuse to negotiate.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

116. Dispute resolution procedures encompass various methods, from formal litigation and arbitration to informal mediation and negotiation.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Managerial Insights Box

■ COMMODITY SWAPPING

Who says competitors cannot be good to one another? One nonobvious way to lower the overall cost of supply chain operations is for competing companies to make a deal with each other to rationalize commodity sourcing. Swapping with a competitor may lead to mutual cost savings where everyone “wins.”

Raw materials are traditionally shipped from the point of extraction to the point of processing. This takes place across vast oceans or continents. The innovation of commodity swapping allows some companies in iron, steel, chemicals, paper, oil, electricity, and textile industries to virtually eliminate the cost of transporting commodities. When a shipment of metal bolts makes its way across the ocean and passes another shipment of nearly identical bolts heading in the opposite direction, the managers receiving these shipments should consider swapping commodities with one another.

Consider the case of the Dow Chemical Company, which makes 100% of its polymers in the United States. Dow Chemical used to ship these polymers to be consumed by its plants around the world, less than half of which were located in the United States. A competitor company, Arkema, with manufacturing based in France and Italy, made the same polymers and shipped them around the world to be consumed internally, some by plants in North America. Both the European Union (EU) and the United States imposed import duties, and the Atlantic Ocean freight cost per metric ton was \$40 to \$60. The competitors saw an opportunity to engage in a cost-saving collaboration. After each company tested the competitor's product, Dow Chemical, and Arkema negotiated a commodity swap to supply one another's polymer plants. This collaborative negotiation between competitors resulted in annual cost savings of tens of millions of dollars.

Swapping allows both parties to eliminate inefficient transport procedures. Commodity swapping is particularly useful when dealing with import taxes, large distances, and bulk quantities. The concept of swapping

commodities can be extended to products as well as to manufacturing capacities. Benefits of swapping include reduced transport costs including import and export levies, reduced logistics costs including storage, reduced uncertainty in supply, reduced price volatility, reduced inventory, and reduced environmental impact.

Negotiation Concepts, Styles, and Tactics

We negotiate, consciously or not, every day. When you decide who will drive in the carpool, when you trade baseball cards, and when you and your date decide where to go to dinner, you are negotiating. Negotiations involve give-and-take, a dance of sorts, where positions are exchanged until the two parties can agree to a mutually beneficial settlement—that is, an agreement that satisfies the underlying interest of the parties. In the context of SCM, negotiations are required to determine the terms of the contractual relationship between business units in a supply chain.

Negotiations can take place concerning almost anything. Issues such as cost, quantity, quality, timing, control, options, shared resources, and penalties for noncompliance are usually subject to negotiation. This section introduces you to negotiation concepts, styles, and tactics that are of great use to managing supply chain relationships.

The Brexit negotiations provide an excellent backdrop to highlight leverage, positions vs interests, negotiation styles, and tactics. Let us look at each of these:

Leverage in Brexit Negotiations: The EU had substantial leverage due to its size, collective bargaining power, and existing trade agreements. It held the upper hand in negotiations, particularly in terms of setting the framework and rules for the UK's exit. The UK sought to leverage its status as the departing member state, aiming to regain control over its laws, borders, and finances. However, this leverage was somewhat limited compared to the collective strength of the EU.

Position vs Interest: Both parties initially held rigid positions, with the EU prioritizing the integrity of its single market and the UK emphasizing regaining sovereignty. Over time, negotiations shifted focus toward interests rather than entrenched positions. Understanding underlying interests became

crucial. For the EU, safeguarding its market integrity was an interest, while for the UK, maintaining autonomy and control was paramount. This shift allowed for the exploration of solutions that addressed underlying concerns.

Negotiation Styles and Tactics: The negotiation styles varied between the UK and the EU. The EU exhibited a more collective approach, speaking with a unified voice across member states, thereby presenting a united front. This unified stance amplified their negotiation power. The UK adopted a more individualistic approach, striving for autonomy and independence. This approach allowed for a more flexible negotiation strategy, enabling the UK to pivot tactics based on its domestic political landscape.

Tactics Used in Brexit Negotiations: Both sides used delay tactics with time as a strategic tool, creating deadlines to pressure the other party and extend negotiations. The looming deadlines became leverage points. Both sides also used informational tactics.

This involved the dissemination of information, sometimes strategic leaks, which was used to influence public opinion and shift negotiation dynamics. Tactics also involved linking multiple issues (e.g., trade, border controls, and fisheries) to drive concessions in interconnected areas.

Overall, the Brexit negotiations demonstrated the complexity of balancing leverage, understanding underlying interests, adapting negotiation styles, and employing tactical maneuvers in high stakes, multidimensional negotiations involving geopolitical, economic, and social considerations.

Concept Check Questions

117. In the context of SCM, negotiations are required to determine the terms of the contractual relationship between business units in a supply chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

118. In the Brexit negotiations, the European Union had substantial leverage due to its size, collective bargaining power, and existing trade agreements.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

119. In the Brexit negotiations, both parties held flexible positions.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

120. In the Brexit negotiations, the negotiation styles between the UK and the EU were roughly the same.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Leverage

Leverage is one of the most important elements in a negotiation. The party with the most leverage is the one who loses the least from walking away from the negotiation table. The leverage one possesses strongly affects one's relative

bargaining power in a negotiation. The party with greater leverage can extract the most value from the counterparty. To illustrate, suppose you own the only Ford Model T that a notorious collector does not already possess. You are perfectly happy maintaining ownership of the car because you believe in good evidence that its value will continue to appreciate. However, you do have bills to pay, and the car is not doing you much financial good sitting in your garage. This collector has an extremely ardent desire to possess this one remaining car so that he may complete his collection. He is, some would say, a fanatic about your Ford Model T. You have several outstanding offers for the car, though his is the highest bid. Because each of you has something the other wants—you have the product, he has the cash—you are in a position to negotiate. However, because you have less to lose from walking away from the negotiation, you have the most leverage. That is, you can choose not to negotiate with the collector because you have alternative bidders. The collector, however, has no choice but to negotiate with you because you possess the only remaining car. You can use this leverage to request a higher price for the car from the collector, regardless of what the other competing bids are. Before entering into a negotiation, you should reflect on who has the most leverage.

Concept Check Questions

121. Leverage is one of the most important elements in a negotiation.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

122. The party with the most leverage is the one who loses the most from walking away from the negotiation table.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

123. The party with greater leverage is able to extract the most value from the counterparty.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

“Position” vs “Interest”

Suppose you are a widget wholesaler, and you are in a negotiation with a retailer who might purchase your widgets. A [position](#) is what you signal to the counterparty about your willingness to accept or willingness to pay. When you say, “I won't accept anything less than \$10.00 per unit,” and the retailer responds with, “I won't pay anything more than \$7.00 per unit,” you are both stating a position. After this initial exchange of positions, you find yourselves at an impasse. You have both stated mutually exclusive positions, and it looks like there is no way forward unless one of you changes your position.

An [interest](#) is the underlying reason for your position. Often, negotiators will conceal their underlying interests because they do not trust each other. This is common in arm's-length negotiations. However, if both wholesalers and retailers in this example were to disclose their underlying interests to one another, they could discover possibilities for mutual gains. Perhaps you believe the retailer is only going to purchase a few widgets, and you need to charge a premium for such a small shipment. Your interest is in making a large enough profit from the deal to make processing the order worth your time. The retailer, on the other hand, has an interest in being the only vendor who supplies your brand of widget but is afraid to mention this because she believes you may use it as leverage against her. If the two of you were to share your underlying interests, several possibilities would emerge. The wholesaler

would realize the retailer was not a one-time buyer and would stop treating her as such. The retailer would realize the wholesaler was not fixed at \$10.00 per unit but was offering that price because of a misperception. The retailer may offer to make repeat widget purchases if the wholesaler offers a lower price per unit. By revealing underlying interests, negotiators are able to find a zone of mutually beneficial agreement.

Concept Check Questions

124. A/n _____ is what you signal to the counterparty about your willingness to accept or willingness to pay.

- ☐ a) stance
- ☐ b) interest
- ☐ c) purpose
- ☐ d) position

Correct or Incorrect?

Clear

Check Answer

125. A/n _____ is the underlying reason for your position.

- ☐ a) stance
- ☐ b) interest
- ☐ c) purpose
- ☐ d) position

Correct or Incorrect?

Clear

Check Answer

126. When you say, “I won't accept anything less than \$10.00 per unit,” and the retailer responds with, “I won't pay anything more than \$7.00 per unit,”

you are both stating a/n _____.

- ☐ a) stance
- ☐ b) interest
- ☐ c) purpose
- ☐ d) position

Correct or Incorrect?

Clear

Check Answer

127. Often, negotiators will conceal their underlying interests because they do not trust each other.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Negotiator's Dilemma

When a negotiator shares truthful information, they have a higher chance of achieving mutually beneficial outcomes. [Integrative opportunities](#) are negotiation opportunities that are nonzero-sum. Here both parties can be made better off without making either party worse off. However, deception confers distributive advantages where one of the parties benefits more than the other. [Distributive opportunities](#), on the other hand, are zero-sum negotiation opportunities. This is where what is good for one party is directly adverse to the other party.

Should you share truthful information about your underlying interests? Or should you conceal this information carefully? The negotiator's dilemma is the inevitable paradox at the core of negotiation. The right answer depends on the setting and the nature of the relationship between the negotiators. Usually, a

negotiation will have integrative and distributive potential. That is, a negotiation will present opportunities for the parties to offer one another things that increase the size of “the pie,” and the negotiation will present opportunities for the parties to claim slices of that “pie.” A good negotiator looks for integrative and distributive opportunities, making efforts to increase the total value of a deal to both parties, even as the negotiator claims as much value as she can for herself.

An example of this negotiation paradox and the balance between truthfulness and deception can be seen in the pharmaceutical industry's pricing negotiations between drug manufacturers and health insurance companies. Truthful information about the research, development costs, and potential benefits of a new drug can create integrative opportunities. Both parties can benefit from fair pricing that ensures access to life-saving medications while allowing manufacturers to recoup investments. However, concealing certain cost breakdowns or overstating development expenses might confer distributive advantages. Manufacturers could negotiate for higher prices, leading to greater profits but potentially burdening healthcare systems with inflated costs.

The negotiator's dilemma here involves navigating the tension between revealing truthful information about R&D investments (which might justify higher prices) and strategically concealing certain details (to negotiate for higher profits). In this scenario, negotiators must balance the need for fair pricing that benefits both patients and companies to maximize profits.

The negotiation's success often hinges on negotiators identifying integrative opportunities where both parties can benefit without compromising ethical considerations, while also carefully navigating distributive opportunities to secure a favorable outcome without undermining trust or fairness in the long run.

Concept Check Questions

128. When a negotiator shares truthful information, they have a higher chance of achieving mutually beneficial outcomes.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

129. _____ are negotiation opportunities that are non-zero-sum.

- ☐ a) Zero-sum opportunities
- ☐ b) Distributive opportunities
- ☐ c) Integrative opportunities
- ☐ d) Weighted opportunities

Correct or Incorrect?

Clear

Check Answer

130. _____ are zero-sum negotiation opportunities.

- ☐ a) Zero-sum opportunities
- ☐ b) Distributive opportunities
- ☐ c) Integrative opportunities
- ☐ d) Weighted opportunities

Correct or Incorrect?

Clear

Check Answer

131. Here both parties can be made better off without making either party worse off.

- ☐ a) Zero-sum opportunities
- ☐ b) Distributive opportunities
- ☐ c) Integrative opportunities
- ☐ d) Weighted opportunities

Correct or Incorrect?

Clear

Check Answer

132. This is where what is good for one party is directly adverse to the other party.

- ☐ a) Zero-sum opportunities
- ☐ b) Distributive opportunities
- ☐ c) Integrative opportunities
- ☐ d) Weighted opportunities
- ☐ e) One sided opportunity

Correct or Incorrect?

Clear

Check Answer

133. Usually, a negotiation will have integrative and distributive potential.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Negotiation Styles

There are two categories of negotiator styles: adversarial and problem solving. [Adversarial negotiators](#) approach a negotiation as a zero-sum game: every benefit one party receives is a direct loss to the other party, and winners use tough positional bargaining tactics. [Problem-solving negotiators](#) approach negotiations as a nonzero-sum game, where concessions are made by each party to create value, and trusting, creative discussions address underlying interests. You should be prepared for adversarial tactics to be employed

against you in a negotiation. However, you should also be willing to engage in problem-solving tactics in negotiations. To be sure, negotiations may require one to be adversarial as well as problem solving to do what is best for your company, so do not dismiss either kind of tactic out of hand.

Concept Check Questions

134. There are three categories of negotiator styles.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

135. _____ negotiators approach a negotiation as a zero-sum game: every benefit one party receives is a direct loss to the other party, and winners use tough positional bargaining tactics.

- ☐ a) Win/lose
- ☐ b) Adversarial
- ☐ c) Problem-solving
- ☐ d) Win/win

Correct or Incorrect?

Clear

Check Answer

136. _____ negotiators approach negotiations as a non-zero-sum game, where concessions are made by each party to create value, and trusting, creative discussions address underlying interests.

- ☐ a) Win/lose
- ☐ b) Adversarial
- ☐ c) Problem-solving
- ☐ d) Win/win

Correct or Incorrect?

Clear

Check Answer

Adversarial Tactics

Extreme opening offers, few and small concessions, withholding information, and manipulating commitments are all adversarial negotiating tactics.³ Here, are some real examples of companies and their negotiation strategies:

Pharmaceutical Industry Negotiations

Pfizer and BioNTech vs Governments: During the COVID-19 pandemic, Pfizer and BioNTech negotiated contracts with various governments worldwide for the supply of their COVID-19 vaccines. Pfizer initially employed anchoring tactics by setting high prices for the vaccine, aiming to negotiate favorable terms. This involved complex negotiations over price, quantity, delivery schedules, liability clauses, and regulatory approvals.

Automotive Industry Negotiations

General Motors (GM) and Labor Unions: GM has historically negotiated with labor unions for collective bargaining agreements. These negotiations include contentious discussions over wages, benefits, working conditions, and job security. Both sides employ adversarial tactics, such as extreme opening offers and making concessions strategically, aiming for a balanced agreement.

Let us look at some adversarial tactics:

Extreme Openers—Anchoring. Extreme opening offers are used to take advantage of what psychologists call the “[anchoring effect](#).” That is, the initial offer has a powerful effect on the final agreement. An analysis of a large database of negotiation studies found that for every \$1.00 increase in opening offer, we can expect the final sale price to increase by \$.50.⁴ Negotiators can

take advantage of the anchoring effect by making an opening offer that is lopsided in their favor. Even when the counterparty forces you to make concessions, you are conceding away from a highly favorable amount toward an amount that is still favorable to you. However, when negotiating with a well-informed counterparty, extreme opening offers can make you look less credible because it suggests you have failed to accurately assess the worth of your good or service.

Few and Small Concessions—Reciprocity. Concessions are made when the parties realize their stated positions are simply incompatible, and one or more is required to budge. When one party makes a concession, a powerful psychological norm is triggered that encourages the other party to do the same: [the norm of reciprocity](#). Adversarial negotiators will make concessions that grow increasingly closer together to signal to the counterparty that they are reaching their bottom line, below which they will not go. For instance, the aggressive negotiator who has a bottom line selling price of \$30 will open with \$100, then concede to \$75, then to \$65, then to \$60. This suggests to the buyer that the seller's bottom line is somewhere around \$60. When the seller makes a concession, the norm of reciprocity encourages the buyer to make a mirror-like concession. Suppose the buyer's original counteroffer was \$30. To reciprocate the seller's generous concessions, the buyer will end up offering more each time. To be sure, buyers can use this tactic just as well as sellers, by increasing their offer in smaller increments each time to signal to the seller that they are reaching their maximum offer.

Another concessionary tactic is the “[rejection-then-retreat](#)” trick. This involves making an opening offer that you know will be rejected, only to immediately make your “real” offer that, because of the norm of reciprocity, will more than likely be accepted. Suppose you ask someone to donate \$20 to your charity, knowing they will decline, but as soon as they decline, you ask them to purchase a candy bar for \$5 instead. This approach is very successful because the counterparty feels obligated to reciprocate your “generous” reduction in the amount of your request by agreeing to the second offer. Like all adversarial tactics, be wary of the use of concessionary tactics, as a savvy counterparty can detect their use, and you may lose credibility or trust as a result.

Withholding Information. “Information asymmetry” is the term used to describe a situation in which one party has access to information that the other party does not know about. Adversarial negotiators can withhold information

to take advantage of information “asymmetries”—that is, the parties’ access to information is not equal. For example, imagine you are an oil prospector, and you come to know that a small farm is sitting on a large oil field. The farmer is elderly and relatively uneducated and has no idea that he is sitting on millions of dollars worth of oil. You approach the farmer and negotiate over the sale of his farm, withholding the information you have about the riches just beneath the surface of his land. The farmer asks for \$150,000 for the property, and you counter with \$100,000, ultimately agreeing to \$125,000 for the property. The farmer walks away believing he secured a good price for his land. By withholding information, you secure an enormous profit for a small expenditure by capitalizing on the information asymmetry with respect to the actual value of the estate. This type of negotiation may be perceived by others as highly unethical, even if it is legal.

One of the risks of withholding information arises when both parties employ the tactic at the same time. This leads to an impasse because neither side knows the other side's actual position. Further, this tactic prevents parties from bargaining based on good information about the actual underlying interests of one another. Negotiated outcomes may be less than satisfactory as a result.

Manipulating Commitments. An adversarial negotiator can use commitments in two ways: binding the counterparty or binding yourself. In the first kind of commitment manipulation, the negotiator can get the counterparty to commit to a principle, and then use that commitment against the counterparty later in the negotiation. For example, you could ask, “Now, you agree that no one should do business with a criminal, right?” and the counterparty agrees in principle. Then you say, “Well, my competitor has been convicted of a crime, so you should not do business with him. Therefore, you should do business with me instead.” This tactic capitalizes on the need for most people to maintain consistency. By getting the counterparty to commit to a principle, you can manipulate them within a negotiation. However, this type of manipulation can backfire in terms of lost credibility and trust if the counterparty views it as trickery.

The other form of commitment manipulation is to bind yourself. You can say, “I simply cannot agree to anything less than \$50,000 or I will be fired by my boss.” This sends a clear, forceful message to the counterparty about your bottom line. They will take the \$50,000 offer or leave the deal. If you have the most leverage—that is, you have less to lose from walking away from the deal than the counterparty—this can be very effective. However, this type of

manipulation of commitments can backfire if you do not have enough leverage. It ultimately constrains your flexibility within the negotiation and may erode your credibility if the counterparty discovers later that you agreed to something else in a separate negotiation.

Concept Check Questions

137. This is used to take advantage of what psychologists call the “anchoring effect.”

- ☐ a) Extreme openers
- ☐ b) Withholding information
- ☐ c) Manipulating commitments
- ☐ d) Few and small concessions

Correct or Incorrect?

Clear

Check Answer

138. These are made when the parties realize their stated positions are simply incompatible, and one or more is required to budge.

- ☐ a) Extreme openers
- ☐ b) Withholding information
- ☐ c) Manipulating commitments
- ☐ d) Few and small concessions
- ☐ e) Rejection-then-retreat

Correct or Incorrect?

Clear

Check Answer

139. When the seller makes a concession, the norm of reciprocity encourages the buyer to make a mirror-like concession.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

140. Information asymmetry is the term used to describe a situation in which one party has access to information that the other party does not know about.

- ☐ a) Extreme openers
- ☐ b) Withholding information
- ☐ c) Manipulating commitments
- ☐ d) Few and small concessions
- ☐ e) Rejection-then-retreat

Correct or Incorrect?

Clear

Check Answer

141. An adversarial negotiator can use commitments in two ways: binding the counterparty or binding yourself.

- ☐ a) Extreme openers
- ☐ b) Withholding information
- ☐ c) Manipulating commitments
- ☐ d) Few and small concessions
- ☐ e) Rejection-then-retreat

Correct or Incorrect?

Clear

Check Answer

Problem-Solving Tactics

Separating people from the problems (listening), focusing on interests rather than positions (asking), inventing options for mutual gain (inventing), and using objective criteria to evaluate the terms (referencing) are all problem-solving negotiating tactics.⁵

Listening. Often disagreement can trigger negative emotions, which lead to personal entanglement, and the source of the conflict is mistakenly attributed to the person on the other side of the negotiating table. When egos get involved, conflicts can escalate. Good communication begins with good listening. It is crucial to attack the problem, rather than the people. This requires negotiators to separate the people from the problem. Listening carefully can help identify misperceptions—if they are never identified, opportunities for mutual benefit may be lost. Listening also allows a negotiator to acknowledge an emotional conflict, which goes a long way toward resolving the issue. Listening can transform a conversation from a heated argument into a collaborative dialogue. When people feel they are not being heard, they understandably become angry, and the resolution of the conflict recedes until it is out of our grasp. On the other hand, when your adversary feels, you are truly listening to them, they are less likely to attribute callous indifference to you, and hence they are more likely to sympathize with your problems as well. Demonstrating that you understand what your counterparty is saying and how they are feeling can help melt the ice and lead to more amicable relations. The technique used to demonstrate that you are listening is “looping”: when the other side responds to your statement, demonstrate that you understand by paraphrasing, and then invite the other side to confirm that you have understood. If the other side confirms that you have understood them, the loop is closed; otherwise, start the loop over. A negotiator must demonstrate listening with authentic, genuine curiosity.

Asking. Usually, negotiators begin by stating various positions that do not reflect their true interests. In other words, positions are usually the means, whereas interests are the ends. Suppose you are selling a stereo to raise money to purchase a new computer. When you say, “I can accept no less than \$1,000 for my stereo,” you state a position that is a means to your end of purchasing a computer. However, your counterparty has no idea why you need the money. If the counterparty does not have \$1,000, the deal is dead. However, if the counterparty asked you why you needed the money, and you were to say, “I

need \$1,000 because I am trying to purchase a computer,” the counterparty might very well say, “If you accept \$500, I can give you my used computer.” Positional statements are used to push back and forth and usually obscure what the parties truly need from one another. Asking questions about underlying interests allows negotiators to focus on interests rather than positions. Asking “why” can uncover hidden interests that can create opportunities for mutual gain. Ask open questions, not closed questions. To continue the example, an open question would be, “Why do you need \$1,000?”, whereas a closed question would be, “Where did you come up with \$1,000?” When you ask “why,” clarify that you are not asking for an excuse but rather you are trying to improve your understanding of the counterparty's situation and needs. Be sure to maintain a courteous, genuinely curious tone when you ask questions, otherwise, you will come off as interrogating the counterparty, which can erode trust.

Inventing. Adversarial situations stifle creativity by putting us in a defensive posture. Creative negotiators can find ways out of an impasse by inventing various options that reconcile competing interests and promote joint gain. Brainstorming can turn a conflict into a constructive endeavor. Differences between the negotiators can help lead to mutually beneficial settlements. Differences in resources, relative valuations, forecasts, risk preferences, and time preferences are more helpful in overcoming obstacles than similarities along these dimensions. By highlighting differences between the parties, negotiators create options and increase the likelihood of discovering a mutually attractive outcome. Remain open to thinking creatively, and avoid overcommitting yourself to any particular dispute resolution. Open brainstorming is the opposite of manipulation through self-commitment.

Referencing. Instead of forcing a settlement with brute strength, negotiators should evaluate the outcome of a dispute using objective criteria to which both sides can agree. This allows the parties to depersonalize the negotiation. Basing outcomes on what one party is willing to do for the other party is likely to fail in an adversarial negotiation, given the mood. However, using objective standards such as industry norms or market value allows negotiators to get past different personal preferences to reach an agreement that is defensible from any perspective. Using objective criteria can also help a negotiator overcome unfair tactics used by the counterparty.



Concept Check Questions

142. Separating people from the problems.

- ☐ a) Listening
- ☐ b) Asking
- ☐ c) Believing
- ☐ d) Inventing
- ☐ e) Referencing

Correct or Incorrect?

Clear

Check Answer

143. Focusing on interests rather than positions.

- ☐ a) Listening
- ☐ b) Asking
- ☐ c) Sharing
- ☐ d) Inventing
- ☐ e) Referencing

Correct or Incorrect?

Clear

Check Answer

144. Coming up with options for mutual gain.

- ☐ a) Listening
- ☐ b) Asking
- ☐ c) Sharing
- ☐ d) Inventing
- ☐ e) Referencing

Correct or Incorrect?

Clear

Check Answer

145. Using objective criteria to evaluate the terms

- ☐ a) Listening
- ☐ b) Asking
- ☐ c) Measuring
- ☐ d) Inventing
- ☐ e) Referencing

Correct or Incorrect?

Clear

Check Answer

146. When egos get involved, conflicts can deescalate.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

147. Listening can transform a conversation from a heated argument into a collaborative dialogue.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

148. Usually, negotiators begin by stating various positions that do not actually reflect their true interests.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

149. Adversarial situations enhance creativity.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

150. Differences in resources, relative valuations, forecasts, risk preferences, and time preferences are more helpful in overcoming obstacles than similarities along these dimensions.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

151. Negotiators should force a settlement using any means necessary.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Relationship Management in Practice

The Keiretsu Supplier-partnering Model

An important issue in supply chain relationship management is how to turn arm's-length relationships with suppliers based on power differentials into close partnerships based on trust. The Japanese concept [keiretsu](#) applied to supplier relationships can provide a model of this. The concept means a close-knit network of suppliers that continuously learn, improve and prosper along with their parent companies.

Toyota and Honda have established successful keiretsu relationships with suppliers in North America while American automotive companies have struggled to do so. [Figure 11.8](#) illustrates the six strategic and interlocking steps that should be taken in developing these relationships. The process starts with step 1 at the bottom of [Figure 11.8](#), first developing an understanding of how suppliers work. Progressively the steps build to the top and culminate with developing joint improvement programs with suppliers. Consider how these six strategies effectively counteract the various sources of conflict—particularly data and structural conflict—discussed in this chapter.

Concept Check Questions

152. An important issue in supply chain relationship management is how to turn arm's-length relationships with suppliers based on power differentials into close partnerships based on trust. The Japanese concept _____ applied to supplier relationships can provide a model of this.

- ☐ a) kanban
- ☐ b) kaizen
- ☐ c) Muda
- ☐ d) mura
- ☐ e) keiretsu

Correct or Incorrect?

Clear

Check Answer

153. Learn about suppliers' businesses.

- ☐ a) Understand how your suppliers work
- ☐ b) Turn supplier rivalry into opportunity
- ☐ c) Supervise your suppliers
- ☐ d) Develop supplier capabilities
- ☐ e) Share information

Correct or Incorrect?

Clear

Check Answer

154. Respect suppliers' capabilities

- ☐ a) Understand how your suppliers work
- ☐ b) Turn supplier rivalry into opportunity
- ☐ c) Supervise your suppliers

- ☐ d) Develop supplier capabilities
- ☐ e) Share information

Correct or Incorrect?

Clear

Check Answer

155. Source each component from two or three suppliers.

- ☐ a) Understand how your suppliers work
- ☐ b) Turn supplier rivalry into opportunity
- ☐ c) Supervise your suppliers
- ☐ d) Develop supplier capabilities
- ☐ e) Share information

Correct or Incorrect?

Clear

Check Answer

156. Create compatible production philosophies and systems.

- ☐ a) Understand how your suppliers work
- ☐ b) Turn supplier rivalry into opportunity
- ☐ c) Supervise your suppliers
- ☐ d) Develop supplier capabilities
- ☐ e) Share information

Correct or Incorrect?

Clear

Check Answer

157. Build suppliers' problem-solving skills.

- ☐ a) Understand how your suppliers work
- ☐ b) Turn supplier rivalry into opportunity
- ☐ c) Supervise your suppliers
- ☐ d) Develop supplier capabilities
- ☐ e) Share information

Correct or Incorrect?

Clear

Check Answer

158. Develop a common lexicon.

- ☐ a) Understand how your suppliers work
- ☐ b) Turn supplier rivalry into opportunity
- ☐ c) Supervise your suppliers
- ☐ d) Develop supplier capabilities
- ☐ e) Share information

Correct or Incorrect?

Clear

Check Answer

159. Insist on accurate data collection.

- ☐ a) Understand how your suppliers work
- ☐ b) Turn supplier rivalry into opportunity
- ☐ c) Supervise your suppliers
- ☐ d) Develop supplier capabilities
- ☐ e) Share information

Correct or Incorrect?

Clear

Check Answer

160. Share information in a structured fashion.

- ☐ a) Understand how your suppliers work
- ☐ b) Turn supplier rivalry into opportunity
- ☐ c) Supervise your suppliers
- ☐ d) Develop supplier capabilities
- ☐ e) Share information

Correct or Incorrect?

Clear

Check Answer

161. Build suppliers' problem-solving skills.

- ☐ a) Joint improvement
- ☐ b) Turn supplier rivalry into opportunity
- ☐ c) Supervise your suppliers
- ☐ d) Develop supplier capabilities
- ☐ e) Share information

Correct or Incorrect?

Clear

Check Answer

162. Develop a common lexicon.

- ☐ a) Joint improvement
- ☐ b) Turn supplier rivalry into opportunity
- ☐ c) Supervise your suppliers
- ☐ d) Develop supplier capabilities
- ☐ e) Share information

Correct or Incorrect?

Clear

Check Answer

163. Exchange best practices with suppliers.

- ☐ a) Joint improvement
- ☐ b) Turn supplier rivalry into opportunity
- ☐ c) Supervise your suppliers
- ☐ d) Develop supplier capabilities
- ☐ e) Share information

Correct or Incorrect?

Clear

Check Answer

164. Initiate kaizen projects at suppliers' facilities.

- ☐ a) Joint improvement
- ☐ b) Turn supplier rivalry into opportunity
- ☐ c) Supervise your suppliers
- ☐ d) Develop supplier capabilities
- ☐ e) Share information

Correct or Incorrect?

Clear

Check Answer

165. Toyota and Honda have established successful keiretsu relationships with suppliers in North America.

- ☐ True
- ☐ False

Correct or Incorrect?

Partnership Agreements

Creating a business relationship is usually accompanied by excitement and a sense of opportunity. However, like relationships between individuals, success does not come without an honest accounting of one another's expectations and obligations. When disagreement occurs, and the contract that created the partnership is either silent or ambiguous with respect to what the parties agreed to, businesses must go to court to litigate the rights and obligations under the contract. Litigation costs are steep enough to persuade reasonable people to expend effort up front to clarify each other's intentions and understandings.

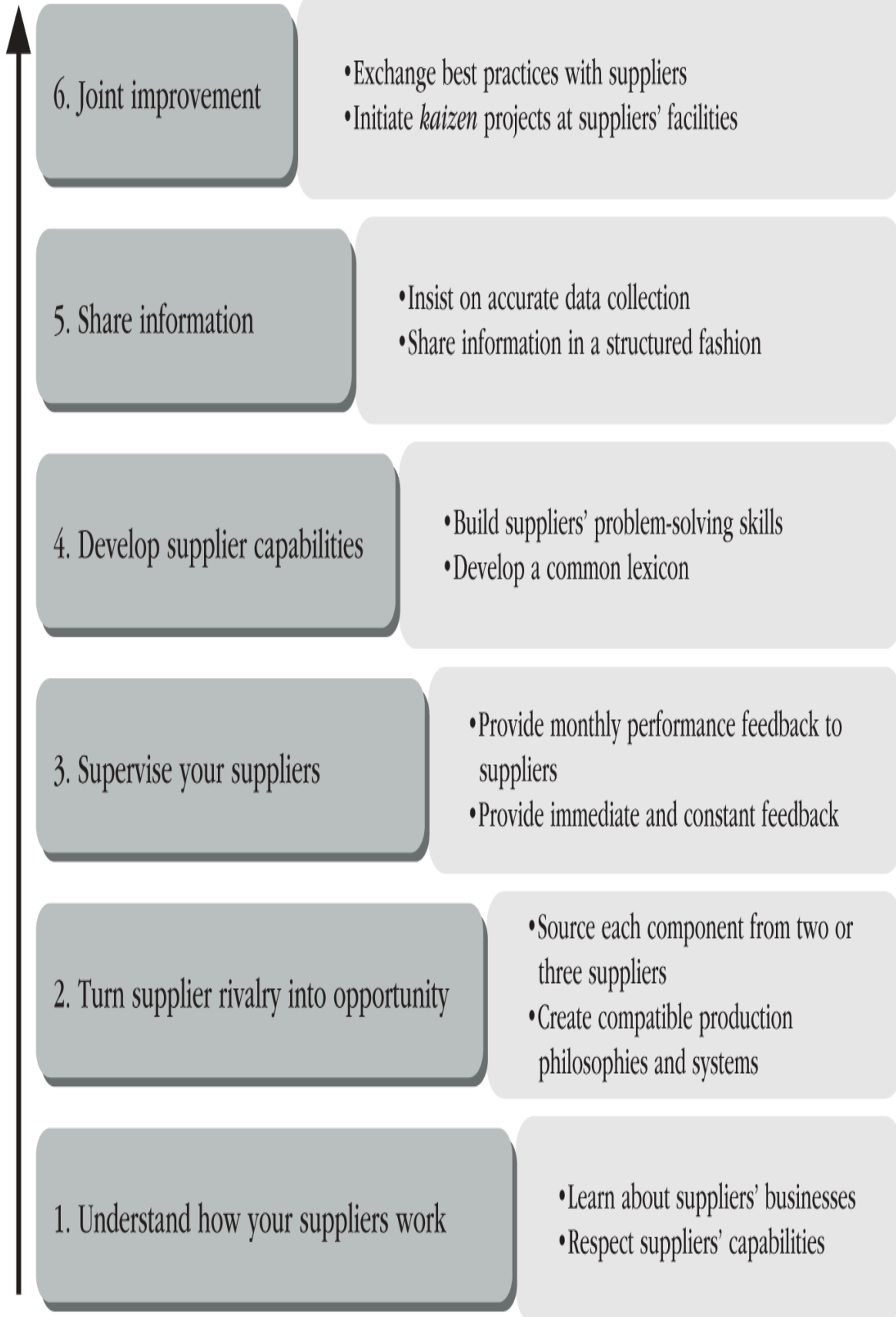


FIGURE 11.8 Steps in developing a keiretsu partnership.⁶

Questions often arise when the parties do not contribute in the same way. For example, if one party contributes ideas, and the other party contributes money or physical effort, how should these contributions stack up? How long will the parties remain involved? What dispute resolution procedures will the parties use in case of disagreement?

A good example of the need for partnership agreements is offered by Steve Hind, a former AP Middle East Correspondent, and Tom Potter, a banker, who both quit their day jobs and cofounded the Brooklyn Brewery in New York in 1987. Today, the Brooklyn Brewery is one of the top 40 breweries in the United States and was ranked 20th on the list of the top 50 brewing companies in the United States, as of April 2023. These two partners explain in their book—called “Beer School”—that it is not sufficient to agree to become partners.

“Even a dog can shake hands,” they say.⁷ At the beginning of their partnership they made sure to “draw up a partnership agreement that defined the agreement financially and also defined a buy–sell agreement, in case one of us wanted out or in case of disputes. Over the years, I saw many partnerships dissolve into chaos. They had shaken hands at the beginning, but there was nothing on paper to define what that meant.”

Agreeing to be bound by a formal contract too early in the relationship can create its own set of problems. The businesses must understand one another's capacity to contribute to the success of the supply chain, not simply take one another's word. Like in human relationships, it is important for the parties in a supply chain relationship to know one another before getting too serious.

Concept Check Questions

166. Creating a business relationship is usually accompanied by excitement and a sense of opportunity.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

167. Litigation costs are fairly low.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

168. Agreeing to be bound by a formal contract too early in the relationship can create its own set of problems.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Diluting Power

It is not uncommon for companies to seek a partner for additional capital, business connections, or managerial skills or to share expenditures. These resources do not come for free. Often, they are offered in exchange for a portion of ownership, control, or some type of decision-making power. Power is a limited resource that must be divided carefully. Giving too many people decision-making power can lead to a “tragedy of the commons,” an expression used to describe situations where resources are not utilized efficiently because too many people exercise control over them simultaneously.

John Mautner founded a successful glazed nut store, Nutty Bavarian, in Florida. Within four years, he was running 20 retail outlets and wanted to expand to 200. However, like many business owners seeking to expand, he lacked sufficient capital to do so on his own. That is when he made a big

mistake. He sold half of the ownership rights to his company for \$1 million. The mistake was not in the price but in the percentage. When two people have an equal say, it is difficult to break the tie in case of disagreement. This is true of any supply chain relationship.

For three years, Mautner and his new partner fell into conflict over and over again, from where to locate new storefronts to which strategy to utilize going forward. “With a 50–50 partnership, no one could make a call,” he says.⁸ Mautner's solution was to sell his interest in the company to his partner and try a different approach. Now, Mautner abides by the principle of never relinquishing majority ownership. The lesson for everyone is to avoid 50–50 partnerships unless you are in perfect harmony with your partner, which is an empty set.



Empowering Entrepreneurs Box

Relationship management is probably the most important aspect of SCM for small firms and startups. It affects all areas of the supply chain and can mean the difference between success and failure. Staying in close touch with a range of entities—customers, suppliers, vendors, and investors—is critical. Small firms are on a tight budget for advertising and developing close relationships can play a huge role in growing the business through referrals. This is especially important in today's interconnected technology world where business offerings are increasingly becoming commoditized. There is also a general awareness that business ratings can be inaccurate, old, or corrupt. This means that “word of mouth,” such as a recommendation from a current client or vendor, is more important than ever for building a business and reputation. It can also help in other areas of the business, such as in developing other partnerships, getting other vendors on board, recruiting talent, and gaining investors.

One key element of successful relationship management is that all relationships are not created equal. Recall that in [Chapter 9](#), we discussed that all inventory items in the supply chain are not of equal importance. Some are very important to the business (e.g., specialized surgical equipment), while others are commodity items (e.g. stationary). In [Chapter 9](#) we discussed the ABC classification for measuring the level of importance. The same classification can be used for segmenting supply chain partners. Recall that based on Pareto's law, roughly 20% of items are most important—these are considered “A” items. For entrepreneurs and founders, it is important to apply the same logic to classifying all their relationships. For the most important contacts—the “A” contacts—entrepreneurs need to develop a plan for frequently reaching out and developing the trust-based relationships discussed in this chapter. An entrepreneur may also want to think about how they go about building this relationship. This may mean specifying exactly how they interact (e.g., regular face-to-face meetings vs telephone calls), outlining detailed methods of communication and transparency, and how often they reach out (e.g., maybe even having a calendar reminder). Although classifying relationships is important for all firms, as discussed in this chapter, it is especially important for small businesses as they are vulnerable given their

small size, tight budgets, and need for growth. For a business founder, relationship management across all elements of the supply chain is one of the most important issues to manage.

Concept Check Questions

169. It is rare for companies to seek a partner for additional capital, business connections, or managerial skills or to share expenditures.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

170. Giving too many people decision-making power can lead to a “tragedy of the commons.”

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

171. 50-50 partnerships are the best approach.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

CHAPTER HIGHLIGHTS

All supply chain relationships are not of equal importance. Supply chain relationships fall into four categories: nonstrategic transactions, contractual, partnerships, and alliances. Nonstrategic transactions are cost-based and do not require relationship management. More comprehensive relationships, such as alliances, require greater attention to relationship management. The keiretsu model is relevant to developing long-term, mutually beneficial outsourcing relationships.

Supply chain relationships should be developed and managed based on trust rather than power exploitation. This improves short-term performance and long-term profitability while helping both companies continuously improve. Trust-based relationships are developed by assessing the value of the relationship, identifying operational roles played by each business unit, negotiating effective contracts, and designing effective conflict-resolution procedures.

Five potential sources of conflict may arise in supply chain relationships: relationship conflicts, data conflicts, interest conflict, structural conflicts, and values conflicts. Turning conflicts into opportunities as they arise between organizations in a supply chain is a highly valuable managerial skill.

Prepare for negotiations by studying the business of the counterparty, identify who has the most leverage, and think about underlying interests. Try to create value and improve supply chain performance through enhanced relationships. Although some situations will require distributive tactics, always look for integrative potential.

KEY TERMS

[Scope](#)

[Criticality](#)

[Contractual](#)

[Relational](#)

[Design phase](#)

Management phase

Sequential interdependence

Reciprocal interdependence

Relationship conflicts

Data conflicts

Interest conflict

Structural conflicts

Values conflicts

Position

Interest

Integrative opportunities

Distributive opportunities

Adversarial negotiators

Problem-solving negotiators

Anchoring effect

The norm of reciprocity

Rejection-then-retreat

Keiretsu

DISCUSSION QUESTIONS

How are supply chain relationships similar to and different from personal relationships?

Can you think of a conflict between units in a supply chain in real life? What kind of conflict was it? How was it resolved? Would you have resolved it differently?

Identify examples of a supply chain where relationship management is not very important. Identify examples of a supply chain where relationship management is crucial.

Do you perceive yourself as a competitive or problem-solving negotiator? Can you think of situations where you may have to adopt a different negotiation style?

Case Study Lucid v. Black Box

Lucid is an up-and-coming Chilean distributor of home entertainment technology. Black Box is a well-known television manufacturer headquartered in the United Kingdom. Black Box was interested in reaching out to the South American market and found Lucid to be sufficiently well connected to reach customers throughout the continent. In January of 2008, Lucid signed an exclusive three-year contract to establish a distribution network for Black Box high-resolution flat screen televisions throughout South America using Black Box's logo. The contract included the following provisions:

1. Lucid has the exclusive right to sell Black Box's high-resolution televisions and any updates to the high-resolution product line.
2. Lucid must establish a distribution network within the agreed region.
3. Lucid must order 4,300 high-resolution televisions or £1,000,000.00 worth of products before January 1, 2011.
4. If Lucid fails to meet these conditions, Black Box has the right to rely on other distributors within South America.
5. If either party is in breach of this contract, the nonbreaching party may terminate this agreement after three months' notice.

In August 2008, Lucid placed an order for 1,000 high-resolution television sets, but the shipment was delayed for several months with no explanation from Black Box. Lucid was frustrated because Black Box's delay in shipment caused Lucid to be late in supplying the televisions to the retailers with whom Lucid had contracted. As a result, some of these retailers terminated their agreement with Lucid before the shipment finally arrived, leaving Lucid with a surplus of high-resolution televisions and in need of new retailers.

In June 2009, Lucid placed an order for 1,000 high-resolution television sets, which arrived shortly thereafter. Lucid discovered that a few retailers had high-resolution televisions with Black Box logos in stock, despite that they were not contracting with Lucid. Lucid believed that Black Box must have contracted directly with these retailers, or perhaps relied on other distributors in violation of the exclusive contract. Either way, Lucid was

frustrated that Black Box was competing with them in their agreed-upon distribution region.

In November 2009, Black Box released a new television, the 3-D Flat Screen, and began marketing this in South America. Lucid wrote an angry letter to Black Box because Lucid believed they had the exclusive right to market updates to the high-resolution product line. Black Box replied that the 3-D Flat Screen was in a distinct product category different from the high-resolution line, so the contract did not apply.

In June 2010, Lucid was still far from reaching the minimum order requirement in the contract but felt this was due to the actions of Black Box. Then Black Box sent Lucid a termination letter that stated Lucid had failed to establish a distribution network to their satisfaction. Fed up with Black Box's poor communication and feeling as though they had been treated unfairly, Lucid executives met with their legal advisors and asked what their options were. The attorneys for Lucid say there are four options available: Lucid can litigate, arbitrate, mediate, or negotiate with Black Box to resolve this dispute.

Case Questions

1. What are the sources of conflict between Lucid and Black Box?
2. Which dispute resolution procedure should Lucid use? Why?
3. If Lucid decides to negotiate with Black Box, what kind of negotiation tactics should be employed?
4. How can Lucid and Black Box improve their supply chain relationship?

Case Study Making Decisions with Data Analytics: Buckeye Deliveries

A year ago, Ms. Cook started a meal delivery service in Columbus, Ohio called Buckeye Deliveries. The goal was to focus on the large campus of the Ohio State University and the surrounding metropolitan area. Being very thorough with her planning, she conducted a survey of 1,000 potential customers on the campus regarding their preferences for a meal delivery service. After analyzing survey responses, she learned that customers in her target market prefer receiving one meal box of fresh food daily instead of receiving six meal boxes for a week all at once, as she had been doing. Importantly, customers have expressed their willingness to pay as much as 25% extra for a daily delivery service. As a result, Ms. Cook has decided to offer a daily fresh meal service starting next month.

She just had a discussion with her delivery partner to introduce the daily service. However, Ms. Cook believes that the delivery partner is quoting a very high price for the new requirement. She has scheduled a meeting with another delivery provider next week. To prepare herself for the meeting, Ms. Cook has decided to conduct a work study of the delivery process and come up with an estimation of the cost. She also needs to make sure that her current trusted raw material suppliers will be able to fulfill the demand. She has assigned this task to you, her intern, and a graduate student at The Ohio State University.

Case Questions

1. As Ms. Cook's intern, how will you go about this assignment?
2. What recommendation can you give to Ms. Cook regarding how to manage her relationship with her trusted raw material supplier? Any suggestions on how you should present the recommendations to Ms. Cook given that you are her intern?
3. Consider that Ms. Cook finds a new delivery partner to deliver daily meals. What measures can she take to ensure that the new contract will be effective?

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Notes

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12

Global Supply Chain Management

LEARNING OBJECTIVES

After completing this chapter, you should be able to:

Describe the global supply chain environment and identify key impact factors.

Explain market and cultural challenges that impact global supply chains.

Describe global infrastructure challenges and the role of technology.

Identify key cost and noncost considerations in managing global supply chains.

Describe key political factors and nontariff barriers that impact global supply chain management.

CHAPTER OUTLINE

- **Global Supply Chain Management**
 - The Global Environment*
 - Opportunities and Barriers*
 - Factors Impacting Global Supply Chains*
- **Global Market Challenges**
 - The Global Consumer*
 - Global vs Local Marketing*
 - Cultural Challenges*
- **Global Infrastructure Design**
 - Infrastructure Challenges*
 - Labor*
 - Transportation*
 - Suppliers*
 - Role of Technology*
- **Cost Considerations**
 - Hidden Costs*
 - Noncost Considerations*
- **Political and Economic Factors**
 - Impact of Exchange Rate Fluctuations*
 - Regional Trade Agreements*
 - Impact of Nontariff Barriers*
- **Chapter Highlights**
- **Key Terms**
- **Discussion Questions**
- **Case Study: Wú's Brew Works**
- **Case Study: Making Decisions with Data Analytics: Mika Enterprises**

Bibliography



[Bloomberg Quicktake Video: Vendit Wants to Tackle Sustainable Supply Chain Solutions](#)

[Bloomberg Quicktake Video: Getting Asian Business Ready for EU Carbon Regulation](#)

India represents an important global economy and a growing opportunity for global supply chains. Between 2014 and 2018 India was the fastest-growing economy in the world. Although India's growth has since slowed down, it continues to have an expanding consumer market, a burgeoning middle class, and a growing young and highly educated population. India topped the World Bank's growth outlook for 2015–2016 with economic growth that has ranged between 8 and 5% and then 9% since 2021.

Then the Indian economy witnessed even greater growth, closing 2023 with a gross domestic product (GDP) of US\$ 3.73 trillion, GDP per capita at US\$ 2,610, and a projected GDP growth rate of 6.3% against the global average of 2.9%. An A. T. Kearney global survey rated India as a large consumer market opportunity. For that reason, many multinational companies have set up their supply chains in India.

Consider that former PepsiCo's chief executive officer Indra Nooyi, an Indian origin, said she had been investing “aggressively” in this emerging market. Retail sales of the company's products in India, including Frito-Lay potato chips, Quaker Oats, and fruit juices, rose by 13% in 2015 and have continued their growth. Other companies have also positioned themselves for this growing market hungry for outside products.

However, this opportunity also presents numerous challenges typical of managing global supply chains. Let us consider just a few of the issues involved in developing a distribution network in India.

Concept Check Questions

1. India represents an important global economy and growing opportunity for global supply chains.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

2. The Indian economy witnessed slow growth recently.\

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

3. PepsiCo does not do business in India.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Warehousing.

Warehousing, needed to store goods, is complicated in India. Most existing warehouses in India are small in size, have dirt rather than cement floors, and have little in the way of technology or material handling. Many distribution facilities are housed in structures that were designed for other purposes. For example, one of the largest pharmaceutical distributors in Mumbai runs a warehouse out on the third floor of an apartment building. There are also land acquisition issues. Even the influential domestic automaker Tata Motors had trouble getting land for a planned factory in West Bengal a few years ago. To obtain the required 997 acres, the company had to work with the state government to consult with 13,000 farmers and pay them either for their land or the rights to use their land. The farmers then protested that their compensation was too low and that some of them were being forced to sell their land. The automaker finally shifted construction to another, less-hostile region of the country. Even the big domestic retailers, such as Reliance Retail Ltd. based in Mumbai, have had similar problems. All this means that a company going into India should consider partnering with a third-party logistics (3PL) provider that already has a warehouse or land on which it can build a facility.

Labor.

Although labor is cheap in India, finding the right skills is much more complicated than expected. The largest market for logistics consulting services in India is not for designing warehouses. Rather, it is for helping teach people how to operate them. The skill gap between educated and uneducated people is much greater in India than it is in the West. As a result, U.S. companies doing business in India cannot simply follow the common practice of recruiting warehouse personnel from the less-educated tiers of society to save money. For example, some concepts and equipment considered basic to business, such as computers, are alien to the uneducated segment of the Indian population.

For that reason, it makes more sense to hire college-educated personnel, even though they may be more costly. Also, the Indian culture has historically emphasized hierarchies, which can be inhibiting to Western companies' use to an open decision-making style. Young and educated workers are more willing to adapt to this style.

Concept Check Questions

4. There is lots of modern warehouse space in India.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

5. Most existing warehouses in India are small in size, have dirt rather than cement floors, and have little in the way of technology or material handling.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Transportation.

Transportation is yet another obstacle in India. When building a distribution network, one must consider slow transit networks and insufficient infrastructure. For example, 60% of India's seaborne trade is handled by just two of the country's 12 major ports. The rail system is also constrained when it comes to freight movements. Historically, the country's rail capacity was restricted to passenger traffic, and only recently has the Indian government begun to promote rail shipments. Most commercial shipments in India are made by truck. However, the country has no large national transportation companies, and most are small trucking companies. Transit times are slow and unpredictable compared to those in Western countries. Also, technology that often is used in the West is not yet common in India. Few truck drivers have cell phones that can be used to call in shipment status, and Global Positioning Systems (GPSs) are virtually nonexistent. These are just some of the many supply chain roadblocks companies need to consider if they want to gain a foothold in India and other emerging markets. It can take years to set up a distribution network due to the complexities. However, companies will find ways to overcome them for the opportunity to serve the world's second-fastest-growing economy.

Concept Check Questions

6. Labor is expensive in India.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

7. The largest market for logistics consulting services in India is for helping teach people how to operate warehouses.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

8. Some concepts and equipment considered basic to business, such as computers, are totally alien to the uneducated segment of the Indian population.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

9. It is very hard for college-educated people to find jobs in India.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Global Supply Chain Management

The Global Environment

All organizations today operate in a global environment and are affected by global trade. Even the smallest rural farms are affected by the global influx of foreign

goods and trade regulations. Many companies serve multiple global markets, with products sourced and produced across many continents. Walmart, the world's second-largest retailer just behind Amazon, operates over 11,200 stores under 55 banners in 27 countries and e-commerce websites in 10 countries. Other multinational companies such as IBM, General Electric, Siemens, and McDonald's have a similar global reach. It is not uncommon for a company to develop a product in the United States, manufacture it in Asia, and sell it in Europe.

The rapid growth of globalization and international trade are a result of advanced transportation and information technology (IT) that have connected us across the globe, as well as a rise in personal income creating a heightened ability to buy. These forces have combined to create a global awareness and a demand for goods that translates into opportunities for companies to rapidly expand their markets.

The global trend will only continue in the future. The International Monetary Fund (IMF) announced the global economy will be growing at a steady pace, with a growth rate ranging between 3.00 and 3.6%, during the period from 2015 to 2020. According to the IMF, global growth is expected to slow from 3.5% in 2022 to 3.0% in 2023, and 2.9% in 2024. Although this is below the historical average of 3.8% from 2000 to 2019, this growth is resulting in a changing global landscape and increased competition. For you as a consumer, this means greater access to a variety of goods across the globe at competitive prices. However, what does this mean for companies and their supply chains? It means intensified and accelerated competitive pressures at all levels. It also means changes like competition. Companies that take on a global presence focus on the challenges of entering markets in other countries, whereas their markets are being opened to foreign competitors. This creates multiple levels of competition—one strategy for competing in new markets, with another strategy to guard the home turf. Companies need to prepare themselves to compete in this new environment.

In principle conducting global trade is not different from domestic trade, as they both require coordinating supply chain management activities. The primary difference, however, is that global supply chain management involves a company's worldwide focus, including diverse and globally scattered markets, production facilities, and suppliers, rather than a local orientation. It requires a well-planned, designed, and managed supply chain network. This translates into large coordination complexities and risks, which companies need to balance against the opportunities and benefits presented by global markets. Just consider the complexities of global product distribution of a soft drink beverage. In the United States, beverages are sold by the pallet via warehouse stores. In India and Southeast Asia, this is not an option, and not all cultures use vending machines. In the United States, a company would not want a high-end product to be distributed via a “dollar

store.” By contrast, in France, a product promoted as the low-cost option would easily find some success in a pricey boutique.

Managing global supply chains is complicated by the fact that numerous environmental factors must be considered. These factors fall into four categories—[economic](#), [cultural](#), [political](#), and [demographic](#)—and are shown in [Figure 12.1](#). They present both opportunities and barriers to going global and must be considered carefully. Local operations cannot simply be copied and placed globally, as Walmart found out with their unsuccessful attempt at operating in Germany a few years ago. Local culture must be well understood.

Economic	Cultural
• Natural resources	• Social structure and dynamics
• Labor	• Work ethics and productivity
• Infrastructure	• Gender roles
• Technology	• Religion and observances
• Capital	• Language
Political	Demographic
• Instability	• Population growth
• Ideology	• Age structure and health status
• Institutions	• Urbanization
• International links	• Per capita income

FIGURE 12.1 Global environmental factors.

When McDonald's expanded its operations globally, it encountered various challenges related to local preferences, cultural differences, and economic landscapes. For instance, in India, where a significant portion of the population prefers vegetarian options, McDonald's had to adapt its menu to include items such as the McAlloo Tikki burger to cater to local tastes and cultural preferences. Similarly, McDonald's faced challenges in operating in different economic environments. In countries with varying economic conditions, the pricing strategy, menu offerings, and overall business model needed adjustments to suit local purchasing power and consumer behaviors.

We look at these challenges in a bit more detail in the next section.

Supply Chain Leader's Box—Challenges of Global Culture

■ WALMART

Even giants such as Walmart can underestimate global challenges. Just consider what happened in 1998 when Walmart moved to Germany, hoping to repeat its U.S. success in Europe's largest economy. Unfortunately, things did not turn out as Walmart expected, forcing the company to close operations in Germany in 2006. The biggest mistake Walmart made was to assume it could directly apply its American approach to business to a very different culture and business environment.

The mistakes Walmart made included not understanding the market, the culture, tradition, and even labor laws. For example, Walmart did not know that American pillowcases are a different size than German ones, resulting in Walmart Germany ending up with a huge pile of pillowcases they could not sell to German customers. Also, many German shoppers did not like having their purchases bagged by others. Similar misunderstandings occurred in the work environment as Walmart's American managers pressured German executives to enforce American-style management practices in the workplace. For example, employees were forbidden from dating colleagues in positions of influence, and workers were also told not to flirt with one another. The company even attempted to introduce a telephone hotline for employees to inform their colleagues, later ruled against by a German court. Other issues included high labor costs, as well as workers who tried to resist management's demands that they felt were unjust. At one point management threatened to close certain stores if staff did not agree to work longer hours than their contracts foresaw and did not permit video surveillance of their work. As a result, Walmart Germany had several run-ins with the trade union that represents retail store workers.

Walmart's retreat from Germany cost the company about \$1 billion and it is a lesson for all companies that they must tailor their operations to local cultures and traditions when going global. For companies to be successful in a foreign market they have to know their customers and local culture well. They cannot simply force a business model that worked well elsewhere onto another country's market.

Concept Check Questions

14. Walmart is the world's largest retailer.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

15. It is not uncommon for a company to develop a product in the United States, manufacture it in Asia, and sell it in Europe.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

16. Globalization and international trade has grown slowly.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

17. Companies that take on a global presence focus on challenges of entering markets in other countries, whereas their own markets are being opened to foreign competitors.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

18. In principle conducting global trade is very different from domestic trade.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

19. Not all cultures use vending machines.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

20. Which of the following is not an economic global environmental factor?

- ☐ a) Capital
- ☐ b) Labor
- ☐ c) Per capita income
- ☐ d) Infrastructure
- ☐ e) Natural resources

Correct or Incorrect?

Clear

Check Answer

21. Which of the following is not a political global environmental factor?

- ☐ a) Social structure and dynamics
- ☐ b) Institutions
- ☐ c) Instability
- ☐ d) International links
- ☐ e) Ideology

Correct or Incorrect?

Clear

Check Answer

22. Which of the following is not a demographic global environmental factor?

- ☐ a) Urbanization
- ☐ b) Population growth
- ☐ c) Per capita income
- ☐ d) Age structure and health status
- ☐ e) Religion and observances

Correct or Incorrect?

Clear

Check Answer

23. Which of the following is not a cultural global environmental factor?

- ☐ a) Social structure and dynamics
- ☐ b) Age structure and health status
- ☐ c) Language
- ☐ d) Gender roles
- ☐ e) Work ethics and productivity

Correct or Incorrect?

Clear

Check Answer

Opportunities and Barriers

Global reach is critical to a firm's survival. Without going global, companies would be limited to just the goods and services produced within their own borders. Also, multinational firms are typically more profitable and grow faster than their domestic counterparts. Being global provides opportunities to tap into huge and growing markets, capitalize on new economic trends, and utilize technological innovations in other parts of the globe. It also enables utilizing natural resources available in other geographic areas.

Managerial Insights Box—Global Reach

When considering the importance of global reach, companies such as Apple stand out. Apple's global presence and supply chain network enables it to access diverse markets worldwide, capitalizing on economic trends and technological innovations. With manufacturing in various countries and a global distribution network, Apple achieves economies of scale and adapts products to local tastes, such as releasing different versions of its products tailored to regional preferences.

Another example is Coca-Cola, renowned for its global market presence. The company's expansive supply chain allows it to utilize natural resources from different regions, ensuring a consistent product globally while adapting flavors to suit local preferences. Coca-Cola's success hinges on its ability to navigate various markets, leveraging its global reach to tap into new and growing markets while adapting marketing strategies to align with cultural nuances.

Companies such as Amazon exemplify the benefits of a global supply chain network. Amazon's expansive reach enables it to efficiently distribute products across borders, optimizing delivery times and reaching customers worldwide. By leveraging technology and logistics, Amazon capitalizes on global opportunities, continually expanding its reach and market share.

These examples illustrate how global companies such as Apple, Coca-Cola, and Amazon leverage their global presence and supply chain networks to tap into diverse markets, adapt to local tastes, and capitalize on economies of scale while navigating the complexities of global business landscapes.

Developing a global supply chain network enables companies to achieve economies of scale in production and distribution in specific regions. Being closer to their respective markets, companies can implement good ideas quickly and target their marketing to local tastes. However, as seen in the chapter opener, numerous barriers must be overcome when going global, as listed in [Figure 12.2](#).

Opportunities	Barriers
Large market	Longer and more varied lead time
Economies of scale in production and distribution	Political risk and instability
Lower select costs (e.g., labor, marketing, and supply)	Overall cost (e.g., transportation, tariffs, and space)
Better ability to target markets	Infrastructure access (e.g., facilities, transportation, and labor)
Leverage good ideas quickly and efficiently	Exchange rate risks

FIGURE 12.2 Global considerations.

Trade on a global, or international, scale is considerably more complicated than domestic. Movement across borders, and even continents, adds numerous additional costs such as tariffs and extends the length and variability of lead time. There are time costs due to border delays, costs of transportation, and higher inventory costs due to longer transit times. There are also operational costs involved in conducting business in a different part of the world. This includes differences in labor productivity and access to labor skills, access to transportation and infrastructural support, as well as availability of technology. As seen in the case of Walmart, companies often overlook the cultural impact and traditions, as well as the legal and political differences. There are also significant risks that include political instability, as well as currency fluctuations. All these factors compound across multiple regions adding to the complexity.

Concept Check Questions

24. Global reach is critical to a firm's survival.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

25. Which of the following is not an opportunity in global considerations?

- ☐ a) Economies of scale in production and distribution
- ☐ b) Lower select costs
- ☐ c) Better ability to target markets
- ☐ d) Smaller markets
- ☐ e) Leverage good ideas quickly and efficiently

Correct or Incorrect?

Clear

Check Answer

26. Which of the following is not a barrier in global considerations?

- ☐ a) Overall cost
- ☐ b) Exchange rate risks
- ☐ c) Shorter lead time
- ☐ d) Infrastructure access
- ☐ e) Political risk and instability

Correct or Incorrect?

Clear

Check Answer

27. Trade on a global, or international, scale is considerably simpler than domestic.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

28. Movement across borders, and even continents, adds numerous additional costs.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Factors Impacting Global Supply Chains

The global environment is extremely dynamic. To compete, companies must constantly assess the global landscape. They must continuously identify new markets, anticipate competition and evaluate costs, and adjust their strategies accordingly. There are six significant factors that companies must monitor throughout the process of managing their global supply chains. They are “market and competition,” “cost, infrastructure,” “technology,” “political and economic environment,” and “culture,” which are shown in [Figure 12.3](#). Although each of these factors will not affect every industry in the same way at the same time, each factor is an important consideration. It is important for companies to always be assessing these factors and proactively reacting to them for competitive positioning. Collectively, these factors comprise a conceptual framework for managing global supply chains.

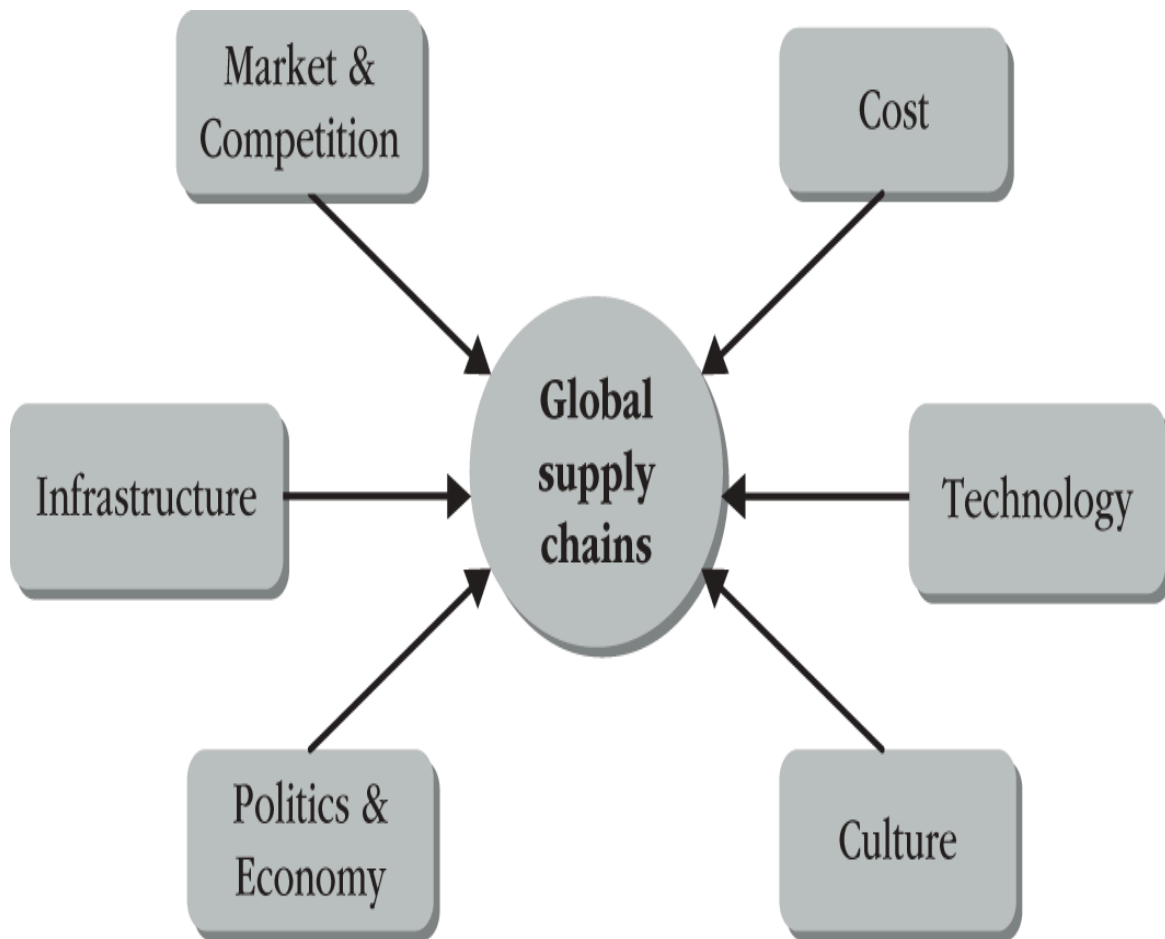


FIGURE 12.3 Factors impacting global supply chains.

Market and competition are all factors involved in marketing and selling to global markets, including considering customer preferences and competition. Customer preferences and expectations are often unique in different global regions. Companies must find ways to compete in these respective markets, whether on price, cost, or innovation. They must then develop global supply chains that enable this type of competition.

Cost is often the most cited reason by companies for going global. Often companies only consider individual costs, such as low direct labor cost, marketing cost, or perhaps local supplier cost. However, it is important for companies to consider total supply chain costs when going global. These include costs of quality, differential productivity, and design costs, as well as added logistical and transportation costs.

Infrastructure availability enables the development and functioning of the supply chain network. This includes access to roads and transportation, equipment and communication networks, distribution systems, and skilled labor. Companies developing global supply chains are often surprised as to the lack of infrastructure in developing countries. This is typically one of the biggest global challenges. The

ability to penetrate global markets depends on having global facilities and distribution and supply networks to respond to customer demands.

Technology significantly reduces time and distance, enabling global coordination and communication. Without technology, global supply chains would not be able to operate. Technology enables manufacturing innovation that allows for more efficient means of changing the product mix and the ability to serve different markets. IT, in particular, enables information sharing and collaboration across the globe. Examples of this are the availability of barcode technology, GPS, electronic data interchange (EDI), and radio frequency identification (RFID), which all enable global product tracking and communication.

Politics and economy include government regulation, political stability, formation of trade agreements, and currency fluctuations. Consider the impact on supply chain management when Europe passed environmental regulations making manufacturers responsible for returning product-packaging materials from customers. This regulation resulted in the design of entire networks for managing reverse flows of waste packaging.

Tesla's experiences in Europe and China underscore the profound impact of government regulations on supply chain management. In Europe, stringent environmental regulations required Tesla to redesign its supply chain for handling reverse logistics, ensuring compliance with directives for recycling materials from vehicles. Similarly, in China, the company adapted its supply chain to align with government initiatives promoting electric vehicles. These examples highlight how political stability, government regulations, trade agreements, and currency fluctuations significantly influence supply chain strategies, compelling companies such as Tesla to adapt and redesign their operations to comply with evolving regulatory landscapes for sustained market success.

Culture refers to acceptable behaviors, beliefs, and norms characteristic of a particular global region. This includes social structures and acceptable interactions, work ethic, observances and manners, gender roles, and adherence to formal chains of authority. Recall Walmart's experience in Germany regarding applying the American policy of employee behavior or shoppers not wanting others to bag their purchased items.



Concept Check Questions

29. _____ are all factors involved in marketing and selling to global markets, including considering customer preferences and competition.

- ☐ a) Market and competition
- ☐ b) Cost
- ☐ c) Technology
- ☐ d) Infrastructure availability
- ☐ e) Politics and economy

Correct or Incorrect?

Clear

Check Answer

30. _____ is often the most cited reason by companies for going global.

- ☐ a) Market and competition
- ☐ b) Cost
- ☐ c) Technology
- ☐ d) Infrastructure availability
- ☐ e) Politics and economy

Correct or Incorrect?

Clear

Check Answer

31. _____ enables the development and functioning of the supply chain network.

- ☐ a) Market and competition
- ☐ b) Cost
- ☐ c) Technology
- ☐ d) Infrastructure availability
- ☐ e) Politics and economy

Correct or Incorrect?

Clear

Check Answer

32. _____ significantly reduces time and distance, enabling global coordination and communication.

- ☐ a) Culture
- ☐ b) Cost
- ☐ c) Technology
- ☐ d) Infrastructure availability
- ☐ e) Politics and economy

Correct or Incorrect?

Clear

Check Answer

33. _____ include government regulation, political stability, formation of trade agreements, and currency fluctuations.

- ☐ a) Culture
- ☐ b) Cost
- ☐ c) Technology
- ☐ d) Infrastructure availability
- ☐ e) Politics and economy

Correct or Incorrect?

Clear

Check Answer

34. _____ refers to acceptable behaviors, beliefs, and norms characteristic of a particular global region.

- ☐ a) Culture
- ☐ b) Cost
- ☐ c) Technology
- ☐ d) Infrastructure availability
- ☐ e) Politics and economy

Correct or Incorrect?

Clear

Check Answer

Global Market Challenges

Companies are attracted to global markets due to the potential size of the product market, providing a company with growth and profitability. However, global markets pose several challenges. One challenge is identifying customer preferences in globally diverse regions. This is especially difficult, as customers across the globe increasingly want customization. This can result in a huge product variety that may be impossible to deliver. Another challenge is deciding how to tailor marketing strategies to fit a variety of environments and customer behaviors. Competing globally requires developing a deep knowledge of global markets and competition, as well as local traditions. Foreign markets differ culturally, and marketing or promotional strategies may have to be modified to meet local needs.

Concept Check Questions

35. Companies are attracted to global markets due to the potential size of the product market, providing a company with growth and profitability.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

36. Global markets rarely pose challenges.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

The Global Consumer

Serving global markets means meeting the needs of the global consumer. The profile of the global consumer has changed over the recent years with a greater emphasis on individualism. Consumers everywhere have higher expectations that companies are going to meet their own needs and expectations. This may be customized clothing or unique service expectations. As a result, businesses are redesigning their operations and supply chains to increasingly move from standardization to customization.

Dell caters to global consumers through a multifaceted approach that prioritizes customization, efficient distribution, localized support, diverse product offerings, and market adaptation. Their direct-to-customer model allows individuals worldwide to customize computers to their preferences, meeting the rising demand for personalized technology solutions. With an extensive global distribution network, Dell ensures prompt and reliable product delivery across diverse regions. Localized customer support centers, offered in multiple languages and time zones, cater to individual needs effectively. Dell's diverse range of products, spanning personal computers to enterprise solutions, addresses varied consumer and business demands globally. Moreover, the company adapts its strategies to align with regional preferences, regulatory demands, and cultural intricacies, allowing Dell to meet the diverse needs of consumers worldwide while maintaining a cohesive global brand identity.

This new profile of the global customer has significant implications for business. The reason is that it explodes the number of possible combinations of product features. Coupled with today's expectations of fast delivery, this can wreak havoc on a company. This means that firms must get their products to markets faster to gain a competitive advantage. This also means moving the product quicker through the design stage, through production, and then distribution. This typically requires logistics, operations, and distribution to be organized using lean systems to get the

products to customers quickly. At the same time, however, the system must maintain flexibility to be able to produce different types of products in varying quantities. This can be quite an operational challenge.

Concept Check Questions

37. Serving global markets means meeting the needs of the global governments.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

38. The profile of the global consumer has changed over recent years with a greater emphasis on individualism.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

39. Consumers have expectations of fast delivery.

- ☐ True
- ☐ False

Correct or Incorrect?

Global vs Local Marketing

Two different marketing approaches can be used when developing a global strategy. One is a [global marketing](#) approach that focuses on bringing standardization to the global market. The other is a [local marketing](#) approach that stresses microsegmentation and localized differentiation. These approaches are contradictory, but they are best used to complement one another when developing a global strategy. One approach may dominate based on the specific demands of each product and market.

Starbucks exemplifies the integration of global and local marketing strategies in its global approach. Through standardized offerings and a consistent brand experience across locations, Starbucks ensures a recognizable and cohesive customer experience worldwide. Simultaneously, the company adapts to local tastes by introducing region-specific menu items and incorporating cultural elements into store designs. This dual strategy allows Starbucks to maintain a global brand identity while catering to diverse regional preferences, striking a balance between standardization and localized differentiation within its global market strategy.

The global marketing approach assumes that there are consumers across the globe with identical needs, resulting in product standardization. The role of marketing here is to identify these consumers and the product characteristics they want. Coca-Cola is a good example of a company that has adopted a global marketing strategy. Although Coca-Cola produces many different beverages for the global market, its primary product remains unchanged. Maintaining product standardization provides many advantages for supply chain management, such as providing uniformity for distribution, sourcing, and packaging. It also makes it easier to balance supply and demand. However, uniformity in product standardization also provides challenges when implemented globally. A consistent and standardized product offered across the globe requires consistency in all global operations. This can be difficult to achieve as there are large variations in logistics, sourcing, and operations capabilities in different geographical locations. To maintain a reputation for product consistency, these capabilities must be uniformly effective, regardless of the location. For example, if a company wants to compete on offering fast and reliable parts distribution service, it must ensure it has the physical capability to provide the same service at all locations.

In contrast to global marketing, the local marketing approach focuses on the microsegmentation of customers and products. With the global customer increasingly demanding individuality, local marketing is becoming more important. The important part here is to judiciously segment the market so that it can take on a

more national or regional characteristic, and that the regions are relatively homogenous. A localized marketing approach to international business adds significant complexity to a global system. Market segments quickly multiply based on the segmentation. Companies must then ensure that they have the infrastructure to reach and serve the customers in these segments around the world.

The best way, if possible, is to merge global and local marketing approaches. Coca-Cola has done this effectively. The company offers more than 500 brands and 4,300 different products that it sells in over 200 countries and 6 operating regions. One strategy for achieving this is to use product postponement in the product design. Recall that [product postponement](#) is a strategy where the product is kept in the most generic form as long as possible in the distribution process. The product is differentiated at the last minute, depending on the product and quantities at the location needed. With a beverage it may be differentiating the product by the amount of carbonation, juice, or sweetener, thereby creating different product versions. This differentiation can take place close to the customer.

Concept Check Questions

40. Three different marketing approaches can be used when developing a global strategy.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

41. A global marketing approach focuses on bringing standardization to the global market.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

42. A local marketing approach stresses micro-segmentation and localized differentiation.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

43. _____ is a strategy where the product is kept in the most generic form as long as possible in the distribution process.

- ☐ a) Delayed completion
- ☐ b) Product postponement
- ☐ c) Delayed production
- ☐ d) Micro-production
- ☐ e) Managed production

Correct or Incorrect?

Clear

Check Answer

Cultural Challenges

Culture is an important element of global supply chain management as it is a critical element of communication. Just consider differences in the amount of acceptable interpersonal distance between individuals of different cultures, or norms of formality in addressing someone. Some cultures tend to value promptness and single-task focus, whereas other cultures do not. In Asia, product packaging is much more important than in the West, as it is seen as more of a reflection of the product itself. All these differences are attributable to culture and have a significant impact

on managing global supply chains. However, culture is especially problematic, as it can often be difficult to understand. This also includes differences in verbal communication and the use of humor, making direct translation of communication between cultures impossible. Further, specific cultural norms can be elusive, and it can be difficult to determine just how pervasive they are.

Walmart's global expansion into markets such as Japan, China, and Mexico showcases the significant impact of cultural differences on its supply chain management. In Japan, the emphasis on packaging aesthetics influenced product design and distribution methods. Cultural variations in communication styles and formality levels posed challenges to effective collaboration. Moreover, differences in work culture and attitudes toward promptness required adjustments in operational strategies. Additionally, understanding the importance of “guanxi” (social connections) in Chinese culture became crucial for Walmart in establishing and maintaining effective supplier relationships and navigating the intricacies of the local business landscape. Walmart's experience underscores the critical role of understanding and adapting to cultural nuances to navigate diverse global supply chain challenges across various international markets.

Managerial Insights Box

■ COCA-COLA'S CHINA BRANDING CHALLENGE

Creating a brand image in a different culture with a different language and word meaning is an enormous challenge for companies competing in global markets. The brand needs to create a direct connection between the product and the market, and the linguistic nuances can affect the brand's meaning. This, in turn, can affect consumer perceptions and brand identity.

Coca-Cola encountered this problem when trying to develop its brand name in China. When Coca-Cola first entered the Chinese market in 1928, it had no official representation of its name in Mandarin. The challenge was to find four Chinese characters whose pronunciations approximated the sound of the brand without producing a nonsensical or adverse meaning when strung together.

This was a challenge. Initially, shopkeepers created signs that combined characters whose pronunciations formed sounds similar to “Coca-Cola,” but they did so with no regard for the meanings of the written phrases they formed in doing so. In some cases, this resulted in unflattering, nonsensical meanings such as “female horse fastened with wax,” “wax-flattened mare,” or “bite the wax tadpole” when read in Mandarin. The company then chose *ké-kǒu-kě-lè*, which meant “can-be-tasty-can-be-happy” opting for the character *lè*, meaning “joy.”

The story exemplifies linguistic nuances that can affect brand sound and brand meaning, when creating a brand image in global markets. Companies must realize prior to entry that each market is culturally distinct and that marketing requires some degree of localization.

Five important dimensions of culture can help us understand how to conduct business in different parts of the globe.¹ These dimensions explain differences in culture and help us understand how to do business in different parts of the globe. They are summarized in [Figure 12.4](#). We look at these five dimensions of culture next.

Small vs. Large Power Distance. Power distance is the extent to which there is a strong separation of individuals based on rank. Northern Europe and the United States have cultures with small power distances, where people relate to one another more as equals. This means that the organizational setting tends to be more democratic. On the contrary, some Latin American, Arab, and Asian countries tend

to have a high-power distance where relationships are formal and based on hierarchical positions. Understanding power distance has a significant impact on managing the workplace. Recall in the opener that traditionally in India power distance is large and that older workers have a difficult time in a more democratic workplace which is more common in the West.

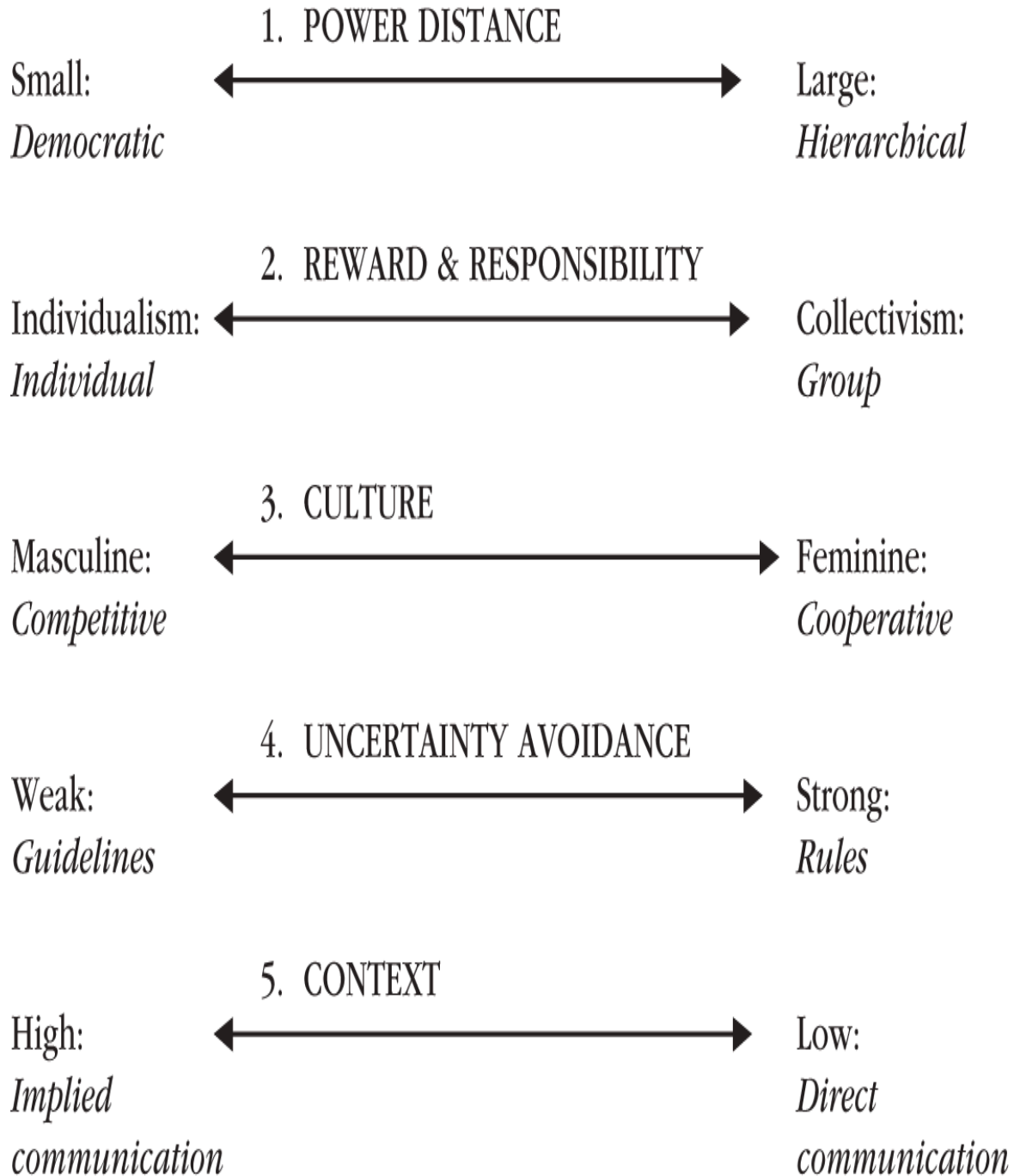


FIGURE 12.4 Dimensional differences of culture.

Toyota's global operations highlight the impact of power distance on its management approach. In regions with smaller power distance, such as Japan and parts of Europe, Toyota encourages open communication and participative decision-making. Conversely, in regions with higher power distance, like some parts of Asia and the Middle East, Toyota respects hierarchical structures and formal relationships. This adaptable approach allows Toyota to navigate diverse cultural

contexts, fostering effective communication and productive workplaces across global markets.

Individualism vs Collectivism. This dimension measures the extent to which people believe in individual responsibility and reward, rather than the reward of the group.

In individualist cultures, such as the United States, the United Kingdom, and the Netherlands, people are expected to be motivated by individual rewards. However, in collectivist cultures, such as Indonesia and West Africa, people are expected to be motivated by the benefits of the group as a whole. Understanding this dimension helps develop motivational structures for workers in different parts of the globe as well as managing teams.

Masculinity vs Femininity. Masculine cultures are defined as those that value competitiveness, assertiveness, ambition, and the accumulation of wealth. By contrast, feminine cultures are those that value relationships, harmony, the environment, and quality of life. Japan is considered a more masculine culture, whereas the Netherlands is a more feminine culture. The United States is close in the middle. Understanding these differences can be important in business negotiations and alliance building, as parties from different cultures may value different aspects of the relationship.

Weak vs. Strong Uncertainty Avoidance. This dimension refers to the degree of comfort members of a culture have with ambiguity and lack of structure. It measures the extent to which a culture prefers situations with clear rules over ambiguous situations. Cultures with strong uncertainty avoidance prefer explicit rules and are uncomfortable with ambiguity. Cultures with weak uncertainty avoidance prefer guidelines vs formal rules and informal activities. These cultures are also more tolerant of risk, such as Japan and India. The United Kingdom, the United States, and Hong Kong tolerate less risk. This has important implications for job design, work structure, and innovation. Cultures that are more comfortable with ambiguity may be more innovative in thinking “outside the box.” This dimension also has implications for employee retention rates. Employees in strong uncertainty avoidance cultures tend to stay longer with one employer, whereas in weak uncertainty avoidance, employees change employers more frequently.

High vs. Low Context Cultures. This last dimension of culture refers to the reliance on high-context over low-context messages when communicating. In high context cultures many things are left unsaid, letting the context explain the meaning. In low-context cultures, “what you see is what you get.” Here the speaker is expected to precisely make their points with limited ambiguity. This is the case in the United States and Northern Europe. By contrast, in Japan facial expressions and what is not said provide clues to what is meant. In the United States and much of

Europe, agreements are typically precise and contractual; in Asia, there is a greater tendency to settle issues based on trust and understanding. Also, “saving face”—where no one openly loses or gets embarrassed—is of utmost importance.

In high-context cultures such as Japan, where unsaid messages and contextual cues are crucial, communication tends to be more implicit. This can pose challenges in supply chain negotiations and collaborations with Japanese counterparts, as crucial information might be implied rather than explicitly stated. In contrast, low-context cultures such as the United States prioritize explicit communication, which can affect how agreements and contracts are approached within the supply chain.

Differences in high context (such as Japan) and low context (such as the United States) communication styles significantly impact supply chain negotiations. High-context cultures rely on implicit cues and non-verbal communication, leaving much unsaid and emphasizing trust. In contrast, low-context cultures prioritize explicit communication and contractual agreements. Understanding these differences is crucial for effective cross-cultural negotiations in supply chain management, as misinterpretations can arise due to varied expectations in communication styles, which may affect agreements and conflict resolution processes.

These dimensions of culture explain key differences in behaviors and expectations. Their understanding is essential for successful global supply chain initiatives, which are based on communication. Managers must understand these differences and keep them in mind as they conduct negotiations, collaborate, and build rapport with members of their supply chain across the globe.



Concept Check Questions

44. _____ is the extent to which there is a strong separation of individuals based on rank.

- ☐ a) Power distance
- ☐ b) Individualism vs. Collectivism
- ☐ c) Masculine
- ☐ d) Feminine
- ☐ e) Avoidance

Correct or Incorrect?

Clear

Check Answer

45. This dimension measures the extent to which people believe in individual responsibility and reward, rather than the reward of the group.

- ☐ a) Power distance
- ☐ b) Individualism vs. Collectivism
- ☐ c) Masculine
- ☐ d) Feminine
- ☐ e) Avoidance

Correct or Incorrect?

Clear

Check Answer

46. _____ cultures are defined as those that value competitiveness, assertiveness, ambition, and the accumulation of wealth.

- ☐ a) Individual
- ☐ b) Collective
- ☐ c) Masculine
- ☐ d) Feminine
- ☐ e) Avoidance

Correct or Incorrect?

Clear

Check Answer

47. _____ cultures are those that value relationships, harmony, the environment, and quality of life.

- ☐ a) Individual
- ☐ b) Collective
- ☐ c) Masculine
- ☐ d) Feminine
- ☐ e) Avoidance

Correct or Incorrect?

Clear

Check Answer

48. This dimension refers to the degree of comfort members of a culture have with ambiguity and lack of structure.

- ☐ a) Individual
- ☐ b) Collective
- ☐ c) Masculine
- ☐ d) Feminine
- ☐ e) Avoidance

Correct or Incorrect?

Clear

Check Answer

49. In high context cultures many things are left unsaid.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Global Infrastructure Design

Infrastructure Challenges

A successful global presence is dependent on having a physical supply network capable of responding to customer demands. The decisions that are involved in developing and managing the physical aspects of the network are referred to as infrastructure. This includes access to roads and transportation, organizational facilities, availability of skilled labor, systems for operations and distribution planning, quality of materials, and availability of suppliers. One of the biggest challenges for companies setting up global supply chains are the significant differences in infrastructure in developing countries. Companies often overlook the substantial deficiencies in infrastructural resources when they begin doing business in developing countries and often encounter significant challenges.

Coca-Cola, renowned for its extensive global supply chain network, encountered substantial infrastructure challenges when expanding its operations in various African countries. In nations like Nigeria, Kenya, and Ghana, Coca-Cola faced significant deficiencies in infrastructure crucial for efficient supply chain management.

Transportation networks posed a challenge due to inadequate road infrastructure and unreliable supply routes, leading to delays in product distribution. This impacted Coca-Cola's ability to reach remote or rural areas efficiently, affecting market penetration and timely deliveries. Moreover, the lack of reliable electricity supply in some regions affected manufacturing operations, distribution centers, and refrigeration systems necessary for storing perishable products. This not only increased operational costs but also affected the quality and shelf life of Coca-Cola's beverages. As a result, Coca-Cola had to invest significantly in developing its infrastructure, including building distribution centers, improving transportation networks, and investing in alternative energy solutions such as solar power, to overcome these challenges. These efforts were crucial to ensure a reliable and efficient supply chain in these regions, underscoring the importance of addressing infrastructure deficiencies when setting up global supply chains in developing countries.

Concept Check Questions

50. A successful global presence is dependent on having a physical supply network capable of responding to customer demands.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

51. A fairly minor challenge for companies setting up global supply chains are the significant differences in infrastructure in developing countries.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Labor

Access to low-cost labor has been a primary draw for companies setting up global operations. A good example of this has been seen when looking for engineering talent. The availability of low-cost, high-quality engineers in some developing countries has been a significant factor contributing to location decision of research and development (R&D) facilities. Taiwan has been a primary location for firms looking for mechanical and electrical engineers, whereas India has been the primary source of software engineering talent. In contrast, the United States produces only 7% of engineers globally, driving many U.S. firms to locate their facilities offshore, closer to a large supply of this low-cost, high-skill talent.

Intel, for example, strategically established multiple R&D centers in various countries based on the availability of specialized engineering talent. In India, Intel set up R&D facilities to tap into the vast pool of software engineering talent. Recognizing India's strength in software development, Intel leveraged this by establishing software-focused R&D centers to develop innovative software solutions and technologies.

Similarly, in Taiwan, Intel recognized the availability of skilled mechanical and electrical engineers. Taiwan's reputation for producing high-quality engineers in these domains led Intel to establish R&D facilities focused on hardware and engineering innovations. These centers aimed to harness Taiwan's expertise in hardware development, including chip design and electronics. Furthermore, considering the global distribution of engineering talent, Intel's location decisions were also influenced by the need to diversify its R&D operations. For instance, while India excelled in software engineering, Taiwan's strength lay in hardware engineering, providing Intel with a balanced global portfolio of engineering capabilities across different domains.

This strategic placement of R&D facilities in countries such as India and Taiwan allowed Intel to access specialized engineering talent pools, fostering innovation and technological advancements across various areas of their semiconductor business.

As we can see, having access to affordable and highly trained technical workers provides firms with significant capability. However, there are often many challenges in achieving successful performance. First, there are typically significant productivity differences between laborers in other countries. This includes speed of work, precision, and quality, as well as acceptable work hours. Companies cannot simply translate labor productivity from one region to another. Second, there are often large variations in labor skills and capability. This can make it difficult to place comparable facilities in different parts of the globe. Lack of labor skills may require altering the production processes or the ability to use certain technologies. For example, there has been a growing use of numerically controlled machines in production processes in South American countries due to the difficulty in finding an adequate supply of trained machinists. The result has been an increased reliance on technology as a substitute for skilled labor.

Concept Check Questions

52. Access to low-cost utilities has been a primary draw for companies setting up global operations.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

53. Having access to affordable and highly trained technical workers provides firms with significant capability.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

54. There are typically significant productivity differences between laborers in other countries.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

55. Companies can simply translate labor productivity from one region to another.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Transportation

Access to roadways and transportation can often be poor in developing countries. These weaknesses in transportation infrastructure can increase the length and variability of distribution lead times. Distribution channels in developing countries can be long and unpredictable. Often the product changes hands many times before reaching the final consumer using different modes of transportation. This may result in high variability in shipping times, uncertainty in delivery lead time, and higher distribution costs. For example, in Russia the primary cause of food shortages is poor distribution. There is ample production, but the difficulty is in distributing the food to all the locations needing it. For this reason, when McDonald's went into Russia, it organized its distribution system with its trucks.

When McDonald's expanded into Russia, it encountered substantial issues related to the country's transportation infrastructure, particularly in distribution. Russia faced food shortages despite ample production due to challenges in efficiently distributing goods to various locations across the vast territory.

Recognizing the transportation inefficiencies and the unreliability of existing distribution channels, McDonald's opted for a strategic solution. To ensure a steady supply chain and maintain quality standards, McDonald's established its distribution system, leveraging its fleet of trucks. By organizing its distribution network, McDonald's could better control the transportation and delivery of its products to various locations in Russia. This allowed the company to manage the unpredictability of shipping times, reduce uncertainty in delivery lead times, and maintain consistent product availability in its outlets.

McDonalds proactive approach in setting up its distribution system highlights the significance of addressing transportation challenges in developing countries. This strategic move not only ensured a steady supply chain but also contributed to overcoming food distribution issues prevalent in Russia, demonstrating the importance of a robust distribution network in sustaining operations in challenging infrastructure environments.

Concept Check Questions

56. Access to roadways and transportation can often be poor in developing countries.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

57. Distribution channels in developing countries can be long and unpredictable.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Suppliers

Designing a global supply chain requires important decisions regarding the number of suppliers and their geographic locations. In general, it is easier to manage fewer suppliers. However, this can create delivery risks due to high dependence on a few suppliers. It also provides less flexibility if sudden excess capacity is needed. Finally, managing numerous and diverse suppliers across the globe can be a daunting task for companies.

Companies are often attracted to foreign suppliers due to substantially lower prices without considering factors such as quality and delivery. It is not uncommon to receive a lower bid without comparable quality from suppliers in developing countries. Lack of availability to high-quality reliable suppliers can be a surprise. This can result in supply shortages and irregular schedules. These then create uncertainty throughout the supply chain and result in everyone keeping higher levels of inventory. In addition, global supply chains sometimes encounter material shortages of certain imported raw materials due to import restrictions. The result may be the unexpected need to redesign production processes to use less of the restricted material.

Companies have become very creative in developing approaches to overcome supply problems. For example, when McDonald's first went into Russia, it faced significant problems as it did not have high-quality reliable Russian suppliers for its restaurant operations. The company finally realized that it would have to control

almost all aspects of the supply chain to ensure the quality and reliability it needed. As a result, they utilized a vertical integration strategy by developing their own plant and distribution facility for processing meat patties, producing French fries, preparing dairy products, and baking buns and apple pies. They even grew their potatoes to have product consistency.

Big Data Analytics Box—Supplier Risk

■ CISCO

Success of supply chains requires a reliable global supply network. However, such a global network has risks. Given the high dependence on suppliers, companies need to evaluate supplier performance and risk on a routine basis. Supplier risk analytics are still underdeveloped compared to other supply chain areas. However, big data analytics can significantly improve supplier risk assessment.

One example of the use of big data analytics is the creation of a supplier resiliency score, which can use many variables to identify high-risk areas. These variables can be determined based on managerial expertise and understanding of the problem areas. An example would be the high risk of weather events near a supplier's manufacturing location or the availability of alternative production sites. If the variables or the overall resiliency scores suggest a problem, companies can then pursue alternative sourcing or work with existing suppliers to identify contingency plans or alternative locations. Cisco is a case in point of a company effectively using a supplier resiliency scorecard. The company faces significant risks, as most of its manufacturing activities are outsourced. As a result, the company relies on a resiliency scorecard that includes four categories—manufacturing resiliency, supplier resiliency, component resiliency, and test equipment resiliency. The scorecard identifies areas with the highest risk and helps Cisco take action to remedy the potential problem.

Concept Check Questions

58. Designing a global supply chain requires important decisions regarding the number of suppliers and their geographic locations.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

59. In general, it is easier to manage fewer suppliers so that backups are available.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

60. Companies are often attracted to foreign suppliers due to substantially lower prices.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Role of Technology

IT is the tool that has broken down the barrier of distance between companies and geographic regions. Just consider the use of the Internet, barcodes, and RFID technology that enhance the speed and accuracy of information shared. Reliable and uninterrupted communication is essential for the functioning of a global firm. However, it is also something we often take for granted. Some geographic regions

do not even have something as simple as reliable phone service. This means that information on supply and demand will not be readily available. This also means that collaboration between members of the supply chain will be difficult. Under these conditions, a company will have to make a substantial investment in communication technology and must factor this cost into the location decision.

AI and Analytics Box: Amazon's Utilization of Information Technology

Amazon heavily relies on advanced IT tools to break down geographical barriers and facilitate global operations. The company's robust use of the Internet, barcoding systems, and innovative logistics technologies epitomizes the utilization of IT in supply chain management. Let us have a look at the following on how Amazon does this:

Efficient Communication and Information Sharing: Amazon's extensive use of the Internet and cutting-edge communication systems allows for seamless and uninterrupted information flow across its global supply chain network. From real-time inventory tracking to automated order processing and shipment tracking, Amazon's IT infrastructure ensures accurate and rapid data exchange across different geographic regions.

Supply Chain Flexibility and Mass Customization: Amazon's emphasis on innovative manufacturing technology and logistical systems allows the company to swiftly adapt to changing market demands. Through sophisticated manufacturing technologies and distribution centers equipped with automated sorting and packaging systems, Amazon efficiently caters to mass customization requirements and shorter product life cycles, offering a diverse range of products to global consumers.

Enhanced Distribution and Delivery: Amazon's utilization of cutting-edge equipment technology, such as advanced robotics and automated warehouses, streamlines its distribution process. These technologies optimize inventory management, order fulfillment, and last-mile delivery, ensuring timely and reliable delivery of a vast array of products to customers worldwide.

Amazon's strategic investment and integration of IT into its supply chain operations have been instrumental in overcoming geographic barriers, enhancing communication, enabling mass customization, and ensuring efficient product distribution across global markets. This exemplifies the transformative power of technology in facilitating global supply chain management.

In addition to IT, [manufacturing technology](#) is needed to provide flexibility to manufacturing processes necessary for mass customization. This enables companies to serve many markets. Recall that today's global markets are characterized by product diversity as customers want greater product customization. In addition,

product life cycles are short, requiring ever-faster product introductions. Without innovative and flexible manufacturing technology, companies would not be able to produce the large product varieties needed to compete in diverse global markets that change rapidly.

Another important technology is [equipment technology](#) used to transport and distribute products to different markets. These technologies have sped up the distribution process and made it much more reliable. These technologies coupled with information technology to enhance communication have enabled companies to produce large product varieties delivered efficiently to global markets.

Concept Check Questions

61. _____ technology is the tool that has broken down the barrier of distance between companies and geographic regions.

- ☐ a) Internet
- ☐ b) Management
- ☐ c) Manufacturing
- ☐ d) Information
- ☐ e) Equipment

Correct or Incorrect?

Clear

Check Answer

62. _____ technology is needed to provide flexibility to manufacturing processes necessary for mass customization.

- ☐ a) Internet
- ☐ b) Management
- ☐ c) Manufacturing
- ☐ d) Information
- ☐ e) Equipment

Correct or Incorrect?

Clear

Check Answer

63. _____ technology is used to transport and distribute products to different markets.

- ☐ a) Internet
- ☐ b) Management
- ☐ c) Manufacturing
- ☐ d) Information
- ☐ e) Equipment

Correct or Incorrect?

Clear

Check Answer



Cost Considerations

Companies are often attracted to global operations by lower labor costs, especially in underdeveloped or emerging nations. Although local labor costs may be significantly lower, companies must consider the overall costs of doing business globally. Often companies find overall operations costs to be significantly higher than expected. This may include higher transportation and distribution costs, cost to upgrade facilities and technology, as well as cost of space, tariffs, taxes, and other expenses related to doing business overseas. We look at these costs next.

Concept Check Questions

64. Companies are often attracted to global operations by lower labor costs.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

65. Lower labor costs are the only cost consideration of doing business globally.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Hidden Costs

The strategy of going after lower labor costs in developing nations became especially popular with U.S. manufacturing firms in the 1980s, in response to their markets becoming flooded with low-priced imports. To compete, companies began to outsource the manufacture of goods to global sites with low-cost labor. This strategy became especially popular in the assembly of electronic devices, such as computers and cell phones. It has also been popular in the retail industry in the manufacture of clothing.

Seeking low-cost labor has made sense in situations where product life cycles are short, such as the frequent changes in models of cell phones. The alternative to cheap labor would require the building of an expensive assembly plant, and the cost may not be justified for product models that change frequently. However, often the strategy of chasing low labor cost across the globe is a poor one for the following reasons. First, labor cost often constitutes a small percentage of overall cost. Second, locations of cheap labor change and shift over time, often after facilities have been put in place. This can leave companies with facilities and higher labor costs than originally planned. For example, Korea and Taiwan were cheap labor wage countries in the 1970s, Thailand in the early 1980s, then China in the 1990s. China continues to lead in low-cost labor, but preference is increasingly moving into rural China and Western China, away from the seaport. Third, companies often find that there are numerous hidden and unexpected costs in going global. Fourth, competitive priorities other than costs are increasingly becoming important, and

achieving success on those dimensions may not be optimal at locations with low-skilled labor and poor infrastructure. Just being driven by labor costs can be misleading.

There may also be unexpected costs of additional training requirements due to a lack of skilled workers. Companies are often surprised to find that workers in developing nations often lack rudimentary education. This can result in high costs due to poor quality of work, lower productivity, and a lack of quality culture among workers. Other problems include increased lead times and associated inventory costs due to poor transportation and communication infrastructure, and unexpected logistics complications due to multilevel and bureaucratic government structures.

Many firms have found that the hidden costs of outsourcing to developing nations can be hard to estimate. Nike learned this lesson in the 1980s with numerous start-up problems at a new production facility in China. In 1981, Nike began shoe production in China, but by 1984, production was well below expectations. The reasons were China's economic structure, a very uneducated labor force, and an unexpectedly poor transportation and communication infrastructure. Also, often ignoring cultural incompatibilities between the firm's management and local workers can easily erode cost savings due to turnover and failures in productivity and quality.

Concept Check Questions

66. The strategy of going after lower labor costs in developing nations became especially popular with U.S. manufacturing firms in the 1960s.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

67. Seeking low-cost labor has made sense in situations where product life cycles are long.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

68. Labor cost often constitutes a small percentage of overall cost.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

69. Locations of cheap labor change and shift over time.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

70. Many firms have found that the hidden costs of outsourcing to developing nations can be hard to estimate.

- ☐ True
- ☐ False

Correct or Incorrect?

[Clear](#)[Check Answer](#)

Noncost Considerations

For many businesses, the order winners in their product markets have shifted beyond just cost toward other considerations, such as quality, delivery speed, product design, and customization. To compete on these dimensions, companies need superior quality of labor, productivity, transportation, telecommunications, and a supplier infrastructure. These factors become more important in determining the location of facilities than merely labor costs.

The total quality management (TQM) movement is one development that has contributed to the awareness of noncost considerations. TQM brought about a focus on the total cost of quality—rather than just direct labor cost—and had shifted from inspection to prevention. Companies began to understand that activities conducted prior to production, such as product design and worker training significantly impacted overall costs. The costs of poor design, poor material quality, defects, scrap, and poor workmanship were all measurable and added to the total cost. These realizations placed access to skilled workers and quality suppliers high on the priority list for firms competing on quality. Lack of worker skills, inadequate transportation and communication infrastructure, and low-quality supply are ultimately extremely costly for the implementation of a global supply chain.

Samsung is a prominent electronics manufacturer that places a strong emphasis on noncost factors in its global manufacturing strategy. The company prioritizes innovative product design, investing significantly in R&D for cutting-edge devices. Samsung's commitment to sleek design, technological advancements, and robust quality control measures underscores its dedication to design innovation and product excellence. The company maintains stringent quality standards across its manufacturing processes, collaborates closely with suppliers to ensure high-quality components, and implements TQM principles for continuous improvement. Samsung's focus on delivering quality products and exceptional customer experiences has contributed to building a strong brand reputation and fostering consumer trust worldwide.



Managerial Insights Box—Beyond Cost

■ BMW

There are many benefits to maintaining geographic proximity to customers, particularly in markets where customers demand high customization and fast delivery. For this reason, BMW chose to locate its state-of-the-art plant in Leipzig, Germany, right in the center of its market. The company chose to equip the facility, which opened in 2005, with numerous innovations to give BMW the ability to customize cars very late in the production process. Then in 2014, it rolled out its 1.5 millionth vehicle. Rather than cost, BMW's customers want quick delivery and the possibility of changing their orders “after” they have placed them. What they usually want is to add more optional equipment—a very high margin and lucrative business for BMW. To accommodate its customers, the Leipzig plant is designed to both reduce delivery lead time and increase the possibility of modifying the order after the car is actually put into production. The Leipzig plant is one of the most modern and sustainable in the world. This enables BMW to be responsive to the latest changes in the market and compete on flexibility.

The flexibility of BMW's factories allows for huge variations on basic models that would be virtually impossible for any other automaker. At the Leipzig plant seemingly random parts—ranging from dashboards and seats to axles—snake onto overhead conveyer belts to be lowered into the assembly line in precise sequence according to customers' orders. BMW buyers can select everything from engine type to the color of the gear-shift box to a seemingly limitless number of interior trims. They can then change their mind and order a completely different configuration in as little as five days before production begins. Customers have loved the flexibility with roughly 170,000 changes being placed per month. There are so many variations that line workers assemble the same car only about once every nine months.

That level of individualization would be impossible to achieve at most automakers due to the complexity and cost. However, BMW has emerged as a sort of anti-Toyota. Whereas Toyota excels in simplifying, BMW excels in mastering complexity and tailoring cars to customers' tastes. That is what differentiates BMW from Lexus and the rest of the premium pack. “BMW drivers never change to other brands,” says Yoichi Tomihara, president of Toyota Deutschland, who concedes that Toyota lags behind BMW in the sort of customization that creates emotional appeal.

In addition to cutting-edge technology and facilities, this level of innovation comes from a highly inclusive culture. Ideas flow from the bottom up, which helps keep BMW's new models fresh and edgy year after year. Young designers in various company studios, from Munich headquarters to DesignWorks in Los Angeles, are constantly pitted against one another in heated competitions. Unlike many car companies, where a design chief dictates a car's outlines to his staff, BMW designers are given only a rough goal but are otherwise free to come up with their best concepts.

Inclusion in design and production extends to suppliers. The facility has a large building for its major suppliers to set up shop within walking distance of the assembly line. This proximity allows the suppliers to react quickly to changes in the production schedule. A sophisticated IT system connects the factory to its suppliers, distribution channels, and BMW sales offices and dealers to keep everyone abreast of the latest changes. The goal is to reduce the lead time for customers in Germany to 10 days and allow them to modify their orders even within that period.

Concept Check Questions

71. For many businesses the order-winners in their product markets have shifted beyond just cost toward other considerations.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

72. The total quality management (TQM) movement is one development that has contributed to the awareness of low-cost considerations.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

73. Lack of worker skills, inadequate transportation and communication infrastructure, and low-quality supply are ultimately extremely costly for the implementation of a global supply chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Political and Economic Factors

Decisions to develop and manage a global supply chain network must consider the global political and economic environment. This environment is increasingly complex and turbulent and must be evaluated continually. Political instability and hostility toward foreign businesses is a serious consideration. Currency rate fluctuations can help or hurt global operations and require careful analysis.

[Regional trade agreements](#), such as NAFTA, and [trade protection mechanisms](#), such as tariffs and trigger price mechanisms, also influence the decision to globalize operations. These factors can either significantly ease global operations or create large barriers and must be carefully considered. Let us look at some of these in a bit more detail.

During the US–China trade tensions in 2019, Nike was affected by increased tariffs on imported goods from China, impacting its production costs. These external factors posed continual challenges for Nike's supply chain management, necessitating strategic adjustments to navigate the complex global economic and political environment.

Concept Check Questions

74. Decisions to develop and manage a global supply chain network must consider the global political and economic environment.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

75. Currency rate fluctuations always hurt global operations.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

76. NAFTA is a trade protection mechanism.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Impact of Exchange Rate Fluctuations

Imagine you are visiting Europe and want to purchase a cup of coffee priced at 3.00 euros at the coffee shop. Then you realize that you have to pay 3.60 in U.S. dollars for that coffee, as the exchange rate is 1.20. Suddenly you may find the coffee is a bit more expensive than you thought. This is the same problem supply chain managers encounter with fluctuating currency exchange rates. They can find themselves in a financial situation where their purchasing power is diminished overnight.

The exchange rate between two currencies specifies how much one currency is worth in terms of the other. For example, the exchange rate between the European euro and the United States dollar has fluctuated over the past 10 years from one euro being equal to 0.825 dollars (in October 2000) to 1.285 (in February 2004) to 1.40 (in November 2010) to 1.12 (in September 2016)—and then stayed at 1.12 (in 2019 and 2020).

This means that in 2010 you needed 1.40 dollars to equal one euro whereas in 2020 you needed 1.20 dollars. Then in March 2024, the exchange rate of euro to US\$ dropped down to 1.09 US\$ again changing these values.

Similarly, the value of the Japanese yen has fluctuated in the range of 80–140 yen per dollar. Then in March of 2024, the exchange rate of US\$ to yen has been increased to 149 yen.

These fluctuations occur continually and can last for months or years. Small fluctuations are expected and do not have a large impact. However, large fluctuations can have huge implications for global operations. It means that the ability to purchase in the currency you possess is suddenly diminished with no fault of your own. Supply chain managers have to include these fluctuations in their management strategies, and there are certain strategies they can use to help minimize their exposure to these risks.

One strategy to minimize risks of exchange rate fluctuations is to maximize operational flexibility. This can be accomplished by diversifying production geographically using global sourcing networks. By diversifying geographically, a company can shift more of its production to facilities and suppliers that are located in a lower-cost area when local currencies shift. For example, if the local currency tends to be consistently undervalued—such as in some Eastern European countries—it is better to shift most sourcing to local vendors. However, the firm may still want to source a limited amount of its inputs from less-favorable suppliers in other countries if it feels that maintaining an ongoing relationship may help in the future when strategies need to be reversed.

Concept Check Questions

77. Firms can find themselves in a financial situation where their purchasing power is diminished literally overnight.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

78. The exchange rate between two currencies specifies how much one currency is worth in terms of gold.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

79. By diversifying geographically, a company can shift more of its production to facilities and suppliers that are located in a lower-cost area when local currencies shift.

- ☐ True
- ☐ False

Correct or Incorrect?

[Clear](#)[Check Answer](#)

Regional Trade Agreements

Trade agreements are pacts between countries that encourage trade in a region by eliminating or lowering tariffs, quotas, and other trade barriers. The purpose is to protect trade in the region, and increase regional growth, by giving preference to members of the pact. Many trading blocs have emerged globally, such as in Europe (Europe 1992) and North America (NAFTA). There are also numerous trade agreements between countries in Asia and the Pacific Rim, such as the Asia–Pacific Economic Cooperation Forum (APEC). APEC has 21 member countries, including the United States, China, and Japan, with the goal of free and open trade in the region by 2020. In 2020 the United States and China signed a new trade deal imposing a new 15% tariff on about \$112 billion worth of Chinese imports. These agreements have serious implications for the way firms structure their global supply chain network, as they have to be aware of the opportunities, as well as restrictions, such trade agreements provide.

For example, Ford Motor Company's operations were significantly influenced by the North American Free Trade Agreement (NAFTA) and the utilization of maquiladoras in its supply chain strategy. The implementation of NAFTA brought a substantial transformation to Ford's manufacturing practices. The elimination of numerous tariffs, duties, and trade barriers under NAFTA allowed Ford to restructure its supply chain operations. The agreement facilitated streamlined cross-border trade between the United States, Mexico, and Canada, offering preferential tariff treatment and enhancing regional growth. Also, Ford, among other American companies, leveraged the maquiladora system in Mexico. This strategy involved setting up manufacturing operations in Mexico, importing materials and equipment duty-free for assembly, and exporting the finished products back to the United States. Before NAFTA, maquiladoras offered a cost-effective solution due to tariff savings on labor-intensive portions of products. Lastly, NAFTA's influence led to a rise in Mexico's national content requirement from 36% to 62.5%. This requirement stipulated the percentage of a product's components that must originate within North America to qualify for preferential tariff treatment. This adjustment incentivized European and Japanese firms, including Ford's competitors, to invest in North American production to meet the revised content requirement and benefit from tariff preferences.

This experience by Ford exemplifies how trade agreements such as NAFTA shaped its supply chain decisions, particularly the utilization of maquiladoras, alteration in tariff dynamics, and the strategic shift in meeting national content requirements to align with trade agreement provisions. These changes were pivotal in restructuring

Ford's manufacturing practices and navigating the evolving landscape of cross-border trade within North America.

Creation of NAFTA resulted in the elimination of nearly 7,000 individual tariffs, duties, and nontariff barriers to trade. For example, NAFTA changed the role of maquiladoras for American companies. Maquiladoras refers to an operation that involves manufacturing in a foreign country and importing materials and equipment on a tariff-free basis for assembly or manufacturing, then exporting the assembled or manufactured product, often back to the original country. American-owned maquiladoras enabled cheap labor on production, which incurred tariffs only on the low-cost labor portion of the product. NAFTA eliminated the tariff barriers, which changed the role of maquiladoras. NAFTA also resulted in the rise of Mexico's national content requirement from 36% to 62.5%. This resulted in European and Japanese firms now wanting to invest in North American production to qualify for the preferential tariff treatment.

Concept Check Questions

80. Trade agreements are pacts between countries that encourage trade in a region by eliminating or lowering tariffs, quotas, and other trade barriers.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

81. The purpose of regional trade agreements is to lower currency fluctuations.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

82. Creation of NA FTA resulted in the addition of nearly 7,000 individual tariffs, duties, and nontariff barriers to trade.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

83. Maquiladoras refers to an operation that involves manufacturing in a foreign country and importing materials and equipment on a tariff-free basis for assembly or manufacturing, then exporting the assembled or manufactured product, often back to the original country.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Impact of Nontariff Barriers

Most of us have heard of tariffs—taxes and duties on imported goods—as a barrier to global trade. However, tariffs have become a less significant form of trade protection due to the General Agreement on Tariffs and Trade (GATT) and more recently the World Trade Organization (WTO), which have dramatically reduced the tariffs for most industrial goods traded among developed countries. GATT and WTO have resulted in a rise of global trade. However, it is the nontariff barriers—various forms of indirect, non-price trade protection—that have become far more significant as obstacles to global exports and imports. Let us consider some of the most important nontariff barriers.

Texas Instruments (TI) and Intel, prominent semiconductor companies, responded strategically to nontariff barriers imposed by the European Union (EU), which established stringent local content requirements.

The EU enforced strict regulations stipulating a portion of value-added semiconductor processing to be conducted within the country's borders. To comply, TI and Intel altered their supply chain strategies, choosing to build semiconductor facilities within Europe. This strategic shift aimed to meet the local content regulations and sustain their market presence in Europe. Both companies' decisions to establish semiconductor facilities within the EU exemplify strategic adaptation to nontariff barriers. By investing in local production, TI and Intel aimed to navigate and comply with the stringent regulations, ensuring access to the European market and addressing the rising demand generated by the local content rules.

TI and Intel's response showcases how multinational corporations strategically adapt to nontariff barriers imposed by regions such as the EU. Their decision to establish local semiconductor facilities in Europe highlights the strategic importance of complying with stringent local content regulations to sustain market presence and meet evolving trade barriers in different global markets.

Import quotas—a quantitative restriction on the volume of imports—is one of the most common forms of nontariff barriers. An example of this is the use of textile quotas that are imposed by industrialized countries against textile imports from developing countries to keep a viable domestic industry. Another nontariff barrier is a **trigger price mechanism**, which is the establishment of a minimum price for sales by an exporter from a foreign country. Yet another form is the setting of “**local content requirements**,” which specify that a certain portion of the value added must be produced inside the country. For example, the EU has established strict local content rules. This has driven both TI and Intel to build semiconductor facilities in Europe to respond to the increase in the amount of semiconductor processing required by the new local content rules.

Other barriers include the use of , which relate to matters such as consumer safety, health, the environment, labeling, packaging, and quality standards. For example, for many years Japan refused to import U.S. skis on the grounds that Japanese snow was different from U.S. snow. Similarly, the United States prohibits imports of many types of agricultural products on such grounds.

Countries come with many nontariff barriers to protect domestic businesses. Despite these efforts, global trade is flourishing. There is an increase in the harmonization of regulations and standards across the globe, making managing global supply chains easier.

Empowering Entrepreneurs Box

There is an assumption that small companies and start-ups begin their business by establishing themselves at home, not venturing too far abroad. That is certainly the case with small firms that have established a strategy of local reach, as discussed earlier in the chapter. However, in today's globally interconnected world, most start-ups are actually starting out global from the very beginning. These companies do not automatically source supplies from local regions or set up factories close to their headquarters. Rather, many small firms start out by sourcing from global suppliers, negotiating the best cost options on the global market, and scouting the best locations considering the global landscape. They may even start out serving global customers.

As it is the case for all companies, there are challenges of managing differences in cultural contexts, navigating distance, and managing global supply of resources. However, for small companies these challenges are more acute as their budgets are smaller, they may have a large dependence on a single source of supply overseas or may have limited resources to manage operations from afar.

One of the biggest challenges for entrepreneurs is setting up global supply chains. Given the size and scope of a small business, they may want to be clear in the reasons and purpose for going global, ensuring that the scope of the global reach matches their purpose. They may also consider building and relying on alliances. The importance of relationship building for entrepreneurs was discussed in [Chapter 11](#) and is especially critical when managing global supply chains, as going global may be best done with an international partner. Lastly, entrepreneurs may want to consider the risks of being dependent on one or a few global suppliers and consider diversifying with local options. They may also remember that global conditions change, such as production and delivery costs, political risks, tariffs, and trade agreements. For small businesses, it may be hard to switch production as these changes occur. Therefore, small companies and start-ups may want to carefully weigh the benefits vs the risks in developing global supply chains.

Concept Check Questions

84. Tariffs have become a less-significant form of trade protection due to the General Agreement on Tariffs and Trade (GATT) and more recently the World Trade Organization

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

85. _____ are a quantitative restriction on the volume of imports.

- ☐ a) Import quotas
- ☐ b) Trigger price mechanism
- ☐ c) Local content requirements
- ☐ d) Technical standards and health regulations
- ☐ e) Shipping limitations

Correct or Incorrect?

Clear

Check Answer

86. _____ is the establishment of minimum price for sales by an exporter from a foreign country.

- ☐ a) Import quotas
- ☐ b) Trigger price mechanism
- ☐ c) Local content requirements
- ☐ d) Technical standards and health regulations
- ☐ e) Mandatory pricing

Correct or Incorrect?

Clear

Check Answer

87. These specify that a certain portion of the value added must be produced inside the country.

- ☐ a) Import quotas
- ☐ b) Trigger price mechanism
- ☐ c) Local content requirements
- ☐ d) Technical standards and health regulations
- ☐ e) Mandatory labor content

Correct or Incorrect?

Clear

Check Answer

88. This relates to matters such as consumer safety, health, the environment, labeling, packaging, and quality standards.

- ☐ a) Import quotas
- ☐ b) Trigger price mechanism
- ☐ c) Local content requirements
- ☐ d) Technical standards and health regulations
- ☐ e) Safety standards

Correct or Incorrect?

Clear

Check Answer

89. Countries come with many non-tariff barriers to protect domestic businesses.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

CHAPTER HIGHLIGHTS

Globalization growth is a result of advances in transportation and IT and a rise in personal income.

Six forces that impact global supply chains are “market and competition,” “cost,” “infrastructure,” “technology,” “political and economic environment,” and “culture.”

Global marketing is an approach that focuses on bringing standardization to the global market. Local marketing stresses microsegmentation and localized differentiation. These approaches are contradictory, but they are best used to complement one another when developing a global strategy.

The availability of infrastructure in global supply chains is a significant factor for going global. Infrastructure includes transportation, access to labor, warehousing, and access to suppliers.

Technology is a significant factor in enabling the functioning of global supply chains. Three types of technology are important: “IT,” “manufacturing technology,” and “equipment technology.”

A significant factor in global supply chains is cost. Pursuing apparent cost reductions can be problematic, as there are numerous hidden costs. Also, companies must take into account many noncost considerations, such as quality and proximity to customers.

Global supply chain management is impacted by political and economic factors, such as politics and government regulations, tariffs and various nontariff barriers that include import quotas, trigger price mechanisms, and labor content regulation.

KEY TERMS

[Economic](#)

[Cultural](#)

[Political](#)

[Demographic](#)

[Market and competition](#)

[Cost](#)

[Infrastructure](#)

Technology

Politics and economy

Culture

Global marketing

Local marketing

Product postponement

Information technology

Manufacturing technology

Equipment technology

Regional trade agreements

Trade protection mechanisms

Import quotas

Trigger price mechanism

Local content requirements

Technical standards and health regulations

DISCUSSION QUESTIONS

Think of a product you are familiar with—the clothes you are wearing or the beverage you just drank or the book you are reading. Identify the challenges that would be involved in distributing this product on a global scale to different markets.

Come up with a new product idea. How might you modify this product to sell it to different global markets? How would you market this product globally?

You have US\$1,500 to spend on a trip abroad. Explain the impact of currency fluctuations on your trip and what you can purchase if you choose to go to Asia vs Australia vs Europe vs Africa.

Think of an idea you are passionate about. How would you sell your idea to a high-context vs low-context culture? How about a low power distance vs a high-power distance culture?

Case Study Wú's Brew Works

One hot afternoon, Kenneth Wú sat on the narrow steps of his apartment complex in Hong Kong, enjoying his latest creation: an alcoholic beverage he made in his kitchen. The drink tasted so good that he preferred to drink it instead of store-bought beer. When Wú paid a visit to friends in Tai-Koo Sing, they ridiculed him for making his alcohol, but eventually, they tried it out of sheer curiosity. To Wú's surprise, his friends unanimously agreed that his beverage would be worth paying money for. That evening, they developed an entrepreneurial spirit, and by the end of the night, Wú was convinced that his concoction could generate a substantial amount of revenue. Later that week, despite Wú's aversion to taking the risks required of an entrepreneur, he decided to manufacture and sell his beverage.

Wú and his friends began by going to different liquor stores in the Hong Kong region to offer samples. The liquor store owners fell in love with his beverage, and soon Wú had his drink on shelves around the region. He named the drink “Wú's Brew.” After a year of steady sales and considerable profit, Wú decided to expand his sales to other countries in East Asia. Based on the advice and esteem he had received from many of these small liquor store owners, he decided to start a partnership with a few of his close friends to sell the product and market what they believed to be the “next big thing” to hit the bars and shelves around the world. His company was named Wú's Brew Works.

Wú wisely acknowledges that he and his friends will never be able to meet global demand if they continue to manufacture the product from their homes. By relying on the relationships, he developed with store owners and their networks, Wú expands his manufacturing operations. Sure enough, Wú's drink has become the most popular item to hit the market in Hong Kong and countries such as Taiwan and the Philippines. Within a year, the beverage begins receiving global attention throughout East Asia. People and tourists from China, Japan, Vietnam, Malaysia, and other East Asian countries start requesting his beverage when visiting Hong Kong. Eventually, people throughout the world—including Australia, Europe, and even the United States—become interested.

Wú begins to envision his product being sold globally. After securing financial commitments from various Hong Kong investors, Wú and his partners rent out the 65th floor of Central Plaza in Wanchai North of the Hong Kong Island region of Hong Kong to locate company operations and the official Wú's Brew Works headquarters. However, he chose to locate the manufacturing plant in Yenda, Australia, as it provides more convenient distribution access.

Wú's Brew Works Manufacturing Plant

Yenda, Australia, is a little town located about 560 km west of Sydney in the New South Wales region of Australia. It is the location where Yellow Tail wine is manufactured and produced. Yenda is a multicultural place where vineyards and rice paddies thrive. It is located at the edge of Cocoparra National Park—a place of spectacular gorges, waterfalls, walking locations in lookouts, and home to more than one hundred species of birds. Wú and Co. decide to have the manufacturing plant in Yenda because of its open land and large capacity for a plant.

Wú decided to target the United States in its business plan to begin global growth; the United States will be the first area outside East Asia to sell Wú's Brew. Wú sought the U.S. market to fulfill his ambition of spreading his product globally because of the large growth potential for alcohol in the United States. However, alcohol is a highly regulated product in the United States, and all alcoholic imports coming into the United States have to follow a three-tier system of alcohol distribution.

The Three-tier System

The three-tier system is the system for distributing alcoholic beverages in the United States that was federally mandated after the repeal of the Prohibition in 1933. The three tiers in this system are the producers, distributors, and retailers. In this system, the delivery of an alcoholic beverage involves the producer to sell to a distributor, who then must sell the product to a retailer, whether it is a liquor store, restaurant, or bar. This system is designed to help ensure the responsible and safe distribution of alcoholic beverages and is a key factor in preventing the distribution of alcohol to minors. It provides a process that guarantees the integrity of products to end consumers.

Different states have various rules and exceptions. In some states, under the brewpub system, a producer (brewers, distillers, wineries, and imports of alcohol) can sell its alcohol directly to retailers and has no obligation to include a distributor in its supply chain. Other states allow a two-tier system, which allows breweries to act as their distributor so that they can distribute alcohol directly to retailers. In some states such as Oregon, intrastate shipments of alcohol directly from the producers to retailers or customers are permitted. Most of the states, however, including Texas and California, adhere to the three-tier system of alcohol distribution.

Project Proposal Plan

After becoming fully educated about the risks and regulations of alcohol distribution in the United States, Wú and his company decided that expanding into the United States would be a good growth opportunity. Wú's Brew Works' corporate managers come up with three different project proposals to distribute alcohol to the United States. Each of the three project proposals is plans to market the product to one particular region of the United States and partner with one distributor because Wú's Brew Works and other international importers of alcohol are not allowed to distribute the product while remaining in the country. They are only allowed to sell the product to the distributor (usually located on the West Coast). They plan to select only one of the project proposals because of capital constraints. Ultimately, they can afford only to work with one distributor that brings the product to just one region of the United States.

The distributor that Wú's Brew Works chooses would not only sell within their respective area, but would also consolidate Wú's product with other international alcohol products to sell to retailers from inland states. This arrangement allows inland retailers to get around their legal inability to buy alcohol directly from the alcohol producer. Wú's West Coast distributors are therefore also known as distribution consolidators. These consolidators would be able to bring Wú's Brew to distributors in Texas or Kansas.

The first project proposal was a plan to partner with R.F. Michinan, located in the port of Los Angeles, California. The project would require bringing the product to the port of Los Angeles and ultimately marketing it to the southern United States, such as Texas and Louisiana. The second project proposal was with JH Distributors and would allow Wú's Brew to be brought to the northwest region and most of the Midwest regions of the United States. JH Distributors is located in Lake Oswego, Oregon, so the product would have to be brought to the port of Portland, Oregon. The final project proposal was to market the product in the east and northeast regions of the United States by partnering with SJT Distributors, located in San Francisco, California, and accessed through the ports of San Francisco. No project is considerably more profitable than the other.

Each project has its risks. For the first project proposal, R.F. Michinan said that the risks of distributing alcohol are minimal and that Wú had nothing to worry about. However, based on reports from the city of Los Angeles, there have been many cases of theft of alcohol imports from R.F. Michinan. For the second project proposal, JH Distributors stated the risk of longer lead times and exposure to lost or damaged products due to long transport from Australia to the port of Portland. Delivering from overseas to the port required going through

the Columbia River and navigating in Oregon. The last project proposal with SJT Distributors had a risk of longer lead times to get the product from California across the United States to the eastern side of the country. This could also make emergency production processes even more complicated.

For the plan to be implemented, Wú's Brew would have to be shipped by truck from its manufacturing plant in Yenda, Australia, to the Sydney Harbor in Sydney, Australia. The product would then be loaded onto a ship, which would bring the product to the port of Los Angeles, the port of Portland, or the port of San Francisco, depending on which project Wú chooses. The international transport is DDP, which stands for "delivered duty paid." This is a code that represents the way international shipments are organized. DDP requires the seller (Wú) to bear all costs and risks of bringing the alcohol to the United States. But once Wú's Brew is brought to the port of its destination, the distributor is responsible for the rest.

The statement of operations and balance sheet of the three companies are displayed in [Exhibits 12.1](#) and [12.2](#), respectively. The projected cash flows of all three projects are displayed in [Exhibit 12.3](#).

	JH Distributors	SJT	R.F. Michinan
Net sales	8,534,662	5,636,884	10,534,729
Cost of sales	7,434,881	3,256,774	9,783,006
Gross profit	1,099,781	2,380,110	751,723
Selling, general and administrative	528,948	598,112	201,477
Others	98,418	1,311,001	47,551
Total operating expenses	627,366	1,909,113	249,028
Operating profit (loss)	472,415	470,997	502,695
Other income (expense)	3,407	3,589	3,287
Earnings before interest and tax	469,008	467,408	499,408
Interest expense	—	—	—
Income (loss) before tax	469,008	467,408	499,408
Income taxes (benefit)	175,878	175,278	187,278
Net income (loss)	293,130	292,130	312,130

EXHIBIT 12.1 Consolidated Statement of Operations

	JH Distributors	SJT Distributors	R.F. Michinan
Cash and equivalents	44,460	27,834	51,330
Accounts receivable	374,470	417,082	435,020
Inventories	407,776	460,684	434,442
Prepaid expenses	26,032	28,518	30,022
Other	41,428	44,368	42,000
Total current assets	894,166	978,486	992,814
Property, plant, and equipment	717,682	655,206	821,976
Less depreciation	366,972	334,828	411,060
Net property, plant, and equipment	350,710	320,378	410,916
Intangible assets	4,198	18,858	3,030
Other assets	35,376	31,446	35,938

	JH Distributors	SJT Distributors	R.F. Michinan
Total assets	\$1,284,450	1,349,168	1,442,698
Accounts payable	68,478	72,898	75,054
Current portion of long-term debt	1,150	1,000	3,030
Accruals and other	465,106	326,738	515,990
Total current liabilities	534,734	400,636	594,074
Long-term debt	17,550	18,000	60,042
Deferred pension costs	128,658	89,580	140,268
Other liabilities	38,424	38,606	642,138
Total liabilities	719,366	546,822	842,448
Common stock	37,710	37,710	37,670
Capital in excess of par	215,814	215,748	215,778
Retained earnings	293,130	292,130	312,130
Treasury stock	-20,988	-20,988	-20,928
Other stockholder's equity	41,418	523,600	95,600
Total stockholder's equity	565,084	802,346	600,250
Total liabilities and equity	\$1,284,450	1,349,168	1,442,698

EXHIBIT 12.2 Consolidated Balance Sheet (dollars in thousands)

JH Distributors

JH Distributors is a major distributor and consolidator of alcohol located in Lake Oswego, Oregon. They distribute alcohol throughout the Northwest region and parts of the Midwest region in the United States. Although they are headquartered in Lake Oswego, a city south of Portland, Oregon, their major warehouse is located in Portland near the port of Portland. They also have several distribution centers located in various parts of Oregon and states that surround Oregon. The owner of this privately held company, Julie Stables, is a long-time friend of Wú's.

After talking and negotiating with each of the companies he is trying to partner with, Wú is convinced that choosing Project 2 with JH Distributors would be best for Wú's Brew. This is because of the high net present value this project has over the other two and also because of the trust that he has developed with

Julie, his contact at JH Distributors. This personal relationship would help solidify the collaboration between the two companies. Wú's Brew Works and JH Distributors decide to begin the partnership.

The Challenge

Within two months of the agreement between the two companies, Wú's Brew Works reviewed its purchase order from JH Distributors and produced the 2,100 cases ordered. Wú's Brew Works hired a 3PL provider to deliver the product in full-truck load from Yenda to Sydney, Australia, and then on a ship from Port Jackson in Sydney to the mouth of the Columbia River. From the mouth of the Columbia River in Oregon, the ship sailed to Portland, where it went through customs and other legal screens. Because the international transport was “delivered duty paid,” JH Distributors did not have to worry about any of the costs prior to receiving the shipment from the port.

Project 1—R.F. Michinan (to Los Angeles, California)					
	<i>Cash Outflow</i>	<i>Cash Inflow</i>			
	Cost to implement	Year 1	Year 2	Year 3	Year 4
Projected cash flows	\$100,000	31,000	31,000	31,000	31,000
Cost of capital = 10%					
Projected life of initial project = 4 years					
Project 2—JH Distributors (to Portland, Oregon)					
	<i>Cash Outflow</i>	<i>Cash Inflow</i>			
	Cost to implement	Year 1	Year 2	Year 3	Year 4
Projected cash flows	\$95,000	30,000	30,000	30,000	30,000
Cost of capital = 10%					
Projected life of initial project = 4 years					
Project 3—SJT Distributors (to San Francisco, California)					
	<i>Cash Outflow</i>	<i>Cash Inflow</i>			
	Cost to implement	Year 1	Year 2	Year 3	Year 4
Projected cash flows	\$93,000	30,000	30,000	30,000	30,000
Cost of capital = 12%					
Projected life of initial project = 4 years					

EXHIBIT 12.3 Projected Cash Flows for 3 Projects²

However, when receiving the shipment, JH Distributors claimed that they had only received 1,849 cases of the alcohol. When this was reported to their headquarters in Lake Oswego, Julie thought to herself, “That’s strange, we ordered 2,700 cases. How did it get down to 1,849?” Some of the crewmembers aboard the ship claimed that they saw a lot of the alcohol bottles broken from the cases and so they threw what was unusable overboard from the ship. Some violent storms in the Northern Pacific Ocean might have caused this. This also

caused the shipment to be late by two days. Later, while JH Distributors transported full-truck loads of alcohol up north on I-5, they encountered a police chase from a local bank robbery, which delayed the shipment even further. The robbers from California were caught but had crashed into one of the truckloads of the alcohol delivery JH Distributors was distributing from the port to its main warehouse.

By the time the shipment had arrived to the warehouse, they realized that there were only 1,507 cases that arrived. When JH Distributors questioned Wú's Brew Works regarding the problem, Wú's Brew Works claimed they had done everything properly. When asked about only producing 2,100 cases, Wú's Brew Works claimed that the purchase order indicated exactly 2,100 cases and not 2,700. After reexamining the PO (purchase order), JH Distributors had realized that the 2,700 on the PO looked like 2,100 and so it was incorrectly inputted in its systems.

After all the troubling events, Wú and Julie wondered if their companies could recover. Although Wú believes that project 2 with JH Distributors is still the project that Wú's Brew Works should pursue, some of his corporate managers beg to differ.

Case Questions

1. Based on all the setbacks in the alcohol supply chain, whose fault is it for all the events leading to the 1,200-case shortage of Wú's Brew?
2. Was bringing Wú's Brew into the United States a good idea in the first place, given the heavy regulation? Why?
3. Disregarding Wú's Brew's first decision to invest in project 2 with JH Distributors, which project should it have invested in based only on the financial information provided? (*Note: Use NPV as noted in the case.*)

$$NPV = CF_0 + \frac{CF_1}{(1+i)^1} + \frac{CF_2}{(1+i)^2} + \dots + \frac{CF_N}{(1+i)^N}$$

4. Kenneth Wú had chosen JH Distributors to partner with in hopes of bringing a very popular product to the United States. Based on all the risks mentioned in the case article, would you have done the same?

5. All the events have left a bad impression on some of Wú's Brew Works managers. Should Wú's Brew Works continue project 2 with JH Distributors? If not, then which project?

Case Study Making Decisions with Data Analytics: Mika Enterprises

Craig Calloway owns a mobile phone company called Mika Enterprises and manufactures his phones locally in Keller, Texas. Currently, the parts are sourced from a domestic supplier and are assembled at his friend's electronic equipment assembly plant. A recent news article on his business published by a known national newspaper created a huge stir in the customer base and the demand suddenly increased beyond the scope of the company's current production capacities.

To take advantage of economies of scale, Craig is now considering sourcing the parts from a few low-cost suppliers in Asia. He has also reached out to a few manufacturers who are willing to assemble the phone for his company. Riding high on his confidence, Craig is also thinking of selling the phones in the Asian market where they will be assembled.

Case Questions

1. What factors should Craig consider before outsourcing to and selling in a new international market?
2. What challenges should Craig anticipate? List these.
3. Identify the uncertainties associated with the new product launch. Offer suggestions on how these uncertainties should be included in the analytics of managing this new project.

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Notes

1 The first four dimensions were identified by Geert Hofstede, a Dutch sociologist, who studied the interactions between national and organizational cultures around the world. The fifth dimension was identified by anthropologist Edward T. Hall.

2 Note: A project can be evaluated through Net Present Value (NPV) computed as follows:

$$\begin{aligned}\text{NPV} &= CF_0 + CF_1/(1+r)^1 + CF_2/(1+r)^2 + \dots + CF_N/(1+r)^N. \\ \text{PI} &= \text{PV of future cash flows/initial cost} = (CF_t/(1+r)^t)/CF_0\end{aligned}$$

Profitability Index (PI) shows the relative profitability of any project (PV per dollar of initial cost). A project is acceptable if its PI is greater than 1.0.

13

Sustainable Supply Chain Management

LEARNING OBJECTIVES

After completing this chapter, you should be able to:

Define sustainability and explain its role in supply chain management (SCM).

Identify environmental and social costs inherent in supply chain activities.

Describe methods of measuring and implementing sustainability.

Explain the supply chain sustainability model.

Identify specific changes organizations can make to support a sustainable supply chain.

Make a business case for sustainable SCM using concepts and examples from this chapter.

CHAPTER OUTLINE

■

What Is Sustainability?

Defining Sustainability

Environmental and Social Sustainability

Environmental Sustainability

Social Sustainability

Principles of Sustainability

Why Sustainability?

Legal Compliance

Community Relations

Revenue

Ethical Responsibility

■

Evaluating Sustainability in SCM

The Supply Chain Sustainability Model

Model Inputs

Leadership

Processes

Sustainability Performance

Stakeholders' Reaction

Financial Performance

Feedback

Enforcement, Compliance, and Innovation

Enforcement

Compliance

Innovation

Measures of Sustainability in SCM

Values in Sustainable SCM

Cost Assessment

Cost of Control

Damage Costing

Costing Systems

Risk Assessment

“Fat Tails”

Scenario-Based Analysis

Fuzzy Logic

Monte Carlo Simulations

Real Option Analysis

- **Sustainability in Practice**

Product Design

Packaging

Sourcing

Process Design

Marketing Sustainability

Unintended Consequences

- **Chapter Highlights**

- **Key Terms**

- **Discussion Questions**

- **Case Study: Haitian Oil**

- **Case Study: Making Decisions with Data Analytics: Wellington's Coffee House**

- **Bibliography**



[Bloomberg Quicktake Video: UOP and Unilever on Advancing Sustainable Growth in Southeast Asia](#)

[Bloomberg Quicktake Video: Summit Advisors on Innovating for People and Planet](#)

On April 20, 2010, a deep-sea oil rig owned by British Petroleum (BP) PLC exploded. The explosion immediately killed 11 rig workers and caused the release of almost five million barrels of crude oil into the Gulf of Mexico as the broken pipe on the ocean floor spewed oil until 19 September 2010. The depth of the well, combined with hurricane-season weather within the Gulf of Mexico, made stemming the flow of oil a prolonged, expensive, and technically challenging project. The price of crude oil at the time was averaging over US\$80 per barrel. That amounted to about US\$400 million lost in product waste alone, without counting environmental degradation in the form of marine and wildlife habitat destruction, fishing and tourism business losses along the Gulf Coast, cleanup costs, stock price decreases, or the loss of human life.

According to the report of the U.S. National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling, the oil spill was “an avoidable disaster that resulted from management failures by BP PLC and its (two) contractors,” and “all three companies did a poor job of assessing the risks associated with their decisions and failed to adequately communicate, either with one another or with their own employees.” Although some have dismissed the Deepwater Horizon disaster as an irresponsible aberration on the part of the three companies, not to be expected from others in the industry, the report suggests otherwise: “The root causes are systemic and, absent significant reform in both industry practices and government policies,” could very well happen again with other companies.

BP suffered an astounding 52% decrease in stock value within 50 days of the explosion as a result of negative shareholder reactions. To avoid litigation over the matter BP created a US\$20 billion spill response fund to compensate for natural resource damages, government response costs, and individual compensation. To finance the compensation fund, BP plans to significantly reduce capital spending, divest about US\$10 billion in assets, and reduce the payment of dividends to shareholders. These are all potentially ruinous consequences for the company itself, not to mention the environmental and social impact.

To achieve environmentally and socially sustainable performance, companies must be aware of the costs and risks that surround their actions. From resource extraction to product disposal, sustainable supply chain

management (SCM) promises to achieve long-term corporate profitability while protecting the environment and human welfare. As demonstrated by the Deepwater Horizon disaster, companies can pay an extremely high price for failing to anticipate low-probability, high-consequence events. Although not all sustainability issues are as dramatic as this example, many have severe consequences for both the organization and the environment. Fortunately, they can be avoided by adequate care and attention to costs and risks; effective leadership and communication; responsiveness to stakeholders such as employees, surrounding communities, and government; and a policy of minimizing environmental and social risks while maximizing long-term corporate profitability.

Concept Check Questions

1. On April 20, 2010, a deep-sea oil rig owned by _____ exploded.

- ☐ a) Devon Energy
- ☐ b) Chevron
- ☐ c) ExxonMobile
- ☐ d) British Petroleum PLC

Correct or Incorrect?

Clear

Check Answer

2. According to the report of the United States' National Commission on the Deepwater Horizon Oil Spill and Offshore Drilling, the oil spill was “an unavoidable disaster.”

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

3. The Deepwater Horizon oil spill had minimal impact on the financials of its parent company.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

4. To achieve environmentally and socially sustainable performance, companies must be aware of the costs and risks that surround their actions.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

What Is Sustainability?

Defining Sustainability

The last few decades have seen increased demand for companies to fully account for the environmental and social impact of their products and services and the associated supply chains. The activities involved in SCM impact these

concerns, including biodegradable product packaging, responsible product disposal, control of manufacturing and transportation emissions, and sustainable sourcing practices. As a result, sustainability has become a central theme in SCM.

Supply chains are indispensable to our daily lives, but they can have significant adverse environmental and social consequences. These include environmental costs, health and human safety risks, and the cost of waste. Sustainable SCM is concerned with changing practices to reduce these negative consequences. Sustainability impacts SCM in areas of product design, product manufacturing, packaging, transportation and logistics, sourcing, and product end of life. As consumers increasingly demand environmentally and socially sustainable products, businesses are being forced to find ways to achieve sustainable supply chain performance. As a result, the challenge to managers posed by sustainability is to incorporate environmental and social responsibilities into their management practices.

Global Insights Box

■ THE GREAT PACIFIC GARBAGE PATCH

For decades, ocean currents circulating between the coasts of California and Japan have accumulated plastic waste into a gyre of nonbiodegradable garbage known as the Great Pacific Garbage Patch. This is a whirling mass of garbage floating in the middle of the ocean. There may be as many as five garbage patches in the earth's oceans. The garbage patches are made up of plastic bits from toys, bottles, and packaging that find their way into the ocean from storm sewers, as well as pollution left by marine vessels. Winds drive the surface-level pollution toward the center of the gyre, where the currents are relatively still and the garbage cannot escape. Sunlight breaks down the garbage into microplastics that are loaded with toxins, with the plastics functioning as a sponge, amassing large concentrations of toxins from the surrounding ocean water. When the plastics degrade into tiny particles, zooplankton, and other life forms at the bottom of the marine food chain consume the garbage that is ultimately passed up through the food chain. Marine wildlife, such as sea turtles, albatrosses, and jellyfish, consumes the plastic particles, leading to death or hormone disruption. Toxins in the garbage patch can wind up back in the human body, threatening our health. Estimates of the size of the Great Pacific Garbage Patch range up to twice the size of the continental United States, but it is difficult to measure its actual span and density. The open-sea garbage patches contain plastics that have broken down into smaller polymers, as well as chemical sludge and larger debris such as abandoned fishing nets. They are an indirect consequence of the use of nonbiodegradable plastics in consumer products and packaging. Although efforts to clean up the patch are underway, scientists suggest that relying on nontoxic, biodegradable, and recyclable materials is the only way to prevent such phenomena from recurring.

As of October 2023, “The Ocean Cleanup” has removed over 17.7 million pounds (8 million kilograms) of trash from rivers around the world using their Interceptors—high-tech water cleanup devices. The organization has 14 Interceptors in seven countries and plans to add more in 2023 and 2024. The

Ocean Cleanup also has camera systems around the nets to catch turtles and sharks. The Ocean Cleanup's device could potentially remove half of the plastic in the Great Pacific Garbage Patch within five years. However, the organization notes that they will never be able to remove every piece of plastic from the oceans.

Sustainability can be defined as meeting present needs without compromising the ability of future generations to meet their own needs. Sustainability is indispensable when both present and future generations depend on the same set of limited resources. The resources of the earth used on the input side of supply chains are borrowed from the future and must be stewarded as such. For example, if the present need for timber was consumed at an unsustainable rate, trees would be cut down faster than they could be re-grown, which would compromise the ability of future generations to access timber. The waste output of supply chains must be disposed of responsibly. Otherwise, concentrations of pollution can jeopardize the integrity of ecosystems or human health.

Although typically defined in terms of the relationship between the present and the future, sustainability is not limited to the intergenerational context. Principles of sustainability also apply to balance competing needs. For example, sustainable use of timber for lumber “would not” jeopardize the need to access timber to make paper. Sustainable resource consumption or pollution *would not* eliminate resources faster than they could be replenished. Sustainability is not simply for the sake of future populations, but for present purposes as well.

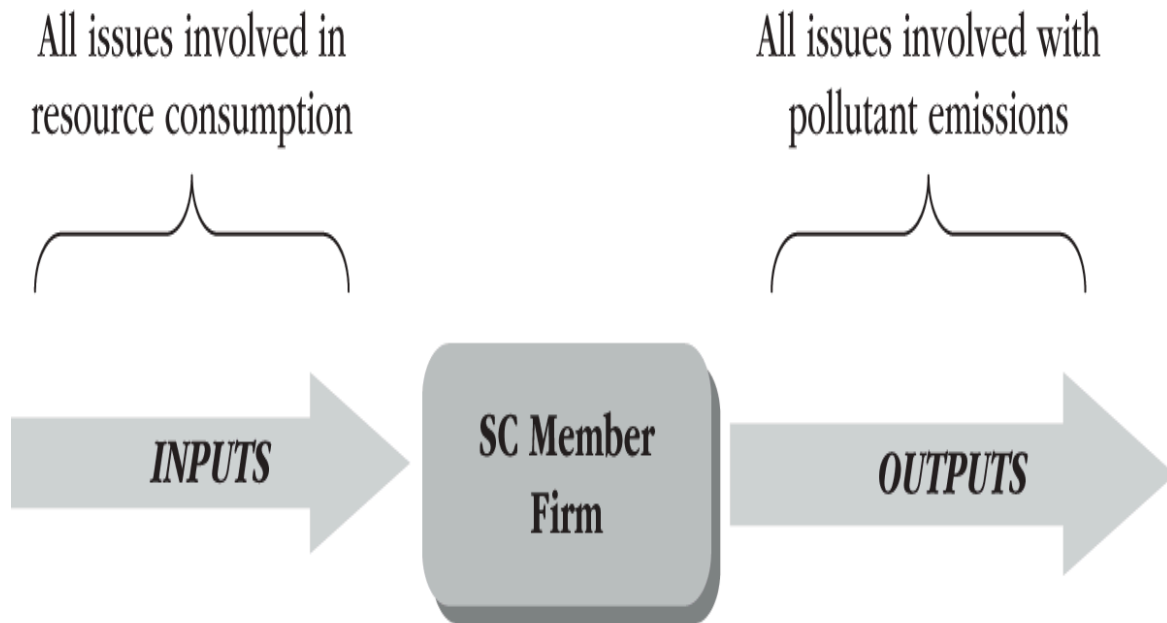


FIGURE 13.1 Sustainability considers the inputs and outputs of each SC member.

SCM must fulfill consumer demand sustainably. Sustainable SCM requires managers to identify sustainability “issues” when analyzing operations and their effects. To determine whether a supply chain is operating sustainably, managers must focus on both inputs and outputs of each stage of the supply chain, as shown in [Figure 13.1](#). Sustainability analysis of inputs requires all aspects of resource consumption—from raw materials to human resources. A sustainable supply chain avoids consuming so much of a resource that future operations are compromised. Sustainability analysis of outputs involves all aspects of pollutant emissions so that the health of neighboring ecosystems or populations is not put in jeopardy.

Sustainable SCM is not just an altruistic effort. Four documented types of payoffs come with improving a company's sustainability performance. [Financial payoffs](#) include reduced operating costs, increased revenue, lower administrative costs, lower capital costs, and stock market premiums. [Customer-related payoffs](#) include increased customer satisfaction, product innovation, market share increase, improved reputation, and new market opportunities. [Operational payoffs](#) include process innovation, productivity gains, reduced cycle times, improved resource yields, and waste minimization. [Organizational payoffs](#) include employee satisfaction, improved stakeholder relationships, reduced regulatory intervention, reduced risk, and increased organizational learning. We will look at all of these throughout this chapter.

IKEA's goal was to source all of its wood from more sustainable sources by 2020. By 2023, 99.9% of the wood used for IKEA products was either Forest Stewardship Council (FSC)-certified or recycled. IKEA only uses wood from responsibly managed forests that do not contribute to deforestation. IKEA is now working toward 100% renewable energy. It has added solar car parks, rooftop panels, and battery energy storage systems to seven stores and fulfillment centers. It also has a renewable heating and cooling project that aims to replace and optimize heating, ventilation, and air conditioning at five stores by the end of 2023. IKEA also aims to phase out its use of virgin plastics by 2030.

Concept Check Questions

5. The last few decades have seen declining demand for companies to fully account for the environmental and social impact of their products and services and the associated supply chains as competition takes center stage.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

6. Supply chains can have significant adverse environmental and social consequences.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

7. Sustainability has minimal impact on SCM.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

8. _____ can be defined as meeting present needs without compromising the ability of future generations to meet their own needs.

- ☐ a) Green
- ☐ b) Lean
- ☐ c) Sustainability
- ☐ d) Efficient

Correct or Incorrect?

Clear

Check Answer

9. _____ payoffs include reduced operating costs, increased revenue, lower administrative costs, lower capital costs, and stock market premiums.

- ☐ a) Financial
- ☐ b) Customer-related
- ☐ c) Operational
- ☐ d) Organizational
- ☐ e) Lean

Correct or Incorrect?

Clear

Check Answer

10. _____ payoffs include increased customer satisfaction, product innovation, market share increase, improved reputation, and new market opportunities.

- ☐ a) Financial
- ☐ b) Customer-related
- ☐ c) Operational
- ☐ d) Organizational
- ☐ e) Marketing

Correct or Incorrect?

Clear

Check Answer

11. _____ payoffs include process innovation, productivity gains, reduced cycle times, improved resource yields, and waste minimization.

- ☐ a) Financial
- ☐ b) Customer-related
- ☐ c) Operational
- ☐ d) Organizational
- ☐ e) Innovation

Correct or Incorrect?

Clear

Check Answer

12. _____ payoffs include employee satisfaction, improved stakeholder relationships, reduced regulatory intervention, reduced risk, and increased organizational learning.

- ☐ a) Financial
- ☐ b) Customer-related
- ☐ c) Operational
- ☐ d) Organizational
- ☐ e) Internal

Correct or Incorrect?

Clear

Check Answer

Environmental and Social Sustainability

Stated most generally, sustainability is the capacity of a system to endure. As such, sustainability is a broad concept with numerous applications. There are two types of sustainable practices: environmental sustainability and social sustainability. [Environmental sustainability](#) is the preservation of diverse biological systems that remain productive over time. [Social sustainability](#) involves maintaining societies' long-term well-being. Although the criteria for sustainability in ecology are different from the criteria for sustainability in human affairs, the two are mediated by supply chain networks. From the extraction of raw materials to the deposit of final waste products, supply chain networks are the links between human activity and the natural world. Social sustainability depends in part on the benefits of environmental sustainability, such as access to clean water, soil and air, and healthy ecosystems. Some human activities, such as overfishing and excessive pollution, have an adverse impact on environmental integrity. Threats to environmental sustainability, such as oil spills, acidification, or natural resource depletion, have an adverse impact on humanity's welfare. Therefore, environmental and social sustainability are interconnected, as shown in [Figure 13.2](#).



FIGURE 13.2 Environmental and social sustainability are interconnected.

Concept Check Questions

13. There are three types of sustainable practices.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

14. _____ sustainability is the preservation of diverse biological systems that remain productive over time.

- ☐ a) Internal
- ☐ b) External
- ☐ c) Global
- ☐ d) Environmental
- ☐ e) Social

Correct or Incorrect?

Clear

Check Answer

15. _____ sustainability involves maintaining societies' long-term well-being.

- ☐ a) Internal
- ☐ b) External
- ☐ c) Global
- ☐ d) Environmental
- ☐ e) Social

Correct or Incorrect?

Clear

Check Answer

Environmental Sustainability

Environmental sustainability is the sustainability practice that deals with either pollution or resource depletion issues. Whether a supply chain network is environmentally sustainable depends on the relationship of the activity in question—say resource procurement or manufacturing—to global warming, acidification, smog, ozone layer depletion, toxin release, habitat destruction, land use issues, and resource depletion.

Tesla is a prime example of a company promoting environmental sustainability through its electric vehicles and renewable energy solutions. By producing electric cars and investing in solar energy products such as solar panels and energy storage systems, Tesla aims to reduce reliance on fossil fuels and lower greenhouse gas (GHG) emissions. Tesla has been gradually reducing the amount of rare earth elements in its motors. Between 2017 and 2022, the company used 25% less heavy rare earth materials for the motors in the Model 3. Tesla uses induction motors that do not use static magnets at all, so no rare earths.

Social Sustainability

Social sustainability consists of either economic or population issues. Whether a supply chain network is socially sustainable depends on the relationship of the activity in question to social issues. These include income inequalities, population growth, levels of migration to cities, gender equality and women's rights, poverty, dislocation, and urban or minority unemployment.

Danone, a multinational food products corporation, prioritizes social sustainability by integrating social and environmental responsibility into its business model. The company has initiatives focusing on community engagement, improving access to clean water, promoting nutrition, and empowering local communities where it operates.

Supply Chain Leader's Box

■ FIBRIA CELULOSE

Fibria Celulose is a Brazilian company and the largest producer of eucalyptus pulp in the world. This material is used to manufacture printing and writing paper, tissue paper, and high-value-added specialty papers. Eucalyptus lumber is also used to create high-quality furniture and interior designs. Chances are that you have used paper or furniture from Fibria's lumber. Fibria is an example of a global company that has developed its supply chain while being committed to environmental and social sustainability. They also demonstrate the financial benefits that can come from such practices.

In 2018, the company merged with its largest rival Suzano Papel e Celulose.

According to Fitch Ratings, Fibria Celulose S.A. no longer exists.

Their company website is also no longer accessible.

Fibria ensures environmental sustainability by preserving the natural ecosystems surrounding the eucalyptus plantations. The company created a forestry management program to preserve native tree populations and prevent overharvesting. They created a watershed project to preserve the quality of nearby rivers in light of insecticide and fertilizer runoff. They also use strict environmental control technology to protect and monitor the impact of their operations on forests and rivers.

In addition to environmental sustainability, Fibria also focuses on social sustainability by contributing to the communities near their operation sites. The company collaborates with nongovernmental organizations, project experts, and financial advisors to give back to the local communities. In addition, Fibria's employees are encouraged to volunteer in the surrounding communities. Volunteer activities include collecting warm winter clothing, collecting food items to feed the hungry, providing emergency support after catastrophic floods, visiting hospitals, and tutoring local students in economic issues by allowing them to run a "minicompany." Fibria is listed on Fortune's list of companies helping change the world.

To provide a simple illustration of what a sustainability analysis would include, consider the logistics decision of locating a chemical processing facility. Initially, the choice of location would be determined by considering economic factors, such as real estate cost or transportation as we discussed in [Chapter 7](#). However, sustainability requires an analysis of environmental and social factors that go well beyond these basic economic considerations, as shown in [Figure 13.3](#). A chemical factory may affect nearby plant and animal populations as well as local human health by introducing air, water, and noise pollution. Furthermore, the choice of location may implicate job availability and commuter behavior, while requiring decisions about wages for local employees.

Decision	Environment Impact	Sustainable Decision
Facility location	Negative consequences of siting on natural habitats (ecosystems) and habitat destruction. Negative effects on humans and animals, from increased noise pollution and energy consumption to contamination of air and water.	Minimize total material and personnel travel distances to and from the facility. Avoid runoff from construction activity and new pavement. Abate noise pollution. Reduce the air pollution effects on the community.
Product packaging	Nonbiodegradable and nonrecyclable packaging leads to landfill clutter and harm to wildlife.	Eliminate or reduce product packaging. Rely on biodegradable and recyclable materials.
Material flow	Modes of transportation used to move materials have significant effects on energy consumption, traffic congestion, and pollution.	Reduce the number of shipments. Source locally. Strategically locate warehouses. Consolidate shipments. Select transportation modes wisely.
Inventory control	Noise pollution, increased energy use, and increased motor vehicle congestion.	Minimize total material movement to and from the facility by delivery consolidation and accepting the carrying of larger inventory quantities.

FIGURE 13.3 SCM decisions and related environmental effects.

Source: Adapted from: Beamon, Benita. "Environmental and Sustainability Ethics in Supply Chain Management." *Science and Engineering Ethics*. Vol. 11, No. 2, 2005, 221–234.

Concept Check Questions

16. Environmental sustainability is the sustainability practice that deals with either pollution or resource depletion issues.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

17. Whether a supply chain network is environmentally sustainable depends on the relationship of the activity in question.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

18. Social sustainability consists of either economic or population issues but not both.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

19. Whether a supply chain network is socially sustainable depends on the relationship of the activity in question to social issues.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Principles of Sustainability

Being able to spot critical sustainability issues, and offer adequate solutions, is a crucial managerial skill in today's business environment. For key “issue spotting” tools, consider the following nine principles of sustainability¹:

Ethics. Ethics involves promoting a corporate culture that fosters truthful and fair conduct between all stakeholders. Ethics are maintained by monitored and enforced codes of conduct. At the bare minimum, an ethical company prohibits violations of human rights or dignity and adheres to honest and just standards and practices. Positions such as a “corporate ombudsman” can be used to ensure that external stakeholder voices are heard, as well as an “organizational ombudsman” to ensure internal stakeholders are respected. This helps create a work environment that encourages the reporting of ethical violations to appropriate authorities by offering a confidential and neutral forum to voice concerns.

Microsoft's commitment to ethical conduct is evident in its comprehensive approach to setting guidelines and codes of conduct for employees and stakeholders. The company places a strong emphasis on ethical behavior, integrity, and honesty in all aspects of its operations, as outlined in its Standards of Business Conduct. These standards serve as a foundation for

Microsoft's corporate culture and guide employees in making ethical decisions.

One of the key aspects of Microsoft's approach to ethics is its commitment to transparency and accountability. The company has established channels for employees to report ethical concerns, ensuring that any potential issues are addressed promptly and effectively. This transparency not only helps maintain high ethical standards within the organization but also enhances trust and credibility with stakeholders.

Overall, Microsoft's emphasis on ethical behavior and its commitment to transparency and accountability have helped establish the company as a leader in ethical business practices. By setting clear guidelines and fostering a culture of integrity, Microsoft continues to uphold its reputation as a responsible corporate citizen.

Governance. Governance concerns the conscientious execution of duties held by corporate board members and managers. Good governance requires a well-understood mission statement supported by performance metrics, as well as the use of decision tools to support management. Good governance should mandate the evaluation of senior management along multiple dimensions, such as sustainability measures, not merely financial performance.

Transparency. Transparency involves visibility. Companies that care about the information needs of others are transparent with them. Full disclosure of financial performance is important with respect to investors or lenders. There are different degrees of transparency—ranging from document disclosure on request to posting information publicly.

Business Relationships. Companies should treat all suppliers, distributors, and partners fairly. They should also deal only with companies that do the same. When forming business partnerships, or seeking sources of supply, they should also consider social, ethical, and environmental factors as selection criteria. Not doing so can put a company's reputation in jeopardy.

Financial Return. To raise capital, companies must provide investors and lenders with a competitive return on investment (ROI). The company should maintain solid financial results and continue to create value while balancing additional nonmonetary factors. Although positive financial returns are necessary, they should be evaluated in conjunction to other principles of sustainability.

Google is known for its significant investments in various community initiatives through its philanthropic arm, Google.org. The company supports numerous projects aimed at promoting economic development, enhancing education, and improving access to technology in communities worldwide.

One of Google's key focus areas is supporting Science, Technology, Engineering, and Mathematics (STEM) education. Google.org provides funding and resources to organizations that promote STEM education, helping to prepare students for careers in technology and innovation.

In addition to education, Google also supports small businesses through its community initiatives. The company provides resources and tools to help small businesses grow and succeed, contributing to local economic development and job creation. Furthermore, Google.org is actively involved in disaster relief and crisis response efforts. The company provides funding and support to organizations working to provide aid and assistance to communities affected by natural disasters and other crises.

Overall, Google's community initiatives reflect the company's commitment to making a positive impact in the world. By investing in education, small businesses, and disaster relief, Google is helping to create a more inclusive and sustainable future for communities around the globe.

Value of Products and Services. Companies typically state a general commitment to customer satisfaction as part of their mission statement. However, they should clarify their obligations and responsibilities to their customers. In addition to products and services being of the highest quality, managers should be aware of the externalities generated by their products or services, and their supply chains.

Employment Practices. A diverse workforce with competitive wages and ample time away from work is bound to be a more loyal, productive workforce than one that is subject to prejudicial abuse, grueling hours, and poor pay. Management practices with respect to employees should go above and beyond minimum requirements of health, safety, and nondiscrimination mandated by labor laws. Employment practices should maximize the productivity and quality of employees by fostering a culture of mutual respect, appreciation, and care in the pursuit of the corporate mission. Investing in employees, in the form of continuing education programs, leave time, child care, and opportunities for advancement, are ultimately investments for the company itself. The result is healthier, happier, more productive employees

and an enhanced reputation of the company. An excellent example of these benefits is the SAS Institute in North Carolina, a company often on “Fortune” magazine's list of top companies to work for. The company provides a superb work environment—from child care to on-site massages—resulting in high productivity and almost no turnover.

Protection of the Environment. At a bare minimum, all corporations must comply with applicable environmental laws. However, corporations can do much more than this to promote environmental integrity. Innovations allow corporations to meet demand, while simultaneously cutting waste, lowering air and water pollutants, and consuming fewer resources are genuinely praiseworthy. Maximizing the use of recyclable materials, increasing product durability, streamlining product packaging, and encouraging stringent safety standards are all management decisions that can be made internally. Allocating resources to fund research into cleaner, more efficient technology, to fund land reclamations, or to create wilderness preservations are all means of stewarding corporate capital to offset corporate environmental harms.

Walmart has made significant strides in sustainability, focusing on reducing its environmental impact. The company aims to achieve zero waste and operate with 100% renewable energy. Walmart works closely with suppliers to improve sustainability across its supply chain, reducing packaging waste, promoting energy efficiency, and investing in renewable energy sources for its operations. For example, Walmart plans to power 50% of its operations with renewable energy by 2025 and 100% by 2035 and has installed solar panels in many of its stores to reduce energy consumption.

These principles are all relevant to a company's sustainability performance. In evaluating the sustainability of a company, analysis should consider these dimensions. Managers should be familiar with them and seek to incorporate them when making decisions.

Concept Check Questions

20. _____ involves promoting a corporate culture that fosters truthful and fair conduct between all stakeholders.

- ☐ a) Ethics
- ☐ b) Governance

- ☐ c) Transparency
- ☐ d) Business relationships
- ☐ e) Moral code

Correct or Incorrect?

Clear

Check Answer

21. _____ concerns the conscientious execution of duties held by corporate board members and managers.

- ☐ a) Ethics
- ☐ b) Governance
- ☐ c) Transparency
- ☐ d) Business relationships
- ☐ e) Authority

Correct or Incorrect?

Clear

Check Answer

22. _____ involves visibility.

- ☐ a) Ethics
- ☐ b) Governance
- ☐ c) Transparency
- ☐ d) Business relationships
- ☐ e) Openness

Correct or Incorrect?

Clear

Check Answer

23. Companies should treat all suppliers, distributors, and partners fairly.

- ☐ a) Ethics
- ☐ b) Governance
- ☐ c) Transparency
- ☐ d) Business relationships
- ☐ e) Equality

Correct or Incorrect?

Clear

Check Answer

24. To raise capital, companies must provide investors and lenders with a competitive return on investment

- ☐ a) Financial return
- ☐ b) Value of products and services
- ☐ c) Employment practices
- ☐ d) Protection of the environment
- ☐ e) Profits

Correct or Incorrect?

Clear

Check Answer

25. In addition to products and services being of the highest quality, managers should be aware of the externalities generated by their products or services, and their supply chains.

- ☐ a) Financial return
- ☐ b) Value of products and services
- ☐ c) Employment practices
- ☐ d) Protection of the environment
- ☐ e) Green

Correct or Incorrect?

Clear

Check Answer

26. A diverse workforce with competitive wages and ample time away from work is bound subject to prejudicial abuse, grueling hours, and poor pay.

- ☐ a) Financial return
- ☐ b) Value of products and services
- ☐ c) Employment practices
- ☐ d) Protection of the environment
- ☐ e) Equality opportunity

Correct or Incorrect?

Clear

Check Answer

27. At a bare minimum, all corporations must comply with applicable environmental laws.

- ☐ a) Financial return
- ☐ b) Value of products and services
- ☐ c) Employment practices
- ☐ d) Protection of the environment
- ☐ e) Green

Correct or Incorrect?

Clear

Check Answer

Why Sustainability?

The anti-environmental posture prevalent in the industry poses an obvious barrier to voluntary sustainability initiatives. This posture stems in part from two paradigms for thinking about environmental management. The “[crisis-oriented](#)” environmental management paradigm considers the purpose of management to protect and enhance business performance in terms of making more money, which encourages uncooperative behavior toward anyone with a countervailing agenda, including environmental advocates. The “[cost-oriented](#)” environmental management paradigm considers environmental regulations as simply a cost of doing business. Corporations will pollute as much as necessary to profit from the polluting activity and will count environmental sanctions as one more cost of operations on the balance sheet. Both of these paradigms place priority on business profitability, viewing environmentally sustainable measures as a barrier to that end.

Why implement sustainable measures in SCM? There are at least four reasons:

- Legal compliance with government regulations
- Maintaining positive community relations
- Increasing revenue
- Satisfying moral obligations

We look at these next.

Concept Check Questions

28. The “_____-oriented” environmental management paradigm considers the purpose of management to protect and enhance business performance in terms of making more money, which encourages uncooperative behavior toward anyone with a countervailing agenda, including environmental advocates.

- ☐ a) profit
- ☐ b) crisis
- ☐ c) green
- ☐ d) cost

Correct or Incorrect?

Clear

Check Answer

29. The “_____ -oriented” environmental management paradigm considers environmental regulations as simply a cost of doing business.

- ☐ a) profit
- ☐ b) crisis
- ☐ c) green
- ☐ d) cost

Correct or Incorrect?

Clear

Check Answer

30. Which of the following is not a reason to implement sustainable measures in SCM?

- ☐ a) Maximizing shareholder wealth
- ☐ b) Increasing revenue
- ☐ c) Satisfying moral obligations
- ☐ d) Maintaining positive community relations
- ☐ e) Legal compliance with government regulations

Correct or Incorrect?

Clear

Check Answer

Legal Compliance

Environmental regulations typically define two sets of standards that must be adopted by major sources of pollutant emissions. The first is a [design standard](#), which specifies the type of technology necessary for the pollution source to comply with the regulation (e.g., a certain type of pollution-scrubbing filter must be installed on a smokestack). The second is a [performance standard](#), which specifies the amount of permissible pollution (e.g., effluent pollution must be reduced to x parts of pollutant per million parts water), leaving the choice of pollutant reduction technology to the polluter. Failure to comply with environmental regulations can result in penalties, fines, litigation costs, and increased inspections leading to lost productivity, plant closure, and bad press (not to mention potential environmental and human health consequences).

International norms are also relevant to corporate sustainability. Although not a binding law, the United Nations Millennium Development Goals are the product of a gathering of world leaders in 2000 and include goals such as the elimination of extreme poverty, the promotion of gender equality and female empowerment, and the attainment of environmental sustainability. The poverty goal entails reducing the number of people living on less than US\$1 per day and achieving full and productive employment for all people. The gender equality goal entails increasing the share of women in wage employment in nonagricultural sectors. The environmental goal entails integrating sustainable principles into policies and programs, as well as reversing the loss of biodiversity and environmental resources. Corporate activity can either advance the world toward meeting these goals or undermine our ability to meet these goals.

Concept Check Questions

31. The _____ standard specifies the type of technology necessary for the pollution source to be in compliance with the regulation (e.g., a certain type of pollution-scrubbing filter must be installed on a smokestack).

- ☐ a) design
- ☐ b) performance
- ☐ c) operational
- ☐ d) green
- ☐ e) legal

Correct or Incorrect?

Clear

Check Answer

32. The _____ standard specifies the amount of permissible pollution (e.g., effluent pollution must be reduced to x parts of pollutant per million parts water), leaving the choice of pollutant reduction technology to the polluter.

- ☐ a) design
- ☐ b) performance
- ☐ c) operational
- ☐ d) green
- ☐ e) legal

Correct or Incorrect?

Clear

Check Answer

33. International norms are not relevant to corporate sustainability.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

34. The United Nations Millennium Development Goals are a binding legal standard.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Community Relations

Another reason to implement sustainability is to effectively manage community relations. Failure to operate a company sustainably can lead to stigma and lost trust in the community. Consumers will cease purchasing from a company that they feel is not loyal to the interests of the community in which business is done. A negative reputation with stakeholders can negatively impact the financial bottom line of a company. Just consider the community relations issues BP encountered following the Gulf oil spill.

Concept Check Questions

35. Failure to operate a company sustainably can lead to stigma and lost trust from the community.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

36. Negative reputation with stakeholders rarely impacts the financial bottom line of a company.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Revenue

Managers are perennially aware of the need for minimizing costs and maximizing revenue—in other words, creating financial value. Sustainability offers a means to this end. Financial value can be created by lowering operating costs through the adoption of more energy-efficient technology. Furthermore, financial value can be created by process improvements such as lean manufacturing principles, eliminating unduly burdensome steps, and eliminating barriers to smooth-flowing processes.

Concept Check Questions

37. Managers are perennially aware of the need for minimizing costs and maximizing revenue.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

38. Sustainability is a cost and rarely creates financial value.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Ethical Responsibility

An additional motive for implementing sustainability principles stems from our sense of moral obligation to preserve life. Hypoxia is the condition of oxygen depletion in aquatic environments that threatens life forms. Caused by pollution and eutrophication from runoff, hypoxia leads to “dead zones” where shark, fish, and invertebrate carcasses can be seen strewn across the ocean floor. Companies concerned that their production processes are causing hypoxia can adopt more effective sewage treatment to prevent pollutants and fertilizers from leaching into bodies of water. Doing so would be motivated by a moral concern for the preservation of living creatures or simply out of self-interest for our access to fish for consumption.

Nike has taken steps to address water pollution in its supply chain. The company initiated the “Nike Water Program” to reduce water usage and improve wastewater treatment in textile manufacturing. Nike collaborates with suppliers to implement water efficiency measures, reducing the impact of its operations on water resources and ecosystems.

Whether we care for the environment because it is intrinsically valuable or because it ultimately serves our ends, our moral radars should consider the welfare of living creatures. In addition, morality would prohibit imposing harms on individuals who do not consent to be put at risk. This moral concern would motivate a company to adopt pollution control technology to decrease the amount that surrounding communities are exposed to airborne or

waterborne pollutants. If a company knew that emissions from a manufacturing plant were directly responsible for the cancer of many locals, even though the plant complied with environmental laws, managers with sensitivity to moral considerations would protect nearby human lives by taking measures to reduce carcinogenic emissions from their plant. A desire to fulfill our moral obligation to avoid unnecessary harm serves to motivate sustainability.

There are at least three different frameworks for thinking about ethical duties to adopt sustainable practices: minimalism, reasonable care, and good works. A [minimalist ethic](#) views precautions as worthwhile simply to avoid liability. A [reasonable care ethic](#) takes available measures to eliminate foreseeable risks either by designing out the risk or providing protection against the risk. A [good work ethic](#) goes beyond what is legally required to take affirmative steps to discover potential hazards and proactively safeguard society against them. Regardless of which of these moral perspectives one adopts, most of us view human welfare as intrinsically valuable, and environmental welfare is worth protecting because of its “instrumental” value for humans. Even under this human-oriented framework, proactive measures to preserve environmental integrity are justified as means of bolstering human welfare.

Governmental regulations, public relations, cost imperatives, and moral obligations are all rationales for sustainability in SCM, and these rationales are interconnected. Failure to adopt sustainable practices can lead to fines for regulatory noncompliance, which negatively impacts the financial bottom line by exacerbating operating costs. Furthermore, noncompliance likely causes some environmental or human health damages, which tarnishes the company's reputation and possibly compromises the moral obligations of managers to avoid imposing uncompensated harm on others. Instead of asking, “Why should we operate sustainably?” the presumptive question should be, “Why ‘not’ operate sustainably?”



Evaluating Sustainability in SCM

Managers are under the burden of balancing the influences of resource availability, customer demand, consumer activism, employee loyalty, and government regulations. In this section, we present a model that integrates social and environmental impacts into a company's SCM strategy.

Concept Check Questions

39. _____ is the condition of oxygen depletion in aquatic environments that threatens life forms.

- ☐ a) Anoxia
- ☐ b) Anaerobiotic
- ☐ c) Hypoxia
- ☐ d) Under saturation

Correct or Incorrect?

Clear

Check Answer

40. Nike has taken steps to address water pollution in its supply chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

41. Morality would prohibit imposing harms on individuals who do not consent to be put at risk.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

42. A _____ ethic views precautions as worthwhile simply to avoid liability.

- ☐ a) superior
- ☐ b) minimalist
- ☐ c) legal
- ☐ d) reasonable care
- ☐ e) good works

Correct or Incorrect?

Clear

Check Answer

43. A _____ ethic takes available measures to eliminate foreseeable risks either by designing out the risk or providing protection against the risk.

- ☐ a) superior
- ☐ b) minimalist
- ☐ c) design
- ☐ d) reasonable care
- ☐ e) good works

Correct or Incorrect?

Clear

Check Answer

44. A _____ ethic goes beyond what is legally required to take affirmative steps to discover potential hazards and proactively safeguard society against them.

- ☐ a) superior
- ☐ b) minimalist
- ☐ c) green
- ☐ d) reasonable care
- ☐ e) good works

Correct or Incorrect?

Clear

Check Answer

45. Failure to adopt sustainable practices can lead to fines for regulatory noncompliance.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

The Supply Chain Sustainability Model

The supply chain sustainability model provides the elements of a successful sustainability strategy and shows how they are related. It is illustrated in

[Figure 13.4.](#) The continuum presented in the model includes inputs that feed into organizational and supply chain processes and lead to outputs.

The model shows that management decisions—in the form of processes and organizational and supply chain structures—create an environmental and social impact. Supply chain sustainability performance, in turn, leads to stakeholder reactions that then impact long-term financial performance. A feedback loop connects processes, outputs, and outcomes, indicating a shift in the inputs as a result of performance. Processes, outputs, and outcomes define the costs and benefits of supply chain activity. Processes also have an immediate effect on long-term financial performance. As shown, financial performance is affected by the stakeholder reaction to sustainability performance. The following expands on each of the elements of this model. H&M has implemented various processes to improve sustainability in its supply chain. The company emphasizes transparency in its supply chain, ensuring ethical manufacturing practices and promoting eco-friendly materials. H&M's initiatives include recycling programs, water-saving technologies, and sustainable fashion collections. H&M aims to use 100% sustainable materials by 2030. This includes recycled materials and materials obtained from sustainable sources. In 2022, 84% of H&M's materials were sustainably sourced.

INPUTS → PROCESSES → OUTPUTS → OUTCOMES

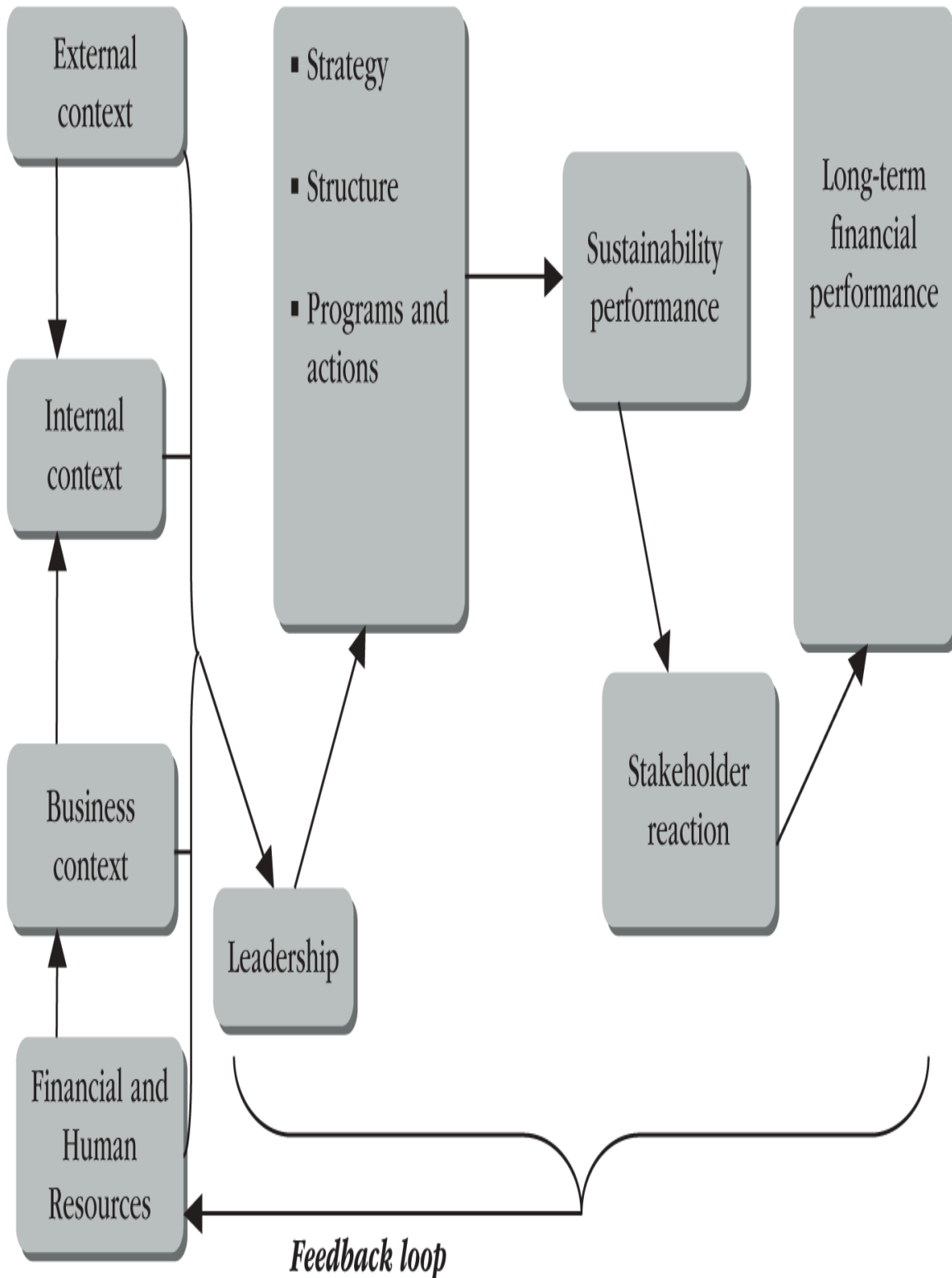


FIGURE 13.4 The Supply Chain Sustainability Model.

Source: Adapted from: Epstein, Marc J., and Adriana R. Buhovac. Making Sustainability Work: Best Practices in Managing and Measuring Corporate Social, Environmental, and Economic Impacts, 2nd edition. Sheffield, UK: Greenleaf Publishing, 2014.

Concept Check Questions

46. The Supply Chain Sustainability Model provides the elements of a successful sustainability strategy and shows how they are related.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

47. Which of the following is not an input to the Supply Chain Sustainability Model?

- ☐ a) Internal context
- ☐ b) Business context
- ☐ c) Financial and human resources
- ☐ d) Profitability
- ☐ e) External context

Correct or Incorrect?

Clear

Check Answer

48. Which of the following is not process of the Supply Chain Sustainability Model?

- ☐ a) Structure
- ☐ b) Strategy
- ☐ c) Leadership
- ☐ d) Programs and actions
- ☐ e) Sustainability performance

Correct or Incorrect?

Clear

Check Answer

Model Inputs

The [external context](#) of SCM pertains to government and market-based influences. In all countries, government regulations impose burdens on industries to follow minimum health and safety standards, although their stringency varies by location. This includes the disposal of hazardous or toxic waste, various emissions pollutants, employee discrimination, safe working conditions, minimum wages, and the minimum age of employees, which are subject to regulation. Similar to governmental regulations, market influences on the sustainability model depend on where the company does business. The marketplace for products and services will reflect consumer tolerance for pollution, among other things. Other factors such as weather patterns, topography, population wealth, and access to information also sway the market's response to corporate sustainability decisions.

The ability of a supply chain to become sustainable also depends on its [internal context](#). Not only the pressure to increase revenue and pay dividends to shareholders, but also the mission statements, dominant strategies, organizational structures, decision-making procedures, and operating systems within each business unit of a corporation form the internal context of sustainability. Each element in this context may have a positive or negative effect on efforts to achieve sustainability and should be critically evaluated in light of its tendency toward efficient, sustainable operations.

Different industry sectors will have to deal with unique issues stemming from different [business contexts](#). For example, energy, chemical, and mining industries will create risks to the environment and human health, whereas

service industries and product manufacturers may pose social risks in terms of working conditions and consumer relations. Companies with the greatest potential to gain or lose from sustainability initiatives include companies with high-profile brands, companies whose supply chains carry significant environmental impacts, companies that significantly depend on natural resources, and companies that face current or potential regulatory exposure. Uniform labor and inspection standards, as well as industry codes of conduct, are responses to pressures arising from the business context.

Sustainability performance is greatly affected by the [human and financial resources](#) committed to its achievement. The implementation of sustainability programs requires a significant upfront allocation of company resources. This resource investment should pay for itself in the long run in terms of avoided costs, but upfront capital is needed to adequately educate pertinent employees to detect sustainability issues. Furthermore, these employees must be equipped with sufficient resources to act on revelations of risk.

Concept Check Questions

49. The _____ of SCM pertains to government and market-based influences.

- ☐ a) external context
- ☐ b) internal context
- ☐ c) business contexts
- ☐ d) human and financial resources
- ☐ e) legal context

Correct or Incorrect?

Clear

Check Answer

50. Not only the pressure to increase revenue and pay dividends to shareholders, but also the mission statements, dominant strategies, organizational structures, decision-making procedures, and operating systems within each business unit of a corporation form the _____ of sustainability.

- ☐ a) external context
- ☐ b) internal context
- ☐ c) business contexts
- ☐ d) human and financial resources
- ☐ e) lean context

Correct or Incorrect?

Clear

Check Answer

51. Different industry sectors will have to deal with unique issues stemming from different _____.

- ☐ a) external context
- ☐ b) internal context
- ☐ c) business contexts
- ☐ d) human and financial resources

Correct or Incorrect?

Clear

Check Answer

52. Sustainability performance is greatly affected by the _____ committed to its achievement.

- ☐ a) external context
- ☐ b) internal context
- ☐ c) business contexts
- ☐ d) human and financial resources
- ☐ e) time

Correct or Incorrect?

Clear

Check Answer

Leadership

Leadership involves factoring all the “inputs” (external, internal, and business contexts, as well as human and financial resources) into management decisions. The most effective leadership comes from a clear commitment to sustainable performance on the part of top management that is effectively communicated through all the layers of the organization. Leaders must be sufficiently knowledgeable and committed to their vision to translate it into actual performance. Creating a vice president position to oversee sustainability, including major business unit managers on a sustainability committee, and joining with suppliers are ways of ensuring sustainability issues are addressed from the top down. Leaders must demonstrate commitment to sustainability, search for risks and opportunities associated with sustainability, and foster a sustainable corporate culture.

Yvon Chouinard, the founder of Patagonia, exemplifies leadership in sustainability. He instilled a strong commitment to environmental responsibility within the company. Patagonia's leadership actively promotes sustainability initiatives, such as the “Don't Buy This Jacket” campaign, encouraging consumers to consider the environmental impact of their purchases.

Concept Check Questions

53. _____ involves factoring all the “inputs” (external, internal and business contexts, as well as human and financial resources) into management decisions.

- ☐ a) Management
- ☐ b) Leadership
- ☐ c) Administration
- ☐ d) Supervision

Correct or Incorrect?

Clear

Check Answer

54. The most effective leadership comes from a clear commitment to sustainable performance on the part of top management that is effectively communicated through all the layers of the organization.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Processes

A sustainability strategy is a plan that guides the company and its supply chain toward long-term profitability that protects consumers, employees, and the environment. This strategy is put into place by a combination of internal structures and programs.

Sustainability can be promoted through changes in organizational design, such as the creation of a sustainable structure. Rather than relegating sustainability concerns to one department within an organization—such as operations or human resources—responsibility for sustainable performance should be diffused within each function of the company. Such a structure enables each operating unit to see the costs and benefits of its environmental and social responsibility. Sustainable structures should be integrated throughout the organization and between supply chain members, capitalize on human resources, and provide feedback on sustainability performance from management to top leaders.

The chocolate manufacturer Mars has integrated sustainability into its organizational structure by emphasizing responsible sourcing and sustainable

agricultural practices. The company's “Sustainable in a Generation Plan” aims to make a positive impact on the planet. Mars has structured its supply chain and operations to prioritize sustainable sourcing of raw materials such as cocoa and palm oil. For example, Mars reduced its mill partners from 1,500 to fewer than 100 to improve traceability and empower farmers to find more sustainable methods for growing cocoa. Mars also maps key supply chains to better understand where it sources products. Furthermore, Mars set a goal to reduce value chain emissions by 67% by 2050.

Management systems, such as programs and actions, must be aligned to achieve sustainability. Programs to promote sustainability should tie incentives and rewards with effective environmental and social sustainability performance. This requires evaluation of economic, environmental, and social factors in assessing performance, not simply an evaluation of quarterly earnings. Sustainability actions can be either [proactive](#) or [reactive](#), depending on when risks are identified. Furthermore, sustainability actions should be both [internal](#) (such as training employees or site audits) and [external](#) (such as supplier audits and public accountability).

Concept Check Questions

55. A sustainability strategy is a plan that guides the company and its supply chain toward long-term profitability that protects consumers, employees, and the environment.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

56. Sustainability should be delegated to one department within an organization.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

57. Programs to promote sustainability should tie incentives and rewards with effective environmental and social sustainability performance.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Sustainability Performance

[Sustainability performance](#) is the overall metric designed to reflect organizational performance along multiple dimensions. This metric incorporates all positive and negative impacts on all of the company's stakeholders. Sustainability performance can be enhanced by reducing negative impacts or increasing positive impacts and preferably both. Regardless of how sustainability performance is measured, it is necessary to evaluate performance, recognize impacts, and look for improvement. One of the most critical variables in evaluating corporate sustainability performance is the definition of stakeholders. A narrowly defined set of stakeholders, such as shareholders in the company, will probably omit a significant array of impacts that accrue to individuals who do not own stock in the company and thus reflect a higher sustainability performance score. A broadly defined set of stakeholders would probably lead to a greater estimate of costs and hence a lower sustainability performance score.

Concept Check Questions

58. Green performance is the overall metric designed to reflect organizational performance along multiple dimensions.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

59. One of the most critical variables in evaluating corporate sustainability performance is the definition of employees.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Stakeholders' Reaction

Given the many potential stakeholders, listening and responding to stakeholder reactions is easier said than done. However, ignoring stakeholder reactions is done at the peril of the supply chain's profitability. At a minimum, supply chains should consider the impacts of their activities on shareholders, customers, suppliers, employees, and surrounding communities. Stakeholders can react in both positive and negative ways. Customers can remain loyal or boycott. Talented employees can migrate to more sustainable employers. Regulators and surrounding communities can exert pressure on major

polluters. Shareholders may use sustainability as a criterion for investment decisions.

Concept Check Questions

60. Listening and responding to stakeholder reactions is easy.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

61. At minimum, supply chains should consider impacts of their activities on shareholders, customers, suppliers, employees, and surrounding communities.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

62. There is not much customers can do if they are unhappy with a firm.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Financial Performance

The monetization of the impact of supply chain activities allows managers to evaluate sustainability initiatives in light of the ultimate goal: improved financial performance. The notion that supply chain sustainability enhances revenue and lowers costs has broad support. Social reputation is a significant success factor in an informed, competitive market. Process improvements can lead to multimillion-dollar energy savings and increase shareholder ROI. Furthermore, sustainable decisions can lead to decreased incidents of legal fees and penalties as well as lower packaging and distribution costs. Internally, companies that invest in the health and welfare of their employees realize benefits in terms of increased productivity and employee loyalty. The supply chain sustainability model allows us to make a business case for sustainability by relating environmental and social impacts to financial performance.

Concept Check Questions

63. The monetization of the impact of supply chain activities allows managers to evaluate sustainability initiatives in light of the ultimate goal of lower stock prices.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

64. Social reputation is a significant success factor in an informed, competitive market.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

65. Sustainable decisions can lead to increased incidents of legal fees and penalties.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Feedback

Effective [feedback loops](#) enable leaders to take data relating to outputs and outcomes and translate them into improvements in internal processes. To be useful toward the goal of sustainability, feedback mechanisms must not rely solely on monetary information but must include performance criteria relating to environmental, social, and economic matters. Feedback mechanisms are essential for organizational learning and allow each supply chain member to continue to assess their progress toward long-term goals.

Concept Check Questions

66. Effective _____ enable leaders to take data relating to outputs and outcomes and translate them into improvements in internal processes.

- ☐ a) feedback loops
- ☐ b) stock markets
- ☐ c) management dashboards
- ☐ d) employee feedback

Correct or Incorrect?

Clear

Check Answer

67. Feedback mechanisms are essential for organizational learning and allow each supply chain member to continue to assess their progress toward long-term goals.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Enforcement, Compliance, and Innovation

Adopting principles of sustainability does not happen accidentally. Owners, directors, and managers must conscientiously and resolutely decide to implement sustainability in their supply chains. There are three drivers of sustainable initiatives. They are enforcement, compliance, and innovation—or a mixture of all three. Let us look at these in a bit more detail.

Concept Check Questions

68. Adopting principles of sustainability can happen accidentally.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

69. There are _____ drivers of sustainable initiatives.

- ☐ a) two
- ☐ b) three
- ☐ c) four
- ☐ d) six

Correct or Incorrect?

Clear

Check Answer

Enforcement

Governmental decision makers can require companies to adopt practices that are deemed environmentally safe and socially responsible, using laws and government regulation. With powers of official oversight accompanied by sanctions for noncompliance, these agencies can enforce sustainable initiatives. For example, the U.S. Clean Air Act authorizes the Environmental Protection Agency (EPA) to enact and enforce mandatory regulations that apply to companies that own major pollutant-emitting facilities.

Concept Check Questions

70. Governmental decision makers cannot require companies to adopt practices that are deemed environmentally safe and socially responsible.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

71. The U.S. Clean Air Act authorizes the Environmental Protection Agency (EPA) to enact and enforce mandatory regulations that apply to companies that own major pollutant-emitting facilities.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Compliance

Compliance is voluntary participation in sustainable practices. A popular way of encouraging compliance with sustainability has been through industry-initiated certification programs. These programs provide benefits to firms in the form of advertising—such as logos that appeal to the preferences of a growing number of environmentally conscious consumers—and group membership—which provides directory listings and other perks. Rather than imposing sanctions, failure to comply with voluntary programs leads simply to the withdrawal of the firm's membership with the host organization and the revocation of certification for the firm's products or services.

Concept Check Questions

72. _____ is voluntary participation in sustainable practices.

- ☐ a) Concession
- ☐ b) Obedience
- ☐ c) Obligation
- ☐ d) Compliance

Correct or Incorrect?

Clear

Check Answer

73. Compliance programs provide benefits to firms in the form of advertising.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

74. Failure to comply with voluntary programs leads simply to sanctions.

- ☐ True
- ☐ False

Correct or Incorrect?

Innovation

Motivated by internal initiatives, companies may be driven to innovate over current practices to enhance operations. Often an incidental benefit of this is the satisfying of environmental or social priorities. Unlike enforcement, innovation is voluntary. Unlike compliance, innovation is internal. What a company's environmental and social goals are, and whether they have been achieved in measurable ways, are not necessarily disclosed to consumers, or if they are published, the data are used as “bragging rights” by the company.

In practice, these three implementation methods exist in a hybrid form. Imagine a large company that emits a great magnitude of pollution in operations that span several countries. This company would be subject to various governmental enforcement measures, would probably voluntarily comply with some industry-sponsored certification programs, and would internally fund research and development to promote sustainable innovation. In this case, all three drivers—enforcement, compliance, and innovation—overlap in realizing sustainable supply chains. These drivers succeed at achieving independent oversight to ensure actual sustainability. Although it appears obvious to everyone that some level of enforcement is necessary, the precise level of enforcement remains an open question.

Implementation of sustainability usually happens incrementally, with companies and their supply chains moving through three stages. This is illustrated in [Figure 13.5](#). First, companies begin incorporating common sense measures such as recycling in bulk, shutting down idling electronics, turning off lights when not in use, and using teleconferencing instead of traveling for meetings. The goal at this stage is simply to reduce the carbon footprint or other metric of sustainability. Microsoft, for example, implemented default double-sided printing across all its offices, reducing paper usage by 40%. Also, set all computers and monitors to sleep when not in use, cutting energy costs. Similarly, Sony instituted a strict recycling program for e-waste and food waste across its facilities. Over 18,000 tons of waste gets recycled annually rather than sent to landfills.

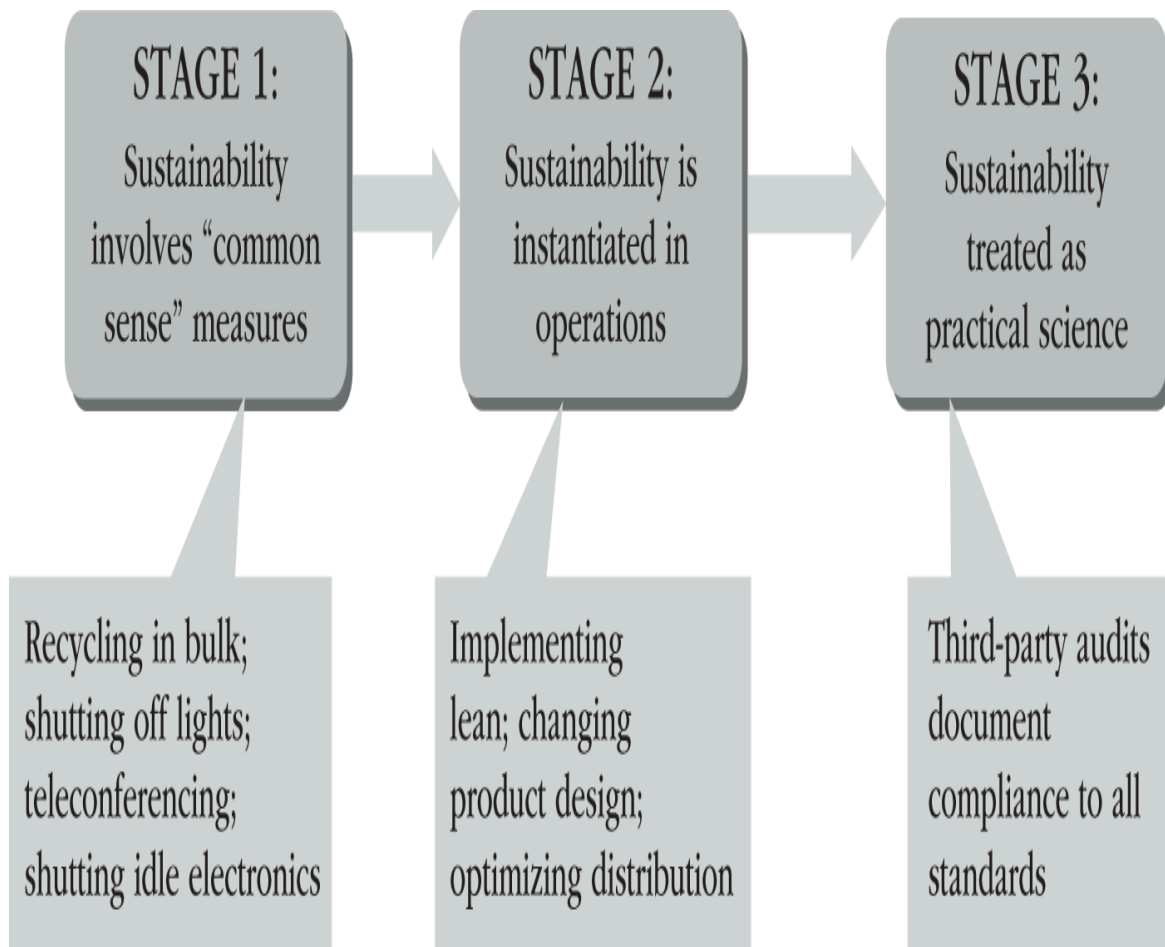


FIGURE 13.5 Stages of sustainability implementation.

Second, at more sophisticated levels of sustainable management, sustainable principles become instantiated in operations. Companies begin to conduct internal assessments to reduce the adverse impacts of their operations on surrounding environments. This stage involves implementing lean principles, rationalizing manufacturing, strategic sourcing, changing product design, and optimizing distribution channels. IKEA, for example, conducted life cycle analyses to find sustainable sourcing opportunities and material changes to reduce carbon emissions from production and transportation. It also redesigned products for flat-packing and minimized packaging.

Third, the most refined perspective with which to approach sustainability treats sustainability as a practical science. At this stage, third-party audits provide an objective framework against which to evaluate organizations and standards that are set by governmental or industry groups. For example, Starbucks got its coffee production facilities certified to the C.A.F.E. Practices standard for sustainable coffee production. This involved third-party

verification on economic, social, and environmental aspects such as water use and pest management.

Concept Check Questions

75. Motivated by internal initiatives, companies may be driven to innovate over current practices to enhance operations.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

76. Sustainability involves “common sense” measures.

- ☐ a) Stage 1 of sustainability implementation
- ☐ b) Stage 2 of sustainability implementation
- ☐ c) Stage 3 of sustainability implementation
- ☐ d) Stage 4 of sustainability implementation
- ☐ e) Stage 5 of sustainability implementation

Correct or Incorrect?

Clear

Check Answer

77. Sustainability is instantiated in operations.

- ☐ a) Stage 1 of sustainability implementation
- ☐ b) Stage 2 of sustainability implementation

- ☐ c) Stage 3 of sustainability implementation
- ☐ d) Stage 4 of sustainability implementation
- ☐ e) Stage 5 of sustainability implementation

Correct or Incorrect?

Clear

Check Answer

78. Sustainability is treated as practical science.

- ☐ a) Stage 1 of sustainability implementation
- ☐ b) Stage 2 of sustainability implementation
- ☐ c) Stage 3 of sustainability implementation
- ☐ d) Stage 4 of sustainability implementation
- ☐ e) Stage 5 of sustainability implementation

Correct or Incorrect?

Clear

Check Answer

79. Recycling in bulk; shutting off lights; teleconferencing; shutting idle electronics.

- ☐ a) Stage 1 of sustainability implementation
- ☐ b) Stage 2 of sustainability implementation
- ☐ c) Stage 3 of sustainability implementation
- ☐ d) Stage 4 of sustainability implementation
- ☐ e) Stage 5 of sustainability implementation

Correct or Incorrect?

Clear

Check Answer

80. Implementing lean; changing product design; optimizing distribution.

- ☐ a) Stage 1 of sustainability implementation
- ☐ b) Stage 2 of sustainability implementation
- ☐ c) Stage 3 of sustainability implementation
- ☐ d) Stage 4 of sustainability implementation
- ☐ e) Stage 5 of sustainability implementation

Correct or Incorrect?

Clear

Check Answer

81. Third-party audits document compliance to all standards.

- ☐ a) Stage 1 of sustainability implementation
- ☐ b) Stage 2 of sustainability implementation
- ☐ c) Stage 3 of sustainability implementation
- ☐ d) Stage 4 of sustainability implementation
- ☐ e) Stage 5 of sustainability implementation

Correct or Incorrect?

Clear

Check Answer

Measures of Sustainability in SCM

Sustainable SCM enables a firm to meet the triple bottom line of social responsibility, environmental stewardship, and economic viability. There are several approaches to measuring whether a product or service is sustainable.

Total cost of ownership (TCO), which we discussed in [Chapter 7](#), is a measure that considers economic viability by estimating the sum of all costs of a product, including procurement, manufacture, distribution, usage, and disposal. Consider a frozen pizza or a car battery. Both products involve gathering component parts, combining these parts into a product, shipping these products to retail, using the product, and efforts to dispose of the residual material. Of course, the costs at each step in the supply chain would widely vary and would involve distinct risks. The frozen pizza seems a relatively benign product until one considers the total costs: the product requires the consumption of trees for packaging, consumption of energy in freezing, and consumption of energy in baking. The car battery's most salient risk is in terms of end of life: improper disposal of car batteries can pose significant negative effects on the environment. The total cost of ownership approach helps us consider the costs of a product that are not reflected in its price tag.

Tesla, for example, considers TCO in its electric vehicles. While the upfront cost of a Tesla might be higher compared to conventional cars, the company emphasizes long-term cost savings in terms of fuel efficiency, reduced maintenance, and potential savings on repair and replacement of components. By highlighting the overall economic viability of owning a Tesla, the company factors in the TCO to justify its premium pricing.

Life-cycle assessment (LCA) is an approach that considers environmental stewardship by analyzing the environmental aspects and potential impacts associated with a product, process, or service. For example, certain lines of products require energy-intensive manufacturing methods, where energy is predominantly supplied by coal-powered electricity plants. In evaluating the sustainability of this product, the LCA would consider the environmental consequences of coal combustion corresponding to the amount of energy generated by that combustion used to manufacture the product. Therefore, the LCA broadens the scope of costs visible to the manufacturer.

Ecological footprint is a metric, similar to LCA, that is sensitive to environmental degradation concerns. However, unlike LCA, it focuses on the consumer rather than the producer. This approach quantifies the land and water area a population requires to produce the resources it consumes and to absorb its wastes. Take, for example, hamburgers. In evaluating the sustainability of hamburgers as a food product, the ecological footprint approach asks how much land is necessary to grow the corn that is used to

feed the cattle—and how much land is needed for the cattle. Therefore, we can spatially represent the impact of product choices by consumers.

There is an ecological footprint metric that measures the amount of carbon released into the atmosphere, which is correlated with adverse effects on climate stability. It is actually a component of the LCA. Measuring the amount of carbon dioxide emitted by manufacturing processes allows us to roughly gauge how much any individual polluter is contributing to atmospheric degradation and, in turn, climate change.

Google has been proactive in measuring and mitigating its carbon footprint. The company has been carbon neutral since 2007 and has set ambitious goals to operate on 24/7 carbon-free energy by 2030. Google invests in renewable energy sources, implements energy-efficient technologies in its data centers, and continuously works on reducing its overall carbon emissions.

The [food mile](#) is a metric that measures the distance between the production source and the retail location, correlating distance traveled with energy consumption and pollution emissions. The longer food travels from its source to the grocery store or restaurant, the more gasoline is combusted, both consuming energy resources and emitting harmful pollutants.

All these measures are effective. Ultimately, it does not matter which analytic criteria is used in measuring the sustainability of a product or service, as long as this framework is employed consistently.

Concept Check Questions

82. _____ is a measure that considers economic viability by estimating the sum of all costs of a product, including procurement, manufacture, distribution, usage, and disposal.

- ☐ a) Total cost of ownership (TCO)
- ☐ b) Life-cycle assessment (LCA)
- ☐ c) Ecological footprint
- ☐ d) Carbon footprint
- ☐ e) Food mile

Correct or Incorrect?

Clear

Check Answer

83. _____ is an approach that considers environmental stewardship by analyzing the environmental aspects and potential impacts associated with a product, process, or service.

- ☐ a) Total cost of ownership (TCO)
- ☐ b) Life-cycle assessment (LCA)
- ☐ c) Ecological footprint
- ☐ d) Carbon footprint
- ☐ e) Food mile

Correct or Incorrect?

Clear

Check Answer

84. _____ is a metric that is sensitive to environmental degradation concerns. It focuses on the consumer rather than the producer.

- ☐ a) Total cost of ownership (TCO)
- ☐ b) Life-cycle assessment (LCA)
- ☐ c) Ecological footprint
- ☐ d) Carbon footprint
- ☐ e) Food mile

Correct or Incorrect?

Clear

Check Answer

85. _____ is an ecological footprint metric that measures the amount of carbon released into the atmosphere, which is correlated with adverse effects on climate stability.

- ☐ a) Total cost of ownership (TCO)
- ☐ b) Life-cycle assessment (LCA)
- ☐ c) Ecological footprint
- ☐ d) Carbon footprint
- ☐ e) Food mile

Correct or Incorrect?

Clear

Check Answer

86. _____ is a metric that measures the distance between the production source and the retail location, correlating distance traveled with energy consumption and pollution emissions.

- ☐ a) Total cost of ownership (TCO)
- ☐ b) Life-cycle assessment (LCA)
- ☐ c) Ecological footprint
- ☐ d) Carbon footprint
- ☐ e) Food mile

Correct or Incorrect?

Clear

Check Answer

Values in Sustainable SCM

To accurately gauge the desirability of implementing sustainability, we must understand the full spectrum of costs and values at stake. Sustainable corporations see market benefits such as increased sales from increased

demand, increased prices from improvements in quality, reductions in operating costs from efficiencies, improved productivity, and avoided future costs in terms of environmental costs or damaged reputation. Nonmarket benefits are not experienced directly by the company, but also need to be considered. These nonmarket benefits include recreational uses of fishable, swimmable bodies of water, improvements in biodiversity, and greater life span and health on the part of the affected community.

The total value of a natural resource is a combination of three separate values: use value, option value, and existence value. Use value is the benefit derived from consumption or utilization of a resource. Option value and existence value are often termed “nonuse” values, as their benefits are not derived from actual use. Option value is the value placed on the ability to exercise the option in the future. It applies to irreplaceable resources with uncertain benefits: we value the ability to preserve the resource for future potential use. Existence value is the benefit people receive from knowing that a resource exists. Unlike the former two concepts of value, existence value is autonomous of human use or utility. For example, people place value on the very existence of a natural resource, such as Yellowstone Park, and seek to preserve it for its own sake. Concepts such as to pay (WTP) for an environmental resource, or WTA compensation in exchange for giving up an environmental resource, are approximate indicators of the value stakeholders place on the environment affected by corporate activity. Managers should attempt to measure these values so as to include them in sustainable organizational behavior.

Concept Check Questions

87. _____ value is the benefit derived from consumption or utilization of a resource.

- ☐ a) Use
- ☐ b) Option
- ☐ c) Existence
- ☐ d) Consumption

Correct or Incorrect?

Clear

Check Answer

88. _____ value is value placed on the ability to exercise the option in the future.

- ☐ a) Use
- ☐ b) Option
- ☐ c) Existence
- ☐ d) Future

Correct or Incorrect?

Clear

Check Answer

89. _____ value is the benefit people receive from knowing that a resource exists.

- ☐ a) Use
- ☐ b) Option
- ☐ c) Existence
- ☐ d) Knowledge

Correct or Incorrect?

Clear

Check Answer

Cost Assessment

Measurements of stakeholder preference are inherently uncertain, but approximations give managers at least a sense of the magnitude of the costs at

stake. Monetizing external costs translates the impacts of corporate activity into terms that are commensurable with the internal motivators of corporate decisions. Monetization therefore allows firms to “see” the cost of their actions and, perhaps, internalize those costs. The two main models for monetizing environmental and social effects are cost-of-control and damage costing.

Concept Check Questions

90. Measurements of stakeholder preference are very certain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

91. Monetizing external costs translates the impacts of corporate activity into terms that are commensurable with the internal motivators of corporate decisions.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Cost of Control

Cost of control represents the cost of avoiding damages before they occur. If avoiding the damage imposes a cost on the corporation, then allowing the damage to occur could be understood as a value to the corporation. This approach effectively places a value on social or environmental damage by calculating the cost to avoid these damages. Consider the decision of whether to upgrade the lining in a waste storage container that holds toxic sludge from coal ash created by electricity generation. The environmental and social costs of such a leaking storage tank could involve (among other things) the death of aquatic animal and plant life, loss of agricultural opportunities, and the carcinogenic contamination of drinking water. The monetary value of these items is extremely difficult to determine, especially because each depends on unique circumstances and probabilities and involves distinct forms of measurement. However, the cost of installing adequate control technology, such as improved synthetic lining inside the storage tank, is easily determined. The cost-of-control method therefore allows simple and accurate calculations of the cost of decisions, without getting into technically challenging determinations of the full consequences of present decisions or future events.

A variation on the cost-of-control model is the **shadow pricing** model. This approach assumes governmental regulations reflect society's willingness to pay for sustainability performance and derives this amount from the cost of compliance with the regulation. This approach depends on the governmental body correctly estimating the level of control society is willing to pay for. It may be true that society would pay much more for improved sustainability performance than what the regulations would suggest, especially when the regulations simply set a minimum safety threshold.

Concept Check Questions

92. This represents the cost of avoiding damages before they actually occur.

- ☐ a) Cost-of-control
- ☐ b) Shadow pricing
- ☐ c) Damage costing
- ☐ d) Activity-based costing
- ☐ e) Life-cycle costing

Correct or Incorrect?

Clear

Check Answer

93. This approach effectively places a value on social or environmental damage by calculating the cost to avoid these damages.

- ☐ a) Cost-of-control
- ☐ b) Shadow pricing
- ☐ c) Damage costing
- ☐ d) Activity-based costing
- ☐ e) Life-cycle costing

Correct or Incorrect?

Clear

Check Answer

94. This approach assumes governmental regulations reflect society's willingness to pay for sustainability performance and derives this amount from the cost of compliance with the regulation.

- ☐ a) Cost-of-control
- ☐ b) Shadow pricing
- ☐ c) Damage costing
- ☐ d) Activity-based costing
- ☐ e) Life-cycle costing

Correct or Incorrect?

Clear

Check Answer

95. This approach depends on the governmental body correctly estimating the level of control society is willing to pay for.

- ☐ a) Cost-of-control
- ☐ b) Shadow pricing
- ☐ c) Damage costing
- ☐ d) Activity-based costing
- ☐ e) Life-cycle costing

Correct or Incorrect?

Clear

Check Answer

Damage Costing

Damage costing represents the cost of damages as if they had occurred. These cost calculations require significant amounts of data, time, and expense to perform accurately. Damage costing approximates the cost of social or environmental damage as an estimate of stakeholders' WTP to avoid the damage. In the coal ash storage tank example discussed earlier, consider how difficult it would be to determine the actual monetary cost of lost amphibious populations, or the slight increase in the probability that a few members of the surrounding community would get cancer. Determining actual costs can be very difficult endeavor and leaves the decision maker with considerable uncertainty. Stakeholders' WTP can be extrapolated from market price or appraisal if the resource is traded on an active market, and even the use of focus groups can help in its determination.

Concept Check Questions

96. This represents the cost of damages as if they had actually occurred.

- ☐ a) Cost-of-control
- ☐ b) Shadow pricing
- ☐ c) Damage costing

- ☐ d) Activity-based costing
- ☐ e) Life-cycle costing

Correct or Incorrect?

Clear

Check Answer

97. Damage costing approximates the cost of social or environmental damage as an estimate of stakeholders' WTP to avoid the damage.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Costing Systems

Once a company has decided to strive for sustainable performance, it must include adequate costing systems to account for environmental costs. This can be done through activity-based costing, life-cycle costing, or full-cost accounting. “[Activity-based costing](#)” seeks to avoid lumping together environmental costs with overhead or nonenvironmental costs. Disaggregating the amount spent on waste, for example, from the amount paid for buildings, allows managers to discover opportunities to improve sustainability performance. As a result, managers can identify the causal relationship between the activities that generate environmental consequences and the company's bottom line. Activity-based costing tries to uncover buried social and environmental costs and attribute them to the activities that cause them.

An alternative to activity-based costing is life-cycle costing, an extension of the life-cycle assessment of environmental impacts. “[Life-cycle costing](#)” is the amortized annual cost of a product (including capital and disposal costs),

discounted over the life cycle of a product. Life-cycle costing requires the monetization of present and future costs and benefits of SCM activities. An alternative to both activity-based and life-cycle costing is full-cost accounting, which seeks to incorporate the broadest set of external and future costs.

“**Full-cost accounting**” incorporates the result of life-cycle costing into an accounting framework, which allows managers to base decisions such as product design or price on sustainability impacts. This framework incorporates internal, external, present, and future costs and benefits.

Costing systems are important for SCM sustainability because they allow managers to identify areas that need both money savings and environmental performance improvements. Furthermore, articulated cost models allow managers to make optimal pricing decisions.

Big Data Analytics Box

■ COCA-COLA

In the past Coca-Cola had been more focused on its economic bottom line than on global warming. Then, in 2004, the company lost a lucrative operating license in India because of a serious water shortage. Global droughts have continued and repeatedly dried up the water needed to produce the company's soda. After a decade of struggles, the company has embraced the idea of climate change as an economically disruptive force to their supply chain. Today the company is using big data analytics for risk assessment. Coca-Cola's long-term goal is to have all of its packaging made from at least 50% recycled materials by 2030.

“Increased droughts, more unpredictable variability, 100-year floods every two years,” said Jeffrey Seabright, Coca-Cola's vice president for environment and water resources, listing the problems that he said were also disrupting the company's supply of sugar cane and sugar beets, as well as citrus for its fruit juices. “When we look at our most essential ingredients, we see those events as threats.”

A report by consulting firm WisdomNet, Inc. identifies a number of factors that are contributing to the vulnerability of organizations and their supply chains. These include globalization resulting in longer supply lines; an increasing trend toward outsourcing, which makes “others” responsible for what goes on in the supply chain; and lean operations that have removed inventory from the system, which make firms more efficient, but more vulnerable when unforeseen events occur. One of the many forces includes natural disasters. Coke reflects a growing view among American business leaders and mainstream economists, who see global warming as one force that contributes to lower gross domestic products, higher food and commodity costs, broken supply chains, and increased financial risk. Big data analytics is helping assess risks and optimize sourcing and supply chains to minimize them. Companies such as Coke are relying on predictive analytics tools to help them foresee problems and take preemptive actions to prevent supply chain interruptions anywhere in the world.

Concept Check Questions

98. Once a company has decided to strive for sustainable performance, it must include adequate costing systems to account for environmental costs.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

99. This seeks to avoid lumping together environmental costs with overhead or nonenvironmental costs.

- ☐ a) Cost-of-control
- ☐ b) Shadow pricing
- ☐ c) Damage costing
- ☐ d) Activity-based costing
- ☐ e) Life-cycle costing

Correct or Incorrect?

Clear

Check Answer

100. This is the amortized annual cost of a product (including capital and disposal costs), discounted over the life cycle of a product.

- ☐ a) Full cost accounting
- ☐ b) Shadow pricing
- ☐ c) Damage costing

- ☐ d) Activity-based costing
- ☐ e) Life-cycle costing

Correct or Incorrect?

Clear

Check Answer

101. This requires the monetization of present and future costs and benefits of SCM activities.

- ☐ a) Full cost accounting
- ☐ b) Shadow pricing
- ☐ c) Damage costing
- ☐ d) Activity-based costing
- ☐ e) Life-cycle costing

Correct or Incorrect?

Clear

Check Answer

102. This incorporates the result of life-cycle costing into an accounting framework, which allows managers to base decisions such as product design or price on sustainability impacts.

- ☐ a) Full cost accounting
- ☐ b) Shadow pricing
- ☐ c) Damage costing
- ☐ d) Activity-based costing
- ☐ e) Life-cycle costing

Correct or Incorrect?

Clear

Check Answer

Risk Assessment

Managers must be able to identify and monetize potential risks and include them in ROI and net-present-value determinations. An investment decision that fails to consider a risk assessment is unsound. The company may find the costs of mandatory responsibilities, including product take back and site cleanup, to destroy the expected profits. Risk assessment requires attention to long-time horizons, as well as attention to low-probability events. Sustainability problems pose high costs when they arise, and there is a tendency to omit them as they often take a long time to manifest, and they occur infrequently.

Shell, the global energy company, extensively uses scenario-based analysis in its risk assessment strategies. Shell employs scenario planning to anticipate and plan for potential future changes in the energy landscape, including variations in demand, regulatory shifts, and technological advancements. This approach helps Shell adapt its business to diverse and uncertain circumstances while considering the long-term sustainability implications.

Concept Check Questions

103. Employees must be able to identify and monetize potential risks and include them in return on investment and net-present-value determinations.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

104. Risk assessment uses short-time horizons.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

“Fat Tails”

Environmental crises can be understood statistically as “fat tails,” shown in [Figure 13.6](#). If we look at a distribution curve with the probability of an event on the x -axis and the magnitude of the harm resulting from the event on the y -axis, these events are called “fat tails” in that they are of low probability (they are many standard deviations away from the mean, at the tail of a distribution curve), yet of high consequence (they are called “fat” relative to the consequences of other issues).

Managers need tools for incorporating risks. These tools include scenario-based analysis, fuzzy logic, Monte Carlo simulations, and real option analysis. We look at these next.

Concept Check Questions

105. Managers need tools for incorporating risks.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

106. _____ are events of low probability (they are many standard deviations away from the mean, at the tail of a distribution curve), yet of high consequence (they are called “fat” relative to the consequences of other issues).

- ☐ a) Risk events
- ☐ b) Fat tails
- ☐ c) Chance events
- ☐ d) Major concerns

Correct or Incorrect?

Clear

Check Answer

Scenario-Based Analysis

Scenario-based analysis identifies issues and opportunities that may arise in various foreseeable circumstances. Royal Dutch Shell uses descriptive scenarios based on forecasting research to provide decision makers with rough sketches of possible future states of affairs to help them focus on the long-term consequences of supply chain impacts. For example, different business scenarios could be envisioned by tweaking variables such as energy source, resource availability, or socioeconomic trends. What would the world look such as if we could convert saltwater into energy? What if freshwater ran short? What if the middle class disappeared? How could companies survive in such scenarios? Scenario-based analyses are thought experiments that bring critical issues into the foreground.

Concept Check Questions

107. _____ identifies issues and opportunities that may arise in various foreseeable circumstances.

- ☐ a) Scenario-based analysis
- ☐ b) Fuzzy logic

- ☐ c) Monte Carlo simulations
- ☐ d) Real option analysis
- ☐ e) Risks

Correct or Incorrect?

Clear

Check Answer

108. Royal Dutch Shell uses descriptive scenarios based on forecasting research to provide decision makers with rough sketches of possible future states of affairs to help them focus on long-term consequences of supply chain impacts.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Fuzzy Logic

[Fuzzy logic](#) is a tool from mathematics that helps managers deal with sets of information that lack precise boundaries. Using the best estimate of the dollar amount required to cover foreseeable consequences, the best- and worst-case monetary values are estimated. Optimistic and pessimistic magnitudes are assigned a “degree of belief” between 0 and 1 to reflect their likelihood. Fuzzy logic associates the net present value of a decision with its degree of belief, which allows managers to see the range of situations that could give rise to future financial liability.

Concept Check Questions

109. _____ is a tool from mathematics that helps managers deal with sets of information that lack precise boundaries.

- ☐ a) Scenario-based analysis
- ☐ b) Fuzzy logic
- ☐ c) Monte Carlo simulations
- ☐ d) Real option analysis
- ☐ e) Risks

Correct or Incorrect?

Clear

Check Answer

110. Fuzzy logic associates the net present value of a decision with its degree of likelihood.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Monte Carlo Simulations

When managers must use a complex decision tree, Monte Carlo simulations can help compare the outcomes of one operation against another. The costs associated with environmental remediation depend on numerous contingencies, such as applicable environmental law and the effectiveness of remediation techniques. Monte Carlo simulations draw random samples from

the cost-probability distribution for each variable (or option) and algorithmically choose the option of the lowest foreseeable cost at each point in the decision tree. The process is performed by computer software that can determine the likelihood that one operation will cost more than another, or simply compare the likely costs of each option. Importantly, cost estimates are associated with confidence levels. The magnitude of a risk standing alone is almost meaningless: it must be associated with a probability of occurrence to be useful to a manager.

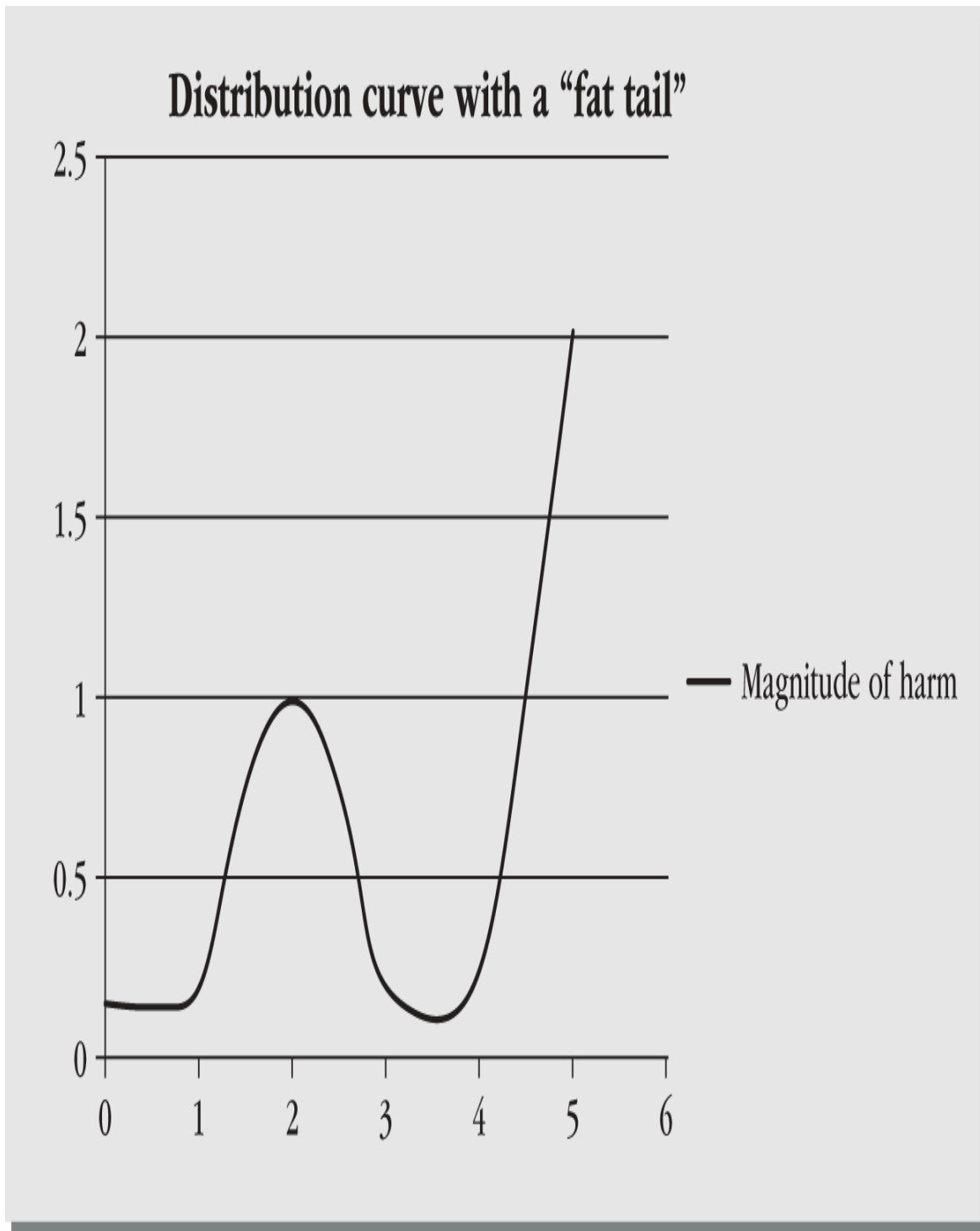


FIGURE 13.6 “Fat tail” diagram.

Concept Check Questions 

111. When managers must use a complex decision tree, these can help compare the outcomes of one operation against another.

- ☐ a) Scenario-based analysis
- ☐ b) Fuzzy logic
- ☐ c) Monte Carlo simulations
- ☐ d) Real option analysis
- ☐ e) Risks

Correct or Incorrect?

Clear

Check Answer

112. This draw random samples from the cost-probability distribution for each variable (or option) and algorithmically choose the option of lowest foreseeable cost at each point in the decision tree.

- ☐ a) Scenario-based analysis
- ☐ b) Fuzzy logic
- ☐ c) Monte Carlo simulations
- ☐ d) Real option analysis
- ☐ e) Risks

Correct or Incorrect?

Clear

Check Answer

113. The magnitude of a risk standing alone is almost meaningless.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Real Option Analysis

Real option analysis helps to frame risk analysis decisions when static models are insufficient. Sometimes a small investment today that preserves an option can lead to a large return in the future when that option leads to a greater opportunity than was available before. Option assessment and option screenings help visualize reasonable available alternative courses of conduct, including their relative costs and benefits. The basic concern is to determine whether to leave an option open for future managers to utilize to avoid environmental or social risks that happen to manifest. Option analysis also enables managers to optimize choices that involve numerous objectives, uncertainties, and constraints.

Risks can be social, political, or environmental. “[Social risks](#)” arise from unmet community expectations and include violence, riots, or economic devastation when monolithic commercial activity dissipates. “[Political risks](#)” arise when governmental influences compromise the company's economic value. Political risks are company-specific when a government targets a single organization for retribution, including the nationalization of an oil company or a state-sponsored terrorist attack on a manufacturing facility. Country-specific political risks include dramatic domestic civil strife, changes in currency value, or changes to the tax code. “[Environmental risks](#)” arise from unpredictable or uncontrollable risks stemming from geological activity (such as earthquakes or volcanoes) or meteorological activity (such as floods or hurricanes).

Siemens, a multinational conglomerate, employs real options analysis in its energy sector to evaluate renewable energy projects and address environmental risks. Siemens faces uncertainties associated with changing government policies, market demand for clean energy, and technological advancements. Real option analysis helps Siemens assess potential investments in renewable energy solutions, allowing the company to adapt to evolving market conditions, manage environmental risks, and make sustainable energy-related decisions.

To make sustainable SCM decisions, risks must be identified, and their monetary impact should be estimated. This allows managers to make better decisions with respect to the environment, human health and safety, and their company's financial bottom line.



Concept Check Questions

114. This helps to frame risk analysis decisions when static models are insufficient.

- ☐ a) Scenario-based analysis
- ☐ b) Fuzzy logic
- ☐ c) Monte Carlo simulations
- ☐ d) Real option analysis
- ☐ e) Risks

Correct or Incorrect?

Clear

Check Answer

115. Option assessment and option screenings help visualize reasonable available alternatives courses of conduct, including their relative costs and benefits.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

116. _____ risks arise from unmet community expectations and include violence, riots, or economic devastation when monolithic commercial activity dissipates.

- ☐ a) Green
- ☐ b) Environmental
- ☐ c) Production
- ☐ d) Social
- ☐ e) Political

Correct or Incorrect?

Clear

Check Answer

117. _____ risks arise when governmental influences compromise the company's economic value.

- ☐ a) Green
- ☐ b) Environmental
- ☐ c) Production
- ☐ d) Social
- ☐ e) Political

Correct or Incorrect?

Clear

Check Answer

118. _____ risks arise from unpredictable or uncontrollable risks stemming from geological activity (such as earthquakes or volcanoes) or meteorological

activity (such as floods or hurricanes).

- ☐ a) Green
- ☐ b) Environmental
- ☐ c) Production
- ☐ d) Social
- ☐ e) Political

Correct or Incorrect?

Clear

Check Answer

Sustainability in Practice

SCM has a tremendous opportunity to impact sustainability given its cross-functional and cross-enterprise nature. Changes in SCM functions can have a major impact on sustainability. For example, the function of logistics is responsible for the movement and storage activities of the supply chain. These activities are among the most energy intensive. Carbon dioxide emissions from the transportation sector alone account for 33% of the United States' total CO₂ emissions. Judicious consideration of modes of transportation and sourcing can dramatically impact sustainability. Just consider the differential between energy consumed to ship a New Zealand lamb chop to a restaurant in New York City, versus procuring a lamb chop from a farm in upstate New York. The same concerns could be raised with respect to sourcing fish from international waters and fruit from foreign producers. The savings in product price or the benefits of product quality may be outweighed by the environmental costs of logistics across large distances.

Many companies are aware of the impact of SCM on sustainability and are making significant changes. For example, to improve environmental performance in logistics, McDonald's has applied the concept of zero waste to delivery processes. In a clever innovation, McDonald's plans to convert the United Kingdom delivery vehicle fleet to run on biodiesel based on the same cooking oil used to make French fries. There are numerous examples such as

these of changes that companies are making. We look at some of these changes next.

Concept Check Questions

119. SCM has minimal opportunity to impact sustainability.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

120. Changes in SCM functions can have a major impact on sustainability.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

121. The function of logistics is responsible for the movement and storage activities of the supply chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

122. Many companies are aware of the impact of SCM on sustainability and are making significant changes.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Product Design

Innovations in product design can significantly improve environmental and social sustainability performance. Changes in product design affect the use of material, sourcing, and disposal. Often companies are not aware that some of their components are harmful to the environment. For example, one of the most distinctive features of Nike shoes, aside from the dramatic swooping check that identifies the brand, is the air bubble in the heel of Nike Air basketball sneakers. However, the company only recently became aware that the pocket contained a gas known as sulfur hexafluoride, or SF₆, which is a GHG. As part of Nike's sustainability initiative, Nike replaced SF₆ with nitrogen, which breaks up more readily on release and is not a GHG. A small change such as this can have a significant environmental impact.

Some environmentally friendly innovations in product design can transform the business model, as happened with Interface, Inc., the world's largest carpet manufacturer. Originally, Interface, Inc. was in the business of selling carpets to clients. When the carpet was worn out, Interface, Inc. would replace the entire carpet. Now, Interface, Inc. installs carpets in modular form, allowing clients to inspect carpet “tiles” for wear monthly, replacing only the tiles that are worn out. This transformation provides savings to clients and is better for

the environment, as it requires less pollution and energy consumption than the original model of replacing the entire product.

Patagonia, the outdoor clothing company, emphasizes sustainable product design by using recycled materials in its garments. The company's “Worn Wear” program encourages customers to repair and recycle clothing rather than disposing of it. Patagonia's initiatives in design and consumer engagement aim to extend the lifespan of its products, reducing environmental impact and fostering a circular economy model.

Managerial Insights Box

■ CARBON FIBER AUTO PARTS

Replacing steel with carbon fiber can significantly reduce the weight of automobile vehicles. Unfortunately, carbon fiber costs four times as much as steel by weight. However, an innovative technique for designing the product promises to cut costs of carbon fiber by 25% while reducing vehicle weight by as much as 20%. Carbon molecules are arranged in parallel, forming incredibly strong filaments, which are wound into strands and woven into a fabric, which is mixed with glue and hardened in molds to form car parts. The “knitting yarn” carbon fiber breakthrough was developed by Oak Ridge National Laboratory in Tennessee, which persuaded a yarn factory in Lisbon, Portugal, to allocate a portion of its plant to produce the new product. BMW AG is getting in on the auto-grade carbon fiber action as well. Because of the energy intensity required to convert the carbon fiber into fabric, BMW produces the product near a cheap hydroelectric power source in Spokane, Washington, and then ships it to Germany, where it is formed into car parts by partner SGL Carbon. BMW plans to use the carbon fiber as an interior shell for the BMW i3 electric car to drop total weight by over 700 pounds.

Concept Check Questions

123. Innovations in product design cannot significantly improve environmental and social sustainability performance.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

124. Changes in product design affect use of material, sourcing, and disposal.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

125. Often companies are not aware that some of their components are harmful to the environment.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Packaging

Packaging offers an excellent opportunity to significantly impact the sustainability of a supply chain. For example, Procter & Gamble (P&G)

reduced the negative environmental consequences of product packaging by designing a toothpaste tube that can be shipped and displayed for retail without any paper packaging. Also, Nestlé Waters North America has created its Eco Shape bottle that uses 25% less plastic compared to earlier bottles. Similarly, Nestlé decided to use smaller labels on the outside of their water bottles to save paper. In five years, the company saves an estimated 20 million pounds of paper. Product packaging is so important that even Walmart has developed an environmental sustainability scorecard to evaluate product packaging used by its vendors. The criteria include GHG emissions from packaging production, product-to-packaging ratio, recycled packaging content, and emissions from transporting the packaging.

Product packaging can serve multiple purposes. It takes just a little bit of imagination to envision a further use for a package that would otherwise end up in a landfill. Innovations in the use of product packaging can lead to considerable environmental and economic savings. For example, Stonyfield Farm, a dairy company famous for its “green” policies, has implemented a zero-waste concept that significantly reduces pollution. The company has a policy of take-back for the yogurt cups it sells. These plastic yogurt cups are then used to manufacture toothbrushes. Other companies use aluminum cans to make office furniture.

Companies can also work together in partnerships to take advantage of each other's talents in creating sustainable packaging. Consider India P&G, which decided to offer Pantene Shampoo in single-serve packages for US\$0.02 each to low-income communities. The goal is to allow individuals at the very bottom of the economic pyramid to access product markets typically only available to consumers in developed countries. However, this creates the problem of disposing of packaging. Companies such as Cargill and Dow Chemical are researching to develop biodegradable packages for these miniproducts to avoid excess waste. Together, these innovations promote social and environmental sustainability.

Concept Check Questions

126. Packaging offers an poor opportunity to significantly impact the sustainability of a supply chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

127. Product packaging can serve multiple purposes.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

128. Companies can also work together in partnerships to take advantage of each other's talents in creating sustainable packaging.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Sourcing

Sourcing practices can dramatically impact sustainability. Selecting suppliers that follow sustainability practices—and finding ways to monitor their

compliance—is a large issue for companies. Just consider the reputational problems Home Depot encountered from 1997 to 1999 when environmental groups organized protests against the company, charging it was failing to ensure that its wood did not come from endangered forests. In response, Home Depot publicly promised that lumber supplies would no longer come from endangered forests and even took affirmative steps to collaborate with environmental groups in Chile to protect such forests.

Improvements in sourcing do not have to be dramatic. Even incremental or piecemeal improvements in sourcing count for something. Instead of overhauling all products, Ben & Jerry's simply released a new product line called “For A Change,” which procures cocoa, vanilla, and coffee beans from farmers who participate in cooperative farmers’ associations that ensure these farmers a fair price for their beans.

Deciding how to evaluate, select, and monitor suppliers is a critical task. A structured screening process can help companies choose suppliers who meet sustainability criteria. For example, Nike developed a New Source Approval Process to determine whether to acquire a new factory. The criteria include inspection results along environmental, safety, and health dimensions, as well as a third-party labor audit. This helps ensure company expansion is consistent with principles of environmental and social sustainability.

Some companies rely on contracting to mandate certain practices from their suppliers. To ensure compliance with labor standards, L'Oréal uses a supplier selection process that begins with contract language requiring compliance from suppliers and supplier subcontractors. L'Oréal enforces these social sustainability initiatives by monitoring compliance through surprise audits involving plant inspections, document reviews, and interviews with supplier employees. When audit results fail on a rated scale, L'Oréal takes necessary corrective measures.

Other companies rely on third-party audits to monitor sustainability compliance. For example, Unilever—the world's largest tea company—has committed to sustainable sourcing for all tea leaves. In collaboration with Rainforest Alliance, Unilever sees to it that all tea-growing estates are audited ensuring sustainable growth and fair trade of the product. Like Unilever, Walmart has partnered with an oversight organization to ensure sustainable sourcing. Walmart plans to purchase all Wild Caught Seafood from sustainable fisheries certified by the Marine Stewardship Council. This helps prevent

overfishing, as well as keep fish containing unhealthy toxins such as mercury off the shelves.

In addition to selecting and monitoring supplier sustainability practices, some companies offer training programs to their suppliers to continue improving. Cadbury Schweppes offers a training program in pest control and labor management techniques to the 4,000 cocoa suppliers in Ghana through the Farmers' Field School. This is a win-win for the suppliers and Cadbury Schweppes: the farmers have improved labor conditions, and Cadbury Schweppes has a more reliable cocoa supply.

Concept Check Questions

129. Selecting suppliers that follow sustainability practices—and finding ways to monitor their compliance—is a large issue for companies.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

130. Improvements in sourcing must be dramatic.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

131. Deciding how to evaluate, select, and monitor suppliers is a critical task.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

132. All companies rely on third-party audits to monitor sustainability compliance.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Process Design

Redesign of organizational processes can go a long way toward improving the environmental and social sustainability of a supply chain. Consider Kingfisher—Europe's leading home improvement retailer and third largest in the world—which uses an evaluation system that provides actions for each operating company to undertake to meet corporate sustainability policy. The program is called Steps to Responsible Growth with formal evaluations taking place two times each year to monitor progress. Similarly, the Swedish hotel chain Scandic Hotels (www.scandichotels.com) created the Resource Hunt program to incentivize employees to improve their use of resources to yield efficiency gains. Hotel employees receive a part of the savings from a reduction in energy and water consumption, as well as a reduction in waste. Through these

measures, Scandic Hotels was able to save over a million dollars in just a few years.

Process improvements that address the disposal of equipment are an important part of sustainability. Technology equipment can contain environmentally damaging materials that are relatively impervious to natural biodegradation. Improper technology equipment disposal can pose serious environmental consequences. In light of this, Hewlett-Packard implemented a product end-of-life or “take back” procedure. This enabled Hewlett-Packard to recycle over 70,000 tons of computer products, which were then refurbished to be resold or donated. In one procedural move, Hewlett-Packard reduced environmentally damaging waste, increased profits by creating a secondary market for used equipment, and promoted social sustainability by donating computers.

Concept Check Questions

133. Redesign of organizational processes can go a long way toward improving the environmental and social sustainability of a supply chain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

134. Process improvements that address disposal of equipment is a relatively minor part of sustainability.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Marketing Sustainability

Products frequently advertise their “green” features, such as their use of recycled materials, or that their packaging is biodegradable, or that they have entered into fair partnerships with international laborers, or the fact that the product does not contain ingredients that are harmful to the environment. Sustainable features are typically displayed through labels on the product itself. Sellers prominently display certifications by independent reviewers as to the genuinely sustainable nature of their product or manufacturing process. As long as consumers place a premium on the sustainability of products and services, advertising will cater to this preference. That is, as long as consumers prefer sustainable products, sellers have an incentive to market their products and services as sustainable, regardless of actual practices. However, without independent and objective evaluation as to the efficacy of the sustainability measures taken, products may be spuriously labeled “sustainable” when in fact they are not. Independent assessment of sustainability practices is important to counteract this “greenwashing” effect and help consumers identify true sustainability measures.

With their Prius line of vehicles, Toyota has heavily marketed the environmental benefits of hybrid cars. They emphasize fuel efficiency and reduced emissions, appealing to consumers who prioritize eco-friendly transportation options. The Prius has reduced CO₂ emissions by 35% and has a recyclability potential of about 90%. The Prius has a claimed fuel economy of up to 67 miles per gallon (mpg) combined and CO₂ emissions as low as 94 grams per kilometer.

Concept Check Questions

135. Products frequently advertise their “green” features.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

136. Sustainable features are rarely displayed on products.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

137. Independent assessment of sustainability practices is important to counteract “greenwashing.”

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

Unintended Consequences

Before any company goes headlong toward implementing a seemingly beneficial sustainability initiative, a holistic assessment of all foreseeable costs and benefits must be conducted. This should include predictable behavioral changes that a new policy may induce on the part of affected parties. For example, a rule that mandated a company to eliminate a certain type of

pollutant from their plant emissions by a certain date, with no other conditions attached, would predictably encourage plant operators to emit as much of this pollutant as possible before the abatement deadline, causing spikes in emissions levels. A rule that prohibited managers from firing elderly employees without good cause could very well have the perverse effect of discouraging employers from hiring elderly employees in the first place. The tendency of good intentions to have unexpected and undesirable consequences requires sustainable SCM decisions to be made only after adequate reflection and analysis.

The push for biofuels as an alternative to fossil fuels had unintended consequences on food prices. When significant agricultural lands were diverted to grow crops for biofuels, it led to a decrease in food supply, driving up prices. This created challenges, especially in developing countries where food affordability became a concern.

Consider the hazards to the environment that can occur even with the best of intentions. Suppose a corporation owns manufacturing plants all over the continent. They want to reduce overall pollutant emissions by 20% to protect the health of the environment. They decide to use an auction system to distribute emissions permits, so the permission to continue emitting pollutants goes to the highest bidders. Plants that can reduce emissions cheaply through technology or process innovations do so. Older plants that would require major modifications to comply with the emissions reduction find it more economically feasible to purchase the permits. This leads to an economically efficient allocation of emissions permits. However, suppose the plants that aggregated the most permits were all clustered in the same region. Suppose further that this region was home to many biologically rich ecosystems. The permit allocation auction may have reduced net pollution emissions by 20%, but it leads to a “hot spot” of highly concentrated pollutants in an area where such pollution could lead to devastating environmental costs. In this way, an attempt at environmental sustainability could backfire with unintended consequences that end up compromising environmental goods.

The obstacles posed by the environmental and social risks of our world force managers to make decisions where intuition hesitates and the data is uncertain. Unintended consequences in the context of sustainability initiatives highlight the importance of making well-thought-out and informed decisions even when managers have the best intentions.

Empowering Entrepreneurs Box

When looking for leadership on sustainability, especially for those companies that are going to deliver real solutions, the search typically begins with big businesses. We tend to start with firms that have large platforms from which they can announce their commitments to changing products, processes, and people as they execute their vision for sustainability. However, more of the time, entrepreneurs have been shown as the real visionaries in sustainability, offering novel and creative sustainability solutions to traditional problems, and often creating new business models. One reason for the success is that, unlike large established firms that have to pivot their supply chains toward sustainability, start-ups often begin with a vision of sustainability at the core, establishing a sustainable business model from the start and building their customer base around this platform. These companies did not have to evolve and change to become sustainable. They are “born” sustainable.

Making it easier is that consumers are increasingly looking for safe, reliable, and high-value products that are sustainable, eco-friendly, and made in a socially responsible way. Consumers have also shown that they are not only willing to pay for these products but actively seek them out. Also, high-level talent, especially millennials, are more willing to work for companies centered around sustainability, even for lower pay. At the same time, governments are investing to support sustainable businesses while helping them incubate and scale their business models. These shifts in the economic landscape all come together to help entrepreneurs center their businesses on sustainability.

Concept Check Questions

138. Before any company goes headlong toward implementing a seemingly beneficial sustainability initiative, a holistic assessment of all foreseeable costs and benefits must be conducted. This

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

139. The push for biofuels as an alternative to fossil fuels had minimal consequences on food prices.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

140. The obstacles posed by the environmental and social risks of our world force managers to make decisions where the intuition hesitates and the data is uncertain.

- ☐ True
- ☐ False

Correct or Incorrect?

Clear

Check Answer

CHAPTER HIGHLIGHTS

The environmental and social initiatives that define the current trend toward sustainability can be effectively incorporated into organizational decision making by expanding the concepts of cost, value, and risk to include longer time horizons and the reactions of all stakeholders.

The supply chain sustainability model can be used to enable managers to make effective sustainability decisions by linking “inputs” (external context, internal context, business context, human and financial resources), “processes” (leadership, strategy, structure, and systems), “outputs” (sustainability performance, stakeholder reactions), and “outcomes” (long-term corporate financial performance) in a feedback loop.

Nine principles of sustainability performance are ethics, governance, transparency, business relationships, financial return, community involvement and economic development, values of products and services, employment practices, and protection of the environment.

Quantifiable data relevant to costs, risks, and stakeholder preferences are needed to accurately measure and predict the impact of sustainability performance.

Sustainability implementation requires a concerted effort from top leadership and cuts across all aspects of a supply chain. In other words, sustainability performance is a serious endeavor that requires considerable commitment of corporate assets and attention.

KEY TERMS

[Sustainability](#)

[Financial payoffs](#)

[Customer-related payoffs](#)

[Operational payoffs](#)

[Organizational payoffs](#)

[Environmental sustainability](#)

Social sustainability

Crisis-oriented

Cost-oriented

Design standard

Performance standard

Minimalist ethic

Reasonable care ethic

Good works ethic

External context

Internal context

Business contexts

Human and financial resources

Leadership

Proactive sustainability actions

Reactive sustainability actions

Internal sustainability actions

External sustainability actions

Sustainability performance

Feedback loops

Compliance

Total cost of ownership (TCO)

Life-cycle assessment (LCA)

Ecological footprint

Carbon footprint

Food mile

Use value

Option value

Existence value

Cost of control

Shadow pricing

Damage costing

Activity-based costing

Life-cycle costing

Full-cost accounting

Scenario-based analysis

Fuzzy logic

Social risks

Political risks

Environmental risks

DISCUSSION QUESTIONS

What economic arguments can be made for and against environmental sustainability initiatives? What economic arguments can be made for and against social sustainability initiatives? What personal choices have you made as a consumer with respect to environmental or social sustainability?

How should a manager handle disagreement over sustainable performance between the various stakeholders to which she is accountable?

Identify a sustainability strategy at a company where you are a consumer. Does “green” marketing appeal to you? Does this depend on your assessment of the company's actual versus advertised sustainability performance?

Identify a corporate strategy that you believe is unsustainable. Discuss possibilities of changing that strategy within the “Input” constraints of the supply chain sustainability model (external context, internal context, business context, and human and financial resources).

Imagine you are a mid-level manager for a manufacturing company driven by the profit motive and only concerned about the financial bottom line. You believe that the operations you oversee could realize great efficiencies by

consuming less energy and thereby polluting less, but this would require some additional investment in technology. How do you go about selling your idea to top leadership?

Case Study Haitian Oil

Read the following two passages concerning the discovery of petroleum reserves in the nation of Haiti. Try to spot environmental and social sustainability issues, then answer the questions at the end.

Passage 1

Adapted from: Polson, Jim. "Haiti Earthquake May Have Exposed Gas, Aiding Economy." January 26, 2010. Available at <http://www.bloomberg.com>.

In 2010, an earthquake killed more than 150,000 people in Haiti. It may have left clues to petroleum reservoirs that could aid economic recovery in the Western Hemisphere's poorest nation, a geologist said.

"The January 12, 2010, earthquake was on a fault line that passes near potential gas reserves," said Stephen Pierce, a geologist who worked in the region for 30 years. The quake may have cracked rock formations along the fault, allowing gas or oil to temporarily seep toward the surface, he said.

"A geologist, callous as it may seem, tracing that fault zone from Port-au-Prince to the border looking for gas and oil seeps, may find a structure that hasn't been drilled," said Pierce, exploration manager at Zion Oil & Gas, Inc., a Dallas-based company that's drilling in Israel. "A discovery could significantly improve the country's economy and stimulate further exploration."

Following the earthquake, the Haitian Prime Minister Jean-Max Bellerive met in Montreal with diplomats, including U.S. Secretary of State Hillary Clinton, to discuss redevelopment initiatives. Canadian Foreign Affairs Minister Lawrence Cannon said wind power may play a role in rebuilding the Caribbean nation, where forests have been denuded for lack of fuel, the Canadian Press reported.

"Haiti, from the standpoint of oil and gas exploration, is a lot less developed than the Dominican Republic," Pierce said. "One could do a lot more work there." More than 600,000 people are without shelter in the Port-au-Prince area, the United Nations said on 22 January 2010. The 7.0 magnitude quake destroyed about one-third of the buildings in Port-au-

Prince. It also knocked out the capital's seaport and water and sewage systems. "Relief and recovery for the survivors is the priority now," Mark Fried, a spokesman for British charity Oxfam, said in a statement. "Hundreds of thousands who lost everything but their lives need water, shelter, and toilets to stop the spread of disease," he said.

Haiti will need "massive support" for a "colossal" reconstruction from the earthquake, Bellerive said at the meeting in Montreal. The Greater Antilles, which includes Cuba, Haiti, the Dominican Republic, Puerto Rico, and their offshore waters, probably hold at least 142 million barrels of oil and 159 billion cubic feet of gas, according to a 2000 report by the U.S. Geological Survey. Undiscovered amounts may be as high as 941 million barrels of oil and 1.2 trillion cubic feet of gas, according to the report.

Among nations in the northern Caribbean, Cuba, and Jamaica have awarded offshore leases for oil and gas development. Trinidad and Tobago, South American islands off the coast of Venezuela, account for most Caribbean oil production, according to the U.S. Energy Department.

Passage 2

Adapted from: Engdahl, F. William. "The Fateful Geological Prize Called Haiti." January 30, 2010. Available at <http://www.engdahl.oilgeopolitics.net>.

Behind the human tragedy in Haiti, following the 2010 earthquake, a drama is in full play for control of what geophysicists believe may be one of the world's richest zones for hydrocarbons—oil and gas—outside the Middle East.

Haiti, and the larger island of Hispaniola of which it is a part, straddles one of the world's most active geological zones, where the deepwater plates of three huge structures rub against one another: the intersection of the North American, South American, and Caribbean tectonic plates. Below the ocean and the waters of the Caribbean, these plates consist of an oceanic crust some 3–6 miles thick, floating atop an adjacent mantle. Haiti also lies at the edge of the region known as the Bermuda Triangle, a vast area in the Caribbean subject to bizarre and unexplained disturbances. These underwater plates are in constant motion, rubbing against each other along lines analogous to cracks in a broken porcelain vase that has been

reglued. The earth's tectonic plates typically move at a rate of 50–100 mm annually in relation to one another and are the origin of earthquakes and of volcanoes. The regions of convergence of such plates are also areas where vast volumes of oil and gas can be pushed upward from the earth's mantle. The geophysics surrounding the convergence of the three plates that run more or less directly beneath Port-au-Prince make the region prone to earthquakes such as the one that struck Haiti with devastating ferocity on 12 January 2010.

Aside from being prone to violent earthquakes, Haiti also happens to lie in a zone that, due to the unusual geographical intersection of its three tectonic plates, might well be straddling one of the world's largest unexplored zones of oil and gas, as well as of valuable rare strategic minerals.

Case Questions

1. Imagine you are a mid-level manager for a major international oil company. You have been asked whether an investment in oil exploration in Haiti is a good business decision. What environmental, social, and political risks might arise in supply chain operations in Haiti?
2. What are the foreseeable costs and benefits of supply chain operations in Haiti?
3. How could you ensure that your company's involvement would play a beneficial role in Haiti's economic recovery?

Case Study

Making Decisions with Data Analytics: Wellington's Coffee House

Welly Sanders has a coffee company. The company is vertically integrated and handles all sourcing of coffee beans, coffee beans processing, and coffee bean distribution. Welly also has a chain of coffee shops where he sells the coffee directly to the consumers, called the Wellington Coffee House.

His direct competitor, Charlie's Café, was recently in the news for alleged sourcing malpractices and for excessive use of plastics at various points in their value chain. Concerned by this news, Welly wants to audit his practices to make sure that he is complying with all the regulations and that the practices are sustainable.

Case Questions

1. What factors should Welly consider when assessing his supply chain? Any suggestions on how he should conduct the audit?
2. How can Welly measure the sustainability of his business?

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Notes

¹ Adapted from: M. Epstein, *Making Sustainability Work* (Sheffield, UK: Greenleaf Publishing, 2008).

² For an entertaining but serious learning tool about sustainability in supply chain management, see the online video called “Story of Stuff,” available at <http://www.youtube.com/watch?v=gLBE5QAYXp8>.

Appendix: The Standard Normal Distribution

This table gives the area under the standardized normal curve from 0 to z , as shown by the shaded portion of the following figure.

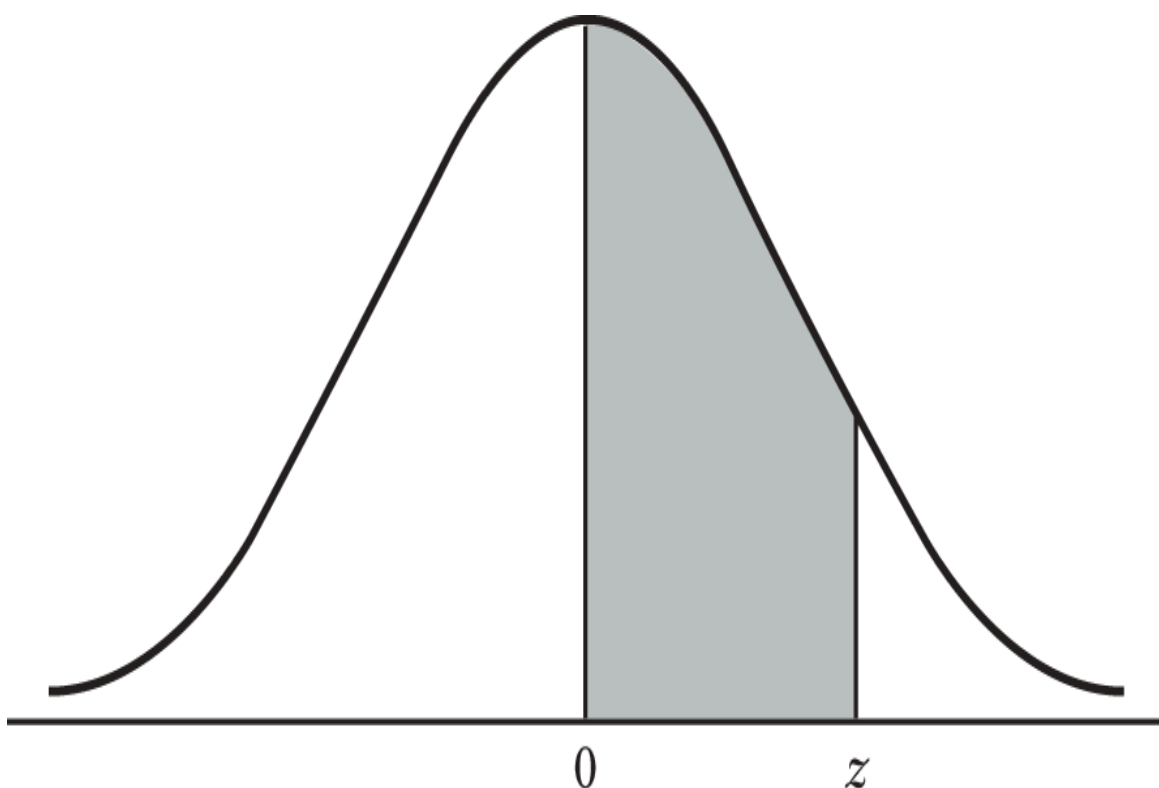
Examples: If z is the standard normal random variable, then

$$\text{Prob}(0 \leq z \leq 1.32) = 0.4066$$

$$\text{Prob}(z \geq 1.32) = 0.5000 - 0.4066 = 0.0934$$

$$\text{Prob}(z \leq 1.32) = \text{Prob}(z \leq 0) + \text{Prob}(0 \leq z \leq 1.32) = 0.5000 + 0.4066 = 0.9066$$

$$\text{Prob}(z \leq -1.32) = \text{Prob}(z \geq 1.32) = 0.0934 \text{ (by symmetry)}$$



z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753

Source: Adapted from: Robert Markland, *Topics in Management Science* , 3rd ed. New York: John Wiley & Sons, 1989.

Glossary

ABC analysis

A tool for classifying inventory based on the degree of importance.

Additive manufacturing

Also known as 3-D printing, it is a process that creates a solid object from a software design. The process deposits materials such as plastics and metals in thick layers one on top of the other, gradually building up one layer at a time until the object is produced.

Alliances

The most comprehensive of buyer–supplier relationships that are reflected by high interaction frequency and significant trust and commitment between supply chain partners.

Anticipation inventory

Inventories that are carried in anticipation of events, such as seasonality or price increases.

Assemble-to-order strategy

An inventory strategy in which the product is partially completed and kept in a generic form, then finished when an order is received.

Assignable variation

Variation that is caused by factors that can be identified and managed.

Batch process

A process used to produce small quantities of products in groups or batches based on customer orders or product specifications.

Benchmarking

A method for comparing and quantifying operational performance to establish internal targets based on best-in-class results.

Big data analytics

Applying math and statistics to large data sets referred to as big data.

Bill of materials (BOM)

A list that shows all the raw materials, components, and subassemblies that go into a product. It also shows the quantities and relationships of items needed to make a final product.

Break-even analysis

A tool used to compute the product quantity that needs to be sold for a company to cover their costs—called the “break-even point.”

Bullwhip effect

The phenomenon where fluctuation and distortion of information increases as it moves up the supply chain, from retailers to manufacturers, to suppliers.

Business process

A structured set of activities or steps with specified outcomes.

Business strategy

A plan for the company that defines the company's long-term goals, how it plans to achieve these goals, and the way the company plans to differentiate itself from its competitors.

Carbon footprint

An ecological footprint metric that measures the amount of carbon released into the atmosphere, which is correlated with adverse effects on climate stability.

Cash-to-cash cycle

The time it takes to convert an order into cash.

Causal models

Forecasting models are based on the assumption that the variable being forecast is related to other variables in the environment; a model is developed identifying these relationships, expressing them in mathematical terms, and using that information to forecast the future.

Cellular layouts

Sometimes called group technology (GT) cells, these are hybrid layout group items based on similar processing characteristics and workstations arranged to form a number of small assembly lines called work cells.

Channel of distribution

The way products and services are passed from the manufacturer to the final consumer.

Collaborative planning, forecasting, and replenishment (CPFR)

A collaborative process of developing joint forecasts and plans with supply chain partners, rather than doing them independently.

Common (random) variation

Variation that is inherent in the process itself.

Concurrent engineering

All organizational functions simultaneously work together in product design.

Continuous processes

Operations processes that produce a high volume of a standardized product continually. Examples include oil refineries, water treatment plants, and certain paint facilities.

Core competency

The distinctive competency of a company it uses to compete in the marketplace.

Cross-docking

An approach used to reconfigure bundles of products where larger shipments are broken down into small shipments for local delivery in an area.

Cycle stock

Also called lot size inventories, this is inventory for immediate use and is computed based on expected demand over a certain period.

Culture

Acceptable behaviors, beliefs, and norms characteristic of a particular global region.

Customer relationship management (CRM)

Software is designed to focus on the interface between the firm and its customers.

Customer segmentation

Identification of unique groups of customers with similar needs.

Customer service

A process of enhancing the level of customer satisfaction by meeting or exceeding customer expectations.

Cycle time

The maximum amount of time each station on the assembly line has to complete its assigned tasks. It is also called takt time.

Demand management

The process of attempting to modify demand through efforts such as promotional campaigns and advertisements, sales incentives, and cost cutting.

Dependent demand

Demand for component parts or subassemblies.

Design for manufacture (DFM)

A series of guidelines for producing a product easily and profitably.

Distribution strategy

A plan for how a company will get its products and services to customers.

e-Auctions

The use of Internet technology to conduct auctions as a means of selecting suppliers and determining aspects of the purchase contract.

Early supplier involvement (ESI)

The practice of including suppliers in new product development to tap into their expertise in product, process, and supply chain design.

Electronic data interchange (EDI)

The interorganizational, computer-to-computer communication of business transactions for orders, confirmations, invoices, and shipping notices.

Enterprise resource planning (ERP)

Large software programs used for planning and coordinating all resources throughout the entire enterprise.

Environmental sustainability

The preservation of diverse biological systems that remain productive over time.

Experience curve

A phenomenon where organizational costs are reduced due to experience and learning effects that result from processing a higher volume.

Facility layout

The physical arrangement of all resources within a facility.

Facility location

The physical location of all facilities, including warehouses, factories, and retail locations.

Factor rating

A tool that can be used to make location decisions.

Fill rate

The percent of products ordered that are delivered.

Fixed position layout

A layout arrangement that is used when a product cannot be moved during production, usually due to size.

Forecasting

The process of predicting future events.

Functional products

Products that satisfy basic functions or needs.

Holding cost

Sometimes called carrying cost—includes all the costs that vary with the amount of inventory held in stock. This includes storage facilities, handling, insurance, pilferage, breakage, obsolescence, depreciation, taxes, and the opportunity cost of capital.

Import quotas

A quantitative restriction on the volume of imports. It is one of the most common forms of nontariff barriers.

Independent demand

Demand for a finished product.

Information technology (IT)

Technology that enables communication, storage, and processing of information within and between firms. It is the backbone of supply chain management that enables managing processes.

Infrastructure

Availability and access to roads and transportation, equipment and communication networks, distribution systems, and skilled labor.

Innovative products

Products that are purchased for reasons other than basic needs, such as innovation or status. These include high-fashion items or technology products, such as those seen in the computer industry.

Intermittent processes

A process used to produce a large variety of products with different processing requirements in low volumes.

Inventory

Quantities of goods in stock.

Inventory policy

Inventory decisions that answer the questions of when and how much to order.

Inventory turnover

A measure of how quickly inventory moves. It is computed as:

Jidoka

An element of Lean that allows workers to “stop the line” when discovering production problems.

Kaizen

An element of quality that means continuous improvement.

Keiretsu

A close-knit network of suppliers that continuously learn, improve, and prosper along with their parent companies.

Key performance indicators (KPI)

Quantifiable measurements that reflect a company's critical success factors.

Lean

A management approach for creating value for the end customer through the most efficient utilization of resources possible.

Lean Six Sigma

A management philosophy that combines the benefits of both Lean and Six Sigma approaches, utilizing the tools from each.

Leverage

Leverage is the amount of bargaining power in negotiation.

Life cycle assessment (LCA)

An approach that considers environmental stewardship by analyzing the environmental aspects and potential impacts associated with a product, process, or service.

Line processes

Processes that are designed to produce a large volume of a standardized product for mass production. They are also known as flow shops, flow lines, or assembly lines.

Logistics

The business function which is responsible for transporting and delivering products to the right place at the right time throughout the supply chain.

Make-to-order strategy

A strategy used to produce products to customer specifications after an order has been received.

Make to stock strategy

A strategy that produces finished products for immediate sale or delivery, in anticipation of demand. Companies using this strategy produce a standardized product in larger volumes.

Marketing

The business function that is responsible for linking the organization to its customers and is concerned with the “downstream” part of the supply chain.

Material requirements planning (MRP)

An inventory control system used to compute order quantities for dependent demand inventory items.

Negotiation

The process of gaining concessions from another party.

Offshoring

Another name for outsourcing to a different country.

Omnichannel

An approach to sales that seeks to provide the customer with a seamless shopping experience across multiple channels.

Operations management (OM)

The business function responsible for producing a company's goods and services, in an efficient and cost-effective way.

Operations strategy

A strategy of a company that involves decisions about how it will produce goods and services.

Ordering cost

Costs involved in placing an order and procuring the item.

Order qualifiers

Characteristics that qualify the company to be a participant in a particular market.

Order winners

Characteristics that win the company orders in the marketplace. A company should excel in their order winners.

Outsourcing

Outsourcing is hiring a third party to perform a set of tasks for a fee.

Pareto principle

A rule that suggests that 80% of an outcome is generated by 20% of an activity.

Physical distribution

Outbound logistics.

Pipeline inventory

Also called transportation inventory, is inventory that is in transit. It exists because the points of demand and supply are not the same.

Planning

The process of selecting actions in anticipation of the forecast.

Power distance

The extent to which there is a strong separation of individuals based on rank.

Predictive analytics

Uses a variety of techniques—such as statistics, modeling, and data mining—to analyze current and historical facts to make predictions.

Product design

The process of specifying the exact features and characteristics of a company's product.

Product layout

A layout design that arranges resources in sequence to enable efficient production of the product.

Product life cycle (PLC)

A marketing concept that states that products and services evolve through a life cycle, and that the specific management concerns vary with each stage of the life cycle.

Process capability

The evaluation of the production process as to its ability to meet or exceed the set product specifications.

Process control charts

A statistical quality control tool used to monitor the process to ensure products are being produced with characteristics that are within the set limits.

Process design

The design of a production process that can create the exact product desired.

Process layout

A layout design where similar processes are grouped together.

Product postponement

A strategy where the product is kept in the most generic form as long as possible in the production and distribution process.

Product traceability

The ability to easily trace a product from the point of origin in the supply chain, through to the customer, and back down the supply chain in the case of returns.

Productivity

A measure of how well a company uses its resources. It is computed as a ratio of outputs to inputs.

Project processes

A process used to make one-of-a-kind products exactly to customer specifications.

Purchase order (PO)

A document that specifies the terms and conditions of the purchase agreement and initiates supplier action.

Purchasing

A term that defines the process of buying goods and services.

Qualitative morecasting methods

Often called judgmental forecasting methods, these are forecasting methods based on subjective opinions and judgments of individuals, such as managers, sales staff, or customers.

Quality

A measure of whether or not a product lives up to customer expectations.

Quality function deployment (QFD)

A tool for translating the voice of the customer into specific technical requirements.

Quantitative forecasting methods

Forecasting methods based on mathematical modeling.

Radio frequency identification (RFID)

A wireless technology that uses memory chips equipped with tiny radio antennas that can be attached to objects to transmit streams of data about the object.

Relationship view

A view of supply chains focused on managing relationships across the supply chain.

Remanufacturing

A process that uses components of old products in the production of new ones.

Repetitive process

A process used to produce one, or a few, standardized products in high volume. Examples include an automobile assembly line, a cafeteria, and an automatic car wash.

Reverse logistics

The process of moving products upstream from the customer back toward manufacturers and suppliers.

Safety stock

Also called buffer stock, safety stock is extra inventory carried to serve as a cushion for uncertainties in supply and demand.

Sales and operations planning (S&OP)

An organizational process intended to match supply and demand through functional collaboration between marketing, operations, and finance, in order to ensure that supply can meet demand requirements.

Setup cost

Costs involved in preparing a production run when items are made in-house.

Shortage costs

Costs that occur when a company runs out of stock.

Six Sigma

A quality management process that uses rigorous measurement to reduce process variation and eliminate defects. Six Sigma defines quality as no more than 3.4 parts per million defective (ppm).

Sourcing

The business function responsible for all activities and processes required to purchase goods and services from suppliers.

Statistical quality control (SQC)

Statistical tools used to measure quality and identify quality problems in both the product and process.

Supply chain

A network of all entities involved in producing and delivering a finished product to the final customer.

Supply chain management (SCM)

The management of flows of products, information, and funds throughout the supply chain.

Supply chain network design

The physical structure and business processes included in the system.

Supply chain strategy

A long-range plan for the design and ongoing management of all supply chain decisions that support the business strategy.

Sustainability

The meeting of present needs without compromising the ability of future generations to meet their own needs.

Task time

Also called cycle time, task time is the maximum amount of time each station on the assembly line has to complete its assigned tasks.

Time series models

Models that generate a forecast by identifying and analyzing patterns in a time series of the data.

Third-party logistics (3PL)

An entity that provides some combinations of logistics services to their customers.

Total cost of ownership (TCO)

The purchase price plus all other costs associated with acquiring the item.

Trade agreements

Pacts between countries that encourage trade in a region by eliminating or lowering tariffs, quotas, and other trade barriers.

Transactional view

The view of supply chains with a focus on making supply chain processes more efficient and effective based on quantitative metrics.

Transportation

The primary function of logistics that enables logistics to provide place utility. There are five primary modes of transportation: truck, water, air, rail, and pipeline.

Value stream mapping

A specific application of process mapping, based on lean manufacturing principles.

Vendor managed inventory (VMI)

An arrangement in which the vendor is responsible for managing the inventory located at a customer's facility.

Vertical integration

Ownership of upstream suppliers and downstream customers.

Voice of the customer (VOC)

The process of capturing customer needs and preferences.

Waste

In Lean systems, waste is defined as anything that does not add value.

Weeks of supply

The length of time demand can be met with on-hand inventory.

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