EIGHTH EDITION

Operations Management in the Supply Chain

DECISIONS AND CASES

Roger Schroeder | Susan Meyer Goldstein

Mc Graw Hill

Operations Management in the Supply Chain

Decisions and Cases

Eighth Edition

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University of Minnesota

Mc Graw Hill

OPERATIONS MANAGEMENT IN THE SUPPLY CHAIN: DECISION AND CASES, EIGHTH EDTION

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Dedication

To our families, whose encouragement and love we appreciate

—Roger G. Schroeder

—Susan Meyer Goldstein

Preface

FEATURES

Operations and supply chain management is an exciting and vital field in today's complex business world. Therefore, students in both MBA and undergraduate courses have an urgent need to understand operations—an essential function in every business.

This textbook on Operations Management in the Supply Chain emphasizes decision making in operations with a supply chain orientation. The text provides materials of interest to general business students and operations and supply chain management majors. By stressing cross-functional decision making, the text provides a unique and current business perspective for all students. This is the first text to incorporate cross-functional decision making in every chapter, which provides more relevance for non-majors.

The book is organized into five unique sections to help students understand the key types of decisions made by operations and supply chain managers. See the illustration below.

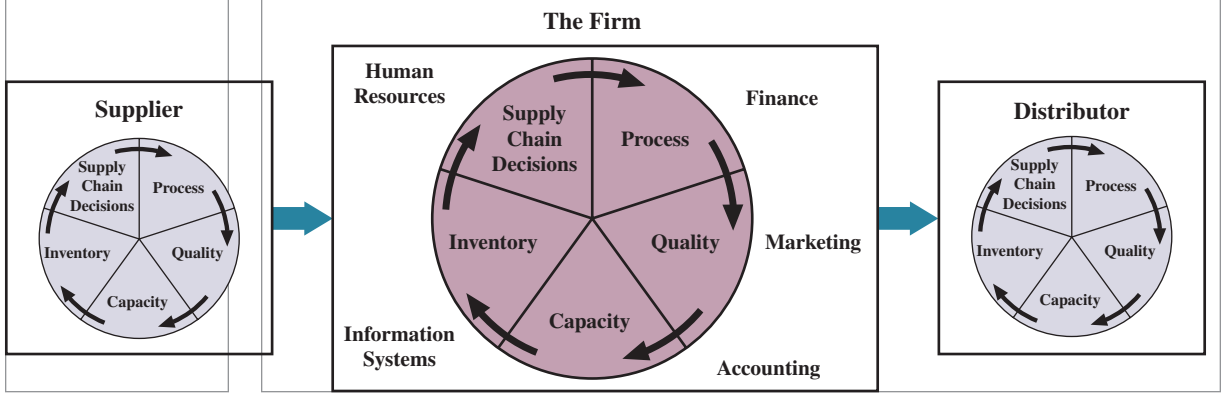
Introduction

1. Process design
   - How to get work done?
2. Quality
   - How to satisfy customers?
3. Capacity and scheduling
   - When and how much work to do?
4. Inventory
   - How to manage parts and products?
5. Supply chain decisions
   - How to manage across organizations?

The text provides a balanced treatment of both service and manufacturing firms. Many books give only cursory treatment to service operations.

The most current knowledge is incorporated, including global operations, supply chain management, service blueprinting, competency-based strategy, Six Sigma, lean systems, 3D printing, blockchain technology, artificial intelligence, analytics, sustainability, and supply chain risk. Complete coverage is also provided on traditional topics, including process design, service systems, quality management, ERP, inventory control, and scheduling.

Decision-making framework for operations in the supply chain.



While covering the concepts of operations and supply chain management in 18 chapters, the book also provides 19 case studies. A key feature of this book is learning how operations issues are tackled in real situations. The cases are intended to strengthen problem formulation skills and illustrate the concepts presented in the text. Long and short case studies are included. The cases are not just large problems or examples; rather, they are substantial management case studies, including some from Amazon, 3M, Mayo Clinic, and Polaris Industries.

The softcover edition with fewer pages than most introductory books covers all the essentials students need to know about operations management in the supply chain, leaving out only superfluous and tangential topics. By limiting the size of the book, we have condensed the material to the basics. The book is also available in Connect and LearnSmart digital versions.

This book is ideal for regular operations and supply chain management courses and also case courses and modular courses. It is particularly useful for those who desire a cross-functional and decision-making perspective that reaches across the supply chain. Instructors can easily supplement the text with their own cases, readings, or course materials as desired.

The Connect Library and Instructor Resources contain 22 Excel templates designed to assist in solving analytic problems at the end of chapters and the case studies. These resources also contain technical chapters on linear programming, simulation, transportation method, and queuing, which can be assigned by the instructor, if desired. Using these resources covers all the main analytics in operations and supply chain management. The resources also have PowerPoint slides, a solutions manual, and the test bank. Access to these resources can be obtained from your McGraw-Hill sales representative or directly in the Connect Library.

Walkthrough of Key Learning Features

- Over forty Operations Leader boxes are included in the chapters to illustrate current practices implemented by leading firms

OPERATIONS LEADER

Nike Does It

Nike and Nike-owned Converse, among other athletic shoe brands, offer customized shoes that can be ordered online for a reasonable price and delivered within a few weeks. Customers can select from numerous fabric or leather colors and patterns on various pieces of the shoe, as well as the colors of laces, stitching, and soles. These shoes, with their many customizable options, are an example of successful mass customization.

obsession.24k/Stockimo/Alamy Stock Photo

Shoes with a customized "fit" are significantly more elusive. While there are firms offering custom-fitted shoes, they sell at prices reflecting the significant work to individually size the shoe, most likely performed in a job shop. These shoes are custom, but not mass customized.

Mass customization gives customers many options, as well as the enjoyment of designing and using a product with their own personal stamp on it.

- Every function in every organization touches Operations and the Supply Chain in some manner. This is the first book to add materials in every chapter to show how topics apply to majors in Marketing, Finance, Accounting, Human Resources, and Information Systems. The handshake symbol indicates these cross-functional decisions.

- To help practice calculations, example boxes are included within chapters and solved problems are added at the end of the chapter.

Example

Suppose demand at the receiving work center B is 2 parts per minute and a standard container holds 25 parts. It takes 100 minutes for a container to make a complete circuit from work center A to work center B and back to A again, including all setup, run, move, and wait times. The number of containers needed in this case is:

$$n = \frac{2(100)}{25} = 8$$

The maximum inventory in the production system, a useful measure of how lean the system is, equal to the container size times the number of containers (200 units = 8 × 25), since the most inventory we can have is all containers filled:

$$\text{Maximum inventory} = nC = DT$$

SOLVED PROBLEMS

Problem

1. **Kanban and takt time.** A work center uses kanban containers that hold 300 parts. To produce enough parts to fill the container, 90 minutes of setup plus run time are needed. Moving the container to the next workstation, waiting time, processing time at the next workstation, and return of the empty container take 140 minutes. There is an overall demand rate of nine units per minute.
   a. Calculate the number of containers needed for the system.
   b. What is the maximum inventory in the system?
   c. A quality team has discovered how to reduce setup time by 65 minutes. If these changes are made, can the number of containers be reduced?
   d. What is the takt time for this process?

Solution

a. T is the time required for a container to complete an entire circuit, in this case 90 minutes for setup and run time plus 140 minutes to move the container through the rest of the circuit.

$$n = DT \div C = (9 \times (90 + 140)) \div 300 = 6.9 \text{ (round up to 7)}$$

b. Since production will stop when all the containers are full, the maximum inventory is when all containers are full, that is, nC:

$$nC = 7(300) = 2100$$

c. $n = DT \div C = (9 \times (25 + 140)) \div 300 = 4.95$ (round up to 5), so yes, the number of containers can be reduced from 7 to 5.

d. Takt time = 1/9 minute = 60/9 seconds = 6.67 seconds. Since the process produces 9 units per minute, the takt time is 1/9 minute or 6.67 seconds per unit.

- Students can both **preview** and **review** the key points and terms. These are found at the end of each chapter.

7.7 KEY POINTS AND TERMS

Lean concepts, principles, and tenets can be deployed to reduce waste in manufacturing and service firms. We have seen how the lean tenets create lean production systems with non-value-added activities eliminated and waste minimized. Key points in the chapter include the following:

- Lean thinking is a way of thinking about processes that includes five tenets: specify customer value, improve the value stream, flow the product or service, pull from the customer, and strive for perfection.
- The five lean tenets seek to eliminate waste by utilizing the full capability of workers and partners in continuous improvement efforts. Lean tools, or methods, are described for each of the five tenets.
- In manufacturing, smooth flow is ensured by a stable and level master schedule. This requires consistent daily production within the master schedule and mixed model assembly. Takt time matches the rate of output with the average demand rate in the market.

Key Terms

Toyota Production System (TPS) 119	Push 123	Internal setup 128
Just-in-Time (JIT) manufacturing 119	Pull 123	External setup 128
Lean production 119	Perfection 124	Cellular manufacturing 129
Lean thinking 120	5 Whys 125	Preventative maintenance 129
Waste (muda) 121	5S 125	Cross-training 130
Value stream 121	Stabilizing the master schedule 127	Respect for people 130
Value stream mapping 121	Uniform load 127	Kanban 130
Gemba 121	Takt time 127	Reducing lead time 133
	Reducing setup time 128	Supplier relationships 133
	Single setups 128	Co-location 133
		Kaizen 135

- Twenty-two Excel spreadsheets are included for solving problems and analyzing case studies using analytic methods.

eXcel 11. As cereal boxes are filled in a factory, they are weighed for their contents by an automatic scale. The target value is to put 10 ounces of cereal in each box. Twenty samples of three boxes each have been weighed for quality control purposes. The fill weight for each box is shown below.

	Observation		
Sample	1	2	3
1	10.01	9.90	10.03
2	9.87	10.20	10.15
3	10.08	9.89	9.76
4	10.17	10.01	9.83

- Case studies provide students practice in formulating and solving unstructured problems.

Case Study Lawn King, Inc.: Sales and Operations Planning eXcel

John Conner, marketing manager for Lawn King, looked over the beautiful countryside as he drove to the corporate headquarters in Moline, Illinois. John had asked his boss, Kathy Wayne, the general manager of Lawn King, to call a meeting in order to review the latest fore-

The changeover cost of the production line depends on which type of mower is being produced and the next production model planned. For example, it is relatively easy to change over from the 20-inch push mower to the 20-inch self-propelled mower, since the mower frame is

- Throughout the text, company and industry examples illustrate real use of the ideas.

Harrah's uses superior customer service to increase profits.
Leonard Zhukovsky/123RF

Grocery self-service is a provider-routed service.
Syda Productions/Shutterstock

- At the end of every chapter, Learning Enrichment boxes provide videos and websites where students can extend their knowledge on chapter topics using Internet content.

LEARNING ENRICHMENT
(for self-study or instructor assignments)

What Is the New Product Development Process? https://youtu.be/vQZjNIRpuFg	Video 2:49
Prototyping https://youtu.be/5SWt-TSYD08	Video 2:26
3D Printing Prototype Example https://youtu.be/RpFTRT8FkP0	Video 3:02
Sustainability in New Product Development https://youtu.be/-HS-slU-XTc	Video 3:56

KEY CHANGES IN THE EIGHTH EDITION

This book is known for its decision orientation and case studies. We have strengthened the decision-making framework by adding new material on digital technology, lean systems, sustainability, and global supply chains. We also include new and existing cases to address these decisions. The Eighth Edition features a new 4-color design and the following major changes:

1. **Cross-functional.** Most books for operations and supply chain core courses are merely summaries for majors in operations and supply chain management. None address the general business student who is interested in Marketing, Finance, Accounting, or Information Systems. We make this book more applicable and interesting to the approximately 80 percent of business students who don't major in operations and supply chain management. We add cross-functional materials in each chapter to show how the topics apply to non-majors. The handshake symbols in the margin identify the content.
2. **Digital Technology.** The Eighth Edition has substantial updates and additions on four digital technologies. 3D printing is becoming useful for producing spare parts, custom manufacturing, medical devices, dental implants, and architectural models. Blockchain software is being developed and tested by many global logistics companies. Artificial intelligence is rapidly developing for service applications, automobiles, and manufacturing plants. Analytics are being applied to both large and small databases. Analytics that are descriptive, predictive, or prescriptive in nature are discussed. These digital technologies are described in detail in several chapters in the book.
3. **Supply Chain Sustainability.** We introduce the idea of the triple bottom line regarding environmental, social, and economic sustainability. Sustainability is preserving the earth and resources for future generations. Environmental sustainability is related to global warming, clean water, clean air, and environmental protection. Social sustainability means hiring a diverse workforce, ethical practices, providing equal opportunity, and safe working conditions, for example. Economic sustainability is making a sufficient profit for the firm's survival in the future. Operations and supply chain managers are actively pursuing all three aspects of sustainability of operations and associated supply chains.

4. **Global Supply Chains.** In this new edition we have increased our attention to global supply chains by adding new sections on global services, global sourcing, and global logistics. The text explains how to make global decisions that balance the lower costs of overseas sourcing and logistics with the risks of quality failures, loss of intellectual property, increased monitoring costs, and exposure to financial and political risks.
5. **Lean Systems.** Most books discuss up to 15 techniques of lean including reduced setup time, small lot sizes, uniform load, and takt time. We have completely reorganized the lean chapter around the five tenets and principles of lean systems to include all of these techniques. This clarifies lean systems in terms of creating value for the customer, eliminating waste, ensuring flow, customer pull, and striving for perfection.
6. **Practical Examples.** The text contains over 70 practical examples of concepts, ideas, and analytics. Nineteen new Operations Leader boxes have been added for companies including Southwest Airlines, Lego Group, Culver's, Nike, LG Electronics, and Trader Joe's. In addition twenty-five existing Operations Leader boxes have been updated in the various chapters.
7. **Learning Enrichment boxes.** Every chapter ends with a Learning Enrichment box for student self-study or instructor assignments. These boxes have YouTube video links and websites that expand on the coverage in the chapter. They cover ideas from the chapter in more detail or provide examples of the how the ideas are used. This is one of the first books to make extensive use of the Internet to enrich the material covered in the text.

When reviewers of this book were asked how they would describe the text to a colleague, they said:

"I would highly recommend the book to them. While other textbooks either focus on the techniques or concepts, this book does a good job in addressing both equally well."

"A solid textbook that is well-written. Good coverage of basic operations management material."

"It is a guide to operations that takes a practical approach with a strong emphasis on case materials to put concepts into practice."

CHAPTER REVISIONS AND CASES FOR THE EIGHTH EDITION

1. **Introduction to Operations.** The first part of the chapter is rewritten to clearly define operations and supply chain management. A new section explains the role of operations in the firm and the economy including productivity calculations. The triple bottom line is defined for environmental, social, and economic sustainability. Internet links are provided in the Learning Enrichment box on sustainability and globalization.
2. **Operations and Supply Chain Strategy.** A new Operations Leader box on Southwest Airlines is added. Sustainability, as an objective, is added to cost, quality, delivery and flexibility. Emphasis is placed on decision making in operations that is contingent on strategy.
3. **Product Design.** New content is added on the use of 3D printing for creating prototypes. Concurrent engineering is illustrated using a new example from NASA. New Operations Leader boxes describe how The LEGO Group tackles sustainability challenges and how TPI Composites is developing and manufacturing blades for wind turbine energy systems.

4. **Process Selection.** There is a new example of focused operations in a service firm, Midwest Orthopedic Specialty Hospital. Two new Operations Leader boxes describe the food production system at Culver's and mass customization at Nike. We also expand on the role of 3D printing in modern manufacturing, particularly in the medical sector.
5. **Service Process Design.** The relevance of service operations to non-majors is discussed. A new Operations Leader box on the City of Fort Collins is added. This edition is the first to offer sections on Technology for Services and Globalization of Services.
6. **Process-Flow Analysis.** Cross-functional material is added to show its importance to systems thinking. A Learning Enrichment box is included with YouTube videos and Internet links on process mapping, Little's Law, and queueing at Disney.
7. **Lean Thinking and Lean Systems.** This chapter is completely reorganized around the five lean tenets to clarify the principles and concepts underlying lean thinking. New material is added on cellular manufacturing and the pull system. The chapter is the first to take a principle and conceptual approach to lean systems, rather than a listing of techniques and methods used.
8. **Managing Quality.** YouTube videos are added to the Learning Enrichment box to expand on ISO9000 certification, mistake proofing, and the Baldrige Award for health care. Quality is expanded to include the entire supply chain, not just the focal firm. The highly cross-functional nature of quality is emphasized.
9. **Quality Control and Improvement.** We explain why all business students should learn about quality control. The difference between special causes and common causes is emphasized. We clarify the differences between statistical process control and process capability. The section on Six Sigma was rewritten to expand the content.
10. **Forecasting.** We shift our description of forecasting to "analytics" so that students can understand how the popular focus on analytics is utilized in operations and supply chain. There is a new section on big data and its use in forecasting, along with a new Operations Leader box on how Amazon uses big data in its own forecasting. When and how to use MAD_t is clarified, in addition to many minor clarifications in using formulas throughout the chapter.
11. **Capacity Planning.** We expand discussion about how all functions are involved in and impacted by capacity planning. Improvements in the descriptions of Sales and Operations Planning (S&OP) as well as aggregate planning help to clarify the process involved and the challenges faced. Calculations for level and chase strategies are clarified. New Operations Leader boxes on Delta Airlines and Hostess Brands make these concepts tangible for students.
12. **Scheduling Operations.** We add new material on the theory of constraints about how to identify the bottleneck constraint and eliminate it while subordinating everything else. In the Learning Enrichment box interesting YouTube videos are provided on job shop scheduling at Washburn Guitar, round-robin CPU scheduling, and the theory of constraints.
13. **Project Planning and Scheduling.** The chapter is updated to illustrate the many industry settings in which projects require skilled management—from manufacturing to service firms, nonprofits, and government. A new Operations Leader box on the Carlsbad Desalination Plant in San Diego provides a nice example of a major multi-government project. Other updates include the Project Management Institute's Body of Knowledge in Table 13.3.

14. **Independent Demand Inventory.** The chapter includes additional content on vendor managed inventory (VMI), along with a new Operations Leader box illustrating VMI at Procter and Gamble Co. An additional new Operations Leader box on IKEA describes the use of a min/max inventory replenishment system. The Learning Enrichment box at the end of the chapter provides video and web sources for additional information.
15. **Materials Requirements Planning and ERP.** We clarify for students exactly which elements constitute the MRP system. We also describe the use of Oracle's ERP software at Cleveland Clinic to help students understand the breadth of these system's use in industry. A new Operations Leader box on LG Electronics provides a useful illustration of how a global firm benefits from these systems.
16. **Supply Chain Management.** This is one of the first books to have a separate section on blockchain technology to explain its uses and methods. More details are also provided on the SCOR model. We rewrote the section on measures of throughput time, cash-to-cash cycle time and total delivered cost for analyzing an entire supply chain. We added a new section on the Amazon effect and omni-channel marketing, also a first in textbooks.
17. **Sourcing.** The chapter includes an entirely new section on Global Sourcing, including discussion of risks and benefits. Presentation of Total Cost Analysis is expanded. A new Operations Leader box on Trader Joe's sourcing strategy will appeal to students.
18. **Global Logistics.** A new section on Global Logistics includes a figure to illustrate the multimodal activities in global supply chains. The concepts of intermodal and shipping zones have been added and described. A new Operations Leader box on Home Depot provides insight on how online sales are served from stores and warehouses, while an expanded box on Ryder gives students a glimpse of the people and assets needed for this major 3PL provider.

Case Study Revisions

A few of the 19 case studies are described below:

Amazon Revolutionizes Supply Chain Management. This new case, written exclusively for this book, describes the evolution of Amazon's supply chain and its purchase of Whole Foods. It challenges students to think about how Amazon can change the future of Whole Foods to increase its revenues and earnings. The case also contrasts what Walmart is doing to use e-commerce to compete with Amazon. The case asks students to define the effect of the emergent business strategies of Amazon and Walmart on the supply chains of these companies in terms of locations, sourcing, capacity, and inventory.

Operations Strategy at BYD of China, Electrifying the World's Automotive Market. BYD, the leading electric vehicle company in the world, must develop a strategy for adapting its supply chain in the future. We updated this case from its last update in 2015 and revised the teaching note for this rapidly changing industry.

Early Supplier Integration for John Deere Skid-Steer Loader. Deere and Company must decide how to involve suppliers in the design of its new Skid-Steer Loader. This case is updated and the teaching note revised.

The Evolution of Lean Six Sigma at 3M Inc. Students are asked to evaluate 3M's use of Six Sigma and lean thinking. We added significant new information since the last update in 2012.

Consolidated Electric: Inventory Control. Management is designing a new inventory control system. The student questions are tailored to increase student learning about this system.

Altimus Brands: Managing Procurement Risk. Altimus is deciding which of four offshore suppliers offers the lowest cost and risk for future purchase contracts. We updated the case and wrote a new teaching note.

ShelterBox: A Decade of Disaster Relief. After the Haiti earthquake of 2010, ShelterBox provided immediate relief and is considering what decisions should be made in advance of future disasters. A new teaching note was written for this case.

INSTRUCTOR RESOURCES

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McGraw-Hill Connect® is an online assignment and assessment solution that connects students with the tools and resources they'll need to achieve success through faster learning, higher retention, and more efficient studying. It provides instructors with tools to quickly pick content and assignments according to the topics they want to emphasize.

Instructor Library. The *Connect Operations Management* Instructor Library is your repository for additional resources to improve student engagement in and out of class. You can select and use any asset that enhances your lecture. The *Connect* Instructor Library includes:

- **Solutions Manual.** Prepared by the authors, this manual contains solutions to all the end-of-chapter problems and cases.
- **Test Bank.** The Test Bank includes true/false, multiple-choice, and discussion questions/problems at varying levels of difficulty. All test bank questions are also available in a flexible electronic test generator. The answers to all questions are given, along with a rating of the level of difficulty, chapter learning objective met, Bloom's taxonomy question type, and the AACSB knowledge category.
- **PowerPoint Slides.** The PowerPoint slides draw on the highlights of each chapter and provide an opportunity for the instructor to emphasize the key concepts in class discussions.
- **Digital Image Library.** All the figures in the book are included for insertion in PowerPoint slides or for class discussion.
- **Excel Spreadsheets.** Twenty Excel Spreadsheets are provided for students to solve designated problems at the end of chapters.
- **Technical Chapters.** Additional Operations analytics are available in four inline Technical Chapters. These are available in the Instructor Resource Library through Connect, or by visiting the URL at www.mhhe.com/schroeder8e

The instructor and student resources can also be accessed directly at **www.mhhe.com/schroeder8e**.

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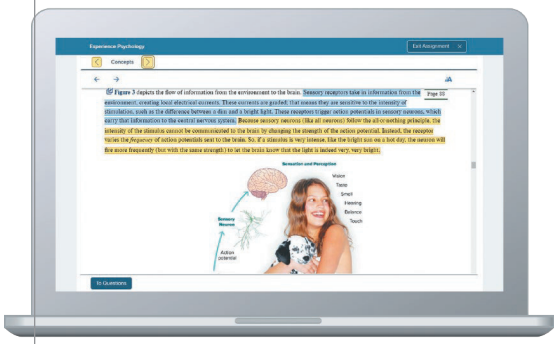

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Brief Table of Contents

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PART I

Introduction

1. Introduction to Operations
2. Operations and Supply Chain Strategy
3. Product Design

The introductory part of this text provides an overview of operations management in the supply chain. In Chapter 1 students gain an appreciation for the importance to the firm of decisions made in the operations function and its associated supply chain. In Chapter 2 the need for strategy to guide all decision making is emphasized. In Chapter 3 new product design is treated as a cross-functional decision responsibility that precedes the production and delivery of goods or services. ■

CHAPTER 1

Introduction to Operations

LEARNING OBJECTIVES

After reading this chapter you should be able to:

LO1.1	Define operations and supply chain management.
LO1.2	Review the role of operations in the firm and the economy.
LO1.3	Describe the five main decisions made by operations and supply chain managers.
LO1.4	Explain the nature of cross-functional decision making with operations.
LO1.5	Describe typical inputs and outputs of an operations transformation system.
LO1.6	Analyze trends in operations and supply chain management.

The operations and supply chain management field deals with the production of goods and services and management of the associated supply chain. Every day we come in contact with an abundant array of goods and services, all of which are produced by the operations function within the firm. Without management of operations and its associated supply chain, a modern industrialized society cannot exist. The operations function is the engine that creates goods and services for the firm and in aggregate the global economy.

Supply chains are critical in supporting operations within the firm. **Supply chains** consist of a network of organizations outside the firm that supply the materials and services to the firm and distribute the product or service to the ultimate customer. A global supply chain engages in all the activities and processes needed to plan, source, make, deliver, and return or dispose of a set of products or services. Managing the supply chain is essential in addition to managing internal operations of the firm.

Apple manages a complex supply chain and operations across the globe.
Jill Braaten/McGraw-Hill Education

This book deals with operations management in the supply chain. This means we take a supply chain perspective to traditional operations. We take ideas from operations management within the firm and combine them with a view of the entire supply chain.

At first glance it may appear that service operations have little in common with manufacturing operations. However, the unifying feature of these operations is that both can be viewed as transformation processes inside organizations that are themselves embedded in supply chains. In manufacturing, inputs of materials, energy, labor, and capital are transformed into finished goods for customers. In service operations, the same types of inputs are transformed into services, for example, surgeries in hospitals. Managing transformation processes in an efficient and effective manner is the task of the operations manager in any organization.

Most Western economies have shifted dramatically from the production of goods to the production of services. It may come as a surprise that more than 80 percent of the U.S. workforce is employed in service industries.[1] Even though the preponderance of employment is in the service sector, manufacturing remains important to provide goods needed for export and internal consumption. Because of the importance of both service and manufacturing operations, they are treated on an equal basis in this text.

In the past when the field was primarily related to manufacturing, operations management was called production management. Later, the name was expanded to operations management to include both manufacturing and service industries. Now it has been expanded again to operations and supply chain management to include not only operations, but also its associated supply chain.

1.1. DEFINITION OF OPERATIONS AND SUPPLY CHAIN MANAGEMENT

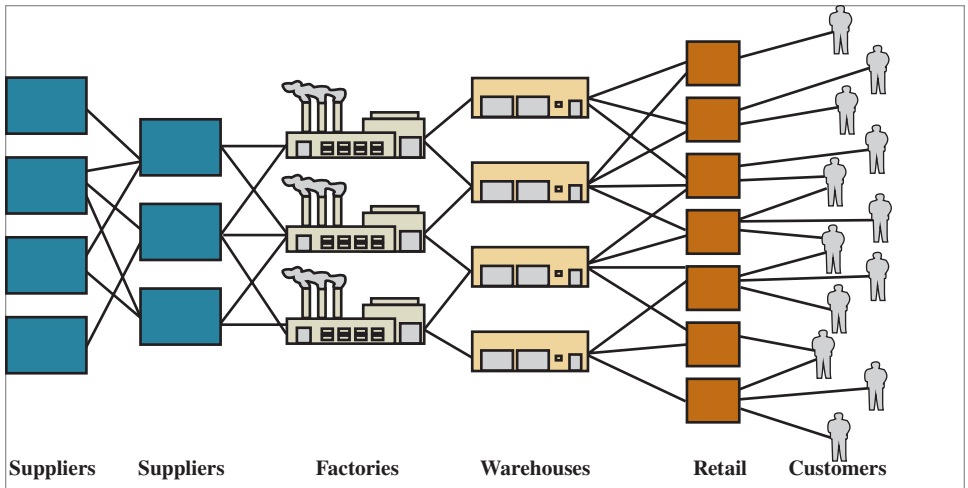
LO1.1 Define operations and supply chain management.

Operations management is defined as managing the production of goods and services. The focus is on production within an organization, for example, production within the four walls of a factory or within multiple factories in a company. Similarly, production of services is treated as within individual service locations or across multiple locations within a single company.

> ***Operations management*** *focuses on decisions for the internal production of the firm's products or services.*

[1] U.S. Census Bureau, *Statistical Abstract of the U.S.,* Washington, D.C. 2019 ed.

FIGURE 1.1
A typical supply chain.



Supply chain management deals with managing the flow of materials, information, and money across multiple organizations from the suppliers to operations to distribution to the final customer, along with reverse flows. The entire supply chain is included from the raw materials through suppliers, factories, warehouses, and retailers to the ultimate customer as shown in Figure 1.1. Reverse flows also occur in the supply chain for returned products, recycled products, and information.

> ***Operations and supply chain management*** *deals with the sourcing, production and distribution of the product or service along with managing the relationships with supply chain partners.*

This definition expands the notion of operations and reflects the role of operations in the supply chain. It adds sourcing and distribution to the traditional definition of operations, and it adds managing the relationships/interactions with supply chain partners. Sourcing, also called purchasing, works with manufacturing and service suppliers of the firm and is part of the larger definition of operations and supply chain management. Distribution, also called logistics, is concerned with transporting materials into operations and taking the output of operations to the ultimate customer. Operations and supply chain management must be concerned with managing not only the internal operations of the firm, but also the relationships and processes shared with supply chain partners along the supply chain.

This text brings together two previously separate fields of operations management and supply chain management into what is called operations and supply chain management. While operations management is concerned with the internal operations of the firm, supply chain management adds external relationships with other firms.

Moreover, every organization along the supply chain needs to manage its own operations together with the relationship with the rest of the supply chain partners. Thus operations management appears in the suppliers, the factories, the wholesalers, and the retail companies, since each of them is producing a product or service that is passed along the supply chain.

1.2 THE ROLE OF OPERATIONS AND SUPPLY CHAIN MANAGEMENT

LO1.2 Review the role of operations in the firm and the economy.

All countries are dependent on economic growth as measured by their GDP (**Gross Domestic Product**). GDP is the monetary value of all the goods and services produced within a country's borders. GDP growth leads not only to prosperity of the country, but income growth for the population, since income is closely related to GDP per capita.

Productivity is the amount of output from a given amount of inputs or vice versa. It is one factor that leads to economic growth and profitability of the firm. More output over time from the same resources increases GDP and allows people to get more of what they want beyond mere survival. Operations and supply chain management plays a central role in achieving GDP growth and productivity not only for individual companies but, in aggregate, for the entire economy of a country.

Productivity is output divided by inputs, all in constant dollars. Since price changes should not affect productivity, constant dollars are used.

$$\text{Productivity} = \frac{output}{capital + labor}$$

If the same output can be achieved by less capital and labor, productivity will improve. Vice versa, more output achieved from the same levels of capital and labor will also improve productivity. Productivity ratios can be calculated at the firm, industry, and national levels.

Henry Ford believed in producing a reliable automobile at the lowest possible cost to be affordable for all Americans. He represented the epitome of productivity improvement by using better production line design and labor training to produce more output at lower costs, illustrating the power of production in improving productivity and profits, and providing higher wages to employees. This story has been repeated thousands of time in many industries, even to the present time. See the Operations Leader box for how Dell drives productivity and value for its customers.

How are productivity growth and firm profitability achieved? It is only through the creativity, imagination, and innovation of operations and supply chain employees,

OPERATIONS LEADER

Dell Delivers Productivity and Value

In 1984 Michael Dell founded Dell Computer Corporation with $1000 in start-up capital and a business model to sell custom-configured personal computers directly to customers while passing along cost savings to customers by cutting out the middlemen. The company offers a range of products beyond personal desktop and mobile computing products; servers, storage, and networking products; printing and imaging products; electronics and accessories; enhanced business and consumer services; and business solutions. Nearly half of Dell's revenue comes from outside of the U.S.

Pe3k/Shutterstock

A key to Dell's strategy is its customer-driven approach to innovation. This approach signals a commitment to delivering new products and services that are valued by customers and that address customer needs while improving productivity. This approach explains how Dell pioneered the direct-selling system to allow customer orders to be placed over the Internet or over the phone and, since 2007, through select retail outlets. Orders for products, once taken, are assembled in one of Dell's factories and often shipped to customers or retail stores within days, with the factories carrying very little finished goods inventory.

In addition to the importance of the operations function at Dell, sourcing and logistics activities are critical. Sourcing managers source the many components required to manufacture Dell products, and logistics managers handle the global movement of components and finished goods to satisfy customer demand. Managing Dell's fast and rapidly changing supply chain is a challenging task that they perform well.

Dell today is pursuing environmentally friendly best practices: Its global headquarters campus is now powered by 100 percent green energy; its desk computer systems have been designed to reduce carbon dioxide emissions; Dell was the first computer manufacturer to offer free computer recycling to customers worldwide; and its "Plant a Tree for Me" and "Plant a Forest for Me" programs have planted over 600,000 trees.

Source: Adapted from www.dell.com, 2019.

managers, and executives. This can be done through innovative product or service design, but also through continuous improvement of the production process and supply chain. A large component of this is achieved through automation, but also the imagination of designers and operations managers for both product and process improvements. It is the responsibility of operations and supply chain managers to improve profitability and productivity for the firm.

Below is a simple example of a computation of labor productivity in a firm.[2]

Example

For a firm with the following labor and output numbers, calculate the rate of labor productivity change assuming annual labor inflation of 3 percent and annual output (sales) inflation of 2 percent.

	Year 1	Year 2	Annual Inflation
Output (sales) $million	$56.7	$64.8	2%
Labor (payroll) $million	$23.4	$26.6	3%

$$\text{Labor productivity year 1} = \frac{\textit{Output year 1}}{\textit{Labor year 1}} = \frac{56.7}{23.4} = 2.42$$

$$\text{Labor productivity year 2} = \frac{\textit{Deflated output year 2}}{\textit{Deflated labor year 2}} = \frac{64.8(.98)}{26.6(.97)} = 2.46$$

$$\text{Change in productivity} = \frac{2.46}{2.42} = 1.016 \text{ which is a 1.6\% increase}$$

Notice, both the output and input in year 2 have been adjusted for inflation between year 1 and year 2. The productivity increase achieved by operations and supply chain managers in one year is 1.6 percent.

Productivity improvement is not the only way to increase GDP and prosperity in a country. Just being more efficient is not enough, if there is no longer demand for the product. Therefore, GDP growth requires innovation and new product development to meet the evolving needs of markets. As a result, productivity improvement and innovation are two of the most important factors that affect GDP growth, firm output, and firm profitability. Operations and supply chain managers have a key role in introducing new products and achieving scale-up of production. They also participate in product design teams consisting of design, marketing, and finance managers. In this way they contribute to both new product innovation and productivity improvement for existing products and ultimately the profitability of the firm and GDP growth.

1.3 WHY STUDY OPERATIONS AND SUPPLY CHAIN MANAGEMENT?

For students majoring in operations and supply chain management this will be an introductory course to the subject. This major leads to challenging and interesting jobs both in domestic and international industries ranging from entry level to middle management

[2] For simplicity we consider only labor inputs for the partial labor productivity ratio. A total productivity ratio would include both capital and labor, and perhaps energy and materials inputs, as well.

OPERATIONS LEADER

Careers in Operations and Supply Chain from Monster.com

SUPPLY CHAIN ANALYST

PayPal, owned by online shopping site eBay, is hiring a supply chain management professional responsible for end-to-end support for PayPal's new *Here* product. The job requires international travel to manufacturing and distribution sites. Responsibilities include product and distribution management, on time and on budget; reviewing inventory reports with supply partners; arranging freight shipments globally; and coordinating and collaborating with internal groups within PayPal and eBay. The job description also requests "maniacal attention to detail."

NetPics/Alamy Stock Photo

BUSINESS METRICS/ANALYTICS SUPPLY CHAIN ANALYST

Cardinal Health is seeking an analyst to develop, quantify, and evaluate the transformation of internal and external information into business intelligence. Qualified candidates will demonstrate knowledge of concepts and principles of business metrics and analytical techniques/tools. The position requires listening to internal/external customers' needs and proactively providing them a quality experience through effective communication.

VICE PRESIDENT OF OPERATIONS

Envista Credit Union is seeking an executive whose responsibilities include organizing, planning, and directing all operations functions associated with branches and central operations. This individual will participate in the development of strategic implementation plans and related objectives. Candidates must have strong communication skills and acknowledge the important relationship with customer members in supporting the credit union's vision and mission.

CONTINUOUS IMPROVEMENT PLANT LEAD

ConAgra Foods seeks a partner to roll out a system establishing a zero-loss manufacturing culture. Coordinating with the Plant Manager, this Plant Lead executes plans for sustainability, develops and maintains training and tracking standards, and coaches sites on improvement methodologies. This position serves as a key development role for a future Plant Manager.

MATERIALS SOURCING MANAGER

Herbalife, a direct-sales nutrition company, is hiring a senior-level sourcing manager for global spending of $200 million on raw materials. Responsibilities include reducing raw materials costs yearly, analyzing market intelligence for trends in commodity markets, and making strategic recommendations to senior management for each category of raw materials. This job also requires maintaining appropriate inventory levels and developing strategic supplier relationships.

Source: Abstracted from www.monster.com.

and top management positions. Some of these positions in both service and manufacturing industries are illustrated in the Operations Leader box on careers in operations and supply chain management.

For non-majors this course is important to gain an understanding of what operations does and its interactions with other functions within the firm and its supply chain. Every decision is cross-functional in nature.[3] You will be working with operations and need to understand it no matter what career path you choose. The organization in which someone works only with people from his or her own function does not exist. That is why we take a cross-functional perspective in this text, so the content is useful to the majority of students who are not majors.

[3] The "handshake" symbol in the margin identifies a point of cross-functional emphasis and is designed to illustrate that the various functions must work together for an organization to be successful and thrive.

As you study operations, you will find that many of the ideas, techniques, and principles can be applied across the business, not just in operations. For example, all work is accomplished through a process (or sequence of steps). The principles of process thinking found in this text can be applied to all parts of business. Toyota, for example, uses lean thinking to improve processes in human resources, accounting, finance, information systems, and even the legal department. Many students find that the ideas learned in this course can be applied to their own department, career, or functional responsibilities and are useful to non-majors.

Operations and supply chain management is an exciting and challenging field of study. The ideas that you learn are both qualitative and quantitative, and both are essential to good management practice. You are embarking on a journey that is interesting and useful no matter what career you choose!

There are three aspects of operations and supply chain management that require elaboration:

1. **Decisions.** Since managers make decisions, it is natural to focus on decision making as a central theme in operations. Within the broader context of supply chain, this decision focus provides a basis for identifying major decision types. In this text, we specify the **five major decision responsibilities** of operations and supply chain management as **process, quality, capacity, inventory,** and **supply chain.** These decisions provide the framework for organizing the text and describing what operations and supply chain managers do. We will discuss these decisions in greater detail in subsequent chapters.
2. **Function.** Operations is a major function in any organization, along with marketing and finance. In a manufacturing company, the operations function typically is called the manufacturing or production department. In service organizations, the operations function may be called the operations department or some name peculiar to the particular industry (e.g., the policy service department in insurance companies). In general, the generic term "operations" refers to the function that produces and delivers goods or services. While separating operations out in this manner is useful for analyzing decision making and assigning responsibilities, we must also integrate the business by considering the cross-functional nature of decision making in the firm.

3. **Process.** Operations managers plan and control the transformation process and its interfaces in organizations as well as across the supply chain. This process view is a powerful basis for the design and analysis of operations in an organization and across the supply chain. Using the process (or systems) view, we consider operations and supply chain managers as designers of the conversion process in the firm. But the process view also provides important insights for the management of productive processes in functional areas outside the operations function. For example, a sales office may be viewed as a production process with inputs, transformation, and outputs. The same is true for an accounts payable office and for a loan office in a bank. In terms of the process view, operations management concepts have applicability beyond the functional area of operations.

Since the field of operations and supply chain management can be defined by decisions, function, and processes, we will expand on these three elements in detail in this chapter. But first we provide an example of the decisions that would be made by operations and supply chain management in a typical company that makes and markets pizzas.

1.4 DECISIONS AT PIZZA U.S.A.

LO1.3 Describe the five main decisions made by operations and supply chain managers.

Pizza U.S.A., Inc., produces and markets pizzas on a national basis. The firm consists of 285 company-owned and franchised outlets (each called a store) in the U.S. The operations function in this company exists at two levels: the corporate level and the level of the individual store.

The major operations and supply chain decisions made by Pizza U.S.A. can be described as follows:

Process

Corporate staff makes some of the process decisions, since uniformity across different stores is desirable. They have developed a standard facility design that is sized to fit a particular location. Each store incorporates a limited menu with equipment that is designed to produce pizza to customer orders. As pizzas are made, customers can watch the process through a glass window; this provides entertainment for both children and adults as they wait for their orders to be filled. Because this is a service facility, special care is taken to make the layout attractive and convenient for the customers.

Within the design parameters established by the corporate operations staff, the store managers seek to improve the process continually over time. This is done both by additional investment in the process and by the use of better methods and procedures, which often are developed by the employees themselves. For example, a store might re-arrange its layout to speed up the process of producing pizzas.

Quality

Certain standards for quality that all stores must follow have been set by the corporate staff. The standards include procedures to maintain service quality and ensure the quality and food safety of the pizzas served. While perceptions of service quality may differ by customer, the quality of the pizzas can be specified more exactly by using criteria such as temperature at serving time and the amount of raw materials used in relation to standards, among others. Service-quality measures include courtesy, cleanliness, speed of service, and a friendly atmosphere. Service quality is monitored by store manager observation, comment cards, and occasional random surveys. Each Pizza U.S.A. store manager must carefully monitor quality internally and with suppliers to make sure that it meets company standards. All employees are responsible for the quality of their work to ensure that service quality and food quality are meeting the standards of the company.

Pizza U.S.A. satisfies its customers by carefully managing the four key decision areas in operations.
Steve Mason/Getty Images

Capacity

Decisions about capacity determine the maximum level of output of pizzas. The capacity available at any point in time is determined by the availability of equipment and labor inputs for the pizza-making process at that time. First, when the initial location and process decisions are made, the corporate staff determines the physical capacity of each facility. Individual store managers then plan for annual, monthly, and daily fluctuations in capacity within the available physical facility. During peak periods, they may employ part-time help, and

advertising is used in an attempt to raise demand during slack periods. In the short run, individual personnel are scheduled in shifts to meet demand during store hours.

Inventory

Each store manager buys the ingredients required to make the recipes provided by corporate staff. The store managers decide how much flour, tomato paste, sausage, and other ingredients to order and when to place orders. Store operators must carefully integrate sourcing and inventory decisions to control the flow of materials in relation to capacity. For example, they do not want to purchase ingredients for more pizzas than they have the capacity to bake. They also do not want to run out of food during peak periods or waste food when demand is low.

Supply Chain

The supply chain decisions consist of sourcing and logistics. Sourcing is done by the corporate office. They select the specific suppliers for all inputs, negotiate prices, write contracts, and issue blanket purchase orders that stores use to order individual ingredients and items as they need them. The orders are then fulfilled by the suppliers, and a logistics provider ensures the orders are delivered on time. Logistics is handled by a third-party provider who secures transportation and uses its distribution centers to make deliveries to Pizza U.S.A. stores.

1.5 OPERATIONS DECISIONS IN THE SUPPLY CHAIN—A FRAMEWORK

The five decision groupings showcased in the Pizza U.S.A. example provide a framework for understanding the various decisions made by operations and supply chain managers. Although many different frameworks are possible, the primary one used here is a conceptual scheme for grouping decisions according to decision responsibilities. The five key decision areas—process, quality, capacity, inventory, and supply chain—encompass what operations and supply chain managers do. This novel and useful decision framework is shown in Figure 1.2. Notice how the five decision areas in the figure apply not only to the firm, but to the supplier and the distributor, since all three must make the same types of decisions in managing their own operations and coordinating those decisions across the supply chain. In Table 1.1, examples are given of key decisions in each area.

FIGURE 1.2 Decision-making framework for operations in the supply chain.

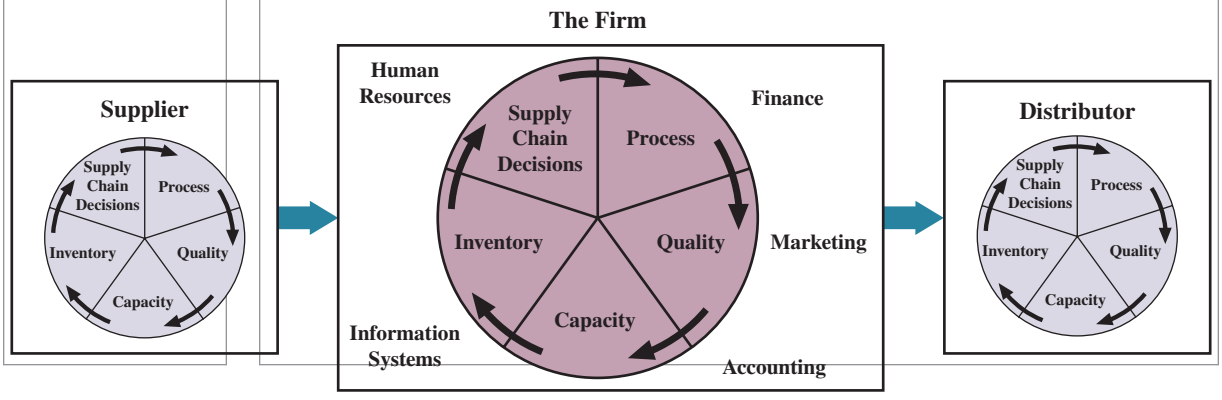


TABLE 1.1
Operations and Supply Chain Decisions—A Framework

Decisions	Examples of Decisions
1. Process	• What type of process should be selected? • How should the service delivery system be designed? • How should material and customer flows be managed? • What principles of lean systems should be deployed? • How should environmental and global goals be met?
2. Quality	• What should the quality standards be? • How can quality be controlled and improved? • What statistical approaches should be used (e.g., control charts and Six Sigma)? • How should the suppliers and customers be involved in quality?
3. Capacity	• What is the facility strategy for size, location, and timing? • How should Sales and Operations Planning be implemented? • How should variable demand be handled with capacity adjustments? • What priority rule should be used for scheduling?
4. Inventory	• How much inventory should be held? • What should the order size and reorder frequency be? • Who should hold the inventory? • How can the inventories of suppliers and customers be coordinated?
5. Supply Chain	• What suppliers should be used for products and services? • How should sourcing be conducted and evaluated? • What form of transportation should be used? • How should warehouses be used to allow economic flow of materials?

Careful attention to the five decision areas in the framework is the key to the successful management of operations and the associated supply chain. Indeed, well-managed operations and its supply chain can be defined in terms of this decision framework. If decisions in each of the five groupings support the strategy of the firm, provide value, and are well integrated with the other functions of the organization, the operations function and its associated supply chain can be considered well managed.

Each major section of this text is devoted to one of the five decision categories.[4] The framework thus provides an integrating mechanism for the text that covers both the decisions faced by operations and supply chain managers as well as the cross-functional issues that must be considered.

The five decisions areas of operations and supply chain can be compared to the 4 Ps of marketing: product, price, place, and promotion. These four Ps in the marketing mix are the tools or decision types that marketing managers can use to influence demand. In a similar way the five decision types of operations and supply chain can be used to influence supply and must be compatible and consistent with the 4 Ps of marketing. They are just two sides of the same coin, one influencing demand and the other supply.

Analytics is the analysis of data to make better decisions. Analytics uses many techniques for the analysis including those from operations research, statistics, data sciences, and computer science. The analysis can use either big data from massive databases or small data depending on the application. Analytics can be descriptive, predictive, or prescriptive in nature. A descriptive analysis typically summarizes the present situation from data. The data can be used to go one step further and predict what will happen in the future. Prescriptive analytics typically uses mathematical models to find an optimal or best decision. Analytics are used in operations and supply chains for a variety of decisions, including quality control, forecasting, capacity, scheduling, inventory, logistics, and sourcing.

[4] Students have called these five categories QPICS, Quality, Process, Inventory, Capacity, and Supply chain, pronounced "Q-PICS."

Throughout the text, best practices are presented. Additionally, discussion and examples of firms in which the best practice is not the best for their particular situation are included. These contingencies, situations, or conditions that require different solutions offer a more nuanced view of operations decision making. For example, successful implementation of a new method such as lean or Six Sigma is contingent on top management support. Similarly, the "best" forecasting tools and concepts depend on the availability of data. If there was a single best practice that works for all firms, then operations would not be the challenging function to manage that it is. Therefore, by offering insight into specific conditions in which best practices may not be best, the text addresses the various contingencies or prerequisites or situations that need to be considered.

1.6 CROSS-FUNCTIONAL DECISION MAKING

LO1.4 Explain the nature of cross-functional decision making with operations.

Managerial decision making is cross-functional in nature.
ammentorp/123RF

The operations function is a critical element in every business. No business can survive without good decisions being made by operations managers. The operations function is one of the three primary functions in an organization, along with marketing and finance. In addition, an organization has supporting functions that include human resources, information systems, and accounting. Some organizations also have separate sourcing and logistics functions that support operations. In others, the operations, sourcing, and logistics functions are joined together to become the supply chain function.

Functional areas are concerned with a particular focus of responsibility or decision making in an organization. The marketing function is typically responsible for creating demand and generating sales revenue; the operations function is responsible for the production and distribution of goods or services (generating supply); and finance is responsible for the acquisition and allocation of capital. Within for-profit businesses, functional areas tend to be closely associated with organizational departments because businesses typically are organized on a functional basis. Supporting functions are essential to provide staff support to the three primary functions.

Every function must be concerned not only with its own decision responsibilities but also with integrating decisions with other functions. The five areas of operations and supply chain decisions, for example, cannot be made separately; they must be carefully integrated with one another and, equally important, with decisions made in marketing, finance, and other parts of the organization. In the Pizza U.S.A. example, if marketing decides to change the price of pizza, this is likely to affect sales and change the capacity needs of operations as well as the amount of ingredients (materials) used. Also, if finance cannot raise the necessary capital, operations may have to redesign the process to require less capital or manage pizza-related inventories more efficiently. This in turn may affect the response time to serve customers, costs, and so on.

Decision making is therefore highly interactive and systemic in nature. Unfortunately, functional silos have developed in many organizations and impede **cross-functional decision making.** As a result, the overall organization suffers due to an emphasis on functional prerogatives. In a similar way, the five decisions need to be coordinated externally with supply chain partners. If capacity of the firm is increased, the capacity of suppliers and distributors must also be increased. The same can be said about coordination of decisions about inventory, quality, sourcing, and logistics.

But some companies are different. Texas Instruments, for example, has been a leader in fostering cross-functional integration. Some companies have done a very good job of cross-functional management. They do this by forming cross-functional teams for new product introductions and for day-to-day improvement. Each member of the team is trained in common methodologies, and the team is given responsibility for achieving its own goals. Some of the key cross-functional decision-making relationships are shown in Table 1.2.

1.7 OPERATIONS AS A PROCESS

LO1.5 Describe typical inputs and outputs of an operations transformation system.

Operations can be defined as a **transformation system** (or process) that converts inputs into outputs. Inputs to the system include energy, materials, labor, capital, and information (see Figure 1.3). Process technology is then used to convert inputs into outputs. The process technology is the methods, procedures, and equipment used to transform materials or inputs into products or services.

Viewing operations as a process is very useful in unifying seemingly different operations from different industries. For example, the transformation process in manufacturing is one of material conversion from raw materials into finished products. When an automobile is produced, steel, plastics, aluminum, cloth, and many other materials are transformed into parts that are then assembled into the finished automobile. Labor is required to operate

TABLE 1.2 Examples of Cross-Functional Decision Making

Key Decision Area	Interface with Operations Decisions
Marketing	
Market segment and needs	Quality design and quality management
Market size (volume)	Type of process selected (assembly line, batch, or project) and capacity required
Distribution channels	Inventory levels and logistics
Pricing	Quality, capacity, and inventory
New product introduction	Cross-functional teams
Finance and Accounting	
Availability of capital	Inventory levels, degree of automation, process type selected, and capacity
Efficiency of conversion process	Process type selection, process flows, value-added determination and sourcing
Net present value and cash flow	Automation, inventory, and capacity
Process costing or job costing	Type of process selected
Measurement of operations	Costing systems used
Human Resources	
Skill level of employees	Process type selected and automation
Number of employees and part-time or full-time employment	Capacity and scheduling decisions
Training of employees	Quality improvement and skills
Job design	Process and technology choice
Teamwork	Cross-functional decisions in operations
Information Systems	
Determination of user needs	Systems should support all users in operations
Design of information systems	Systems should help streamline operations and support all analytics and decisions in operations
Software development	Software is needed for capacity, quality, inventory, scheduling, and supply chain decisions
Hardware acquisition	Hardware is needed to support automation decisions in operations and to run software

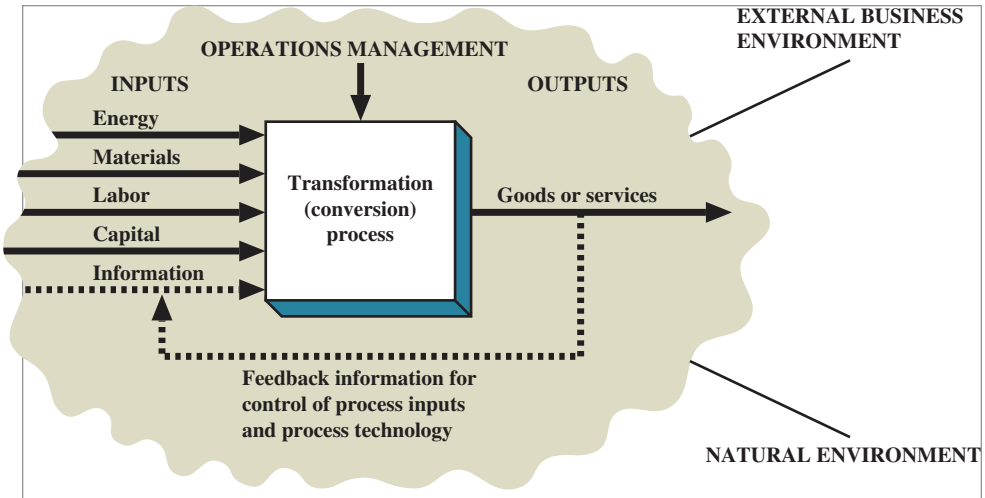


FIGURE 1.3
An operation as a productive system.

and maintain the equipment, and energy and information are also required to produce the finished automobile.

In service industries a transformation process is also used to transform inputs into service outputs. For example, airlines use capital inputs of aircraft and equipment and human inputs of pilots, flight attendants, and support personnel to produce safe, reliable, fast, and efficient transportation. Transformations of many different types occur in all industries, as indicated in Table 1.3. By studying these different types of transformation processes, you can learn a great deal about how to analyze and manage any operation.

Operations as a process provides a basis for seeing an entire business as a system of interconnected processes. This makes it possible to analyze an organization and improve it from a process point of view. All work, whether in finance, marketing, accounting, or other functions, is accomplished by processes. For example, financial analysis of a stock, closing the books at the end of the year, or conducting market research are each conducted by carrying out an appropriate process. Thus, process principles and tools can be applied in every function in a business.

All of these processes and systems interact with their **internal and external environments.** We have indicated the nature of internal interaction through cross-functional decision making. Interaction with the external environment occurs through the economic, physical, social, and political environment of operations. Examples include

TABLE 1.3
Examples of Productive Systems

Operation	Inputs	Outputs
Bank	Tellers, staff, computer equipment, facilities, and energy	Financial services (loans, deposits, safekeeping, etc.)
Restaurant	Cooks, waiters, food, equipment, facilities, and energy	Meals, entertainment, and satisfied customers
Hospital	Doctors, nurses, staff, equipment, facilities, and energy	Health services and healthy patients
University	Faculty, staff, equipment, facilities, energy, and knowledge	Educated students, research, and public service
Manufacturing plant	Equipment, facilities, labor, energy, and raw materials	Finished goods
Airline	Planes, facilities, pilots, flight attendants, maintenance people, labor, and energy	Transportation from one location to another

economic changes such as rising labor costs, social changes such as customer preference for "green" products, and political changes such as regulations. Each of these can mean that the operations function and associated supply chain will have to change the way it was producing products and services.

Operations is surrounded by both internal and external environments and constantly interacts with them. The interactive nature of these relationships makes it necessary to constantly monitor the environment and make decisions related to corresponding changes in operations and the supply chain when needed. In the fast-changing world of today's global business, constant change has become essential as a means of survival. Viewing operations as a process or a constantly updating transformation system helps us understand how operations and the supply chain cannot be insulated from changes in the environment but rather must adapt to them.

1.8 TRENDS IN OPERATIONS AND SUPPLY CHAIN MANGEMENT

LO1.6 Analyze trends in operations and supply chain management.

Operations and supply chain managers face serveral opportunities and trends that will be addressed repeatedly throughout this text. These trends make operations and supply chain management an exciting and interesting career for future leaders.

Sustainability

The focus on **sustainability** of the natural environment has been heightened in recent years with concerns over global warming, water contamination, air pollution, and so on. Organizations are increasingly being asked to produce and deliver products or services while minimizing the negative impact on the global ecosystem and not endangering the ability to meet the needs of future generations. See the Operations Leader box titled "Sustainability in Interface Inc.'s Operations Transformation Process" for an example of one firm's success in facing these issues. Operations and supply chain partners have made tremendous strides in reducing pollution of the environment from air to ground to water, but there is still a long way to go. Operations and its supply chain are going beyond environmental sustainability to include social and economic sustainability: the so-called **triple bottom line.** Social sustainability means hiring a diverse workforce, ethical practices, providing equal opportunity, and safe working conditions, for example. Economic sustainability is making a sufficient profit for firm survival into the future. Operations and their supply chains are finding they can reduce pollution, conserve resources, recycle products, and be socially responsible to provide a sustainable world for future generations. Sustainability is an opportunity that progressive operations and supply chain organizations are pursuing. For more details, see the sustainability link in the Learning Enrichment box at the end of this chapter.

Services

Operations concepts and ideas have been applied in service operations for years. Yet, service operations lag behind manufacturing in applying the latest ideas in supply chain management, lean operations, and quality improvement. This represents a tremendous opportunity to apply what is learned in this course. Also, service-specific ideas such as service recovery, web-enabled service, and globalization of service still represent implementation challenges. Nevertheless, some leading service businesses do excel in operations including Walmart, Nordstrom, Starbucks, Amazon.com, FedEx, and Delta Airlines, to name only a few. They excel by applying many of the operations concepts that are presented in this text.

OPERATIONS LEADER

Sustainability in Interface Inc.'s Operations Transformation Process

The philosophy of sustainability is "meeting the needs of the present without compromising the ability of future generations to meet their own needs." Over the past 15 years, carpet manufacturer Interface Inc. has shifted its operations toward this philosophy and triple bottom-line impacts: social, environmental, and financial. Or, in their words: People, Planet, and Profit.

Following production, customers use and then dispose of carpet products. Interface Inc. set out to change this typical supply chain. Creating a closed-loop supply chain, they use their own post-consumer waste (used carpet) as raw material input to their production system. It is not a perfect system, as it still requires some newly extracted raw materials, but they believe they are moving in the right direction for achieving sustainability.

Arcaid Images/Alamy

With production on four continents and offices in more than 100 countries, Interface Inc. is the global leader in the design, production, and sales of modular carpet squares. Since undertaking the goal of sustainability, Interface Inc. reports more than 133 million pounds of post-consumer carpet waste has been diverted from landfills to serve as raw materials for new carpet squares. They have achieved a series of major milestones at the European manufacturing facility in The Netherlands. As of 2015, the plant is operating with 100 percent renewable energy, using virtually zero water in manufacturing processes and has attained zero waste to landfill.

Source: Adapted from Dave Gustashaw and Robert W. Hall, "From Lean to Green: Interface, Inc.," *Target* 24, no. 5 (2008), pp. 6–14 and interfaceglobal.com 2019.

Digital Technologies

Emerging digital technologies that operations and supply chain managers are implementing include artificial intelligence, blockchain, 3D printing, and data analytics. Artificial intelligence is used in manufacturing and services to perform complex tasks that require human learning. Block chain technology is used to secure information that is passed along the supply chain. 3D printing is used to rapidly make prototypes or custom products. All of these technologies and analytics are discussed throughout this text.

Integration of Decisions Internally and Externally

A difficult opportunity and challenge facing all managers is cross-functional integration within the organization. Some organizations are managing functions as separate departments with little integration across them. The best operations are now seeking increased integration through the use of cross-functional teams, information systems, management coordination, rotation of employees, and other methods of integration. Most of the implementation problems of new systems or new approaches can be traced to lack of cross-functional internal cooperation. The same thing can be said about interorganizational change in supply chains. Even when companies partner with their suppliers or customers the partnerships are often not successful. Adequate information systems may also be lacking for supply chain integration.

Globalization of Operations and the Supply Chain

Finally, the **globalization** of operations and supply chains is a pervasive theme in business today. One can hardly avoid information on the accelerating nature of global business. Strategies for operations and its supply chain partners should be formulated with global effects in mind. Even many small businesses compete globally, sourcing or selling goods and services in markets with global competitors. Facility location must be considered in view of its global implications. Technology can be transferred rapidly across national borders. All decisions in operations and its associated supply chains are affected by the global nature of business.

Coke is produced and sold globally.
StreetVJ/Shutterstock

1.9 KEY POINTS AND TERMS

This text provides a broad overview of the challenging and dynamic field of operations management and the supply chain. It stresses decision making in operations, its associated supply chain, and the relationship of these decisions to other functions. The five major decision categories—process, quality, capacity, inventory, and supply chain are the organizing framework for each of the five major sections in the text.

Key points emphasized in the chapter are these:

- Operations and its associated supply chain produces and delivers goods or services deemed to be of value to customers in a global economy. Operations and supply chain management is responsible for productivity, innovation and GDP growth in aggregate. Without operations and supply chain management a firm, industry, and country cannot prosper.
- Operations and supply chain management focuses on decisions for the production, sourcing, and delivery of the firm's products and services. These decisions are intended to maximize firm profitability and the value inherent in goods or services delivered to customers throughout the entire supply chain.
- The supply chain is the network of manufacturing and service operations that supply each other from raw materials through manufacturing to the ultimate customer. The supply chain consists of the physical flow of materials, money, and information along the entire chain of suppliers, production, and distribution and the reverse supply chain of recycled and returned products and information. The supply chain connects many different organizations.
- There are five key groupings of decisions in operations and supply chain management: process, quality, capacity, inventory, and supply chain. These decisions need to utilize analytics when appropriate and account for contingencies, or special situations, because a best practice may not be best in all circumstances.

- Operations and supply chain decisions are often cross-functional in nature. Decisions may impact or be impacted by activities in other functions such as marketing and finance. Often, cross-functional teams are formed to undertake complex decisions.
- We identify several opportunities and trends facing operations and supply chain managers that are emerging and will be important in the future. These are sustainability, services, digital technologies, integration of decisions, and globalization of operations and the supply chain.

Key Terms

Supply chain 2
Operations management 3
Supply chain management 4
Operations and supply chain management 4
Gross Domestic Product (GDP) 4
Productivity 5
Five major decision responsibilities 8
Process 8
Quality 8
Capacity 8
Inventory 8
Supply chain 8
Analytics 11
Cross-functional decision making 12
Transformation system 13
Internal and external environments 14
Sustainability 15
Triple bottom line 15
Globalization 17

LEARNING ENRICHMENT

(for self-study or instructor assignments)

What Is Operations Management? https://youtu.be/leMOReAE2hk	Video 5:19
Supply Chain Management: A Force for Good https://youtu.be/Bl0UhiOvrdc	Video 5:01
Coca-Cola: Supply Chain https://youtu.be/UBSOiHUctrY	Video 2:29
Sustainability https://www.epa.gov/sustainability/learn-about-sustainability#what	Web Link
Globalization http://www.globalization101.org/what-is-globalization/	Web Link

Discussion Questions

1. Why study operations management in the supply chain?
2. What is the difference between the terms "production management" and "operations management"?
3. What is the difference between operations management and supply chain management?
4. How does the work of an operations manager differ from the work of a marketing manager or a finance manager? How are these functions similar?
5. How is the operations management function related to activities in human resources, information systems, and accounting?
6. Describe the nature of operations management in the following organizations. In doing this, first identify the outputs of the organization and then use the five decision types to identify important operations decisions and responsibilities.
   a. A college library
   b. A hotel
   c. A small manufacturing firm
7. For the organizations listed in question 6, describe the inputs, transformation process, and outputs of the production system.

8. Describe the decision-making view and the view of operations as a process. Why are both views useful in studying the field of operations management?
9. Write a short paper on some of the challenges facing operations management in the future. Use newspapers, business magazines, or the Internet as your sources.
10. Review job postings from various sources for management positions that are available for operations management graduates. Summarize the responsibilities of these positions.
11. Describe how the view of operations as a process can be applied to the following types of work:
    a. Acquisition of another company.
    b. Closing the books at the end of the year.
    c. Marketing research for a new product.
    d. Design of an information system.
    e. Hiring a new employee.
12. What is the role of operations and supply chain management in national economic prosperity? How does it contribute to GDP, jobs, income, and society in general?
13. What is the role of the operations function? How does it contribute to profitability, return on investment, growth, and other corporate objectives?
14. For the following problem calculate the labor productivity improvement from year 1 to year 2.

	Year 1	Year 2	Annual Inflation
Output (sales) $million	$103.4	$108.4	2%
Labor (payroll) $million	$ 19.6	$ 22.4	3%

15. A company has experienced the following changes in sales, labor, and capital. Calculate the total productivity percentage improvement from year 1 to year 2. Does the total productivity measure make more sense in this problem, since both labor and capital have been used?

	Year 1	Year 2	Annual Inflation
Output (sales) $million	$260.5	$270.4	2%
Labor (payroll) $million	$110.4	$111.5	3%
Capital	$ 60.2	$ 61.0	1%

16. The Atlas company makes weight lifting equipment. They are in the process of automating and have added $5 million in capital equipment to their operations and reduced the labor content. Has this resulted in increased productivity based on the following numbers? What is the productivity gain or loss as a percentage?

	Year 1	Year 2	Annual Inflation
Output (sales) $million	$358.5	$361.4	2%
Labor (payroll) $million	$110.4	$100.6	3%
Capital	$ 60.2	$ 65.2	0%

2
CHAPTER

Operations and Supply Chain Strategy

LEARNING OBJECTIVES

After reading this chapter, you should be able to:

LO2.1	Define operations strategy.
LO2.2	Describe the elements of operations strategy and alignment with business and other functional strategies.
LO2.3	Differentiate the ways to compete with operations objectives.
LO2.4	Compare product imitator and innovator strategies.
LO2.5	Explain the nature of global operations and supply chains.
LO2.6	Analyze two types of supply chain strategies.
LO2.7	Illustrate how operations and supply chain can become more sustainable.

LO2.1 Define operations strategy.

There is an increasing awareness that operations and the supply chain contribute to the global competitive position of a business and are not merely making a firm's products or services. This can be done by contributing distinctive capability (or competence) to the business and continually improving the products, services, and processes. Operations strategies and decisions should fulfill the needs of the business and add *competitive advantage* to the firm. The Operations Leader box on Southwest Airlines illustrates how operations adds competitive advantage to its firm.

The operations function is a key value creator for the firm. Value is providing products and services that customers want to buy at low cost. All functions of the firm must be well coordinated for value to be created and competitive advantage to occur. The cross-functional coordination of decision making is facilitated by an operations strategy that is developed by a team of managers from across the entire business.

OPERATIONS LEADER

Southwest Airlines

Southwest Airlines was founded in 1971 as a regional airline. It has achieved financial success with its 47th consecutive year of profitability. In 2018 it reported $3.5 billion in net income on $21 billion in revenue with an annual return on invested capital of 25.9 percent. It has achieved this amazing record through a consistent business and operations strategy over its history.

The mission of Southwest Airlines is to provide the highest quality customer service at the lowest cost fares. This might have seemed impossible for a start-up regional airline competing against existing large airlines with massive economies of scale and purchasing power. Southwest Airlines accomplished this by using an innovative operations strategy from the beginning with the following features:

- Purchasing only Boeing 737 aircraft. Operating a single aircraft saved on maintenance training, spare parts storage, and special prices from Boeing for aircraft. Today, Southwest airlines operates 706 aircraft, all 737s.

Markus Mainka/123RF

- Flying out of regional secondary airports such as Midway Field in Chicago and Love Field in Dallas where gate fees and operating costs are much lower, and flights are more convenient and accessible for customers.
- Flying only point-to-point routes between pairs of cities avoiding large airport hubs and thus cutting turnaround time between flights to only 15 minutes with very high aircraft utilization. High utilization of very expensive capital investment is a key to their success.
- Achieving high productivity from employees who have significant profit sharing, training, excellent working conditions, and low employee turnover.
- Making flights fun for the aircrews and passengers and giving passengers free bags when all other airlines charge a bag fee. This improves customer service and customer satisfaction.

Southwest Airlines has received numerous awards for customer satisfaction including being ranked #1 by the U.S. Department of Transportation, and receiving the Best Customer Service Award by Freddie Awards for frequent flyers. It has withstood fierce competition from global airlines and other low-cost airlines such as JetBlue. Southwest Airlines has achieved its success by implementing a consistent operations strategy that is well integrated with business strategy and marketing strategy.

The following definition of operations strategy is a starting point for our discussion:

Operations strategy *is a consistent pattern of decisions for operations and the associated supply chain that are linked to the business strategy and other functional strategies, leading to a competitive advantage for the firm.*

This definition will be expanded throughout this chapter as a basis for guiding all decisions that occur in operations and its supply chain with decisions in other functions.

We will use McDonald's as an example in the next several sections to illustrate the elements of an operations strategy. In 1955, Ray Kroc opened his first restaurant in Des Plaines, Illinois, patterned after the McDonald brothers' hamburger stand in California. The McDonald's service system was designed on the idea of a very limited menu and fast production of standardized food and service with convenience and a low price. Never before had customers been served food so fast in a clean and courteous environment. Using a standard design for equipment, facilities, and employee training, the McDonald's system was replicated in many locations and rapidly expanded throughout the U.S. and then the world.

McDonald's is a leading global service firm with an operations and supply chain strategy.
Christopher Kerrigan/ McGraw-Hill Education

The McDonald's system is a standardized service system designed to meet stringent specifications. Every detail of the system is designed to provide fast and efficient food and service.

McDonald's has continuously adapted its service system and supply chain over the years. For example, the menu has been expanded to offer many more food and beverage items, but always within the capability of the existing restaurants. They have updated their information systems in operations, and responded to environmental challenges by replacing, for example, the foam boxes previously used for sandwiches with biodegradable paper wrappers. In response to healthy food trends, they added salads, apple slices, and grilled chicken. Nevertheless, McDonald's still has its critics and sometimes is blamed for the obesity of Americans and for having an adverse environmental impact.

McDonald's is a global service firm. The operations strategy for global expansion has been to replicate the service system design and supply chain in each country with minimum modifications to the menu or processes. However, a few local international options are provided. For example, McDonald's serves beer in Germany, McRice in Indonesia, soup in Portugal, and salmon burgers in Japan. They have also extended their supply chain forward by developing a franchise system that maintains strong control over the product and service.

Today, McDonald's is the global leader in food service with more than 37,000 restaurants in 120 countries serving an average of 68 million customers each day. Next we will describe the elements of operations strategy in detail and use McDonald's to illustrate how the elements of operations strategy support overall business strategy.

2.1 OPERATIONS STRATEGY MODEL

LO2.2 Describe the elements of operations strategy and alignment with business and other functional strategies.

Operations strategy is a functional strategy along with the firm's other functional strategies such as those of marketing, engineering, information systems, and human resources. Since operations strategy is a **functional strategy,** it should be guided by the business and corporate strategies shown in Figure 2.1. The four elements inside the dashed box—mission, objectives, strategic decisions, and distinctive competence—are the heart of operations strategy. The other elements in the figure are inputs or outputs from the process of

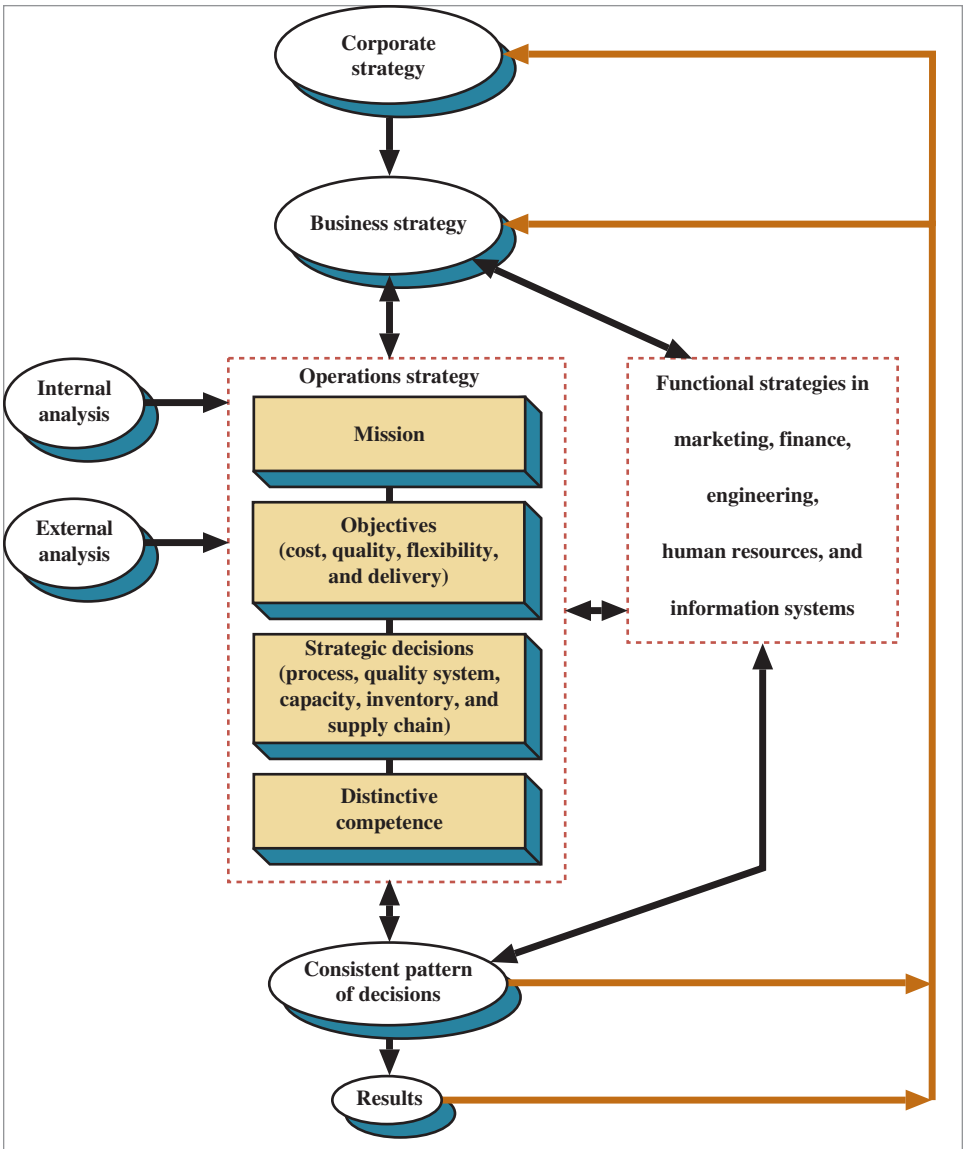


FIGURE 2.1
Operations strategy process.

developing operations strategy. The outcome of using the operations strategy is a consistent pattern of operations decisions that are well connected with the other functions in the business and help provide a competitive advantage to the business.

Corporate and Business Strategy

Corporate strategy and business strategy are at the top of Figure 2.1. The corporate strategy defines the business that the company is pursuing. For example, Walt Disney Corporation considers itself in the business of "making people happy." Disney Corporation includes not only theme parks but the production of cartoons, movie production, merchandising, and a variety of entertainment-related businesses around the world.

Business strategy follows from the corporate strategy and defines how each particular business will compete. Most large corporations have several different businesses, each competing in different market segments. Michael Porter describes three generic business strategies: differentiation, low cost, and focus. Differentiation is associated with a unique and

frequently innovative product or service, while low cost is pursued in commodity markets where the products or services are imitative. Focus refers to the geographical or product portfolio being narrow or broad in nature. Focus can be combined with either a differentiation or a low-cost strategy.

Operations Mission

Every operation should have a **mission** that is connected to the business strategy and is coordinated with the other functional strategies. For example, if the business strategy is differentiation through innovative products, the operations mission should emphasize new product introduction and flexibility to adapt products to changing market needs. Other business strategies lead to other operations missions, such as low cost or fast delivery. The operations mission is thus derived from the particular business strategy selected by the business unit.

At McDonald's, the operations mission is to provide food and service quickly to customers with consistent quality and low cost in a clean and friendly environment.

THE MAGIC KINGDOM. Disney Corporation is in the business of "making people happy."
Phelan M. Ebenhack/AP Images

Operations Objectives

Operations objectives, sometimes called competitive priorities, are the second element of operations strategy. The four common objectives of operations are cost, quality, delivery, and flexibility. In certain situations, other objectives may be added, such as innovation, safety, and sustainable operations. The objectives should be derived from the operations mission, and they constitute a restatement of the mission in quantitative and measurable terms. The objectives should be long-range-oriented (5 to 10 years) to be strategic in nature and should be treated as goals.

Definitions of the four common operations objectives follow:

- Cost is a measure of the resources used by operations, typically the unit cost of production or the cost of goods or services sold.
- Quality is the conformance of the product or service to the customers' requirements.
- Delivery is providing the product or service quickly and on time.
- Flexibility is the ability to rapidly change operations.

Table 2.1 shows some common measures of objectives that can be used to quantify long-range operations performance. The four common objectives are listed along with a fifth objective, sustainability, that is becoming more important to many firms. The objectives for five years into the future are compared to the current year and also to a current world-class competitor. The comparison to a world-class competitor is for **benchmarking** purposes and may indicate that operations is behind or ahead of the competition. However, the objectives should be suited to the particular business, which will not necessarily exceed the competition in every category.

At McDonald's, each restaurant has specific objectives with respect to cost, quality, and service times. These objectives are pursued using extensive standards and are frequently

TABLE 2.1
Typical Operations Objectives

	Current Year	Objective: 5 Years in the Future	Current: World-Class Competitor
Cost			
Manufacturing cost as a percentage of sales	55%	52%	50%
Inventory turnover	4.1	5.2	5.0
Quality			
Customer satisfaction (percentage satisfied with products)	85%	99%	95%
Percentage of scrap and rework	3%	1%	1%
Warranty cost as a percentage of sales	1%	0.5%	1%
Delivery			
Percentage of orders filled from stock	90%	95%	95%
Lead time to fill stock	3 wk	1 wk	3 wk
Flexibility			
Number of months to introduce new products	10 mo	6 mo	8 mo
Number of months to change capacity by ±20%	3 mo	3 mo	3 mo
Sustainability			
Reduce carbon emissions (ppm)	400	200	400
Reduce workplace accidents per thousand workers	30	15	15

measured for compliance. McDonald's tracks the performance of each restaurant and compares the results with those of competitors.

Strategic Decisions

Strategic decisions constitute the third element of operations strategy. These decisions determine how the operations objectives will be achieved. A consistent pattern of strategic decisions should be made for each of the major operations decision categories (process, quality, capacity, inventory, and supply chain). These decisions must be well integrated with other functional decisions. This coordination and consistency is one of the most difficult things to achieve in business.

Table 2.2 indicates some important strategic decisions for operations. Note that these decisions may require trade-offs or choices. For example, in the capacity area there is a

TABLE 2.2
Examples of Important Strategic Decisions in Operations

Strategic Decision	Decision Type	Strategic Choice
Process	Span of process	Make or buy
	Automation	Handmade or machine-made
	Process flow	Project, batch, line, or continuous
	Job specialization	High or low specialization
Quality	Approach	Prevention or inspection
	Training	Technical or managerial training
	Suppliers	Selected on quality or cost
Capacity	Facility size	One large or several small facilities
	Location	Near markets, low cost, or foreign
	Investment	Permanent or temporary
Inventory	Amount	High or low levels of inventory
	Distribution	Centralized or decentralized warehouse
	Control systems	Control in greater or less detail
Supply Chain	Sourcing	Insource or outsource products
	Logistics	National or global distribution

choice between one large facility and several smaller ones. While the large facility may require less total investment due to economies of scale, the smaller facilities can be located in their markets and provide better customer service. Thus, the strategic decision depends on what objectives are being pursued in operations, the availability of capital, marketing objectives, and so forth.

McDonald's illustrates how a consistent pattern of strategic decisions is made in the five operations decisions areas:

Process: Specialized equipment and work flows ensure meals are delivered to customers quickly. For example, the special French fry scoop puts the right amount of fries in each serving with little effort. Also, servers use information technology to instantly communicate orders to food preparers.

Quality: More than 2000 quality, food safety, and inspections monitor food as it moves from farms to suppliers to restaurants. McDonald's requires that 72 safety and quality protocols be conducted at each restaurant every day. Managers are trained at "Hamburger U" in the McDonald's system to ensure standards for service, speed, food quality, cleanliness, and courtesy are met.

Capacity: Restaurant capacity is carefully designed to control customer waiting times. Employees are scheduled to meet the fluctuating demand during the day.

Inventory: Just-in-time replenishment ensures food and packaging are available when needed. Food and packaging are highly standardized across restaurants.

Supply Chain: Each restaurant is connected to its supply chain for fast replenishment. The supply chain is designed for frequent deliveries and to avoid stockouts.

Distinctive Competence

All operations should have a **distinctive competence** (or operations capability) that differentiates it from the competitors. The distinctive competence is something that operations does better than anyone else. It may be based on unique resources (human or capital) that are difficult to imitate. Distinctive competence can also be based on an embedded organizational culture, proprietary or patented technology, or any innovation in operations that cannot be copied easily.

The distinctive competence should match the mission of operations. For example, it is a mismatch to have a distinctive competence of superior inventory management systems when the operations mission is to excel at new product introduction. Likewise, the distinctive competence must be coordinated with marketing, finance, and the other functions so that it is supported across the entire business as a basis for competitive advantage.

Distinctive competence may be used to define a particular business strategy in an ongoing business. The business strategy does not always emanate from the market; it may be built instead on matching operations' distinctive competence (current or projected) with a current or potential new market. Both a viable market segment and a unique capability to deliver the product or service offered must be present for the firm to compete.

Walmart has distinctive competencies to support its low-cost strategy.
John Flournoy/McGraw-Hill Education

Walmart has a mission to be the low-cost retailer. To achieve this mission it has developed a distinctive competence in cross-docking aimed at lowering the costs of shipping. Using cross-docking, goods from suppliers' trucks are transferred across the loading dock to waiting Walmart trucks and delivered to the stores without entering the warehouse. Walmart also has a sophisticated inventory control system and more purchasing power than its competitors and

therefore can minimize inventories and related costs. These distinctive competencies help Walmart compete on the basis of low cost.

McDonald's early distinctive competence was its unique service and supply chain that it designed. Since other firms have copied this system over time, the distinctive competence has shifted to continuous improvement of the transformation system along with the brand. McDonald's system and its brand are now its distinctive competence.

2.2 COMPETING WITH OPERATIONS OBJECTIVES

LO2.3 Differentiate the ways to compete with operations objectives.

We will now use the four operations objectives discussed above to describe different ways to compete through operations. Most firms choose one or two objectives to focus on, so that the strategic decisions made in operations can be aligned with and support these focused objectives.

Suppose we start with the idea of competing through a **quality objective.** Delivering quality means satisfying customer requirements. This assumes that marketing has identified a particular target market, and that operations understands these customers' specific requirements. Operations processes must be capable of meeting those requirements. If competing through quality is the objective, strategic decisions related to product or service design, operations, and the supply chain must support customers' expectations for quality. For example, in a manufacturing company quality is improved by taking preventative measures in training workers, design of the process, and eliminating rework and non-value-added activities. Customers who require quality expect a very low level of defects.

Now, suppose we decide to pursue a **low-cost objective.** Perhaps the best way to achieve low cost is to focus on conforming to customer requirements (quality) in product/service design and operations processes by eliminating rework, scrap, and other non-value-added activities. By preventing errors through continuous improvement, costs can be lowered at the same time as quality improves. A low-cost objective may require more than just an emphasis on conformance quality. Investment in automation and information systems may also be needed to reduce costs.

If we select a **delivery objective,** strategic decisions should support fast or on-time delivery, depending on the expectations of customers. Industrial (business) customers often want on-time delivery because they schedule loading docks at warehouses or retail stores and do not want several trucks delivering at the same time. Fast delivery may be desirable for consumers ordering products online (they will order from the company that can deliver the product soonest). When quality improvement efforts reduce non-value-added steps, the time to produce and deliver the product is indirectly reduced. Time can also be directly reduced by improving process changeover times, simplifying complex operations, and redesigning the product or service for fast production.

Finally, we could choose to emphasize a **flexibility objective.** If we reduce delivery time, flexibility will automatically improve. For example, if it originally took 16 weeks to make a product and we reduce production time to 2 weeks, then it is possible to change the schedule within a 2-week time frame rather than 16 weeks, making operations more flexible to changes in customer requirements. Other types of flexibility can be directly improved by adding capacity, buying more flexible equipment, training workers to perform a wider variety of tasks, or redesigning the product or service for high variety.

We can see that operations objectives are connected. If we stress a quality objective, we also naturally get some cost reduction, delivery improvement, and more flexibility. Quality is often a good place to start for improving operations. Then other objectives may be tackled by directing strategic decisions to impact them.

While objectives are connected, an operation must still choose its number one or number two strategic objectives to emphasize. For example, McDonald's excels at low-cost and fast (delivery) service. It does not emphasize flexibility, rather exactly the opposite. Zara, a giant European fashion retailer, is able to achieve fast replenishment (delivery) of hot-selling items within a few weeks by holding spare capacity and supporting rapid supply chain management practices. Zara emphasizes fast fashion, not low cost. Lexus is renowned for high quality in its cars, which results from both its design and its manufacturing process. Chipotle uses a highly flexible serving process that allows each customer to self-customize a meal.

2.3 CROSS-FUNCTIONAL STRATEGIC DECISIONS

LO2.4 Compare product imitator and innovator strategies.

Not only should objectives be linked to an operations mission, operations strategic decisions should be linked to business strategy and to marketing and financial strategies as well. Table 2.3 illustrates this linkage by showing two diametrically opposite business strategies that can be selected and the resulting functional strategies. The first one is the **product imitator** (low-cost) business strategy, which is typical of a mature, price-sensitive market with a standardized product (or service). In this case, the operations objective should emphasize cost as the dominant objective, and operations should strive to reduce costs through strategic decisions such as superior process technology, low personnel costs, low inventory levels, a high degree of vertical integration, and quality improvement aimed at saving cost. Marketing and finance also need to pursue and support the product imitator business strategy, as shown in Table 2.3.

The second business strategy shown in the table is one of **product innovator** and new product introduction (or product/service leadership). This strategy typically is used in emerging and possibly growing markets where advantage can be gained by bringing to

TABLE 2.3
Strategic Alternatives

	Strategy A	Strategy B
Business Strategy	**Product Imitator**	**Product Innovator**
Market Conditions	Price-sensitive Mature market High volume Standardization	Product-features-sensitive Emerging market Low volume Customized products
Operations Mission and Objectives	Emphasize low cost for mature products	Emphasize flexibility to introduce new products
Operations Strategic Decisions	Superior processes Dedicated automation Slow reaction to changes Economies of scale Workforce involvement	Superior products Flexible automation Fast reaction to changes Economies of scope Use of product development teams
Distinctive Competence Operations	Low cost through superior process technology and vertical integration	Fast and reliable new product introduction through product teams and flexible automation
Marketing Strategies	Mass distribution Repeat sales Maximizing of sales opportunities National sales force	Selective distribution New-market development Product design Sales made through agents
Finance Strategies	Low risk Low profit margins	Higher risks Higher profit margins

market superior-quality products in a short amount of time. Price is not the dominant form of competition, and higher prices are charged, thereby putting a lower emphasis on costs. In this case, the operations and supply chain objective is flexibility to introduce superior new products rapidly and effectively. Operations strategic decisions include the use of new product introduction teams, flexible automation that is adapted to new products, a workforce with flexible skills, and rapidly responding to marketplace changes. Once again, finance and marketing also need to support the business strategy to achieve an integrated whole.

What Table 2.3 indicates is that drastically different types of operations are needed to support different business strategies. Flexibility and superior-quality products may cost more for the product innovator strategy. There is no such thing as an all-purpose operation that is best for all circumstances. Thus, when asked to evaluate operations, one must immediately ask, what is the business strategy, mission, and objective of operations? Evaluating operations is contingent on strategy. In other words, operations with different strategies should adopt different best practices and decisions.

Table 2.3 also suggests that all functions must support the business strategy for it to be effective. For example, in the product imitator strategy, marketing should focus on mass distribution, repeat sales, a national sales force, and maximization of sales opportunities. In contrast, in the product innovator strategy, marketing should focus on selective distribution, new-market development, product design, and perhaps sales through agents. It is not enough for just operations to be integrated with the business strategy; all functions must support the business strategy and one another.

Integrating marketing and operations and clearly laying out a particular mission and objective for operations is essential to meet customer preferences for **order winners** and **order qualifiers.** An order winner is an objective that will cause customers in a particular segment that marketing has selected as the target market to choose a particular product or service. In the product imitator strategy, the order winner for the customer is price; this implies the need for low cost in operations, marketing, and finance. Other objectives in this case (flexibility, quality, and delivery) are order qualifiers in that the company must have acceptable levels of these three objectives to qualify to get the customer order. Insufficient levels of performance on order qualifiers can cause the business to lose the order, but higher performance on order qualifiers cannot by themselves win the order. Only low price/cost will win the order in this case.

3M corporate strategy is product innovation.
Jill Braaten/McGraw-Hill Education

In the product innovator strategy, the order winner is flexibility to introduce superior products rapidly and effectively; the order qualifiers are cost, delivery, and quality. Note how the order winner depends on the particular strategy selected and that all functions must pursue superior levels relative to the competition on the order winner while achieving levels acceptable to the customer on order qualifiers.

What is the order winner at Walmart? It's low cost, and strategic decisions in operations are made to keep costs down. The same cannot be said about Nordstrom, which competes on upscale merchandise and superior customer service. Since the order winners in these stores are different, so are the operations strategies.

2.4 GLOBAL OPERATIONS AND SUPPLY CHAINS

LO2.5 Explain the nature of global operations and supply chains.

Every day we hear that markets are becoming global in nature. Many products and services are global in nature, including soft drinks, cell phones, TVs, fast food, banking, travel, automobiles, motorcycles, farm equipment, machine tools, and a wide variety of other products. To be sure, there are still market niches that are national or even local but the trend is toward more global markets and products.

When operating in global markets, a company needs to be organized properly to produce and market its products. As a result, the **global corporation** has emerged with the following characteristics. Facilities and plants are located on a worldwide basis, not country by country. Products and services can be shifted between countries. Components, parts, and services are sourced on a global basis. The best worldwide suppliers are sought, regardless of their national origin. The entire supply chain is global in nature. A few well-known manufacturing companies that are global corporations are Ford, 3M, Nestlé, Philips, Deere & Company, Coca-Cola, and Caterpillar.

The global corporation uses global product design and process technology. A basic product or service is designed, whenever possible, to fit global tastes. When a local variation is needed, it is handled as an option rather than as a separate product or service. Process technology is also standardized globally. For example, Black & Decker recently designed worldwide hand tools. Even fast food, clothing, and soft drinks have become global products.

In the global corporation, demand for products or services is considered on a worldwide, not a local, basis. Therefore, the economies of scale are greatly magnified, and costs can be lower. The iPhone came out as a worldwide product and was marketed globally. Its demand and cost were scaled for a global market right from the start.

Logistics and inventory control systems are also global in nature. This makes it possible to coordinate shipments of products and components on a worldwide basis.

Some services have taken on a global scope of operations. For example, consulting firms, fast food, telecommunications, air travel, entertainment, financial services, and software programming have global operations. Global consolidation has taken the place of these formerly fragmented service industries. Certainly, not all service is global. There remain services that are delivered on a local basis to serve local markets, but the trend toward globalization is undeniable. A few of the service companies that are globally oriented are British Airways, Starbucks, Microsoft, and McDonald's.

Some firms have adopted a hybrid approach with global economies of scale but a local touch. In this case certain functions, for example, product design and manufacturing, are handled on a local basis, while other functions, such as logistics and inventory control systems, are standardized around the world. See the Under Armour Operations Leader box for a strategy to compete in global markets with local manufacturing.

Pfizer competes globally in 52 locations around the world.
Ulrich Baumgarten/Getty Images

The implications for operations strategy of this change toward global business are profound. Operations and supply chains must be conceived of as global in nature, including very broad searches for both suppliers and customers. A global distinctive competence should be developed for operations, along with a global mission, objectives, and strategic decisions. Product design, process design, facility location, workforce policies, and virtually all decisions in operations and the supply chain are affected.