

JAY HEIZER BARRY RENDER CHUCK MUNSON PAUL GRIFFIN

OPERATIONS MANAGEMENT

SUSTAINABILITY AND SUPPLY CHAIN MANAGEMENT

THIRD CANADIAN EDITION

AGRICULTURE



INDUSTRY



CONSUMERS



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OPERATIONS MANAGEMENT

SUSTAINABILITY AND SUPPLY CHAIN MANAGEMENT

THIRD CANADIAN EDITION

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To Kathryn Ann Heizer

—JH

To Donna, Charlie, Jesse, and Reva
and to Howard G. Kornacki, the teacher who taught
me to love math

—BR

To Suzanne, Alexandra, Kenna, Ryan, and
Robert Kathleen

—PG

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Dr. Griffin continues to write for practitioner-targeted publications and develops a continuous stream of technical manuals, materials, and courses for both the academic and industrial sectors. He remains an active member of the Editorial Advisory Board for the *Journal of Financial Planning*.

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Preface

Welcome to your operations management (OM) course and to the third Canadian edition of this textbook. This text presents a state-of-the-art view of the activities of the operations function from a Canadian perspective. Operations is an exciting and dynamic area of management that has a profound effect on the productivity of both services and manufacturing. Indeed, few other activities have so much impact on the quality of your life. The goal of this book is to present a broad introduction to the field of operations in a realistic, meaningful, and practical manner. OM includes a blend of subject areas, including accounting, industrial engineering, management, management science, and statistics. Whether you are pursuing a career in the operations field or not, you will likely be working with people in operations. Therefore, having a solid understanding of the role of operations in an organization is of substantial benefit to you. This text will also help you understand how OM affects society and your life. Certainly, you will better understand what goes on behind the scenes when you buy a coffee at Tim Hortons, take a flight from Edmonton to Vancouver, place an order with Amazon.ca, or enter a Canadian hospital for medical care.

Although many readers of this book are not OM majors, students studying marketing, finance, accounting, and MIS will hopefully find the material both interesting and useful as they develop a fundamental working knowledge of the operations side of the firm.

ABOUT THE THIRD CANADIAN EDITION

The goal of this third Canadian edition is to retain the features and strengths that have made this book so successful over the years while bringing a new Canadian perspective to the text. Readers will find examples of Canadian companies and success stories woven throughout the book with cases drawn from the manufacturing and service industry taken from both the private and public sectors. The text describes many Canadian locations and uses Canadian data when available. Readers can follow the story of the construction of a hockey arena as a recurring case study that touches upon many aspects of OM in a familiar setting. It is also important to acknowledge the global nature of today's business environment. Operations management is a discipline that encompasses both the local and the international, with global considerations affecting everything from location strategies to scheduling and transportation. This third Canadian edition therefore retains many of the best and most familiar U.S. and international examples.

NEW TO THIS EDITION

We've made significant revisions to this edition, and we want to share some of the changes with you.

Five New Video Case Studies Featuring Alaska Airlines In this edition we take you behind the scenes of Alaska Airlines, consistently rated as one of the top carriers in North America. This fascinating organization opened its doors—and planes—so we could examine leading-edge OM in the airline industry. We observe the quality program at Alaska Air (Chapter 6), the process analysis behind the airline's 20-minute baggage retrieval guarantee (Chapter 7), how Alaska empowers its employees (Chapter 10), the airline's use of Lean, 5s, kaizen, and Gemba walks (Chapter 16), and the complexities of scheduling (Module B). These videos, and other video case studies that feature real companies, can be found in MyLab Operations Management.

New Sustainability in the Supply Chain Supplement 5 We have enhanced the coverage of sustainability in this edition with the inclusion of a brand-new supplement that covers the topics of corporate social responsibility, design and production for sustainability, and regulations and industry standards.

Creating Your Own Excel Spreadsheets We continue to provide two free decision support software programs, Excel OM for Windows and Mac and POM for Windows, to help

you and your students solve homework problems and case studies. These excellent packages are found in MyLab Operations Management's Download Center.

Many instructors also encourage students to develop their own Excel spreadsheet models to tackle OM issues. With this edition we provide numerous examples at chapter end on how to do so. "Creating Your Own Excel Spreadsheets" examples now appear in Chapters 2, 4, 8, 12, and Supplement 6, Supplement 7, and Modules A, and F. We hope these 8 samples will help expand students' spreadsheet capabilities.

Expanding and Reordering Our Set of Homework Problems We believe that a vast selection of quality homework problems, ranging from easy to challenging (denoted by one to four dots), is critical for both instructors and students. Instructors need a broad selection of problems to choose from for homework, quizzes, and exams—without reusing the same set from semester to semester. We take pride in having more problems than any other OM text. We added dozens of new problems this edition.

Further, with the majority of our adopters now using the MyLab Operations Management learning system in their classes, we have reorganized all the homework problems—both those appearing in the printed text and the additional homework problems that are available in MyLab Operations Management—by topic heading. We identify all problems by topic.

The list of all problems by topic also appears at the end of each boxed example as well as in the Rapid Review that closes each chapter. These handy references should make it easier to assign problems for homework, quizzes, and exams. A rich set of assignable problems and cases makes the learning experience more complete and pedagogically sound.

Lean Operations In previous editions we sought to explicitly differentiate the concepts of just-in-time, Lean, and the Toyota Production System in Chapter 16. However, there is significant overlap and interchangeability among those three concepts, so we have revised Chapter 16 to incorporate the three concepts into an overall concept of "Lean". The chapter suggests that students view Lean as a comprehensive integrated operations strategy that sustains competitive advantage and results in increased returns to all stakeholders.

In addition, the following changes have been made for the third Canadian edition:

- New section on strategic planning, core competencies, and outsourcing added to Chapter 2.
- Coverage of agile and waterfall approaches to project management have been revised in Chapter 3.
- New section on supply chain management in Chapter 4.
- Added coverage of sustainability and life cycle assessment (LCA) to Chapter 5.
- New section on ISO 9000 International Quality Standards in Chapter 6.
- Coverage of bottleneck analysis in Supplement 7 has been completely revised.
- Added coverage of supplier certification, contracting, and centralized purchasing to Chapter 11.
- Added section on warehouse storage to Supplement 11.
- Coverage of economic order quantity enhanced with new section on period order quantity in Chapter 14.
- Added coverage of finite and infinite loading to Chapter 15.
- Added coverage of Lean sustainability to Chapter 16.
- Added coverage of parallel redundancy to Chapter 17.
- New examples and case studies throughout the text.

MyLab Operations Management Resources In addition to our video case studies and our Excel OM and POM for Windows software, we provide the following resources in MyLab Operations Management:

- Excel OM data files: Prepared for specific examples, these files allow users to solve all the marked text examples without reentering data.
- Active Models: These are Excel-based OM simulations, designed to help students understand the quantitative methods shown in the textbook examples. Students may change the

data to see how the changes affect the answers. These files are available in the Download Center.

- Online Tutorial Chapters: “Statistical Tools for Managers,” “Acceptance Sampling,” “The Simplex Method of Linear Programming,” “The MODI and VAM Methods of Solving Transportation Problems,” and “Vehicle Routing and Scheduling” are provided as additional material.
- Additional case studies: These case studies supplement the ones in the text.
- Virtual office hours videos: Professors Heizer, Render, and Munson walk students through the Solved Problems in a series of 5- to 20-minute explanations.

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1

Learning Objectives

- LO1** Define *operations management* 2
- LO2** Explain the distinction between goods and services 9
- LO3** Explain the difference between production and productivity 11
- LO4** Compute single-factor productivity 12
- LO5** Compute multifactor productivity 13
- LO6** Identify the critical variables in enhancing productivity 14

Operations and Productivity

Operations Management at Hard Rock Cafe

Operations managers throughout the world are producing products daily to provide for the well-being of society. These products take on a multitude of forms, including auto parts at Magna International, motion pictures at DreamWorks Studios, rides at Disney World, and food at Hard Rock Cafe. These firms produce thousands of complex products every day—to be delivered as the customer ordered them, when the customer wants them, and where the customer wants them. Hard Rock does this for over 35 million guests worldwide every year. This is a challenging task, and the operations manager’s job—whether at Magna International, DreamWorks, Disney, or Hard Rock—is demanding.

Orlando-based Hard Rock Cafe opened its first restaurant in London in 1971, making it over four decades old and the granddaddy of theme restaurants. Although other theme restaurants have come and gone, Hard Rock is still going strong, with 150 restaurants in 53 countries—and new restaurants opening each year. Hard Rock made its name with rock music memorabilia, having started when Eric Clapton, a regular customer, marked his favourite bar stool by hanging his guitar on the wall in the London cafe. Now Hard

◀ **Global Company Profile**
Hard Rock Cafe

Rock has 70 000 items and millions of dollars invested in memorabilia. To keep customers coming back time and again, Hard Rock creates value in the form of good food and entertainment.

The operations managers at Hard Rock Cafe at Universal Studios in Orlando provide more than 3500 custom products—in this case, meals—every day. These products are designed, tested, and then analyzed for cost of ingredients, labour requirements, and customer satisfaction. On approval, menu items are put into production—and then only if the ingredients are available from qualified suppliers. The production process—from receiving, to cold storage, to grilling or baking or frying, and a dozen other steps—is designed and maintained to yield a quality meal. Operations managers, using the best people they can recruit and train, also prepare effective employee schedules and design efficient layouts.

Managers who successfully design and deliver goods and services throughout the world understand operations. In this textbook, we look not only at how



Andre Jemmy/Alamy Stock Photo

Hard Rock Cafe in Orlando, Florida, prepares over 3500 meals each day. Seating more than 1500 people, it is one of the largest restaurants in the world. But Hard Rock's operations managers serve the hot food hot and the cold food cold.

Hard Rock's managers create value but also at how operations managers in other services, as well as in manufacturing, do so. Operations management is demanding, challenging, and exciting. It affects our lives every day. Ultimately, operations managers determine how well we live.

STUDENT TIP

Operations management is one of the three functions that every organization performs.

LO1 Define *operations management*

VIDEO 1.1

Operations Management at Hard Rock

VIDEO 1.2

Operations Management at Frito-Lay

Production

The creation of goods and services.

Operations management (OM)

Activities that relate to the creation of goods and services through the transformation of inputs to outputs.

What Is Operations Management?

Operations management (OM) is a discipline that applies to restaurants like Hard Rock Cafe as well as to factories like Ford and Whirlpool. The techniques of OM apply throughout the world to virtually all productive enterprises. It doesn't matter if the application is in an office, a hospital, a restaurant, a department store, or a factory—the production of goods and services requires operations management. And the *efficient* production of goods and services requires effective application of the concepts, tools, and techniques of OM that we introduce in this book.

As we progress through this text, we will discover how to manage operations in a changing global economy. An array of informative examples, charts, text discussions, and pictures illustrate concepts and provide information. We will see how operations managers create the goods and services that enrich our lives.

In this chapter, we first define *operations management*, explaining its heritage and exploring the exciting role operations managers play in a huge variety of organizations. Then we discuss production and productivity in both goods- and service-producing firms. This is followed by a discussion of operations in the service sector and the challenge of managing an effective and efficient production system.

Production is the creation of goods and services. **Operations management (OM)** is the set of activities that creates value in the form of goods and services by transforming inputs into outputs. Activities creating goods and services take place in all organizations. In manufacturing firms, the production activities that create goods are usually quite obvious. In them, we can see the creation of a tangible product such as a Sony TV or a Harley-Davidson motorcycle.

In an organization that does not create a tangible good or product, the production function may be less obvious. We often call these activities *services*. The services may be “hidden” from the public and even from the customer. The product may take such forms as the transfer of funds from a savings account to a chequing account, the transplant of a human organ, the filling of an empty seat on an airplane, or the education of a student. Regardless of whether the end product is a good or service, the production activities that go on in the organization are often referred to as operations, or *operations management*.

Organizing to Produce Goods and Services

STUDENT TIP

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

To create goods and services, all organizations perform three functions (see Figure 1.1). These functions are the necessary ingredients not only for production but also for an organization's survival. They are:

1. *Marketing*, which generates the demand, or at least takes the order for a product or service (nothing happens until there is a sale).

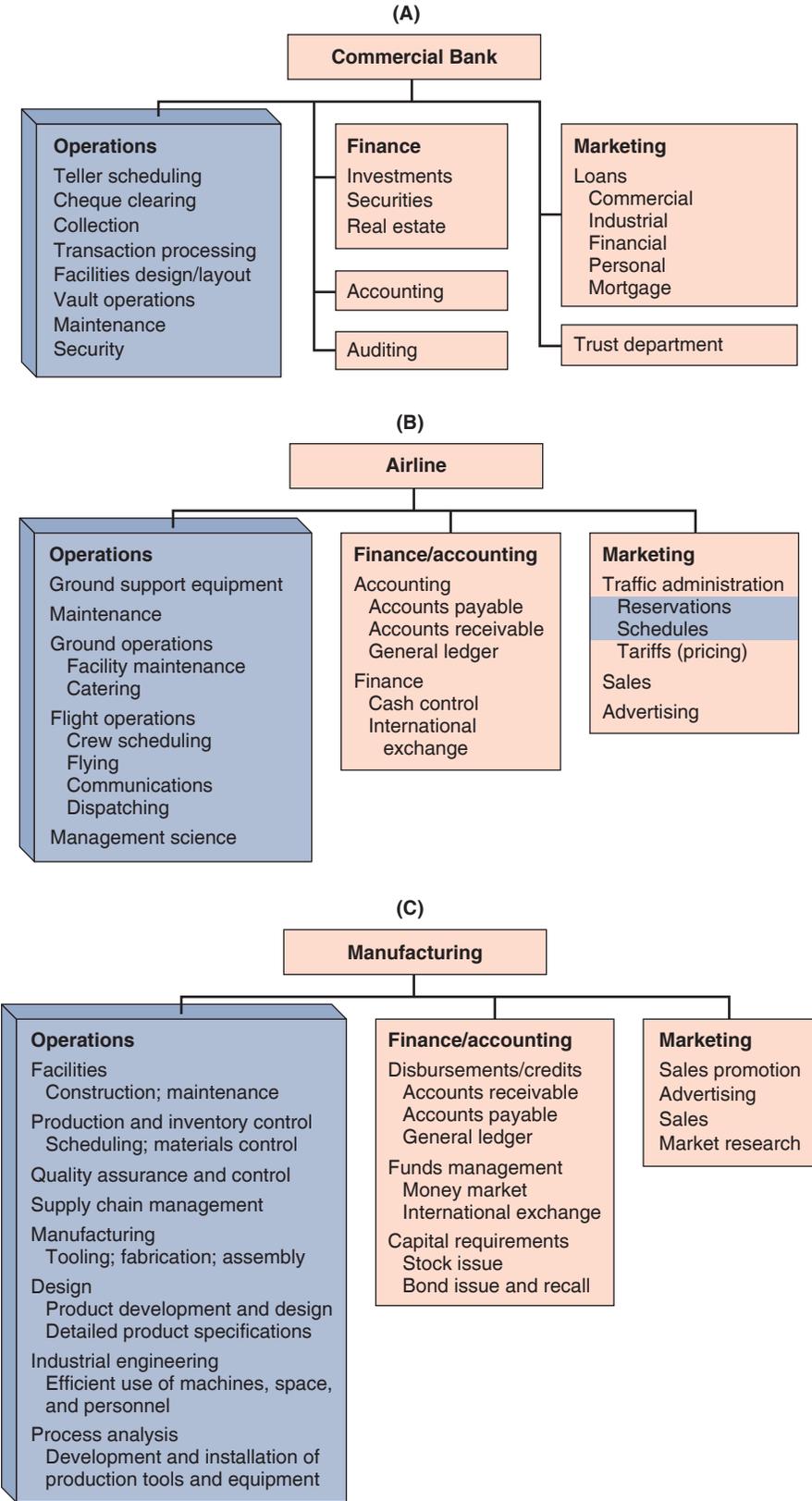


FIGURE 1.1
Organization Charts for Two Service Organizations and One Manufacturing Organization
 (A) A bank, (B) an airline, and (C) a manufacturing organization. The blue areas are OM activities.

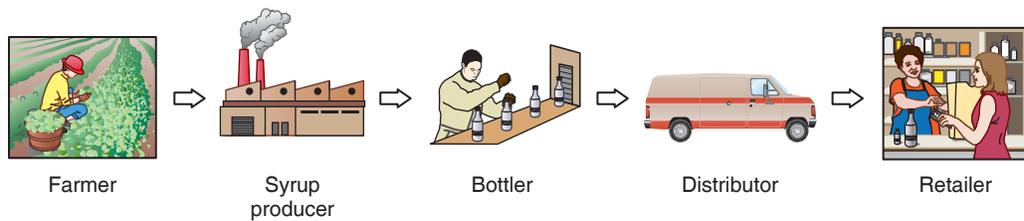


FIGURE 1.2 Soft Drink Supply Chain

A supply chain for a bottle of Coke requires a beet or sugar cane farmer, a syrup producer, a bottler, a distributor, and a retailer, each adding value to satisfy a customer. Only with collaborations between all members of the supply chain can efficiency and customer satisfaction be maximized. The supply chain, in general, starts with the provider of basic raw materials and continues all the way to the final customer at the retail store.

2. *Production/operations*, which creates, produces, and delivers the product.
3. *Finance/accounting*, which tracks how well the organization is doing, pays the bills, and collects the money.

Universities, places of worship, and businesses all perform these functions. Even a volunteer group such as Scouts Canada is organized to perform these three basic functions. Figure 1.1 shows how a bank, an airline, and a manufacturing firm organize themselves to perform these functions. The blue-shaded areas of Figure 1.1 show the operations functions in these firms.

THE SUPPLY CHAIN

Through the three functions—marketing, operations, and finance—value for the customer is created. However, firms seldom create this value by themselves. Instead, they rely on a variety of suppliers who provide everything from raw materials to accounting services. These suppliers, when taken together, can be thought of as a supply chain. A **supply chain** (see Figure 1.2) is a global network of organizations and activities that supply a firm with goods and services.

As our society becomes more technologically oriented, we see increasing specialization. Specialized expert knowledge, instant communication, and cheaper transportation also foster specialization and worldwide supply chains. It just does not pay for a firm to try to do everything itself. The expertise that comes with specialization exists up and down the supply chain, adding value at each step. When members of the supply chain collaborate to achieve high levels of customer satisfaction, we have a tremendous force for efficiency and competitive advantage. Competition in the 21st century is no longer between companies; it is between supply chains.

Supply chain

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

STUDENT TIP

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

Why Study Operations Management?

We study OM for four reasons:

1. OM is one of the three major functions of any organization, and it is integrally related to all the other business functions. All organizations market (sell), finance (account), and produce (operate), and it is important to know how the OM activity functions. Therefore, we study *how people organize themselves for productive enterprise*.
2. We study OM because we want to know *how goods and services are produced*. The production function is the segment of our society that creates the products and services we use.
3. We study OM to *understand what operations managers do*. Regardless of your job in an organization, you can perform better if you understand what operations managers do. In addition, understanding OM will help you explore the numerous and lucrative career opportunities in the field.
4. We study OM *because it is such a costly part of an organization*. A large percentage of the revenue of most firms is spent in the OM function. Indeed, OM provides a major opportunity for an organization to improve its profitability and enhance its service to society. Example 1 considers how a firm might increase its profitability via the production function.

Fisher Technologies is a small firm that must double its dollar contribution to fixed cost and profit in order to be profitable enough to purchase the next generation of production equipment. Management has determined that if the firm fails to increase its contribution, its bank will not make the loan and the equipment cannot be purchased. If the firm cannot purchase the equipment, the limitations of the old equipment will force Fisher to go out of business and, in doing so, put its employees out of work and discontinue producing goods and services for its customers.

APPROACH ▶ Table 1.1 shows a simple profit-and-loss statement and three strategic options (marketing, finance/accounting, and operations) for the firm. The first option is a *marketing option*, where good marketing management may increase sales by 50%. By increasing sales by 50%, contribution will in turn increase 71%. But increasing sales 50% may be difficult; it may even be impossible.

		<i>Marketing Option^a</i>	<i>Finance/ Accounting Option^b</i>	<i>OM Option^c</i>
	Current	Increase Sales Revenue 50%	Reduce Finance Costs 50%	Reduce Production Costs 20%
Sales	\$100 000	\$ 150 000	\$100 000	\$100 000
Costs of goods	<u>−80 000</u>	<u>−120 000</u>	<u>−80 000</u>	<u>−64 000</u>
Gross margin	20 000	30 000	20 000	36 000
Finance costs	<u>−6 000</u>	<u>−6 000</u>	<u>−3 000</u>	<u>−6 000</u>
Subtotal	14 000	24 000	17 000	30 000
Taxes at 25%	<u>−3 500</u>	<u>−6 000</u>	<u>−4 250</u>	<u>−7 500</u>
Contribution ^d	\$ 10 500	\$ 18 000	\$ 12 750	\$ 22 500

^a Increasing sales 50% increases contribution by \$7500, or 71% (= 7500/10 500).
^b Reducing finance costs 50% increases contribution by \$2250, or 21% (= 2250/10 500).
^c Reducing production costs 20% increases contribution by \$12 000, or 114% (= 12 000/10 500).
^d Contribution to fixed costs (excluding finance costs) and profit.

EXAMPLE 1**Examining the Options for Increasing Contribution****Table 1.1**
Options for Increasing Contribution

The second option is a *finance/accounting option*, where finance costs are cut in half through good financial management. But even a reduction of 50% is still inadequate for generating the necessary increase in contribution. Contribution is increased by only 21%.

The third option is an *OM option*, where management reduces production costs by 20% and increases contribution by 114%.

SOLUTION ▶ Given the conditions of our brief example, Fisher Technologies has increased contribution from \$10 500 to \$22 500. It may now have a bank willing to lend it additional funds.

INSIGHT ▶ The OM option not only yields the greatest improvement in contribution but also may be the only feasible option. Increasing sales by 50% and decreasing finance costs by 50% may both be virtually impossible. Reducing operations costs by 20% may be difficult but feasible.

LEARNING EXERCISE ▶ What is the impact of only a 15% decrease in costs in the OM option? [Answer: A \$19 500 contribution; approximately an 86% increase.]

Example 1 underscores the importance of an effective operations activity of a firm. Development of increasingly effective operations is the approach taken by many companies as they face growing global competition.

What Operations Managers Do

All good managers perform the basic functions of the management process. The **management process** consists of *planning, organizing, staffing, leading, and controlling*. Operations managers apply this management process to the decisions they make in the OM function. The 10 major decisions of OM are shown in Table 1.2. Successfully addressing each of these decisions requires planning, organizing, staffing, leading, and controlling. Typical issues relevant to these decisions and the chapter in which each is discussed are also shown.

STUDENT TIP

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

Management process

The application of planning, organizing, staffing, leading, and controlling to the achievement of objectives.

Table 1.2
10 Critical Decisions
of Operations Management

10 Decision Areas	Issues	Chapter(s)
1. Design of goods and services	What good or service should we offer? How should we design these products?	5
2. Managing quality	How do we define the quality? Who is responsible for quality?	6, Supplement 6
3. Process and capacity design	What process and what capacity will these products require? What equipment and technology are necessary for these processes?	7, Supplement 7
4. Location strategy	Where should we put the facility? On what criteria should we base the location decision?	8
5. Layout strategy	How should we arrange the facility? How large must the facility be to meet our plan?	9
6. Human resources and job design	How do we provide a reasonable work environment? How much can we expect our employees to produce?	10
7. Supply chain management	Should we make or buy this component? Who should be our suppliers, and how can we integrate them into our strategy?	11, Supplement 11
8. Inventory, material requirements planning, and JIT (just-in-time)	How much inventory of each item should we have? When do we reorder?	12, 14, 16
9. Intermediate and short-term scheduling	Are we better off keeping people on the payroll during slowdowns? Which job do we perform next?	13, 15
10. Maintenance	Who is responsible for maintenance?	17

STUDENT TIP

Current OM emphasis on quality and supply chain has increased job opportunities in these 10 areas.

WHERE ARE THE OM JOBS?

How does one get started on a career in operations? The 10 OM decisions identified in Table 1.2 are made by individuals who work in the disciplines shown in the blue areas of Figure 1.1. Competent business students who know their accounting, statistics, finance, and OM have an opportunity to assume entry-level positions in all of these areas. As you read this text, identify disciplines that can assist you in making these decisions, then take courses in those areas. The more background an OM student has in accounting, statistics, information systems, and mathematics, the more job opportunities will be available. About 40% of all jobs are in OM.

The following professional organizations provide various certifications that may enhance your education and be of help in your career:

- APICS, the Association for Operations Management (www.apics.org)
- Standards Council of Canada (www.scc.ca)
- Institute for Supply Management (ISM) (www.instituteforsupplymanagement.org)
- Project Management Institute (PMI) (www.pmi.org)
- Council of Supply Chain Management Professionals (www.cscmp.org)

Figure 1.3 shows some possible job opportunities.

The Heritage of Operations Management

The field of OM is relatively young, but its history is rich and interesting. Our lives and the OM discipline have been enhanced by the innovations and contributions of numerous individuals. We now introduce a few of these people, and we provide a summary of significant events in operations management in Figure 1.4.

Eli Whitney (1800) is credited for the early popularization of interchangeable parts, which was achieved through standardization and quality control. Through a contract he signed with the

Operations Management Positions

SEARCH JOBS

Date Job Title

1/15 **Plant Manager**
Division of Fortune 1000 company seeks plant manager for plant located in the Vancouver area. This plant manufactures loading dock equipment for commercial markets. The candidate must be experienced in plant management including expertise in production planning, purchasing, and inventory management. Good written and oral communication skills are a must, along with excellent application of skills in managing people.

2/23 **Operations Analyst**
Expanding national coffee shop: top 10 "Best Places to Work" wants junior-level systems analyst to join our excellent store improvement team. Business or I.E. degree, work methods, labour standards, ergonomics, cost accounting knowledge a plus. This is a hands-on job and excellent opportunity for a team player with good people skills. West coast location. Some travel required.

3/18 **Quality Manager**
Several openings exist in our small package processing facilities in Montreal and Winnipeg for quality managers. These highly visible positions require extensive use of statistical tools to monitor all aspects of service, timeliness, and workload measurement. The work involves (1) a combination of hands-on applications and detailed analysis using databases and spreadsheets, (2) process audits to identify areas for improvement, and (3) management of implementation of changes. Positions involve night hours and weekends. Send résumé.

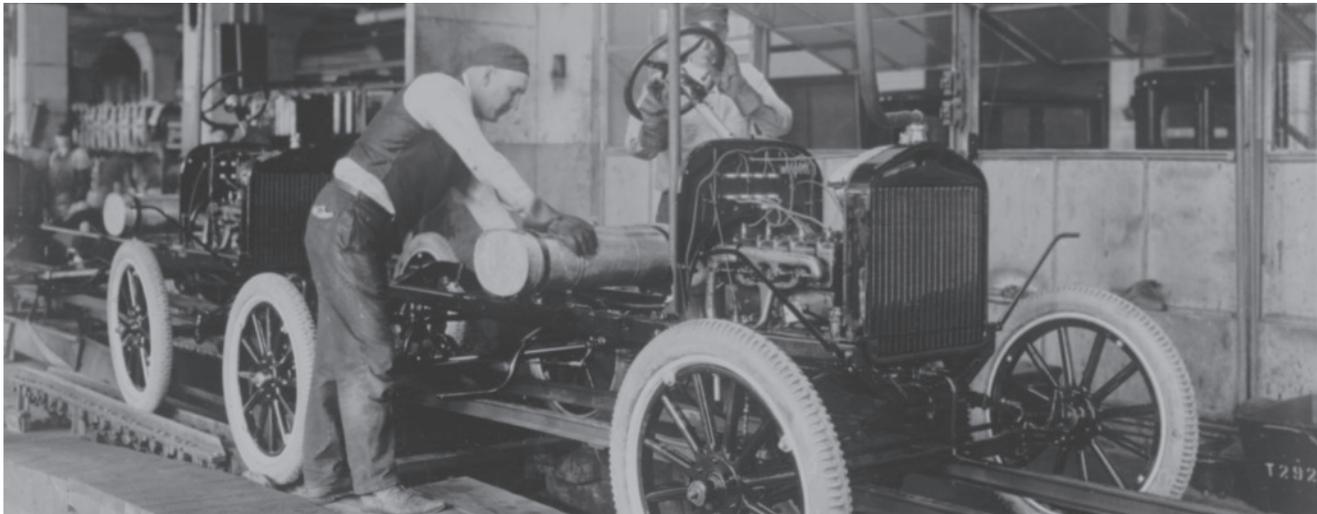
4/6 **Supply Chain Manager and Planner**
Responsibilities entail negotiating contracts and establishing long-term relationships with suppliers. We will rely on the selected candidate to maintain accuracy in the purchasing system, invoices, and product returns. A bachelor's degree and up to two years' related experience are required. Working knowledge of MRP, ability to use feedback to master scheduling and suppliers and consolidate orders for best price and delivery are necessary. Proficiency in all PC Windows applications, particularly Excel and Word, is essential. Knowledge of Oracle business systems is a plus. Effective verbal and written communication skills are essential.

5/14 **Process Improvement Consultants**
An expanding consulting firm is seeking consultants to design and implement lean production and cycle time reduction plans in both service and manufacturing processes. Our firm is currently working with an international bank to improve its back office operations, as well as with several manufacturing firms. A business degree required; APICS certification a plus.

FIGURE 1.3 Many Opportunities Exist for Operations Managers

Cost Focus		Quality Focus	Customization Focus
Early Concepts 1776–1880	Mass Production Era 1910–1980	Lean Production Era 1980–1995	Mass Customization Era 1995–2015
Labour Specialization (Smith, Babbage)	Moving Assembly Line (Ford/Sorensen)	Just-in-Time (JIT)	Globalization
Standardized Parts (Whitney)	Statistical Sampling (Shewhart)	Computer-Aided Design (CAD)	Internet/Ecommerce
Scientific Management Era 1880–1910	Economic Order Quantity (Harris)	Electronic Data Interchange (EDI)	Enterprise Resource Planning
Gantt Charts (Gantt)	Linear Programming	Total Quality Management (TQM)	International Quality Standards (ISO)
Motion & Time Studies (Gilbreth)	PERT/CPM (DuPont)	Baldrige Award	Finite Scheduling
Process Analysis (Taylor)	Material Requirements Planning (MRP)	Empowerment	Supply Chain Management
Queueing Theory (Erlang)		Kanbans	Mass Customization
			Build-to-Order
			Sustainability

FIGURE 1.4 Significant Events in Operations Management



U.S. government for 10 000 muskets, he was able to command a premium price because of their interchangeable parts.

Frederick W. Taylor (1881), known as the father of scientific management, contributed to personnel selection, planning and scheduling, motion study, and the now popular field of ergonomics. One of his major contributions was his belief that management should be much more resourceful and aggressive in the improvement of work methods. Taylor and his colleagues, Henry L. Gantt and Frank and Lillian Gilbreth, were among the first to systematically seek the best way to produce.

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

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

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

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

Operations management will continue to progress with contributions from other disciplines, including *industrial engineering* and *management science*. These disciplines, along with statistics, management, and economics, contribute to improved models and decision making.

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

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

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

Operations in the Service Sector

STUDENT TIP

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

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

Services

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

DIFFERENCES BETWEEN GOODS AND SERVICES

Let's examine some of the differences between goods and services:

- Services are usually *intangible* (for example, your purchase of a ride in an empty airline seat between two cities) as opposed to a tangible good.
- Services are often *produced and consumed simultaneously*; there is no stored inventory. For instance, the beauty salon produces a haircut that is “consumed” simultaneously, or the doctor produces an operation that is “consumed” as it is produced. We have not yet figured out how to inventory haircuts or appendectomies.
- Services are often *unique*. Your mix of financial coverage, such as investments and insurance policies, may not be the same as anyone else's, just as the medical procedure or a haircut produced for you is not exactly like anyone else's.
- Services have *high customer interaction*. Services are often difficult to standardize, automate, and make as efficient as we would like because customer interaction demands uniqueness. In fact, in many cases this uniqueness is what the customer is paying for; therefore, the operations manager must ensure that the product is designed (i.e., customized) so that it can be delivered in the required unique manner.
- Services have *inconsistent product definition*. Product definition may be rigorous, as in the case of an auto insurance policy, but inconsistent because policyholders change cars and policies mature.
- Services are often *knowledge based*, as in the case of educational, medical, and legal services, and therefore hard to automate.
- Services are frequently *dispersed*. Dispersion occurs because services are frequently brought to the client/customer via a local office, a retail outlet, or even a house call.

LO2 Explain the distinction between goods and services

The activities of the operations function are often very similar for both goods and services. For instance, both goods and services must have quality standards established, and both must be designed and processed on a schedule in a facility where human resources are employed.

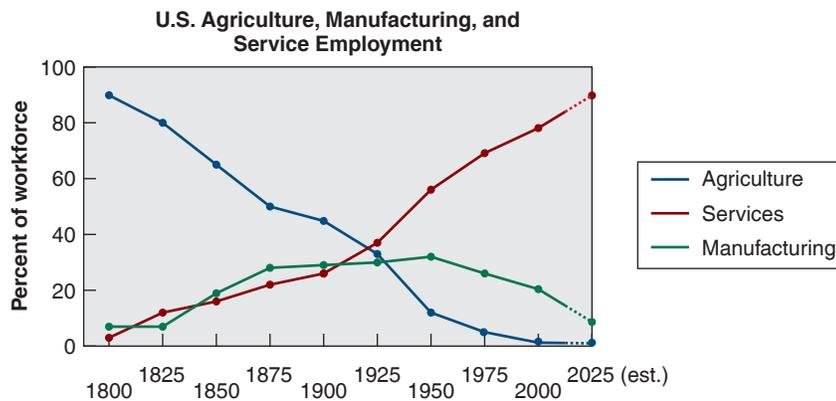
Having made the distinction between goods and services, we should point out that, in many cases, the distinction is not clear-cut. In reality, almost all services and almost all goods are a mixture of a service and a tangible product. Even services such as consulting may require a tangible report. Similarly,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

GROWTH OF SERVICES

Services constitute the largest economic sector in postindustrial societies. Until about 1900, many Canadians were employed in agriculture. Increased agricultural productivity allowed people to leave the farm and seek employment in the city. Similarly, manufacturing employment has decreased in North America in the past 30 years. The Canadian market tends to follow U.S. trends, as can be seen in the following comparison. The changes in U.S. agriculture, manufacturing, and service employment are shown in Figure 1.5. Although the number of people employed in manufacturing has decreased since 1950, each person is now producing almost 20 times more than in 1950. Services became the dominant employer in the early 1920s, with manufacturing employment peaking at about 32% in 1950. The huge productivity increases in

FIGURE 1.5
U.S. Agriculture, Manufacturing, and Service Employment

Source: U.S. Bureau of Labor Statistics.



Service sector

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

STUDENT TIP

Service jobs with their operations component are growing as a percentage of all jobs.

agriculture and manufacturing have allowed more of our economic resources to be devoted to services. Consequently, much of the world can now enjoy the pleasures of education, health services, entertainment, and myriad other things that we call services. Examples of firms and percentage of employment in the Canadian **service sector** are shown in Table 1.3. The table also provides employment percentages for the nonservice sectors of manufacturing, construction, utilities, agriculture, and mining on the bottom five lines.

SERVICE PAY

Although there is a common perception that service industries are low paying, in fact, many service jobs pay very well. Operations managers in the maintenance facility of an airline are very

Table 1.3
Examples of Organizations in Each Sector

Sector	Example	Percent of All Jobs
Service-Producing Sector		
Trade	Hudson Bay Company; Real Canadian Superstore	15%
Transportation and warehousing	WestJet; Maritime–Ontario Freight Lines Limited	5%
Finance, insurance, real estate, and leasing	Royal Bank; Manulife	6%
Professional, scientific, and technical services	Borden Ladner Gervais Law Firm	8%
Business, building, and other support services ¹	Edmonton Waste Management Centre; Carlson Wagonlit Travel	4%
Educational services	McGill University	7%
Health care and social assistance	SickKids Hospital	12%
Information, culture, and recreation	Calgary Flames; Princess of Wales Theatre	5%
Accommodation and food services	Tim Hortons; Royal York Hotel	6%
Other Services	Joe’s Barber Shop; ABC Landscaping	4%
Public administration	Province of Manitoba; City of Hamilton	6%
Goods-Producing Sector		
Agriculture	Farming Operations	2%
Forestry, fishing, mining, quarrying, oil, and gas ²	Canadian Mining Company Inc.; Dome Pacific Logging Ltd.	2%
Utilities	Ontario Power Generation	1%
Construction	PCL Construction Management Inc.	7%
Manufacturing	Magna International Inc.	10%

¹ Formerly “Management of companies, administrative, and other support services.”

² Also referred to as “Natural resources.”

Source: Statistics Canada, CANSIM, table 282-0008 and Catalogue no. 71F0004XCB.

well paid, as are the operations managers who supervise computer services to the financial community. However, the accommodation and food services sectors followed by the arts, recreation, and entertainment sectors offer the lowest average weekly pay levels in Canada.

New Challenges in Operations Management

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

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

These trends are part of the exciting OM challenges currently facing operations managers.

The Productivity Challenge

The creation of goods and services requires changing resources into goods and services. The more efficiently we make this change, the more productive we are and the more value is added to the good or service provided. **Productivity** is the ratio of outputs (goods and services) divided by the inputs (resources, such as labour and capital) (see Figure 1.6). The operations manager's job is to enhance (improve) this ratio of outputs to inputs. Improving productivity means improving efficiency. *Efficiency* means doing the job well—with a minimum of resources and waste. Note the distinction between being *efficient*, which implies doing the job well, and being *effective*, which means doing the right thing. A job well done—say, by applying the 10 decisions of operations management—helps us be *efficient*; developing and using the correct strategy helps us be *effective*.

STUDENT TIP

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

STUDENT TIP

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

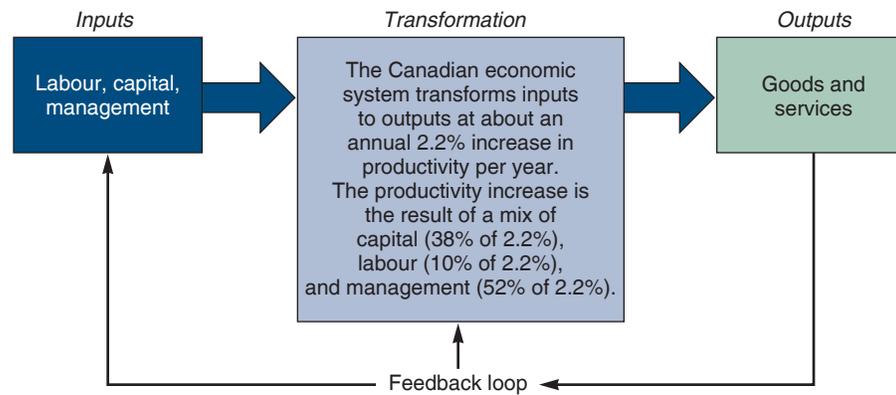
Productivity

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

LO3 Explain the difference between production and productivity

FIGURE 1.6**The Economic System Adds Value by Transforming Inputs to Outputs**

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



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

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

The benefits of increased productivity are illustrated in the *OM in Action* box "Improving Productivity at Starbucks". Since 1973, labour productivity in Canada has experienced an annual rate of growth averaging approximately 1.25%, down considerably from the previous level of 3.00% during the period between 1961 and 1973. An increase of one percentage point in this performance would almost double the annual growth rate to 2.25%. Such a growth rate in labour productivity would mean that the average level of labour productivity in Canada would double every 32 years, not every 58 years as it will with a 1.25% growth rate. Moreover, if our labour productivity level were to double every 32 years, then (in the absence of major demographic effects) so would Canada's standard of living.

PRODUCTIVITY MEASUREMENT

LO4 Compute single-factor productivity

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

The measurement of productivity can be quite direct. Such is the case when productivity is measured by labour-hours per tonne of a specific type of steel. Although labour-hours are a common measure of input, other measures such as capital (dollars invested), materials (tonnes of ore), or energy (kilowatts of electricity) can be used.¹ An example of this can be summarized in the following equation:

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

¹ The quality and time period are assumed to remain constant.

OM in Action**Improving Productivity at Starbucks**

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

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

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

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

As a result, operations improvements at Starbucks outlets have increased the average yearly volume by nearly \$200 000, to about \$940 000 in the past six years. This is a 27% improvement in productivity—about 4.5% per year. In the service industry, a 4.5% per year increase is very tasty.

Sources: Based on *The Wall Street Journal* (August 4, 2009): A1, A10 and (April 12, 2005): B2:B7; *Industrial Engineer* (January 2006): 66; and www.finfacts.com, October 6, 2005.

For example, if units produced = 1000 and labour-hours used is 250, then:

$$\text{Single-factor productivity} = \frac{\text{Units produced}}{\text{Labour-hours used}} = \frac{1000}{250} = 4 \text{ units per labour-hour}$$

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

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

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

LO5 Compute multifactor productivity

Single-factor productivity

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

Multifactor productivity

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

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

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

SOLUTION ►

$$\text{Labour productivity with the old system: } \frac{8 \text{ titles per day}}{32 \text{ labour-hours}} = 0.25 \text{ titles per labour-hour}$$

$$\text{Labour productivity with the new system: } \frac{14 \text{ titles per day}}{32 \text{ labour-hours}} = 0.4375 \text{ titles per labour-hour}$$

$$\text{Multifactor productivity with the old system: } \frac{8 \text{ titles per day}}{\$640 + 400} = 0.0077 \text{ titles per dollar}$$

$$\text{Multifactor productivity with the new system: } \frac{14 \text{ titles per day}}{\$640 + 800} = 0.0097 \text{ titles per dollar}$$

EXAMPLE 2

Computing Single-Factor and Multifactor Gains in Productivity

Labour productivity has increased from 0.25 to 0.4375. The change is $(0.4375 - 0.25)/0.25 = 0.75$, or a 75% increase in labour productivity. Multifactor productivity has increased from 0.0077 to 0.0097. This change is $(0.0097 - 0.0077)/0.0077 = 0.26$, or a 26% increase in multifactor productivity.

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

LEARNING EXERCISE ► If the overhead goes to \$960 (rather than \$800), what is the multifactor productivity? [Answer: 0.00875.]

RELATED PROBLEMS ► 1.1, 1.2, 1.5, 1.6, 1.7, 1.8, 1.9, 1.11, 1.12, 1.14, 1.15

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

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

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

PRODUCTIVITY VARIABLES

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

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

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

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

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

Productivity variables

The three factors critical to productivity improvement—labour, capital and management.

LOG Identify the critical variables in enhancing productivity

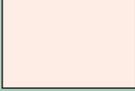
<p>6 yds</p>  <p>4 yds</p> <p>What is the area of this rectangle?</p> <p>_____ 4 square yds _____ 6 square yds _____ 10 square yds _____ 20 square yds _____ 24 square yds</p>	<p>If $9y + 3 = 6y + 15$ then $y =$</p> <p>_____ 1 _____ 4 _____ 2 _____ 6</p>
	<p>Which of the following is true about 84% of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

FIGURE 1.7
 About Half of the 17-Year-Olds in the United States Cannot Correctly Answer Questions of This Type

STUDENT TIP

Perhaps as many as 25% of North American workers lack the basic skills needed for their current job.

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

In developed nations, the challenge becomes *maintaining and enhancing the skills of labour* in the midst of rapidly expanding technology and knowledge. Recent data suggest that the average American 17-year-old knows significantly less mathematics than the average Japanese person of the same age, and about half cannot answer the questions in Figure 1.7. Moreover, more than 38% of U.S. job applicants tested for basic skills were deficient in reading, writing, or math.²

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

CAPITAL Human beings are tool-using animals. Capital investment provides those tools. Capital investment has increased in Canada most years except during a few very severe recession periods. Accumulated capital investment has increased in Canada at a compound annual growth rate of 4.5%.

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

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

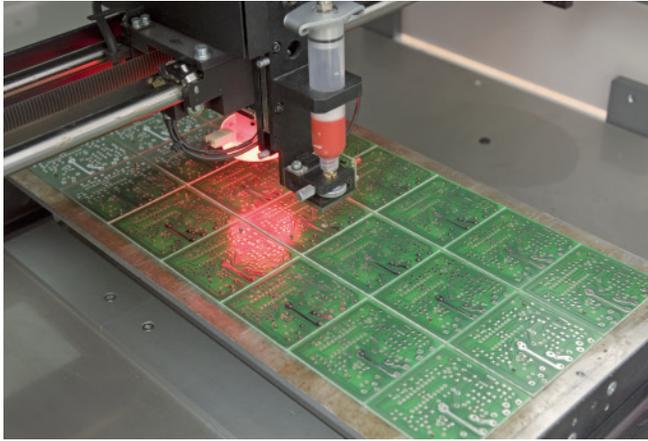
MANAGEMENT Management is a factor of production and an economic resource. Management is responsible for ensuring that labour and capital are effectively used to increase productivity. Management accounts for over half of the annual increase in productivity. This increase includes improvements made through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

Using knowledge and technology is critical in postindustrial societies. Consequently, postindustrial societies are also known as knowledge societies. A **knowledge society** is one in which much of the labour force has migrated from manual work to technical and information-processing tasks requiring ongoing education. The required education and training are important high-cost items that are the responsibility of operations managers as they build organizations and workforces. The expanding knowledge base of contemporary society requires that managers use *technology and knowledge effectively*.

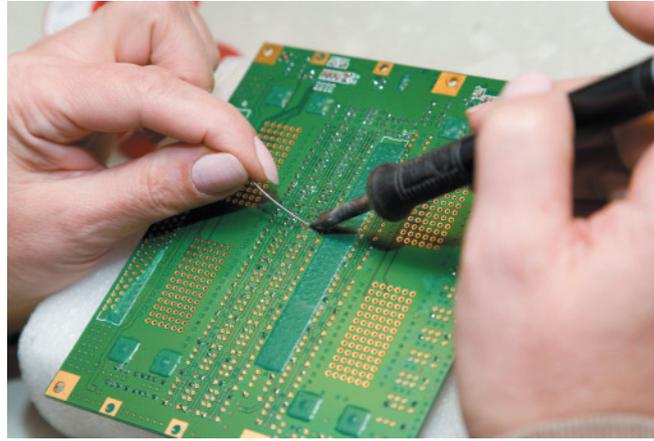
Knowledge society

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

² “Can’t Read, Can’t Count,” *Scientific American* (October 2001): 24; and “Economic Time Bomb: U.S. Teens Are among Worst at Math,” *The Wall Street Journal* (December 7, 2004): B1.



Andrzej Thiel/Fotolia



Guy Shapira/Shutterstock

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



Olaf Janotke/Agencja Fotograficzna Caro/Alamy Stock Photo

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

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

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

PRODUCTIVITY AND THE SERVICE SECTOR

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

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

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

OM in Action**Taco Bell Improves Productivity and Goes Green to Lower Costs**

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

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

Operations managers at Taco Bell believe they have cut in-store labour by 15 hours per day and reduced floor space by more than 50%. The result is a store that can handle twice the volume with half the labour.

In 2010, Taco Bell completed the rollout of its new Grill-to-Order kitchens by installing water- and energy-saving grills that conserve over a billion litres of water and 200 million kWh of electricity each year. This “green”-inspired cooking method also saves the company’s 5600 restaurants \$17 million per year.

Effective operations management has resulted in productivity increases that support Taco Bell’s low-cost strategy. Taco Bell is now the fast-food low-cost leader with a 73% share of the Mexican fast-food market.

Sources: Based on Energy Business Journal (May 12, 2008): 111; Harvard Business Review (July/August 2008): 118; and J. Hueter and W. Swart, Interfaces (January–February 1998): 75–91.

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

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

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

Ethics, Social Responsibility, and Sustainability

Operations managers are subjected to constant changes and challenges. The systems they build to convert resources into goods and services are complex. The physical and social environments change, as do laws and values. These changes present a variety of challenges that come from the conflicting perspectives of stakeholders such as customers, distributors, suppliers, owners, lenders, and employees. These stakeholders, as well as government agencies at various levels, require constant monitoring and thoughtful responses.

Identifying ethical and socially responsible responses while building productive systems is not always clear-cut. Among the many ethical challenges facing operations managers are:

- Efficiently developing and producing safe, quality products.
- Maintaining a sustainable environment.
- Providing a safe workplace.
- Honouring stakeholder commitments.

STUDENT TIP

Ethics must drive all of a manager’s decisions.

OM in Action Magna International

In operations management, balancing the interests of the various stakeholders associated with a company can be challenging at the best of times. To add to the challenge, progressive organizations are now placing the needs of society high on the priority list and have declared their corporate social responsibility. Automotive parts manufacturer Magna International is an example of one of these companies.

Magna has publicly stated that it is committed to supporting the basic fabric of society through a number of programs, volunteer work, and charitable activities. Magna's "Corporate Constitution" allocates a maximum of 2% of its pretax profits to support charitable and nonprofit organizations, and it has pledged support to many programs dealing with health, culture, education, sports, and politics. Magna's executive officers have expressed their desire to continuously improve the quality of life in each of the communities in which their employees work and live.

Magna International's "Corporate Constitution" publicly declares and defines the rights of its employees and investors to participate in its profits and growth, while also imposing specified disciplines on management. This constitution strikes a balance between employees, investors,

society, and management. This business philosophy was introduced by the company's founder, Frank Stronach, in 1971—it is known as "Fair Enterprise" and is at the heart of Magna's operating structure.



Magna International actively supports the concept of corporate social responsibility.

Source: Based on www.magna.com/about-magna/our-culture/corporate-constitution.

Managers must do all of this in an ethical and socially responsible way while meeting the demands of the marketplace. If operations managers have a *moral awareness and focus on increasing productivity* in a system where all stakeholders have a voice, then many of the ethical challenges will be successfully addressed (for example, see the *OM in Action* box "Magna International"). The organization will use fewer resources, the employees will be committed, the market will be satisfied, and the ethical climate will be enhanced. Throughout this text, we note ways in which operations managers can take ethical and socially responsible actions while successfully addressing these challenges of the market. We also conclude each chapter with an Ethical Dilemma exercise.

CHAPTER SUMMARY

Operations, marketing, and finance/accounting are the three functions basic to all organizations. The operations function creates goods and services. Much of the progress of operations management has been made in the 20th century, but since the beginning of time, humankind has been attempting to improve its material well-being. Operations managers are key players in the battle to improve productivity.

As societies become increasingly affluent, more of their resources are devoted to services. In Canada, more than three-quarters of the workforce is employed in the service sector. Productivity improvements are difficult to achieve, but operations managers are the primary vehicle for making improvements.

ETHICAL DILEMMA

Major corporations with overseas subcontractors (such as IKEA in Bangladesh, Unilever in India, and Nike in China) have been criticized, often with substantial negative publicity, when children as young as 10 have been found working in the subcontractor's facilities. The standard response is to perform an audit and then enhance controls so it does not happen again. In one such case, a 10-year-old

was terminated. Shortly thereafter, the family, without the 10-year-old's contribution to the family income, lost its modest home, and the 10-year-old was left to scrounge in the local dump for scraps of metal. Was the decision to hire the 10-year-old ethical? Was the decision to terminate the 10-year-old ethical?

Discussion Questions

1. Why should one study operations management?
2. Identify four people who have contributed to the theory and techniques of operations management.
3. Briefly describe the contributions of the four individuals identified in the preceding question.
4. Figure 1.1 outlines the operations, finance/accounting, and marketing functions of three organizations. Prepare a chart similar to Figure 1.1 outlining the same functions for one of the following:
 - a. newspaper
 - b. drugstore
 - c. college library
 - d. summer camp
 - e. small costume-jewellery factory
5. Answer Question 4 for some other organization, perhaps an organization where you have worked.
6. What are the three basic functions of a firm?
7. Name the 10 decision areas of operations management.
8. Name four areas that are significant to improving labour productivity.
9. Canada, and indeed much of the world, has been described as a *knowledge society*. How does this affect productivity measurement and the comparison of productivity between Canada and other countries?
10. What are the measurement problems that occur when one attempts to measure productivity?
11. Mass customization and rapid product development were identified as current trends in modern manufacturing operations. What is the relationship, if any, between these trends? Can you cite any examples?
12. What are the five reasons productivity is difficult to improve in the service sector?
13. Describe some of the actions taken by Taco Bell to increase productivity that have resulted in Taco Bell's ability to serve "twice the volume with half the labour".

Solved Problems Virtual Office Hours help is available at MyLab Operations Management.

▼ SOLVED PROBLEM 1.1

Productivity can be measured in a variety of ways, such as by labour, capital, energy, material usage, and so on. At Modern Lumber, Inc., Art Binley, president and producer of apple crates sold to growers, has been able, with his current equipment, to produce 240 crates per 100 logs. He currently purchases 100 logs per day, and each log requires three labour-hours to process. He

believes that he can hire a professional buyer who can buy a better-quality log at the same cost. If this is the case, he can increase his production to 260 crates per 100 logs. His labour-hours will increase by eight hours per day.

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

▼ SOLUTION

$$\begin{aligned}
 \text{(a) Current labour productivity} &= \frac{240 \text{ crates}}{100 \text{ logs} \times 3 \text{ hours/log}} \\
 &= \frac{240}{300} \\
 &= 0.8 \text{ crate per labour-hour}
 \end{aligned}$$

(b) Labour productivity with buyer

$$\begin{aligned}
 &= \frac{260 \text{ crates}}{100 \text{ logs} \times 3 \text{ hours/log} + 8 \text{ hours}} \\
 &= \frac{260}{308} \\
 &= 0.844 \text{ crates per labour-hour}
 \end{aligned}$$

Using current productivity (0.80 from part [a]) as a base, the increase will be 5.5% ($= 0.844/0.8 = 1.055$, or a 5.5% increase).

▼ SOLVED PROBLEM 1.2

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

will increase to 308 per day. His capital and energy costs will remain constant at \$350 and \$150 per day, respectively. Material costs for the 100 logs per day are \$1000 and will remain the same. Because he pays an average of \$10 per hour (with fringes), Binley determines his productivity increase as follows:

▼ SOLUTION

	Current System	System with Professional Buyer
Labour:	300 h @ \$10/h = \$3000	308 h @ \$10/h = \$3080
Material:	100 logs/day 1000	1000
Capital:	350	350
Energy:	150	150
Total Cost:	<u>\$4500</u>	<u>\$4580</u>
Multifactor productivity of current system:		Multifactor productivity of proposed system:
= 240 crates/\$4500 = 0.0533 crates/dollar		= 260 crates/\$4580 = 0.0568 crates/dollar

Using current productivity (0.0533) as a base, the increase will be 0.066. That is, $0.0568/0.0533 = 1.066$, or a 6.6% increase.

Problems*

•• **1.1** John Lucy makes wooden boxes in which to ship motorcycles. John and his three employees invest a total of 40 hours per day making 120 boxes.

- a) What is their productivity?
- b) John and his employees have discussed redesigning the process to improve efficiency. If they can increase the rate to 125 boxes per day, what will be their new productivity?
- c) What will be their unit *increase* in productivity per hour?
- d) What will be their percentage change in productivity? **PX**

•• **1.2** Riverside Metal Works produces cast bronze valves on a 10-person assembly line. On a recent day, 160 valves were produced during an eight-hour shift.

- a) Calculate the labour productivity of the line.
- b) The manager at Riverside changed the layout and was able to increase production to 180 units per eight-hour shift. What is the new labour productivity per labour-hour?
- c) What is the percentage of productivity increase? **PX**

•• **1.3** This year, Benson, Inc., will produce 57 600 hot water heaters at its plant in Saskatoon, Saskatchewan, in order to meet expected global demand. To accomplish this, each labourer at the Saskatoon plant will work 160 hours per month. If the labour productivity at the plant is 0.15 hot water heaters per labour-hour, how many labourers are employed at the plant?

•• **1.4** As a library or internet assignment, find the U.S. productivity rate (increase) last year for the (a) national economy, (b) manufacturing sector, and (c) service sector.

•• **1.5** Aditi produces “Final Exam Care Packages” for resale. She is currently working a total of five hours per day to produce 100 care packages.

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

•• **1.6** Eric Lafleur makes billiard balls in his New Brunswick plant. With recent increases in his costs, he has a newfound interest in efficiency. Eric is interested in determining the productivity of his organization. He would like to know if his organization is maintaining the manufacturing average of 3% increase in productivity. He has the following data representing a month from last year and an equivalent month this year:

	Last Year	Now
Units produced	1 000	1 000
Labour (hours)	300	275
Resin (kilograms)	50	45
Capital invested (\$)	10 000	11 000
Energy (BTU)	3 000	2 850

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

•• **1.7** Eric Lafleur (using data from Problem 1.6) determines his costs to be as follows:

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

Show the percentage change in productivity for one month last year versus one month this year, on a multifactor basis with dollars as the common denominator. **PX**

•• **1.8** Kleen Karpel cleaned 65 rugs in October, consuming the following resources:

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

- a) What is the labour productivity per dollar?
- b) What is the multifactor productivity? **PX**

•• **1.9** David Upton is president of Upton Manufacturing, a producer of Go-Kart tires. Upton makes 1000 tires per day with the following resources:

Labour:	400 hours per day @ \$12.50 per hour
Raw material:	20 000 pounds per day @ \$1 per pound
Energy:	\$5000 per day
Capital costs:	\$10 000 per day

- a) What is the labour productivity per labour-hour for these tires at Upton Manufacturing?
- b) What is the multifactor productivity for these tires at Upton Manufacturing?
- c) What is the percent change in multifactor productivity if Upton can reduce the energy bill by \$1000 per day without cutting production or changing any other inputs? **PX**

•• **1.10** Sawyer’s, a local bakery, is worried about increased costs—particularly energy. Last year’s records provide a fairly good estimate of the parameters for this year. Judy Sawyer, the owner, does not believe things have changed much, but she did invest an additional \$3000 for modifications to the bakery’s ovens to make them more energy efficient. The modifications were supposed to make the ovens at least 15% more efficient. Sawyer has asked you to check the energy savings of the new ovens and also to look over other measures of the bakery’s productivity to see if the modifications were beneficial. You have the following data to work with:

	Last Year	Now
Production (dozen)	1 500	1 500
Labour (hours)	350	325
Capital investment (\$)	15 000	18 000
Energy (BTU)	3 000	2 750

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

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

Average labour cost last year was \$20 per hour, kits cost \$1000 each, and energy costs were \$3 per kilowatt-hour. What do you tell Cunningham? **PX**

•• **1.12** Halifax Seafood makes 500 wooden packing boxes for fresh seafood per day, working in two 10-hour shifts. Due to increased demand, plant managers have decided to operate three eight-hour shifts instead. The plant is now able to produce 650 boxes per day.

- Calculate the company's productivity before the change in work rules and after the change.
- What is the percentage increase in productivity?
- If production is increased to 700 boxes per day, what is the new productivity? **PX**

•• **1.13** Marjatta Viitasalo operates a bakery in Thunder Bay, Ontario. Because of its excellent product and excellent location, demand has increased by 25% in the last year. On far too many occasions, customers have not been able to purchase the bread of their choice. Because of the size of the store, no new ovens can be added. At a staff meeting, one employee suggested ways to load the ovens differently so that more loaves of bread can be baked at one time. This new process will require that the ovens be loaded by hand, requiring additional manpower. This is the only thing to be changed. If the bakery makes 1500 loaves per month with a labour productivity of 2.344 loaves per labour-hour, how many workers will Viitasalo need to add? (*Hint*: Each employee works 160 hours per month.)

•• **1.14** Refer to Problem 1.13. The pay will be \$8 per hour for employees. Marjatta Viitasalo can also improve the yield by purchasing a new blender. The new blender will mean an increase in her investment. This added investment has a cost of \$100 per month, but she will achieve the same output (an increase to 1875) as the change in labour-hours. Which is the better decision?

- Show the productivity change, in loaves per dollar, with an increase in labour cost (from 640 to 800 hours).
- Show the new productivity, in loaves per dollar, with only an increase in investment (\$100 per month more).
- Show the percent productivity change for labour and investment.

•• **1.15** Refer to Problems 1.13 and 1.14. If Marjatta Viitasalo's utility costs remain constant at \$500 per month, labour at \$8 per hour, and cost of ingredients at \$0.35 per loaf, but Viitasalo does not purchase the blender suggested in Problem 1.14, what will the productivity of the bakery be? What will be the percent increase or decrease?

•• **1.16** In December, General Motors produced 6600 customized vans at its plant in Windsor. The labour productivity at this plant is known to have been 0.10 vans per labour-hour during that month; 300 labourers were employed at the plant that month.

- How many hours did the average labourer work that month?
- If productivity can be increased to 0.11 vans per hour, how many hours would the average labourer work that month?

•• **1.17** Natalie Attired runs a small job shop where garments are made. The job shop employs eight workers. Each worker is paid \$10 per hour. During the first week of March, each worker worked 45 hours. Together, they produced a batch of 132 garments. Of these garments, 52 were "seconds" (meaning that they were flawed). The seconds were sold for \$90 each at a factory outlet store. The remaining 80 garments were sold to retail outlets at a price of \$198 per garment. What was the labour productivity, in dollars per labour-hour, at this job shop during the first week of March?

CASE STUDIES

National Air Express

National Air Express is a competitive air-express firm with offices around the country. Mohammed Chaudry, the Ottawa station manager, is preparing his quarterly budget report, which will be presented at the Eastern regional meeting next week. He is very concerned about adding capital expense to the operation when business has not increased appreciably. This has been the worst first quarter he can remember, with snowstorms, freezing rain, and bitter cold. He has asked Martha Lewis, field services supervisor, to help him review the available data and offer possible solutions.

Service Methods

National Air offers door-to-door overnight air-express delivery within Canada. Chaudry and Lewis manage a fleet of 24 trucks to handle freight in the Ottawa area. Routes are assigned by area, usually delineated by postal codes, major streets, or key geographical features, such as the Ottawa River. Pickups are generally handled between 3:00 p.m. and 6:00 p.m., Monday through Friday. Driver routes are a combination of regularly scheduled daily stops and pickups that the customer calls in as needed. These call-in pickups are dispatched by radio to the driver. Most call-in customers want as late a pickup as possible, just before closing (usually at 5:00 p.m.).

When the driver arrives at each pickup location, he or she provides supplies as necessary (an envelope or box if requested) and must receive a completed air waybill for each package. Because the industry is extremely competitive, a professional, courteous driver is essential to retaining customers. Therefore, Chaudry has always been concerned that drivers not rush a customer to complete his or her package and paperwork.

Budget Considerations

Chaudry and Lewis have found that they have been unable to meet their customers' requests for a scheduled pickup on many occasions in the past quarter. Although, on average, drivers are not handling any more business, they are unable on some days to arrive at each location on time. Chaudry does not think he can justify increasing costs by \$1200 per week for additional trucks and drivers while productivity (measured in shipments per truck/day) has remained flat. The company has established itself as the low-cost operator in the industry but has at the same time committed itself to offering quality service and value for its customers.

Discussion Questions

1. Is the productivity measure of shipments per day per truck still useful? Are there alternatives that might be more effective?
2. What, if anything, can be done to reduce the daily variability in pickup call-ins? Can the driver be expected to be at several locations at once at 5:00 p.m.?
3. How should package pickup performance be measured? Are standards useful in an environment that is affected by the weather, traffic, and other random variables? Are other companies having similar problems?

Source: Adapted from a case by Phil Pugliese under the supervision of Professor Marilyn M. Helms, University of Tennessee at Chattanooga. Reprinted by permission.

Video Case

Frito-Lay: Operations Management in Manufacturing

Frito-Lay, the massive Dallas, Texas-based subsidiary of PepsiCo, has 38 plants and 48 000 employees in North America. Seven of Frito-Lay's 41 brands exceed \$1 billion in sales: Fritos, Lay's Cheetos, Ruffles, Tostitos, Doritos, and Walker's Potato Chips. Operations are the focus of the firm—from designing products for new markets, to meeting changing consumer preferences, to adjusting to rising commodity costs, to subtle issues involving flavours and preservatives—OM is under constant cost, time, quality, and market pressure. Here is a look at how the 10 decisions of OM are applied at this food processor.

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

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

Sources: Professors Beverly Amer (Northern Arizona University), Barry Render (Rollins College), and Jay Heizer (Texas Lutheran University).

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

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

Discussion Questions*

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

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

Video Case

Hard Rock Cafe: Operations Management in Services

Since its inception in 1971, Hard Rock has grown from a modest London pub to a global power managing 150 cafes, 13 hotels/casinos, live music venues, and a huge annual Rockfest concert. This puts Hard Rock firmly in the service industry—a sector that employs over 75% of the people in the United States. Hard Rock moved its world headquarters to Orlando, Florida, in 1988 and has expanded to more than 40 locations throughout the United States, serving over 100 000 meals each day. Hard Rock chefs are modifying the menu from classic American—burgers and chicken wings—to include

higher-end items such as stuffed veal chops and lobster tails. Just as taste in music changes over time, so does Hard Rock Cafe, with new menus, layouts, memorabilia, services, and strategies.

At Orlando's Universal Studios, a traditional tourist destination, Hard Rock Cafe serves over 3500 meals each day. The cafe employs about 400 people. Most are employed in the restaurant, but some work in the retail shop. Retail is now a standard and increasingly prominent feature in Hard Rock Cafes (since close to 48% of revenue comes from this source). Cafe employees include kitchen

and wait staff, hostesses, and bartenders. Hard Rock employees are not only competent in their job skills but are also passionate about music and have engaging personalities. Cafe staff is scheduled down to 15-minute intervals to meet seasonal and daily demand changes in the tourist environment of Orlando. Surveys are done on a regular basis to evaluate quality of food and service at the cafe. Scores are rated on a 1 to 7 scale, and if the score is not a 7, the food or service is considered a failure.

Hard Rock is adding a new emphasis on live music and is redesigning its restaurants to accommodate the changing tastes. Since Eric Clapton hung his guitar on the wall to mark his favourite bar stool, Hard Rock has become the world’s leading collector and exhibitor of rock ‘n’ roll memorabilia, with changing exhibits at its cafes throughout the world. The collection includes thousands of pieces, valued at \$40 million. In keeping with the times, Hard Rock also maintains a website, www.hardrock.com, which receives over 100 000 hits per

week, and a weekly cable television program on VH-1. Hard Rock’s brand recognition, at 92%, is one of the highest in the world.

Discussion Questions*

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

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

CHAPTER 1 | RAPID REVIEW

MyLab Operations Management

Main Heading	Review Material	
WHAT IS OPERATIONS MANAGEMENT? (p. 2)	<ul style="list-style-type: none"> • Production—The creation of goods and services. • Operations management (OM)—Activities that relate to the creation of goods and services through the transformation of inputs to outputs. 	<p>VIDEO 1.1 Operations Management at Hard Rock</p> <p>VIDEO 1.2 Operations Management at Frito-Lay</p>
ORGANIZING TO PRODUCE GOODS AND SERVICES (pp. 3–4)	<p>All organizations perform three functions to create goods and services:</p> <ol style="list-style-type: none"> 1. <i>Marketing</i>, which generates demand 2. <i>Production/operations</i>, which creates the product 3. <i>Finance/accounting</i>, which tracks how well the organization is doing, pays the bills, and collects the money 	
THE SUPPLY CHAIN (p. 4)	<ul style="list-style-type: none"> • Supply chain—A global network of organizations and activities that supplies a firm with goods and services. 	
WHY STUDY OPERATIONS MANAGEMENT? (pp. 4–5)	<p>We study OM for four reasons:</p> <ol style="list-style-type: none"> 1. To learn how people organize themselves for productive enterprise 2. To learn how goods and services are produced 3. To understand what operations managers do 4. Because OM is a costly part of an organization 	
WHAT OPERATIONS MANAGERS DO (pp.5–6)	<ul style="list-style-type: none"> • Management process—The application of planning, organizing, staffing, leading, and controlling to achieve objectives.Ten major decisions are required of operations managers: <ol style="list-style-type: none"> 1. Design of goods and services 2. Managing quality 3. Process strategy 4. Location strategy 5. Layout strategy 6. Human resources 7. Supply chain management 8. Inventory management 9. Scheduling 10. Maintenance <p>About 40% of all jobs are in OM. Operations managers possess job titles such as plant manager, quality manager, process-improvement consultant, and operations analyst.</p>	

MyLab Operations Management

Main Heading Review Material

THE HERITAGE OF OPERATIONS MANAGEMENT (pp. 6–8)

Significant events in modern OM can be classified into five eras:

1. Early concepts (1776–1880)—Labour specialization (Smith, Babbage), standardized parts (Whitney)
2. Scientific management (1880–1910)—Gantt charts (Gantt), motion and time studies (Gilbreth), process analysis (Taylor), queuing theory (Erlang)
3. Mass production (1910–1980)—Assembly line (Ford/Sorensen), statistical sampling (Shewhart), economic order quantity (Harris), linear programming (Dantzig), PERT/CPM (DuPont), material requirements planning
4. Lean production (1980–1995)—Just-in-time, computer-aided design, electronic data interchange, total quality management, Baldrige Award, empowerment, kanbans
5. Mass customization (1995–2005)—Globalization, internet/e-commerce, enterprise resource planning, international quality standards, finite scheduling, supply chain management, mass customization, build-to-order, sustainability
6. Globalization era (2005–2020)—Global supply chains, growth of transnational organizations, instant communications, sustainability, ethics in a global work force, logistics and shipping

OPERATIONS IN THE SERVICE SECTOR (pp. 9–11)

- **Services**—Economic activities that typically produce an intangible product (such as education, entertainment, lodging, government, financial, and health services). Almost all services and almost all goods are a mixture of a service and a tangible product.
- **Service sector**—The segment of the economy that includes trade, finance, lodging, education, law, medicine, and other professional occupations. Services now constitute the largest economic sector in postindustrial societies. The huge productivity increases in agriculture and manufacturing have allowed more of our economic resources to be devoted to services. Many service jobs pay very well.

NEW CHALLENGES IN OPERATIONS MANAGEMENT (p. 11)

Some of the current challenges for operations managers include:

- Global focus; international collaboration
- Rapid product development; design collaboration
- Environmentally sensitive production; green manufacturing; sustainability
- Mass customization
- Supply chain partnering; joint ventures; alliances
- Lean operations; continuous improvement and elimination of waste

THE PRODUCTIVITY CHALLENGE (pp. 11–17)

- **Productivity**—The ratio of outputs (goods and services) divided by one or more inputs (such as labour, capital, or management).

High production means producing many units, while high productivity means producing units efficiently.

Only through increases in productivity can the standard of living of a country improve. Canadian productivity has averaged over 3% for the past half century.

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

- **Single-factor productivity**—Indicates the ratio of one resource (input) to the goods and services produced (outputs).
- **Multifactor productivity**—Indicates the ratio of many or all resources (inputs) to the goods and services produced (outputs). Also called *total factor productivity*.

Multifactor Productivity

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

Problems: 1.1–1.17
Virtual Office Hours for Solved Problems: 1.1, 1.2

MyLab Operations Management

Main Heading Review Material

	<p>Measurement problems with productivity include: (1) the quality may change, (2) external elements may interfere, and (3) precise units of measure may be lacking.</p> <ul style="list-style-type: none"> • Productivity variables—The three factors critical to productivity improvement are labour (10%), capital (38%), and management (52%). • Knowledge society—A society in which much of the labour force has migrated from manual work to work based on knowledge. 	
<p>ETHICS, SOCIAL RESPONSIBILITY, AND SUSTAINABILITY (pp. 17–18)</p>	<p>Among the many ethical challenges facing operations managers are (1) efficiently developing and producing safe, quality products; (2) maintaining a clean environment; (3) providing a safe workplace; and (4) honouring stakeholder commitments.</p>	

Self-Test

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

- LO1** Productivity increases when:
- inputs increase while outputs remain the same.
 - inputs decrease while outputs remain the same.
 - outputs decrease while inputs remain the same.
 - inputs and outputs increase proportionately.
 - inputs increase at the same rate as outputs.
- LO2** Services often:
- are tangible.
 - are standardized.
 - are knowledge based.
 - are low in customer interaction.
 - have consistent product definition.
- LO3** Productivity:
- can use many factors as the numerator.
 - is the same thing as production.
 - increases at about 0.5% per year.
 - is dependent upon labour, management, and capital.
 - is the same thing as effectiveness.
- LO4** Single-factor productivity:
- remains constant.
 - is never constant.
 - usually uses labour as a factor.
 - seldom uses labour as a factor.
 - uses management as a factor.
- LO5** Multifactor productivity:
- remains constant.
 - is never constant.
 - usually uses substitutes as common variables for the factors of production.
 - seldom uses labour as a factor.
 - always uses management as a factor.
- LO6** Productivity increases each year in Canada are a result of three factors:
- labour, capital, management
 - engineering, labour, capital
 - engineering, capital, quality control
 - engineering, labour, data processing
 - engineering, capital, data processing

Answers: LO1. b; LO2. c; LO3. d; LO4. c; LO5. c; LO6. a

MyLab Operations Management

Most of these questions can be found in MyLab Operations Management. Visit MyLab Operations Management to access cases, videos, downloadable software, and much more. MyLab Operations Management also features a personalized Study Plan that helps you identify which chapter concepts you've mastered and guides you towards study tools for additional practice.

2



Peter Carey/Alamy Stock Photo

Learning Objectives

- LO1** Define *mission* and *strategy* 32
- LO2** Identify and explain three strategic approaches to competitive advantage 32
- LO3** Identify and define the 10 decisions of operations management 36
- LO4** Understand the significance of key success factors and core competencies 41
- LO5** Identify and explain four global operations strategy options 47

Operations Strategy in a Global Environment

Boeing's Global Strategy Yields Competitive Advantage

Boeing's strategy for its 787 Dreamliner is unique from both an engineering and a global perspective.

The Dreamliner incorporates the latest in a wide range of aerospace technologies, from airframe and engine design to super-lightweight titanium-graphite laminate, carbon-fibre and epoxy, and composites. Another innovation is the electronic monitoring system that allows the airplane to report maintenance requirements to ground-based computer systems. Boeing has also worked with General Electric and Rolls-Royce to develop more efficient engines. The advances in engine technology contribute as much as 8% of the increased fuel/payload efficiency of the new airplane, representing a nearly two-generation jump in technology.

This state-of-the-art Boeing 787 is also *global*. Led by Boeing at its Everett, Washington, facility, an international team of aerospace companies developed the airplane. New technologies, new design, new manufacturing processes, and committed international suppliers are helping Boeing and its

Global
Company
Profile
Boeing

partners achieve unprecedented levels of performance in design, manufacture, and operation.

The 787 is global not only because it has a range of 13 800 km but also because it is built all over the world—with a huge financial risk of over US \$5 billion, Boeing needed partners. The global nature of both technology and the aircraft market meant finding exceptional developers and suppliers, wherever they might be. It also meant finding firms willing to step up to the risk associated with a very expensive new product. These partners not only spread the risk but also bring commitment to the table. Countries that have a stake in the 787 are more likely to buy from Boeing than from the European competitor Airbus Industrie.

Boeing teamed with more than 20 international systems suppliers to develop technologies and design concepts for the 787. Boeing found its 787 partners in over a dozen countries; a few of them are shown in the table.



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

Boeing Corporation

Some of the International Suppliers of Boeing 787 Components

Latecoere	France	Passenger doors
Labinal	France	Wiring
Dassault	France	Design and PLM software
Messier-Bugatti	France	Electric brakes
Thales	France	Electrical power conversion system and integrated standby flight display
Messier-Dowty	France	Landing gear structure
Diehl	Germany	Interior lighting
Cobham	United Kingdom	Fuel pumps and valves
Rolls-Royce	United Kingdom	Engines
Smiths Aerospace	United Kingdom	Central computer system
BAE Systems	United Kingdom	Electronics
Alenia Aeronautica	Italy	Upper centre fuselage and horizontal stabilizer
Toray Industries	Japan	Carbon fibre for wing and tail units
Fuji Heavy Industries	Japan	Centre wing box
Kawasaki Heavy Industries	Japan	Forward fuselage, fixed sections of wing, landing gear wheel well
Teijin Seiki	Japan	Hydraulic actuators
Mitsubishi Heavy Industries	Japan	Wing box
Chengdu Aircraft Group	China	Rudder
Hafei Aviation	China	Parts
Korean Airlines	South Korea	Wingtips
Saab	Sweden	Cargo and access doors

The Japanese companies Toray, Teijin Seiki, Fuji, Kawasaki, and Mitsubishi are producing over 35% of the project, providing whole composite fuselage sections. Italy's Alenia Aeronautica is building an additional 10% of the plane.

Many North American companies—including Crane Aerospace, Fairchild Controls, Goodrich, General Dynamics, Hamilton Sundstrand, Honeywell, Moog, Parker Hannifin, Rockwell Collins, and Triumph Group—

are also suppliers. Boeing has 70% to 80% of the Dreamliner built by other companies. And even some of the portion built by Boeing is produced at Boeing facilities outside the United States, in Australia and Canada.

The Dreamliner is efficient, has a global range, and is made from components produced around the world. The result: a state-of-the-art airplane reflecting the global nature of business in the 21st century and one of the fastest-selling commercial jets in history.

STUDENT TIP

As Prof. Thomas Sewell observed, "No great civilization has developed in isolation."

Source: Thomas Sowell, *Race, Culture, and Equality*, Hoover Press, 1998.

A Global View of Operations and Supply Chains

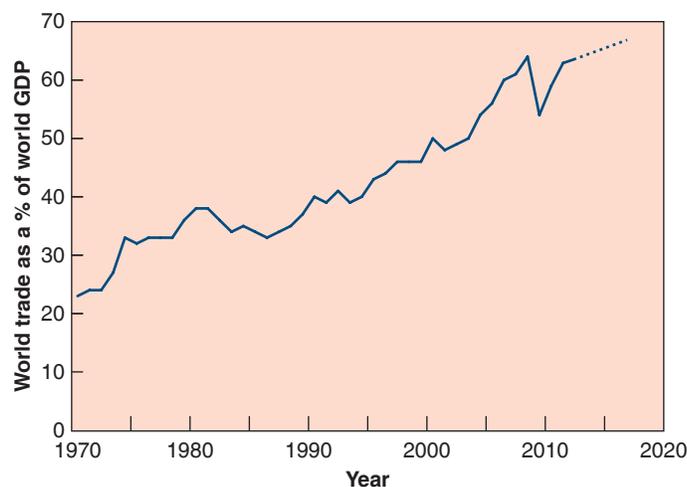
Today's operations manager must have a global view of operations strategy. Since the early 1990s, nearly 3 billion people in developing countries have overcome the cultural, religious, ethnic, and political barriers that constrain productivity and are now players on the global economic stage. As these barriers disappear, simultaneous advances are being made in technology, reliable shipping, and cheap communication. The unsurprising result is the growth of world trade (see Figure 2.1), global capital markets, and the international movement of people. This means increasing economic integration and interdependence of countries—in a word, globalization. In response, organizations are hastily extending their operations globally with innovative strategies. For instance:

- Boeing is competitive because both its sales and production are worldwide.
- Italy's Benetton moves inventory to stores around the world faster than its competition by building flexibility into design, production, and distribution.
- Sony purchases components from suppliers in Thailand, Malaysia, and elsewhere around the world for assembly in its electronic products.
- Volvo, considered a Swedish company, was recently controlled by a U.S. company (Ford) and has been subsequently acquired by Geely of China. But the current Volvo S40 is built in Belgium on a platform shared with the Mazda 3 (built in Japan) and the Ford Focus (built in Europe.)

Globalization means that domestic production and exporting may no longer be a viable business model; local production and exporting no longer guarantee success or even survival. There are new standards of global competitiveness that impact quality, variety, customization, convenience, timeliness, and cost. The globalization of strategy contributes efficiency and adds value to products and services, but it also complicates the operations manager's job. Complexity, risk, and competition are intensified; companies must carefully account for them.

FIGURE 2.1
Growth of World Trade as a Percent of World GDP

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



OM in Action**Cartoon Production at Home in Manila**

Fred Flintstone is not from Bedrock. He is actually from Manila, capital of the Philippines. So are Tom and Jerry, Aladdin, and Donald Duck. More than 90% of North American television cartoons are produced in Asia and India, with the Philippines leading the way. With their competitive advantage of English as an official language and a strong familiarity with North American culture, animation companies in Manila now employ more than 1700 people. Filipinos understand Western culture, and “You need to have a group of artists that can understand the humour that goes with it,” says Bill Dennis, a Hanna-Barbera executive.

Major studios like Disney, Marvel, Warner Brothers, and Hanna-Barbera send *storyboards*—cartoon action outlines—and voice tracks to the Philippines. Artists there draw, paint, and film about 20 000 sketches for a 30-minute episode. The cost of \$130 000 to produce an episode in the Philippines compares with \$160 000 in Korea and \$500 000 in the United States.

Sources: *Journal of Global Information Technology Management* (2007): 1–6; *The New York Times* (February 26, 2004): A29; and *The Wall Street Journal* (August 9, 2005): D8.

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

1. Reduce costs (labour, taxes, tariffs, etc.).
2. Improve the supply chain.
3. Provide better goods and services.
4. Understand markets.
5. Learn to improve operations.
6. Attract and retain global talent.

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

REDUCE COSTS

Many international operations seek to take advantage of the tangible opportunities to reduce their costs. Foreign locations with lower wages can help lower both direct and indirect costs. (See the *OM in Action* box “Cartoon Production at Home in Manila.”) Less stringent government regulations on a wide variety of operations practices (e.g., environmental control, health and safety, etc.) reduce costs. Opportunities to cut the cost of taxes and tariffs also encourage foreign operations. In Mexico, the creation of **maquiladoras** (free-trade zones) allows manufacturers to cut their costs of taxation by paying only on the value added by Mexican workers. If a Canadian manufacturer brings a \$500 machine to a maquiladora operation for assembly work costing \$25, tariff duties will be charged only on the \$25 of work performed in Mexico.

Shifting low-skilled jobs to another country has several potential advantages. First, and most obviously, the firm may reduce costs. Second, moving the lower-skilled jobs to a lower-cost location frees higher-cost workers for more valuable tasks. Third, reducing wage costs allows the savings to be invested in improved products and facilities (and the retraining of existing workers, if necessary) at the home location. The impact of this approach is shown in the *OM in Action* box, “Going Global to Compete”.

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

Another trading group is the **European Union (EU)**.¹ The European Union has reduced trade barriers among the participating European nations through standardization and a common

Maquiladoras

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

World Trade Organization (WTO)

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

United States, Mexico, Canada Agreement (USMCA)

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

European Union (EU)

A European trade group that has 28 member states as of 2015.

¹ The 28 members of the European Union (EU) as of 2015 were Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom. Not all have adopted the euro. In addition, Albania, Montenegro, Serbia, Macedonia, and Turkey are candidates for entry into the EU.

OM in Action Going Global to Compete

Headquartered in Montreal and founded in 1880, Bell Canada is one of Canada's prominent players in wireless telecommunications, controlling about 30% of the domestic market. Approximately 50% of Bell Canada's revenue stems from its wireless initiatives. It is active in contracting suitable vendors as part of outsourcing key voice-based projects for its satellite TV, Bell Mobility, Solo Mobility, and internet divisions. Bell Canada intends to outsource these particular projects via fixed payouts as part of a deal worth roughly between \$25 million and \$30 million per year. India is the beneficiary of these outsourced contracts, and the projects include inbound customer contact. Bell remains watchful for outsourcing partners with strong competencies in managing this type of front-end work.

In a similar fashion, the Canadian Bar Association reported through its in-house magazine about the "commoditization" of legal services, and noted a trend toward outsourcing certain aspects of legal work. Although the concept is fairly new to Canadian lawyers, firms that do engage in it suggest they provide hourly savings of up to 75%.

Resourceful organizations, such as Bell Canada and these law firms, use a global perspective to become more efficient, which allows them to develop new products, retrain employees, and invest in new plant and equipment.

Sources: *Ottawa Citizen* (2006); and www.bell.ca.

currency, the euro. However, this major Canadian trading partner, with 503 million people, is also placing some of the world's most restrictive conditions on products sold in the EU. Everything from recycling standards to automobile bumpers to hormone-free farm products must meet EU standards, complicating international trade.

IMPROVE THE SUPPLY CHAIN

The supply chain can often be improved by locating facilities in countries where unique resources are available. These resources may be expertise, labour, or raw material. For example, a trend is evident in which precious metals companies are relocating to the mining regions of northern Ontario. Auto-styling studios from throughout the world are migrating to the auto Mecca of southern California to ensure the necessary expertise in contemporary auto design. Similarly, world athletic shoe production has migrated from South Korea to Guangzhou, China: this location takes advantage of the low-cost labour and production competence in a city where 40 000 people work making athletic shoes for the world. And a perfume essence manufacturer wants a presence in Grasse, France, where much of the world's perfume essences are prepared from the flowers of the Mediterranean.

PROVIDE BETTER GOODS AND SERVICES

Although the characteristics of goods and services can be objective and measurable (e.g., number of on-time deliveries), they can also be subjective and less measurable (e.g., sensitivity to culture). We need an ever better understanding of differences in culture and of the way business is handled in different countries. Improved understanding as the result of a local presence permits firms to customize products and services to meet unique cultural needs in foreign markets.

Another reason to have international operations is to reduce response time to meet customers' changing product and service requirements. Customers who purchase goods and services from Canadian firms are increasingly located in foreign countries. Providing them with quick and adequate service is often improved by locating facilities in their home countries.

UNDERSTAND MARKETS

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

Another reason to go into foreign markets is the opportunity to expand the *life cycle* (i.e., stages a product goes through; see Chapter 5) of an existing product. While some products in



Minerva Studio/Fotolia



Alvey & Towers Picture Library/Alamy Stock Photo

A worldwide strategy places added burdens on operations management. Because of regional differences, designers and manufacturers must adapt their products to suit their various markets. A common example of the market differences involves automobiles and the need to place the driver on either the right or the left due to the local roadways and infrastructure.

Canada are in a “mature” stage of their product life cycle, they may represent state-of-the-art products in less-developed countries. For example, the market for personal computers could be characterized as “mature” in Canada but as in the “introductory” stage in many developing countries, such as Vietnam and Myanmar (Burma).

LEARN TO IMPROVE OPERATIONS

Learning does not take place in isolation. Firms serve themselves and their customers well when they remain open to the free flow of ideas. For example, General Motors found that it could improve operations by jointly building and running, with the Japanese, an auto assembly plant in San Jose, California. This strategy allowed GM to contribute its capital and knowledge of North American labour and environmental laws while the Japanese contributed production and inventory ideas. Similarly, operations managers have improved equipment and layout by learning from the ergonomic competence of the Scandinavians.

ATTRACT AND RETAIN GLOBAL TALENT

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

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

Cultural and Ethical Issues

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

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

STUDENT TIP

As the owner of a Guatemala plant said, “The ethics of the world markets is very clear: Manufacturers will move wherever it is cheapest or most convenient to their interests.”

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

STUDENT TIP

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

Developing Missions and Strategies

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

LO1 Define mission and strategy

Mission

The purpose or rationale for an organization's existence.

MISSION

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

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

Strategy

How an organization expects to achieve its missions and goals.

VIDEO 2.1

Operations Strategy at Regal Marine

STRATEGY

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

Firms achieve missions in three conceptual ways: (1) differentiation, (2) cost leadership, and (3) response. This means operations managers are called on to deliver goods and services that are (1) *better*, or at least different, (2) *cheaper*, and (3) more *responsive*. Operations managers translate these *strategic concepts* into tangible tasks to be accomplished. Any one or combination of

LO2 Identify and explain three strategic approaches to competitive advantage

FIGURE 2.2
Mission Statements for Three Organizations

Royal Canadian Mounted Police
The RCMP is Canada's national police service. Proud of our traditions and confident in meeting future challenges, we commit to preserve the peace, uphold the law and provide quality service in partnership with our communities. <small>Source: Mission Statement for Royal Canadian Mounted Police. Reprinted with permission.</small>
Hard Rock Cafe
Our Mission: To spread the spirit of rock 'n roll by creating authentic experiences that rock. <small>Source: Mission Statement for Hard Rock Café, Hard Rock Café International (USA), Inc. Reprinted with permission.</small>
Arnold Palmer Hospital
Arnold Palmer Hospital for Children provides state of the art, family-centered healthcare focused on restoring the joy of childhood in an environment of compassion, healing and hope. <small>Source: Mission Statement from Arnold Palmer Hospital for Children. Copyright © by Orlando Health. Reprinted with permission.</small>

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

FIGURE 2.3
Sample Missions for a Company, the Operations Function, and Major OM Departments

these three strategic concepts can generate a system that has a unique advantage over competitors. For example, Hunter Fan has differentiated itself as a premier maker of quality ceiling fans that lower heating and cooling costs for its customers. Nucor Steel, on the other hand, satisfies customers by being the lowest-cost steel producer in the world. And Dell achieves rapid response by building personal computers with each customer's requested software in a matter of hours.

Clearly, strategies differ. And each strategy puts different demands on operations management. Hunter Fan's strategy is one of *differentiating* itself via quality from others in the industry. Nucor focuses on value at *low cost*, and Dell's dominant strategy is quick, reliable *response*.

Achieving Competitive Advantage Through Operations

Each of the three strategies provides an opportunity for operations managers to achieve competitive advantage. **Competitive advantage** implies the creation of a system that has a unique advantage over competitors. The idea is to create customer value in an efficient and sustainable

Competitive advantage

The creation of a unique advantage over competitors.

STUDENT TIP

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

way. Pure forms of these strategies may exist, but operations managers will more likely be called on to implement some combination of them. Let us briefly look at how managers achieve competitive advantage via *differentiation*, *low cost*, and *response*.

COMPETING ON DIFFERENTIATION

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

Differentiation is concerned with providing *uniqueness*. A firm’s opportunities for creating uniqueness are not located within a particular function or activity but can arise in virtually everything the firm does. Moreover, because most products include some service, and most services include some product, the opportunities for creating this uniqueness are limited only by imagination. Indeed, **differentiation** should be thought of as going beyond both physical characteristics and service attributes to encompass everything about the product or service that influences the value that the customers derive from it. Therefore, effective operations managers assist in defining everything about a product or service that will influence the potential value to the customer. This may be the convenience of a broad product line, product features, or a service related to the product. Such services can manifest themselves through convenience (location of distribution centres, stores, or branches), training, product delivery and installation, or repair and maintenance services.

In the service sector, one option for extending product differentiation is through an *experience*. Differentiation by experience in services is a manifestation of the growing “experience economy”. The idea of **experience differentiation** is to engage the customer—to use people’s five senses so they become immersed, or even an active participant, in the product. Disney does this with the Magic Kingdom. People no longer just go on a ride; they are immersed in the Magic Kingdom—surrounded by a dynamic visual and sound experience that complements the physical ride. Some rides further engage the customer by having them steer the ride or shoot targets or villains.

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

COMPETING ON COST

Porter Airlines has been a consistent success while other North American airlines have lost billions of dollars. Porter has done this by fulfilling a need for low-cost and short-hop flights. Its operations strategy has included use of secondary airports and terminals, few fare options, smaller crews, and no expensive ticket offices.

Additionally, and less obviously, Porter has very effectively matched capacity to demand and effectively utilized this capacity. It has done this by designing a route structure that matches the capacity of its Bombardier Q400, the only plane in its fleet. Second, it achieves more air miles than other airlines through faster turnarounds—its planes are on the ground less.

One driver of a low-cost strategy is a facility that is effectively utilized. Porter and others with low-cost strategies understand this and utilize resources effectively. Identifying the optimum size (and investment) allows firms to spread overhead costs, providing a cost advantage. For instance, Walmart continues to pursue its low-cost strategy with superstores that are open 24 hours a day. For more than 50 years, it has successfully grabbed market share. Walmart has driven down store overhead costs, shrinkage, and distribution costs. Its rapid transportation of goods, reduced warehousing costs, and direct shipment from manufacturers have resulted in high inventory turnover and made it a low-cost leader.

Differentiation

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

Experience differentiation

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

VIDEO 2.2
Hard Rock’s Global Strategy

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

Low-cost leadership

Achieving maximum value, as perceived by the customer.

COMPETING ON RESPONSE

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

Response

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

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

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

The second aspect of response is the *reliability* of scheduling. One way the German machine industry has maintained its competitiveness despite having the world's highest labour costs is through reliable response. This response manifests itself in reliable scheduling. German machine firms have meaningful schedules—and they perform to these schedules. Moreover, the results of these schedules are communicated to the customer, and the customer can, in turn, rely on them. Consequently, the competitive advantage generated through reliable response has value to the end customer. This is also true for organizations such as grocerygateway.com, where reliability in scheduling and adhering to these schedules is an expectation of customers.

The third aspect of response is *quickness*. Whether it is a production system at a Toyota plant, a pizza delivered in five minutes by Pizza Hut, or customized phone products delivered in three days from Motorola, the operations manager who develops systems that respond quickly can have a competitive advantage.

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



Whether it is because of a busy lifestyle or other reasons, customers can shop at home for groceries by placing an order with grocerygateway.com and arranging for a delivery time within a 90-minute window. Reliability is vital for this type of service.

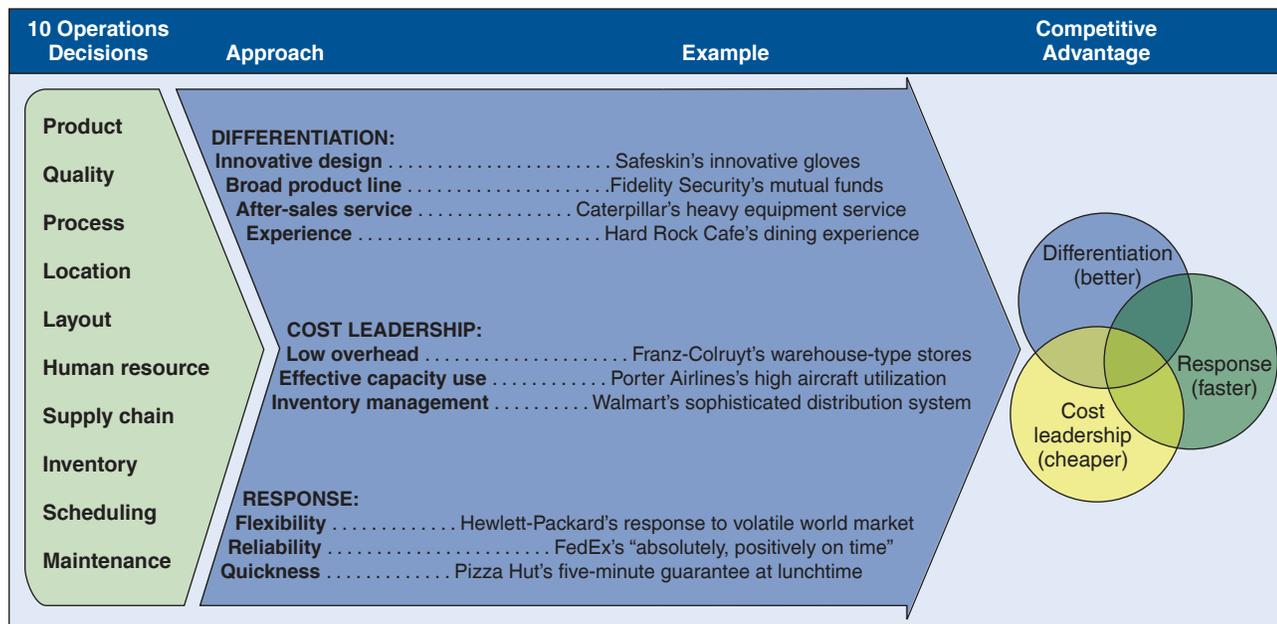


FIGURE 2.4 Achieving Competitive Advantage Through Operations

STUDENT TIP

This text is structured around these 10 decisions.

Operations decisions

The strategic decisions of OM are goods and service design, quality, process and capacity design, location selection, layout design, human resources and job design, supply chain management, inventory, scheduling, and maintenance.

STUDENT TIP

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

LO3 Identify and define the 10 decisions of operations management

10 Strategic OM Decisions

Differentiation, low cost, and response can be achieved when managers make effective decisions in 10 areas of OM. These are collectively known as **operations decisions**. The 10 decisions of OM that support missions and implement strategies are:

1. *Goods and service design:* Designing goods and services defines much of the transformation process. Costs, quality, and human resource decisions are often determined by design decisions. Designs usually determine the lower limits of cost and the upper limits of quality.
2. *Quality:* The customer's quality expectations must be determined and policies and procedures established to identify and achieve that quality.
3. *Process and capacity design:* Process options are available for products and services. Process decisions commit management to specific technology, quality, human resource use, and maintenance. These expenses and capital commitments determine much of the firm's basic cost structure.
4. *Location selection:* Facility location decisions for both manufacturing and service organizations may determine the firm's ultimate success. Errors made at this juncture may overwhelm other efficiencies.
5. *Layout design:* Material flows, capacity needs, personnel levels, technology decisions, and inventory requirements influence layout.
6. *Human resources and job design:* People are an integral and expensive part of the total system design. Therefore, the quality of work life provided, the talent and skills required, and their costs must be determined.
7. *Supply chain management:* These decisions determine what is to be made and what is to be purchased. Consideration is also given to quality, delivery, and innovation, all at a satisfactory price. Mutual trust between buyer and supplier is necessary for effective purchasing.
8. *Inventory:* Inventory decisions can be optimized only when customer satisfaction, suppliers, production schedules, and human resource planning are considered.
9. *Scheduling:* Feasible and efficient schedules of production must be developed; the demands on human resources and facilities must be determined and controlled.
10. *Maintenance:* Decisions must be made regarding desired levels of reliability and stability, and systems must be established to maintain that reliability and stability.

Table 2.1**The Differences Between Goods and Services Influence How the 10 Operations Management Decisions Are Applied**

Operations Decisions	Goods	Services
Goods and services design	Product is usually tangible (a computer).	Product is not tangible. A new range of product attributes (a smile).
Quality	Many objective quality standards (battery life).	Many subjective quality standards (nice colour).
Process and capacity design	Customer is not involved in most of the process (auto assembly).	Customer may be directly involved in the process (a haircut). Capacity must match demand to avoid lost sales (customers often avoid waiting).
Location selection	May need to be near raw materials or labour force (steel plant near ore).	May need to be near customer (car rental).
Layout design	Layout can enhance production efficiency (assembly line).	Can enhance product as well as production (layout of a classroom or a fine-dining restaurant).
Human resources and job design	Workforce focused on technical skills (stonemason). Labour standards can be consistent (assembly line employee). Output-based wage system possible (garment sewing).	Direct workforce usually needs to be able to interact well with customer (bank teller); labour standards vary depending on customer requirements (legal cases).
Supply chain management	Supply chain relationships critical to final product.	Supply chain relationships important but may not be critical.
Inventory	Raw materials, work-in-process, and finished goods may be inventoried (beer).	Most services cannot be stored; so other ways must be found to accommodate fluctuations in demand (can't store haircuts, but even the hair salon has an inventory of supplies).
Scheduling	Ability to inventory may allow levelling of production rates (lawn mowers).	Often concerned with meeting the customer's immediate schedule with human resources.
Maintenance	Maintenance is often preventive and takes place at the production site.	Maintenance is often "repair" and takes place at the customer's site.

STUDENT TIP

The production of both goods and services requires execution of the 10 OM decisions.

Operations managers implement these 10 decisions by identifying key tasks and the staffing needed to achieve them. However, the implementation of decisions is influenced by a variety of issues, including a product's proportion of goods and services (see Table 2.1). Few products are either all goods or all services. Although the 10 decisions remain the same for both goods and services, their relative importance and method of implementation depend on this ratio of goods and services. Throughout this text, we discuss how strategy is selected and implemented for both goods and services through these 10 operations management decisions.

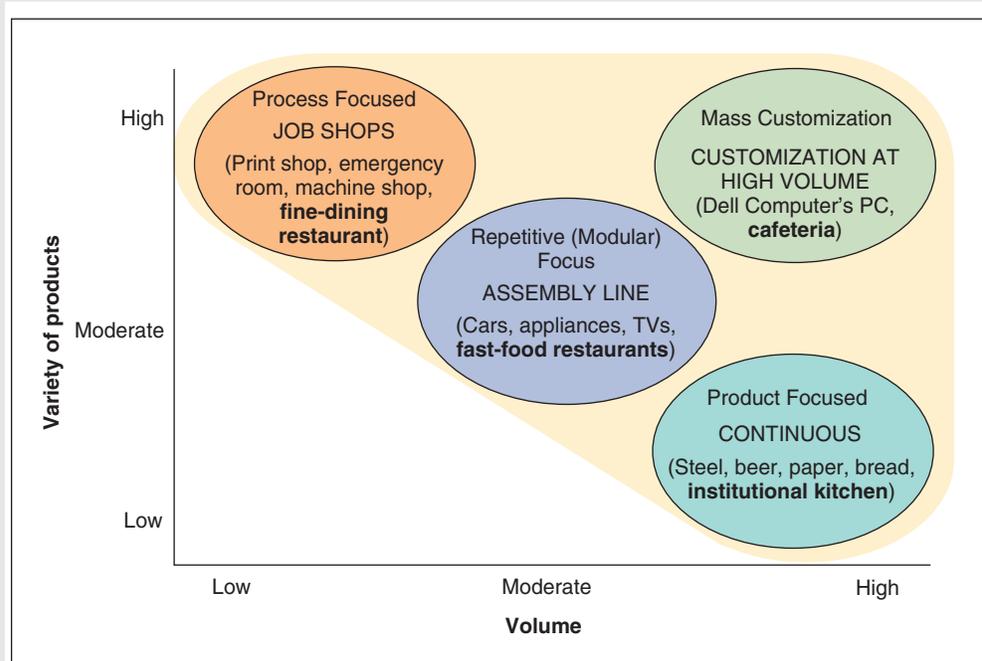
Let's look at an example of strategy development through one of the 10 decisions.

Pierre Alexander has just completed culinary school and is ready to open his own restaurant. After examining both the external environment and his prospective strengths and weaknesses, he makes a decision on the mission for his restaurant, which he defines as, "To provide outstanding French fine dining for the people of Calgary."

APPROACH ► Alexander's supporting operations strategy is to ignore the options of *cost leadership* and *quick response* and focus on *differentiation*. Consequently, his operations strategy requires him to evaluate product designs (menus and meals) and selection of process, layout, and location. He must also evaluate the human resources, suppliers, inventory, scheduling, and maintenance that will support his mission as well as a differentiation strategy.

EXAMPLE 1**Strategy Development**

SOLUTION ► Examining just one of these 10 decisions, *process design*, requires that Alexander consider the issues presented in the following figure.



The first option is to operate in the lower right corner of the figure above, where he could produce high volumes of food with a limited variety, much as in an institutional kitchen. Such a process could produce large volumes of standard items such as baked goods and mashed potatoes prepared with state-of-the-art automated equipment. Alexander concludes that this is not an acceptable process option.

Alternatively, he can move to the middle of the figure, where he could produce more variety and lower volumes. Here, he would have less automation and use prepared modular components for meals, much as a fast-food restaurant does. Again, he deems such process designs inappropriate for his mission.

Another option is to move to the upper right corner and produce a high volume of customized meals, but neither Alexander nor anyone else knows how to do this with gourmet meals.

Finally, Alexander can design a process that operates in the upper left corner of the figure, which requires little automation but lends itself to high variety. This process option suggests that he build an extremely flexible kitchen suitable for a wide variety of custom meals catering to the whims of each customer. With little automation, such a process would be suitable for a huge variety. This process strategy will support his mission and desired product differentiation. Only with a process such as this can he provide the fine French-style gourmet dining that he has in mind.

INSIGHT ► By considering the options inherent in each of the 10 OM decisions, managers—Alexander, in this case—can make decisions that support the mission.

LEARNING EXERCISE ► If Alexander's mission were to offer less expensive meals and reduce the variety offered but still do so with a French flair, what might his process strategy be? [Answer: Alexander might try a repetitive (modular) strategy and mimic the La Madeleine cafeteria-style restaurants. The La Madeleine chain has more than 60 locations and would be a good model for Alexander to mirror. It has the approach, atmosphere, style, and menu he is seeking.]

STUDENT TIP

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

The 10 decisions of operations management are implemented in ways that provide competitive advantage, not just for fine-dining restaurants, but for all the goods and services that enrich our lives. How this might be done for two drug companies—one seeking a competitive advantage via differentiation, and the other via low cost—is shown in Table 2.2.

Table 2.2
Operations Strategies of Two Drug Companies

	Brand Name Drugs, Inc.	Generic Drug Corp.
Competitive Advantage	Product Differentiation	Low Cost
Product Selection and Design	Heavy R&D investment; extensive labs; focus on development in a broad range of drug categories	Low R&D investment; focus on development of generic drugs
Quality	Quality is major priority; standards exceed regulatory requirements	Meets regulatory requirements on a country-by-country basis, as necessary
Process	Product and modular production process; tries to have long product runs in specialized facilities; builds capacity ahead of demand	Process focused; general production processes; “job shop” approach, short-run production; focus on high utilization
Location	Still located in city where it was founded	Recently moved to low-tax, low-labour-cost environment
Layout	Layout supports automated product-focused production	Layout supports process-focused “job shop” practices
Human Resources	Hire the best; nationwide searches	Very experienced top executives provide direction; other personnel paid below industry average
Supply Chain	Long-term supplier relationships	Tends to purchase competitively to find bargains
Inventory	Maintains high finished goods inventory primarily to ensure all demands are met	Process focus drives up work-in-process inventory; finished goods inventory tends to be low
Scheduling	Centralized production planning	Many short-run products complicate scheduling
Maintenance	Highly trained staff; extensive parts inventory	Highly trained staff to meet changing demands

Issues in Operations Strategy

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

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

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

In this chapter’s *Global Company Profile*, Boeing provides an example of how strategy must change as technology and the environment change. Boeing can now build planes from carbon fibre, using a global supply chain. Like many other OM strategies, Boeing’s strategy has changed with technology and globalization. Microsoft has also had to adapt quickly to a changing

STUDENT TIP

An effective strategy finds the optimum fit for the firm’s resources in the dynamic environment.

Resources view

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

Value chain analysis

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

Five forces model

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

² M. E. Porter, *Competitive Advantage: Creating and Sustaining Superior Performance*. New York, NY: The Free Press, 1985.

³ Michael E. Porter, *Competitive Strategy: Techniques for Analyzing Industries and Competitors*. New York, NY: The Free Press, 1980, 1998.

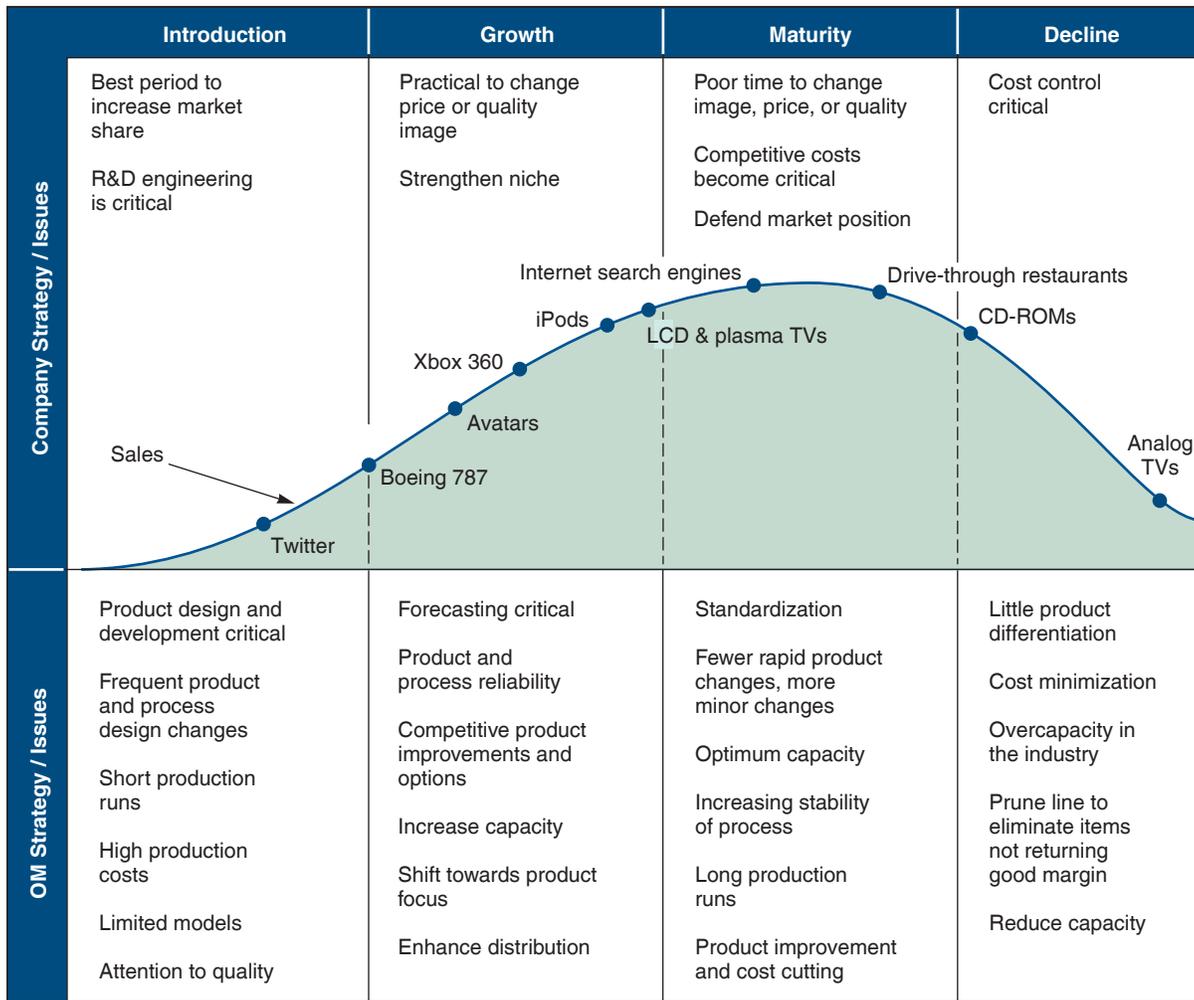


FIGURE 2.5 Strategy and Issues During a Product’s Life

environment. Faster processors, new computer languages, changing customer preferences, increased security issues, the internet, the cloud, and Google have all driven changes at Microsoft. These forces have moved Microsoft’s product strategy from operating systems to office products, to internet service provider, and now to integrator of computers, cell phones, games, and television via the cloud.

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

STUDENT TIP

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

SWOT analysis

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

Strategy Development and Implementation

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

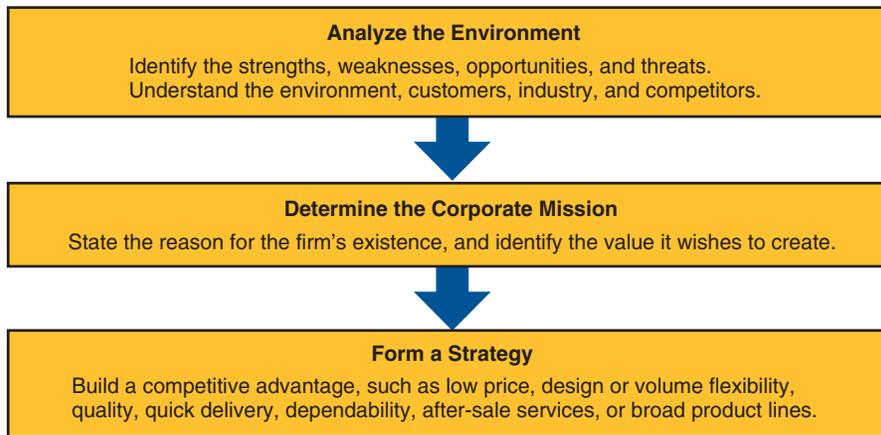


FIGURE 2.6
Strategy Development Process

KEY SUCCESS FACTORS AND CORE COMPETENCIES

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

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

Only by identifying and strengthening key success factors and core competencies can an organization achieve sustainable competitive advantage.

In this text-book, we focus on the 10 OM decisions that typically include the KSFs. Potential KSFs for marketing, finance, and operations are shown in Figure 2.7. The 10 OM decisions we develop in this text provide an excellent initial checklist for determining KSFs and identifying core competencies within the operations function. For instance, the 10 decisions, related KSFs, and core

LO4 Understand the significance of key success factors and core competencies

Key success factors (KSFs)

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

Core competencies

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

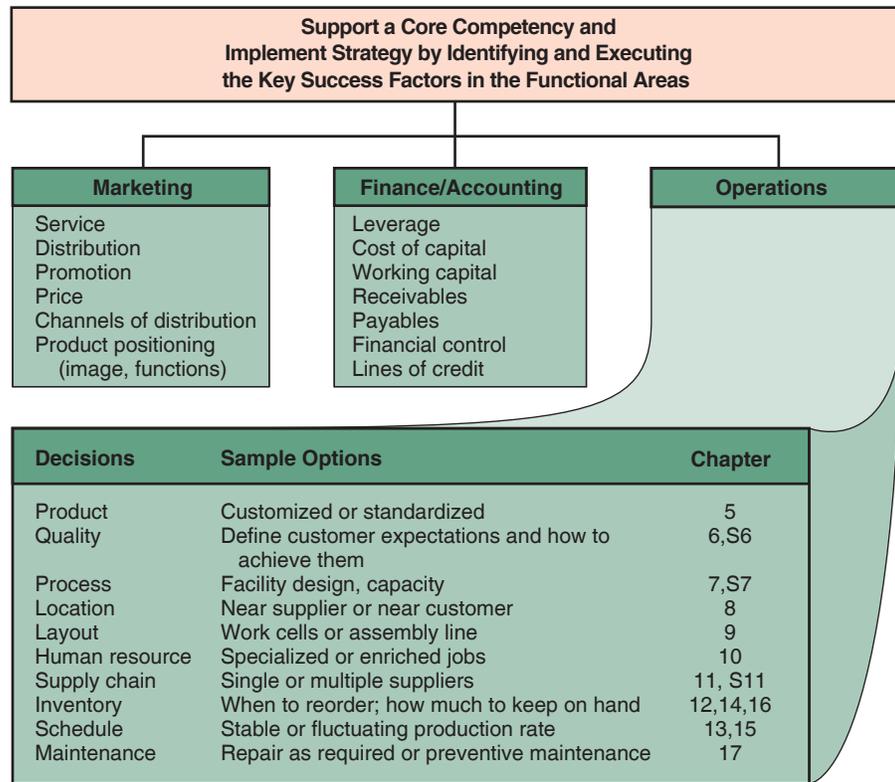


All images: American Honda Motor Co., Inc.

Julie Lucht/
Shutterstock

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

FIGURE 2.7
 Implement Strategy by Identifying and Executing Key Success Factors That Support Core Competencies



competencies can allow a firm to differentiate its product or service. That differentiation may be via a core competency of innovation and new products, where the KSFs are product design and speed to market, as is the case for 3M and Rubbermaid. Similarly, differentiation may be via quality, where the core competency is institutionalizing quality, as at Toyota. Differentiation may also be via maintenance, where the KSFs are product reliability and after-sale service, as is the case at IBM and Canon.

Whatever the KSFs and core competencies, they must be supported by the related activities. One approach to identifying the activities is an **activity map**, which links competitive advantage, KSFs, and supporting activities. For example, Figure 2.8 shows how Porter Airlines, whose core competency is operations, built a set of integrated activities to support its low-cost competitive advantage. Notice how the KSFs support operations and in turn are supported by other activities. The activities fit together and reinforce each other. And the better they fit and reinforce each other, the more sustainable the competitive advantage. By focusing on enhancing its core competency and KSFs with a supporting set of activities, Porter Airlines has become one of the great airline success stories.

Activity map

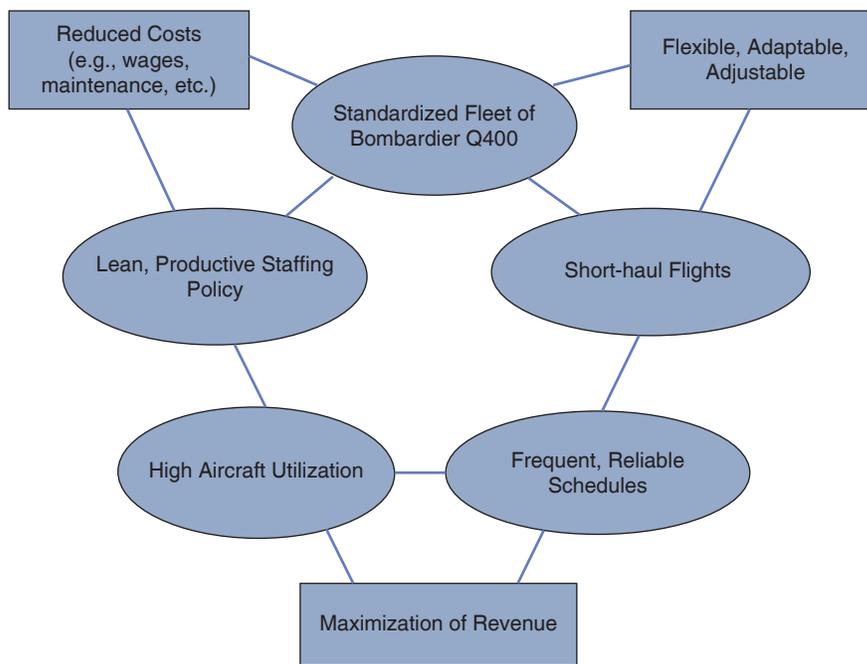
A graphical link of competitive advantage, KSFs, and supporting activities.

BUILD AND STAFF THE ORGANIZATION

The operations manager’s job is a three-step process. Once a strategy and key success factors have been identified, the second step is to group the necessary activities into an organizational structure. The third step is to staff it with personnel who will get the job done. The manager works with subordinate managers to build plans, budgets, and programs that will successfully implement strategies that achieve missions. Firms tackle this organization of the operations function in a variety of ways. The organization charts shown in Chapter 1 (Figure 1.1) indicate the way some firms have organized to perform the required activities.

INTEGRATE OM WITH OTHER ACTIVITIES

The organization of the operations function and its relationship to other parts of the organization vary with the OM mission. Moreover, the operations function is most likely to be successful when the operations strategy is integrated with other functional areas of the firm, such as marketing, finance, information technology, and human resources. In this way, all of the areas support the company’s objectives. For example, short-term scheduling in the airline industry is dominated by volatile customer travel patterns. Day-of-week preference, holidays, seasonality, school schedules, and so on all play a role in changing flight schedules. Consequently, airline

**FIGURE 2.8****Activity Mapping of Porter Airlines's Low-Cost Competitive Advantage**

To achieve a low-cost competitive advantage, Porter Airlines addresses a number of key success factors. As the figure illustrates, a low-cost advantage is highly dependent on a very well-run operations function.

scheduling, although an OM activity, can be a part of marketing. Effective scheduling in the trucking industry is reflected in the amount of time trucks travel loaded. However, scheduling of trucks requires information from delivery and pickup points, drivers, and other parts of the organization. When the OM function results in effective scheduling in the air passenger and commercial trucking industries, a competitive advantage can exist.

The operations manager transforms inputs into outputs. The transformations may be in terms of storage, transportation, manufacturing, dissemination of information, and utility of the product or service. *The operations manager's job is to implement an OM strategy, provide competitive advantage, and increase productivity.*

Strategic Planning, Core Competencies, and Outsourcing

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

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

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

Outsourcing manufacturing is an extension of the long-standing practice of *subcontracting* production activities, which when done on a continuing basis is known as *contract manufacturing*. Contract manufacturing is becoming standard practice in many industries, from computers to automobiles. For instance, Johnson & Johnson, like many other big drug companies whose core competency is research and development, often farms out manufacturing to contractors. On the other hand, Sony's core competency is electromechanical design of chips. This is its core competency, but Sony is also one of the best in the world when it comes to rapid response and specialized production of these

Outsourcing

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



Keith Dammiller/Alamy Stock Photo

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

chips. Therefore, Sony finds that it wants to be its own *manufacturer*, while specialized providers come up with major innovations in such areas as software, human resources, and distribution. These areas are the providers' business, not Sony's, and the provider may very well be better at it than Sony.

Other examples of outsourcing noncore activities include:

- DuPont's legal services routed to the Philippines
- IBM's handing of travel services and payroll and Hewlett-Packard's provision of IT services to P&G
- Production of the Audi A4 convertible and Mercedes CLK convertible by Wilhelm Karmann in Osnabruck, Germany
- Blue Cross sending hip resurfacing surgery patients to India

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

THE THEORY OF COMPARATIVE ADVANTAGE

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

RISKS OF OUTSOURCING

Risk management starts with a realistic analysis of uncertainty and results in a strategy that minimizes the impact of these uncertainties. Indeed, outsourcing *is* risky, with roughly half of all outsourcing agreements failing because of inadequate planning and analysis. Timely delivery and quality standards can be major problems, as can underestimating increases in inventory and logistics costs. Some potential advantages and disadvantages of outsourcing are shown in Table 2.3. A survey of North American companies found that, as a group, those that outsourced customer service saw a drop in their score on the American Consumer Satisfaction Index. The declines were roughly the same whether companies outsourced domestically or overseas.⁴

Theory of comparative advantage

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

STUDENT TIP

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

⁴ J. Whitaker, M. S. Krishnan, and C. Fornell. "How Offshore Outsourcing Affects Customer Satisfaction." The Wall Street Journal (July 7, 2008): R4.

Table 2.3
Potential Advantages and Disadvantages of Outsourcing

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

However, when outsourcing is overseas, additional issues must be considered. These issues include financial attractiveness, people skills and availability, and the general business environment. Another risk of outsourcing overseas is the political backlash that results from moving jobs to foreign countries. The perceived loss of jobs has fuelled anti-outsourcing rhetoric. This rhetoric is contributing to a process known as *reshoring*, the return of business activity to the originating country. (See the *OM in Action* box “Reshoring to Smaller Towns in North America”.)

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

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

RATING OUTSOURCE PROVIDERS

Research indicates that the most common reason for the failure of outsourcing agreements is that the decisions are made without sufficient analysis. The *factor rating method* provides an objective way to evaluate outsource providers. We assign points for each factor to each provider and then importance weights to each of the factors. We now apply the technique in Example 2 to compare outsourcing providers being considered by a firm.

OM in Action

Reshoring to Smaller Towns in North America

North American companies continue their global search for efficiency by outsourcing call centres and back-office operations, but many find they need to look no farther than a place like Dubuque, Iowa.

To North American firms facing quality problems with their outsourcing operations overseas and bad publicity at home, small-town America is emerging as a pleasant alternative. Dubuque (population 57,313), Nacogdoches, Texas (population 29,914), or Twin Falls, Idaho (population 34,469), may be the perfect call centre location. Even though the pay is low, the jobs are some of the best available to small-town residents.

By moving out of big cities to the cheaper labour and real estate of small towns, companies can save millions and still increase productivity. A call centre in a town that just lost its major manufacturing plant finds the jobs easy to fill.

IBM, which has been criticized in the past for moving jobs to India and other offshore locations, picked Dubuque for its new remote computer-services centre with 1300 jobs.

Taking advantage of even cheaper wages in other countries will not stop soon, though. Is India the unstoppable

overseas call centre capital that people think it is? Not at all. Despite its population of 1.3 billion, only a small percentage of its workers have the language skills and technical education to work in Western-style industries. Already, India has been warned that if call centres can't recruit at reasonable wages, its jobs will move to the Philippines, South Africa, and Ghana. And indeed, Dell, Apple, and Britain's Powergen are reshoring from Indian call centres, claiming their costs had become too high.



Frederik Remander/Alamy Stock Photo

Sources: *Industry Week* (August 5, 2014) and *The Wall Street Journal*, (November 27, 2013).

EXAMPLE 2

Rating Provider Selection Criteria

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

APPROACH ► National's VP–Operations, Susan Cholette, has made a list of seven criteria she considers critical. After putting together a committee of four other VPs, she has rated each firm (boldface type, on a 1–5 scale, with 5 being highest) and has also placed an importance weight on each of the factors, as shown in Table 2.4.

Table 2.4
Factor Ratings Applied to National Architects's Potential IT Outsourcing Providers

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

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

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

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

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

RELATED PROBLEMS ► 2.8–2.12

EXCEL OM Data File Ch02Ex2.xlsx can be found in MyLab Operations Management.

Most North American toy companies now outsource their production to Chinese manufacturers. Cost savings are significant, but there are several downsides, including loss of control over such issues as quality. A few years ago, Mattel had to recall 10.5 million Elmos, Big Birds, and SpongeBobs. These made-in-China toys contained excessive levels of lead in their paint. More recently, quality issues have dealt with poisonous pet food, tainted milk products, and contaminated sheetrock.



Global Operations Strategy Options

STUDENT TIP

As we suggested earlier in this chapter, many operations strategies now require an international dimension. We tend to call a firm with an international dimension an international business or a multinational corporation. An **international business** is any firm that engages in international trade or investment. This is a broad category and is the opposite of a domestic, or local, firm.

A **multinational corporation (MNC)** is a firm with *extensive* international business involvement. MNCs buy resources, create goods or services, and sell goods or services in a variety of countries. The term *multinational corporation* applies to most of the world's large, well-known businesses. Bombardier is a good example of an MNC. It has a presence in 60 countries worldwide, including 76 production and engineering sites. Bombardier acquires parts and raw materials from around the world, and ships its finished products (including planes, trains, and buses) to its customers wherever they may be.

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

Firms that ignore the global economy will not survive.

International business

A firm that engages in cross-border transactions.

Multinational corporation (MNC)

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

LO5 Identify and explain four global operations strategy options

INTERNATIONAL STRATEGY

An **international strategy** uses exports and licences to penetrate the global arena. As Figure 2.9 suggests, the international strategy is the least advantageous, with little local responsiveness and little cost advantage. There is little responsiveness because we are exporting or licensing goods from the home country. And the cost advantages may be few because we are using the existing production process at some distance from the new market. However, an international strategy is

International strategy

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

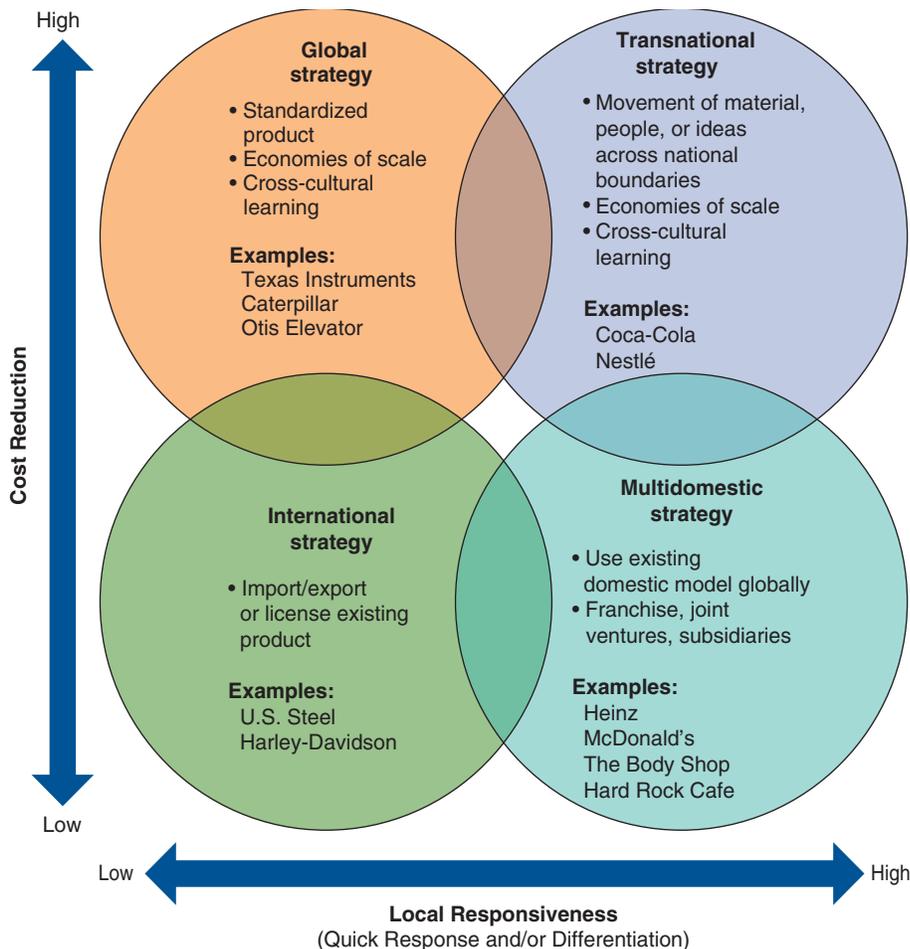


FIGURE 2.9 Four International Operations Strategies

Source: Based on M. Hitt, R. D. Ireland, and R. E. Hoskisson, *Strategic Management, Competitiveness and Globalization*, 7th ed. (Cincinnati: Southwestern College Publishing, 2009).

often the easiest, as exports can require little change in existing operations, and licensing agreements often leave much of the risk to the licensee.

MULTIDOMESTIC STRATEGY

Multidomestic strategy

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

The **multidomestic strategy** has decentralized authority with substantial autonomy at each business. Organizationally, these are typically subsidiaries, franchises, or joint ventures with substantial independence. The advantage of this strategy is maximizing a competitive response for the local market; however, the strategy has little or no cost advantage. Many food producers, such as Heinz, use a multidomestic strategy to accommodate local tastes because global integration of the production process is not critical. The concept is one of “We were successful in the home market; let’s export the management talent and processes, not necessarily the product, to accommodate another market.” McDonald’s is operating primarily as a multidomestic, which gives it the local responsiveness needed to modify its menu country by country. McDonald’s can then serve beer in Germany, wine in France, McHuevo (poached egg hamburger) in Uruguay, and hamburgers without beef in India. With over 2000 restaurants in Japan and a presence for more than a generation, McDonald’s is thought to have been invented in Japan, according to the average Japanese family. Interestingly, McDonald’s prefers to call itself *multilocal*.⁵

GLOBAL STRATEGY

Global strategy

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

A **global strategy** has a high degree of centralization, with headquarters coordinating the organization to seek out standardization and learning between plants, thus generating economies of scale. This strategy is appropriate when the strategic focus is cost reduction but has little to recommend it when the demand for local responsiveness is high. Caterpillar, the world leader in earth moving equipment, and Texas Instruments, a world leader in semiconductors, pursue global strategies. Caterpillar and Texas Instruments find this strategy advantageous because the end products are similar throughout the world. Earth moving equipment is the same in Nigeria as in Prince Edward Island, which allows Caterpillar to have individual factories focus on a limited line of products to be shipped worldwide. This results in economies of scale and learning within each facility. A global strategy also allows Texas Instruments to build optimum-size plants with similar processes and to then maximize learning by aggressive communication between plants. The result is an effective cost reduction advantage for Texas Instruments.

TRANSNATIONAL STRATEGY

Transnational strategy

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

A **transnational strategy** exploits the economies of scale and learning, as well as pressure for responsiveness, by recognizing that core competence does not reside in just the “home” country but can exist anywhere in the organization. *Transnational* describes a condition in which material, people, and ideas cross—or *transgress*—national boundaries. These firms have the potential to pursue all three operations strategies (i.e., differentiation, low cost, and response). Such firms can be thought of as “world companies” whose country identity is not as important as its interdependent network of worldwide operations. Key activities in a transnational company are neither centralized in the parent company nor decentralized so that each subsidiary can carry out its own tasks on a local basis. Instead, the resources and activities are dispersed, but specialized, so as to be both efficient and flexible in an interdependent network. Nestlé is a good example of such a company. Although it is legally Swiss, 95% of its assets are held and 98% of its sales are made outside Switzerland. Fewer than 10% of its workers are Swiss. Similarly, service firms such as Asea Brown Boveri (an engineering firm that is Swedish but headquartered in Switzerland), Reuters (a news agency), Bertelsmann (a publisher), and Citicorp (a banking corporation) can be viewed as transnationals. We can expect the national identities of these transnationals to continue to fade.

⁵ James L. Watson, ed., *Golden Arches East: McDonald’s in East Asia* (Stanford University Press, 1997): 12. *Note:* McDonald’s also operates with some of the advantages of a global organization. By using very similar product lines throughout the world, McDonald’s obtains some of the standardization advantages of a global strategy. However, it manages to retain the advantages of a multidomestic strategy.



Washington Imaging/Alamy Stock Photo



Bernd Wulstneek/dpa/picture-alliance/Newscom

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

CHAPTER SUMMARY

Global operations provide an increase in both the challenges and opportunities for operations managers. Although the task is challenging, operations managers can and do improve productivity. They can build and manage OM functions that contribute in a significant way to competitiveness. Organizations identify their strengths and weaknesses. They then develop effective missions and strategies that account for these strengths and weaknesses and complement the opportunities and threats in the environment. If this procedure is performed well, the organization can

have competitive advantage through some combination of product differentiation, low cost, and response. This competitive advantage is often achieved via a move to international, multidomestic, global, or transnational strategies.

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

ETHICAL DILEMMA

As a manufacturer of athletic shoes whose image, indeed performance, is widely regarded as socially responsible, you find your costs increasing. Traditionally, your athletic shoes have been made in Indonesia and South Korea. Although the ease of doing business in those countries has been improving, wage rates have also been increasing. The labour-cost differential between your present suppliers and a contractor who will get the shoes made in China now exceeds \$1 per pair. Your sales next year are projected to be 10 million pairs, and your analysis suggests that this cost differential is not

offset by any other tangible costs; you face only the political risk and potential damage to your commitment to social responsibility. Thus, this \$1 per pair savings should flow directly to your bottom line. There is no doubt that the Chinese government engages in censorship, remains repressive, and is a long way from a democracy. Moreover, you will have little or no control over working conditions, sexual harassment, and pollution. What do you do, and on what basis do you make your decision?

Discussion Questions

1. Based on the descriptions and analyses in this chapter, would Boeing be better described as a global firm or a transnational firm? Discuss.
2. List six reasons to internationalize operations.
3. Coca-Cola is called a global product. Does this mean that it is formulated in the same way throughout the world? Discuss.
4. Define *mission*.
5. Define *strategy*.
6. Describe how an organization's *mission* and *strategy* have different purposes.
7. Identify the mission and strategy of your automobile repair garage. What are the manifestations of the 10 OM decisions at the garage? That is, how is each of the 10 decisions accomplished?
8. As a library or internet assignment, identify the mission of a firm and the strategy that supports that mission.
9. How does an OM strategy change during a product's life cycle?
10. There are three primary ways to achieve competitive advantage. Provide an example, not included in the text, of each. Support your choices.
11. Given the discussion of Porter Airlines in the text, define an *operations* strategy for that firm.
12. How must an operations strategy integrate with marketing and accounting?
13. How would you summarize outsourcing trends?
14. What potential cost-saving advantages might firms experience by using outsourcing?
15. What internal issues must managers address when outsourcing?
16. How should a company select an outsourcing provider?
17. What are some of the possible consequences of poor outsourcing?
18. What global operations strategy is most descriptive of McDonald's?

Solved Problems Virtual Office Hours help is available at MyLab Operations Management.

▼ SOLVED PROBLEM 2.1

The global tire industry continues to consolidate. Michelin buys Goodrich and Uniroyal and builds plants throughout the world. Bridgestone buys Firestone, expands its research budget, and focuses on world markets. Goodyear spends almost 4% of its sales revenue on research. These three aggressive firms have come to dominate the world tire market, with total market share approaching 60%. And the German tire maker Continental AG has strengthened its position as fourth in the world, with a dominant presence in Germany. Against this formidable array, the old-line Italian tire company Pirelli SpA found it difficult to respond effectively. Although Pirelli still had 5% of the market, it was losing millions of dollars per year while the competition was getting stronger. Tires are a tough, competitive business that rewards companies having strong market shares and long production runs. Pirelli has some strengths: an outstanding reputation for excellent high-performance tires and an innovative manufacturing function.

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

▼ SOLUTION

First, find an opportunity in the world tire market that avoids the threat of the mass-market onslaught by the big three tire makers. Second, utilize the internal marketing strength represented by Pirelli's strong brand name and history of winning World Rally Championships. Third, maximize the internal innovative capabilities of the operations function.

To achieve these goals, Pirelli made a strategic shift out of low-margin standard tires and into higher-margin performance tires. Pirelli established deals with luxury brands Jaguar, BMW, Maserati, Ferrari, Bentley, and Lotus Elise and established itself as a provider of a large share of tires on new Porsches, S-class Mercedes, and Saabs. As a result, more than 70% of the company's tire production is now high-performance tires. People are willing to pay a premium for Pirellis.

The operations function continued to focus its design efforts on performance tires and developing a system of modular tire manufacture that allows much faster switching between models. This modular system, combined with investments in new manufacturing flexibility, has driven batch sizes down to as small as 150 to 200, making small-lot performance tires economically feasible. Manufacturing innovations at Pirelli have streamlined the production process, moving it from a 14-step process to a three-step process. A threat from the Big Three going after the performance market remains, but Pirelli has bypassed its weakness of having a small market share. The firm now has 24 plants in 12 countries and a presence in more than 160 countries, with sales exceeding \$4.5 billion.

Sources: *Just Auto* (February 2009): 14–15 and (December 2008): 14–15; *Hoover's Company Records* (October 15, 2005): 41369; and www.pirelli.com/corporate/en/investors/pirelli_at_glance/default.html.

Using Software to Solve Outsourcing Problems

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

CREATING YOUR OWN EXCEL SPREADSHEETS

Program 2.1 illustrates how to build an Excel spreadsheet for the data in Example 2. In this example the factor rating method is used to compare National Architects's three potential outsourcing providers.

This program provides the data inputs for seven important factors, including their weights (0.0–1.0) and ratings (1–5 scale where 5 is the highest rating) for each country. As we

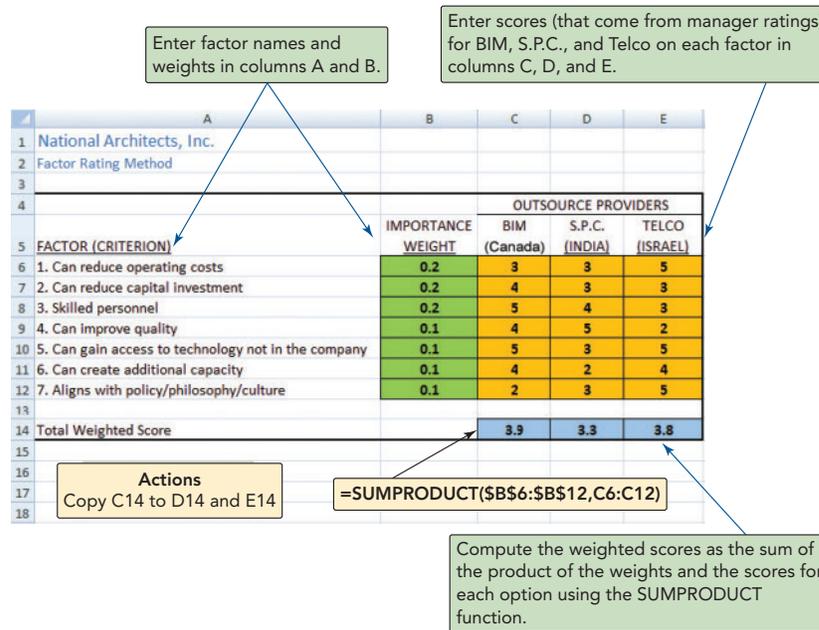
see, BIM is most highly rated, with a 3.9 score, versus 3.3 for S.P.C. and 3.8 for Telco.

X USING EXCEL OM

Excel OM (free with your text and also found in MyLab Operations Management) may be used to solve Example 2 (with the Factor Rating module).

P USING POM FOR WINDOWS

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



PROGRAM 2.1
Using Excel to Develop a Factor Rating Analysis, With Data from Example 2.

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

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

Problems 2.4 and 2.5 relate to *Achieving Competitive Advantage Through Operations*

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

Product	Parent Company	Country
Arrow Shirts	Volkswagen	1. France
Braun Household Appliances	Bidermann International	2. Great Britain
Volvo Autos	Bridgestone	3. Germany
Firestone Tires	Campbell Soup	4. Japan
Godiva Chocolate	Credit Lyonnais	5. United States
Häagen-Dazs Ice Cream (USA)	Tata	6. Switzerland
Jaguar Autos	Procter & Gamble	7. China
MGM Movies	Michelin	8. India
Lamborghini Autos	Nestlé	
Goodrich Tires	Geely	
Alpo Pet Foods		

- **2.4** The text provides three primary strategic approaches (differentiation, cost, and response) for achieving competitive advantage. Provide an example of each not given in the text. Support your choices. (*Hint*: Note the examples provided in the text.)

- **2.5** Within the food service industry (restaurants that serve meals to customers, but not just fast food), find examples of firms that have sustained competitive advantage by competing on the basis of (1) cost leadership, (2) response, and (3) differentiation. Cite one example in each category; provide a sentence or two in support of each choice. Do not use fast-food chains for all categories. (*Hint*: A “99¢ menu” is very easily copied and is not a good source of sustained advantage.)

Problem 2.6 relates to *Issues in Operations Strategy*

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

Problem 2.7 relates to *Strategy Development and Implementation*

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

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

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

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

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

Selection Criterion	England	Mexico
Price of service from outsourcer	2	3
Nearness of facilities to client	3	1
Level of technology	1	3
History of successful outsourcing	1	2

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

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

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

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

Culture Selection Criterion	Costa Rica			
	Mexico	Panama	Rica	Peru
Trust	1	2	2	1
Society value of quality work	7	10	9	10
Religious attitudes	3	3	3	5
Individualism attitudes	5	2	4	8
Time orientation attitudes	4	6	7	3
Uncertainty avoidance attitudes	3	2	4	2

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

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

Criterion	Weight	Rating of Logistics Providers		
		Overnight Shipping	Worldwide Delivery	United Freight
Quality	5	90	80	75
Delivery	3	70	85	70
Cost	2	70	80	95

- Garza decides to increase the weights for quality, delivery, and cost to 10, 6, and 4, respectively. How does this change your conclusions? Why?
- If Overnight Shipping’s ratings for each of the factors increase by 10%, what are the new results? **Px**

••• **2.11** Walker Accounting Software is marketed to small accounting firms throughout the United States and Canada. Owner George Walker has decided to outsource the company’s help desk and is considering three providers: Manila Call Center (Philippines), Delhi Services (India), and Moscow Bell (Russia). The following table summarizes the data Walker has assembled. Which outsourcing firm has the best rating? (Higher weights imply higher importance and higher ratings imply more desirable providers.) **Px**

Criterion	Importance Weight	Provider Ratings		
		Manila	Delhi	Moscow
Flexibility	0.5	5	1	9
Trustworthiness	0.1	5	5	2
Price	0.2	4	3	6
Delivery	0.2	5	6	6

•••• **2.12** Rao Technologies, a Quebec-based high-tech manufacturer, is considering outsourcing some of its electronics production. Four firms have responded to its request for bids, and CEO Mohan Rao has started to perform an analysis on the scores his OM team has entered in the table below.

Factor	Weight	Ratings of Outsource Providers			
		A	B	C	D
Labour	w	5	4	3	5
Quality procedures	30	2	3	5	1
Logistics system	5	3	4	3	5
Price	25	5	3	4	4
Trustworthiness	5	3	2	3	5
Technology in place	15	2	5	4	4
Management team	15	5	4	2	1

Weights are on a scale from 1 through 30, and the outsourcing provider scores are on a scale of 1 through 5. The weight for the labour factor is shown as a w because Rao’s OM team cannot agree on a value for this weight. For what range of values of w , if any, is company C a recommended outsourcing provider, according to the factor rating method?

Problem 2.13 relates to Global Operations Strategy Options

- **2.13** Does Boeing practice a multinational operations strategy, a global operations strategy, or a transnational operations strategy? Support your choice with specific references to Boeing’s operations and the characteristics of each type of organization.

CASE STUDIES

Mr. Lube

A substantial market exists for automobile tune-ups, oil changes, and lubrication service for the more than 12 million cars on Canadian roads. Some of this demand is filled by full-service auto dealerships, some by Canadian Tire, and some by other tire/service dealers. However, Mr. Lube, Great Canadian Oil Change, Jiffy Lube, and others have also developed strategies to accommodate this opportunity.

Mr. Lube stations perform oil changes, lubrication, and interior cleaning in a spotless environment. The buildings are clean, freshly painted, and often surrounded by neatly trimmed landscaping and clean parking areas. To facilitate fast service, cars can be driven through the facility. At Mr. Lube, the customer is greeted by service representatives who take their order, which typically includes fluid checks (oil, water, brake fluid, transmission fluid, and differential grease) and the necessary lubrication, as well as filter changes for air and oil. Service personnel in neat uniforms then move into action. The standard team has one person checking fluid levels under the

hood, another in the garage pit removing the oil filter, draining the oil, checking the differential and transmission, and lubricating as necessary. Precise task assignments and good training are designed to move the car into and out of the bay in minutes. The idea is to charge no more, and hopefully less, than gas stations, automotive repair chains, and auto dealers. While doing so, Mr. Lube strives to provide better service than its competitors.

Discussion Questions

1. What constitutes the mission of Mr. Lube?
2. How does the Mr. Lube operations strategy provide competitive advantage? (*Hint: Evaluate how Mr. Lube's traditional competitors perform the 10 decisions of operations management compared to how Mr. Lube performs them.*)
3. Is it likely that Mr. Lube has increased productivity over its more traditional competitors? Why? How would we measure productivity in this industry?

Video Case

Operations Strategy at Regal Marine

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

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

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

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

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

Discussion Questions*

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

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

Video Case

Hard Rock Cafe's Global Strategy

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

altogether different game.”* At Hard Rock, the different game is the experience game.

From the opening of its first cafe in London in 1971, during the British rock music explosion, Hard Rock has been serving food and rock music with equal enthusiasm. Hard Rock Cafe has two Canadian outlets, more than 40 U.S. locations, about a dozen in Europe, and the remainder scattered throughout the world, from Bangkok and Beijing to Beirut. New construction, leases, and investment in remodelling are long term; a global strategy means special consideration of political risk, currency risk, and social norms in a context of a brand fit. Although Hard Rock is one of the

most recognized brands in the world, this does not mean its cafe is a natural everywhere. Special consideration must be given to the supply chain for the restaurant and its accompanying retail store. About 48% of a typical cafe's sales are from merchandise.

The Hard Rock Cafe business model is well defined, but because of various risk factors and differences in business practices and employment law, Hard Rock elects to franchise about half of its cafes. Social norms and preferences often suggest some tweaking of menus for local taste. For instance, Hard Rock focuses less on hamburgers and beef and more on fish and lobster in its British cafes.

Because 70% of Hard Rock's guests are tourists, recent years have found it expanding to "destination" cities. While this has been a winning strategy for decades, allowing the firm to grow from one London cafe to 145 facilities in 60 countries, it has made Hard Rock susceptible to economic fluctuations that hit the tourist business hardest. So Hard Rock is signing a long-term lease for a new location in Nottingham, England, to join recently opened

cafes in Manchester and Birmingham—cities that are not standard tourist destinations. At the same time, menus are being upgraded. Hopefully, repeat business from locals in these cities will smooth demand and make Hard Rock less dependent on tourists.

Discussion Questions†

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

* Constantinos Markides, "Strategic Innovation," *MIT Sloan Management Review* 38, no. 3 (spring 1997): 9.

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

► **Additional Case Study:** Visit **MyLab Operations Management** for this free case study: **Motorola's Global Strategy:** Focuses on Motorola's international strategy.

CHAPTER 2 | RAPID REVIEW

MyLab Operations Management

Main Heading Review Material

A GLOBAL VIEW OF OPERATIONS AND SUPPLY CHAINS (pp. 28–31)

Domestic business operations decide to change to some form of international operations for six main reasons:

1. Reduce costs (labour, taxes, tariffs, etc.)
 2. Improve supply chain
 3. Provide better goods and services
 4. Understand markets
 5. Learn to improve operations
 6. Attract and retain global talent
- **Maquiladoras**—Mexican factories located along the U.S.–Mexico border that receive preferential tariff treatment.
 - **World Trade Organization (WTO)**—An international organization that promotes world trade by lowering barriers to the free flow of goods across borders.
 - **United States, Mexico, Canada Agreement (USMCA)**—A free trade agreement between Canada, Mexico, and the United States.
 - **European Union (EU)**—A European trade group that has 28 member states as of 2015.

Other trade agreements include APEC (the Pacific Rim countries), SEATO (Australia, New Zealand, Japan, Hong Kong, South Korea, New Guinea, and Chile), MERCOSUR (Argentina, Brazil, Paraguay, and Uruguay), and CAFTA (Central America, the Dominican Republic, and the United States).

The World Trade Organization helps to make uniform the protection of both governments and industries from foreign firms that engage in unethical conduct.

CULTURAL AND ETHICAL ISSUES (pp. 31–32)

Globalization involves many challenges, including reconciling differences in social and cultural behaviour.

MyLab Operations Management

Main Heading Review Material

Main Heading	Review Material	VIDEO 2.1
DEVELOPING MISSIONS AND STRATEGIES (pp. 32–33)	<p>An effective operations management effort must have a <i>mission</i> so it knows where it is going and a <i>strategy</i> so it knows how to get there.</p> <ul style="list-style-type: none"> • Mission—The purpose or rationale for an organization’s existence. • Strategy—How an organization expects to achieve its missions and goals. <p>The three strategic approaches to competitive advantage are:</p> <ol style="list-style-type: none"> 1. Differentiation 2. Cost leadership 3. Response 	Operations Strategy at Regal Marine
ACHIEVING COMPETITIVE ADVANTAGE THROUGH OPERATIONS (pp. 33–36)	<ul style="list-style-type: none"> • Competitive advantage—The creation of a unique advantage over competitors. • Differentiation—Distinguishing the offerings of an organization in a way that the customer perceives as adding value. • Experience differentiation—Engaging a customer with a product through imaginative use of the five senses, so the customer “experiences” the product. • Low-cost leadership—Achieving maximum value, as perceived by the customer. • Response—A set of values related to rapid, flexible, and reliable performance. <p>Differentiation can be attained, for example, through innovative design, by providing a broad product line, by offering excellent after-sale service, or through adding a sensory experience to the product or service offering.</p> <p>Cost leadership can be attained, for example, via low overhead, effective capacity use, or efficient inventory management.</p> <p>Response can be attained, for example, by offering a flexible product line, reliable scheduling, or speedy delivery.</p>	VIDEO 2.2 Hard Rock’s Global Strategy
10 STRATEGIC OM DECISIONS (pp. 36–39)	<ul style="list-style-type: none"> • Operations decisions—The strategic decisions of OM are goods and service design, quality, process and capacity design, location selection, layout design, human resources and job design, supply chain management, inventory, scheduling, and maintenance. 	
ISSUES IN OPERATIONS STRATEGY (pp. 39–40)	<ul style="list-style-type: none"> • Resources view—A method managers use to evaluate the resources at their disposal and manage or alter them to achieve competitive advantage. • Value chain analysis—A way to identify the elements in the product/service chain that uniquely add value. • Five forces model—A method of analyzing the five forces in the competitive environment. <p>The potential competing forces in Porter’s five forces model are (1) immediate rivals, (2) potential entrants, (3) customers, (4) suppliers, and (5) substitute products.</p> <p>Different issues are emphasized during different stages of the product life cycle:</p> <ul style="list-style-type: none"> • Introduction—Company strategy: Best period to increase market share, R&D engineering is critical. OM strategy: Product design and development critical, frequent product and process design changes, short production runs, high production costs, limited models, attention to quality. • Growth—Company strategy: Practical to change price or quality image, strengthen niche. OM strategy: Forecasting critical, product and process reliability, competitive product improvements and options, increase capacity, shift towards product focus, enhance distribution. • Maturity—Company strategy: Poor time to change image or price or quality, competitive costs become critical, defend market position. OM strategy: Standardization, less rapid product changes (more minor changes), optimum capacity, increasing stability of process, long production runs, product improvement, and cost cutting. • Decline—Company strategy: Cost control critical. OM strategy: Little product differentiation, cost minimization, overcapacity in the industry, prune line to eliminate items not returning good margin, reduce capacity. 	

MyLab Operations Management

Main Heading Review Material

Virtual Office Hours for Solved Problem: 2.1

STRATEGY DEVELOPMENT AND IMPLEMENTATION (pp. 40–43)

- **SWOT analysis**—A method of determining internal strengths and weaknesses and external opportunities and threats.
- The strategy development process first involves performing environmental analysis, followed by determining the corporate mission, and finally forming a strategy.
- **Key success factors (KSFs)**—Activities or factors that are key to achieving competitive advantage.
 - **Core competencies**—A set of skills, talents, and activities in which a firm is particularly strong.
- A core competency may be a subset of, or a combination of, KSFs.
- **Activity map**—A graphical link of competitive advantage, KSFs, and supporting activities.
- An operations manager’s job is to implement an OM strategy, provide competitive advantage, and increase productivity.

STRATEGIC PLANNING, CORE COMPETENCIES, AND OUTSOURCING (pp. 43–46)

- **Outsourcing**—Transferring a firm’s activities that have traditionally been internal to external suppliers
- **Theory of comparative advantage**—A theory which states that countries benefit from specializing in (and exporting) goods and services in which they have relative advantage, and they benefit from importing goods and services in which they have a relative disadvantage.

GLOBAL OPERATIONS STRATEGY OPTIONS (pp. 47–49)

- **International business**—A firm that engages in cross-border transactions.
 - **Multinational corporation (MNC)**—A firm that has extensive involvement in international business, owning or controlling facilities in more than one country.
 - **International strategy**—A strategy in which global markets are penetrated using exports and licences.
 - **Multidomestic strategy**—A strategy in which operating decisions are decentralized to each country to enhance local responsiveness.
 - **Global strategy**—A strategy in which operating decisions are centralized and headquarters coordinates the standardization and learning between facilities.
 - **Transnational strategy**—A strategy that combines the benefits of global-scale efficiencies with the benefits of local responsiveness. These firms transgress national boundaries.
- The four operations strategies for approaching global opportunities can be classified according to local responsiveness and cost reduction:
1. **International**—Little local responsiveness and little cost advantage
 2. **Multidomestic**—Significant local responsiveness but little cost advantage
 3. **Global**—Little local responsiveness but significant cost advantage
 4. **Transnational**—Significant local responsiveness and significant cost advantage

Self-Test

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

LO1 A mission statement is beneficial to an organization because it:

- a) is a statement of the organization’s purpose.
- b) provides a basis for the organization’s culture.
- c) identifies important constituencies.
- d) details specific income goals.
- e) ensures profitability.

LO2 The three strategic approaches to competitive advantage are _____, _____, and _____.

LO3 Core competencies are those strengths in a firm that include:

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

- LO4** Evaluating outsourcing providers by comparing their weighted average scores involves:
- a) factor rating analysis.
 - b) cost-volume analysis.
 - c) transportation model analysis.
 - d) linear regression analysis.
 - e) crossover analysis.
- LO5** A company that is organized across international boundaries, with decentralized authority and substantial autonomy at each business via subsidiaries, franchises, or joint ventures, has:
- a) a global strategy.
 - b) a transnational strategy.
 - c) an international strategy.
 - d) a multidomestic strategy.

Answers: LO1. a; LO2. differentiation, cost leadership, response; LO3. e; LO4. a; LO5. c.

MyLab Operations Management

Most of these questions can be found in MyLab Operations Management. Visit MyLab Operations Management to access cases, videos, downloadable software, and much more. MyLab Operations Management also features a personalized Study Plan that helps you identify which chapter concepts you've mastered and guides you towards study tools for additional practice.

3

Learning Objectives

- LO1** Use a Gantt chart for scheduling 62
- LO2** Draw AOA and AON networks 67
- LO3** Complete forward and backward passes for a project 70
- LO4** Determine a critical path 74
- LO5** Calculate the variance of activity times 77
- LO6** Crash a project 81



AboutLife/Shutterstock

Project Management

Project Management Is a Core Strength for EllisDon

Doing a good job is commendable, but in the construction industry it is imperative that it is also done on time, every time, and at each step during the process. Excellence in project management is a defining factor in successful companies.

EllisDon is a Canadian leader in engineering and construction project management. It is self-described as a project management service that takes a “hands-on” approach. The company’s belief is that by becoming deeply involved in a project, it can ensure that the job is completed as the owner intended. This level of commitment and involvement aids in foreseeing issues, thus allowing challenges to be faced head-on and resolved faster.

EllisDon works with clients to keep its projects on track from project conception through to the selection of consultants, planning, tendering, and finally completion, closeout, and commissioning. In instances where EllisDon is not the builder of the project, it oversees all the work, manages the consultants, and reports the progress to the owner.

Global
Company
Profile
EllisDon

The company has a wealth of experience and knowledge, having worked on projects of all sizes and complexities in a wide variety of locations around the world. It has also built solid relationships with architects, engineers, and subcontractors. This network of expertise is a valuable resource for project management in this industry.

On the global scene, EllisDon is the project manager for the Palm Jumeirah in Dubai, United Arab Emirates. This is a property development project using land reclamation to create an artificial archipelago so large that it can be seen from space; upon completion, it is anticipated it will be visible from the moon. It contains apartment buildings, town houses, plus food and retail outlets.

The following is a list of some of the company's other more notable current projects, both those that are completed and ongoing:

- Increased expansion at the Calgary Airport.
- Union Station (Toronto) renovation and expansion.
- Design-builder for the Halifax 4-Pad Arena.
- General contractor for additions to the Hamilton Community Centre for the City of Richmond, British Columbia.
- Construction manager for George Brown College's Waterfront Campus.
- Construction of the SickKids (Hospital) Research Tower.



SickKids Foundation/Newscom

Construction of the SickKids (Hospital) Research Tower.

- Construction management contract for the Ritz-Carlton, Toronto, and the Residences at the Ritz-Carlton.
- Construction work on the Saskatoon Police Headquarters.
- Engineer-procure-construct contract for an ethanol plant for Terra Grain Fuels, Inc., of Regina, Saskatchewan.

EllisDon's excellence in project management continues to provide a competitive advantage. Due to the company's reputation and experience in project management, it is not difficult to understand why EllisDon is a Canadian success story.

Source: www.ellisdon.com.

The Importance of Project Management

When EllisDon, the subject of the opening *Global Company Profile*, received confirmation that it was awarded the contract to be the project manager for the Palm Jumeirah in Dubai, United Arab Emirates, it had to mobilize a large force of subcontractors, workers, construction professionals, and engineers. The project management team was also required to ensure ongoing access to physical resources and an uninterrupted flow of supplies. Similarly, when Hard Rock Cafe sponsors Rockfest, hosting more than 100 000 fans at its annual concert, the project manager begins planning some nine months earlier. Using the software package Microsoft Project, described in this chapter, each of the hundreds of details can be monitored and controlled. When a band can't reach the Rockfest site by bus because of massive traffic jams, Hard Rock's project manager is ready with a helicopter backup.

EllisDon and Hard Rock Cafe are just two examples of firms that face modern phenomena: growing project complexity and collapsing product/service life cycles. This change stems from awareness of the strategic value of time-based competition and a quality mandate for continuous improvement. Each new product/service introduction is a unique event—a project. In addition, projects are a common part of our everyday life, whether we are planning a wedding or a surprise birthday party, remodelling a house, or preparing a semester-long class project.

STUDENT TIP

Wherever your career takes you, one of the most useful tools you can have, as a manager, is the ability to manage a project.

VIDEO 3.1

Project Management at Hard Rock's Rockfest

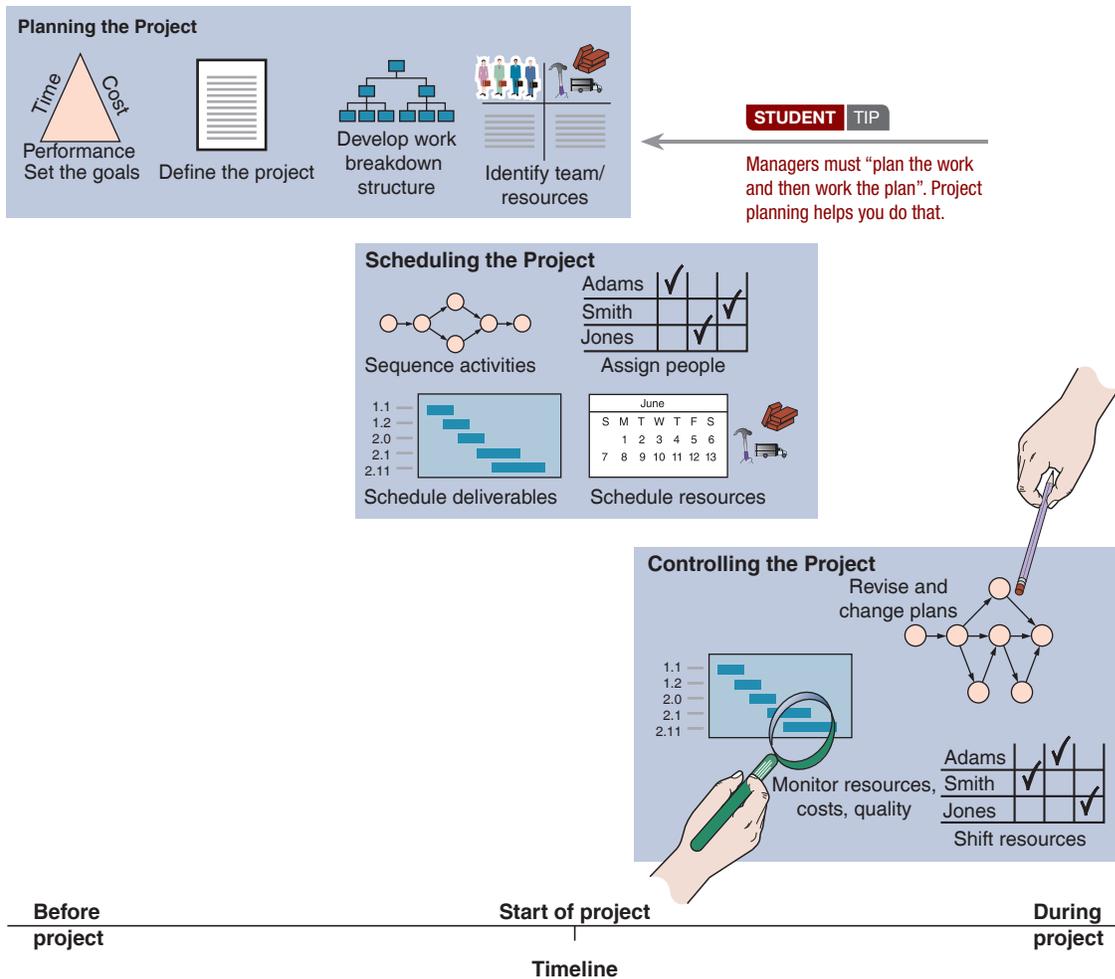


FIGURE 3.1 Project Planning, Scheduling, and Controlling

Scheduling projects is a difficult challenge for operations managers. The stakes in project management are high, and cost overruns and unnecessary delays occur due to poor scheduling and poor controls.

Projects that take months or years to complete are usually developed outside the normal production system. Project organizations within the firm may be set up to handle such jobs and are often disbanded when the project is complete. On other occasions, managers find projects just a part of their job. The management of projects involves three phases (see Figure 3.1):

1. *Planning*: This phase includes goal setting, defining the project, and team organization.
2. *Scheduling*: This phase relates people, money, and supplies to specific activities and relates activities to each other.
3. *Controlling*: Here, the firm monitors resources, costs, quality, and budgets. It also revises or changes plans and shifts resources to meet time and cost demands.

We begin this chapter with a brief overview of these functions. We also describe three popular techniques to allow managers to plan, schedule, and control—Gantt charts, the program evaluation and review technique (PERT), and the critical path method (CPM).

Project Planning

Projects can be defined as a series of related tasks directed towards a major output. In some firms, a **project organization** is developed to make sure existing programs continue to run smoothly on a day-to-day basis while new projects are successfully completed.

For companies with multiple large projects, such as a construction firm, a project organization is an effective way of assigning the people and physical resources needed. It is a temporary

Project organization

An organization formed to ensure that programs (projects) receive the proper management and attention.

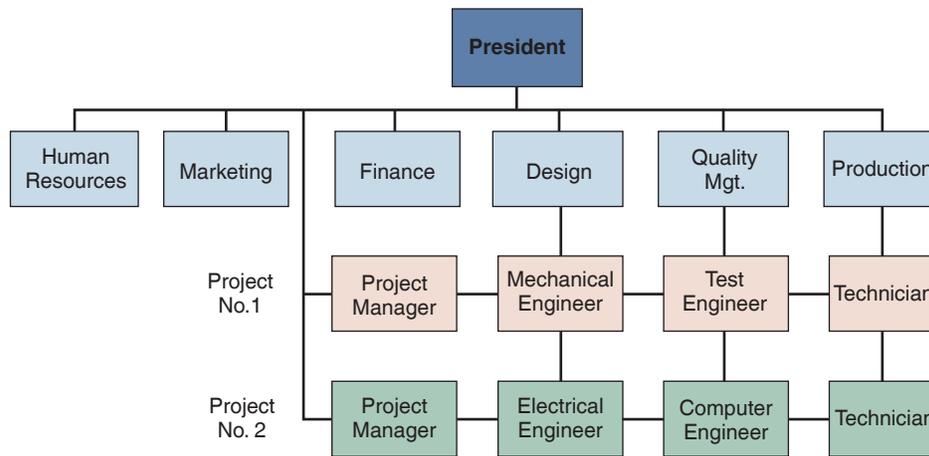


FIGURE 3.2
A Sample Project
Organization

STUDENT TIP

Project organizations can be temporary or permanent. A permanent organization is usually called a “matrix organization”.

organization structure designed to achieve results by using specialists from throughout the firm. NASA and many other organizations use the project approach. You may recall Project Gemini and Project Apollo, terms used to describe teams that NASA organized to reach space exploration objectives.

The project organization works best when:

1. Work can be defined with a specific goal and deadline.
2. The job is unique or somewhat unfamiliar to the existing organization.
3. The work contains complex interrelated tasks requiring specialized skills.
4. The project is temporary but critical to the organization.
5. The project cuts across organizational lines.

THE PROJECT MANAGER

An example of a project organization is shown in Figure 3.2. Project team members are temporarily assigned to a project and report to the project manager. The manager heading the project coordinates activities with other departments and reports directly to top management. Project managers receive high visibility in a firm and are responsible for making sure that (1) all necessary activities are finished in proper sequence and on time; (2) the project comes in within budget; (3) the project meets its quality goals; and (4) the people assigned to the project receive the motivation, direction, and information needed to do their jobs. This means that project managers should be good coaches and communicators, and be able to organize activities from a variety of disciplines.

ETHICAL ISSUES FACED IN PROJECT MANAGEMENT Project managers not only have high visibility but also face ethical decisions on a daily basis. How they act establishes the code of conduct for the project. Project managers often deal with (1) offers of gifts from contractors, (2) pressure to alter status reports to mask the reality of delays, (3) false reports for charges of time and expenses, and (4) pressures to compromise quality to meet bonus or penalty schedules.

Using the Project Management Institute’s (www.pmi.org) ethical codes is one means of trying to establish standards. Research has shown that without good leadership and a strong organizational culture, most people follow their own sets of ethical standards and values.¹

WORK BREAKDOWN STRUCTURE

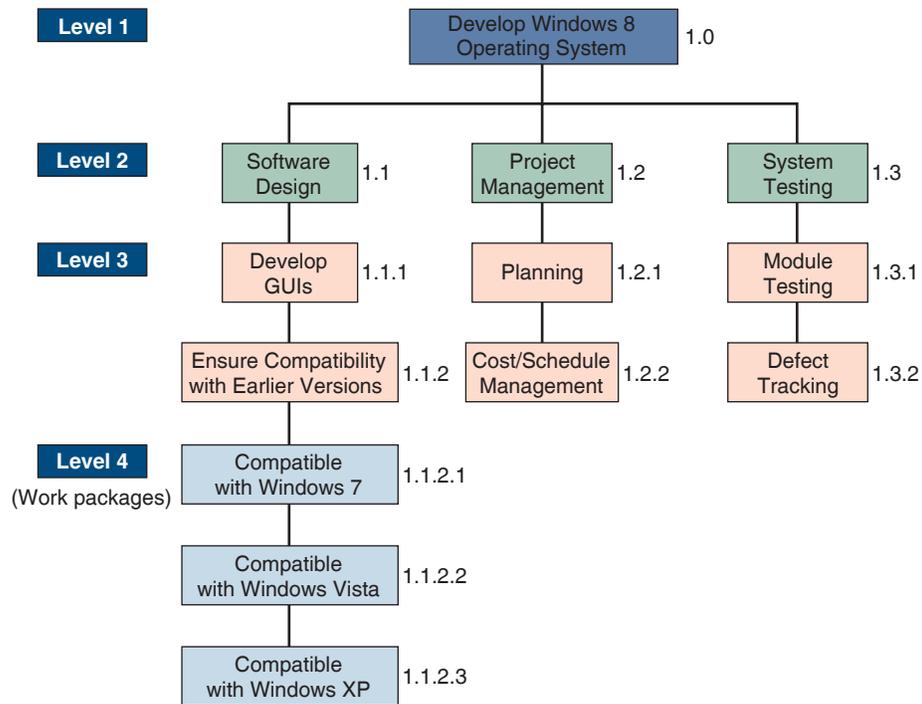
The project management team begins its task well in advance of project execution so that a plan can be developed. One of its first steps is to carefully establish the project’s objectives, then break the project down into manageable parts. This **work breakdown structure (WBS)** defines the project by dividing it into its major subcomponents (or tasks), which are then subdivided into

Work breakdown structure (WBS)

A hierarchical description of a project into more and more detailed components.

¹ See Hilder Helgadottir, “The Ethical Dimension of Project Management,” *International Journal of Project Management* 26, no. 7 (October 2008): 743–748.

FIGURE 3.3
Work Breakdown Structure



more detailed components, and finally into a set of activities and their related costs. The division of the project into smaller and smaller tasks can be difficult but is critical to managing the project and to scheduling success. Gross requirements for people, supplies, and equipment are also estimated in this planning phase.

The work breakdown structure typically decreases in size from top to bottom and is indented like this:

Level

- 1 Project
- 2 Major tasks in the project
- 3 Subtasks in major tasks
- 4 Activities (or “work packages”) to be completed

This hierarchical framework can be illustrated with the development of Microsoft’s operating system Windows 8. As we see in Figure 3.3, the project, creating a new operating system, is labelled 1.0. The first step is to identify the major tasks in the project (level 2). Three examples would be software design (1.1), project management (1.2), and system testing (1.3). Two major subtasks for 1.1 are development of graphical user interfaces (GUIs) (1.1.1) and creating compatibility with previous versions of Windows (1.1.2). The major subtasks for 1.1.2 are level 4 activities, such as creating a team to handle compatibility with Windows 7 (1.1.2.1), creating a team for Windows Vista (1.1.2.2), and creating a team for Windows XP (1.1.2.3). There are usually many level 4 activities.

STUDENT TIP

Gantt charts are simple and visual, making them widely used.

LO1 Use a Gantt chart for scheduling

Gantt charts

Planning charts used to schedule resources and allocate time.

Project Scheduling

Project scheduling involves sequencing and allotting time to all project activities. At this stage, managers decide how long each activity will take and compute how many people and what materials will be needed at each stage of production. Managers also chart separate schedules for personnel needs by type of skill (management, engineering, or pouring concrete, for example). Charts also can be developed for scheduling materials.

One popular project scheduling approach is the Gantt chart. **Gantt charts** are low-cost means of helping managers make sure that (1) activities are planned, (2) order of performance is documented, (3) activity time estimates are recorded, and (4) overall project time is developed. As Figure 3.4 shows, Gantt charts are easy to understand. Horizontal bars are drawn for each project activity along a timeline. This illustration of a routine servicing of a Delta jetliner during a 40-minute lay-

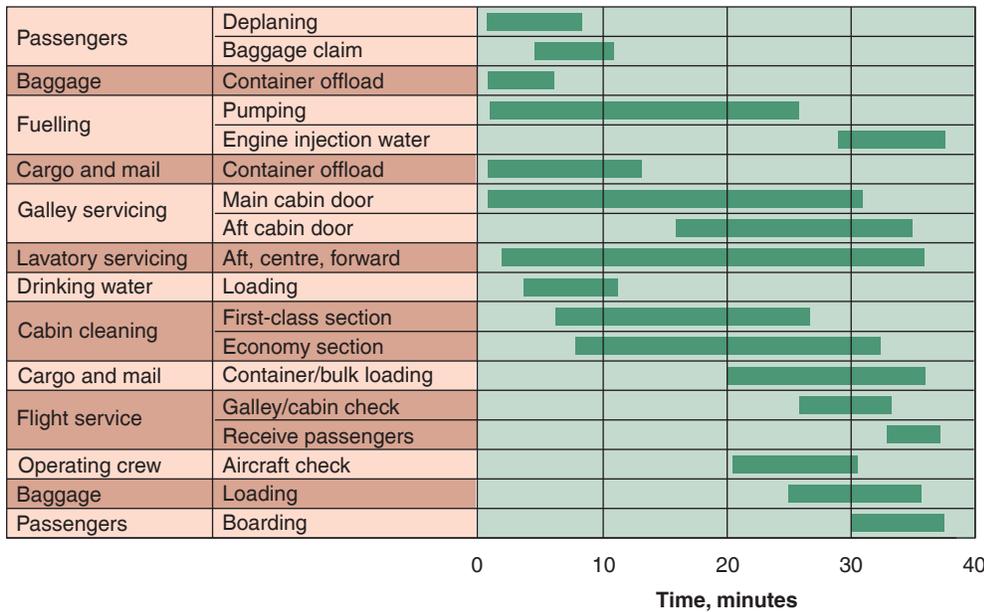


FIGURE 3.4
Gantt Chart of Service Activities for a Delta Jet during a 40-Minute Layover
 Delta hopes to save U.S. \$50 million a year with this turnaround time, which is a reduction from its traditional 60-minute routine.

over shows that Gantt charts also can be used for scheduling repetitive operations. In this case, the chart helps point out potential delays. The *OM in Action* box on Delta provides additional insights.

On simple projects, scheduling charts such as these permit managers to observe the progress of each activity and to spot and tackle problem areas. Gantt charts do not adequately illustrate the interrelationships between the activities and the resources, however.

PERT and CPM, the two widely used network techniques that we shall discuss shortly, do have the ability to consider precedence relationships and interdependency of activities. On complex projects, the scheduling of which is almost always computerized, PERT and CPM thus have an edge over the simpler Gantt charts. Even on huge projects, though, Gantt charts can be used as summaries of project status and may complement the other network approaches.

To summarize, whatever the approach taken by a project manager, project scheduling serves several purposes:

1. It shows the relationship of each activity to others and to the whole project.
2. It identifies the precedence relationships among activities.
3. It encourages the setting of realistic time and cost estimates for each activity.
4. It helps make better use of people, money, and material resources by identifying critical bottlenecks in the project.

OM in Action

Delta's Ground Crew Orchestrates a Smooth Takeoff

Flight 574's engines screech its arrival as the jet lumbers down Richmond's taxiway with 140 passengers arriving from Atlanta. In 40 minutes, the plane is to be airborne again.

However, before this jet can depart, there is business to attend to: passengers, luggage, and cargo to unload and load; thousands of gallons of jet fuel and countless drinks to restock; cabin and restrooms to clean; toilet holding tanks to drain; and engines, wings, and landing gear to inspect.

The 10-person ground crew knows that a miscue anywhere—a broken cargo loader, lost baggage, misdirected passengers—can mean a late departure and trigger a chain reaction of headaches from Richmond to Atlanta to every destination of a connecting flight.

Carla Sutera, the operations manager for Delta's Richmond International Airport, views the turnaround operation like a pit boss awaiting a race car. Trained crews are in place for Flight 574, with baggage carts and tractors, hydraulic cargo loaders, a truck to load food and drinks, another to lift the cleanup crew, another to put fuel on, and a fourth to take water off. The "pit crew" usually performs so smoothly that most passengers never suspect the proportions of the effort. Gantt charts, such as the one in Figure 3.4, aid Delta and other airlines with the staffing and scheduling that are needed for this task.

Sources: Knight Ridder Tribune Business News (July 16, 2005): 1 and (November 21, 2002): 1.



Courtesy Arnold Palmer Medical Center

Courtesy Arnold Palmer Medical Center

Construction of the new 11-storey building at Arnold Palmer Hospital in Orlando, Florida, was an enormous project for the hospital administration. The photo on the left shows the first six floors under construction. The photo on the right shows the building as completed two years later. Prior to beginning actual construction, regulatory and funding issues added, as they do with most projects, substantial time to the overall project. Cities have zoning and parking issues; the U.S. Environmental Protection Agency has drainage and waste issues; and regulatory authorities have their own requirements, as do issuers of bonds. The \$100 million, four-year project at Arnold Palmer Hospital is discussed in the Video Case Study at the end of this chapter.

STUDENT TIP

Software has revolutionized project control.

VIDEO 3.2

Project Management at Arnold Palmer Hospital

Project Controlling

The control of projects, like the control of any management system, involves close monitoring of resources, costs, quality, and budgets. Control also means using a feedback loop to revise the project plan and having the ability to shift resources to where they are needed most. Computerized PERT/CPM reports and charts are widely available today on personal computers. Some of the more popular of these programs are Oracle Primavera (by Oracle), MindView (by Match Ware), HP Project (by Hewlett-Packard), Fast Track (by AEC Software), and Microsoft Project (by Microsoft Corp.), which we illustrate in this chapter.

These programs produce a broad variety of reports, including (1) detailed cost breakdowns for each task, (2) total program labour curves, (3) cost distribution tables, (4) functional cost and hour summaries, (5) raw material and expenditure forecasts, (6) variance reports, (7) time analysis reports, and (8) work status reports.

Controlling projects can be difficult. The stakes are high; cost overruns and unnecessary delays can occur due to poor planning, scheduling, and controls. Some projects are “well-defined,” whereas others may be “ill-defined”. Projects typically only become well-defined after detailed extensive initial planning and careful definition of required inputs, resources, processes, and outputs. Well-established projects where constraints are known (e.g., buildings and roads) and engineered products (e.g., airplanes and cars) with well-defined specifications and drawings may

OM in Action

Agile Project Management at Mastek

Agile project management has changed the way that Mastek Corp., in Mumbai, India, develops its educational software products. On a traditional well-defined project, managers are actively involved in directing work and telling their team what needs to be done—a style often referred to as a step-by-step waterfall style of project management.

Agile project management is different. In the early stages, the project manager creates a high-level plan, based on outline requirements and a high-level view of the solution. From that point, the end project is created iteratively and incrementally, with each increment building on the output of steps preceding it.

The principles of agile are essentially communication and transparency. Instead of waiting for something to be

delivered, with limited understanding of the desired end result, there are numerous checkpoints and feedback loops to track progress.

Agile provides Mastek the ability to keep costs under control. Without agile, the cost of quality increases. “It’s much harder to correct mistakes when a software product is nearing its final phase of development,” says a company executive. “It’s much better to develop it as you go along. I think agile project management would help any software developer.”

Sources: AMPG International (2015) and www.cprime.com (2012).

fall into this category. Well-defined projects are assumed to have changes small enough to be managed without substantially revising plans. They use what is called a *waterfall* approach, where the project progresses smoothly, in a step-by-step manner, through each phase to completion.

But many projects, such as software development (e.g., 3-D games) and new technology (e.g., landing the Mars land rover) are ill-defined. These projects require what is known as an *agile* style of management with collaboration and constant feedback to adjust to the many unknowns of the evolving technology and project specifications. The *OM in Action* box “Agile Project Management at Mastek” provides such an example. Most projects fall somewhere between waterfall and agile.

Project Management Techniques: PERT and CPM

STUDENT TIP

To use project management software, you first need to understand the next two sections in this chapter.

Program evaluation and review technique (PERT) and the **critical path method (CPM)** were both developed in the 1950s to help managers schedule, monitor, and control large and complex projects. CPM arrived first, in 1957, as a tool developed by J. E. Kelly of Remington Rand and M. R. Walker of DuPont to assist in the building and maintenance of chemical plants at DuPont. Independently, PERT was developed in 1958 for the U.S. Navy.

Program evaluation and review technique (PERT)

A project management technique that employs three time estimates for each activity.

THE FRAMEWORK OF PERT AND CPM

PERT and CPM both follow six basic steps:

1. Define the project and prepare the work breakdown structure.
2. Develop the relationships among the activities. Decide which activities must precede and which must follow others.
3. Draw the network connecting all the activities.
4. Assign time and/or cost estimates to each activity.
5. Compute the *longest* time path through the network. This is called the **critical path**.
6. Use the network to help plan, schedule, monitor, and control the project.

Critical path method (CPM)

A project management technique that uses only one time factor per activity.

Critical path

The computed *longest* time path(s) through a network.

Step 5, finding the critical path, is a major part of controlling a project. The activities on the critical path represent tasks that will delay the entire project if they are not completed on time. Managers can gain the flexibility needed to complete critical tasks by identifying noncritical activities and replanning, rescheduling, and reallocating labour and financial resources.

Although PERT and CPM differ to some extent in terminology and in the construction of the network, their objectives are the same. Furthermore, the analysis used in both techniques is very similar. The major difference is that PERT employs three time estimates for each activity. These time estimates are used to compute expected values and standard deviations for the activity. CPM makes the assumption that activity times are known with certainty and hence requires only one time factor for each activity. For an example of large project that put these principles into action see the *OM in Action* box “Rebuilding the Electricity Grid in China”.

For purposes of illustration, the rest of this section concentrates on a discussion of PERT. Most of the comments and procedures described, however, apply just as well to CPM.

PERT and CPM are important because they can help answer questions such as the following about projects with thousands of activities:

1. When will the entire project be completed?
2. What are the critical activities or tasks in the project—that is, which activities will delay the entire project if they are late?
3. Which are the noncritical activities—the ones that can run late without delaying the whole project’s completion?
4. What is the probability that the project will be completed by a specific date?
5. At any particular date, is the project on schedule, behind schedule, or ahead of schedule?
6. On any given date, is the money spent equal to, less than, or greater than the budgeted amount?
7. Are there enough resources available to finish the project on time?
8. If the project is to be finished in a shorter amount of time, what is the best way to accomplish this goal at the least cost?

NETWORK DIAGRAMS AND APPROACHES

Activity-on-node (AON)

A network diagram in which nodes designate activities.

Activity-on-arrow (AOA)

A network diagram in which arrows designate activities.

The first step in a PERT or CPM network is to divide the entire project into significant activities in accordance with the work breakdown structure. There are two approaches for drawing a project network: **activity on node (AON)** and **activity on arrow (AOA)**. Under the AON convention, *nodes* designate activities. Under AOA, *arrows* represent activities. Activities consume time and resources. The basic difference between AON and AOA is that the nodes in an AON diagram represent activities. In an AOA network, the nodes represent the starting and finishing times of an activity and are also called *events*. So nodes in AOA consume neither time nor resources.

Figure 3.5 illustrates both conventions for a small portion of the airline turnaround Gantt chart (in Figure 3.4). The examples provide some background for understanding six common activity relationships in networks. In Figure 3.5(a), activity A must be finished before activity B is started, and B must, in turn, be completed before C begins. Activity A might represent “deplaning passengers,” while B is “cabin cleaning,” and C is “boarding new passengers”.

Figures 3.5(e) and 3.5(f) illustrate that the AOA approach sometimes needs the addition of a **dummy activity** to clarify relationships. A dummy activity consumes no time or resources but is required when a network has two activities with identical starting and ending events, or when two or more follow some, but not all, “preceding” activities. The use of dummy activities is also

Dummy activity

An activity having no time that is inserted into a network to maintain the logic of the network.

	Activity-on-Node (AON)	Activity Meaning	Activity-on-Arrow (AOA)
(a)		A comes before B, which comes before C.	
(b)		A and B must both be completed before C can start.	
(c)		B and C cannot begin until A is completed.	
(d)		C and D cannot begin until both A and B are completed.	
(e)		C cannot begin until both A and B are completed; D cannot begin until B is completed. A dummy activity is introduced in AOA.	
(f)		B and C cannot begin until A is completed. D cannot begin until both B and C are completed. A dummy activity is again introduced in AOA.	

FIGURE 3.5 A Comparison of AON and AOA Network Conventions

important when computer software is employed to determine project completion time. A dummy activity has a completion time of zero and is shown graphically with a dashed line.

Although both AON and AOA are popular in practice, many of the project management software packages, including Microsoft Project, use AON networks. For this reason, although we illustrate both types of networks in the next examples, we focus on AON networks in subsequent discussions in this chapter.

ACTIVITY-ON-NODE EXAMPLE

Hamilton Paper Manufacturing, Inc., located near downtown Hamilton, has long been delaying the expense of installing air pollution control equipment in its facility. The province has recently given the manufacturer 16 weeks to install a complex air filter system. Hamilton Paper has been warned that it may be forced to close the facility unless the device is installed in the allotted time. Joni Steinberg, the plant manager, wants to make sure that installation of the filtering system progresses smoothly and on time.

Given the following information, develop a table showing activity precedence relationships.

APPROACH ► Hamilton Paper has identified the eight activities that need to be performed in order for the project to be completed. When the project begins, two activities can be simultaneously started: building the internal components for the device (activity A) and making the modifications necessary for the floor and roof (activity B). The construction of the collection stack (activity C) can begin when the internal components are completed. Pouring the concrete floor and installation of the frame (activity D) can be started as soon as the internal components are completed and the roof and floor have been modified.

After the collection stack has been constructed, two activities can begin: building the high-temperature burner (activity E) and installing the pollution control system (activity F). The air pollution device can be installed (activity G) after the concrete floor has been poured, the frame has been installed, and the high-temperature burner has been built. Finally, after the control system and pollution device have been installed, the system can be inspected and tested (activity H).

SOLUTION ► Activities and precedence relationships may seem rather confusing when they are presented in this descriptive form. It is therefore convenient to list all the activity information in a table, as shown in Table 3.1. We see in the table that activity A is listed as an *immediate predecessor* of activity C. Likewise, both activities D and E must be performed prior to starting activity G.

Activity	Description	Immediate Predecessors
A	Build internal components	—
B	Modify roof and floor	—
C	Construct collection stack	A
D	Pour concrete and install frame	A, B
E	Build high-temperature burner	C
F	Install pollution control system	C
G	Install air pollution device	D, E
H	Inspect and test	F, G

INSIGHT ► To complete a network, all predecessors must be clearly defined.

LEARNING EXERCISE ► What is the impact on the sequence of activities if provincial approval is required after *Inspect and test*? [Answer: The immediate predecessor for the new activity would be H, *Inspect and test*, with *Provincial approval* as the last activity, I.]

Note that in Example 1, it is enough to list just the *immediate predecessors* for each activity. For instance, in Table 3.1, since activity A precedes activity C, and activity C precedes activity E, the fact that activity A precedes activity E is *implicit*. This relationship need not be explicitly shown in the activity precedence relationships.

When there are many activities in a project with fairly complicated precedence relationships, it is difficult for an individual to comprehend the complexity of the project from just the tabular information. In such cases, a visual representation of the project, using a *project network*, is convenient and useful. A project network is a diagram of all the activities and the precedence relationships that exist between these activities in a project. Example 2 illustrates how to construct a project network for Hamilton Paper Manufacturing.

EXAMPLE 1

Activity-on-Node for Environmental Problem at Hamilton Paper

LO2 Draw AOA and AON networks

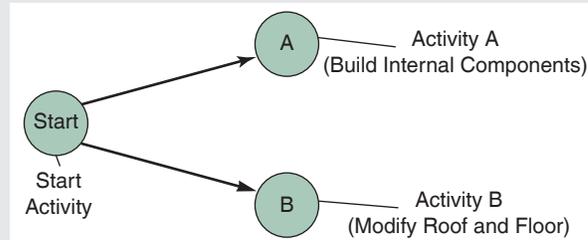
Table 3.1
Hamilton Paper Manufacturing's Activities and Predecessors

EXAMPLE 2**AON Graph for Hamilton Paper****FIGURE 3.6**
Beginning AON Network for Hamilton Paper

Draw the AON network for Hamilton Paper, using the data in Example 1.

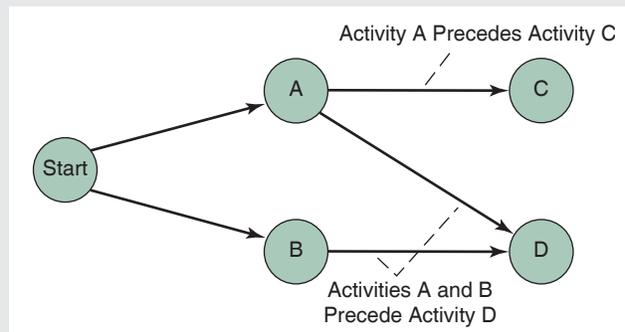
APPROACH ► In the AON approach, we denote each activity by a node. The lines, or arrows, represent the precedence relationships between the activities.

SOLUTION ► In this example, there are two activities (A and B) that do not have any predecessors. We draw separate nodes for each of these activities, as shown in Figure 3.6. Although not required, it is usually convenient to have a unique starting activity for a project. We have therefore included a dummy activity called Start in Figure 3.6. This dummy activity does not really exist and takes up zero time and resources. Activity Start is an immediate predecessor for both activities A and B, and serves as the unique starting activity for the entire project.

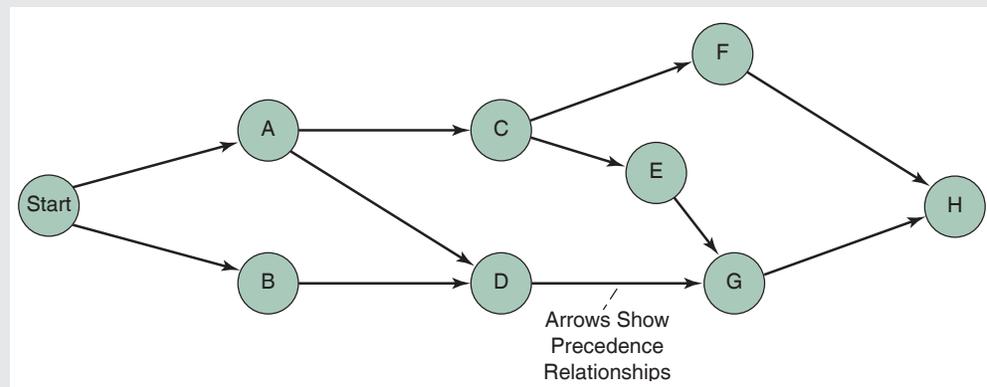


We now show the precedence relationships using lines with arrow symbols. For example, an arrow from activity Start to activity A indicates that Start is a predecessor for activity A. In a similar fashion, we draw an arrow from Start to B.

Next, we add a new node for activity C. Since activity A precedes activity C, we draw an arrow from node A to node C. Likewise, we first draw a node to represent activity D. Then, since activities A and B both precede activity D, we draw arrows from A to D and from B to D (see Figure 3.7).

FIGURE 3.7
Intermediate AON Network for Hamilton Paper

We proceed in this fashion, adding a separate node for each activity and a separate line for each precedence relationship that exists. The complete AON project network for the Hamilton Paper Manufacturing project is shown in Figure 3.8.

FIGURE 3.8
Complete AON Network for Hamilton Paper

INSIGHT ► Drawing a project network properly takes some time and experience. We would like the lines to be straight and arrows to move to the right when possible.

LEARNING EXERCISE ► If *Provincial approval* occurs after *Inspect and test*, what is the impact on the graph? [Answer: A straight line is extended to the right beyond H to reflect the additional activity.]

RELATED PROBLEMS ► 3.3, 3.6, 3.7, 3.9a, 3.10, 3.12, 3.15a