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OPERATIONS MANAGEMENT

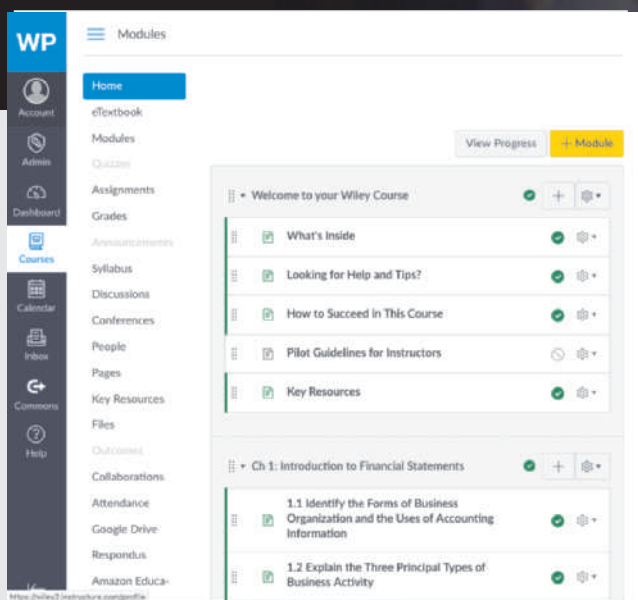
Creating Value
Along the
Supply Chain

Second Canadian Edition



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Operations Management

Creating Value Along the Supply Chain

Second Canadian Edition

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Courtesy of Wilfrid Laurier University

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Organization of the Content

The organization of the content reflects the emergence of supply chain management as an integral part of the study of operations. The first half concentrates on issues and decisions that are common to most enterprises—ensuring quality, designing products and services, analyzing processes, designing facilities, developing human resources, and managing projects. The second half emphasizes activities that are influenced by and are most likely shared with entities along the supply chain—sourcing and logistics, forecasting demand, establishing inventory levels, coordinating sales and operations, developing resource plans, leaning operations and supply chains, and scheduling work. Please note that these topics may be covered in a different order than presented in the text. This is perfectly understandable given the interdependency of decisions in operations and supply chain management.

Learning Objectives of This Course

The learning objectives of this course are threefold:

1. **To gain an appreciation of the strategic importance of operations and supply chain management in a global business environment and to understand how operations relates to other business functions.** By the conclusion of this course, students will be able to describe the impact of operations and supply chain management on other functions within a firm, as well as on the competitive position of the firm. They will also be more aware of the global nature of operations and the complexity of supply chains.
2. **To develop a working knowledge of the concepts and methods related to designing and managing operations and to create value along the supply chain.** This course teaches the basic steps involved in bringing a product to market from its design through production and delivery. It covers such skills as how to forecast demand, lay out a facility, manage a project, work with suppliers, and schedule work.
3. **To develop a skill set for continuous improvement.** This course provides students the ability to conceptualize how systems are interrelated, to organize activities effectively, to analyze processes critically, to make decisions based on data, and to push for continual process

improvement. These skills will serve you well in whatever career you choose.

Changes in the Second Canadian Edition

This new second Canadian edition of *Operations Management: Creating Value Along the Supply Chain* is organized around the increasingly important and prevalent topic of operations as a way to create value along the supply chain. We describe how every chapter topic fits within a supply chain framework in a company or organization in a global operating environment. To this end, two chapters deal directly with supply chain management: Chapter 10, Supply Chain Management: Strategy and Design, and Chapter 11, Global Supply Chain Procurement and Distribution. In addition, Chapter 5, Service Design, reflects the expanding presence and importance of service companies in operations management.

We have also added new material throughout the book on the increasingly important operations management (OM) topics of sustainability, corporate social responsibility, global trade policies, securing the supply chain, and risk and resilience. To show how the OM topics in this new edition fit together within a supply chain framework, we open nearly every chapter with a specific example about Tim Hortons coffee. Tim Hortons is an iconic Canadian brand that not only operates restaurants across the country, but also manages a complex supply chain. Tim Hortons is an ideal company to use as an example to introduce various topics because its supply chain is global, and its production process is interesting and familiar to most Canadians.

This new edition also includes 70 Along the Supply Chain boxes that describe real-world business applications of OM topics at companies around the world. Many of these boxes focus on the increasingly important topics of social responsibility and global supply chains. The boxes conclude with critical-thinking questions that can be used for assignments and in-class or online discussion.

Chapter 1, Introduction to Operations and Supply Chain Management, focuses on examples of excellence in operations management, current issues in operations and supply chain management, and the strategic design of operations and supply chain management. Chapter 2, Quality Management, emphasizes the necessity and use of quality management systems throughout the supply chain, and includes a section on ISO and its most recent updates, including sustainability as part of a company's quality

management system. Chapter 3, Statistical Process Control, introduces statistical process control as essential to ensuring quality along the supply chain.

Chapter 4 has sections on Design for the Environment and Collaborative Product Design Systems. Chapter 5, Service Design, incorporates new statistics on the service economy, the blending of products and services, and service innovations. A streamlined waiting line analysis section is also included in the chapter. Chapter 6, Processes and Technology, emphasizes process analysis skills and includes revised material on the Internet of Things, 3D printing, blockchain, and other new technologies. Chapter 7, Capacity and Facilities Design, incorporates strategies for capacity management, facility selection and design, green facilities, and examples of various service layouts.

Chapter 8, Human Resources, has an increased emphasis on sustainability in the workplace, especially among global suppliers of North American companies, as well as increased attention to employee cultural and diversity issues. Chapter 9, Project Management, has an increased focus on cultural and diversity issues in the management of global projects, several Along the Supply Chain boxes related to sustainability projects, plus sections on project risk and how to manage it. Chapter 10, Supply Chain Management Strategy and Design, has a section on risk and resilience in global supply chains, increased attention to global sustainability issues, and an updated section on SCOR (supply chain operations reference). This chapter also includes two new sections on blockchain and the Internet of Things and how these recent innovations impact supply chain management. Chapter 11, Global Supply Chain Procurement and Distribution, addresses spend analysis, global logistics, and additional issues in sustainability. Chapter 12, Forecasting, includes a section on the increasingly important IT topic of data mining. Chapter 13, Inventory Management, emphasizes its important role in controlling costs along a global supply chain.

Chapter 14 emphasizes the need for effective Sales and Operations Planning and includes a section on revenue management. Chapter 15, Resource Planning, updates resource planning with discussions of cloud computing, in-memory computing, algorithmic decision making, and advanced analytics. Chapter 16 expands Lean Systems to lean services, including lean supply chain and lean and the environment. Chapter 17, Scheduling, incorporates employee scheduling, artificial intelligence, and theory of constraints, along with traditional scheduling methods.

In addition to this new topical coverage, this edition also includes exhibits in nearly every chapter reflecting the latest version of Excel, with Excel files of almost every exhibit available to instructors and students in the course. For instructors, a printable Solutions Manual in Word is supplemented with Excel files for several problems and cases in the text. A digital Instructors Resource Manual outlines each chapter and provides additional examples to be used in class, along with teaching tips, video suggestions, questions for class discussions, and experiential exercises. Additional online material includes Office Hour Videos, Internet Exercises, and Practice Quizzes.

Major Themes

Operations Strategy: Creating Value Along the Supply Chain

A company's plan for being competitive is its strategy. The success of a strategic plan is largely determined by how well a company coordinates all of its internal processes, including operations, with its suppliers and customers to produce products and services that provide value. Throughout this book, we try to show how the functions and processes described in each chapter fit into a company's strategic design for the creation of value. In each chapter, we emphasize the need for considering the overall strategic implications of particular operating decisions.

One way in which companies can gain a competitive edge is by deploying the basic functions of operations management in a more effective manner than their rivals—for example, building a better supply chain. Therefore, we give dozens of examples that explain how companies deploy specific operations functions along their supply chain to provide value and make them successful. Throughout the book, Along the Supply Chain boxes describe how successful companies have gained a competitive edge through operations.

Global Operations

Companies and organizations today must increasingly compete in a global marketplace. The establishment of new trade agreements between countries, innovations in information technology, and improvements in transport and shipping are just a few of the factors that have enabled companies to develop global supply chains. The opening of the global marketplace has only served to introduce more competitors and make competition tougher, thus making strategic supply chain design even more important for achieving success. We have sought to introduce this global aspect of operations into our discussion at every opportunity. In each chapter, we include examples that touch on the impact of global operations relative to the topic under discussion, and we discuss how globalization affects supply chain management.

Sustainability

Environmental concerns are changing every aspect of operations and supply chain management, from product and service design, to supplier sourcing, to manufacture and delivery. In virtually every chapter, we address the impact of sustainability (i.e., meeting present needs without sacrificing future resources) and give examples of green practices. For example, in Chapter 4 on product design, we discuss the design for environment life cycle, eco-labelling, recycling and reuse, and sustainable operations; in Chapter 7 on facilities, we discuss LEED-certified green buildings; in Chapter 10 on supply chain management, we discuss green supply chains; and in Chapter 16 on lean systems, we discuss lean and the environment.

Services and Manufacturing

We have attempted to strike a balance between manufacturing and service operations in this book. Traditionally, operations and supply chain management were thought of almost exclusively in a manufacturing context. However, Canada and other industrialized nations have made a dramatic shift toward service industries. Thus, managing service operations is an important area of study. Operations management processes and techniques are often indistinguishable between service and manufacturing. However, in many other instances, service operations present unique situations and problems that require focused attention and unique solutions. We have tried to reflect the uniqueness of service operations by providing focused discussions on service operations throughout the course. For example, in Chapter 2 on quality management, we specifically address the importance of quality management in service companies; in Chapter 5 on service design, we emphasize the differences in design considerations between manufacturing and services; and in Chapter 14, we discuss aggregate planning in services. One type of service examined in almost every chapter in the book is health care.

Qualitative and Quantitative Processes

We have also attempted to strike a balance between the qualitative (or managerial) aspects of operations management and the quantitative aspects. In the contemporary world of operations management, the quantitative and technological aspects are probably more important than ever. The ability to manage people and resources effectively—to motivate, organize, control, evaluate, and adapt to change—have become critical to competing in today's global markets. Thus, throughout the book we seek to explain and clearly demonstrate how the successful operations manager manages and how to use quantitative techniques and technology when they are applicable. We have also included a balanced mix of qualitative and quantitative questions and problems at the end of each chapter. However, we attempt to present these quantitative topics in a way that's not overly complex or mathematically intimidating. Above all, we want to show how the quantitative topics fit in with, and complement, the qualitative aspects of operations management. We want students to be able to see both *the forest and the trees*.

Teaching and Learning Support Features

The content is accompanied by many features and supplements, for students and instructors.

Pedagogy

A Focus on Learning The Canadian edition focuses on useful and effective pedagogy. We include learning objectives

at the beginning of each chapter that are linked to the end-of-chapter summary as well as to the questions and problem material—ensuring that students understand and are able to apply the most important topics in the course. In addition, the questions and problem material at the end of each chapter provide a balanced approach to covering the qualitative and quantitative aspects of operations and supply chain management.

Along the Supply Chain Boxes These boxes are located in every chapter. They describe the application of operations in a real-world company, organization, or agency related to specific topics in each chapter. They emphasize how companies effectively compete with operations management in the global marketplace. The descriptions of operations at actual companies in these boxes help students understand how specific OM techniques and concepts are used by companies; this also makes the topics and concepts easier to understand. In addition, we have added discussion questions to these boxes to help students and teachers “connect” the example to the chapter topics. A significant number of these boxes provide real-world examples of sustainability, global supply chains, and innovations like the Internet of Things.

Examples The primary means of teaching the various quantitative topics is through examples. These examples are liberally distributed throughout the course and are solved in a clear, straightforward manner to make them easier to understand.

Solved Example Problems At the end of each chapter, just prior to the homework questions and problems, a section with solved examples is included to serve as a guide for the homework problems. These examples are solved in a detailed step-by-step manner.

Summary of Learning Objectives Every chapter ends with a summary linked to the learning objectives, where the key points from the chapter are revisited for a quick study aid.

Summary of Key Formulas These summaries at the end of each chapter and supplement provide all of the key quantitative formulas introduced in the chapter in one location for easy reference.

Summary of Key Terms Located at the end of each chapter, these summaries provide a list of key terms introduced in that chapter and their definitions in one convenient location for quick and easy reference.

Homework Problems, Questions, and Cases Our text contains a large number of end-of-chapter exercises for student assignments. Almost 650 homework problems and 59 more advanced end-of-chapter case problems are included. In addition, 447 end-of-chapter discussion questions are provided. Answers to selected homework problems are included in the back of the book. As we mention in the following Online Resources section, Excel spreadsheet solution files are available to the instructor for the majority of the end-of-chapter problems and cases.

Online Resources www.wiley.com/go/russell-canada The textbook is accompanied by a website that includes learning tools and resources for both students and instructors, which are organized by chapter.

Digital Resources for Students and Instructors

Operations Management, Second Canadian Edition, is completely integrated with WileyPLUS, featuring a suite of teaching and learning resources. WileyPLUS allows students to create a personalized study plan, assess their progress along the way, and access the content and resources needed to master the material. WileyPLUS provides immediate insight into students' strengths and problem areas with visual reports that highlight what's most important for both the instructor and student. Many dynamic resources are integrated into the course to help students build knowledge and understanding, stay motivated, and prepare for decision making in a real-world context. New to the second Canadian edition, WileyPLUS also includes integrated adaptive practice that helps students build proficiency and use study time most effectively. Additional features of the WileyPLUS course include resources for students and instructors.

Resources for Students

Internet Exercises provide up-to-date access to current issues in operations. These add immediacy to classroom discussions and ensure that operations management topics remain relevant to students.

Office Hour Videos provide students with step-by-step solutions to selected problems from each chapter. Videos are prepared by Canadian author, Ignacio Castillo.

Excel Files of Exhibits Excel is used extensively to solve various quantitative problems, and many Excel illustrations are provided throughout the text. Almost every Excel spreadsheet used to prepare the examples in the text is available in WileyPLUS for students and instructors. They are organized by chapter and are listed by their exhibit number. In many cases several sheets in one file are used to display different parts of a problem, such as a graphical solution as well as a numerical solution.

Resources for Instructors

The Instructor's Manual features lecture outlines, teaching notes, experiential exercises, alternate examples to those provided in the text, pause and reflect questions for classroom discussion, and a guide to suggested videos that can be accessed online.

The Test Bank consists of true/false, multiple-choice, short answer, and essay questions. The questions are also available as a Computerized Test Bank in a test-generating program that allows instructors to modify and add questions to customize their exams.

PowerPoint Presentations include outlines for every chapter, exhibits from the text, accompanying lecture notes on each slide, and additional examples.

The Instructor Solutions Manual features detailed answers to end-of-chapter questions, homework problems, and case problems.

Excel Homework Solutions and Excel Exhibit Files are available for almost 650 end-of-chapter homework problems and the bulk of the case problems. Excel solution files for the instructor are provided in WileyPLUS for the majority of these problems. In addition, Smartsheet solution files are provided for most of the homework problems in Chapter 9 (Project Management). Excel worksheets for class handouts or homework assignments are provided for QFD, process flow charts, MRP matrices, and others. Excel exhibit files for every example in the text solved with Excel are provided as templates for solving similar problems for both students and instructors and are available in WileyPLUS.

Data Analytics & Decision-Making Module With the emergence of Data Analytics transforming the business environment, Wiley has partnered with business leaders in the Business-Higher Education Forum (BHEF) to identify the competencies graduates need to be successful in their careers. As a result, WileyPLUS includes a new data analytics module with industry-validated content that prepares operations management students for changing workforce.

Bloomberg Video Activities A new feature in WileyPLUS offers chapter-level graded analysis activities on cutting-edge business video content from Bloomberg. The corresponding video activities challenge students to tie content directly to real-world business scenarios, offering an applied, engaging learning experience to supplement their operations management course.

Adaptive Practice A significant new addition to WileyPLUS for *Operations Management* is integrated adaptive practice that is proven to help students build proficiency, manage study time, and gain mastery.

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Tiffany Bayley and Ignacio Castillo
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Introduction to Operations and Supply Chain Management

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LEARNING OBJECTIVES

After reading this chapter, you will be able to:

- 1.1 Describe what the operations function is and how it relates to other business functions.
- 1.2 Discuss the key factors that have contributed to the evolution of operations and supply chain management.
- 1.3 Discuss how and why businesses operate globally and the importance of globalization in supply chain management.
- 1.4 Calculate and interpret productivity measures used for measuring competitiveness.
- 1.5 Discuss the process of developing, deploying, and monitoring the success of an operations strategy.

WEB RESOURCES FOR THIS CHAPTER INCLUDE

- Excel Exhibits
- Internet Exercises
- Online Practice Quiz
- PowerPoint Lecture Slides
- Virtual Tours
- www.wiley.com/go/russellcanada

Tim Hortons: Every Cup Tells a Story

Tim Hortons was founded based on the promise of making fresh, delicious coffee every time. Customers can easily see the expiry times written in white on the ready-to-serve coffee pots. This time proves that every cup of coffee is served within 20 minutes—or not at all. For Tim Hortons staff, it's a reminder; for customers, it's a guarantee.

But every cup of coffee makes a long journey to get to your local Tim Hortons—a journey closely watched by managers at every step of the supply chain to ensure the quality and value the firm is known for. The journey starts with small coffee producers in Central and South America. From there, the coffee can be traded along its supply chain several times among the producers, intermediaries, exporters, importers, and roasters. Meanwhile, the firm is negotiating with suppliers in Canada for things such as cream, which give rise to the iconic “double-double,” and the packaging for its products. It's also keeping a close eye on other operational costs, including labour, and tries to design new products to keep up with competitors.

In the quick-service restaurant industry, it used to be good enough to provide quality food and drinks at a competitive price. Today, consumers are wanting to know more about the supply chain, and are demanding that businesses show commitment to ethically treating people, animals, and the environment. Tim Hortons has responded by producing sustainability and responsibility reports about their efforts in this area. For example, the company requires suppliers to sign a code of conduct, has committed to using 100% cage-free eggs by 2025, is working with researchers at the University of Guelph to reduce the use of antibiotics, has partnered with a third-party company to certify that its coffee is ethically sourced, and began buying more environmentally friendly palm oil.

Tim Hortons is an excellent example to consider when studying several topics covered in this text. How do they get the coffee beans from growers in South America to Canada? How do they design their restaurants to maximize efficiency? How does the company ensure your local Tims doesn't run out of a product, or that there will be enough staff to keep that line moving quickly? What are the key strategic relationships

with their suppliers? As you'll see, operations management is key to ensuring that customers are happy and that firms along a supply chain are profitable.

In this chapter, we'll learn about the operations function in the business firm, including such issues as productivity, competitiveness, and strategy.

Sources: Restaurant Brands International 2016 Sustainability Report; Tim Hortons 2014 Sustainability and Responsibility Report.

Introduction

Operations management designs, operates, and improves manufacturing and service systems—systems for getting work done. The food you eat, the movies you watch, the stores in which you shop, and the books you read are provided to you by the people in operations. Operations managers are found in banks, hospitals, factories, and government. They design systems, ensure quality, produce products, and deliver services. They work with customers and suppliers, the latest technology, and global partners. They solve problems, reengineer processes, innovate, and integrate. Operations is more than planning and controlling: it's doing. Whether it's superior quality, speed to market, customization, or low cost, excellence in operations is critical to a firm's success.

1.1 The Operations Function

LEARNING OBJECTIVE 1.1

Describe what the operations function is and how it relates to other business functions.

Operations a function or system that transforms inputs into outputs of greater value.

Operations management the design, operation, and improvement of manufacturing and service systems.

Value chain a series of activities from supplier to customer that add value to a product or service.

Operations is often defined as a transformation process. As shown in **Figure 1.1**, inputs (such as material, machines, labour, management, and capital) are transformed into outputs (goods and services). Requirements and feedback from customers are used to adjust factors in the transformation process, which may in turn alter inputs. In **operations management**, we try to ensure that the transformation process is performed efficiently and that the output is of greater *value* than the sum of the inputs. Thus, the role of operations is to create value. The transformation process itself can be viewed as a series of activities along a **value chain** extending from supplier to customer.

The input–transformation–output process is characteristic of a wide variety of operating systems. In an automobile factory, sheet steel is formed into different shapes, painted and finished, and then assembled with thousands of component parts to produce a working automobile. In an aluminum factory, various grades of bauxite are mixed, heated, and cast into ingots of different sizes. In a hospital, patients are helped to become healthier individuals through special care, meals, medication, lab work, and surgical procedures. Obviously, “operations” can take many different forms.

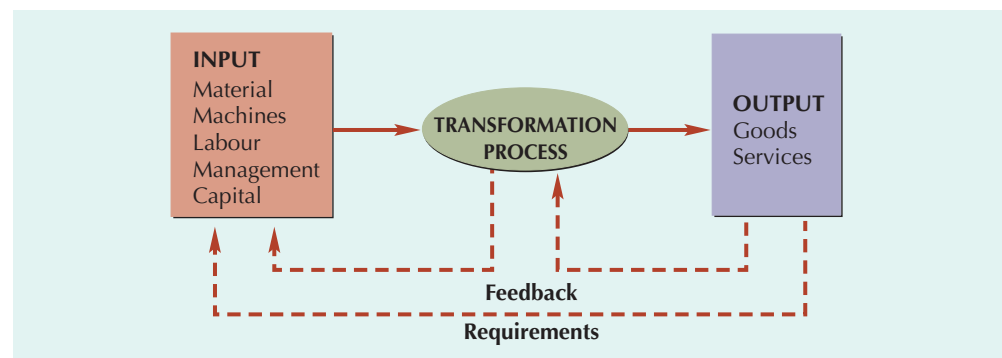


FIGURE 1.1 Operations as a Transformation Process

The transformation process can be

<i>physical,</i>	as in manufacturing operations;
<i>locational,</i>	as in transportation or warehouse operations;
<i>exchange,</i>	as in retail operations;
<i>physiological,</i>	as in health care;
<i>psychological,</i>	as in entertainment; or
<i>informational,</i>	as in communication.

Activities in operations management (OM) include organizing work, selecting processes, arranging layouts, locating facilities, designing jobs, measuring performance, controlling quality, scheduling work, managing inventory, and planning production. Operations managers deal with people, technology, and deadlines. These managers need good technical, conceptual, and behavioural skills. Their activities are closely intertwined with other functional areas of a firm, as described in Along the Supply Chain 1.1.

Along the Supply Chain 1.1

What Do Operations and Supply Chain Managers Do?

Operations and supply chain managers are the *improvement people*, the realistic, hard-nosed, make-it-work, get-it-done people; the planners, coordinators, and negotiators. They perform a variety of tasks in many different types of businesses and organizations.

Let's meet Claire Thielen, director of business intelligence for a health care organization; Ada Liu, division manager for Li & Fung Trading Company; and Erin Hiller, food technologist at a major branded food manufacturer.

Claire Thielen is a health care professional who specializes in decision support, process improvement, and organizational performance. She facilitates interdisciplinary teams as they pursue continuous quality improvement projects and analyzes methods and systems for managing information. Her projects include determining staffing patterns and workflow for computerized scheduling systems; consolidating policies, procedures, and practices for hospital mergers; developing and implementing balanced scorecards and benchmarking reports; designing clinical studies of new medication effectiveness; and conducting training sessions on process mapping and analysis. Claire Thielen improves quality, productivity, and information in the health care sector.

Ada Liu is a division manager for Li & Fung, a global sourcing company. She coordinates global production and distribution for major players in the garment industry. For one particular trouser order, she had the fabric woven in China (for their unique dyeing process), chose fasteners from Hong Kong and Korea (for their

durability), and sent the raw materials to Guatemala for sewing (for their basic skills, low cost, and proximity to Canada). If problems should arise, she can reroute the order to one of the company's 7500 suppliers in 37 countries. Ada Liu is a supply chain expert for Li & Fung.



GA161076/iStock/Getty Images



leaf/iStock/Getty Images



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Erin Hiller is a food technologist at a major food manufacturer. She works in research and development (R&D) devising, developing, and testing new products. For part of her job, she travels to manufacturing plants across the country to monitor the ramp-up of production for consumer food products with new formulas or ingredients. She verifies that correct procedures are being followed, samples and tests output for quality and consistency, and revises formulaic recipes as required. She also evaluates

new and emerging technologies and determines whether they would be beneficial to the product lines and manufacturing operations. Erin Hiller brings fresh designs to the market, keeps operations up to date, and ensures the safety and quality of the foods you eat every day.

Sources: Claire Thielen, LinkedIn, accessed January 4, 2019; Joanne Lee-Young, “Furiously Fast Fashions,” *The Industry Standard Magazine* (June 22, 2001); interview with Erin Hiller (January 3, 2019).

The four primary functional areas of a firm are marketing, finance, operations, and human resources. As shown in **Figure 1.2**, for most firms, operations is the technical core or “hub” of the organization, interacting with the other functional areas and suppliers to produce goods and provide services for customers. For example, to obtain monetary resources for production, operations provides finance and accounting with production and inventory data, capital budgeting requests, and capacity expansion and technology plans. Finance pays workers and suppliers, performs cost analyses, approves capital investments, and communicates requirements of shareholders and financial markets. Marketing provides operations with sales forecasts, customer orders, customer feedback, and information on promotions and product development. Operations, in turn, provides marketing with information on product or service availability, lead-time estimates, order status, and delivery schedules. For personnel needs, operations relies on human resources to recruit, train, evaluate, and compensate workers and to assist with legal issues, job design, and union activities. Outside the organization, operations interacts with suppliers to order materials or services, communicate production and delivery requirements, certify quality, negotiate contracts, and finalize design specifications.

As a field of study, operations brings together many disciplines and provides an integrated view of business organizations. Operations managers are in demand in business, industry, and government. Chief operating officers (COOs) run major corporations, as shown in **Figure 1.3**. Vice-presidents of Operations and Supply Chain Management oversee scores of departments, facilities, and employees. Typical jobs for new university and college graduates include business process analyst, inventory analyst, project coordinator, unit supervisor, supply chain analyst, materials manager, quality assurance specialist, production scheduler, and logistics planner. Even if you do not pursue a career in operations, you’ll be able to use

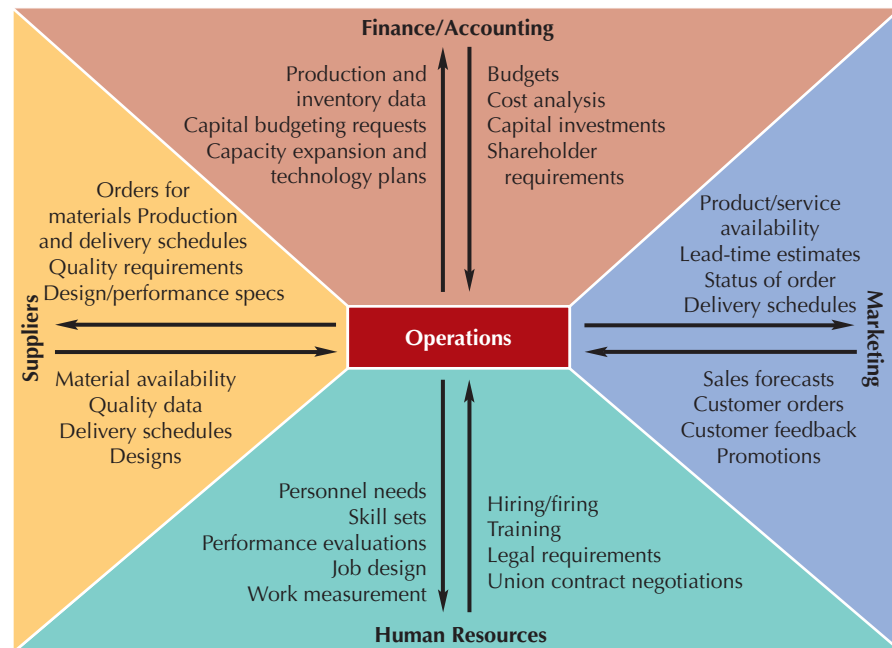


FIGURE 1.2 Operations as the Technical Core

the ideas you learn in this course to organize work, ensure quality, and manage processes. Regardless of your major or concentration area, you can apply some aspect of operations management to your future career—as did Mark, Nicole, Margie, John, Vignesh, and Anastasia, who tell their stories in **Figure 1.4**.

Now that you are aware of how operations might relate to your interests, let's take a brief look at how the field of OM has evolved to its present state.

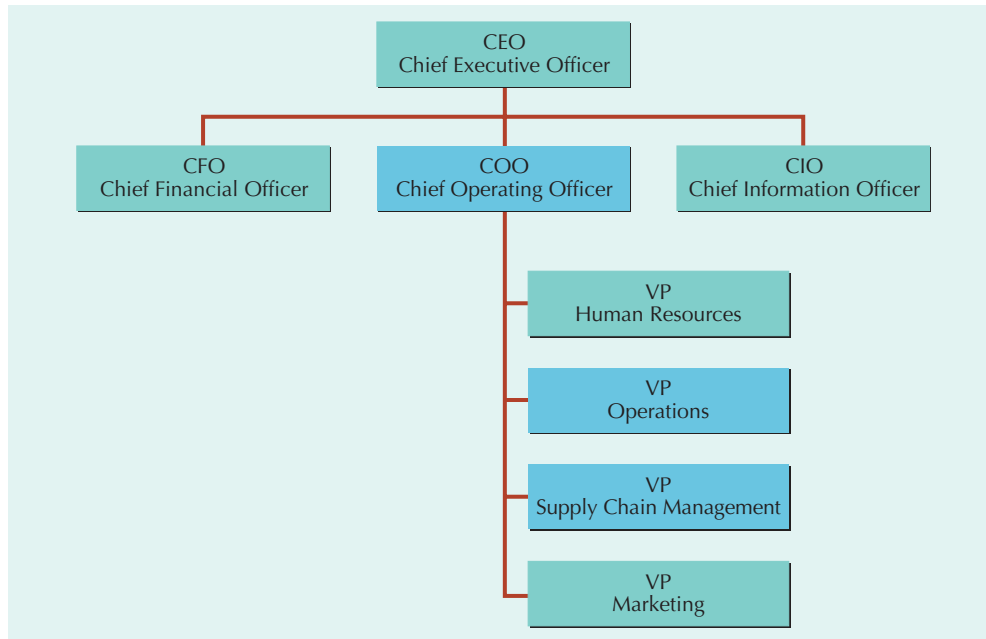


FIGURE 1.3 Sample Organizational Structure



Gino Santa Maria/123RF

MARKETING

Mark: “How can you do a good job marketing a product if you’re unsure of its quality or deliver status?”



HONGQI ZHANG/123RF

MANAGEMENT

Margie: “We use so many things you learn in an operations class—scheduling, lean production, theory of constraints, and tons of quality tools.”



szefei/123RF

ACCOUNTING

Vignesh: “As an auditor you must understand the fundamentals of operations management.”



racorn/123RF

INFORMATION TECHNOLOGY

Nicole: “IT is a tool, and there’s no better place to apply it than in operations.”



Natalia Zhekova/123RF

FINANCE

John: “Most of our capital budgeting requests are from operations, and most of our cost savings, too.”



Rocketclips, Inc./
Shutterstock.com

ECONOMICS

Anastasia: “It’s all about processes. I live by flowcharts and Pareto analysis.”

FIGURE 1.4 How Is Operations Relevant to My Major or Concentration Area?

1.2 The Evolution of Operations and Supply Chain Management

LEARNING OBJECTIVE 1.2

Discuss the key factors that have contributed to the evolution of operations and supply chain management.

Craft production the process of handcrafting products or services for individual customers.

Division of labour the separation of a job into a series of small tasks, each performed by a different worker.

Interchangeable parts the standardization of parts, initially as replacement parts, which enabled mass production.

Scientific management the systematic analysis of work methods.

Mass production the high-volume production of a standardized product for a mass market.

Although history is full of amazing production feats—the pyramids of Egypt, the Great Wall of China, the roads and aqueducts of Rome—the widespread production of consumer goods and, thus, operations management, did not begin until the Industrial Revolution in the 1700s. Prior to that time, skilled craftspersons and their apprentices fashioned goods for individual customers from studios in their own homes. Every piece was unique, hand-fitted, and made entirely by one person, a process known as **craft production**. Although craft production still exists today, the availability of coal, iron ore, and steam power set into motion a series of industrial inventions that revolutionized the way work was performed. Great mechanically powered machines replaced the labourer as the primary factor of production and brought workers to a central location to perform tasks under the direction of an “overseer” in a place called a “factory.” The revolution first took hold in textile mills, grain mills, metalworking, and machine-making facilities.

Around the same time, Adam Smith’s *Wealth of Nations* (1776) proposed the **division of labour**, in which the production process was broken down into a series of small tasks, each performed by a different worker. The specialization of the workers on limited, repetitive tasks allowed them to become very proficient at those tasks and further encouraged the development of specialized machinery.

The introduction of **interchangeable parts** by Eli Whitney (1790s) allowed the manufacture of firearms, clocks, watches, sewing machines, and other goods to shift from customized one-at-a-time production to volume production of standardized parts. This meant the factory needed a system of measurements and inspection, a standard method of production, and supervisors to check the quality of the worker’s production.

Advances in technology continued through the 1800s. Cost accounting and other control systems were developed, but management theory and practice were virtually nonexistent.

In the early 1900s, an enterprising labourer (and later chief engineer) at Midvale Steel Works named Frederick W. Taylor approached the management of work as a science. Based on observation, measurement, and analysis, he identified the best method for performing each job. Once determined, the methods were standardized for all workers, and economic incentives were established to encourage workers to follow the standards. Taylor’s philosophy became known as **scientific management**. His ideas were embraced and extended by efficiency experts Frank and Lillian Gilbreth, Henry Gantt, and others. One of Taylor’s biggest advocates was Henry Ford.

Henry Ford applied scientific management to the production of the Model T in 1913 and reduced the time required to assemble a car from a high of 728 hours to 1½ hours. A Model T chassis moved slowly down a conveyor belt with six workers walking alongside it, picking up parts from carefully spaced piles on the floor and fitting them to the chassis.¹ The short assembly time per car allowed the Model T to be produced in high volumes, or “en masse,” yielding the name **mass production**.

Manufacturers became adept at mass production over the next 50 years and easily dominated manufacturing worldwide. The human relations movement of the 1930s, led by Elton Mayo and the Hawthorne studies, introduced the idea that worker motivation, as well as the technical aspects of work, affected productivity. Theories of motivation were developed by Frederick Herzberg, Abraham Maslow, Douglas McGregor, and others. Quantitative models

¹David Halberstam, *The Reckoning* (New York: William Morrow, 1986), pp. 79–81.

and techniques spawned by the operations research groups of World War II continued to develop and were applied successfully to manufacturing and services. Computers and automation led still another upsurge in technological advancements applied to operations. These events are summarized in **Table 1.1**. Many of these events and concepts will be discussed in later chapters.

From the Industrial Revolution through the 1960s, North America was the world's greatest producer of goods and services, as well as the major source of managerial and technical expertise. But in the 1970s and 1980s, industry by industry, Canadian and U.S. manufacturing

TABLE 1.1 Historical Events in Operations Management

Era	Events/Concepts	Dates	Originator
Industrial Revolution	Steam engine	1769	James Watt
	Division of labour	1776	Adam Smith
	Interchangeable parts	1790	Eli Whitney
Scientific Management	Principles of scientific management	1911	Frederick W. Taylor
	Time and motion studies	1911	Frank and Lillian Gilbreth
	Activity scheduling chart	1912	Henry Gantt
	Moving assembly line	1913	Henry Ford
Human Relations	Hawthorne studies	1930	Elton Mayo
	Motivation theories	1940s	Abraham Maslow
		1950s	Frederick Herzberg
		1960s	Douglas McGregor
Operations Research	Linear programming	1947	George Dantzig
	Digital computer	1951	Remington Rand
	Simulation, waiting line theory, decision theory	1950s	Operations research groups
	PERT/CPM	1960s	
	MRP, EDI, EFT, CIM	1970s	Joseph Orlicky, IBM, and others
Quality Revolution	JIT (just-in-time)	1970s	Taichi Ohno (Toyota)
	TQM (total quality management)	1980s	W. Edwards Deming, Joseph Juran
	Strategy and operations		Wickham Skinner, Robert Hayes
	Reengineering	1990s	Michael Hammer, James Champy
	Six Sigma	1990s	GE, Motorola
Internet Revolution	Internet, WWW	1990s	ARPANET, Tim Berners-Lee
	ERP, supply chain management		SAP, i2 Technologies, Oracle, Dell, Apple
	E-commerce, social networking	2000s	Amazon, Yahoo, eBay, Google, Facebook, YouTube, Twitter, etc.
Globalization	World Trade Organization	1990s	GATT
	European Union	2000s	Europe
	Global supply chains		China, India
	Outsourcing		Emerging economies
	Service science		
Sustainability	Global warming	2010s, Today	Numerous scientists, statesmen, governments
	Carbon footprint		
	Green products		
	Corporate social responsibility (CSR)		
	UN Global Compact		
Digital Revolution	Big data, Internet of Things (IoT), 3D printing, smart cities, autonomous vehicles, drones, privacy, and security		Google, Apache, Procter & Gamble, MIT, Amazon, and others

superiority was challenged by lower costs and higher quality from foreign manufacturers, led by Japan. Several studies published during those years confirmed what the consumer already knew—Canadian- and U.S.-made products of that era were inferior and could not compete on the world market. Early rationalizations that the Japanese success in manufacturing was a cultural phenomenon were disproved by the successes of Japanese-owned plants in Canada and the United States, such as the Matsushita purchase of a failing Quasar television plant in Chicago from Motorola. Part of the purchase contract specified that Matsushita had to retain the entire hourly workforce of 1000 persons. After only two years, with the same workers, half the management staff, and little or no capital investment, Matsushita doubled production, cut assembly repairs from 130% to 6%, and reduced warranty costs from \$16 million a year to \$2 million a year. You can bet Motorola took notice, as did the rest of Canadian and U.S. industry.

Quality revolution an emphasis on quality and the strategic role of operations.

Lean production an adaptation of mass production that prizes quality and flexibility.

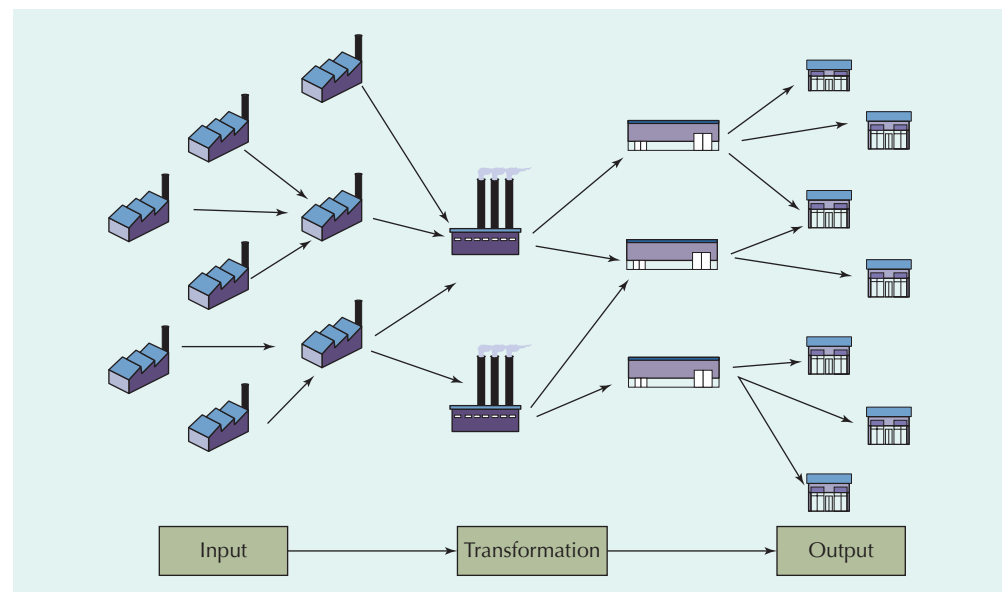
The **quality revolution** brought with it a realization that production should be tied to consumer demand. Product proliferation, shortened product life cycles, shortened product development times, changes in technology, more customized products, and segmented markets did not fit mass production assumptions. Using a concept known as just-in-time, Toyota changed the rules of production from mass production to **lean production**, a system that prizes flexibility (rather than efficiency) and quality (rather than quantity).

The renewed emphasis on quality and the *strategic importance* of operations made some Canadian and U.S. companies competitive again. Others continued to stagnate, buoyed temporarily by the expanding economies of the Internet era and globalization. Productivity soared as return on investment in information technology finally came to fruition. New types of businesses and business models emerged, such as Amazon, Google, and eBay, and companies used the Internet to connect with customers and suppliers around the world. The inflated expectations of the dot-com era came to an end and brought many companies back to reality, searching for ways to cut costs and survive in a global economy. They found relief in the emerging economies of China and India, and began accelerating the outsourcing of not only goods production, but services, such as information technology, call centres, and other business processes. The outsourcing of business processes brought with it a new awareness of business-to-business (B2B) services and the need for viewing services as a science.

With more and more activities taking place outside the enterprise in factories, distribution centres, offices, and stores overseas, managers needed to develop skills in coordinating operations across a global supply chain. The field of **supply chain management** was born to manage the flow of information, products, and services across a network of customers, enterprises, and supply chain partners. In Figure 1.1, we depicted operations as a transformation process. Extending that analogy in **Figure 1.5**, supply chain management concentrates on the input and output sides of transformation processes. Increasingly, however, as

Supply chain management the management of the flow of information, products, and services across a network of customers, enterprises, and suppliers.

FIGURE 1.5 Supply Chain Management



the transformation process is performed by suppliers who may be located around the world, the supply chain manager is also concerned with the timeliness, quality, and legalities of the supplier's operations.

The era of globalization was in full swing in 2008 when a financial crisis brought on by risky loans, inflated expectations, and unsavoury financial practices brought the global economy to a standstill. Operations and supply chain management practices based on assumptions of growth had to be re-evaluated for declining markets and resources. Companies began to reassess the value of their businesses, their customers, and their suppliers by focusing on the most critical factors to sustain their business through the downturn.

Thus began the *era of sustainability*, in which countries, companies, and industries evaluated what it takes to sustain the health of their enterprise or people in the long term. This is especially important in light of climate change, natural and man-made disasters, scarcity of resources, and the competitive landscape.

A concept related to sustainability is **resilience**, the ability to bounce back, change, or adapt in response to a disaster, failure, or disruption. Globalization has increased the risk of disruptions in operations and supply chain activities, but it has also provided more flexibility in responding to disruptions.

In the midst of a global concern about trade and sustainability comes dramatic new technology ushering in the *digital revolution*. Smart materials, smart phones, smart appliances, smart cars, even smart cities contain sensors that collect data, connect with networks, and have the ability to control processes and affect behaviour. This explosion of the Internet of Things (IoT) has been accompanied by new platforms for consuming products and services, the immediacy of which has raised consumer expectations and amped up innovation. Wearable technology, 3D printing, 5G networks, the sharing economy, and autonomous vehicles are just some of the results of the digital revolution. This is indeed an exciting time for innovation and technology.

We discuss technology at length later in the text, but we should note that new technologies also bring risk. The ubiquitous collection of huge amounts of data on individuals leads to privacy concerns. Companies permitted to collect data must also be stewards of that data. Concentrating the power of technology in a few dominant corporations is a risky situation, especially when it may be difficult to regulate industries whose technology may not be fully understood. The digital revolution also highlights a digital divide that may form between those who can afford the new technology and those who cannot. These are all issues that have been faced by previous generations with technologies that were new and different in their times. Yet it is wise to be diligent as we make decisions for ourselves and our companies. In the next section, we delve more deeply into the effect of globalization on operations and supply chain management.

Resilience the ability to bounce back, change, or adapt in response to a disaster, failure, or disruption.

1.3 Globalization

LEARNING OBJECTIVE 1.3

Discuss how and why businesses operate globally and the importance of globalization in supply chain management.

More than two-thirds of today's businesses operate globally through global markets, global operations, global financing, and global supply chains. Globalization can take the form of selling in foreign markets, producing in foreign lands, purchasing from foreign suppliers, or partnering with foreign firms (see Along the Supply Chain 1.2). Companies "go global" to take advantage of favourable costs, to gain access to international markets, to be more responsive to changes in demand, to build reliable sources of supply, and to keep abreast of the latest trends and technologies.

Falling trade barriers and the Internet paved the way for globalization. The World Trade Organization (WTO) has opened up the heavily protected industries of agriculture, textiles, and telecommunications, and extended the scope of international trade rules to cover