

# Chapter 1

## Operations and Productivity

### Background

Operations management has created industry giants. The Ritz-Carlton Hotel Company's mission is to provide an outstanding customer experience through a complete focus on quality management. UPS operates trucks that run for 20 years because their drivers care. Disney has made a science of accurate forecasts and queuing theory. Darden restaurants (Olive Garden and others) view operations as their strategy for success. Frito-Lay dominates the snack market by keeping fresh snacks on the shelves with a production process that converts raw materials into a bag of chips sitting in a grocery store in as little as a day or two.

The importance of operations management can be highlighted early in the course with humorous videos or stories about "operations gone wrong." Most people can share "disaster" stories about poor experiences that they have had dealing with companies.

It can be useful as well to spend some class time right away on the job market for operations management majors, showing starting salaries and job titles compared to other business majors. It can also be helpful to find an MBA program with a strong operations focus and display the starting salaries of those graduates. (Such data are available on many MBA program websites.) Instructors can also share research results showing that (1) more CEOs "learn the ropes" by coming up through operations than any other functional area, and (2) Chief Operating Officer salaries tend to be approximately 10% higher than the salaries of the other "Chiefs" (CFO, CMO, and CIO).

Videos from recent graduates who now work in some aspect of operations management are available in MyLab Operations Management. These 2- to 4-minute video clips feature young professionals talking about their jobs in the gamut of OM functions—each tied to a specific chapter and accompanied by multiple-choice quizzes that may be assigned.

### Class Discussion Ideas

1. Choose an organization the students will be familiar with and ask them to identify and describe the product of that organization. Direct the discussion to highlight the complex nature of the product offerings of most organizations today where product and service elements are found to some degree in almost all organizations.
2. Have the students choose a few different tasks or jobs and identify possible productivity measures for these. They should describe how they would go about making the necessary measurements. Student and faculty productivity are easy examples that can generate quite a bit of discussion. One possible way to start the discussion is to ask whether grades or research output is an effective measure of student and faculty productivity, respectively.

## Active Classroom Learning Exercises

1. Labor productivity is sometimes perceived to be driven by employee motivation. Have the students split up into small groups to discuss effective ways to motivate hourly employees vs. salaried managers. If productivity of these workers is below expectation, what are good and poor ways to try to motivate them? What methods might work well with blue collar employees but not white collar employees, and vice versa? What methods might work well in the short run but not in the long run, and vice versa? Have each student group report its ideas to the whole class. (And if any group has little to say, ask them what could have been done to motivate them to do better!)
2. Companies often locate in other countries to take advantage of low wage rates. However, the difference in labor costs should be adjusted to account for productivity differences among the workers in the two locations. One way to do this is to compute a “relative wage rate”  $R$  of operating in another country. Note that  $R$  is not the actual wage rate paid, but it is the hourly wage rate of operating in another country *relative* to the home country, after taking productivity differences into account. If the foreign country’s workers are more productive,  $R$  will decrease, and vice versa. The formula is  $R = (W \div X)(U \div F)$ , where  $W$  = the foreign wage rate (in foreign currency per hour),  $X$  = the exchange rate (in foreign currency per local currency),  $U$  = home country productivity (in units per hour), and  $F$  = foreign country productivity (in units per hour).

A problem could be described as follows. Suppose that workers in Britain earn £10/hour. The exchange rate with the U.S. is \$1.5 per £1. American workers can produce 40 units per hour, while British workers at a similar facility can produce 50 units per hour. If the U.S. wage rate is \$14 per hour, should the firm produce in the U.S. or in Britain?

Have the students try the exercise in class. They will probably analyze this problem by computing a labor cost per unit in each country (35 cents vs. 30 cents). Then introduce the concept and formula for relative wage rate ( $R = \$12$  in Britain). Both approaches are equally accurate, but using a relative wage rate has political advantages, i.e., it seems easier to talk about one wage rate vs. another (\$14 vs. \$12) as opposed to comparing costs per unit (35 cents vs. 30 cents).

3. A Class Exercise Relating Productivity and the Olympics (Guest Post by Howard Weiss)  
<https://heizerrenderom.wordpress.com/2014/02/17/guest-post-a-class-exercise-relating-productivity-and-the-olympics/>
4. A First Day of Class OM Exercise (Guest Post by Steven Harrod)  
<https://heizerrenderom.wordpress.com/2013/07/11/guest-post-a-first-day-of-class-om-exercise/>

## Company Videos

1. *Frito-Lay: Operations Management in Manufacturing (7:11)*  
Frito-Lay, a subsidiary of PepsiCo, has over 40 product lines, seven of which having sales exceeding \$1 billion *each*. In this video, the textbook authors review the 10 OM strategy decisions and briefly describe how Frito-Lay addresses each one. For example, the company is constantly innovating with new products. For quality assurance, it uses multiple inspection points both within and outside the factory, and it utilizes statistical process control. The plant applies a product focus strategy, which is appropriate for a high-volume, low-variety producer. As raw materials are perishable and shelf life is relatively short, plant location decisions are driven by proximity to raw materials or markets. The plant has low employee turnover, driven by good benefits, respect for people, and a strong concern for safety and ergonomics. Inventory levels are quite low, and inventory is turned over 200 times per

year. Potatoes are delivered 10 times per day. Schedules are driven by demand forecasts and adjusted for local events, such as the annual Daytona 500 auto race. All of these practices, along with excellent layout, supply chain, and maintenance policies, have helped to make Frito-Lay the world's largest snack manufacturer.

If the video is shown before the 10 OM decisions are covered, prior to showing the video, the instructor could ask the students to list the major decisions that they think operations managers make. Afterwards, the 10 decisions from the book can be compared to the students' lists. Then the instructor can choose a different company, perhaps a service organization, with which students might be familiar. The class could try to identify ways in which that organization addresses the 10 decisions and perhaps compare those to some of Frito-Lay's tactics.

2. *Hard Rock Cafe: Operations Management in Services (8:26)*

Hard Rock is interesting because it's so much more than just a restaurant. Management speaks about its "experience strategy," which, in addition to quality food, includes rock-and-roll memorabilia, music, lighting, jovial staff, and a retail store. The video is sprinkled with scenes of happy employees dancing around or volunteering in the community. Most of the video is spent covering how Hard Rock Cafe approaches some of the 10 operations management decisions. For example: (1) scheduling is driven by forecasts that are based on prior sales, seasonality, recent trends, and current local events; (2) cafe layout focuses on maximizing the customer experience and driving customers toward revenue-generating activities; and (3) inventory management goes well beyond the inventory of food and retail items—Hard Rock has a \$40 million inventory of rock-and-roll memorabilia to manage, and each restaurant goes through a complete changeover of memorabilia every 5-7 years.

As an entertaining piece and one that covers a variety of OM decisions, this is certainly a good video to show early in the course when discussing Chapter 1. Many students will have eaten at a Hard Rock Cafe themselves, and most should enjoy seeing memorabilia from rock stars such as Madonna and KISS. This is also a good way, early in the course, to show that operations management is just as important in services as it is in manufacturing. Prior to showing the video, the instructor might ask the students to think about the 10 OM decisions and how Hard Rock approaches them. Afterwards, discussion might revolve around aspects of those decisions that are unique to service businesses in general and then to Hard Rock Cafe in particular. Two clear differences about Hard Rock Cafe itself are: (1) because of and contributing to such successful branding, the cafe's retail sales (shirts, etc.) account for nearly the same amount of revenue as the main product (the food) itself; and (2) the management of the memorabilia around the world represents a unique and extremely important management effort on its own.

3. *Celebrity Cruises: Operations Management at Sea (6:39)*

A Celebrity Cruise ship is a floating "city on the sea," with a world-class hotel sitting on top of a power plant. This video describes how the 10 OM decisions affect the outcome of every voyage. Celebrity must manage both shoreline and marine operations. The *design* decision includes numerous features, including the physical ship itself, the food, and shore excursions. The floating city houses tens of thousands of SKUs, which must be loaded quickly when the ship is docked and meticulously managed to have everything in place when needed. The *maintenance* decision is especially important for a cruise ship because human lives are at stake and mechanical problems could ruin a voyage. Celebrity ships undergo complete dry-dock maintenance every 2–5 years. The international crews stay with the company for an impressive 5–7 years, which no doubt contributes heavily to Celebrity's quality image, including being named the Best Premium Cruise line for 9 consecutive years.

Prior to showing the video, instructors might ask students to list all of the different types of decisions that they think operations managers of a cruise line would need to make, both in the corporate office

for all of their ships as well as for an individual cruise on a specific ship. Afterwards, it could be interesting to compare the aggregate student responses to the 10 OM decisions, placing special emphasis on the decisions that students didn't identify. As with most any service business, employees can make all the difference. Class discussion could revolve around Celebrity's impressively low turnover rate. How can the firm attract and retain the best talent? How can management ensure a constantly friendly staff? What types of general training should all staff undergo when first hired?

## Cinematic Ticklers

1. *Fawlty Towers: "Waldorf Salad"* (John Cleese and Prunella Scales), CBS/FOX VIDEO, 1986 (1979)  
This can actually be the first thing done in class all semester. The very start of the episode contains a funny scene about suppertime in the dining room of a bed and breakfast in England. The owners and staff make numerous errors. A class discussion can directly follow, listing what went well (almost nothing) and what didn't (many things). This clip can start a course off well because: (1) it's a very easy way to create an atmosphere of student participation right away in the course because identifying poor operations is easy in this clip, (2) it emphasizes right away that operations management applies to services, not just manufacturing, and (3) it's a fun way to begin a course.
2. *The Simpsons, Season 7: "King-Size Homer,"* 20<sup>th</sup> Century Fox Video, 2006 (1995-1996)  
Homer gets so fat that he is allowed to work from home. He realizes that he can triple his productivity by just pressing "Y" on his computer instead of typing "YES."
3. *The Simpsons, Season 8: "You Only Move Twice,"* 20<sup>th</sup> Century Fox Video, 2006 (1996-1997)  
Homer gets a new job working for a James Bond-like villain. He is put in charge of a set of three workers. It's his job to motivate them. As they type along, Homer asks if they are working. "Yes," they reply. "Can you work any faster than that?" he asks. "Sure thing, Mr. Simpson," they say, as they start typing faster. (If only motivation were that easy.)
4. *Modern Times* (Charlie Chaplin), CBS/FOX VIDEO, 1992 (1936)  
The movie deals with worker alienation in an assembly line environment and offers an interesting historical perspective on early Taylorism. Interesting issues arise, including workers having to clock out to go to the bathroom, the automatic assembly line being sped up as the day wears on, sneezing or scratching being enough to make one behind on his or her work, and, most importantly, the dehumanization of early assembly line work.

## Jay, Barry, and Chuck's OM Blog

1. *OM in the News: Seven Jobs Robots Will Create*  
The newest generation of robots continues to replace human jobs, but the existence of robots also creates new job opportunities—perhaps 20–50 million globally by 2030. Seven such new jobs include: AI builders, customer-robot liaisons, robot managers, data labelers, drone-performance artists, AI lab scientists, and safety & test drivers.

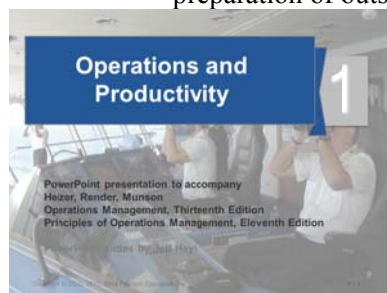
<https://heizerrenderom.wordpress.com/2018/05/07/om-in-the-news-seven-jobs-robots-will-create/>

2. *OM in the News: Machines are Making Your Sushi, and That's Good*  
 Services have lagged behind other sectors in spending on labor-saving equipment, but that is beginning to change. A sushi robot can churn out 200 precisely calibrated sushi rolls per hour compared to approximately 50 per human chef. Given the rising chef shortage, that's a good thing.  
<https://heizerrenderom.wordpress.com/2018/01/07/om-in-the-news-machines-are-making-your-sushi-and-thats-good/>
  
3. *OM in the News: Robots Aren't Destroying Enough Jobs*  
 "Too many sectors, such as health care or personal services, are so resistant to automation that they are holding back the entire country's standard of living." (*The Wall Street Journal*, 5/11/17) By enabling society to produce more with the same workers, automation is a major driver of rising standards of living.  
<https://heizerrenderom.wordpress.com/2017/05/15/om-in-the-news-robots-arent-destroying-enough-jobs/>
  
4. *OM in the News: German Apprenticeships in South Carolina*  
 BMW's plant in Spartanburg, SC, trains 100 apprentices at any given time. This practice contributes to a skilled and motivated American workforce as an alternative to a college education. That approach in Germany has provided a solid return on companies' investment, helped them to innovate, and contributed to warm relations between employers and employees.  
<https://heizerrenderom.wordpress.com/2017/05/12/om-in-the-news-german-apprenticeships-in-south-carolina/>

## Presentation Slides

### INTRODUCTION (1-1 through 1-6)

Slide 4: This Global Company Profile from the first chapter helps to illustrate the wide variety of decisions that an operations manager must face. In the case of Hard Rock Cafe, the "product" includes more than tasty meals—the layout, the memorabilia on display, and the service all encompass the dining package at Hard Rock that consumers now expect. The meals themselves are designed, tested, and then analyzed for the cost of ingredients, labor requirements, and customer satisfaction. Among other tasks, the operations manager must consider both the attractiveness and efficiency of restaurant layout, supplier quality and reliability, employee motivation and training, maintenance of tight schedules, and preparation of outstanding meals.



1-1

#### Outline

- ▶ Global Company Profile: *Hard Rock Cafe*
- ▶ What Is Operations Management?
- ▶ Organizing to Produce Goods and Services
- ▶ The Supply Chain
- ▶ Why Study OM?
- ▶ What Operations Managers Do

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1-2

#### Outline - Continued

- ▶ The Heritage of Operations Management
- ▶ Operations for Goods and Services
- ▶ The Productivity Challenge
- ▶ Current Challenges in Operations Management
- ▶ Ethics, Social Responsibility, and Sustainability

1-2

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1-3

1-3

### Operations Management at Hard Rock Cafe

- ▶ First opened in 1971
- ▶ Now – 23 hotels and 168 restaurants in over 68 countries
- ▶ Rock music memorabilia
- ▶ Creates value in the form of good food and entertainment
- ▶ 3,500+ custom meals per day in Orlando
- ▶ How does an item get on the menu?
- ▶ Role of the Operations Manager

1-4

### Learning Objectives

When you complete this chapter you should be able to:

- 1.1 **Define** operations management
- 1.2 **Identify** the 10 strategic decisions of operations management
- 1.3 **Identify** career opportunities in operations management
- 1.4 **Explain** the distinction between goods and services

1-5

### Learning Objectives

When you complete this chapter you should be able to:

- 1.5 **Explain** the difference between production and productivity
- 1.6 **Compute** single-factor productivity
- 1.7 **Compute** multifactor productivity
- 1.8 **Identify** the critical variables in enhancing productivity

1-6

## WHAT IS OPERATIONS MANAGEMENT? (1-7)

Slide 7: Starting with the Hard Rock Cafe example, it is important to stress from the very beginning of the course that operations management applies just as much to service businesses as to manufacturing businesses.

### What Is Operations Management?

**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

1-7

## ORGANIZING TO PRODUCE GOODS AND SERVICES (1-8 through 1-11)

Slide 8: To create goods and services, all organizations must perform the three functions identified on this slide. Firms must create demand, satisfy that demand, and manage and monitor the financial flows associated with creating and satisfying that demand.

Slides 9-11: These slides (Figure 1.1) present example organization charts from three different companies. The areas in blue indicate the significant role that operations management plays in both manufacturing and service firms.

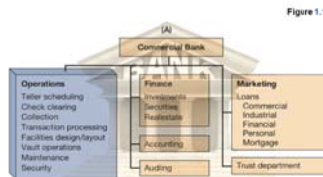
### Organizing to Produce Goods and Services

▶ Essential functions:

1. **Marketing** – generates demand
2. **Production/operations** – creates the product
3. **Finance/accounting** – tracks how well the organization is doing, pays bills, collects the money

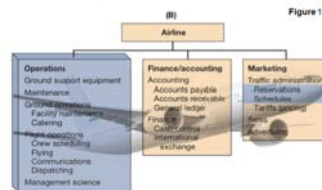
1-8

### Organization Charts



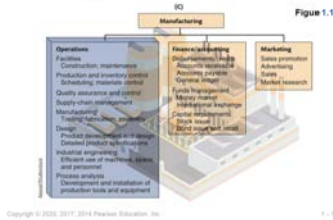
1-9

### Organization Charts



1-10

### Organization Charts



1-11

### THE SUPPLY CHAIN (1-12)

Slide 12: The supply chain is described right at the beginning of the book to emphasize that competition is no longer between companies; it is between *supply chains*. Companies no longer try to do everything themselves. Rather, they outsource numerous functions and activities to specialized providers. Supply chains that have members who effectively collaborate foster an enormous competitive advantage. Chapter 11, Supplement 11, and part of Chapter 2 provide comprehensive coverage of this topic.

#### The Supply Chain

- ▶ A global network of organizations and activities that supplies a firm with goods and services
- ▶ Members of the supply chain collaborate to achieve high levels of customer satisfaction, efficiency and competitive advantage



1-12

### WHY STUDY OM? (1-13 through 1-14)

Slides 13-14: These slides can be used early on in the course to help “sell” the usefulness and importance of the class. In most cases, a large percentage of revenue is spent on the OM function. Slide 14 (Example 1) shows a common circumstance, that is, often the best and easiest way to meet improved contribution targets is through finding efficiencies in operations. In this particular example, the hefty requirements for the marketing and finance options might make them infeasible anyway.

#### Why Study OM?

1. OM is one of three major functions of any organization; we want to study *how people organize themselves for productive enterprise*
2. We want (*and need*) to know *how goods and services are produced*
3. We want to *understand what operations managers do*
4. OM is *such a costly part of an organization*

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1-13

#### Options for Increasing Contribution

**TABLE 1.1**

|               | CURRENT   | MARKETING OPTION           |                          | FINANCE ACCOUNTING OPTION |                             | OM OPTION |  |
|---------------|-----------|----------------------------|--------------------------|---------------------------|-----------------------------|-----------|--|
|               |           | INCREASE SALES REVENUE 50% | REDUCE FINANCE COSTS 50% | REDUCE FINANCE COSTS 50%  | REDUCE PRODUCTION COSTS 20% |           |  |
| Sales         | \$100,000 | \$150,000                  | \$100,000                | \$100,000                 |                             |           |  |
| Cost of goods | -80,000   | -120,000                   | -80,000                  | -80,000                   |                             |           |  |
| Gross margin  | 20,000    | 30,000                     | 20,000                   | 20,000                    |                             |           |  |
| Finance costs | -4,000    | -4,000                     | -3,000                   | -4,000                    |                             |           |  |
| Subtotal      | 14,000    | 24,000                     | 17,000                   | 16,000                    |                             |           |  |
| Taxes at 25%  | -3,500    | -6,000                     | -4,250                   | -4,000                    |                             |           |  |
| Contribution  | \$ 10,500 | \$ 18,000                  | \$ 12,750                | \$ 12,000                 |                             |           |  |

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1-14

### WHAT OPERATIONS MANAGERS DO (1-15 through 1-24)

Slide 15: All good managers, including operations managers, perform the basic management functions identified in this slide.

Slides 16-21: The 10 strategic OM decisions are useful to cover one by one, not only as a precursor to the rest of the text, but also to emphasize the wide array of responsibilities that are under an operation manager’s jurisdiction. Slide 16 maps them to the rest of the text, while Slides 17-21 provide examples for each decision of issues that the operations manager must address.

Slides 22-24: Salary information pertaining to local students (perhaps with help from the university’s career center) can be combined with Slides 22 through 24 to help sell the operations management field as a viable career option for students. A very common entry-level position for OM majors is in the *purchasing* area of organizations. Slide 23 (Figure 1.3) identifies several of the many types of career opportunities that exist for operations managers. The organizations identified in Slide 24 provide various certifications that may help forward students’ careers. The Six Sigma Green Belt and Black Belt certifications offered through the American Society for Quality represent particularly highly sought-after acknowledgements of professional expertise.

### What Operations Managers Do

**Basic Management Functions**

- ▶ Planning
- ▶ Organizing
- ▶ Staffing
- ▶ Leading
- ▶ Controlling



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1-15

### Ten Strategic Decisions

| DECISION                          | CHAPTER(S)        |
|-----------------------------------|-------------------|
| 1. Design of goods and services   | 5, Supplement 5   |
| 2. Managing quality               | 6, Supplement 6   |
| 3. Process and capacity strategy  | 7, Supplement 7   |
| 4. Location strategy              | 8                 |
| 5. Layout strategy                | 9                 |
| 6. Human resources and job design | 10                |
| 7. Supply-chain management        | 11, Supplement 11 |
| 8. Inventory management           | 12, 14, 16        |
| 9. Scheduling                     | 13, 15            |
| 10. Maintenance                   | 17                |

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1-16

### The Strategic Decisions

- Design of goods and services**
  - ▶ Defines what is required of operations
  - ▶ Product design determines cost, quality, sustainability and human resources
- Managing quality**
  - ▶ Determine the customer’s quality expectations
  - ▶ Establish policies and procedures to identify and achieve that quality

Table 1.2 (cont.) 1-17

1-17

### The Strategic Decisions

- Process and capacity design**
  - ▶ How is a good or service produced?
  - ▶ Commits management to specific technology, quality, human resources, and investments
- Location strategy**
  - ▶ Nearness to customers, suppliers, and talent
  - ▶ Considering costs, infrastructure, logistics, and government

Table 1.2 (cont.) 1-18

1-18

### The Strategic Decisions

- Layout strategy**
  - ▶ Integrate capacity needs, personnel levels, technology, and inventory
  - ▶ Determine the efficient flow of materials, people, and information
- Human resources and job design**
  - ▶ Recruit, motivate, and retain personnel with the required talent and skills
  - ▶ Integral and expensive part of the total system design

Table 1.2 (cont.) 1-19

1-19

### The Strategic Decisions

- Supply chain management**
  - ▶ Integrate supply chain into the firm’s strategy
  - ▶ Determine what is to be purchased, from whom, and under what conditions
- Inventory management**
  - ▶ Inventory ordering and holding decisions
  - ▶ Optimize considering customer satisfaction, supplier capability, and production schedules

Table 1.2 (cont.) 1-20

1-20

### The Strategic Decisions

- Scheduling**
  - ▶ Determine and implement intermediate- and short-term schedules
  - ▶ Utilize personnel and facilities while meeting customer demands
- Maintenance**
  - ▶ Consider facility capacity, production demands, and personnel
  - ▶ Maintain a reliable and stable process

Table 1.2 (cont.) 1-21

1-21

### Where are the OM Jobs?

- ▶ Introducing new technologies and methods
- ▶ Improving facility location and space utilization
- ▶ Defining and implementing operations strategy
- ▶ Improving response time
- ▶ Developing people and teams
- ▶ Improving customer service
- ▶ Managing quality
- ▶ Managing and controlling inventory
- ▶ Enhancing productivity

1-22

1-22

### Opportunities



Figure 1.3 1-23

1-23



**Certifications**

- ▶ APICS, the Association for Operations Management
- ▶ American Society for Quality (ASQ)
- ▶ Institute for Supply Management (ISM)
- ▶ Project Management Institute (PMI)
- ▶ Council of Supply Chain Management Professionals
- ▶ Chartered Institute of Procurement and Supply (CIPS)

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**1-24**

THE HERITAGE OF OPERATIONS MANAGEMENT (1-25 through 1-32)

Slide 25: This slide (Figure 1.4) presents a nice summary of the past and future of OM. Videos showing historical footage (see Other Supplementary Material below), can fit in well here.

Slides 26-31: Presenting students with a good historical context of the field is important. There is a lot of important history there that is directly tied to the economic growth of nations. These slides provide information about some of the most important historical figures in the field.

Slide 32: Operations management continues to progress with innovations and contributions from other disciplines, particularly those identified on this slide.

**Significant Events in OM**



| Event | Year | Significance                         |
|-------|------|--------------------------------------|
| 1765  | 1765 | James Watt's parallel motion linkage |
| 1769  | 1769 | James Watt's parallel motion linkage |
| 1784  | 1784 | Richard Arkwright's water frame      |
| 1785  | 1785 | James Hargreaves' spinning jenny     |
| 1789  | 1789 | James Watt's parallel motion linkage |
| 1792  | 1792 | James Watt's parallel motion linkage |
| 1799  | 1799 | James Watt's parallel motion linkage |
| 1800  | 1800 | James Watt's parallel motion linkage |
| 1801  | 1801 | James Watt's parallel motion linkage |
| 1802  | 1802 | James Watt's parallel motion linkage |
| 1803  | 1803 | James Watt's parallel motion linkage |
| 1804  | 1804 | James Watt's parallel motion linkage |
| 1805  | 1805 | James Watt's parallel motion linkage |
| 1806  | 1806 | James Watt's parallel motion linkage |
| 1807  | 1807 | James Watt's parallel motion linkage |
| 1808  | 1808 | James Watt's parallel motion linkage |
| 1809  | 1809 | James Watt's parallel motion linkage |
| 1810  | 1810 | James Watt's parallel motion linkage |
| 1811  | 1811 | James Watt's parallel motion linkage |
| 1812  | 1812 | James Watt's parallel motion linkage |
| 1813  | 1813 | James Watt's parallel motion linkage |
| 1814  | 1814 | James Watt's parallel motion linkage |
| 1815  | 1815 | James Watt's parallel motion linkage |
| 1816  | 1816 | James Watt's parallel motion linkage |
| 1817  | 1817 | James Watt's parallel motion linkage |
| 1818  | 1818 | James Watt's parallel motion linkage |
| 1819  | 1819 | James Watt's parallel motion linkage |
| 1820  | 1820 | James Watt's parallel motion linkage |

Figure 1.4 Copyright © 2020, 2017, 2014 Pearson Education, Inc. 1-25

**1-25**

**Taylor's Principles**

**Management Should Take More Responsibility for:**

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

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**1-28**

**W. Edwards Deming**

- ▶ Born 1900; died 1993
- ▶ Engineer and physicist
- ▶ Credited with teaching Japan quality control methods in post-WW2
- ▶ Used statistics to analyze process
- ▶ His methods involve workers in decisions

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**1-31**

**Eli Whitney**

- ▶ Born 1765; died 1825
- ▶ In 1798, received government contract to make 10,000 muskets
- ▶ Showed that machine tools could make standardized parts to exact specifications
- ▶ Musket parts could be used in any musket

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**1-26**

**Frank and Lillian Gilbreth**

- ▶ Frank (1868-1924); Lillian (1878-1972)
- ▶ Husband and wife engineering team
- ▶ Further developed work measurement methods
- ▶ Applied efficiency methods to their home and 12 children!
- ▶ Book and Movie: "Cheaper by the Dozen," "Bells on Their Toes"

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**1-29**

**OM Relies on Contributions From**

- ▶ Industrial engineering
- ▶ Statistics
- ▶ Management
- ▶ Analytics
- ▶ Economics
- ▶ Physical sciences
- ▶ Information technology

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**1-32**

**Frederick W. Taylor**

- ▶ Born 1856; died 1915
- ▶ Known as 'father of scientific management'
- ▶ In 1881, as chief engineer for Midvale Steel, studied how tasks were done
- ▶ Began first motion and time studies
- ▶ Created efficiency principles

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**1-27**

**Henry Ford**

- ▶ Born 1863; died 1947
- ▶ In 1903, created Ford Motor Company
- ▶ In 1913, first used moving assembly line to make Model T
  - ▶ Unfinished product moved by conveyor past work station
- ▶ Paid workers very well for 1911 (\$5/day!)

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**1-30**

**OPERATIONS FOR GOODS AND SERVICES (1-33 through 1-38)**

Slides 33-35: The manufacturing-service distinction is more like a continuum, as most manufacturing companies provide some services (e.g., financing from an auto manufacturer) and most service companies provide some goods (e.g., shampoo at a hair salon). Nevertheless, the two extremes differ in important ways, which may impact how operations managers approach decision making in one case vs. another. Slide 35 identifies the major differences.

Slides 36-37: These slides illustrate the tremendous growth of services over time. Slide 36 (Figure 1.5) shows that, after peaking around 1950, the percentage of U.S. workers in manufacturing has declined steadily while service employment continues to capture a larger and larger share of the jobs. The huge productivity increases in 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, etc. Slide 37 (Table 1.4) provides examples of firms and percentages of employment in the U.S. in various sectors of the economy. Well more than half of the students taking this class will likely end up working for a firm in the service sector.

Slide 38: Salaries in services present a mixed bag. Some jobs, such as airline maintenance operations managers, pay very well, while others lag behind the national average. Not all jobs in services are low paying, but some can be.

**Operations for Goods and Services**

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

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1-33

**Operations for Goods and Services**

- ▶ Manufacturers produce tangible product, services often intangible
- ▶ Operations activities are performed in both manufacturing and services
- ▶ Distinction not always clear
- ▶ Few pure services

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1-34

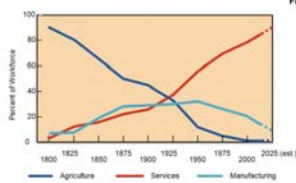
**Differences Between Goods and Services**

| CHARACTERISTICS OF SERVICES  | CHARACTERISTICS OF GOODS  |
|--|---|
| Intangible: Ride in an airline seat  | Tangible: The seat itself   |
| Produced and consumed simultaneously: Beauty salon produces a haircut that is consumed as it is produced | Product can usually be kept in inventory (Beauty care products)                         |
| Unique: Your investments and medical care are unique   | Similar products produced (Pepsi)   |
| High customer interaction: Often what the customer is paying for (consulting, education)                 | Limited customer involvement in production  |
| Inconsistent product definition: Auto insurance changes with age and type of car                         | Product standardized (Phone)  |
| Often knowledge based: Legal, education, and medical services are hard to automate                       | Standard tangible product tends to make automation feasible                             |
| Services dispersed: Service may occur at retail store, local office, home call, or via Internet          | Product typically produced at a fixed facility  |
| Quality may be hard to evaluate: Consulting, education, and medical services                             | Many aspects of quality for tangible products are easy to evaluate (strength of a bolt) |
| Reversing is unusual: Musical concert or medical care  | Product often has some residual value   |

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1-35

**U.S. Agriculture, Manufacturing, and Service Employment**



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1-36

**Organizations in Each Sector**

| SECTOR   | EXAMPLE  | PERCENT OF ALL JOBS |
|--|--|---------------------|
| Service Sector                                       |  | 85.9                |
| Education, Medical, Other                            | San Diego State University, Arnold Palmer Hospital   | 16.2                |
| Trade (retail, wholesale), Transportation            | Walmart, Walmart, Nordstrom, Alaska Airlines   | 17.1                |
| Information, Publishing, Broadcast                   | IBM, Bloomberg, Pearson, ESPN  | 1.8                 |
| Professional, Legal, Business Services, Associations | Swelling and Swelling, Waste Management, Inc., American Medical Association, Ernst & Young | 17.0                |
| Finance, Insurance, Real Estate                      | Citigroup, American Express, Prudential, Aetna   | 9.6                 |
| Food, Lodging, Entertainment                         | Olive Garden, Walt Disney World, U.S. State of Arkansas, Cook County                       | 10.0                |
| Public Administration                                | U.S. State of Arkansas, Cook County  | 14.2                |
| Manufacturing Sector                                 | General Electric, Ford, U.S. Steel, Intel  | 7.9                 |
| Construction Sector                                  | Bechtel, McDermott   | 4.3                 |
| Agriculture  | King Ranch   | 1.3                 |
| Mining Sector  | Homestake Mining   | .4                  |
| Grand Total  |  | 100.0               |

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1-37

**Service Pay**

- ▶ Perception that services are low-paying
- ▶ 42% of service workers receive above average wages
- ▶ 14 of 33 service industries pay below average
- ▶ Retail trade pays only 61% of national average
- ▶ Overall average wage is 96% of the average

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1-38

**THE PRODUCTIVITY CHALLENGE (1-39 through 1-58)**

Slide 39: The basic formula for productivity is simple:  $outputs \div inputs$ . This sometimes varies as interest focuses on a specific output or input, or a set of outputs or inputs. At the firm level, productivity improvement usually leads to greater profits. At a macro level, productivity improvement in an economy usually leads to a higher standard of living. Productivity improvement means getting more “bang for the buck”—either (1) reducing inputs while keeping output constant, or (2) increasing output while keeping inputs constant.

Slide 40: This slide (Figure 1.6) describes how productivity in the U.S. economy grows at about 2.5% per year, comprised of capital factors (0.95%), labor factors (0.25%), and management factors (1.3%). The picture also suggests that an effective feedback loop is an important component for continuous improvement.

- Slides 41-42: These slides (OM in Action) describe how some relatively simple management and equipment changes improved Starbuck’s productivity significantly, which led to six-figure increases in revenue *per outlet*.
- Slides 43-45: The most common productivity formulas are presented in these slides. Slide 43 shows the basic formula. Slide 44 provides an example of a *single-factor* productivity measure, in this case, the common measure of labor productivity. Slide 45 is a *multifactor* productivity measure. Note that a multifactor measure only makes sense if all of the inputs are expressed in the same units (usually a monetary unit such as dollars).
- Slides 46-49: These slides illustrate Example 2 from the text, calculating both single-factor and multifactor productivity measures. Here, as in most cases, the multifactor measure makes more sense because it includes all costs connected with the increase in output. In fact, a situation that replaces workers with more expensive robots may appear to improve labor productivity but may actually be decreasing multifactor productivity (and firm profits) overall.
- Slide 50: These potential measurement problems with productivity should be emphasized. If evaluating performance of a plant, a manager, a division, etc., it is important to compare “apples to apples” and to evaluate individuals on outcomes over which they have control.
- Slide 51: The three factors identified in this slide are critical to achieving improved productivity. The percentages listed represent their respective historical contributions to productivity improvement.
- Slide 52: As we see in this slide, sometimes training and education produce more productive workers, while in other cases, the workers’ general health along with environmental factors may determine their respective capabilities.
- Slide 53: As unbelievable as it seems, a large number of U.S. high school students cannot solve very simple math problems, such as those shown in this slide (Figure 1.7). It has been suggested that perhaps up to 25% of U.S. workers lack the basic skills needed for their current job. The situation may be even worse in some other countries, particularly in some of the low-wage countries.
- Slide 54: Historically, annual capital investment in the U.S. has increased at an annual rate of 1.5% after allowances for depreciation. In general, higher investment levels lead to higher productivity gains.
- Slide 55: At 52%, management provides the biggest contribution toward productivity gains. Effective management is challenging, especially now that much of the labor force in postindustrial countries has migrated from manual work to work based on knowledge (knowledge societies) and requires ongoing education.
- Slide 56: The items identified in this slide all contribute to the difficulty in improving productivity in the service sector.
- Slides 57-58: The service firm Taco Bell (OM in Action) implemented several innovative productivity improvement measures (Slide 57), which produced impressive results (Slide 58).

### Productivity Challenge

Productivity is the ratio of outputs (goods and services) divided by the inputs (resources such as labor and capital)

**The objective is to improve productivity!**

*Important Note!*  
Production is a measure of output only and not a measure of efficiency

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### The Economic System

Figure 1.6

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### Improving Productivity at Starbucks

**A team of 10 analysts continually look for ways to shave time. Some improvements:**

- Stop requiring signatures on credit card purchases under \$25 ➡ Saved 8 seconds per transaction
- Change the size of the ice scoop ➡ Saved 14 seconds per drink
- New espresso machines ➡ Saved 12 seconds per shot

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### Improving Productivity at Starbucks

A team of 10 analysts continually look for ways to shave time from Starbucks' operations to improve productivity.

Operations improvements have helped Starbucks increase yearly revenue per outlet by \$250,000 to \$1,000,000. Productivity has improved by 27%, or about 4.5% per year.



per shot

1-42

### Productivity

$$\text{Productivity} = \frac{\text{Units produced}}{\text{Input used}}$$

- ▶ Measure of process improvement
- ▶ Represents output relative to input
- ▶ Only through productivity increases can our standard of living improve

1-43

### Productivity Calculations

#### Labor Productivity

$$\text{Productivity} = \frac{\text{Units produced}}{\text{Labor-hours used}} = \frac{1,000}{250} = 4 \text{ units/labor-hour}$$

One resource input ⇒ single-factor productivity

1-44

### Multi-Factor Productivity

$$\text{Multifactor} = \frac{\text{Output}}{\text{Labor} + \text{Material} + \text{Energy} + \text{Capital} + \text{Miscellaneous}}$$

- Also known as total factor productivity
- Output and inputs are often expressed in dollars

Multiple resource inputs ⇒ multi-factor productivity

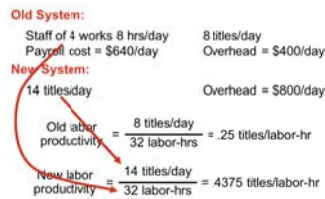
1-45

### Collins Title Productivity



1-46

### Collins Title Productivity



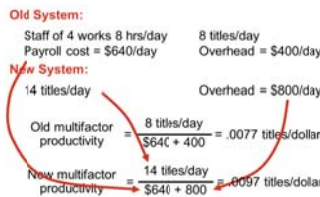
1-47

### Collins Title Productivity



1-48

### Collins Title Productivity



1-49

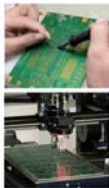
### Measurement Problems

1. **Quality** may change while the quantity of inputs and outputs remains constant
2. **External elements** may cause an increase or decrease in productivity
3. **Precise units of measure** may be lacking

1-50

### Productivity Variables

1. **Labor** - contributes about 10% of the annual increase
2. **Capital** - contributes about 38% of the annual increase
3. **Management** - contributes about 52% of the annual increase



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1-51

### Key Variables for Improved Labor Productivity

1. Basic education appropriate for the labor force
  2. Diet of the labor force
  3. Social overhead that makes labor available
- ▶ Challenge is in maintaining and enhancing skills in the midst of rapidly changing technology and knowledge

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1-52

### Labor Skills

About half of the 17-year-olds in the U.S. cannot correctly answer questions of this type

3 yds  
4 yds

What is the area of this rectangle?

4 square yds  
6 square yds  
10 square yds  
20 square yds  
24 square yds

If  $8y + 3 = 6y + 15$ , then  $y =$

1      4  
2      6

Which of the following is true about 84% of 100?

It is greater than 100  
It is less than 100  
It is equal to 100

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1-53

### Capital



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1-54

### Management

- ▶ Ensures labor and capital are effectively used to increase productivity
- ▶ Use of knowledge
  - ▶ Application of technologies
- ▶ Knowledge societies
- ▶ Labor has migrated from manual work to technical and information-processing tasks
- ▶ More effective use of technology, knowledge, and capital

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1-55

### Productivity in the Service Sector

- ▶ Productivity improvement in services is difficult because:
1. Typically labor intensive
  2. Frequently focused on unique individual attributes or desires
  3. Often an intellectual task performed by professionals
  4. Often difficult to mechanize and automate
  5. Often difficult to evaluate for quality

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1-56

**Productivity at Taco Bell**

Improvements:

- ▶ Revised the menu
- ▶ Designed meals for easy preparation
- ▶ Shifted some preparation to suppliers
- ▶ Efficient layout and automation
- ▶ Training and employee empowerment
- ▶ New water and energy saving grills



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1-57

Results:

- ▶ Preparation time cut to 8 seconds
- ▶ Management span of control increased from 5 to 30
- ▶ In-store labor cut by 15 hours/day
- ▶ Floor space reduced by more than 50%
- ▶ Stores average 164 seconds/customer from drive-up to pull-out
- ▶ Water- and energy-savings grills conserve 300 million gallons of water and 200 million kWh of electricity each year
- ▶ Green-inspired cooking method saves 5,800 restaurants \$17 million per year

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1-58

**CURRENT CHALLENGES IN OPERATIONS MANAGEMENT (1-59)**

Slide 59: Some traditional operations areas of emphasis are changing. New challenges based on these changes are identified on this slide. Each of these issues will be explored more fully later in the book.

**Current Challenges in OM**

- ▶ Globalization
  - ▶ Supply-chain partnering
  - ▶ Sustainability
  - ▶ Rapid product development
  - ▶ Mass customization
  - ▶ Lean operations
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1-59

**ETHICS, SOCIAL RESPONSIBILITY, AND SUSTAINABILITY (1-60 through 1-61)**

Slide 60: Managers must address the challenges identified in the slide, along with many other challenges, in an ethical and socially responsible way while meeting demands of the marketplace.

**Ethics, Social Responsibility, and Sustainability**

Challenges facing operations managers:

- ▶ Develop and produce safe, high-quality green products
- ▶ Train, retrain, and motivate employees in a safe workplace
- ▶ Honor stakeholder commitments

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1-60

**Ethics**

**Stakeholders**  
Those with a vested interest in an organization, including customers, distributors, suppliers, owners, lenders, employees, and community members.

Challenges facing operations managers:

- ▶ Develop and produce safe, high-quality green products
- ▶ Train, retrain, and motivate employees in a safe workplace
- ▶ Honor stakeholder commitments

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1-61

**Additional Assignment Ideas**

1. Search the Internet for organizations that offer productivity consulting services; there will be quite a few. Different organizations will offer different service packages and specialize in different areas. Pick two organizations that demonstrate differences and compare and contrast their services, their areas of specialization, and their approach to productivity. That is, explain how they are similar and how they are different. Make sure you include examples from their websites that support your analysis. (Two examples are Alexander Proudfoot at <http://www.proudfoot.com/> and West Monroe Partners at <http://www.westmonroepartners.com/>.)

2. Labor productivity is by far the most commonly seen expression of productivity. Search the Internet for sites that offer labor productivity statistics. Certainly, the Bureau of Labor Statistics ([www.bls.gov](http://www.bls.gov)) is one, but there are others from around the world. Compare the labor productivity in the U.S. for the past decade to that of another country of your choosing. How and why are they different or similar?
3. Students can be assigned a paper that compares the service company Hard Rock Cafe to the manufacturing firm Frito-Lay, both of which have videos for Chapter 1. Specifically, the paper could compare and contrast how the two firms approach the 10 major OM decisions described in the text.

## Internet Resources

|  |  |
|--|--|
| American Productivity and Quality Center (APQC)  | <a href="http://www.apqc.org/">www.apqc.org/</a>                     |
| American Statistical Association (ASA) offers business and economics DataLinks, a searchable index of statistical data | <a href="http://www.econ-datalinks.org/">www.econ-datalinks.org/</a> |
| National Bureau of Economic Research   | <a href="http://www.nber.org">www.nber.org</a>                       |
| U.S. Bureau of Labor Statistics  | <a href="http://www.bls.gov">www.bls.gov</a>                         |
| U.S. Census Bureau   | <a href="http://www.census.gov">www.census.gov</a>                   |

## Other Supplementary Material

### Videos

1. *Modern Marvels*, “The Assembly Line”  
<https://www.history.com/shows/modern-marvels/season-12/episode-26>  
 The first part of this History Channel production shows Henry Ford and the Ford assembly line, with real historical footage. It describes the poor working conditions, as well as Ford’s response, which was to pay a very high hourly rate for the time.
2. “Loose Bolts?” (30:00), <http://www.merrimack-films.com/loose.html>  
 Offers a more modern perspective on assembly lines and highlights the difficulties of making changes in existing organizations when implementing productivity improvement programs.
3. *Ford Historic Model T*, CarDataVideo (5:16), <http://www.youtube.com/watch?v=S4KrIMZpwCY>  
 This narrated video is a very detailed look at the first assembly lines at the original Ford auto plant, plus some driving scenes with the Model T.