Principles of Operations Management 11th edition Heizer Solutions Manual

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Instructor's Solutions Manual (Download only) for Operations Management, 13e and Principles of Operations Management 11e

Operations Management
Thirteenth Edition

Principles of Operations Management
Eleventh Edition

Jay Heizer
Barry Render
Chuck Munson



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CHAPTER 1

Operations and Productivity

Discussion Questions

1. The text suggests four reasons to study OM. We want to understand (1) how people organize themselves for productive enterprise, (2) how goods and services are produced, (3) what operations managers do, and (4) this costly part of our economy and most enterprises.

LO 1.1: Define operations management

AACSB: Application of knowledge

2. With some 40% of all jobs being in the OM field, the career opportunities are prolific. The text suggests many career opportunities. OM students find initial jobs throughout the OM field, including supply chain, logistics, purchasing, production planning and scheduling, plant layout, maintenance, quality control, inventory management, etc.

LO 1.3: Identify career opportunities in operations management

AACSB: Application of knowledge

3. Possible responses include: Adam Smith (work specialization/ division of labor), Charles Babbage (work specialization/division of labor), Frederick W. Taylor (scientific management), Walter Shewart (statistical sampling and quality control), Henry Ford (moving assembly line), Charles Sorensen (moving assembly line), Frank and Lillian Gilbreth (motion study), Eli Whitney (standardization).

LO 1.1: Define operations management

AACSB: Application of knowledge

4. See references in the answer to Question 3.

LO 1.1: Define operations management

AACSB: Application of knowledge

5. The actual charts will differ, depending on the specific organization the student chooses to describe. The important thing is for students to recognize that all organizations require, to a greater or lesser extent, (a) the three primary functions of operations, finance/accounting, and marketing; and (b) that the emphasis or detailed breakdown of these functions is dependent on the specific competitive strategy employed by the firm.

LO 1.1: Define operations management

AACSB: Application of knowledge

6. The answer to this question may be similar to that for Question 5. Here, however, the student should be encouraged to utilize a more detailed knowledge of a past employer and indicate on the chart additional information such as the number of persons employed to perform the various functions and, perhaps, the position of the functional areas within the overall organization hierarchy.

LO 1.1: Define operations management

AACSB: Application of knowledge

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7. The basic functions of a firm are marketing, accounting/ finance, and operations. An interesting class discussion: "Do all firms/organizations (private, government, not-for-profit) perform these three functions?" The authors' hypothesis is yes, they do.

LO 1.1: Define operations management

AACSB: Application of knowledge

8. The 10 strategic decisions of operations management are product design, quality, process, location, layout, human resources, supply-chain management, inventory, scheduling (intermediate and short-term), and maintenance. We find this structure an excellent way to help students organize and learn the material.

LO 1.1: Define operations management

AACSB: Application of knowledge

9. Four areas that are important to improving labor productivity are (1) basic education (basic reading and math skills), (2) diet of the labor force, (3) social overhead that makes labor available (water, sanitation, transportation, etc.), and (4) maintaining and expanding the skills necessary for changing technology and knowledge, as well as for teamwork and motivation.

LO 1.8: Identify the critical variables in enhancing productivity

AACSB: Application of knowledge

10. Productivity is harder to measure when the task becomes more intellectual. A knowledge society implies that work is more intellectual and therefore harder to measure. Because the U.S. and many other countries are increasingly "knowledge" societies, productivity is harder to measure. Using labor-hours as a measure of productivity for a postindustrial society versus an industrial or agriculture society is very different. For example, decades spent developing a marvelous new drug or winning a very difficult legal case on intellectual property rights may be significant for postindustrial societies, but not show much in the way of productivity improvement measured in labor-hours.

LO 1.8: Identify the critical variables in enhancing productivity

AACSB: Analytical thinking

11. Productivity is difficult to measure because precise units of measure may be lacking, quality may not be consistent, and exogenous variables may change.

LO 1.8: Identify the critical variables in enhancing productivity

AACSB: Reflective thinking

12. Mass customization is the flexibility to produce to meet specific customer demands, without sacrificing the low cost of a product-oriented process. Rapid product development is a source of competitive advantage. Both rely on agility within the organization.

LO 1.1: Define operations management

AACSB: Application of knowledge

13. Labor productivity in the service sector is hard to improve because (1) many services are labor intensive and (2) they are individually (personally) processed (the customer is paying for that service—the haircut), (3) it may be an intellectual task performed by professionals, (4) it is often difficult to mechanize and automate, and (5) it is often difficult to evaluate for quality.

LO 1.8: Identify the critical variables in enhancing productivity

AACSB: Reflective thinking

14. Taco Bell designed meals that were easy to prepare; with actual cooking and food preparation done elsewhere; automation to save preparation time; reduced floor space; manager training to increase span of control.

LO 1.8: Identify the critical variables in enhancing productivity

AACSB: Application of knowledge

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15. Bureau of Labor Statistics (stats.bls.gov) is a good place to start. Results will vary for each year, but overall data for the economy will range from 0.9% to 4.8%, and mfg. could be as high as 5% and services between 1% and 2%. The data will vary even more for months or quarters. The data are frequently revised, often substantially.

LO 1.7: Compute multifactor productivity

AACSB: Application of knowledge

ETHICAL DILEMMA

AMERICAN CAR BATTERY INDUSTRY

You may want to begin the discussion by asking how ethical it is for you to be in the lead battery business when you know that any batteries you recycle will very likely find their way to an overseas facility (probably Mexico) with, at best, marginal pollution containment. Then after a likely conclusion of "Well someone has to provide batteries," you can move to the following discussion.

(a) As owner of an independent auto repair shop trying to dispose of a few old batteries each week, your options may be limited. But as an ethical operator, your first option is to put pressure on your battery supplier to take your old batteries. Alternatively, shop for a battery supplier who wants your business enough to dispose of your old batteries. Third, because there is obviously a market for the lead in old batteries, some aggressive digging may uncover an imaginative recycler who can work out an economical arrangement for pickup or delivery of your old batteries. Another option is, of course, to discontinue the sale of batteries. (This is a problem for many small businesses; ethical decisions and regulation may be such that they often place an expensive and disproportionate burden on a small firm.)

(b) As manager of a large retailer responsible for disposal of thousands of used batteries each week, you should have little trouble finding a battery supplier with a reverse supply chain suitable for disposal of old batteries. Indeed, a sophisticated retailer, early on in any supply-chain development process, includes responsible disposal of environmentally dangerous material as part of the negotiations. Disposal of old batteries should be a minor issue for a large retailer.

(c) For both a small and large retailer, the solution is to find a "sustainable" solution or get out of the battery business. Burying the batteries behind the store is not an option. *Supplement 5: Sustainability in the Supply Chain* provides some guidelines for a deeper class discussion.

END-OF-CHAPTER PROBLEMS

1.1 (a) $\dfrac{120 \text{ boxes}}{40 \text{ hours}} = 3.0 \text{ boxes/hour}$

(b) $\dfrac{125 \text{ boxes}}{40 \text{ hours}} = 3.125 \text{ boxes/hour}$

(c) Change in productivity = 0.125 box/hour

(d) Percentage change = $\dfrac{0.125 \text{ box}}{3.0} = 4.167\%$

1.2 (a) Labor productivity is 160 valves/80 hours = 2 valves per hour

(b) New labor productivity = 180 valves/80 hours = 2.25 valves per hour

(c) Percentage change in productivity = .25 valve/2 valves = 12.5%

1.3 $0.15 = \dfrac{57{,}600}{(160)(12)(L)}$, where L = number of laborers employed at the plant

So, $L = \dfrac{57{,}600}{(160)(12)(0.15)} = 200$ laborers employed

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1.4 (a) $\frac{\text{Units produced}}{\text{Input}} = \frac{100 \text{ pkgs}}{5} = 20 \text{ pkgs/hour}$

(b) $\frac{133 \text{ pkgs}}{5} = 26.6 \text{ pkgs per hour}$

(c) Increase in productivity $= \frac{6.6}{20} = 33.0\%$

1.5

Resource	Last Year	This Year	Change	Percentage Change
Labor	$\frac{1,000}{300} = 3.33$	$\frac{1,000}{275} = 3.64$	0.31	$\frac{0.31}{3.33} = 9.3\%$
Resin	$\frac{1,000}{50} = 20$	$\frac{1,000}{45} = 22.22$	2.22	$\frac{2.22}{20} = 11.1\%$
Capital	$\frac{1,000}{10,000} = 0.1$	$\frac{1,000}{11,000} = 0.09$	–0.01	$\frac{-0.01}{0.1} = -10.0\%$
Energy	$\frac{1,000}{3,000} = 0.33$	$\frac{1,000}{2,850} = 0.35$	0.02	$\frac{0.02}{0.33} = 6.1\%$

1.6

	Last Year	This Year
Production	1,000	1,000
Labor hr. @ $10	$3,000	$2,750
Resin @ $5	250	225
Capital cost/month	100	110
Energy	1,500	1,425
	$4,850	$4,510

$$\frac{[(1,000 / 4,510) - (1,000 / 4,850)]}{(1,000 / 4,850)} =$$

$$\frac{0.222 - 0.206}{0.206} = \frac{0.016}{0.206} = 7.8\% \text{ improvement*}$$

*with rounding to 3 decimal places.

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

(a) Labor productivity $= \frac{65}{(520 \times 13)} = \frac{65}{\$6,760}$

$= .0096$ rug per labor \$

(b) Multifactor productivity $= \frac{65}{(520 \times \$13) + (100 \times \$5) + (20 \times \$50)}$

$= \frac{65}{\$8,260} = .00787$ rug per \$

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1.8 (a) Labor productivity = 1,000 tires/400 hours = 2.5 tires/hour.

(b) Multifactor productivity is 1,000 tires/(400 × $12.50 + 20,000 × $1 + $5,000 + $10,000) = 1,000 tires/$40,000 = 0.025 tire/dollar.

(c) Multifactor productivity changes from 1,000/40,000 to 1,000/39,000, or from 0.025 to 0.02564; the ratio is 1.0256, so the change is a 2.56% increase.

1.9

	Last Year	This Year	Change	Percentage Change
Labor hrs.	$\frac{1,500}{350} = 4.29$	$\frac{1,500}{325} = 4.62$	$\frac{0.33}{4.29}$	= 7.7%
Capital invested	$\frac{1,500}{15,000} = 0.10$	$\frac{1,500}{18,000} = 0.08$	$\frac{-0.02}{0.1}$	= –20%
Energy (btu)	$\frac{1,500}{3,000} = 0.50$	$\frac{1,500}{2,750} = 0.55$	$\frac{0.05}{0.50}$	= 10%

Productivity of capital did drop; labor productivity increased as did energy, but by less than the anticipated 15%.

1.10 Multifactor productivity is:

375 autos/[($20 × 10,000) + ($1,000 × 500) + ($3 × 100,000)] = 375/(200,000 + 500,000 +300,000) = 375/1,000,000 = .000375 auto per dollar of inputs

1.11 (a) Before: 500/20 = 25 boxes per hour;

After, 650/24 = 27.08

(b) 27.08/25
= 1.083, or an increase of 8.3% in productivity

(c) New labor productivity = 700/24 = 29.167 boxes per hour

1.12 1,500 × 1.25 = 1,875 (new demand)

$$\frac{\text{Outputs}}{\text{Inputs}} = \text{Productivity}$$

$$\frac{1,875}{\text{Labor-hours}} = 2.344$$

$$\text{New process} = \frac{1,875}{2.344} \cong 800 \text{ labor-hours}$$

$$\frac{800}{160} = 5 \text{ workers}$$

$$\text{Current process} = \frac{1,500}{\text{labor-hours}} = 2.344$$

$$\frac{1,500}{2.344} = \text{labor-hours} \cong 640$$

$$\frac{640}{160} = 4 \text{ workers}$$

Add one worker.

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1.13 (a) Labor change:

$$\frac{1,500}{(640 \times \$8)} = \frac{1,500}{5,120} = .293 \text{ loaf/\$}$$

$$\frac{1,875}{(800 \times \$8)} = 0.293 \text{ loaf/\$}$$

(b) Investment change:

$$\frac{1,500}{(640 \times \$8)} = \frac{1,500}{5,120} = .293 \text{ loaf/\$}$$

$$\frac{1,875}{(640 \times 8) + (100)} = \frac{1,875}{5,220} = .359 \text{ loaf/\$}$$

(c) Percentage change: $\frac{.293 - .293}{.293} = 0$ (labor)

Percentage change: $\frac{.359 - .293}{.293} = .225$

$= 22.5\%$ (investment)

The better option is to purchase a new blender because it generates more loaves per dollar.

1.14

$$\text{Old process} = \frac{1,500}{(640 \times 8) + 500 + (1,500 \times 0.35)}$$

$$= \frac{1,500}{6,145} = 0.244 \text{ loaf/\$}$$

$$\text{New process} = \frac{1,875}{(800 \times 8) + 500 + (1,875 \times 0.35)}$$

$$= \frac{1,875}{7,556.25} = 0.248 \text{ loaf/\$}$$

$$\text{Percentage change} = \frac{0.248 - 0.244}{0.244} = 1.6\%$$

1.15 (a) $\frac{6,600 \text{ vans}}{x \text{ labor-hours}} = 0.10$

$x = 66,000$ labor-hours

There are 300 laborers. So,

$$\frac{66,000 \text{ labor-hours}}{300 \text{ laborers}} = 220 \text{ labor-hours/laborer on average, per month}$$

(b) Now $\frac{6,600 \text{ vans}}{x \text{ labor-hours}} = 0.11$, so $x = 60,000$ labor-hours

so, $\frac{60,000 \text{ labor-hours}}{300 \text{ laborers}} = 200$ labor-hours/laborer on average, per month

1.16 $\frac{\$ \text{ output}}{\text{labor-hours}} = \frac{52(\$90) + 80(\$198)}{8(45)}$

$= \frac{\$20,520}{360} = \$57.00$ per labor-hour

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1.17

$$\text{Last year} = \frac{1,500}{(350 \times 8) + (15,000 \times 0.0083) + (3,000 \times 0.6)}$$

$$= \frac{1,500}{2,800 + 124.50 + 1,800}$$

$$= \frac{1,500}{4,724.5} = 0.317 \text{ doz / \$}$$

$$\text{This year} = \frac{1500}{(325 \times 8) + (18,000 \times 0.0083) + (2,750 \times 0.6)}$$

$$= 0.341 \text{ doz / \$}$$

$$\text{Percentage change} = \frac{0.341 - 0.317}{0.317}$$

$$= 0.076, \text{ or } 7.6\% \text{ increase}$$

CASE STUDY

UBER TECHNOLOGIES, INC.

1. First, some drivers (maybe most) may not require a wage that equals those fully engaged in the "taxi" business. It truly could be a supplemental income. . . . "I'm going that way anyhow so let's make a few dollars while on the way." Similarly, the capital investment cost approaches zero as the car is going that direction anyhow. These are idle or underutilized resources.

From society's perspective, Uber and its like competitors are desirable because both idle or wasted labor and capital resources are being utilized. At the same time, as a bonus, Uber is reducing traffic and auto pollution while speeding up the transport of individuals and local commerce.

As a competitor for the traditional taxi service, Uber seems to be an enhancement in efficiency.

For those faculty who what to spend some time on the larger productivity message, this case provides such an opportunity. Uber, as Joseph Schumpeter would suggest, has developed a disruptive technology (creative destruction, in a Schumpeterian translation). Innovations such as this are exactly how economic efficiency is enhanced. The traditional taxi services, with some imagination, could have developed and adopted this technology, but most were ensconced in their own regulatory cocoon. As is often the case, it takes an outsider, such as Uber et al. to be creative by putting unused resources to use and providing society greater efficiency.

LO 1.8: Identify the critical variables in enhancing productivity

AACSB: Analytical thinking

2. Perhaps a business model similar to Uber's can be applied to the trucking industry. And, indeed, Uber has established an Uber app for the trucking industry. An estimated 30% of trucking backhauls are empty. However, the number of independent truckers or truckers with the latitude to alter their route may be very small. And this number must be a tiny fraction of independent automobile drivers. So, the ability to "Uberize" trucking may be very difficult, but utilizing that idle 30% would be huge benefit to society.

LO 1.8: Identify the critical variables in enhancing productivity

AACSB: Analytical thinking

3. Perhaps the Uber model can be used for package delivery, documents, and everything from flowers to groceries. Airbnb (www.airbnb.com) is applying a similar model to short-term rentals of rooms, apartments, and homes—competing with more traditional bed and breakfast facilities and hotels.

LO 1.8: Identify the critical variables in enhancing productivity

AACSB: Analytical thinking

VIDEO CASE STUDIES

1 FRITO-LAY: OPERATIONS MANAGEMENT IN MANUFACTURING

This case provides a great opportunity for an instructor to stimulate a class discussion early in the course about the pervasiveness of the 10 decisions of OM with this case alone or in conjunction with the Hard Rock Cafe case. There is a short video (7 minutes) available in MyLab Operations Management that is filmed specifically for this text and supplements this case.

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1.

- *Product design:* Each of Frito-Lay's 40-plus products must be conceived, formulated (designed), tested (market studies, focus groups, etc.), and evaluated for profitability.
- *Quality:* The standards for each ingredient, including its purity and quality, must be determined.
- *Process:* The process that is necessary to produce the product and the tolerance that must be maintained for each ingredient by each piece of equipment must be specified and procured.
- *Location:* The fixed and variable costs of the facility, as well as the transportation costs and the delivery distance, given the freshness, must be determined.
- *Layout:* The Frito-Lay facility would be a process facility, with great care given to reducing movement of material within the facility.
- *Human resources:* Machine operators may not have inherently enriched jobs, so special consideration must be given to developing empowerment and enriched jobs.
- *Supply chain management:* Frito-Lay, like all other producers of food products, must focus on developing and auditing raw material from the farm to delivery.
- *Inventory:* Freshness and spoilage require constant effort to drive down inventories.
- *Scheduling:* The demand for high utilization of a capital-intensive facility means effective scheduling will be important.
- *Maintenance:* High utilization requires good maintenance, from machine operator to the maintenance department and depot service.

LO 1.1: Define operations management

AACSB: Reflective thinking

2. Determining output (in some standard measure, perhaps pounds) and labor-hours would be a good start for single-factor productivity.

For multifactor productivity, we would need to develop and understand capital investment and energy, as well as labor, and then translate those into a standard, such as dollars.

LO 1.6: Compute single-factor productivity

LO 1.7: Computer multifactor productivity

AACSB: Reflective thinking

3. Hard Rock performs all 10 of the decisions as well, only with a more service-sector orientation. Each of these is discussed in the solution to the Hard Rock Cafe case.

LO 1.8: Identify the critical variables in enhancing productivity

AACSB: Reflective thinking

2 HARD ROCK CAFE: OPERATIONS MANAGEMENT IN SERVICES

There is a short video (7 minutes) available in MyLab Operations Management that is filmed specifically for this text and supplements this case.

1. Hard Rock's 10 decisions: This is early in the course to discuss these in depth, but still a good time to get the students engaged in the 10 OM decisions around which the text is structured.

- *Product design:* Hard Rock's tangible product is food and like any tangible product it must be designed, tested, and "costed out." The intangible product includes the music, memorabilia, and service.
- *Quality:* The case mentions the quality survey as an overt quality measure, but quality can be discussed from a variety of perspectives—hiring the right people, food ingredients, good suppliers, speed of service, friendliness, etc.
- *Process:* The process can be discussed from many perspectives: (a) the process of processing a guest, to their seat, taking the order, order processing, delivery of the meal, payment, etc., (b) the process of how a meal is prepared (see, for instance, how one would make a Hard Rock Hickory BBQ Bacon Cheeseburger (Figure 5.9) or a Buffalo Chicken Mac & Cheese (Figure 14.9) or use the Method Analysis tool discussed in Chapter 10, or (c) some subset of any of these.
- *Location:* Hard Rock Cafes have traditionally been located in tourist locations, but that is beginning to change.
- *Layout:* Little discussion in the case, but students may be very aware that a kitchen layout is critical to efficient food preparation and that a bar is critical in many food establishments for profitability. The retail shop in relation to the restaurant and its layout is a critical ingredient for profitability at Hard Rock.
- *Human resources:* Jim Knight, VP for Human Resources at Hard Rock, seeks people who are passionate about music, love to serve, can tell a story. This OM decision is a critical ingredient for success of a Hard Rock Cafe and an integral part of the Hard Rock dining experience.

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- *Supply chain management:* Although not discussed in the case, students should appreciate the importance of the supply chain in any food service operation. Some items like leather jackets have a 9-month lead time. Contracts for meat and poultry are signed 8 months in advance.
- *Inventory:* Hard Rock, like any restaurant, has a critical inventory issue that requires that food be turned over rapidly and that food in inventory be maintained at the appropriate and often critical temperatures. But the interesting thing about Hard Rock's inventory is that they maintain $40 million of memorabilia with all sorts of special care, tracking, and storage issues.
- *Scheduling:* Because most Hard Rock Cafe's sales are driven by tourists, the fluctuations in seasonal, daily, and hourly demands for food are huge. This creates a very interesting and challenging task for the operations managers at Hard Rock. (Not mentioned in the case, linear programming is actually used in some cafes to schedule the waitstaff.)
- *Maintenance/reliability:* The Hard Rock Cafe doors must open every day for business. Whatever it takes to provide a reliable kitchen with hot food served hot and cold food served cold must be done. Bar equipment and point-of-sale equipment must also work.

LO 1.1: Define operations management

AACSB: Reflective thinking

2. Productivity of kitchen staff is simply the output (number of meals) over the input (hours worked). The calculation is how many meals prepared over how many hours spent preparing them. The same kind of calculation can be done for the waitstaff. In fact, Hard Rock managers begin with productivity standards and staff to achieve those levels. (You may want to revisit this issue when you get to Chapter 10 and Supplement 10 on labor standards and discuss how labor can be allocated on a per-item basis with more precision.)

LO 1.6: Compute single-factor productivity

AACSB: Analytical thinking

3. Each of the 10 decisions discussed in Question 1 can be addressed with a tangible product like an automobile.

- *Product design:* The car must be designed, tested, and costed out. The talents may be those of an engineer or operations manager rather than a chef, but the task is the same.
- *Quality:* At an auto plant, quality may take the form of measuring tolerances or wear of bearings, but there is still a quality issue.
- *Process:* With an auto, the process is more likely to be an assembly-line process.
- *Location:* Hard Rock Cafe may want to locate at tourist destinations, but an auto manufacturer may want to go to a location that will yield low fixed or variable cost.
- *Layout:* An automobile assembly plant is going to be organized on an assembly line criterion.
- *Human resources:* An auto assembly plant will be more focused on hiring factory skills rather than a passion for music or personality.
- *Supply chain management:* The ability of suppliers to contribute to design and low cost may be a critical factor in the modern auto plant.
- *Inventory:* The inventory issues are entirely different—tracking memorabilia at Hard Rock, but an auto plant requires tracking a lot of expensive inventory that must move fast.
- *Scheduling:* The auto plant is going to be most concerned with scheduling material, not people.
- *Maintenance:* Maintenance may be even more critical in an auto plant as there is often little alternate routing, and downtime is very expensive because of high fixed and variable cost.

LO 1.4: Explain the distinction between goods and services

AACSB: Reflective thinking

3 CELEBRITY CRUISES: OPERATIONS MANAGEMENT AT SEA

There is a short video (6.5 minutes) available in MyLab Operations Management that is filmed specifically for this text and supplements this case.

1. Celebrity's 10 decisions: It is early in the course to discuss these in depth, but still a good time to get the students engaged in the 10 OM decisions around which the text is structured.

- *Product design:* Celebrity's product consists of a complete 'premium' vacation/holiday experience. It includes accommodations, ports-of-call, shipboard facilities, food, service, etc. Students should appreciate the full scope of how Celebrity Cruises designs all of the many attributes of its 'product.'
- *Quality:* The case mentions the quality survey as an overt quality measure, but quality can be discussed from a variety of perspectives—hiring the right people, food ingredients, good suppliers, speed of service, cleanliness, friendliness, etc.

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- *Process:* Operation of a successful cruise line consists of many processes. The process can be discussed from various perspectives: (a) the process of welcoming a guest aboard, (b) bill and payment processing, (c) delivery of meals, (d) supply chain, (e) off ship excursions, etc. The methods analysis tools discussed in Chapter 10 provide a way for students to address and analyze these processes.
- *Location:* Celebrity Cruises provides a unique opportunity for students to address the many aspects of the location decision. First, where in the world are the customers? Second, from what home ports will Celebrity operate? Third, where are the locations of the ports-of-call for the ship?
- *Layout:* How should the ship itself be designed…how many restaurants, how many kitchens, what other amenities (i.e. gym, spa, theater, shops, library, etc.)? What shipboard features will distinguish differences in pricing?
- *Human resources:* The unique international flavor of the crew on cruise ships generates a wide variety of special recruiting, motivational, and teamwork issues. A service-oriented staff, carefully recruited and well trained, is a critical ingredient for success of a 'hotel at sea' and an integral part of the premium Celebrity Cruises experience.
- *Supply chain management:* Students should appreciate the importance of the supply chain for a floating hotel that is going to be at sea for days or even weeks at a time.
- *Inventory:* Because there is seldom resupply once at sea, inventory, but particularly food inventory for hundreds of people, is a critical issue. Food requirements must be accurately forecasted and be maintained at the appropriate and often critical temperatures. Food is only one of the many inventory items to be maintained: water, fuel, cleaning supplies, clothes, and memorabilia require all sorts of special care, tracking, and storage issues.
- *Scheduling:* Fluctuations in location and season create a very interesting and challenging task for the operations managers. Not only the ships and port access and excursions, but also food deliveries and crews, must all be scheduled.
- *Maintenance/reliability:* The ship is open every day for business. Minor maintenance is performed while the ship is operating, with more significant maintenance performed annually and major long-term maintenance conducted in dry dock every 5 years.

LO 1.2: Identify the 10 strategic decisions of operations management

AACSB: Reflective thinking

2. Celebrity's 10 OM decisions are also executed by a manufacturing firm. See, for instance, the Frito-Lay case discussed earlier in this chapter. Indeed, the theme of the text is that these 10 decisions are pervasive in OM. It matters little if the product is a Frito-Lay product, an iPhone, or a premium vacation with Celebrity Cruises; all of these 10 decisions are going to be made. The distinction is the implementation and emphasis placed on each. For instance, product design at Frito-Lay may begin with selecting the proper potatoes, cooking oils, and temperature. Celebrity, as noted above, has a very different product design task. Similarly, quality of Frito-Lay chips may be dependent on precise cutting blades and processing temperature, while Celebrity's quality manifests itself in accommodations, food, and service. Students should be challenged to recognize that the 10 decisions are made, albeit with distinctions dependent upon the product and strategy.

LO 1.2: Identify the 10 strategic decisions of operations management

ACSB: Reflective thinking

3. Celebrity's 10 OM decisions are also executed by a retail firm. Indeed, the theme of the text is that these 10 decisions are pervasive in OM. It matters little if the product is a retail firm or a restaurant (such as Hard Rock, discussed in the prior case) or a premium vacation with Celebrity Cruises; all of these 10 decisions are going to be made. Perhaps in a different way and with different emphasis, but they will be made. For instance, Hard Rock's product is a unique memorabilia-filled dining experience. Celebrity's product is a holiday with premium accommodations, food, and service. Students should be challenged to recognize that the 10 decisions are made, albeit with distinctions dependent upon the product and strategy.

LO 1.2: Identify the 10 strategic decisions of operations management

ACSB: Reflective thinking

4. The differences between a land-based hotel and the "hotel at sea" may be very small in terms of guest expectations and the quality decision. However, the emphasis on various aspects of the other decisions can be expected to change. For instance, for the "hotel at sea" the location decision changes as a function of the season, port-of-call performance, and even weather. A hotel may or may not include dining excellence a part of its product, but for most cruise lines, a premium dining experience is critical. In the case of supply chain, logistics, and inventory, for the ship there is often no resupply; therefore, there is an added emphasis on forecasts, logistics, and inventory. Forecasts must be accurate, suppliers punctual, and inventory counts precise. Similarly, maintenance onboard ship must remove all variability; the emergency backup may be days away. Most hotels will very likely have little in common with the implementation of the human resource function at an international cruise line with employees from dozens of countries. But they both must be successful at the HR decision.

LO 1.2: Identify the 10 strategic decisions of operations management

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ACSB: Reflective thinking

ADDITIONAL CASE STUDIES (available in MyLab Operations Management)

1 NATIONAL AIR EXPRESS

This case can be used to introduce the issue of productivity and how to improve it, as well as the difficulty of good consistent measures of productivity. This case can also be used to introduce some of the techniques and concepts of OM.

1. The number of stops per driver is certainly a good place to start. However, mileage and number of shipments will probably be good additional variables. (Regression techniques, addressed in Chapter 4, can be addressed here.)

LO 1.8: Identify the critical variables in enhancing productivity

AACSB: Analytical thinking

2. Customer service should be based on an analysis of customer requirements. Document requirements in terms of services desired (supply needs, preprinted waybills, package weights, pickup and drop-off requirements) should all be considered. (The house of quality technique discussed in Chapter 5 is one approach for such an analysis.)

LO 1.8: Identify the critical variables in enhancing productivity

AACSB: Analytical thinking

3. Other companies in the industry do an effective job of establishing very good labor standards for their drivers, sorters, and phone personnel. Difficult perhaps, but doable. (Work measurement in Chapter 10 addresses labor standards.)

LO 1.8: Identify the critical variables in enhancing productivity

AACSB: Analytical thinking

2 ZYCHOL CHEMICALS CORPORATION

1. The analysis of the productivity data is shown on the next page. Both labor and material productivity increased, but capital equipment productivity did not. The net result is a large negative change in productivity. If this is a one-time change in the accounting procedures, this negative change should also be a one-time anomaly. The effect of accounting procedures is often beyond the control of managers. For example, perhaps the capital allocation is based on an accelerated allocation of depreciation of newly installed technology. This accounting practice will seriously impact near-term productivity and then later years' productivity figures will benefit from the reduced depreciation flows. This highlights the difficulty in accounting for costs in an effective managerial manner. Decisions and evaluation of operating results should be based on sound managerial accounting practices and not necessarily generally accepted financial accounting principles.

LO 1.6: Compute single-factor productivity

LO 1.7: Compute multifactor productivity

AACSB: Analytical thinking

2. An analysis of adjusted results reduces the negative impact on the capital allocation but there is still a negative growth in multifactor productivity. After adjustment for inflation, the material costs are still higher in 2019. Yet, one must be aware of the extra volatility of the cost of petroleum-based products. Did the manager have control over his price increases? One should look at the changes in a petroleum-based price index, including the cost of oil, over the last two years in order to gain a better understanding of the degree to which the manager had control over these costs. The increase in wages was beyond the manager's control, and a constant rate should be used for comparing both years' results. Yet a negative result still remains. Even when material costs in 2019 are converted to the original cost of $320, a negative 5% growth in productivity remains. The increase in the capital base is responsible yet should not persist in future years if the increase was the result of an adoption of new technology.

LO 1.6: Compute single-factor productivity

LO 1.7: Compute multifactor productivity

AACSB: Analytical thinking

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3. The manager did not reach the goal. An analysis of the changes in capital costs is warranted. Even after adjusting for inflation, multifactor productivity was not positive. However, labor and materials productivity were favorable. The capital investment cost (as figured by the accounting department) was so large as to make his multifactor productivity negative. Multifactor productivity has fallen by 11.61% before adjustment and by 7.87% after the adjustment for inflation.

LO 1.7: Compute multifactor productivity

AACSB: Application of knowledge

Single-Factor Productivity Analysis	**2018**	**2019**	**Adjusted Cost***	**Adjusted Total Cost**
Production (units)	4,500	6,000		
Material Used (Barrels)	700	900		
Material Cost per Barrel	$320.00	$360.00	$345.60 (360/1.04167)	$311,040 (900 × 345.60)
Labor-Hours	22,000	28,000		
Compensation Rate	$13.00	$14.00	$13.44 (14/1.04167)	$376,320 (28,000 × $13.44)
Capital Applied ($)	$375,000	$620,000	$595,200 (620,000)/1.04167)	$595,200
Producer Price Index (PPI)	120	125		$1,282,560
*Change in PPI = 4.167% = (125/120 − 1) = 0.04167				
Total Cost	$885,000	$1,336,000		$1,282,560 (Adjusted)

Multifactor Productivity (MFP) Analysis	**2018**	**2019**	**% Change**	
Labor Productivity (Units per hr.)	4,500/22,000 = 0.2045	6,000/28,000 = 0.2143	4.79%	Nearly reached the goal
Material Productivity (Units per barrel)	4,500/700 = 6.4286	6,000/900 = 6.6667	3.70%	Positive change
Capital Productivity (Units per $)	4,500/375,000 = 0.0120	6,000/620,000 = 0.0097	−19.17%	Large negative change

	2018	**2019**	
MFP Before Adjustment per $)	0.00508	0.00449	(0.00449 − 0.00508)/0.00508 = −11.61%
MFP After Adjustment (per $)	0.00508	0.00468	(0.00468 – 0.00508)/0.00508 = −7.88%

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