

## Chapter

# 1

## Using Operations to Create Value

### DISCUSSION QUESTIONS

1. Answering this question demonstrates that processes underlie all of our jobs. What might be surprising is how many students would put their job in the category of “other,” suggesting that many jobs do not fall neatly into any one functional area. Perhaps many in the “other” category might best be called “operations” on further reflection. Customers, both internal and external, are part of each process, and the goal is to manage the processes to add the most value for them.
2. Amazon.com offers a very broad range of services and products at competitive prices. Its competitive priorities would include fast delivery time, on-time delivery, customization, variety and low-cost operations. As a business, Amazon.com is actually assembling a customized basket of goods that must be delivered in a short window of time in a dependable fashion. Low-cost operations are needed to remain competitive. To remain in business, Amazon.com needs to maintain high volumes of traffic. Operations strategy must focus on stock availability and quick, economical, and dependable delivery.
3. The hospital’s commitment *to provide attention to patients arriving to the emergency unit in less than 15 minutes and never to turn away patients who need to be hospitalized* implies that the facility must be designed to have extra capacity in both beds and emergency room facilities. It must plan on having extra personnel in the emergency room and also plan on having additional emergency personnel on call to take care of unprecedented heavy loads. In line with the mission statement, maximum utilization of the facilities (i.e., beds and emergency room personnel) would not be one of the performance objectives for the hospital.
4. FedEx traditionally has competed on the basis of fast, dependable delivery. Before the boom in Internet applications, many businesses relied on FedEx to get things to other businesses overnight. Now, this need is beginning to diminish as sophisticated systems are being installed to assist companies in planning operations better. And, the Internet based companies are adding more demands for low cost ground deliveries to specific customer doors. FedEx, in order to remain competitive with companies such as UPS, has moved into the door-to-door delivery business, perhaps through acquisition. Nonetheless, it will require changes to this company’s competitive priorities.
5. Technology Management. To identify a market segment, we need to determine answers to questions such as: Which colleges and departments currently offer the subject? What do instructors desire in the way of textbook support? Is there a trend toward Technology Management courses? Are there other Technology Management

texts? Some needs assessment can be accomplished by survey, but the response rate may be low. A high-investment strategy would be to ask or hire instructors to review and critique a list of topics, then an outline, then a draft. Explicit services include supplying information about the subject in the form of a textbook and instructor support in the form of ancillary publications.

6. It is often not a good idea for a company to try to excel in all of the competitive priorities because it is generally impossible to do so. Mediocrity is a predictable result. The choice and the minimum level of one or more of the competitive priorities are set by the order qualifiers for the particular product or service. The choice of the competitive priorities that the company should emphasize is usually governed by the company's strategy driven by its mission statement and the core competencies that the company wants to harness to seek the best competitive advantage.
7. Core processes should link to a firm's core competencies. Core processes are those processes that provide the firm the best competitive advantage. Essential to the definition a firm's core processes is the concept of "interaction costs." These costs include the time and money that are expended whenever people and companies exchange services, products, or ideas. If the transaction costs are higher to retain a process within the firm's organization than to outsource the process, the process should be outsourced.
8. Wendy's assembles hamburgers to order. When materials are held at the stage just before final assembly, they can be used to complete a wide variety of different sandwiches. Because no finished-goods stock exists, when customers say, "Hold the sauce," there is no delay or waste of materials. Service clerks specialize. One clerk takes orders and payment. Others fill portions of the order. Orders are processed in single file. Throughput is normally restricted by transactions at the cash register. At busy times, throughput is increased by splitting the bottleneck operation. One clerk takes customer orders, another receives payment. The Wendy's operation has some characteristics of assembly. Therefore, the impact of new menu items on the production operations must be carefully considered.
9. Grandmother's Chicken.
  - a. Kathryn Shoemaker's strategic plans include the following:
    - Product and service plans: Should the new location offer a new mix?
    - Competitive priorities: If the product mix and service mix are different at the new location, the thrust could be on low volumes and high quality.
    - Quality management: Should the goal be reliability or top quality?
    - Process strategy: What processes will be needed to make chicken dinners in the addition or new facility?
    - New technologies: Is it time to automate? Is this why there is a problem in service times?
    - Capacity: How large should the addition or new facility be?
    - Location: Should we locate in Uniontown or expand in Middlesburg?

- b. Attitudes toward nutrition could change the demand for chicken. Competitors such as Boston Market may be planning to move to Uniontown or even Middlesburg. There may be a trend toward demands for ever-faster service, which cannot be supported by the processes specified in the “unique recipe.” The economy of Uniontown might not be supportive of restaurant services. Shoemaker should also consider the availability of key resources, such as servers, whole chickens, spices, and cooking oil. Will Uniontown labor organize?
  - c. The possible distinctive competencies at Grandmother’s Chicken Restaurant include the “unique recipe,” the homey atmosphere, and friendly, prompt service.
10. Wild West, is recognizable as US WEST, which was bought out by Qwest in a hostile takeover in June, 2000. But many other “Baby Bells” are in a similar position.
- a. Strategic plans include reducing overhead, reengineering operations, and investing in new technologies to meet competition. The “do-nothing” option of remaining a local monopoly telephone company is not viable because of competition from cable systems and wireless systems that are capable of business and personal communication. If the mission is too broad, Wild West should sell its financial services and commercial real-estate businesses. Those businesses do not match their distinctive competencies.
  - b. One environmental issue is whether communication, like health care, will be viewed as a “right” and therefore should be free. A significant portion of Wild West’s business is governed by regulatory agencies. Customer service in their core business is essential to maintaining a favorable regulatory environment. Other business opportunities, such as manufacturing and providing information services, are prohibited by the same court order that formed the “Baby Bells” from AT&T.
  - c. Wild West’s distinctive competency is in connecting people (or machines) for the purpose of communication. A weakness is high overhead inherited from the era of telecommunication monopoly.
11. Although the answers may vary depending on the “niche” elements of the business, the competitive priorities would include on-time delivery, low-cost operations, and customization. The latter competitive priority comes from the capability to assemble unique “baskets” of food items for each customer. There may be a need to coordinate a given basket between two different stores. Capabilities to develop would include information systems and Web page design, efficient scheduling of delivery trucks (which must first collect the items in the basket and then deliver them to the customer’s door), and an adequate fleet of trucks with drivers.
12. Additive manufacturing is an excellent approach to achieving low volume, highly customized output. If time is of the essence in producing the parts and the manufacturer has access to 3D printers, they may be able to produce what they need more quickly than working with a subcontractor or outsourcing the work. If volumes increase, then the inexpensive, custom tooling that can be achieved via additive manufacturing may not be the best approach. The high volume of output might enable the manufacturer to recoup their investment in more substantial tooling or by exploring the use of other forms of automation.

**PROBLEMS**

**Addressing the Trends and Challenges in Operations Management**

1. Boehring University

a. Value of output:

$$75 \frac{\text{students}}{\text{class}} \times 3 \frac{\text{credit-hours}}{\text{student}} \times \left( \frac{\$200 \text{ tuition} + \$100 \text{ state support}}{\text{credit-hours}} \right) = \$67,500/\text{class}$$

Value of input: labor + material + overhead

$$\frac{\$6500 + \left( \frac{\$25}{\text{student}} \times 75 \text{ students} \right) + \$30,000}{\text{class}} = \$38,375/\text{class}$$

Multifactor Productivity ratio:

$$\text{Productivity} = \frac{\text{Output}}{\text{Input}} = \frac{\$67,500}{\$38,375} = 1.76$$

Compared to Solved problem 1, multifactor productivity has increased from 1.25 to 1.76.

b. Value of output is the same as in part a: \$67,500/class

Labor-hours of input:

$$20 \frac{\text{hours}}{\text{week}} \times 16 \frac{\text{weeks}}{\text{class}} = 320 \frac{\text{hours}}{\text{class}}$$

Productivity ratio:

$$\text{Labor Productivity} = \frac{\text{Output}}{\text{Input}} = \frac{\$67,500}{320 \text{ hours}} = \$210.94/\text{hour}$$

The \$192 season ticket price is not used in this calculation. It is a “red herring.”

2. Suds and Duds Laundry

a. Labor productivity

| Week | Number of Workers | Input (Labor-hours) | Output (Shirts) | Output/Input Ratio |
|------|-------------------|---------------------|-----------------|--------------------|
| 1    | 2                 | 24                  | 68              | 2.83 shirts/hour   |
| 2    | 2                 | 46                  | 130             | 2.83 shirts/hour   |
| 3    | 3                 | 62                  | 152             | 2.45 shirts/hour   |
| 4    | 3                 | 51                  | 125             | 2.45 shirts/hour   |
| 5    | 2                 | 45                  | 131             | 2.91 shirts/hour   |

b. Output per person does not vary much whether it is Sud, Dud, or Jud working. Productivity declines when all three are present. Perhaps there isn’t enough work to keep three persons occupied, or perhaps there is not enough work space or equipment to accommodate three workers.

## 3. White Tiger Electronics compact disc players

Value of Output: \$300

Value of Input: Labor + Materials + Overhead

$$\text{Productivity} = \frac{\text{Output}}{\text{Input}} = \frac{\$300}{\$30 + \$70 + \$50} = 2.000$$

10% productivity improvement  $\rightarrow 2.00 \times 1.10 = 2.200$ 

Given productivity = 2.20, and the value of output = \$300, we solve for the cost of inputs:

$$\text{Productivity} = \frac{\text{Output}}{\text{Input}} = \frac{\$300}{\text{Input}} = 2.20$$

$$\text{Input} = \frac{\$300}{2.2} = \$136.36 \text{ or } \$136$$

The cost of inputs must decrease by  $(\$150 - \$136) = \$14$ .

- A \$14 reduction in material costs is  $\$14/\$70 = 20.00\%$
- A \$14 reduction in labor costs is  $\$14/\$30 = 46.67\%$
- A \$14 reduction in overhead is  $\$14/\$50 = 28.00\%$

## 4. Symtecks

The output of a process is valued at \$100 per unit. The cost of labor is \$50 per hour including benefits. The accounting department provided the following information about the process for the past four weeks:

|                                 | Week 1        | Week 2        | Week 3        | Week 4        |
|---------------------------------|---------------|---------------|---------------|---------------|
| <b>Units Produced</b>           | 1124          | 1310          | 1092          | 981           |
| <b>Total Value</b>              | 112,400       | 131,000       | 109,200       | 98,100        |
| <b>Labor (\$)</b>               | 12,735        | 14,842        | 10,603        | 9526          |
| <b>Labor (hrs)</b>              | 254.7         | 296.8         | 212.1         | 190.5         |
| <b>Material (\$)</b>            | 21,041        | 24,523        | 20,442        | 18,364        |
| <b>Overhead (\$)</b>            | 8,992         | 10,480        | 8,736         | 7,848         |
| <b>Multifactor Productivity</b> | 2.63          | 2.63          | 2.75          | 2.75          |
| <b>Labor Productivity</b>       | 4.41 units/hr | 4.41 units/hr | 5.15 units/hr | 5.15 units/hr |

- Use the multifactor productivity ratio to see whether recent process improvements had any effect and, if so, when the effect was noticeable.

Value of output

$$1124 \text{ units} \times \$100 = \$112,400$$

Value of input: labor + material + overhead

$$\$12,735 + \$21,041 + \$8,992 = \$42,768$$

Productivity ratio:

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

$$\text{Week 1} \quad \text{Productivity} = \frac{\text{Output}}{\text{Input}} = \frac{\$112,400}{\$42,768} = 2.628$$

$$\text{Week 2} \quad \text{Productivity} = \frac{\text{Output}}{\text{Input}} = \frac{\$131,000}{\$49,845} = 2.628$$

$$\text{Week 3} \quad \text{Productivity} = \frac{\text{Output}}{\text{Input}} = \frac{\$109,200}{\$39,781} = 2.745$$

$$\text{Week 4} \quad \text{Productivity} = \frac{\text{Output}}{\text{Input}} = \frac{\$98,100}{\$35,738} = 2.745$$

$$\frac{2.745 - 2.628}{2.628} \times 100\% = 4.45\%$$

**Improved 4.45% - noticeable in Week 3**

- b. Has labor productivity changed? Use the labor productivity ratio to support your answer.

Labor-hours of input: Labor \$50/hour

Labor costs

$$\text{Week 1} = \$12,735/\$50 = 254.7$$

$$\text{Week 2} = \$14,842/\$50 = 296.84$$

$$\text{Week 3} = \$10,603/\$50 = 212.06$$

$$\text{Week 4} = \$9,526/\$50 = 190.52$$

Productivity ratio:

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

$$\text{Week 1} = \text{Labor Productivity} = \frac{\text{Output}}{\text{Input}} = \frac{1124}{254.7 \text{ hours}} = 4.4130/\text{hour}$$

$$\text{Week 2} = \text{Labor Productivity} = \frac{\text{Output}}{\text{Input}} = \frac{1310}{296.84 \text{ hours}} = 4.413/\text{hour}$$

$$\text{Week 3} = \text{Labor Productivity} = \frac{\text{Output}}{\text{Input}} = \frac{1092}{212.06 \text{ hours}} = 5.1495/\text{hour}$$

$$\text{Week 4} = \text{Labor Productivity} = \frac{\text{Output}}{\text{Input}} = \frac{981}{190.52 \text{ hours}} = 5.1491/\text{hour}$$

$$\frac{5.1491 - 4.4130}{4.4130} \times 100\% = 16.68\%$$

**Improved 16.68%**

## 5. Alyssa's Custom Cakes

a.

5 Birthday cakes x \$50 per cake = \$250

2 Wedding cakes x \$150 per cake = \$300

3 Specialty cakes x \$100 per cake = \$300

Total monthly revenue = \$850

Multifactor productivity ratio = output/input

$$1.25 = \$850/x$$

Solve for x =  $\$850/1.25 = \$680$ 

Total costs = \$680

Average cost per cake =  $\$680/10 = \$68/\text{cake}$ 

b. Labor productivity

Birthday cake =  $\$50/1.5 \text{ hours} = \$33.30/\text{hour}$ Wedding Cake =  $\$150/4 \text{ hours} = \$37.50/\text{hour}$ Specialty Cake =  $\$100/1 \text{ hours} = \$100/\text{hour}$ 

c. Based on labor productivity, Alyssa should try to sell specialty cakes the most.

d. Yes, Alyssa should stop selling birthday cakes. Based on answer a, she loses \$68 - \$50 = \$18 every time she sells a birthday cake.

## 6. Big Black Bird Company

The Big Black Bird Company problem is based on a product made by Raven Industries. None of the numbers are representative of actual costs or volume.

a. Multifactor Productivity

*Original Situation:*Value of output:  $(2500 \text{ uniforms} \times \$200) = \$500,000$ Value of input:  $(2500 \text{ uniforms} \times \$120) = \$300,000$ 

Productivity ratio:

$$\text{Productivity} = \frac{\text{Output}}{\text{Input}} = \frac{\$500,000}{\$300,000} = 1.67$$

*Overtime Situation:*Value of output:  $(4000 \text{ uniforms} \times \$200) = \$800,000$ Value of input:  $(4000 \text{ uniforms} \times \$144) = \$576,000$ 

Productivity ratio:

$$\text{Productivity} = \frac{\text{Output}}{\text{Input}} = \frac{\$800,000}{\$576,000} = 1.39$$

Productivity decreases by:

$$\frac{1.67 - 1.39}{1.67} \times 100\% = 16.77\%$$

b. Labor Productivity

*Original Situation:*

Value of output (from part a) is: \$500,000

Labor-hours of input:  $(70 \times 40 \text{ hours}) + (30 \times 40 \text{ hours}) = 4000 \text{ hours}$

Labor productivity =  $\$500,000/4000$  hours =  $\$125/\text{hour}$

*Overtime Situation:*

Value of output (from part a) is:  $\$800,000$

Labor-hours of input:  $(70 \times 72 \text{ hours}) + (30 \times 72 \text{ hours}) = 7200$  hours

Labor productivity =  $\$800,000 / 7200$  hours =  $\$111.11/\text{hours}$

Labor productivity decreases by:

$$(125/111.11) / 125 \times 100\% = 11.1\%$$

c. Gross profits

*Original Situation:*  $\$500,000 - \$300,000 = \$200,000$

*Overtime Situation:*  $\$800,000 - \$576,000 = \$224,000$

Weekly profits increased.

7. Mack's Guitar Company

a. Labor productivity = output/input

*Output* = 100 guitars x 80% completion rate x price/guitar  
= 80 guitars/ month x  $\$250/\text{guitar} = \$20,000$

*Input*

Labor = 10/hours per guitar x 100 guitars = 1000 hours

Labor productivity is  $\$20,000/1000 = \$20/\text{hour}$

Multifactor productivity ratio = output/input

*Output* = 100 guitars x 80% completion rate x price/guitar  
= 80 guitars/ month x  $\$250/\text{guitar} = \$20,000$

*Input*

Labor =  $\$10/\text{hour} \times 10/\text{hours per guitar} \times 100$  guitars =  $\$10,000$

Material =  $\$40/\text{guitar} \times 100$  guitars =  $\$4,000$

Overhead =  $\$4,000$

Multifactor productivity ratio =  $\$20,000/\$18,000 = 1.11$

b. Option 1. Increase sales price by 10%

*Output* = 100 guitars x 80% completion rate x  $(\$250 \times 1.1) = \$22,000$

*Input*

Labor is same as in part (a) =  $\$10,000$

Material is same as in part (a) =  $\$4,000$

Overhead is same as in part (a) =  $\$4,000$

Multifactor productivity ratio =  $\$22,000/\$18,000 = 1.22$

Option 2. Improve Quality

*Output* = 100 guitars x 90% completion rate x  $\$250/\text{guitar} = \$22,500$

*Input*

Labor is same as in part (a) =  $\$10,000$

Material is same as in part (a) =  $\$4,000$

Overhead is same as in part (a) =  $\$4,000$

Multifactor productivity ratio =  $\$22,500/\$18,000 = 1.25$

Option 3. Reduce costs by 10%

*Output* = same as in part (a) =  $\$20,000$

*Input*



Reduce costs by 10% yields 90% of the input costs from part (a).  
 = \$18,000 x 0.90 = \$16,200  
 Multifactor productivity ratio = \$20,000/\$16,200 = 1.23

Darren should choose Option 2 and improve quality because it yields the greatest improvement in multifactor productivity.

8. Mariah Enterprises Productivity of Process Alpha and Process Beta

Excel used to perform all calculations

|                          | Process  |          |                   |
|--------------------------|----------|----------|-------------------|
|                          | Alpha    | Beta     |                   |
| Total Value of Output    | \$17,150 | \$16,450 |                   |
| Total Cost of Labor      | \$2,600  | \$3,000  |                   |
| Total Cost of Materials  | \$5,500  | \$4,900  |                   |
| Total Cost of Overhead   | \$6,000  | \$5,000  |                   |
| Labor Productivity       | \$6.596  | \$5.483  | unit \$/ labor \$ |
| Multifactor Productivity | \$1.216  | \$1.275  | unit \$/ total \$ |

Process alpha has 20% [(6.596-5.483)/5.483] higher labor productivity.

Process beta has 5% [(1.275-1.216)/1.216] higher multifactor productivity.

While process beta generates more dollars of output per dollar invested in input, it doesn't use labor as efficiently as process alpha.

9. Morning Brew Coffee Shop

Excel used to perform all calculations

a. Current labor and multifactor productivity

| Currently         | Regular Coffee | Cappuccino | Vienna coffee | total      |
|-------------------|----------------|------------|---------------|------------|
| Output in dollars | \$700.00       | \$300.00   | \$600.00      | \$1,600.00 |
| Labor cost        |                |            |               | \$320.00   |
| Material cost     | \$175.00       | \$75.00    | \$187.50      | \$437.50   |
| Equipment cost    |                |            |               | \$125.00   |
| Overhead cost     |                |            |               | \$225.00   |
|                   |                |            | Profit        | \$492.50   |

Labor Productivity 5.0000  
 Multifactor Productivity 1.4447

After adding new product

| After Adding New Product | Regular Coffee | Cappuccino | Vienna coffee | Eiskaffee | total      |
|--------------------------|----------------|------------|---------------|-----------|------------|
| Output in dollars        | \$700.00       | \$300.00   | \$600.00      | \$375.00  | \$1,975.00 |
| Labor cost               |                |            |               |           | \$320.00   |
| Material cost            | \$175.00       | \$75.00    | \$187.50      | \$112.50  | \$550.00   |
| Equipment cost           |                |            |               |           | \$200.00   |
| Overhead cost            |                |            |               |           | \$350.00   |
|                          | Profit         |            |               |           | \$555.00   |

Labor Productivity 6.1719  
 Multifactor Productivity 1.3908

Change in Labor Productivity 23.438%  
 Change in Multifactor Productivity -3.727%

- b. The units of Eiskaffee that would have to be sold to ensure that the multifactor productivity increases from its current level may be calculated as follows:

$$\frac{\text{output}}{\text{input}} = \frac{\text{Coffee sold in \$}}{\text{Labor cost} + \text{Material cost} + \text{Equipment cost} + \text{Overhead cost}} = 1.4447$$

$$\frac{350(\$2) + 100(\$3) + 150(\$4) + x(\$5)}{\$320 + (350(\$0.5) + 100(\$0.75) + 150(\$1.25) + x(\$1.5)) + 200 + 350} = 1.4447$$

$$\frac{\$1600 + \$5.0x}{\$1307.5 + \$1.5x} = 1.4447$$

$$\$1600 + \$5x = 1.4447(\$1307.5 + \$1.5x)$$

$$\$1600 + 5x = 1888.945 + 2.1670x$$

$$2.833X = 288.945$$

$$x \cong 102$$

Calculation confirmed in Excel:

| After Adding New Product | Regular Coffee | Cappuccino | Vienna coffee | Eiskaffee | total      |
|--------------------------|----------------|------------|---------------|-----------|------------|
| Output in dollars        | \$700.00       | \$300.00   | \$600.00      | \$510.00  | \$2,110.00 |
| Labor cost               |                |            |               |           | \$320.00   |
| Material cost            | \$175.00       | \$75.00    | \$187.50      | \$153.00  | \$590.50   |
| Equipment cost           |                |            |               |           | \$200.00   |
| Overhead cost            |                |            |               |           | \$350.00   |
|                          | Profit         |            |               |           | \$649.50   |

|                          |        |
|--------------------------|--------|
| Labor Productivity       | 6.5938 |
| Multifactor Productivity | 1.4447 |

|                                    |         |
|------------------------------------|---------|
| Change in Labor Productivity       | 31.875% |
| Change in Multifactor Productivity | 0.001%  |

## CASE: CHAD'S CREATIVE CONCEPTS\*

### A. Synopsis

This case describes a small furniture manufacturing company that has gained a reputation for creative designs and quality by focusing on producing custom-designed furniture. As its reputation grew, it began to sell some standard furniture pieces to retail outlets. The overall growth in sales volume and the diversification into the production of standard furniture pieces have caused a number of issues to arise concerning both the internal manufacturing operations and its relationship to the other functional areas of the company.

### B. Purpose

This case is designed to be used as either a “cold-call” case for class discussion or an assigned homework reading. Major points to be brought out in the discussion include:

1. The range of decisions that are made in designing and operating processes.
2. The impact that these operating decisions have on the organization as a whole, such as on marketing and finance.
3. The impact that decisions made in other functional areas of the organization have on the operating function.
4. The need to go beyond the “functional silo” mentality and manage in an integrative manner.

### C. Analysis

\* This case was prepared by Dr. Brooke Saladin, Wake Forest University, as a basis for classroom discussion.

**Question 1:** *What types of decisions must Chad Thomas make daily for his company's operations to run effectively? Over the long run?*

The students should be able to discuss a number of short-term-oriented decisions that are facing Chad Thomas. These should include:

- a. How to set priorities and schedule different orders? Chad is receiving orders for both custom-made, low-volume furniture pieces and higher-volume, standard pieces. Sales have increased, but the amount of equipment and the production capacity of the company have not. Neither has the type or mix of equipment changed. Different orders with different manufacturing requirements are now competing for the same productive capacity.
- b. What orders to accept and how long of a lead time to plan for in promising a delivery date?
- c. What type of work policies should be maintained for his employees? Decisions such as the number and type of employees to employ, the number of hours to work per day, and the amount of overtime to allow are all work policy decisions that impact the available capacity level.
- d. The allocation of resources, equipment, labor, and money to each product line.
- e. The level of inventory to maintain at various stages of the production process for both the custom and standard furniture lines (i.e., raw material, WIP, finished goods). These decisions are linked to the longer-term, total inventory-investment decision.

Examples of longer-term decisions that face Chad Thomas include:

- a. Amount of money to tie up in the total inventory investment.
- b. The type of equipment to invest in to support efficient production. At what point should more specialized equipment be purchased to manufacture high-volume, standard furniture pieces more efficiently?
- c. What should be the overall workforce level to maintain, and what should be the proper mix of skills and capabilities?
- d. How should the facilities be laid out to accommodate the two different product lines? This gets the students into a whole range of capacity and equipment allocation decisions including size, type, and configuration.

In these decisions it is important that the students see the significance of maintaining consistency of both strategic and operating decisions across functional areas.

**Question 2:** *How did sales and marketing affect operations when they began to sell standard pieces to retail outlets?*

Standard furniture pieces compete on a different set of competitive priorities than custom-designed pieces. Timely delivery and low costs are much more important than product flexibility. Quality may also be defined differently. The existing facilities are set up to provide flexibility with its job-shop orientation and general-purpose equipment. By introducing a standard line that should be manufactured on a flow line with some dedicated, more specialized equipment, a conflict has developed, and scheduling problems have resulted.

**Question 3:** *How has the move to producing standard furniture pieces affected the company's financial structure?*

Inventory investment and operating costs are rising because of the frequent changeovers to accommodate the two different product lines and their scheduling conflicts.

Profit margins for the standard line are smaller, which puts pressure on manufacturing to increase productivity and reduce costs. There may also be an issue concerning the assignment of overhead costs to each product line.

Finally, the potential need to rent warehouse space to store either WIP or finished-goods inventory cuts into the profit margin for the standard furniture line.

**Question 4:** *What might Chad Thomas have done differently to help avoid some of these problems he now faces?*

Chad needs to address issues relating to functional areas. Make sure the student is able to identify decisions that relate to more than one functional area. Examples include the following:

*Operations Function*

1. Monitoring capacity and utilization of facilities
2. Formulating inventory policies—dollars, items, and unit levels
3. Setting scheduling policies and priorities
4. Maintaining product line quality

*Marketing and Sales*

1. Accurately forecasting orders for standard pieces
2. Defining market segments and customer needs
3. Determining what delivery schedules can be promised to customers

*Finance*

1. Deciding level and type of investment

## 2. Investigating the effect of capacity investment decisions on ROI

*Distribution/Logistics*

1. Managing distribution and pipeline inventory
2. Comparing cost and advantages of various transportation modes
3. Meeting delivery lead times

Three possible avenues that students may focus on are: Chad Thomas might have -

- a. Established a plan for a more controlled growth. Part of this plan would be the development of the appropriate infrastructure to manage a controlled growth as to what markets to enter, what product lines to develop, and how to develop the proper manufacturing capabilities.
- b. Maintained the company focus on custom-designed furniture only. This alternative presents a whole different set of issues and decisions pertaining to future growth, but it would have avoided the issues of mixed competitive priorities and scheduling conflicts.
- c. Realized the different requirements for each product line and focused the manufacturing facilities into two separate sets of production facilities designed to cater to each product line's specific needs.

**D. Recommendations**

This case is not designed to be a decision-making case per se but rather a vehicle to get students thinking about the types and the integrated nature of decisions that operations managers face. The students may, indeed, have suggestions as to what should be done to help out Chad Thomas. These recommendations will more than likely follow the alternatives already discussed. As recommendations are provided by students, make sure you push them to understand the implications of their recommendations with respect to the company as a whole and the other functional areas.

**E. Teaching Strategy**

This case can be effectively discussed in 20 to 30 minutes by following the discussion questions provided at the end. The questions are interconnected and somewhat redundant on purpose to reinforce the inter-relatedness of decisions made in various functional areas of the company. The intent is to have the students understand the range of decisions that face managers in the operations function and to realize that different types of products competing in different markets place different demands on the operations function. Therefore, manufacturing systems will take on a variety of configurations.

Exhibit TN.1 lays out a sample table to be written on the board displaying important issues in the class discussion. Each column can be used to compare and contrast the differences in the requirements imposed by custom versus standard furniture for each area.

**EXHIBIT TN.1** Board Plan

| <b>Important Issues</b>                        | <b>Custom Furniture</b> | <b>Standard Furniture</b> |
|--|-------------------------|---------------------------|
| Marketing                                      |                         |                           |
| Quality level and quality control              |                         |                           |
| Process equipment                              |                         |                           |
| Process flow                                   |                         |                           |
| Production scheduling system                   |                         |                           |
| Purchasing                                     |                         |                           |
| Type of inventory and inventory control system |                         |                           |
| Type of engineering                            |                         |                           |
| Type of labor and supervision needed           |                         |                           |
| Wage/reward system                             |                         |                           |
| Layout   |                         |                           |

**Crayola: Using Operations to Create Value at Crayola**

|                            |  |
|----------------------------|--|
| <b>Length:</b>             | 07:50  |
| <b>Subject:</b>            | Using Operations to Create Value at Crayola          |
| <b>Textbook Reference:</b> | Chapter 1: Using Operations to Create Value, page 29 |

**Summary**

This video discusses the operations and supply chain strategy and challenges at Crayola, the world's leading company in arts and crafts products. A set of supply chain leadership principles are defined as cost, innovation, quality & ethical responsibility, sustainability, and resilience and agility. These principles are derived from the daily decisions Crayola faces such as choosing colors to drive demand, and launching new products while maintaining quality standards. As the supply chain grows globally and the company enters new foreign markets, operational challenges arise in managing fluctuating demands and a complex supply base.

**Key Concepts related to the chapter**

The video case includes rich discussion avenues in operations strategy, competitive priorities and capabilities. Also, the written case in the textbook covers Crayola's potentially new markets in China, which creates challenges as well as opportunities. The instructor should make sure that students understand and become comfortable in applying the core concepts of operations strategy and competitive priorities/capabilities to this case.

*Operations Strategy*

The corporate strategy and market analysis of Crayola can be discussed in detail. In order to develop a corporate strategy, Crayola first monitors and identifies adjustments that need to be implemented. Already being the dominant player in the North American market, Crayola is now looking for new markets overseas including China. Consumer needs are becoming more diversified than ever, and a large portion of purchasing takes place online. Crayola has strong core competencies in terms of customer-focused culture, strong innovation capabilities, and reliable product quality. Another key issue to be pointed out is their strong focus around environmental sustainability, which originated from the founders of the company. By leveraging their core competencies and adjusting to these external changes, Crayola strengthened their operations management functions and supply chain management activities. Four key strategies were developed -- international expansion, consumer commercialization, dot.com strategy, and Crayola experience. Two points to consider for the international expansion are - what works well in their home country might not work well elsewhere?, and secondly, the importance of choosing the appropriate entry strategy such that it can ward off fierce competition and overcome cultural frictions.

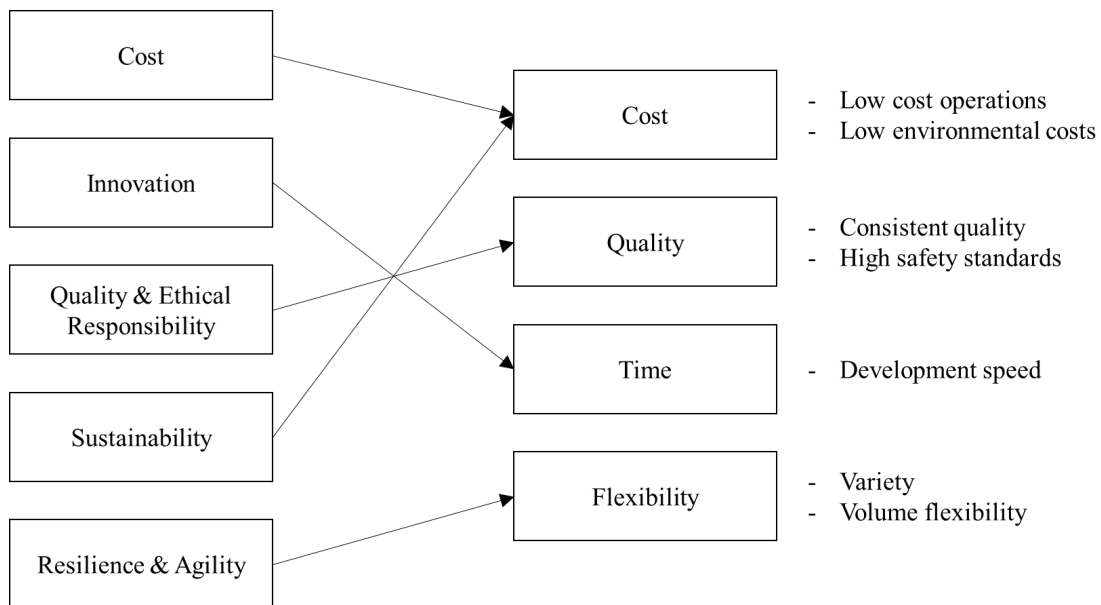
*Competitive Priorities and Capabilities*

The competitive priorities of Crayola are characterized by its five principles of cost, innovation, quality & ethical responsibility, sustainability, and resilience & agility. These critical operational dimensions can be elaborated in detail based on the case information. Competitive priorities of cost, quality, time, and flexibility should be critically evaluated to make sure that its achieved competitive capability goals are met. Students should be able to make clear distinctions between priorities (targeted) and capabilities (achieved) in order to address the discussion questions at the end of the case.

Another useful way to assess a firm’s ability is to use the order winner and order qualifier framework. In the video, Crayola’s customers mention order qualifiers as givens, and include consistently top quality, quick and on-time delivery, customized products and displays, variety, and flexibility. Order winners on the other hand, are mentioned as color selection (market knowledge), innovation, and high product reliability.

**Discussion Questions Based on Video**

1. Map Crayola’s five pillars of operational leadership to the competitive priorities in Table 1.3.





- The figure above shows an example of mapping the five pillars to the four competitive priorities. The pillars can be translated as having low operations and environmental costs, consistent and safe quality levels, fast new product development speed, and high responsiveness via customization and volume flexibility.

2. Create an assessment of Crayola's competitive priorities as it relates to their Asian expansion plants.

| Competitive Priority/Pillar | Measure  | Capability  | Gap   | Action  |
|-----------------------------|--|---|---|---|
| Low cost Operations         | Production cost<br>Transportation cost<br>Material cost                    | Mostly sourced in USA<br>Automated with US workers  | Foreign expansion causes additional costs             | Multilanguage packaging<br>Offshore production and sourcing                         |
| Sustainable efficiency      | Carbon dioxide emission<br>Energy consumption                              | Recycled plastic<br>Reforested wood<br>Solar farm   | Acceptable  | No action   |
| Ethical responsibility      | Fair wages to workers<br>Adherence to all local laws and ethical standards | Meeting laws and standards in North America         | Foreign markets may have different laws and standards | Education of local managers for strict adherence to the company's ethical standards |
| Consistent quality          | Percent defects<br>Rework, scrap<br>Product returns                        | High consistency in packaging and product quality   | Acceptable  | No action   |
| High safety quality         | Certifications<br>Chemical use   | All products are non-toxic                          | Acceptable  | No action   |
| Development speed           | New product time to market   | First to the market with every innovation           | Acceptable  | No action   |
| Variety                     | Product mix range  | Wide variety of colors                              | Acceptable  | No action   |
| Volume flexibility          | Utilization<br>Order-fill rate   | Maintains capacity and integrated supply base in US | Less responsive to overseas demand fluctuations       | Postponement<br>Modular process   |

3. Which of the competitive priorities might present the biggest challenge to Crayola as it expands internationally?

In order to maintain their emphasis on quality and environmental sustainability, Crayola sources most of the required materials from the USA. However, this practice could be put into question when they decide to aggressively expand to overseas markets. Studies show that locating production facilities in foreign countries and increasing the local presence reduces customer aversion and enhances market penetration. Crayola would also have to decide whether the benefits arising from the low production cost in the Chinese labor market are sufficient to overcome the disadvantages associated with technology leakage, political risks, quality risks, and increased competition.