ENGINEERING MANAGEMENT

COMPETITIVENESS & PRODUCTIVITY

Introduction

This chapter discusses **competitiveness**, **strategy**, and **productivity**, three separate but related topics that are vitally important to business organizations.

In this chapter we will learn about the different ways companies compete and why some firms do a very good job of competing.

We will learn how effective strategies can lead to competitive organizations, and you will learn what productivity is, why it is important, and what organizations can do to improve it.

COMPETITIVENESS

Companies must be competitive to sell their goods and services in the marketplace.

How effectively an organization meets the wants and needs of customers relative to others that offer similar goods or services.

Businesses Compete Using Marketing

1. Identifying consumer wants and/or needs is a basic input in an organization's decision-making process, and central to competitiveness.

The ideal is to achieve a perfect match between those wants and needs and the organization's goods and/or services.

2. Price and quality are key factors in consumer buying decisions.

It is important to understand the trade-off decision consumers make between price and quality.

3. Advertising and promotion are ways organizations can inform potential customers about features of their products or services, and attract buyers.

Businesses Compete Using OPERATIONS

1. Product and service design should reflect joint efforts of many areas of the firm to achieve a match between financial resources, operations capabilities, supply chain capabilities, and consumer wants and needs.

Special characteristics or features of a product or service can be a key factor in consumer buying decisions.

Other key factors include **innovation** and the **time-to-market** for new products and services.

Businesses Compete Using OPERATIONS(Contd.)

2. Cost of an organization's output is a key variable that affects pricing decisions and profits.

Cost-reduction efforts are generally ongoing in business organizations.

Productivity (discussed later in the chapter) is an important determinant of cost.

Organizations with higher productivity rates than their competitors have a competitive cost advantage.

A company may outsource a portion of its operation to achieve lower costs, higher productivity, or better quality.

Businesses Compete Using OPERATIONS(Contd.)

3. Location can be important in terms of cost and convenience for customers.

Location near inputs can result in lower input costs.

Location near markets can result in lower transportation costs and quicker delivery times.

Convenient location is particularly important in the retail sector.

Businesses Compete Using OPERATIONS(Contd.)

4. Quality refers to materials, workmanship, design, and service.

Consumers judge quality in terms of how well they think a product or service will satisfy its intended purpose.

Customers are generally willing to pay more for a product or service if they perceive the product or service has a higher quality than that of a competitor.

Businesses Compete Using OPERATIONS(Contd.)

5. Quick response can be a competitive advantage.

One way is quickly bringing new or improved products or services to the market.

Another is being able to quickly deliver existing products and services to a customer after they are ordered, and still another is quickly handling customer complaints.

Businesses Compete Using OPERATIONS(Contd.)

6. Flexibility is the ability to respond to changes.

Changes might relate to alterations in design features of a product or service, or to the volume demanded by customers, or the mix of products or services offered by an organization.

High flexibility can be a competitive advantage in a changeable environment.

7. Inventory management can be a competitive advantage by effectively matching supplies of goods with demand.

8. Supply chain management involves coordinating internal and external operations (buyers and suppliers) to achieve timely and cost-effective delivery of goods throughout the system.

Businesses Compete Using OPERATIONS(Contd.)

9. Service might involve after-sale activities customers perceive as value-added, such as delivery, setup, warranty work, and technical support.

Or it might involve extra attention while work is in progress, such as courtesy, keeping the customer informed, and attention to details.

Service quality can be a key differentiator; and it is one that is often sustainable.

Moreover, businesses rated highly by their customers for service quality tend to be more profitable, and grow faster, than businesses that are not rated highly.

Businesses Compete Using OPERATIONS(Contd.)

10. Managers and workers are the people at the heart and soul of an organization, and if they are competent and motivated, they can provide a distinct competitive edge by their skills and the ideas they create

Why Some Organizations Fail?

Organizations fail, or perform poorly, for a variety of reasons.

Being aware of those reasons can help managers avoid making similar mistakes.

Among the chief reasons are the following:

1. Neglecting operations strategy.

2. Failing to take advantage of strengths and opportunities, and/or failing to recognize competitive threats.

3. Putting too much emphasis on short-term financial performance at the expense of research and development.

Why Some Organizations Fail?(Contd.)

4. Placing too much emphasis on product and service design and not enough on process design and improvement.

5. Neglecting investments in capital and human resources.

6. Failing to establish good internal communications and cooperation among different functional areas.

7. Failing to consider customer wants and needs.

PRODUCTIVITY

- One of the primary responsibilities of a manager is to achieve productive use of an **organization's resources**.

- The term productivity is used to describe this.

- **Productivity** is an index that measures **output** (goods and services) relative to the **input** (labor, materials, energy, and other resources) used to produce it.

- It is usually expressed as the ratio of output to input:

- **Productivity** = $\frac{\text{OUTPUT}}{\text{INPUT}}$

PRODUCTIVITY

- Although productivity is important for all business organizations, it is particularly important for organizations that use a strategy of **low cost**, because the **higher the productivity**, the **lower the cost of the output**.

- A **productivity ratio** can be computed for a single operation, a department, an organization, or an entire country.

- In business organizations, productivity ratios are used for planning workforce requirements, scheduling equipment, financial analysis, and other important tasks.

PRODUCTIVITY

- Productivity has important implications for business organizations and for entire nations.

- For non-profit organizations, **higher productivity** means **lower costs**; for profit-based organizations, productivity is an important factor in determining how competitive a company is.

PRODUCTIVITY

- For a nation, the rate of productivity growth is of great importance.
- Productivity growth is the increase in productivity from one period to the next relative to the productivity in the preceding period.
- Thus, **Productivity growth**

$$= \frac{\textbf{Current Productivity – Previous Productivity}}{\textbf{Previous productivity}} \times 100$$

- **For example, if productivity increased from 80 to 84, the growth rate would be:** $= \frac{84 - 80}{80} \times 100 = 5\%$
- Productivity growth is a key factor in a country's rate of inflation and the standard of living of its people.
- Productivity increases add value to the economy while keeping inflation in check.

Computing PRODUCTIVITY

- **Productivity** measures can be based on a single input (partial productivity), on more than one input (multifactor productivity), or on all inputs (total productivity).
- Table 2.7 lists some examples of productivity measures.

Partial measures	$\frac{\text{Output}}{\text{Labor}}$	$\frac{\text{Output}}{\text{Machine}}$	$\frac{\text{Output}}{\text{Capital}}$	$\frac{\text{Output}}{\text{Energy}}$
Multifactor measures	$\frac{\text{Output}}{\text{Labor + Machine}}$		$\frac{\text{Output}}{\text{Labor + Capital + Energy}}$	
Total measure	$\frac{\text{Goods or services produced}}{\text{All inputs used to produce them}}$			

TABLE 2.7
Some examples of different types of productivity measures

Computing PRODUCTIVITY

- Partial measures are often of greatest use in operations management.
- Table 2.8 provides some examples of partial productivity measures.

TABLE 2.8
Some examples of partial productivity measures

Labor productivity	Units of output per labor hour
	Units of output per shift
	Value-added per labor hour
	Dollar value of output per labor hour
Machine productivity	Units of output per machine hour
	Dollar value of output per machine hour
Capital productivity	Units of output per dollar input
	Dollar value of output per dollar input
Energy productivity	Units of output per kilowatt-hour
	Dollar value of output per kilowatt-hour

Computing PRODUCTIVITY

- The units of output used in productivity measures depend on the type of job performed.
- The following are examples of labor productivity:

$$\frac{\textbf{Yards of carpet installed}}{\textbf{Labor hours}} = \text{Yards of carpet installed per labor hour}$$

$$\frac{\textbf{Number of motel rooms cleaned}}{\textbf{Number of workers}} = \text{Number of motel rooms cleaned per worker}$$

- Similar examples can be listed for machine productivity (e.g., the number of pieces per hour turned out by a machine).

Computing PRODUCTIVITY

EXAMPLE 2

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Computing Productivity

Determine the productivity for these cases:

a. Four workers installed 720 square yards of carpeting in eight hours.

b. A machine produced 70 pieces in two hours. However, two pieces were unusable.

SOLUTION

a. $$\text{Productivity} = \frac{\text{Yards of carpet installed}}{\text{Labor hours worked}}$$

$$= \frac{720 \text{ square yards}}{4 \text{ workers} \times 8 \text{ hours/worker}}$$

$$= \frac{720 \text{ yards}}{32 \text{ hours}}$$

$$= 22.5 \text{ yards/hour}$$

b. $$\text{Productivity} = \frac{\text{Usable pieces}}{\text{Production time}}$$

$$= \frac{70 - 2 = 68 \text{ usable pieces}}{2 \text{ hours}}$$

$$= 34 \text{ pieces/hour}$$

Computing PRODUCTIVITY

- Calculations of **multifactor productivity** measure inputs and outputs using a common unit of measurement, such as cost.
- For instance, the measure might use cost of inputs and units of the output:

$$\frac{\text{Quantity of Production}}{\text{Labor cost + Materials cost + Overhead cost}}$$

Note: The unit of measure must be the same for all factors in the denominator

Computing PRODUCTIVITY

EXAMPLE 3

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Computing Multifactor Productivity

Determine the multifactor productivity for the combined input of labor and machine time using the following data:

Output: 7,040 units

Input

Labor: $1,000

Materials: $520

Overhead: $2,000

SOLUTION

$$\text{Multifactor productivity} = \frac{\text{Output}}{\text{Labor} + \text{Materials} + \text{Overhead}}$$

$$= \frac{7{,}040 \text{ units}}{\$1{,}000 + \$520 + \$2{,}000} = 2 \text{ units per dollar input}$$

Computing PRODUCTIVITY

Productivity measures are useful on a number of levels.

For an individual department or organization, productivity measures can be used to track performance over time.

This allows managers to judge performance and to decide where improvements are needed.

For example, if productivity has slipped in a certain area, operations staff can examine the factors used to compute productivity to determine what has changed and then devise a means of improving productivity in subsequent periods.

Process yield

A useful measure closely related to productivity is **process yield**.

Where products are involved, process yield is defined as the ratio of **output of good product** (i.e., defective product is not included) to the **quantity of raw material input**.

Where services are involved, process yield measurement is often dependent on the particular process.

Process yield

For example, in a car rental agency, a measure of yield is the ratio of cars rented to cars available for a given day.

In education, a measure for college and university admission yield is the ratio of student acceptances to the total number of students approved for admission.

For subscription services, yield is the ratio of new subscriptions to the number of calls made or the number of letters mailed.

Factors That Affect Productivity

Numerous factors affect productivity.

Generally, they are **methods**, **capital**, **quality**, **technology**, and **management**.

Other factors that affect productivity include the following:

Standardizing processes and procedures wherever possible to reduce variability can have a significant benefit for both productivity and quality.

Quality differences may distort productivity measurements. One way this can happen is when comparisons are made over time, such as comparing the productivity of a factory now with one 30 years ago. Quality is now much higher than it was then, but there is no simple way to incorporate quality improvements into productivity measurements.

Use of the Internet can lower costs of a wide range of transactions, thereby increasing productivity. It is likely that this effect will continue to increase productivity in the foreseeable future.

Factors That Affect Productivity

Computer viruses can have an immense negative impact on productivity.

Searching for lost or misplaced items wastes time, hence negatively affecting productivity.

Scrap rates have an adverse effect on productivity, signaling inefficient use of resources.

New workers tend to have lower productivity than seasoned workers.

Thus, growing companies may experience a productivity lag.

Safety should be addressed.

Accidents can take a toll on productivity.

A **shortage of technology-savvy workers** hampers the ability of companies to update computing resources, generate and sustain growth, and take advantage of new opportunities.

Factors That Affect Productivity

Layoffs often affect productivity.

The effect can be positive and negative. Initially, productivity may increase after a layoff, because the workload remains the same but fewer workers do the work—although they have to work harder and longer to do it.

However, as time goes by, the remaining workers may experience an increased risk of burnout, and they may fear additional job cuts. The most capable workers may decide to leave.

Labor turnover has a negative effect on productivity; replacements need time to get up to speed.

Design of the workspace can impact productivity.

For example, having tools and other work items within easy reach can positively impact productivity.

Incentive plans that reward productivity increases can boost productivity.

Factors That Affect Productivity

The opportunity to obtain lower costs due to higher productivity elsewhere is a key reason many organizations turn to **outsourcing**.

Hence, an alternative to outsourcing can be improved productivity.

Moreover, as a part of their strategy for quality, the best organizations strive for **continuous improvement**.

Productivity improvements can be an important aspect of that approach.

Improving Productivity

A company or a department can take a number of key steps toward improving productivity:

Develop productivity measures

Determine critical (bottleneck) operations

Develop methods for productivity improvements

Establish reasonable goals

Get management support

Measure and publicize improvements

Productivity

SOLVED PROBLEMS

Computing Productivity

Problem 1

A company that processes fruits and vegetables is able to produce 400 cases of canned peaches in one-half hour with four workers. What is labor productivity?

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Solution

$$\text{Labor productivity} = \frac{\text{Quantity produced}}{\text{Labor hours}} = \frac{400 \text{ cases}}{4 \text{ workers} \times 1/2 \text{ hour/worker}}$$

$$= 200 \text{ cases per labor hour}$$

Computing Multifactor Productivity

Problem 2

A wrapping-paper company produced 2,000 rolls of paper one day. Labor cost was $160, material cost was $50, and overhead was $320. Determine the multifactor productivity.

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Solution

$$\text{Multifactor productivity} = \frac{\text{Quantity produced}}{\text{Labor cost} + \text{Material cost} + \text{Overhead}}$$

$$= \frac{2{,}000 \text{ rolls}}{\$160 + \$50 + \$320} = 3.77 \text{ rolls per dollar input}$$

A variation of the multifactor productivity calculation incorporates the standard price in the numerator by multiplying the units by the standard price.

Productivity

Computing Multifactor Productivity

Compute the multifactor productivity measure for an eight-hour day in which the usable output was 300 units, produced by three workers who used 600 pounds of materials. Workers have an hourly wage of $20, and material cost is $1 per pound. Overhead is 1.5 times labor cost.

Problem 3

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Solution

$$\text{Multifactor productivity} = \frac{\text{Usable output}}{\text{Labor cost} + \text{Material cost} + \text{Overhead cost}}$$

$$= \frac{300 \text{ units}}{(3 \text{ workers} \times 8 \text{ hours} \times \$20/\text{hour}) + (600 \text{ pounds} \times \$1/\text{pound}) + (3 \text{ workers} \times 8 \text{ hours} \times \$20/\text{hour} \times 1.50)}$$

$$= \frac{300 \text{ units}}{\$480 + \$600 + \$720}$$

$$= .167 \text{units of output per dollar of input}$$

Productivity

Problem 4 Computing Multifactor Productivity

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A health club has two employees who work on lead generation. Each employee works 40 hours a week, and is paid $20 an hour. Each employee identifies an average of 400 possible leads a week from a list of 8,000 names. Approximately 10 percent of the leads become members and pay a onetime fee of $100. Material costs are $130 per week, and overhead costs are $1,000 per week. Calculate the multifactor productivity for this operation in fees generated per dollar of input.

Solution

$$\text{MFP} = \frac{(\text{Possible leads})(\text{No. of workers})(\text{Fee})(\text{Conversion percentage})}{\text{Labor cost} + \text{Material cost} + \text{Overhead cost}}$$

$$= \frac{(400)(2)(\$100)(.10)}{2(40)(\$20) + \$130 + \$1{,}000} = \frac{\$8{,}000}{\$2{,}730} = 2.93$$

END OF THE CHAPTER