

Chapter 5

Strategic Capacity Planning for Products
and Services

Learning Objective: Chapter 5

You should be able to:

- ❖ Name the three key questions in capacity planning
- ❖ Explain the importance of capacity planning
- ❖ Describe ways of defining and measuring capacity
- ❖ Name several determinants of effective capacity
- ❖ Discuss factors to consider when deciding whether to operate in-house or outsource
- ❖ Discuss the major considerations related to developing capacity alternatives
- ❖ Describe the steps that are used to resolve constraint issues
- ❖ Briefly describe approaches that are useful for evaluating capacity alternatives

Capacity Planning

- **Capacity**
 - The upper limit or ceiling on the **load** that an **operating unit** can handle
 - Capacity needs include
 - Equipment
 - Space
 - Employee skills

Capacity Planning Questions

- Key Questions:
 - **What kind** of capacity is needed?
 - **How much** is needed to match demand?
 - **When** is it needed?
- Related Questions:
 - How much will it cost?
 - What are the potential benefits and risks?
 - Are there sustainability issues?
 - Should capacity be changed all at once, or through several smaller changes
 - Can the supply chain handle the necessary changes?

Capacity Decisions Are Strategic

- Capacity decisions
 1. impact the ability of the organization to meet future demands
 2. affect operating costs
 3. are a major determinant of initial cost
 4. often involve long-term commitment of resources
 5. can affect competitiveness
 6. affect the ease of management
 7. have become more important and complex due to globalization
 8. need to be planned for in advance due to their consumption of financial and other resources

Defining and Measuring Capacity

- Measure capacity in units that do not require updating
 - Why is measuring capacity in dollars problematic?

Business	Inputs	Outputs
Auto manufacturing	Labor hours, machine hours	Number of cars per shift
Steel mill	Furnace size	Tons of steel per day
Oil refinery	Refinery size	Gallons of fuel per day
Farming	Number of acres, number of cows	Bushels of grain per acre per year, gallons of milk per day
Restaurant	Number of tables, seating capacity	Number of meals served per day
Theater	Number of seats	Number of tickets sold per performance
Retail sales	Square feet of floor space	Revenue generated per day

Defining and Measuring Capacity

- Two useful definitions of capacity
 - **Design capacity**
 - The maximum output rate or service capacity an operation, process, or facility is designed for
 - **Effective capacity**
 - Design capacity minus allowances such as personal time and maintenance

Defining and Measuring Capacity

- Two useful system effectiveness
 - **Efficiency**

Ratio of actual output to effective capacity.

$$\text{Efficiency} = \frac{\text{Actual output}}{\text{Effective capacity}} \times 100\%$$

- **Utilization**

Ratio of actual output to design capacity.

$$\text{Utilization} = \frac{\text{Actual output}}{\text{Design capacity}} \times 100\%$$

Determinants of Effective Capacity

- Facilities
- Product and service factors
- Process factors
- Human factors
- Policy factors
- Operational factors
- Supply chain factors
- External factors

Capacity Planning

1. Estimate future capacity requirements.
2. Evaluate existing capacity and facilities and identify gaps.
3. Identify alternatives for meeting requirements.
4. Conduct financial analyses of each alternative.
5. Assess key qualitative issues for each alternative.
6. Select the alternative to pursue that will be best in the long term.
7. Implement the selected alternative.
8. Monitor results.

Capacity Planning

A department works one 8-hour shift, 250 days a year, and has these figures for usage of a machine that is currently being considered:

Product	Annual Demand	Standard Processing Time per Unit (hr)	Processing Time Needed (hr)
1	400	5.0	2,000
2	300	8.0	2,400
3	700	2.0	1,400
			<u>5,800</u>

$$\text{Units of capacity needed} = \frac{\text{Processing time needed}}{\text{Processing time capacity per unit}}$$

In-House or Outsource?

- Once capacity requirements are determined, the organization must decide whether to produce a good or service itself or outsource
- Factors to consider:
 - Available capacity
 - Expertise
 - Quality considerations
 - The nature of demand
 - Cost
 - Risks

Developing Capacity Alternatives

- Things that can be done to enhance capacity management:
 - Design flexibility into systems
 - Take stage of life cycle into account
 - Take a “big-picture” approach to capacity changes
 - Prepare to deal with capacity “chunks”
 - Attempt to smooth capacity requirements
 - Identify the optimal operating level
 - Choose a strategy if expansion is involved

Constraint Management

- **Constraint**
 - Something that limits the performance of a process or system in achieving its goals
 - Categories
 - Market
 - Resource
 - Material
 - Financial
 - Knowledge or competency
 - Policy

Resolving Constraint Issues

1. Identify the most pressing constraint
2. Change the operation to achieve maximum benefit, given the constraint
3. Make sure other portions of the process are supportive of the constraint
4. Explore and evaluate ways to overcome the constraint
5. Repeat the process until the constraint levels are at acceptable levels

Evaluating Alternatives

- Alternatives should be evaluated from varying perspectives
 - Economic
 - Is it economically feasible?
 - How much will it cost?
 - How soon can we have it?
 - What will operating and maintenance costs be?
 - What will its useful life be?
 - Will it be compatible with present personnel and present operations?
 - Non-economic
 - Public opinion

Evaluating Alternatives

- Techniques for Evaluating Alternatives
 - Cost-volume analysis
 - Financial analysis
 - Decision theory
 - Waiting-line analysis
 - Simulation

Cost-Volume Analysis

Cost-volume analysis

- Focuses on the relationship between cost, revenue, and volume of output

- **Fixed Costs (FC)**

- tend to remain constant regardless of output volume

- **Variable Costs (VC)**

- vary directly with volume of output

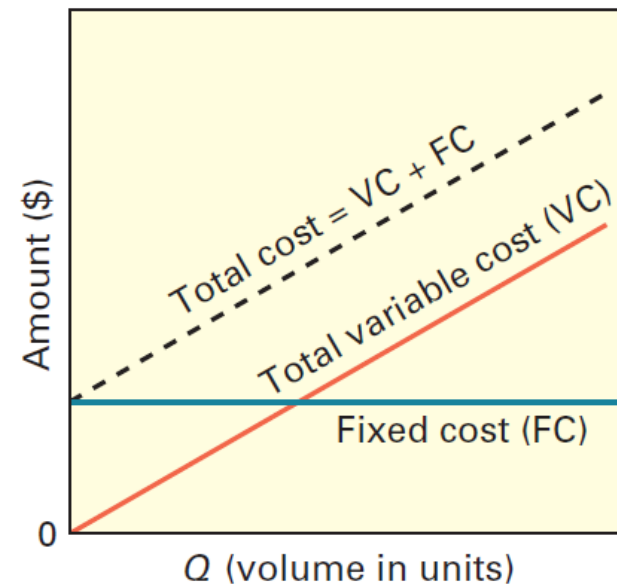
- $VC = \text{Quantity}(Q) \times \text{variable cost per unit}(v)$

- **Total Cost**

- $TC = FC + VC$

- **Total Revenue (TR)**

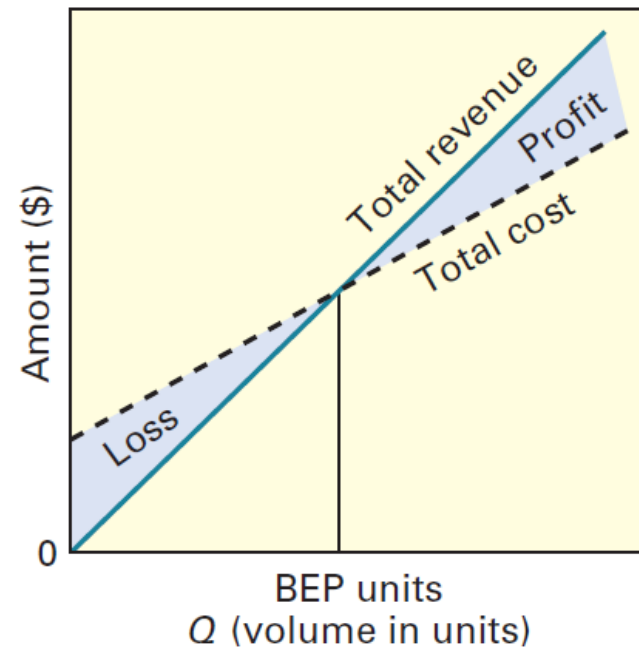
- $TR = \text{revenue per unit}(R) \times Q$



Cost-Volume Analysis

- **Cost-volume analysis**
 - Focuses on the relationship between cost, revenue, and volume of output
 - **Total Revenue (TR)**
 - TR = revenue per unit (R) x Q

$$Q_{\text{BEP}} = \frac{FC}{R - v}$$



Cost-Volume Analysis

The owner of Old-Fashioned Berry Pies, S. Simon, is contemplating adding a new line of pies, which will require leasing new equipment for a monthly payment of \$6,000. Variable costs would be \$2 per pie, and pies would retail for \$7 each.

- a. How many pies must be sold in order to break even?
- b. What would the profit (loss) be if 1,000 pies are made and sold in a month?
- c. How many pies must be sold to realize a profit of \$4,000?
- d. If 2,000 can be sold, and a profit target is \$5,000, what price should be charged per pie?

Financial Analysis

- **Cash flow**
 - The difference between cash received from sales and other sources, and cash outflow for labor, material, overhead, and taxes
- **Present value**
 - The sum, in current value, of all future cash flow of an investment proposal