CHAPTER FIVE
Manufacturing and Service Process Structures

Where We Are Now

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Learning Objectives

1. Distinguish between capacity strategies
2. Identify and explain economies of scale
3. Compare and contrast the seven manufacturing process structures
4. Compare and contrast service process structures
5. Describe four operations layouts
6. Use break-even analysis for process selection

Capacity Planning

• **Capacity**: the amount of output that can be created by, a process, with a given level of resources over a given time period
Economies & Diseconomies of scale

- **Economies of Scale**: as volume increases, unit costs decrease to an optimal level
- **Diseconomies of Scale**: unit costs increase as an operation’s size increases

![Cost per Unit vs Volume Graph](image)

**Figure 5-1**

**Reasons for Economies of Scale**

1. Allocation of fixed costs
2. Equipment and construction costs
3. Lower costs for purchases
4. Learning curves
Capacity Planning Decisions

<table>
<thead>
<tr>
<th>Time Frame (time required for changes)</th>
<th>Limiting Resource</th>
<th>Types of Capacity Change</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short term (0-6 months)</td>
<td>Low-skilled labor</td>
<td>Overt-time, part-time, temporary labor, layoffs</td>
<td>Restaurant wait staff, bank tellers, production line workers</td>
</tr>
<tr>
<td></td>
<td>Equipment, space</td>
<td>Rental, leasing</td>
<td>Landscaping equipment, temporary storage</td>
</tr>
<tr>
<td>Medium term (6-24 months)</td>
<td>Specialized labor</td>
<td>Hiring, firing, contract labor</td>
<td>Engineers, accountants, machine operators, physicians</td>
</tr>
<tr>
<td></td>
<td>Equipment, space</td>
<td>Leasing, subcontracting, equipment installation and renovation</td>
<td>Distribution/warehousing, fast-food restaurant rebuild, production line renovation</td>
</tr>
<tr>
<td>Long term (2+ years)</td>
<td>Physical plant</td>
<td>New building, outsourcing</td>
<td>Automotive plant open or closure, new office building</td>
</tr>
</tbody>
</table>

Table 5-1

Product-Process Matrix

- Project
- Job Shop
- Batch
- Cellular Manufacturing
- Mass Customization
- Repetitive Process
- Continuous Process

Figure 5-2
Activity

• Identify a product and competitive priorities for:
  – Project
  – Job Shop
  – Batch
  – Repetitive
  – Continuous
  – Mass Customization
  – Cellular Manufacturing

Process Structure and Market Orientation

• Engineer to Order (ETO): unique, customized products
• Make to Order (MTO): similar design, customized during production
• Assemble to Order (ATO): produced from standard components and modules
• Make to Stock (MTS): goods made and held in inventory in advance of customer orders
### Service Process Matrix

- **Service Factory**: Low Labor, Low Customization/Customer Interaction
- **Service Shop**: High Labor, High Customization/Customer Interaction
- **Mass Service**: Low Labor, High Customization/Customer Interaction
- **Professional Service**: High Labor, Low Customization/Customer Interaction

![Service Process Matrix Diagram](image-url)

**Activity**

- Think of an example of each:
  - Service Factory
  - Service Shop
  - Mass Service
  - Professional Service

- Think of the last service you purchased:
  - What category was it?
  - What changes can you suggest to move it to another category?
  - What could be the advantages of the changes?
Service Blueprinting

- **Customer actions**: all actions done by customers during service delivery
- **Front office**: employee actions in the face-to-face encounter
- **Back office**: behind the scenes activities
- **Support processes**: activities necessary for the service, done by employees without direct customer contact
- **Physical evidence**: tangibles the customers see or collect from the organization
Operations Layout

- **Fixed position**: product cannot be moved during production – house.

- **Process layout**: groups together similar resources – fitness center.

- **Product layout**: resources arranged by regularly occurring sequence of activities – car manufacturer.

Line Balancing in Product Layouts

Used to assign individual tasks to work areas for a desired output rate

1. Determine precedence relationships

2. Calculate **Takt time** = \( \frac{\text{available production time per day}}{\text{output needed per day}} \)

3. Determine minimum number of work stations =
   Total of all task times/takt time

4. Determine efficiency =
   \[ \frac{\text{[sum of all task times/(actual work stations X takt time)]}}{\text{X 100}} \]
## Line Balancing

<table>
<thead>
<tr>
<th>Task</th>
<th>Predecessors</th>
<th>Time (minutes)</th>
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<tbody>
<tr>
<td>A Shape dough</td>
<td>None</td>
<td>2</td>
</tr>
<tr>
<td>B Add pizza sauce</td>
<td>A</td>
<td>1</td>
</tr>
<tr>
<td>C Add cheese</td>
<td>B</td>
<td>2</td>
</tr>
<tr>
<td>D Add sausage</td>
<td>C</td>
<td>0.75</td>
</tr>
<tr>
<td>E Add pepperoni</td>
<td>C</td>
<td>1</td>
</tr>
<tr>
<td>F Package pizza</td>
<td>D, E</td>
<td>1.5</td>
</tr>
<tr>
<td>G Label package</td>
<td>F</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Total Time: 8.75 minutes

## Break Even Analysis

[Figure 5-7: Break-Even Point]
Break Even Point

A firm has variable costs of per unit of $3 and annual fixed costs of $30,000. What is the break-even point if the sales price is 48 per unit

\[ \text{Total Revenue} = \text{Total Cost} \]

\[ TR = 8 \times \text{volume} \quad \text{and} \quad TC = 30,000 + 3 \times \text{volume} \]

\[ 8 \times \text{volume} = 30,000 + 3 \times \text{volume} \]

\[ 5 \times \text{volume} = 30,000 \]

volume = 6,000 units per year

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Manufacturing/Service Process Summary

1. Strategic capacity decisions include when, where and how much to adjust
2. Economics/Diseconomies of scale affect costs per unit
3. Product-process matrix classifies processes based on volume and variety
4. Service are categorized by customization and labor/capital intensity
5. Services processes can be front or back office
6. Layouts should fit with processes used
7. Process automation affects costs and capabilities