Learning Objectives

- Understand
  - Types of Firms
  - Types of Production Processes
  - Product-Process Matrix
- Perform Break-even Analysis

Types of Firms

- **Make-to-stock**: firms that serve customers from finished goods inventory
- **Assemble-to-order**: firms that combine a number of preassembled modules to meet a customer’s specifications
- **Make-to-order**: firms that make the customer’s product from raw materials, parts, and components
- **Engineer-to-order**: firms that work with the customer to design and then make the product
Production Processes Terms

- **Lead time**: the time needed to respond to a customer order
  - Short for make-to-stock but long for make-to-order or engineering-to-order products
- **Customer order decoupling point**: location where inventory is positioned to allow entities in the supply chain to operate independently
  - The closer this point is to the customer, the shorter the lead time, but the higher is the cost of inventory

Inventory Positioning in A Supply Chain

Process Selection

Types of Processes
Production Processes Defined

- **Project**: the product remains in a fixed location and manufacturing equipment is moved to the product.
- **Workcenter (job shop)**: similar equipment or functions are grouped together.
- **Manufacturing cell**: a dedicated area where products that are similar in processing requirements are produced.
- **Assembly line (flow shop)**: work processes are arranged according to the progressive steps by which the product is made.
- **Continuous process**: assembly line only the flow is continuous such as with liquids.

Process Selection

**Product - Process Matrix**

<table>
<thead>
<tr>
<th>Type of Process</th>
<th>Product Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project</td>
<td>Movie production</td>
</tr>
<tr>
<td>Workcenter</td>
<td>Printing shop</td>
</tr>
<tr>
<td>Manufacturing Cell</td>
<td>Bakery</td>
</tr>
<tr>
<td>Assembly Line</td>
<td>Auto assembly</td>
</tr>
<tr>
<td>Continuous</td>
<td>Oil, sugar refinery</td>
</tr>
</tbody>
</table>

Lower flexibility & unit cost

Higher flexibility & unit cost

Product - Process Matrix

- Low one-of-a-kind product
- High standardized product
- Low - High volume product

- Project
- Workcenter
- Manufacturing Cell
- Assembly Line
- Continuous Process

Low - High volume

- Moviemaking
- Printing shop
- Bakery
- Auto assembly
- Oil, sugar refinery
Job Shop Vs. Flow Shop

<table>
<thead>
<tr>
<th>Issue</th>
<th>Job Shop</th>
<th>Flow Shop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of changeovers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labor content of product</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flexibility</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

General Observations of Process Structures

From project to continuous production,
- Demand /Production volume increases
- Products become more standardized
- Processes become more capital-intensive, more automated, less flexible
- Customers become less involved

Process Selection

Break-even Analysis
- A standard approach for cost/benefit analysis of adopting one particular process or choosing among alternative processes
- It seeks to determine the point in units produced (and sold) where total revenue and total cost are equal or where we will start making (more) profit on the process
Process Selection

Break-even Analysis

- Single Process--Adopt it or not?
  - Break-even point:
    Profit = 0 or TR = TC -------> BE=?

- Two Processes--Which one is better?
  - Cross-over point:
    Profit$_1$ = Profit$_2$ or TC$_1$ = TC$_2$------> CO=?

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Break-even Analysis

Example--I

Tom Smith, a recent graduate of GSU, has just formed a company called the New Age Surf to provide high speed internet access with a competitive price of $20 per month. The fixed cost each month is estimated to be $60,000. Unit cost for each customer is approximately $10 per month. How many customers must be attracted in order to break even?

Solution: Profit = 20X - 60,000 - 10X
           = 10X - 60,000
           Profit = 0
           $X_{BE} = 6,000$

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Break-Even Analysis: One Process
Suppose now Tom is given another option. Instead of purchasing equipments, he can rent them from other companies. This will reduce the monthly fixed cost to $20,000. But unit cost for each customer will be $15 per month. What option should Tom adopt?

**Solution:**

\[ \text{TC}_1 = 60,000 + 10X \]
\[ \text{TC}_2 = 20,000 + 15X \]

\[ \text{TC}_1 = \text{TC}_2 \]
\[ 60,000 + 10X = 20,000 + 15X \]

\[ X_{CO} = 8,000 \]

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**Break-even Analysis: Two Processes**

<table>
<thead>
<tr>
<th>Units</th>
<th>Total cost of process 1</th>
<th>Total cost of process 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>3000</td>
<td>$30,000</td>
<td>$30,000</td>
</tr>
<tr>
<td>6000</td>
<td>$60,000</td>
<td>$60,000</td>
</tr>
<tr>
<td>9000</td>
<td>$90,000</td>
<td>$90,000</td>
</tr>
<tr>
<td>12000</td>
<td>$120,000</td>
<td>$120,000</td>
</tr>
</tbody>
</table>

Point of indifference = 8,000 Units

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**Break-even Analysis Example—II (Cont.)**

- **If demand is above 8,000, choose 1**
- **If demand is below 8,000, choose 2**

**General rule for choosing a process:**
- Above the cross-over point, choose the process with lower variable cost
- Below that point, choose the process with lower fixed cost
In-class Exercise

Soft Key is trying to determine how best to produce its newest product, DVORK keyboards. The keyboards could be produced in house using either Process A or Process B, or purchase from a supplier. Cost data is given below. For what levels of demand should each process be chosen?

<table>
<thead>
<tr>
<th></th>
<th>Fixed Cost</th>
<th>Variable cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process A</td>
<td>$ 8,000</td>
<td>$10</td>
</tr>
<tr>
<td>Process B</td>
<td>$20,000</td>
<td>$ 4</td>
</tr>
<tr>
<td>Supplier</td>
<td>$    0</td>
<td>$20</td>
</tr>
</tbody>
</table>

In-Class Exercise Solution

Supplier vs. Process A

Process A vs. Process B

Use the when demand is less than ____ keyboards.
Use _______ when demand is over ____ keyboards.
Use _______ otherwise.