Learning Objectives

• List some of the main reasons organizations need to make location decisions.
• Explain why location decisions are important.
• Discuss the options that are available for location decisions.
• Describe some of the major factors that affect location decisions.
• Outline the decision process for making these kinds of decisions.
• Understand quantitative techniques to solving location problems

Need for Location Decisions

• Marketing Strategy
• Cost of Doing Business
• Growth
• Depletion of Resources

Nature of Location Decisions

• Importance
  • Long term commitment/costs
  • Often difficult to reverse decision
• Transportation cost
  • As much as 25% of product price
• Options
  • Expand existing facilities
  • Add new facilities
  • Move
  • Do nothing

Location Decision Sequence

Location Decision Factors
Location Factors

- Corporate desires
- Location of raw materials
- Location of markets
- Labor factors (e.g., cost, skills)
- Climate and taxes
- Foreign locations
  - Government
  - Exchange rates & currency risks

Community Considerations

- Quality of life
- Services
- Attitudes
- Taxes
- Environmental regulations
- Developer support

Site Related Factors

- Land
- Transportation
- Environmental
- Legal

Trends in Locations

- Manufacture overseas
- Use modern transportation systems
- Supply chain
- Smaller factories
- Information highway

Globalization

- Disadvantages
  - Transportation costs
  - Security
  - Unskilled labor
  - Import restrictions
  - Criticisms
- Risks
  - Political
  - Terrorism
  - Legal
  - Cultural

Quantitative Models for Location Planning

- Factor Rating
  - Decision based on quantitative and qualitative inputs
- Break-Even analysis
  - Compare fixed and variable costs of alternative at different production volumes
- Transportation Model
  - Decision based on movement costs of raw materials or finished goods
- Center of Gravity Method
  - Decision based on minimum distribution costs
Factor-Rating Method

- Most widely used location technique
- Useful for service & industrial locations
- Rates locations using factors
  - Tangible (quantitative) factors
    - Example: Short-run & long-run costs
  - Intangible (qualitative) factors
    - Example: Education quality, labor skills

Steps in Factor Rating Method

- List relevant factors
- Assign importance weight to each factor (such as 0 – 1)
- Develop scale for each factor (such as 1 – 100)
- Score each location using factor scale
- Multiply scores by weights for each factor & total
- Select location with maximum total score

Factor-Rating Example

<table>
<thead>
<tr>
<th>Critical Success Factor</th>
<th>Weight</th>
<th>France</th>
<th>Denmark</th>
<th>Weighted Scores France</th>
<th>Weighted Scores Denmark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor availability and attitude</td>
<td>.25</td>
<td>70</td>
<td>60</td>
<td>(.25)(70) = 17.5</td>
<td>(.25)(60) = 15.0</td>
</tr>
<tr>
<td>People-to-car ratio</td>
<td>.05</td>
<td>50</td>
<td>60</td>
<td>(.05)(50) = 2.5</td>
<td>(.05)(60) = 3.0</td>
</tr>
<tr>
<td>Per capita income</td>
<td>.10</td>
<td>85</td>
<td>80</td>
<td>(.10)(85) = 8.5</td>
<td>(.10)(80) = 8.0</td>
</tr>
<tr>
<td>Tax structure</td>
<td>.39</td>
<td>75</td>
<td>70</td>
<td>(.39)(75) = 29.3</td>
<td>(.39)(70) = 27.3</td>
</tr>
<tr>
<td>Education and health</td>
<td>.21</td>
<td>60</td>
<td>70</td>
<td>(.21)(60) = 12.6</td>
<td>(.21)(70) = 14.7</td>
</tr>
<tr>
<td>Totals</td>
<td>1.00</td>
<td>69.4</td>
<td>68.6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Location Break-Even Analysis

- Method of cost-volume analysis used for industrial locations
- Steps
  - Determine fixed & variable costs for each location
  - Plot total cost for each location versus production volume
  - Select location with lowest total cost for expected production volume

Cost-Volume Analysis Example

- Fixed and variable costs for four potential locations

<table>
<thead>
<tr>
<th>Location</th>
<th>Fixed Cost</th>
<th>Variable Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$250,000</td>
<td>$10,000</td>
</tr>
<tr>
<td>B</td>
<td>$100,000</td>
<td>$30</td>
</tr>
<tr>
<td>C</td>
<td>$150,000</td>
<td>$20</td>
</tr>
<tr>
<td>D</td>
<td>$200,000</td>
<td>$35</td>
</tr>
</tbody>
</table>

Solution
Center of Gravity Method

- Finds location of single distribution center serving several destinations
- Used primarily for services
- Considers
  - Location of existing destinations
    - Example: Markets, retailers etc.
  - Volume to be shipped
  - Shipping distance (or cost)
    - Shipping cost/unit/mile is constant

Center of Gravity - Steps

1. Place existing locations on a coordinate grid
   - Grid has arbitrary origin & scale
   - Maintains relative distances
2. Calculate X & Y coordinates for ‘center of gravity’
   - Gives location of distribution center
   - Minimizes transportation cost

Center of Gravity - Equations

\[
C_x = \frac{\sum d_i x_i W_i}{\sum W_i}
\]
\[
C_y = \frac{\sum d_i y_i W_i}{\sum W_i}
\]

Center of Gravity - Solution

Transportation Model

- Finds amount to be shipped from several sources to several destinations
- Used primarily for industrial locations
- Type of linear programming model
  - Objective: Minimize total production & shipping costs
  - Constraints
    - Production capacity at source (factory)
    - Demand requirement at destination
Linear Programming

Decision variables:

- $x_1$ = Quantity of product 1 to produce
- $x_2$ = Quantity of product 2 to produce
- $x_3$ = Quantity of product 3 to produce

Maximize $5x_1 + 8x_2 + 4x_3$ (profit)  
(Objective function)

Subject to:

- Labor: $2x_1 + 4x_2 + 8x_3 \leq 250$ hours
- Material: $7x_1 + 6x_2 + 5x_3 \leq 100$ pounds
- Product 1: $x_1 \leq 10$ units
  $x_1, x_2, x_3 \geq 0$  
(Costs and constraints)

A Transportation Table

<table>
<thead>
<tr>
<th>Factory</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>Total Supply Capacity</th>
<th>Total Demand per Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>7</td>
<td>7</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>12</td>
<td>3</td>
<td>8</td>
<td>8</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>10</td>
<td>16</td>
<td>5</td>
<td>150</td>
<td>450</td>
</tr>
</tbody>
</table>

Warehouse B can use 90 units per period

Excel Template