Operations Management

Chapter 8 – Location Strategies

PowerPoint presentation to accompany
Heizer/Render
Principles of Operations Management, 7e
Operations Management, 9e

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✓ Global Company Profile: FedEx
✓ The Strategic Importance of Location
Factors That Affect Location Decisions

- Labor Productivity
- Exchange Rates and Currency Risks
- Costs
- Political Risk, Values, and Culture
- Proximity to Markets
- Proximity to Suppliers
- Proximity to Competitors (Clustering)
Methods of Evaluating Location Alternatives

- The Factor-Rating Method
- Locational Break-Even Analysis
- Center-of-Gravity Method
- Transportation Model
Outline – Continued

☑ Service Location Strategy
  ☑ How Hotel Chains Select Sites
  ☑ The Call Center Industry
  ☑ Geographic Information Systems
Learning Objectives

When you complete this chapter you should be able to:

1. **Identify and explain seven major factors that effect location decisions**
2. **Compute labor productivity**
3. **Apply the factor-rating method**
4. **Complete a locational break-even analysis graphically and mathematically**
5. **Use the center-of-gravity method**
Federal Express

- **Central hub concept**
  - Enables service to more locations with fewer aircraft
  - Enables matching of aircraft flights with package loads
  - Reduces mishandling and delay in transit because there is total control of packages from pickup to delivery
Location Strategy

☑ One of the most important decisions a firm makes
☑ Increasingly global in nature
☑ Significant impact on fixed and variable costs
☑ Decisions made relatively infrequently
☑ The objective is to maximize the benefit of location to the firm
Location and Costs

- Location decisions based on low cost require careful consideration.
- Once in place, location-related costs are fixed in place and difficult to reduce.
- Determining optimal facility location is a god investment.
Location and Innovation

☑ Cost is not always the most important aspect of a strategic decision

☑ Four key attributes when strategy is based on innovation

☑ High-quality and specialized inputs

☑ An environment that encourages investment and local rivalry

☑ A sophisticated local market

☑ Local presence of related and supporting industries
Location Decisions

- Long-term decisions
- Decisions made infrequently
- Decision greatly affects both fixed and variable costs
- Once committed to a location, many resource and cost issues are difficult to change
Location Decisions

Country Decision

Critical Success Factors

1. Political risks, government rules, attitudes, incentives
2. Cultural and economic issues
3. Location of markets
4. Labor talent, attitudes, productivity, costs
5. Availability of supplies, communications, energy
6. Exchange rates and currency risks

Figure 8.1
Location Decisions

Critical Success Factors

1. Corporate desires
2. Attractiveness of region
3. Labor availability, costs, attitudes towards unions
4. Costs and availability of utilities
5. Environmental regulations
6. Government incentives and fiscal policies
7. Proximity to raw materials and customers
8. Land/construction costs

Figure 8.1
Location Decisions

Site Decision

Critical Success Factors

1. Site size and cost
2. Air, rail, highway, and waterway systems
3. Zoning restrictions
4. Proximity of services/supplies needed
5. Environmental impact issues

Figure 8.1
### Growth Competitiveness Index of Countries

<table>
<thead>
<tr>
<th>Country</th>
<th>2006-2007 Rank</th>
<th>2005 Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switzerland</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>USA</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Japan</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Germany</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>UK</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Israel</td>
<td>15</td>
<td>23</td>
</tr>
<tr>
<td>Canada</td>
<td>16</td>
<td>13</td>
</tr>
<tr>
<td>New Zealand</td>
<td>23</td>
<td>22</td>
</tr>
<tr>
<td>Italy</td>
<td>42</td>
<td>38</td>
</tr>
<tr>
<td>China</td>
<td>54</td>
<td>48</td>
</tr>
<tr>
<td>Mexico</td>
<td>58</td>
<td>59</td>
</tr>
<tr>
<td>Russia</td>
<td>62</td>
<td>53</td>
</tr>
</tbody>
</table>

Table 8.1
Factors That Affect Location Decisions

- **Labor productivity**
  - Wage rates are not the only cost
  - Lower productivity may increase total cost

\[
\frac{\text{Labor cost per day}}{\text{Productivity (units per day)}} = \text{Cost per unit}
\]

<table>
<thead>
<tr>
<th>Location</th>
<th>Labor Cost per Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connecticut</td>
<td>$1.17 per unit</td>
</tr>
<tr>
<td>Juarez</td>
<td>$1.25 per unit</td>
</tr>
</tbody>
</table>

\[
\frac{\$70}{60 \text{ units}} = \$1.17 \text{ per unit} \quad \frac{\$25}{20 \text{ units}} = \$1.25 \text{ per unit}
\]
Factors That Affect Location Decisions

☑ Exchange rates and currency risks
  ☑ Can have a significant impact on cost structure
  ☑ Rates change over time

☑ Costs
  ☑ Tangible - easily measured costs such as utilities, labor, materials, taxes
  ☑ Intangible - less easy to quantify and include education, public transportation, community, quality-of-life
Factors That Affect Location Decisions

- Exchange rates and currency risks
  - Can have a significant impact on cost structure
  - Rates change over time

- Costs
  - Tangible - easily measured costs such as utilities, labor
  - Intangible - less easy to quantify and include education, public transportation, community, quality-of-life

Location decisions based on costs alone can create difficult ethical situations
Factors That Affect Location Decisions

☑ Political risk, values, and culture

☑ National, state, local governments attitudes toward private and intellectual property, zoning, pollution, employment stability may be in flux

☑ Worker attitudes towards turnover, unions, absenteeism

☑ Globally cultures have different attitudes towards punctuality, legal, and ethical issues
## Ranking Corruption

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>2006 CPI Score (out of 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Finland</td>
<td>9.6</td>
</tr>
<tr>
<td>1</td>
<td>Iceland</td>
<td>9.6</td>
</tr>
<tr>
<td>1</td>
<td>New Zealand</td>
<td>9.6</td>
</tr>
<tr>
<td>5</td>
<td>Singapore</td>
<td>9.4</td>
</tr>
<tr>
<td>7</td>
<td>Switzerland</td>
<td>9.1</td>
</tr>
<tr>
<td>11</td>
<td>UK</td>
<td>8.6</td>
</tr>
<tr>
<td>14</td>
<td>Canada</td>
<td>8.5</td>
</tr>
<tr>
<td>15</td>
<td>Hong Kong</td>
<td>8.3</td>
</tr>
<tr>
<td>16</td>
<td>Germany</td>
<td>8.0</td>
</tr>
<tr>
<td>17</td>
<td>Japan</td>
<td>7.6</td>
</tr>
<tr>
<td>20</td>
<td>USA, Belgium</td>
<td>7.3</td>
</tr>
<tr>
<td>34</td>
<td>Israel, Taiwan</td>
<td>5.9</td>
</tr>
<tr>
<td>70</td>
<td>Brazil, China, Mexico</td>
<td>3.3</td>
</tr>
<tr>
<td>121</td>
<td>Russia</td>
<td>2.5</td>
</tr>
</tbody>
</table>

**Least Corrupt:**
- Finland
- Iceland
- New Zealand

**Most Corrupt:**
- Russia

Table 8.2
Factors That Affect Location Decisions

✓ **Proximity to markets**
  ✓ Very important to services
  ✓ JIT systems or high transportation costs may make it important to manufacturers

✓ **Proximity to suppliers**
  ✓ Perishable goods, high transportation costs, bulky products
Factors That Affect Location Decisions

- Proximity to competitors
  - Called clustering
  - Often driven by resources such as natural, information, capital, talent
  - Found in both manufacturing and service industries
## Clustering of Companies

<table>
<thead>
<tr>
<th>Industry</th>
<th>Locations</th>
<th>Reason for clustering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wine making</td>
<td>Napa Valley (US)</td>
<td>Natural resources of land and climate</td>
</tr>
<tr>
<td></td>
<td>Bordeaux region (France)</td>
<td></td>
</tr>
<tr>
<td>Software firms</td>
<td>Silicon Valley, Boston, Bangalore (India)</td>
<td>Talent resources of bright graduates in scientific/technical areas, venture capitalists nearby</td>
</tr>
<tr>
<td>Race car builders</td>
<td>Huntington/North Hampton region (England)</td>
<td>Critical mass of talent and information</td>
</tr>
</tbody>
</table>

Table 8.3
## Clustering of Companies

<table>
<thead>
<tr>
<th>Industry</th>
<th>Locations</th>
<th>Reason for clustering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theme parks (Disney World, Universal Studios)</td>
<td>Orlando, Florida</td>
<td>A hot spot for entertainment, warm weather, tourists, and inexpensive labor</td>
</tr>
<tr>
<td>Electronics firms</td>
<td>Northern Mexico</td>
<td>NAFTA, duty free export to US</td>
</tr>
<tr>
<td>Computer hardware manufacturers</td>
<td>Singapore, Taiwan</td>
<td>High technological penetration rate and per capita GDP, skilled/educated workforce with large pool of engineers</td>
</tr>
</tbody>
</table>

Table 8.3
## Clustering of Companies

<table>
<thead>
<tr>
<th>Industry</th>
<th>Locations</th>
<th>Reason for clustering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast food chains</td>
<td>Sites within 1 mile of each other</td>
<td>Stimulate food sales, high traffic flows</td>
</tr>
<tr>
<td>(Wendy’s, McDonald’s, Burger King, and Pizza Hut)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General aviation aircraft</td>
<td>Wichita, Kansas</td>
<td>Mass of aviation skills</td>
</tr>
<tr>
<td>(Cessna, Learjet, Boeing)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orthopedic devices</td>
<td>Warsaw, Indiana</td>
<td>Ready supply of skilled workers, strong U.S. market</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 8.3
Factor-Rating Method

- Popular because a wide variety of factors can be included in the analysis
- Six steps in the method
  1. Develop a list of relevant factors called critical success factors
  2. Assign a weight to each factor
  3. Develop a scale for each factor
  4. Score each location for each factor
  5. Multiply score by weights for each factor for each location
  6. Recommend the location with the highest point score
### Factor-Rating Example

<table>
<thead>
<tr>
<th>Critical Success Factor</th>
<th>Weight</th>
<th>Scores (out of 100)</th>
<th>Weighted Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>France</td>
<td>Denmark</td>
</tr>
<tr>
<td>Labor availability and attitude</td>
<td>.25</td>
<td>70</td>
<td>60</td>
</tr>
<tr>
<td>People-to-car ratio</td>
<td>.05</td>
<td>50</td>
<td>60</td>
</tr>
<tr>
<td>Per capita income</td>
<td>.10</td>
<td>85</td>
<td>80</td>
</tr>
<tr>
<td>Tax structure</td>
<td>.39</td>
<td>75</td>
<td>70</td>
</tr>
<tr>
<td>Education and health</td>
<td>.21</td>
<td>60</td>
<td>70</td>
</tr>
</tbody>
</table>

**Totals**  
1.00  
70.4  
68.0

Table 8.4
Locational Break-Even Analysis

- **Method of cost-volume analysis used for industrial locations**

- **Three steps in the method**
  1. Determine fixed and variable costs for each location
  2. Plot the cost for each location
  3. Select location with lowest total cost for expected production volume
## Locational Break-Even Analysis Example

Three locations:

- **Selling price** = $120
- **Expected volume** = 2,000 units

<table>
<thead>
<tr>
<th>City</th>
<th>Fixed Cost</th>
<th>Variable Cost</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Akron</td>
<td>$30,000</td>
<td>$75</td>
<td>$180,000</td>
</tr>
<tr>
<td>Bowling Green</td>
<td>$60,000</td>
<td>$45</td>
<td>$150,000</td>
</tr>
<tr>
<td>Chicago</td>
<td>$110,000</td>
<td>$25</td>
<td>$160,000</td>
</tr>
</tbody>
</table>

\[
\text{Total Cost} = \text{Fixed Cost} + (\text{Variable Cost} \times \text{Volume})
\]
**Locational Break-Even Analysis Example**

Figure 8.2
Center-of-Gravity Method

- Finds location of distribution center that minimizes distribution costs
- Considers
  - Location of markets
  - Volume of goods shipped to those markets
  - Shipping cost (or distance)
Center-of-Gravity Method

- Place existing locations on a coordinate grid
  - Grid origin and scale is arbitrary
  - Maintain relative distances
- Calculate X and Y coordinates for ‘center of gravity’
  - Assumes cost is directly proportional to distance and volume shipped
Center-of-Gravity Method

\[ x \text{- coordinate} = \frac{\sum_{i} d_{ix} Q_i}{\sum_{i} Q_i} \]

\[ y \text{- coordinate} = \frac{\sum_{i} d_{iy} Q_i}{\sum_{i} Q_i} \]

where

\( d_{ix} = x\text{-coordinate of location } i \)
\( d_{iy} = y\text{-coordinate of location } i \)
\( Q_i = \text{Quantity of goods moved to or from location } i \)
Center-of-Gravity Method

Figure 8.3

North-South

Chicago (30, 120)

New York (130, 130)

Pittsburgh (90, 110)

Atlanta (60, 40)

East-West

Arbitrary origin
## Center-of-Gravity Method

<table>
<thead>
<tr>
<th>Store Location</th>
<th>Number of Containers Shipped per Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicago (30, 120)</td>
<td>2,000</td>
</tr>
<tr>
<td>Pittsburgh (90, 110)</td>
<td>1,000</td>
</tr>
<tr>
<td>New York (130, 130)</td>
<td>1,000</td>
</tr>
<tr>
<td>Atlanta (60, 40)</td>
<td>2,000</td>
</tr>
</tbody>
</table>

\[
x\text{-coordinate} = \frac{(30)(2000) + (90)(1000) + (130)(1000) + (60)(2000)}{2000 + 1000 + 1000 + 2000}
\]

\[
x\text{-coordinate} = \frac{66000 + 90000 + 130000 + 120000}{2000 + 1000 + 1000 + 2000}
\]

\[
x\text{-coordinate} = \frac{410000}{6000}
\]

\[
x\text{-coordinate} = 66.7
\]

\[
y\text{-coordinate} = \frac{(120)(2000) + (110)(1000) + (130)(1000) + (40)(2000)}{2000 + 1000 + 1000 + 2000}
\]

\[
y\text{-coordinate} = \frac{240000 + 110000 + 130000 + 80000}{6000}
\]

\[
y\text{-coordinate} = \frac{560000}{6000}
\]

\[
y\text{-coordinate} = 93.3
\]
Center-of-Gravity Method

Figure 8.3
Transportation Model

✓ Finds amount to be shipped from several points of supply to several points of demand

✓ Solution will minimize total production and shipping costs

✓ A special class of linear programming problems
Worldwide Distribution of Volkswagens and Parts

Figure 8.4
Service Location Strategy

1. Purchasing power of customer-drawing area
2. Service and image compatibility with demographics of the customer-drawing area
3. Competition in the area
4. Quality of the competition
5. Uniqueness of the firm’s and competitors’ locations
6. Physical qualities of facilities and neighboring businesses
7. Operating policies of the firm
8. Quality of management
## Location Strategies

<table>
<thead>
<tr>
<th>Service/Retail/Professional Location</th>
<th>Goods-Producing Location</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Revenue Focus</strong></td>
<td><strong>Cost Focus</strong></td>
</tr>
<tr>
<td><strong>Volume/revenue</strong></td>
<td><strong>Tangible costs</strong></td>
</tr>
<tr>
<td>Drawing area; purchasing power</td>
<td>Transportation cost of raw material</td>
</tr>
<tr>
<td>Competition; advertising/pricing</td>
<td>Shipment cost of finished goods</td>
</tr>
<tr>
<td><strong>Physical quality</strong></td>
<td>Energy and utility cost; labor; raw material; taxes, and so on</td>
</tr>
<tr>
<td>Parking/access; security/lighting;</td>
<td>Intangible and future costs</td>
</tr>
<tr>
<td>appearance/image</td>
<td>Attitude toward union</td>
</tr>
<tr>
<td><strong>Cost determinants</strong></td>
<td>Quality of life</td>
</tr>
<tr>
<td>Rent</td>
<td>Education expenditures by state</td>
</tr>
<tr>
<td>Management caliber</td>
<td>Quality of state and local government</td>
</tr>
<tr>
<td>Operations policies (hours, wage</td>
<td></td>
</tr>
<tr>
<td>rates)</td>
<td></td>
</tr>
</tbody>
</table>

Table 8.6
# Location Strategies

<table>
<thead>
<tr>
<th>Service/Retail/Professional Location</th>
<th>Goods-Producing Location</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Techniques</strong></td>
<td><strong>Techniques</strong></td>
</tr>
<tr>
<td>Regression models to determine</td>
<td>Transportation method</td>
</tr>
<tr>
<td>importance of various factors</td>
<td>Factor-rating method</td>
</tr>
<tr>
<td>Factor-rating method</td>
<td>Locational break-even analysis</td>
</tr>
<tr>
<td>Traffic counts</td>
<td>Crossover charts</td>
</tr>
<tr>
<td>Demographic analysis of drawing area</td>
<td></td>
</tr>
<tr>
<td>Purchasing power analysis of area</td>
<td></td>
</tr>
<tr>
<td>Center-of-gravity method</td>
<td></td>
</tr>
<tr>
<td>Geographic information systems</td>
<td></td>
</tr>
</tbody>
</table>

Table 8.6
## Location Strategies

<table>
<thead>
<tr>
<th>Service/Retail/Professional Location</th>
<th>Goods-Producing Location</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assumptions</strong></td>
<td><strong>Assumptions</strong></td>
</tr>
<tr>
<td>Location is a major determinant of revenue</td>
<td>Location is a major determinant of cost</td>
</tr>
<tr>
<td>High customer-contact issues are critical</td>
<td>Most major costs can be identified explicitly for each site</td>
</tr>
<tr>
<td>Costs are relatively constant for a given area; therefore, the revenue function is critical</td>
<td>Low customer contact allows focus on the identifiable costs</td>
</tr>
<tr>
<td></td>
<td>Intangible costs can be evaluated</td>
</tr>
</tbody>
</table>

Table 8.6
How Hotel Chains Select Sites

- Location is a strategically important decision in the hospitality industry
- La Quinta started with 35 independent variables and worked to refine a regression model to predict profitability
- The final model had only four variables
  - Price of the inn
  - Median income levels
  - State population per inn
  - Location of nearby colleges

$r^2 = .51$
51% of the profitability is predicted by just these four variables!
The Call Center Industry

- Requires neither face-to-face contact nor movement of materials
- Has very broad location options
- Traditional variables are no longer relevant
- Cost and availability of labor may drive location decisions
Geographic Information Systems (GIS)

☑ Important tool to help in location analysis
☑ Enables more complex demographic analysis
☑ Available data bases include
  ☑ Detailed census data
  ☑ Detailed maps
  ☑ Utilities
  ☑ Geographic features
  ☑ Locations of major services
Geographic Information Systems (GIS)