Module Six
Logistics Network Design and Facility Location
Outline

- Example Logistics Network
- Facility Location Decisions
  - Tools
- Summary
Example Networks
Why Logistics Network

- Manufacturers (GM, Ford, Boeing, etc.)
- Retailers (Wal-Mart, Home Depot, Amazon.com, etc.)
- Couriers (FedEx, UPS, DHL, etc.)
- Carriers (Railroads, Trucking Firms, etc.)
A Six-DC Network
National Transportation Network

Highways in the United States

Ports in the United States

Railways in the United States

Waterways in the United States
Other Factors

Steps for Network Design

1. Assess/evaluate current network.
2. Design and populate network optimization database.
3. Create network design alternatives, such as more or fewer hierarchies, multi-commodity flows, pooling opportunities, merge-in-transit, direct shipping, cross docking, and supply-flow optimization concepts.
4. Develop network optimization model.
5. Choose network optimization tool.
6. Implement network model in chosen tool.
7. Evaluate alternative network designs.
8. “Practicalize” recommended network structure.
9. Compute reconfiguration cost.
10. Make go/no-go decision.
The Center-of-Gravity Model

- Map all of the market locations on an x and y coordinate grid
- Find a central location closest to the market with highest demand
- Choose this location as the DC to serve the market
A Facility Location: CoG Model

\[ \bar{X} = \frac{\sum_{i=1}^{n} d_i x_i}{\sum_{i=1}^{n} d_i} \]
\[ \bar{Y} = \frac{\sum_{i=1}^{n} d_i y_i}{\sum_{i=1}^{n} d_i} \]

Where \( x_i \) is x-coordinate of location \( i \), \( y_i \) is the y-coordinate of location \( i \).

\( d_i \) is demand associated with location \( i \).
An Example

The XYZ company would like to set up a distribution center to serve several key supply chain customers in the area. The annual demand and location of these customers are shown in the table. Use COG model of decide the approximate location of the DC.

<table>
<thead>
<tr>
<th>Customer</th>
<th>x-y-coordinate</th>
<th>Annual Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>(5,12)</td>
<td>2,000</td>
</tr>
<tr>
<td>B</td>
<td>(7,8)</td>
<td>10,000</td>
</tr>
<tr>
<td>C</td>
<td>(12,10)</td>
<td>4,000</td>
</tr>
<tr>
<td>D</td>
<td>(3,9)</td>
<td>15,000</td>
</tr>
<tr>
<td>E</td>
<td>(15,4)</td>
<td>6,000</td>
</tr>
<tr>
<td>F</td>
<td>(7,15)</td>
<td>8,000</td>
</tr>
</tbody>
</table>
Answer: Location of DC

\[
\bar{X} = \frac{\sum_{i=1}^{n} d_ix_i}{\sum_{i=1}^{n} d_i} = \frac{5*2k + 7*10k + 12*4k + 3*15k + 15*6k + 7*8k}{2k + 10k + 4k + 15k + 6k + 8k} = \frac{423}{45} = 7.09
\]

\[
\bar{Y} = \frac{\sum_{i=1}^{n} d_iy_i}{\sum_{i=1}^{n} d_i} = \frac{12*2k + 8*10k + 10*4k + 9*15k + 4*6k + 15*8}{2k + 10k + 4k + 15k + 6k + 8k} = \frac{423}{45} = 9.34
\]
Example: Demographic Shift

- New Location of DC
- New Customer
A Technical Network Design Example
Implications of the Example

- The DC incurs heavy truckload traffic for inventory replenishment.
- From the DC to customers, the traffic is in relatively low volume, at a higher frequency, more time sensitive.
- Conclusion: economic patterns, geographic locations and demographic distribution have a say on the distribution system design.
- High transportation cost (congestion delay, user fees, etc.) and poor access to intermodal facilities equivalently make geographical distance to a certain point longer.
Factors In Network Design

- Strategic Factors
- Technological Factors
- Macroeconomic Factors
- Exchange Rate and Demand Risk
- Political Factors
- Infrastructure Factors
- Competitive Factors
- Customer Response Time and Local Presence
- Logistics and Facility Cost
Summary

- Private sector logistics network efficiency is determined by the nation’s freight transportation network.
- Freight network should provide access to markets and suppliers at the lowest possible cost to make the system most efficient.
- Historically, private sector logistics networks have responded gradually to changes in demand, freight infrastructure, and population, but this is changing.