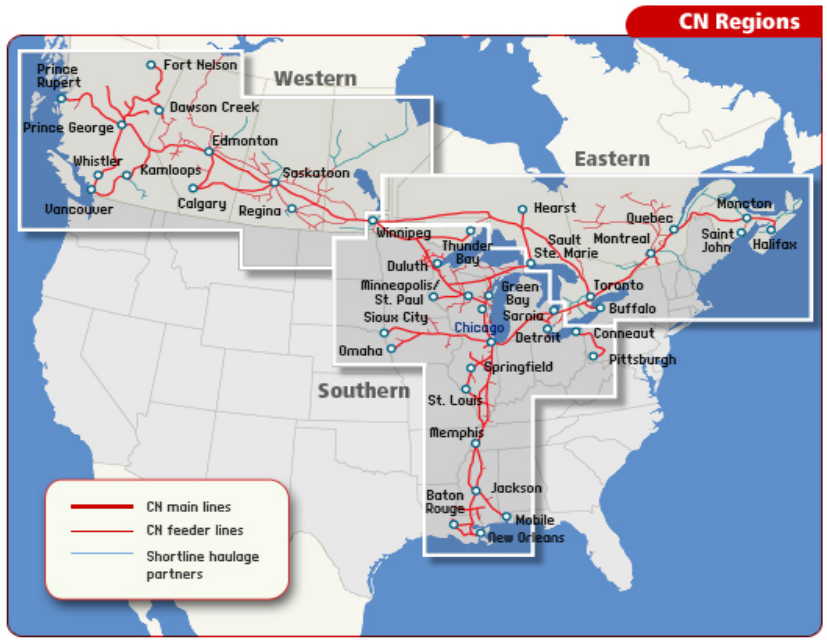
Module Six

Logistics Network Design and Facility Location

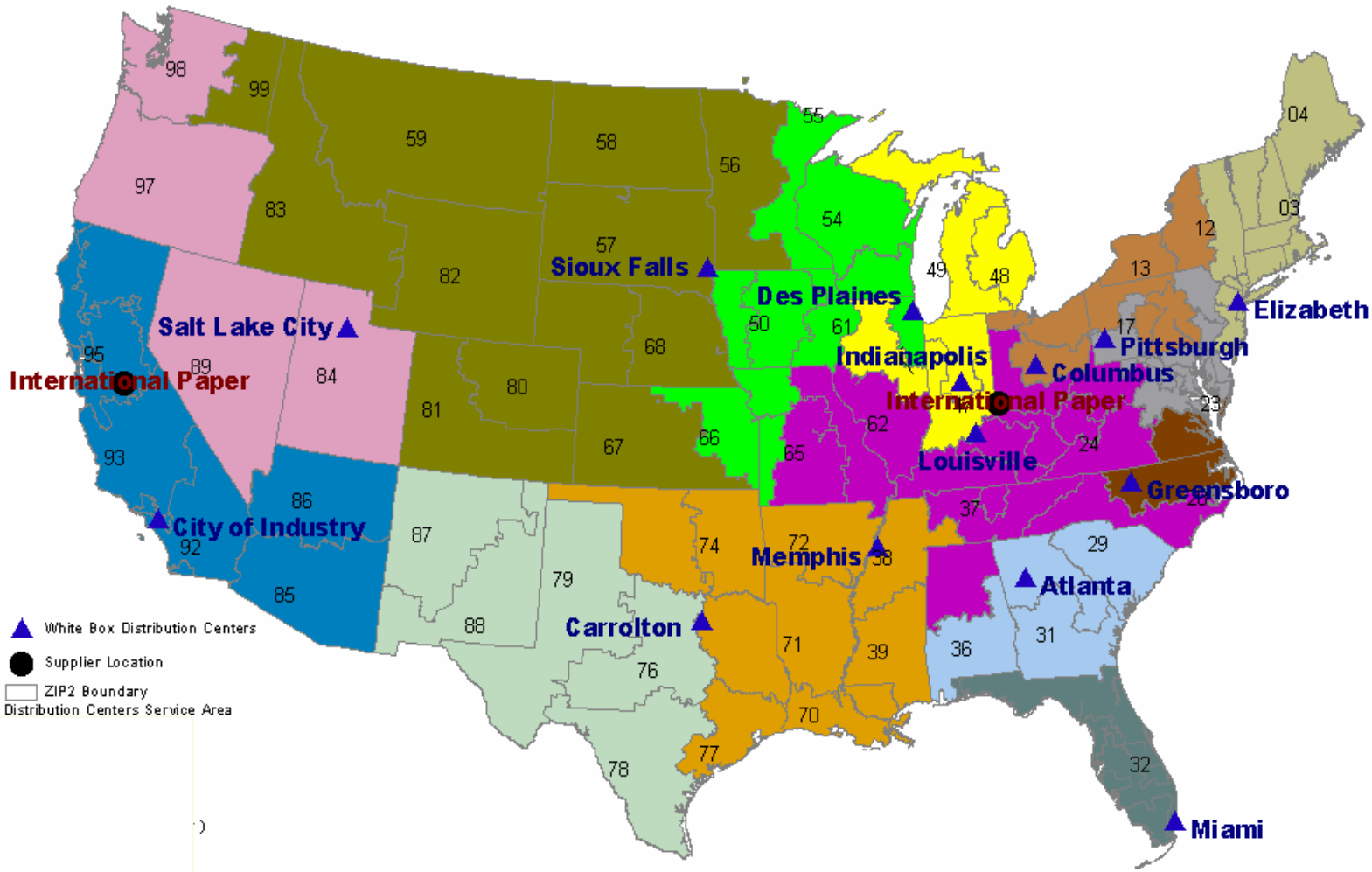
Outline

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

Example Networks



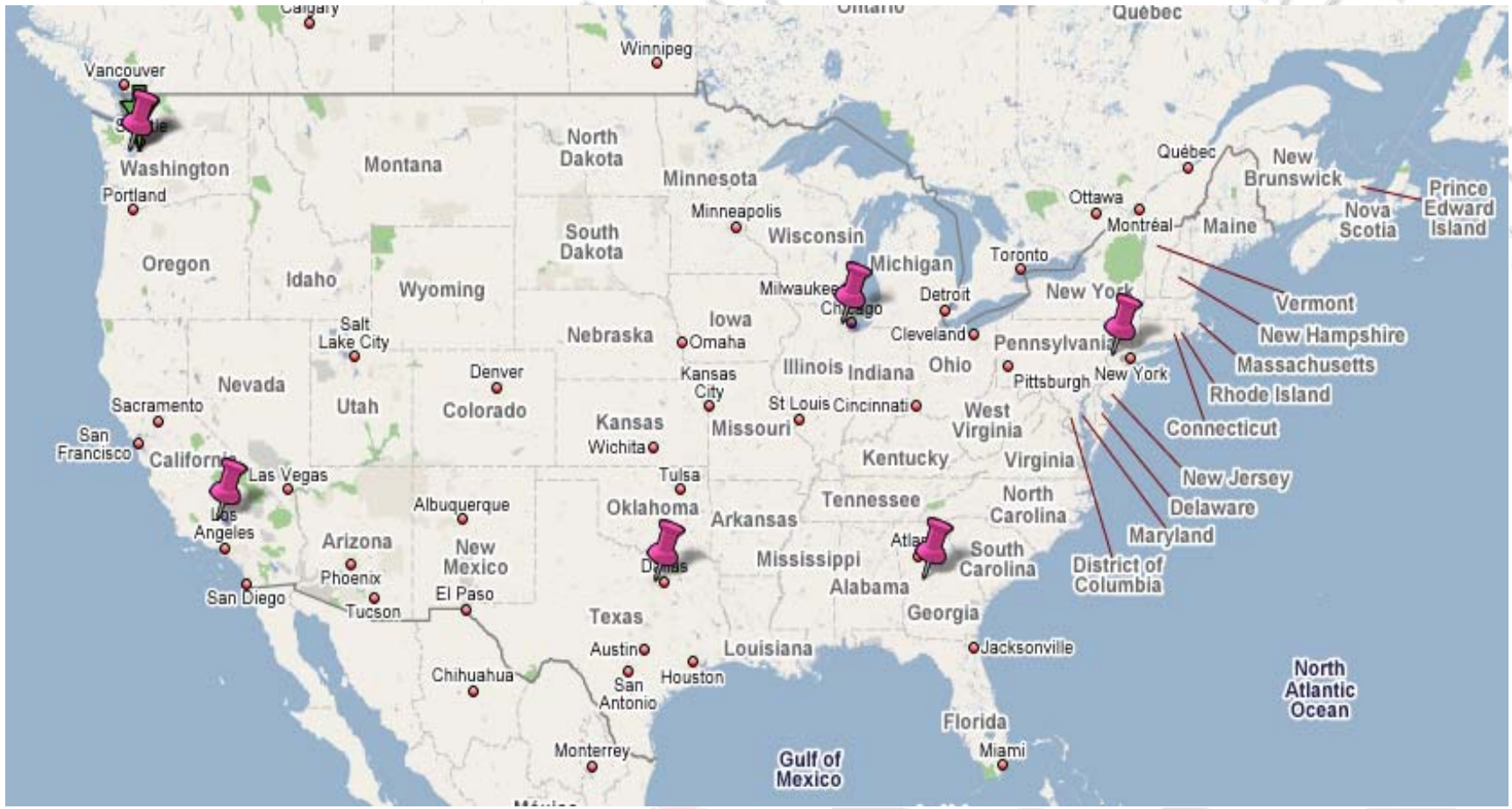
Example Logistics Network



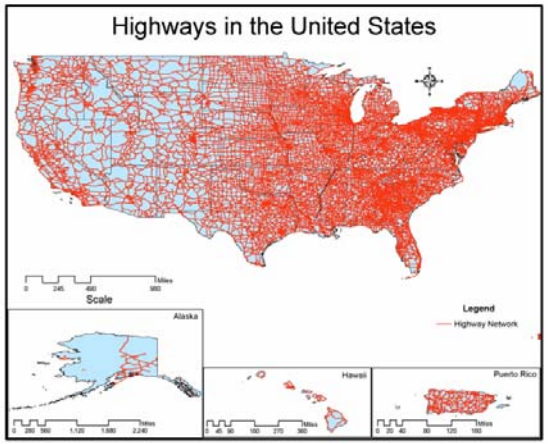
Why Logistics Network

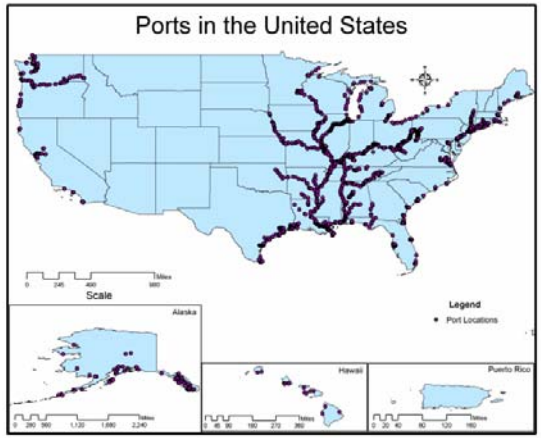
- Manufacturers (GM, Ford, Boeing, etc.)
- Retailers (Wal-Mart, Home Depot, Amazon.com, etc.)
- Couriers (FedEx, UPS, DHL, etc.)
- Carriers (Railroads, Trucking Firms, etc.)

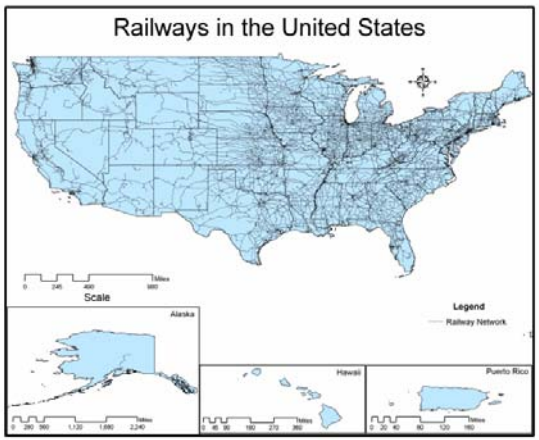
A Six-DC Network

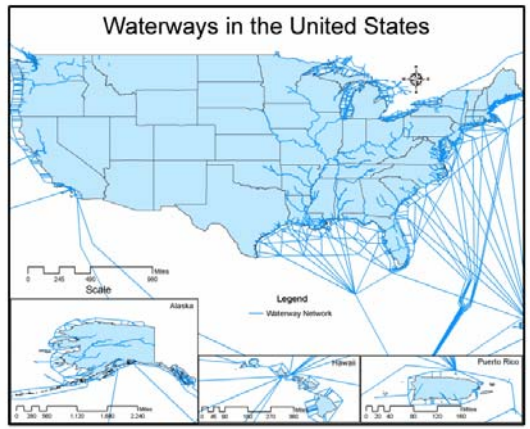


National Transportation Network

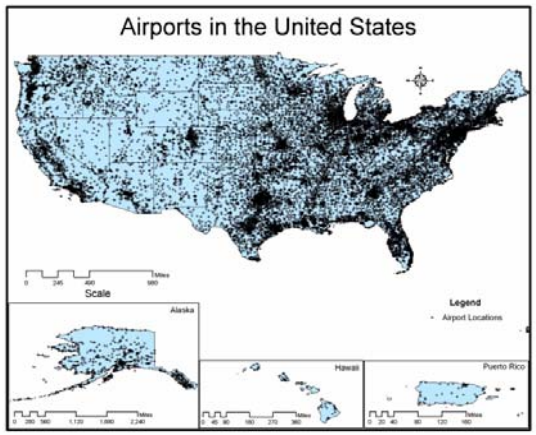


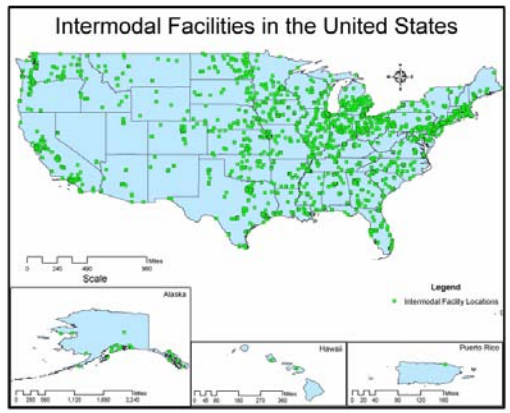




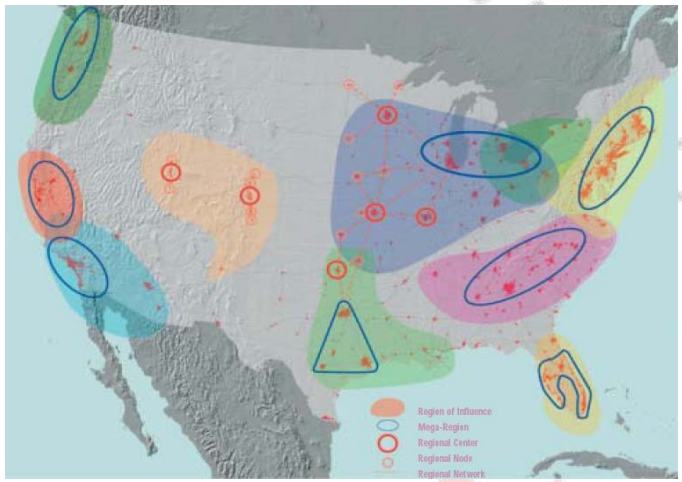


Other Factors





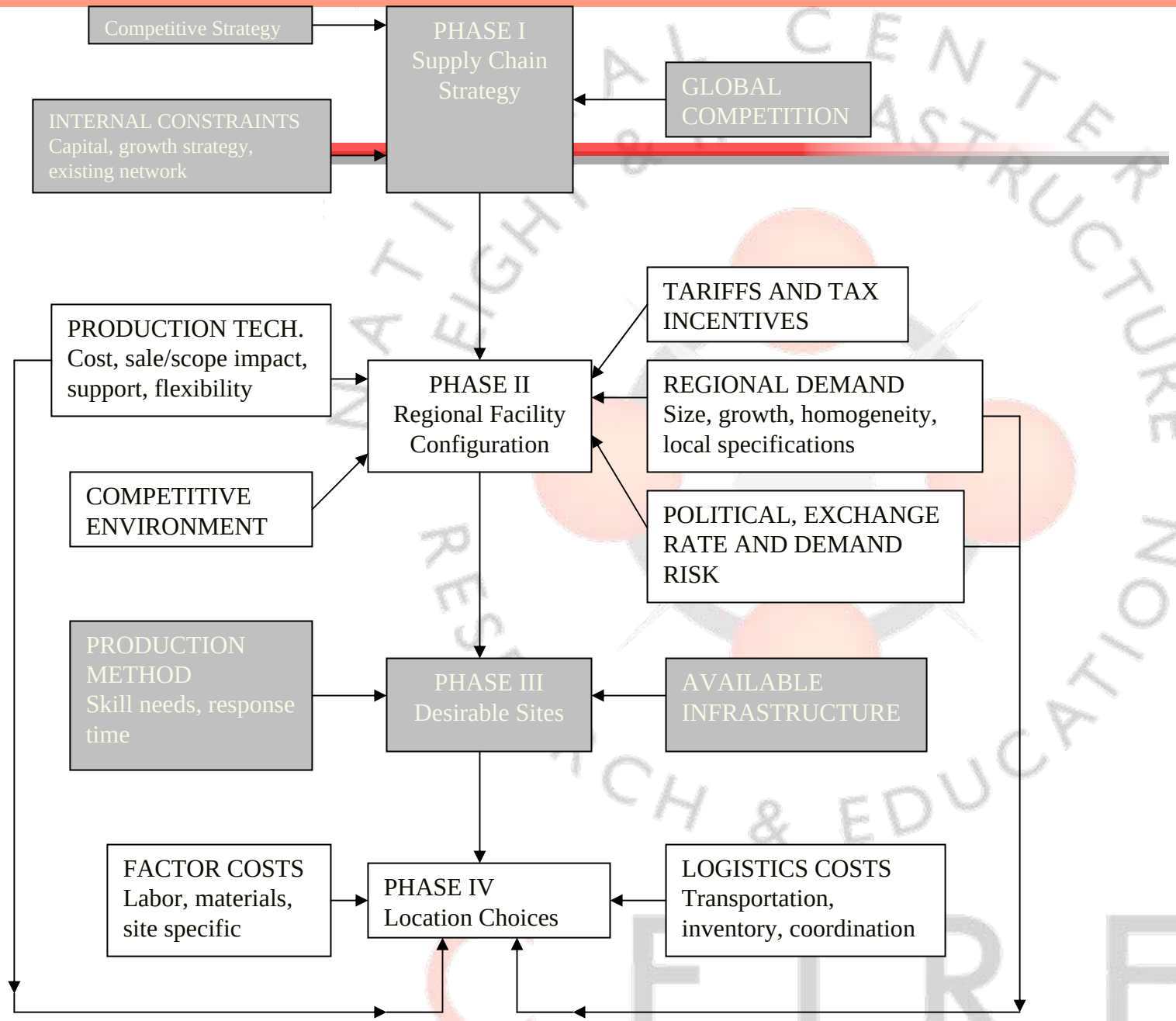
America's Future Mega-Areas



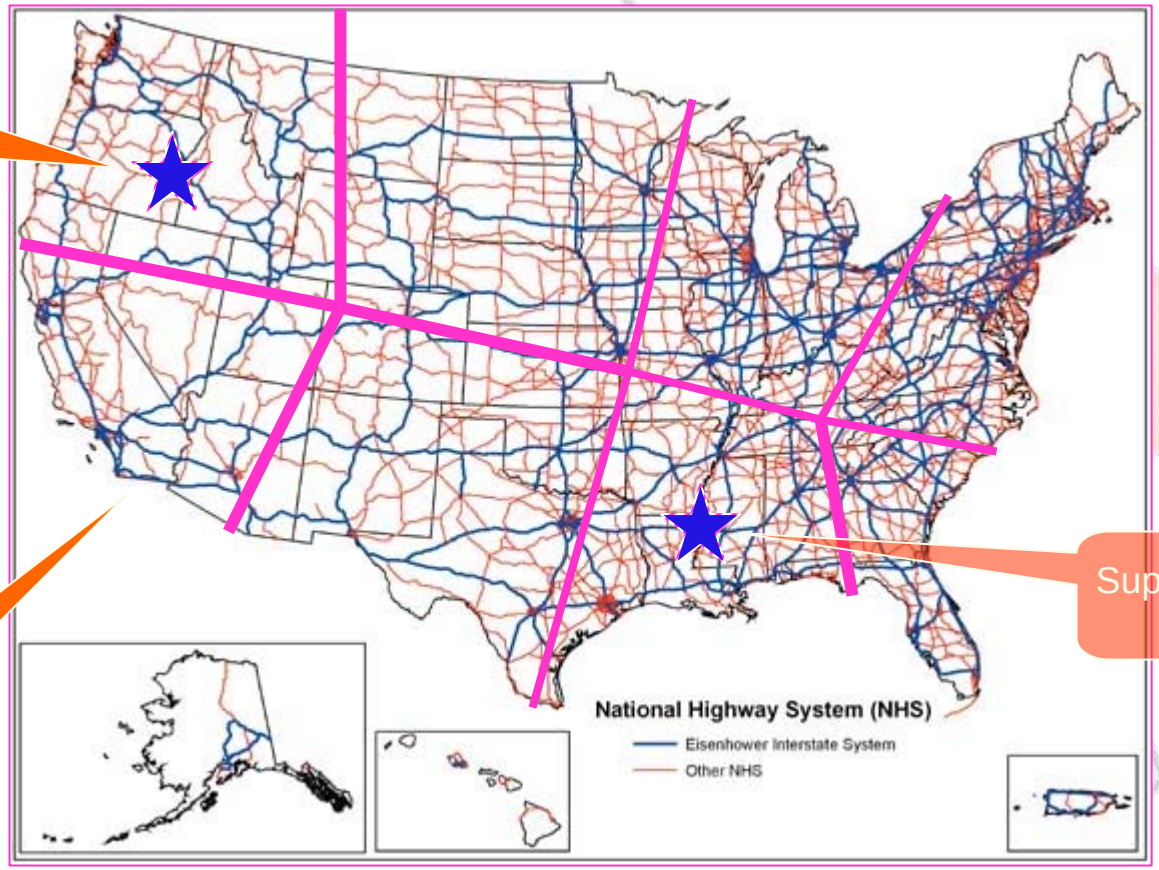
Source: Carbonell et al, Global Gateway Regions, The United States of America's Third Century Strategy, Southern California Association of Governments, Los Angeles, CA, Sept. 2005; based on "Toward an American Spatial Development Perspective," University of Pennsylvania, Department of Planning, Spring 2004.

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.


Competitive Strategy
PHASE I
Supply Chain
Strategy
GLOBAL
COMPETITION
INTERNAL CONSTRAINTS
Capital, growth strategy,
existing network
TARIFFS AND TAX
INCENTIVES
PRODUCTION TECH.
Cost, sale/scope impact,
support, flexibility
PHASE II
Regional Facility
Configuration
REGIONAL DEMAND
Size, growth, homogeneity,
local specifications
COMPETITIVE
ENVIRONMENT
POLITICAL, EXCHANGE
RATE AND DEMAND
RISK
PRODUCTION
METHOD
Skill needs, response
time
PHASE III
Desirable Sites
AVAILABLE
INFRASTRUCTURE
FACTOR COSTS
Labor, materials,
site specific
PHASE IV
Location Choices
LOGISTICS COSTS
Transportation,
inventory, coordination

Illustrative Network



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

- Equation (Location of the Central DC)

$$\overline{X} = \frac{\sum_{i=1}^{n} d_i x_i}{\sum_{i=1}^{n} d_i} \qquad \overline{Y} = \frac{\sum_{i=1}^{n} d_i y_i}{\sum_{i=1}^{n} d_i}$$

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.

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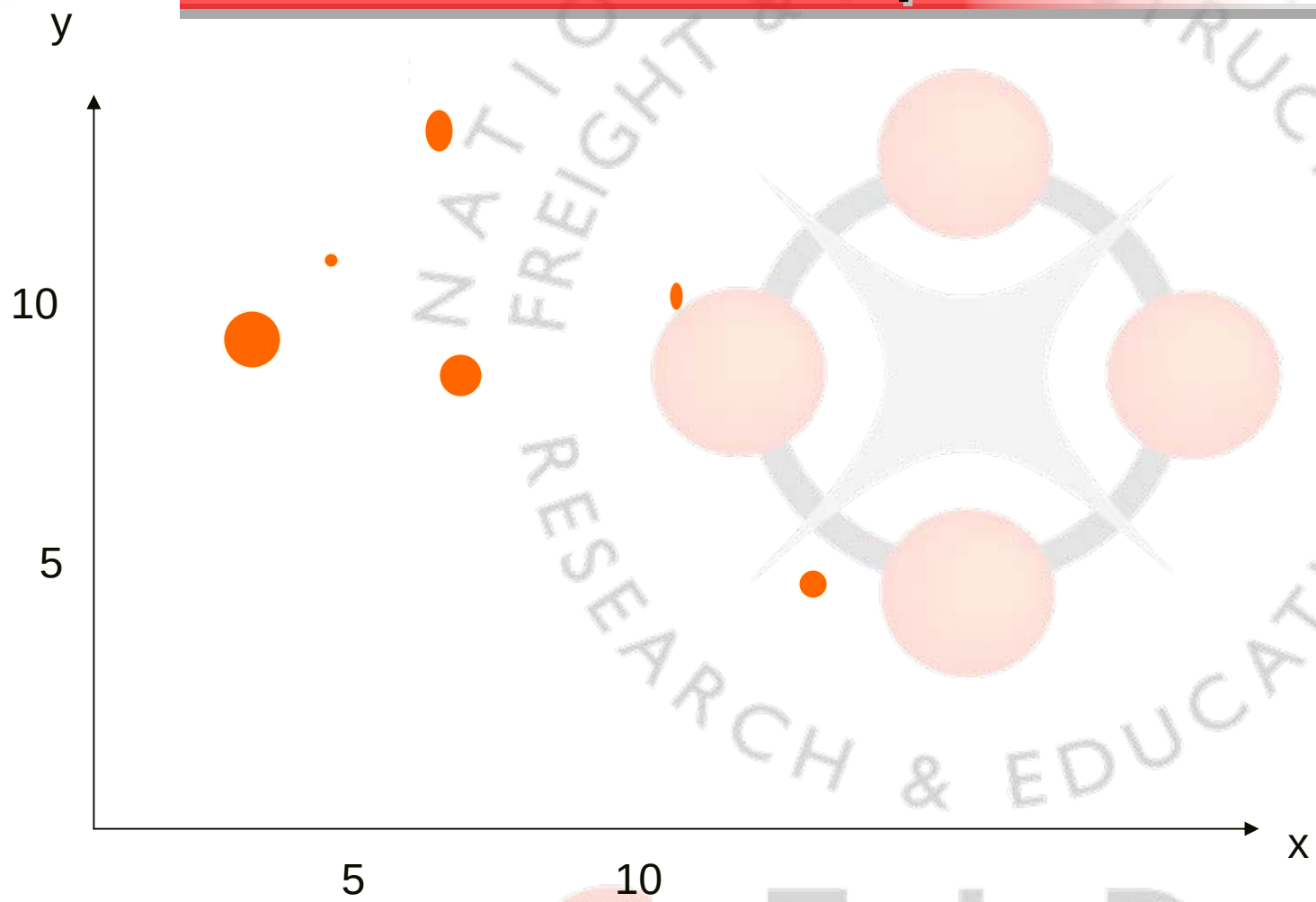
An Example

- 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.

Customer	x-y-coordinate	Annual Demand
A	(5,12)	2,000
B	(7,8)	10,000
C	(12,10)	4,000
D	(3,9)	15,000
E	(15,4)	6,000
F	(7,15)	8,000

Example

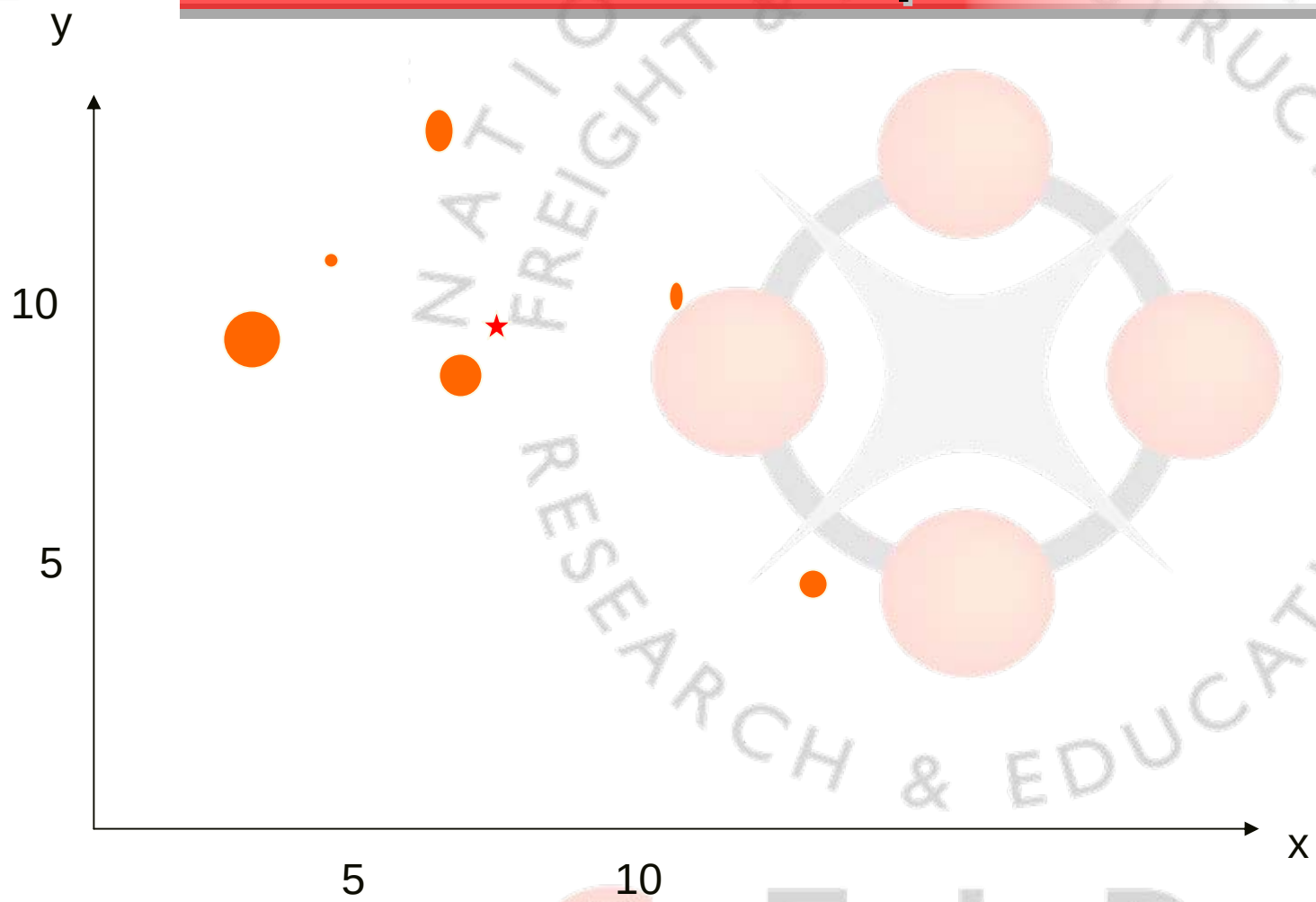


Answer: Location of DC

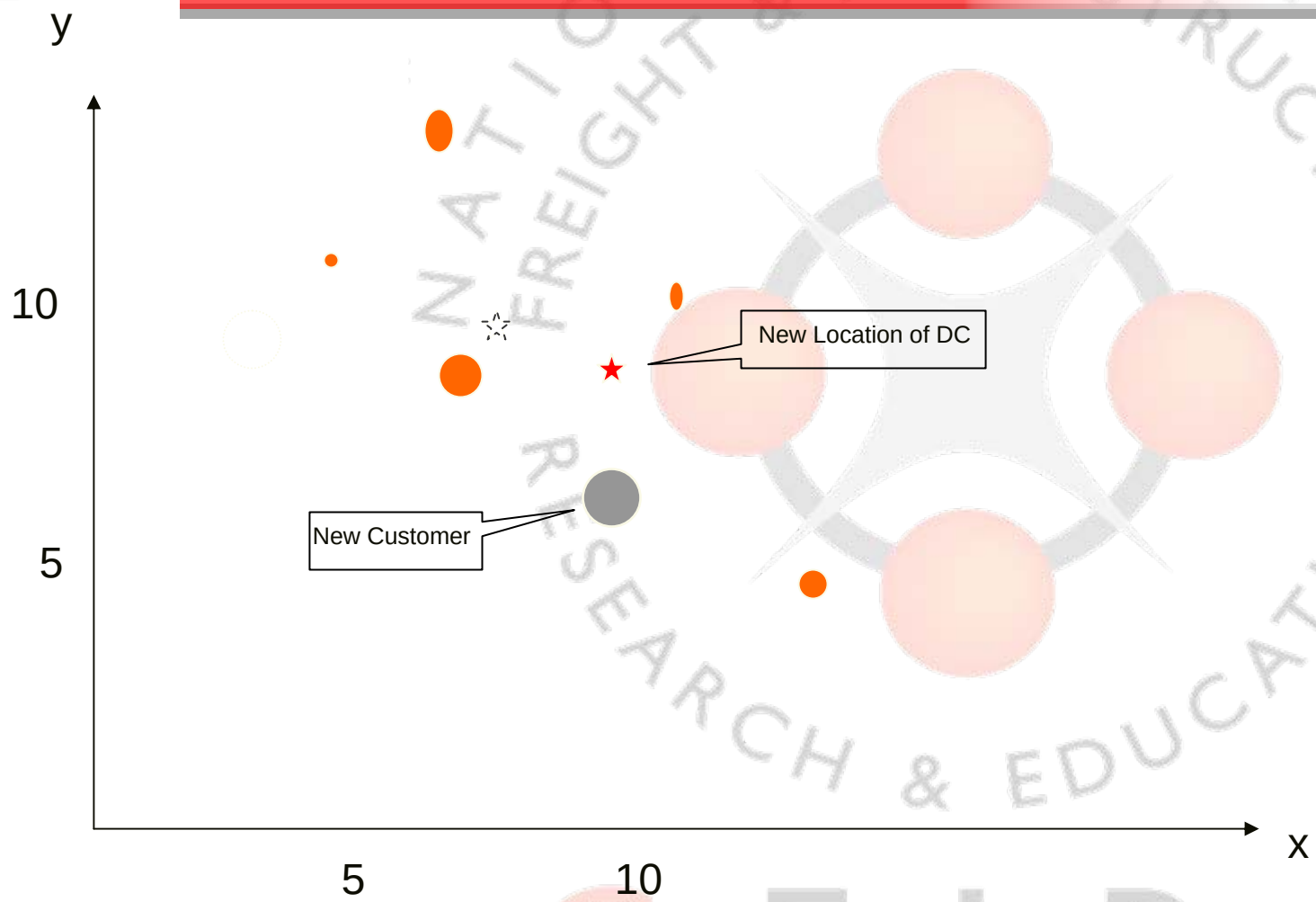
$$\overline{X} = \frac{\sum_{i=1}^{n} d_i x_i}{\sum_{i=1}^{n} d_i} = \frac{5*2k + 7*10k + 12*4k + 3*15k + 15*6k + 7*8k}{2k + 10k + 4k + 15k + 6k + 8k} = 7.09$$

$$\overline{Y} = \frac{\sum_{i=1}^{n} d_i y_i}{\sum_{i=1}^{n} d_i} = \frac{12*2k + 8*10k + 10*4k + 9*15k + 4*6k + 15*8}{2k + 10k + 4k + 15k + 6k + 8k} = \frac{423}{45} = 9.34$$

Example



Example: Demographic Shift

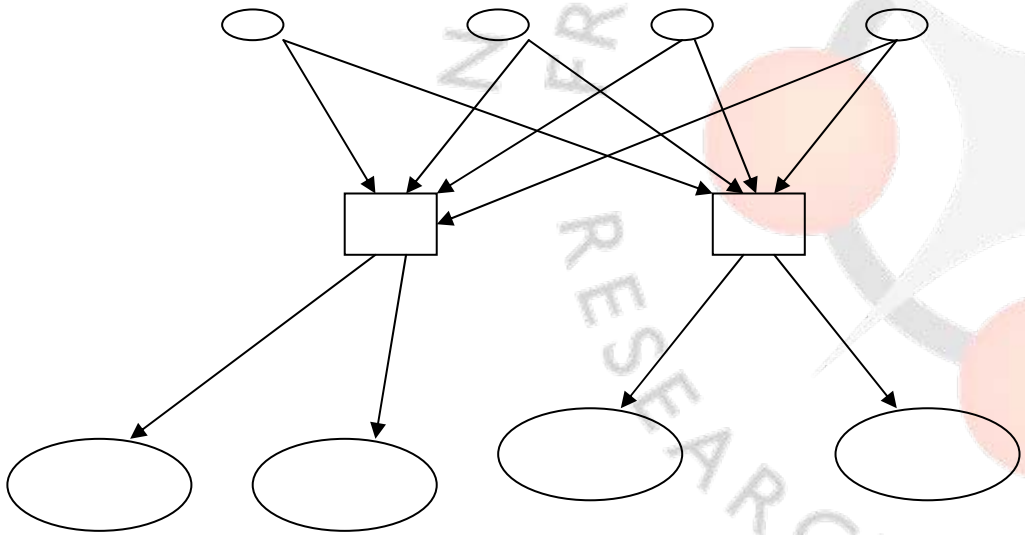


A Technical Network Design Example

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.

Illustrative Distribution Network



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.