

# CLTD

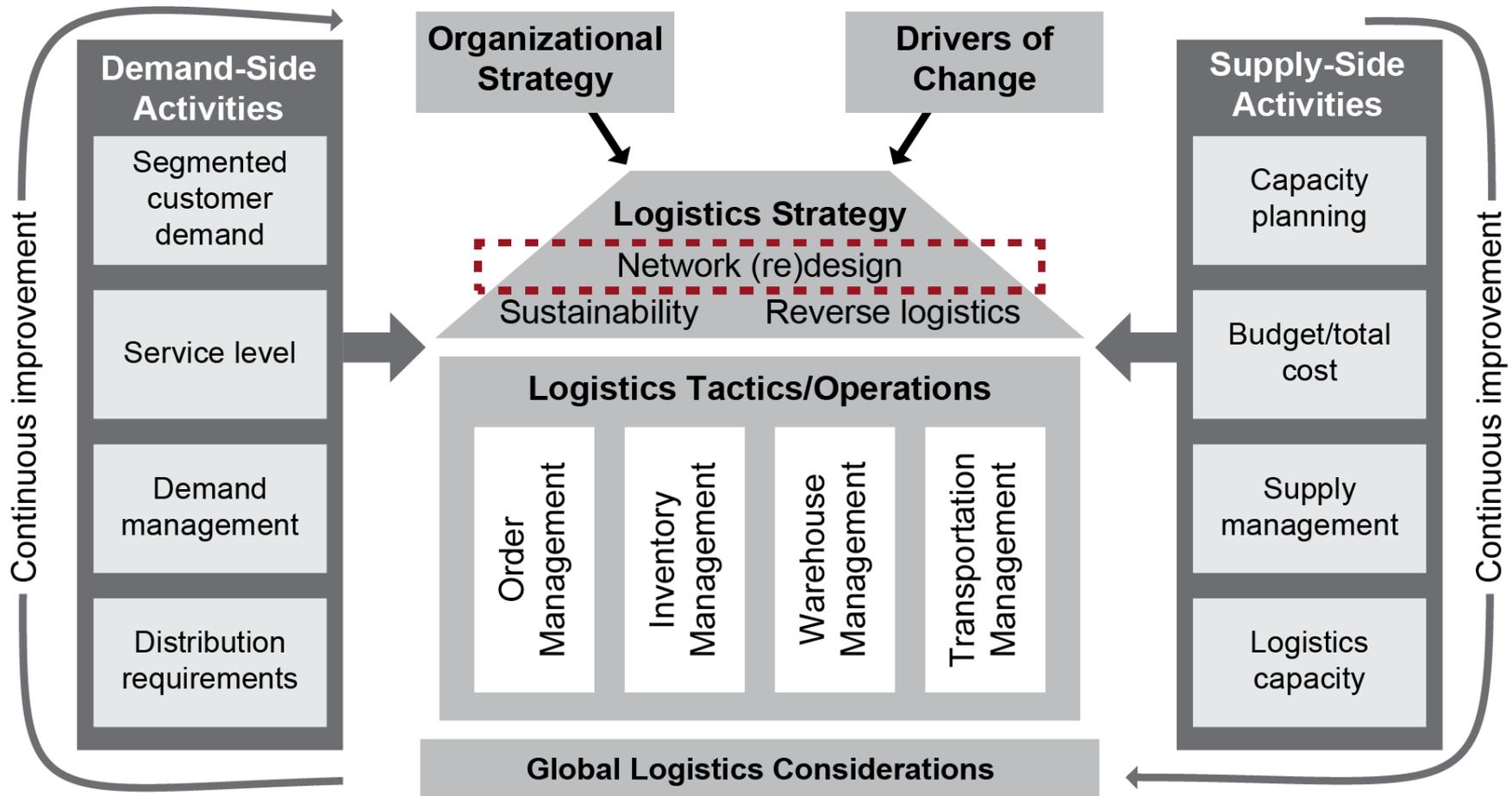
CERTIFIED IN LOGISTICS,  
TRANSPORTATION AND DISTRIBUTION

## MODULE 2: LOGISTICS NETWORK DESIGN



# Module 2: Logistics Network Design

## Module 2 Overview



# CLTD

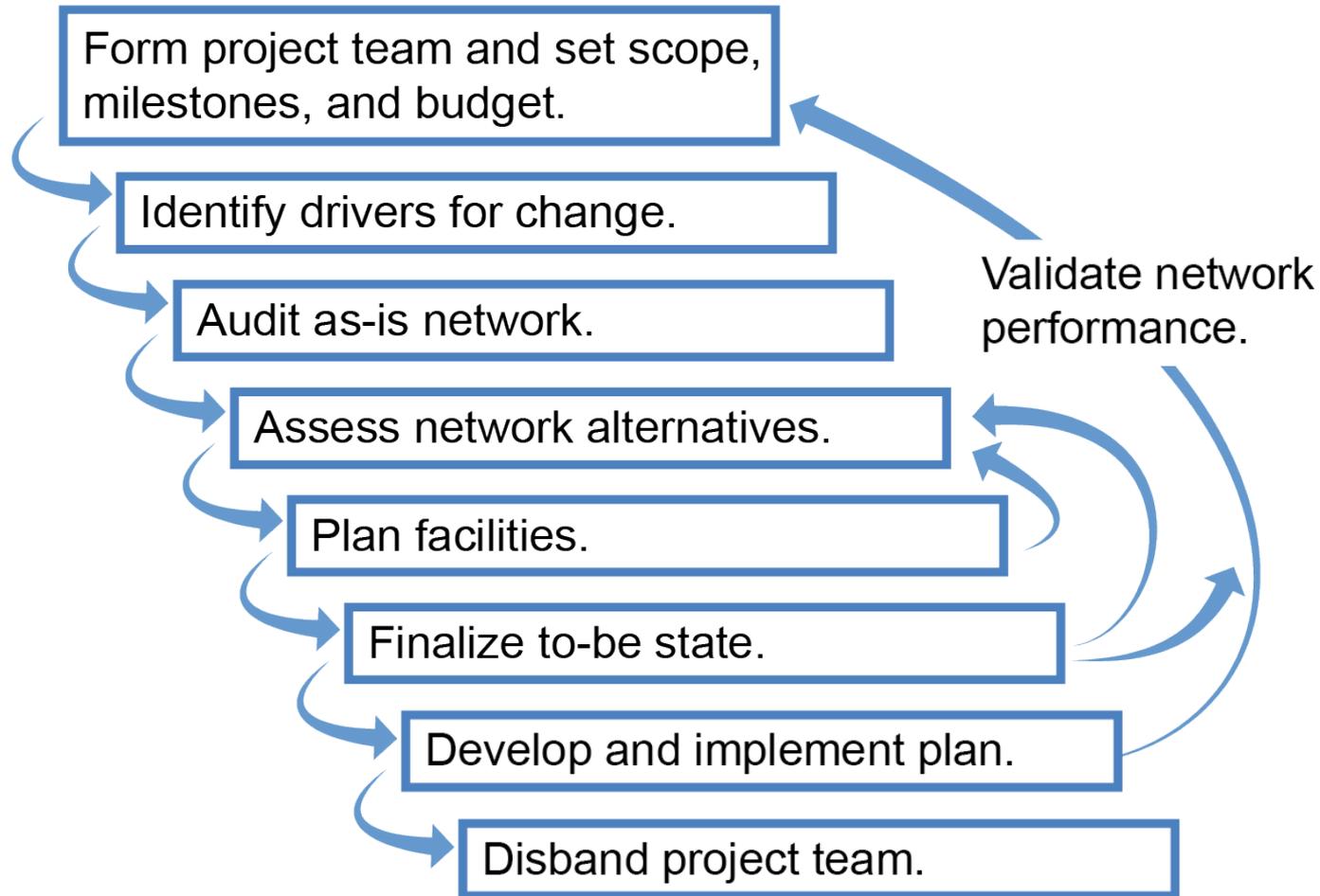
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MODULE 2, SECTION A:  
FACILITIES PLANNING AND NETWORK  
DESIGN



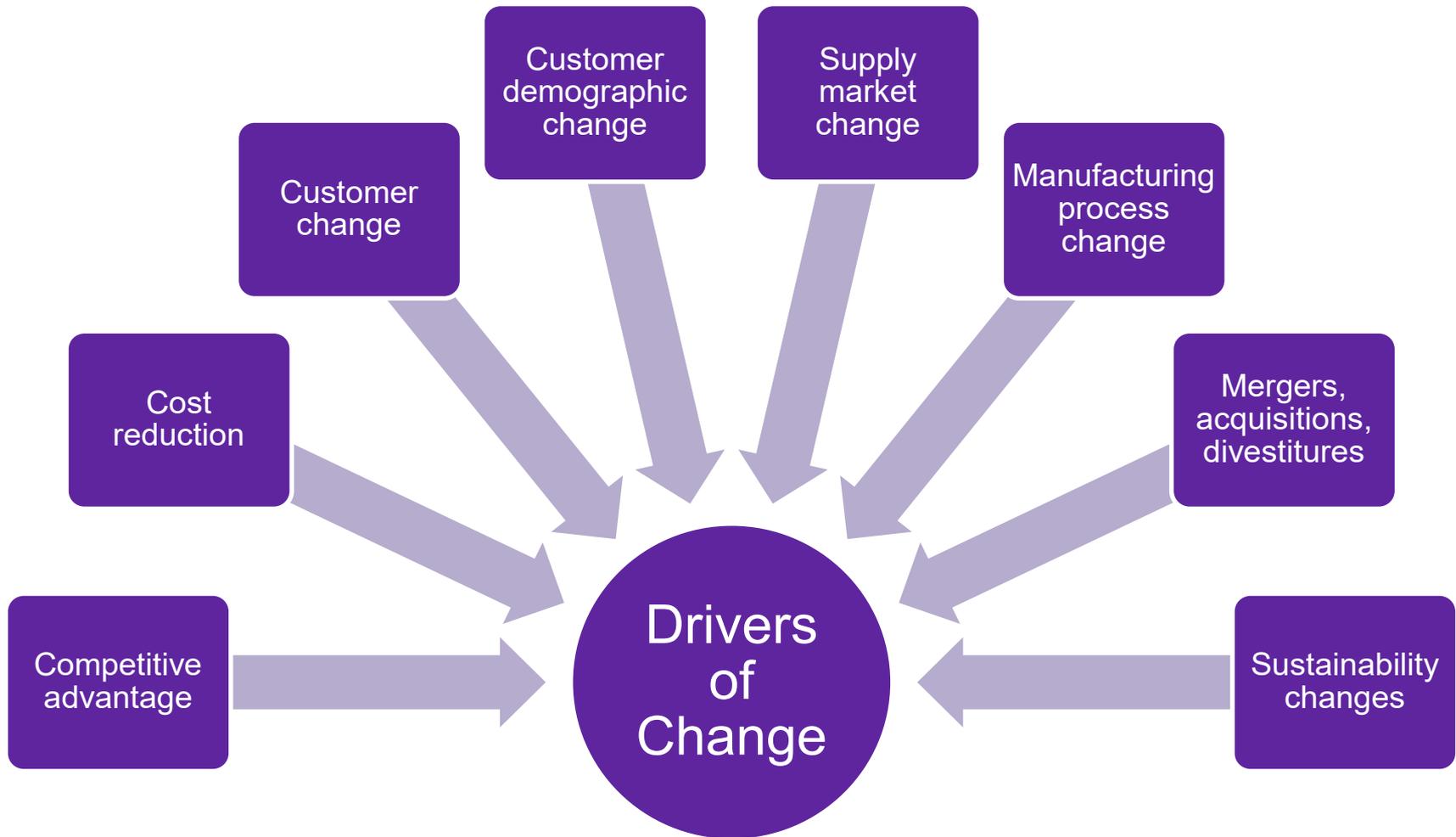
# Topic 1: Designing or Redesigning a Logistics Network

## Design Process



# Topic 1: Designing or Redesigning a Logistics Network

## Common Drivers of Change



# Topic 1: Designing or Redesigning a Logistics Network

## As-Is Audit Steps

Gather data and business information.

Map current system (e.g., nodes and links).

Describe key activities and functions.

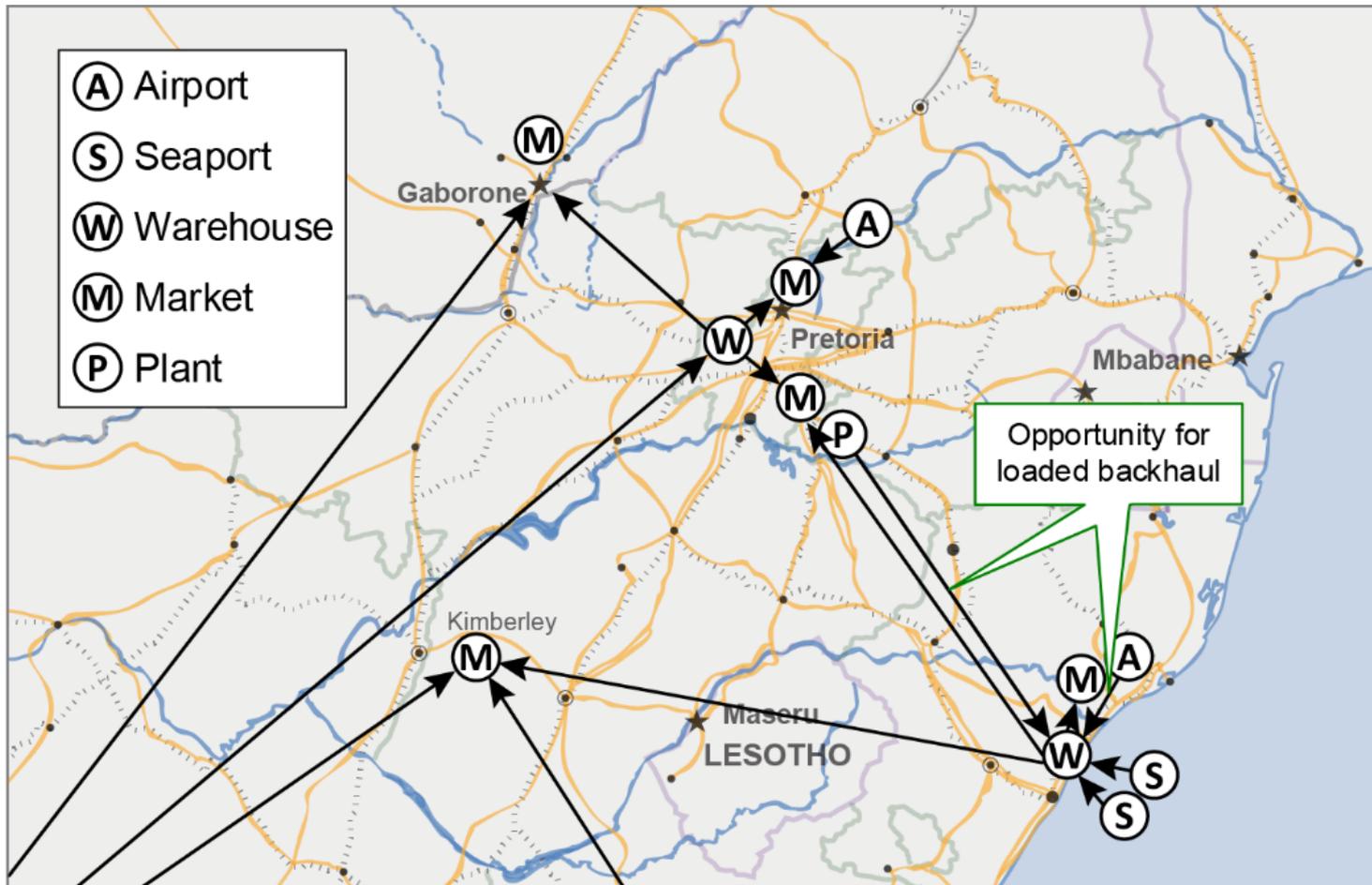
Measure against benchmarks.

List gaps between actual and strategy.

Generate tactical plans for closing gaps.

# Topic 1: Designing or Redesigning a Logistics Network

## Sample Map of Network Nodes and Links



# Topic 2: Methods for Entering Global Markets

## Methods of Entry

### Variables considered

- Market strategy
- Product type and life cycle
- Market size
- Infrastructure, economic climate, culture, trade partners
- Growth potential

DETERMINE  
METHOD

Exporting

Indirect exporting

Licensing

Direct ownership and  
production abroad

Joint ventures

# Topic 2: Methods for Entering Global Markets

## Exporting and Indirect Exporting

### Exporting

- Agent
- Distributor
- Marketing subsidiary
- Foreign sales corporation

### Indirect exporting

- Export trading company (ETC)
- Export management company (EMC)

## Business Strategy and Customer Requirements

- **Step 1:** Determine customer requirements and network servicing expectations.
- **Step 2:** Calculate threshold service level and determine network capabilities.
- **Step 3:** Use sensitivity analysis to adjust factors.
- **Step 4:** Present alternatives and their cost differences and finalize strategy.

## Determine Servicing Expectations



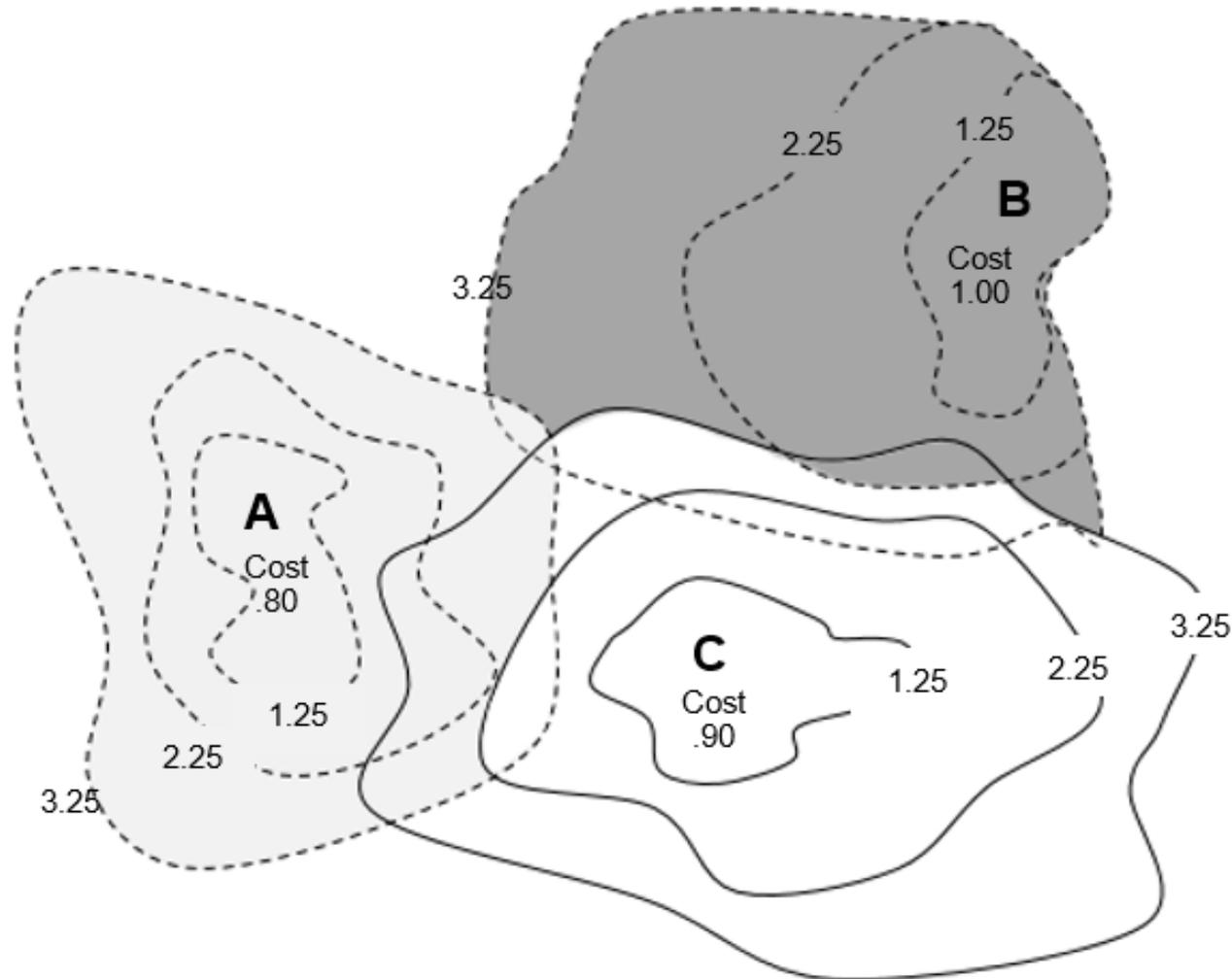
Why is information on customers' acceptable lead times or network servicing frequency so important to network design?

### **Answer:**

Dictates number of distribution centers (DCs) that will be needed.

# Topic 3: Transportation Requirements and Network Size

## Economic Cost Map



## Sensitivity Analysis

Marginal analysis impact on service time and cost:

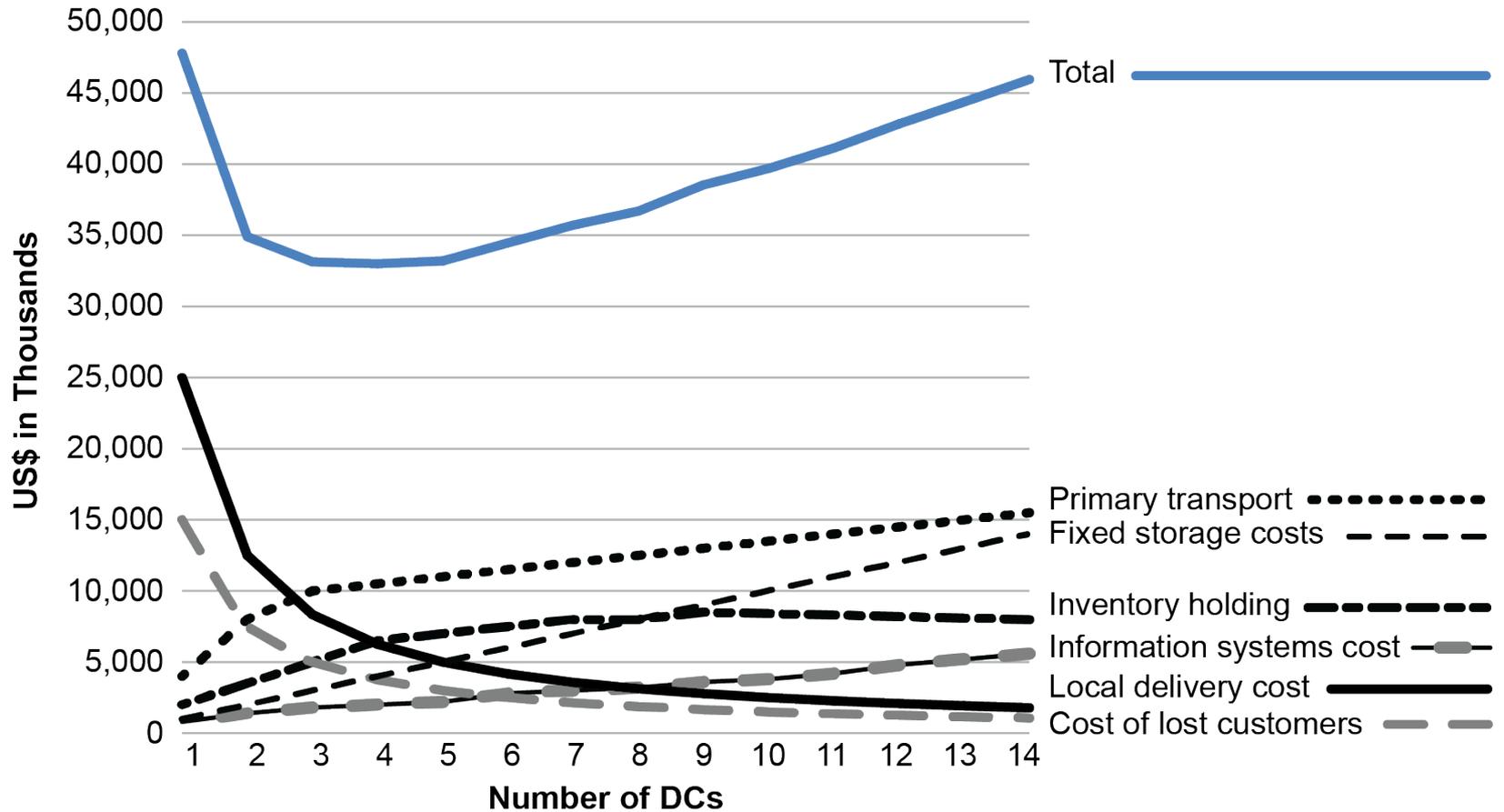
- Adjust number of DCs up and down.
- Then adjust safety stock levels.
- Maister's square root rule (portfolio effect):

$$\text{New Aggregate Safety Stock} = \frac{\sqrt{\text{New DCs}}}{\sqrt{\text{Existing DCs}}} \times \text{Existing Aggregate Safety Stock}$$

$$\text{From 3 to 4 DCs} = \frac{\sqrt{4}}{\sqrt{3}} \times 100\% = 115\%$$

# Topic 3: Transportation Requirements and Network Size

## Total Cost Analysis for Number of DCs



## Transportation Requirements Analysis

### Average shipments per period

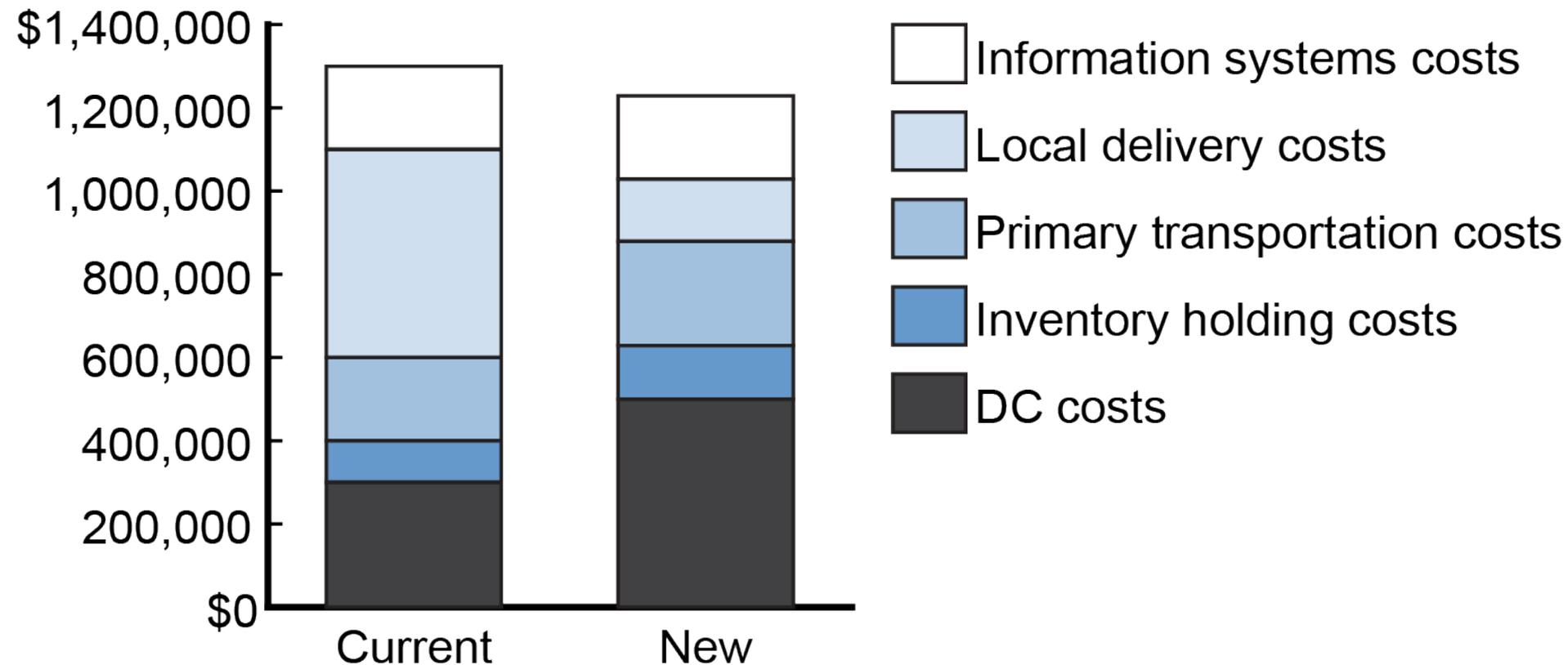
- Product family demand forecast
- Sales and marketing commitments

### Aggregate transportation requirements for network

- Requirements per mode with average rates
- Estimated proportion of full and partial loads
- Primary transportation and local delivery segments
- Lane volumes

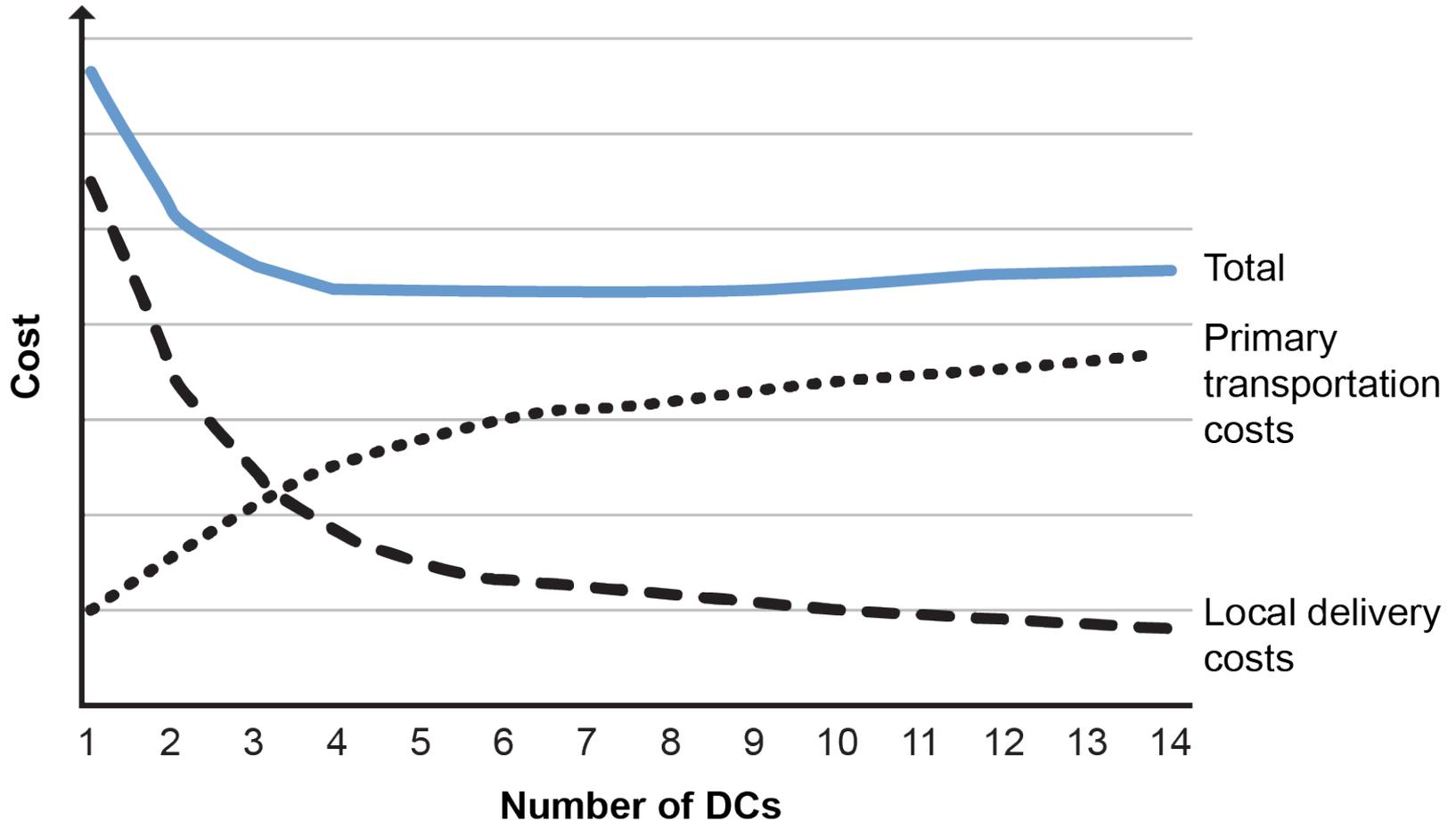
# Topic 3: Transportation Requirements and Network Size

## Tradeoff Analysis



# Topic 3: Transportation Requirements and Network Size

## Tradeoffs



# Topic 3: Transportation Requirements and Network Size

## Use Consolidation/Break-Bulk or Not?

$$\sum \frac{\text{TL Transport} + \text{TL Processing}}{\text{Avg. Number of TLs}} + \text{Avg. Shipment DC Cost} + \text{Avg. Shipment Local Delivery}$$

$$\leq \sum \text{Processing Cost of Avg. Shipment} + \text{Direct Freight Cost of Avg. Shipment}$$

## Impact of DC Locations on Inventory Levels

- Adding locations doesn't impact cycle stock.
- Safety stock rises, but rate slows.
  - Shorter outbound order cycle time, less variability, less need for safety stock.
- Less in-transit inventory.
- Increased inbound order cycle time and in-transit time.

Average Aggregate Inventory =

$$\sum_{i=1}^n \frac{\text{Order Quantity}_i}{2} + \text{Safety Stock}_i + \text{In-Transit Inventory}_i$$

## Deployment Considerations

### Proximity

- Weight
- Fuel
- Average lead time
- Demographics

### Labor rates

- Cost
- Labor market

### Quality

- Work ethics
- Quality of life

## Deployment Considerations

Consumers (retail, manufacturing, direct)

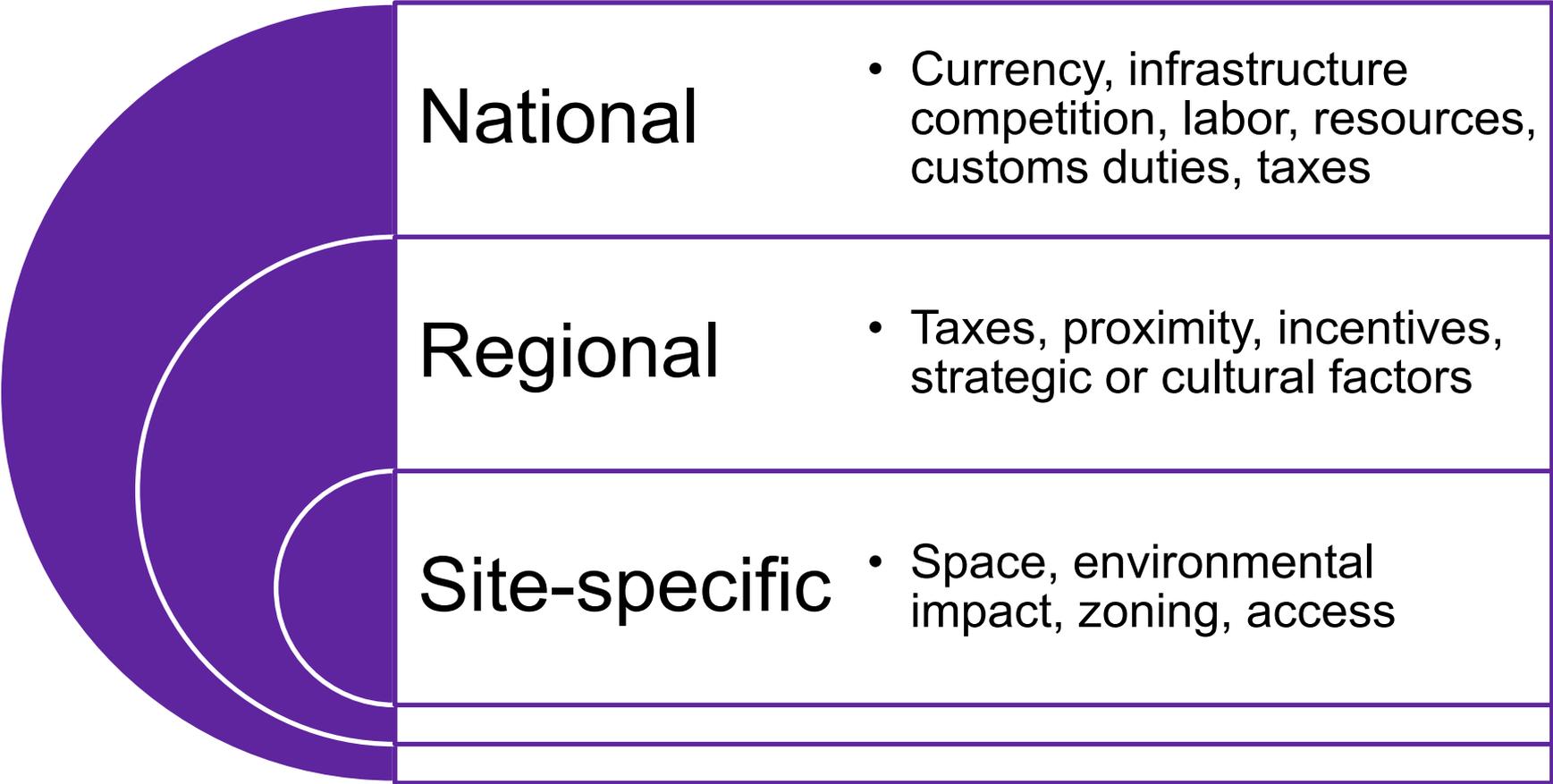
Operational costs—infrastructure

- Space and equipment utilization.
- Infrastructure costs can vary significantly.
- Basic services.
- Access to roadways, ports; congestion.

Incentives

- Sustainability, economic renewal.

## National, Regional, and Site-Specific Decision Factors



### National

- Currency, infrastructure competition, labor, resources, customs duties, taxes

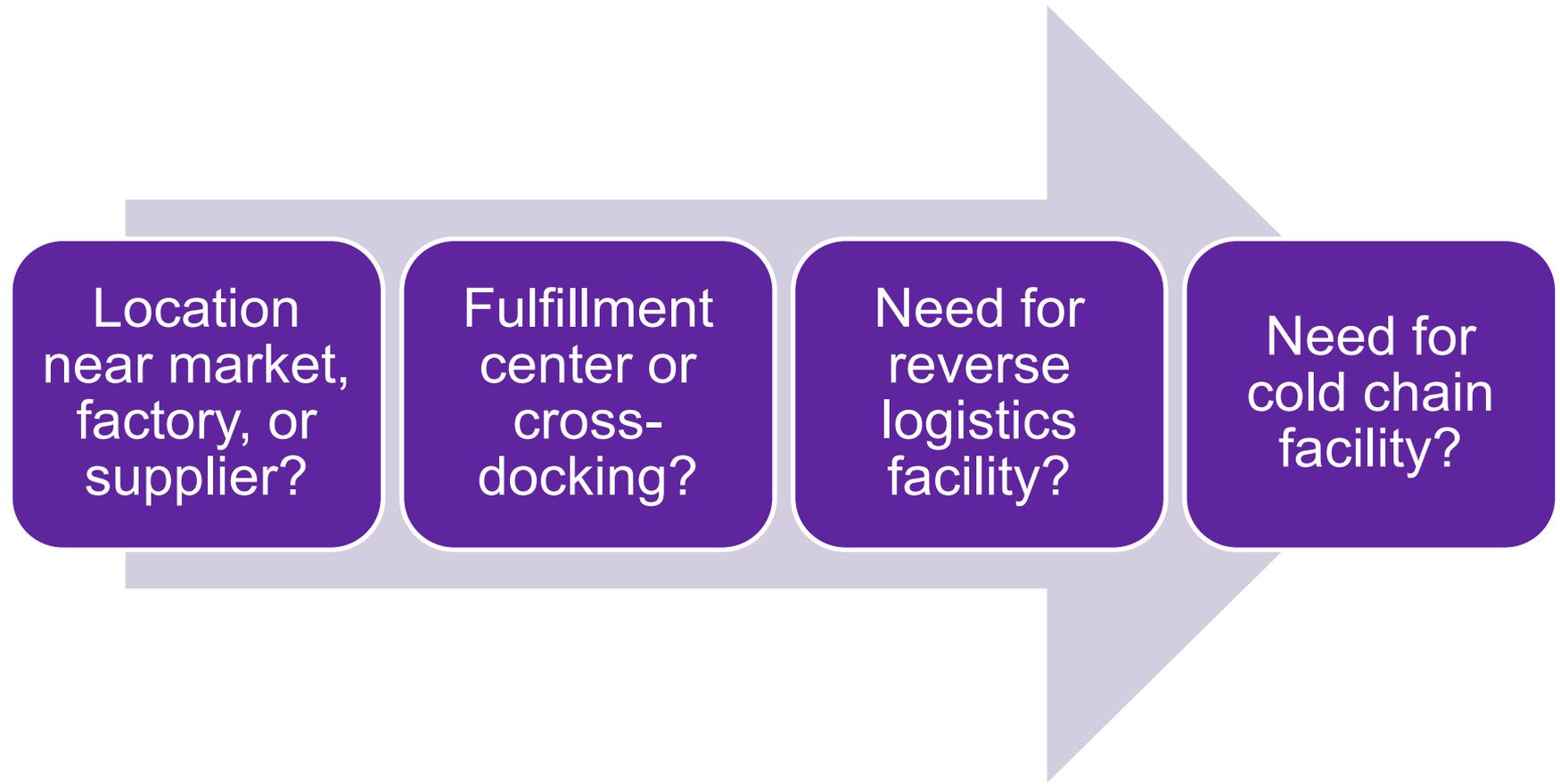
### Regional

- Taxes, proximity, incentives, strategic or cultural factors

### Site-specific

- Space, environmental impact, zoning, access

## Determining Appropriate Facility Type



# Topic 5: Modeling Approaches

## Heuristics

Form of problem solving in which the results or rules have been determined by experience or intuition instead of by optimization

- Experiment to find approximate answer
- Trade accuracy for speed, ease of calculation
- Decision rules and math
- Example usage:
  - Forecasting
  - Inventory levels
  - Staffing

# Topic 5: Modeling Approaches

## Cost-Volume Analysis

$$\text{Total Cost} = \text{Fixed Cost} + (\text{Variable Cost} \times \text{Volume})$$

City	Fixed Costs	Variable Costs	Maximum Units	Total Cost at Maximum Units
Denver	\$2,000,000	\$615	26,000	\$17,990,000
Seattle	\$4,000,000	\$385	26,000	\$14,010,000
Los Angeles	\$8,000,000	\$115	26,000	\$10,990,000

What is the crossover point?

# Topic 5: Modeling Approaches

## Cost-Volume Analysis Scenario

$$x = \frac{\text{Fixed Cost}_2 - \text{Fixed Cost}_1}{(\text{Variable Cost}_1 - \text{Variable Cost}_2)}$$

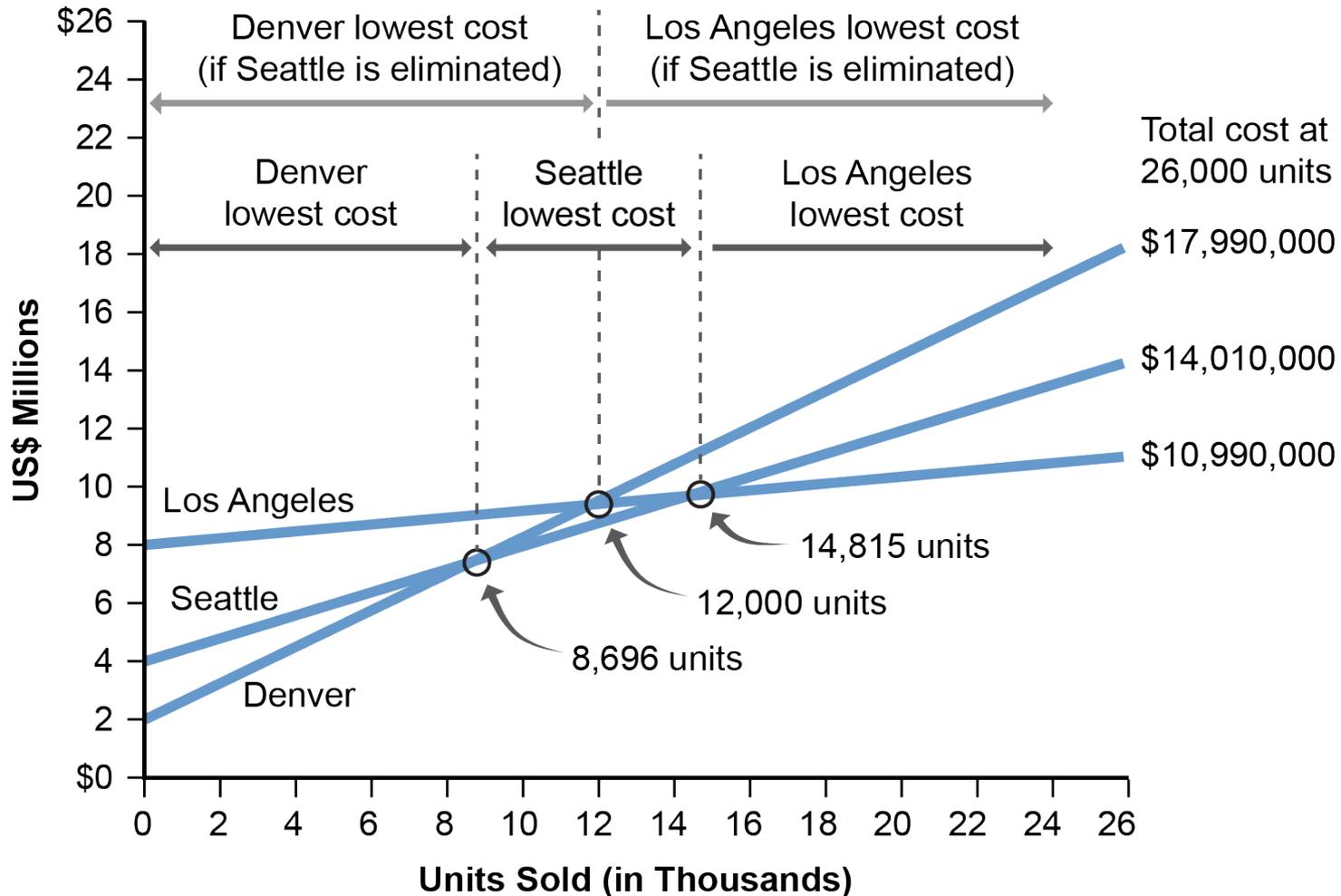
$$\text{Denver-Seattle Crossover Point} = \frac{\$4,000,000 - \$2,000,000}{(\$615/\text{Unit} - \$385/\text{Unit})} = \frac{\$2,000,000}{\$230/\text{Unit}} = 8,696 \text{ Units}$$

$$\text{Seattle-Los Angeles Crossover Point} = \frac{\$8,000,000 - \$4,000,000}{(\$385/\text{Unit} - \$115/\text{Unit})} = \frac{\$4,000,000}{\$270/\text{Unit}} = 14,815 \text{ Units}$$

$$\text{Denver-Los Angeles Crossover Point} = \frac{\$8,000,000 - \$2,000,000}{(\$615/\text{Unit} - \$115/\text{Unit})} = \frac{\$6,000,000}{\$500/\text{Unit}} = 12,000 \text{ Units}$$

# Topic 5: Modeling Approaches

## Cost-Volume Analysis Graph



# Topic 5: Modeling Approaches

## Other Modeling Methods

### Weighted factor rating

Qualitative and quantitative

Priority based on weight

Weight  $\times$  rating

Find finalists and use other tools

### Center of gravity

x-y map coordinates

Sum of each (x coordinate  $\times$  shipping volume)  $\div$  sum of all shipping volumes

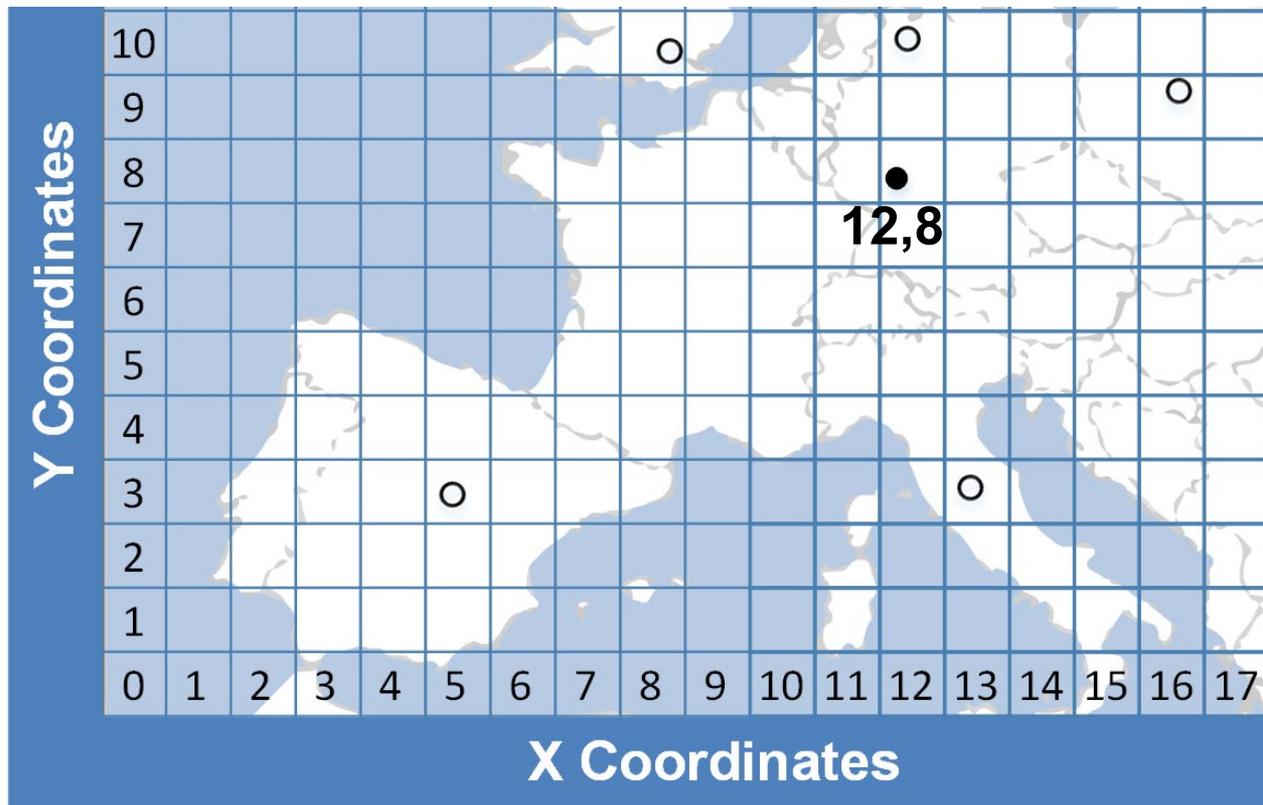
Repeat for y coordinates

### Regression analysis

Independent variables predict dependent variable

# Topic 5: Modeling Approaches

## Center-of-Gravity Map



Location	X	Y	Volume
London	8	10	8,000
Warsaw	16	9	9,000
Madrid	5	3	4,000
Hamburg	12	10	11,000
Rome	13	3	6,000
Center of gravity	12	8	38,000

# Topic 5: Modeling Approaches

## Optimization

- Seeks optimum result.
- Changing any variable yields different answer.
- Significant improvement over heuristics.
- Number of DCs, location, own or lease, make-or-buy, postponement.
- Can use Excel Solver for simple problems.

# Topic 5: Modeling Approaches

## Simulation

Sensitivity  
analysis

One  
change

Scenario  
analysis

“What-if”

Monte Carlo  
simulation

Min-max

# Topic 6: Network Design Performance Validation

## Forecasting, Benchmarking, and Costing/Financing

### Forecasting

- Long-term forecast → Logistics capacity
- New markets, economic conditions

### Benchmarking

- Best in class
- Same industry or same process

### Costing/ financing

- Budget/project accounting variances
- Savings/revenue offset cost of funds?

# Topic 6: Network Design Performance Validation

## Analytics for Supply Chain (Re)Design

Assess supply chain framework to-be vs. as-is.

- Order-to-cash cycle (throughput)
- Landed cost by echelon
- Cash-to-cash velocity by echelon
- Cash-to-cash variability by echelon

Assess product/service packages to-be vs. as-is.

- Inventory turnover by echelon
- Delivery lead time
- Planning horizon
- Return on supply chain fixed assets

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MODULE 2, SECTION B:  
RISK MANAGEMENT

The APICS logo features a stylized white 'A' with a curved line above it, followed by the letters 'PICS' in a clean, sans-serif font.

The ASCM logo consists of the letters 'ASCM' in a bold, white, sans-serif font, with a small white arrow pointing to the right integrated into the letter 'M'.

# Topic 1: Logistics Risks and the Risk Management Process

## Supply and Demand Risks

Category	Examples	Common Responses
Demand risks	Forecast error	Error thresholds trigger review; aggregate forecasts.
	Unpredictable demand, bullwhip effect	Visibility to actual demand; pull over push; agile; communication.
	Lost customers	Satisfaction with various service aspects.
Supply risks	Poor quality	Lean/JIT; audits; certification.
	Reliability/capacity	Avoid sole sourcing.
	Malfeasance	Transaction monitoring software; split up designs among several suppliers.

# Topic 1: Logistics Risks and the Risk Management Process

## Process Risks

Category	Examples	Common Responses
<b>Process risks</b>	Poor information systems, inefficient/ineffective planning or execution	Improve management practices; invest in technology; change management.
	Over-reliance on particular facilities, equipment, staff	Some amount of redundancy.
	Capacity constraints	Excess capacity or multi-use equipment.
	Inventory shortages/overages	Better visibility/planning; shorter order cycles.
	Labor unrest or union negotiations	Early negotiations in good faith.
	Infrastructure failures	Backup generators; relocation.
	Loss of intellectual property from supplier	Different suppliers making different components; better IT security; patents; limiting access.

## Transportation and Warehousing Risks

### Transportation

- Loss of goods
- Mode selection
- Carrier selection
- Transportation security

### Warehousing

- Location selection
- Security checks and balances
- Physical barriers and security equipment

## Financial and Environmental Risks

### Financial

- Organization and supplier solvency
- Red flags
  - Quality, payment terms, long lead times, few investments, layoffs, turnover

### Environmental

- Regulatory
- Weather and natural disasters
- Government, economic, war, and terrorism

## Responses to Risk

- **Redundancy**

Same capabilities at multiple facilities, 2+ of same equipment, 2+ warehouses servicing same market.

- **Visibility**

Encouraging communication policies, using data sharing among partners, linked information systems.

- **Packaging**

Primary response to risk of damage as preventive measure; used to deter theft.

## Risk Management Process

1. Identify and document risks.
2. Categorize and prioritize risks.
3. Quantitatively analyze risk if desired.

$$\text{EMV} = \text{Probability} \times \text{Monetary Impact}$$

4. Pick a basic risk response.
5. Develop preventive and contingent action plans.
6. Implement preventive action plans.
7. Regularly meet to review risks and risk response status.

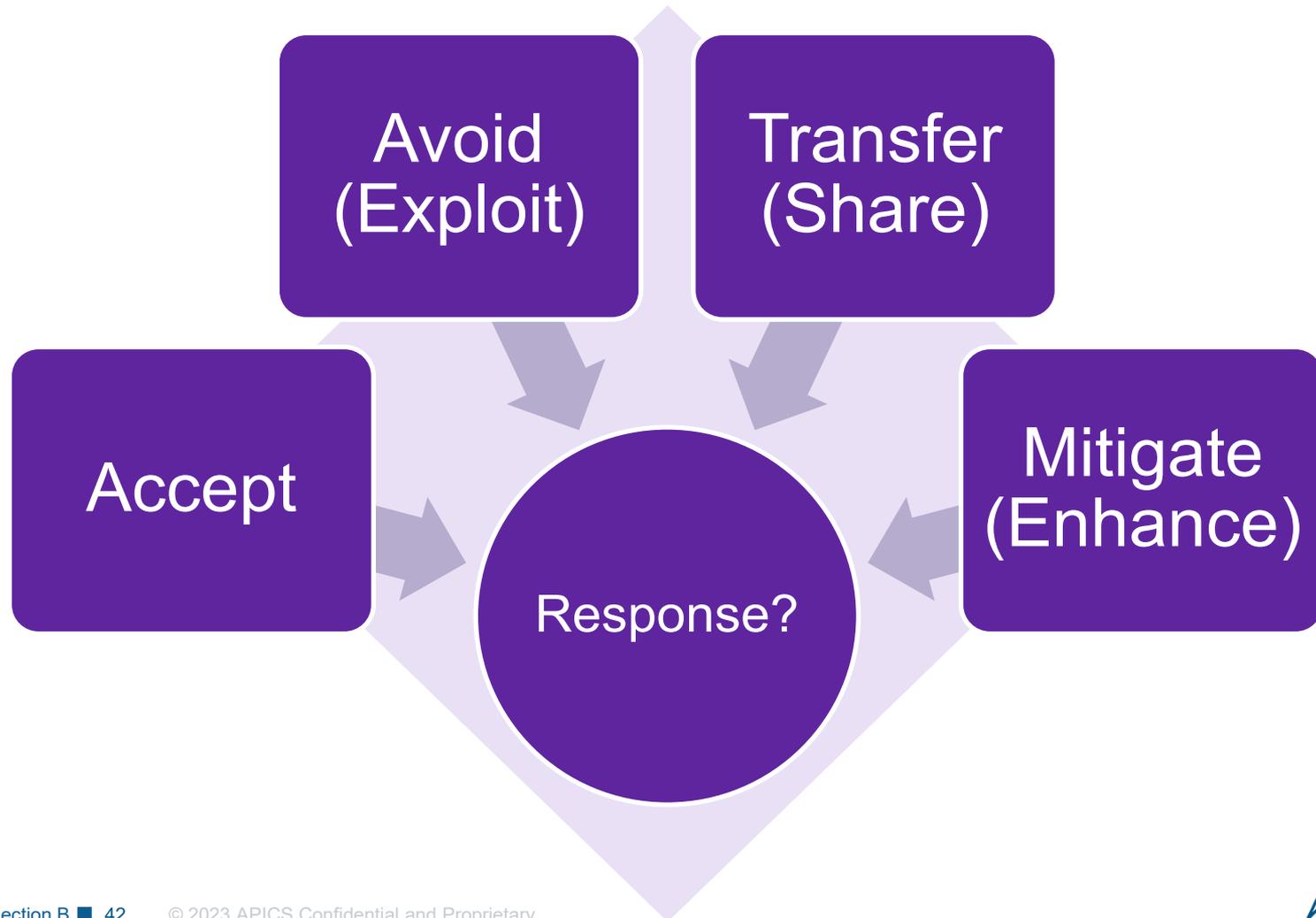
# Topic 1: Logistics Risks and the Risk Management Process

## Probability and Impact Matrix

$$\text{Risk Rating} = \text{Probability} \times \text{Impact}$$

		Impact				
		Insignificant	Minor	Moderate	Major	Extreme
Probability		5%	10%	20%	40%	80%
Almost certain	90%	5%	9%	18%	36%	72%
Likely	70%	4%	7%	14%	28%	56%
Possible	50%	3%	5%	10%	20%	40%
Unlikely	30%	2%	3%	6%	12%	24%
Rare	10%	1%	1%	2%	4%	8%

## Risk Responses



# Topic 2: International Security Measures

## International Organizations

International  
Chamber of  
Commerce

Incoterms<sup>®</sup>  
trade terms

Uniform Customs  
and Practice for  
Documentary  
Credit

World Customs  
Organization

Secure and  
Facilitate Global  
Trade (SAFE) for  
ASNs

International Maritime  
Organization of the  
U.N.

International Ship  
and Port Facility  
Security Code  
(ISPS)

Safety of Life at  
Sea Convention  
(SOLAS)

# Topic 2: International Security Measures

## Border Security Partnerships

EU

### Authorized Economic Operator (AEO) program

- Business audit, good customs record
- AEOC: Customs
- AEOS: Security
- AEOF: Both of above
- Mutual recognition agreements

U.S.

### Customs-Trade Partnership Against Terrorism (C-TPAT)

- Questionnaire
- Continually improve security
- Fewer inspections, less border time (no guarantee)

# Topic 3: Business Continuity Planning

## Business Continuity Planning

- ISO 22301
  - Emergency roles
  - Order for restoring services
  - Business continuity insurance
- **Logistics' role**
  - In-transit and DC inventory risk
  - Emergency supplier replacement plans
  - Logistics information systems restoration

**Ensures the organizational capability of continuing to deliver products or services at acceptable levels after disruptive incident.**

# Topic 4: Insurance

## Insuring Against Loss

### Risk transfer

- Transfers the risk to a third party, usually an insurance company

### Self-insurance

- Risk retention strategy that requires setting aside a large sum of money in a fund

# Topic 4: Insurance

## Cargo Insurance

- Domestic terms or Incoterms<sup>®</sup> trade terms assign who insures:
  - Carrier liability exemptions/low carrier liability limits.
  - Negotiate/purchase acceptable additional insurance.
- Theft of containers more prevalent than damage.
- Damage:
  - Fires, high seas (heave, pitch, roll, surge, sway, and yaw).
  - General average losses vs. particular average losses.

# Topic 4: Insurance

## Types of Insurance for Logistics

