

CLTD

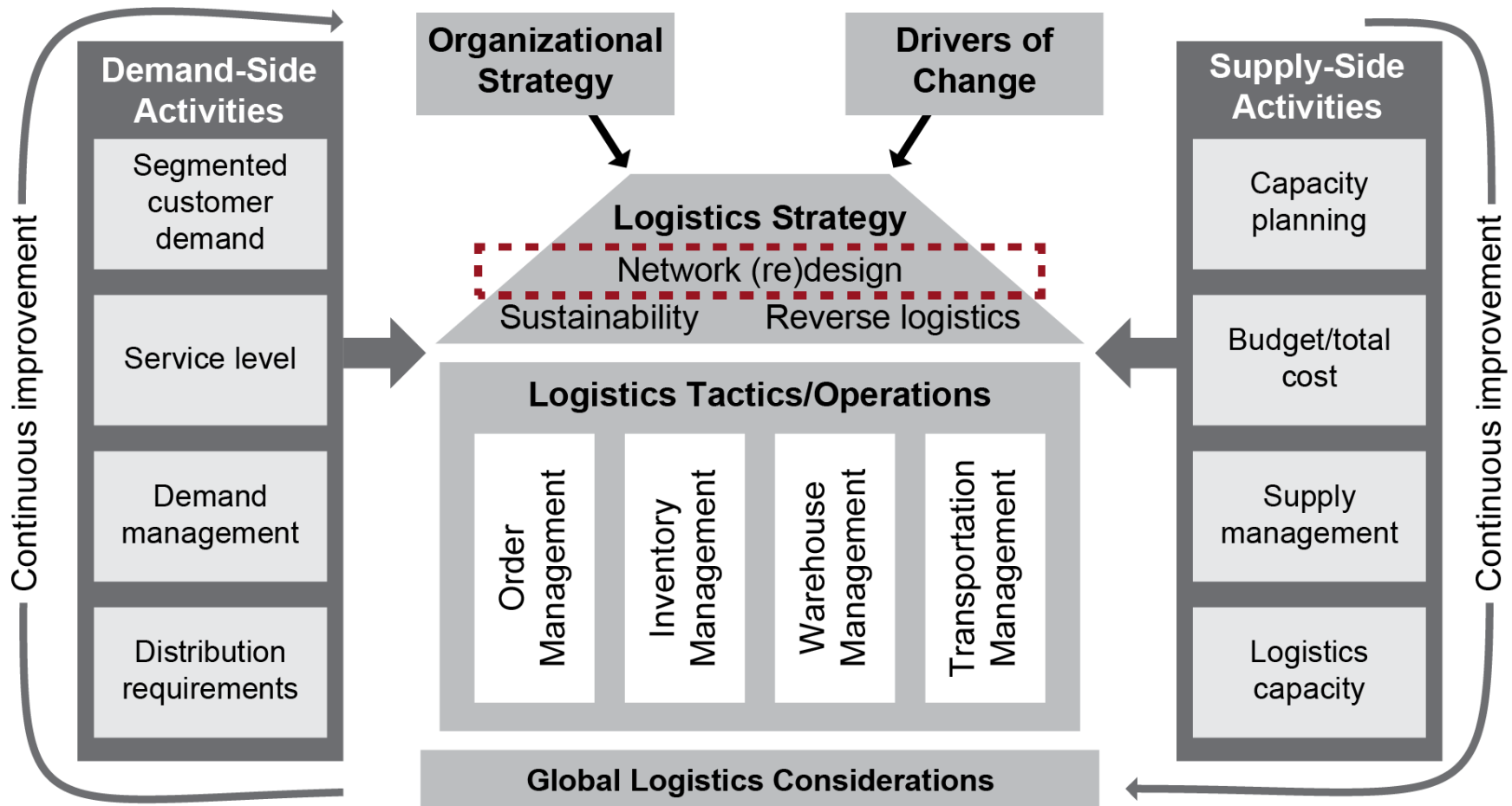
CERTIFIED IN LOGISTICS,
TRANSPORTATION AND DISTRIBUTION

MODULE 2: LOGISTICS NETWORK DESIGN



Module 2: Logistics Network Design

Module 2 Overview



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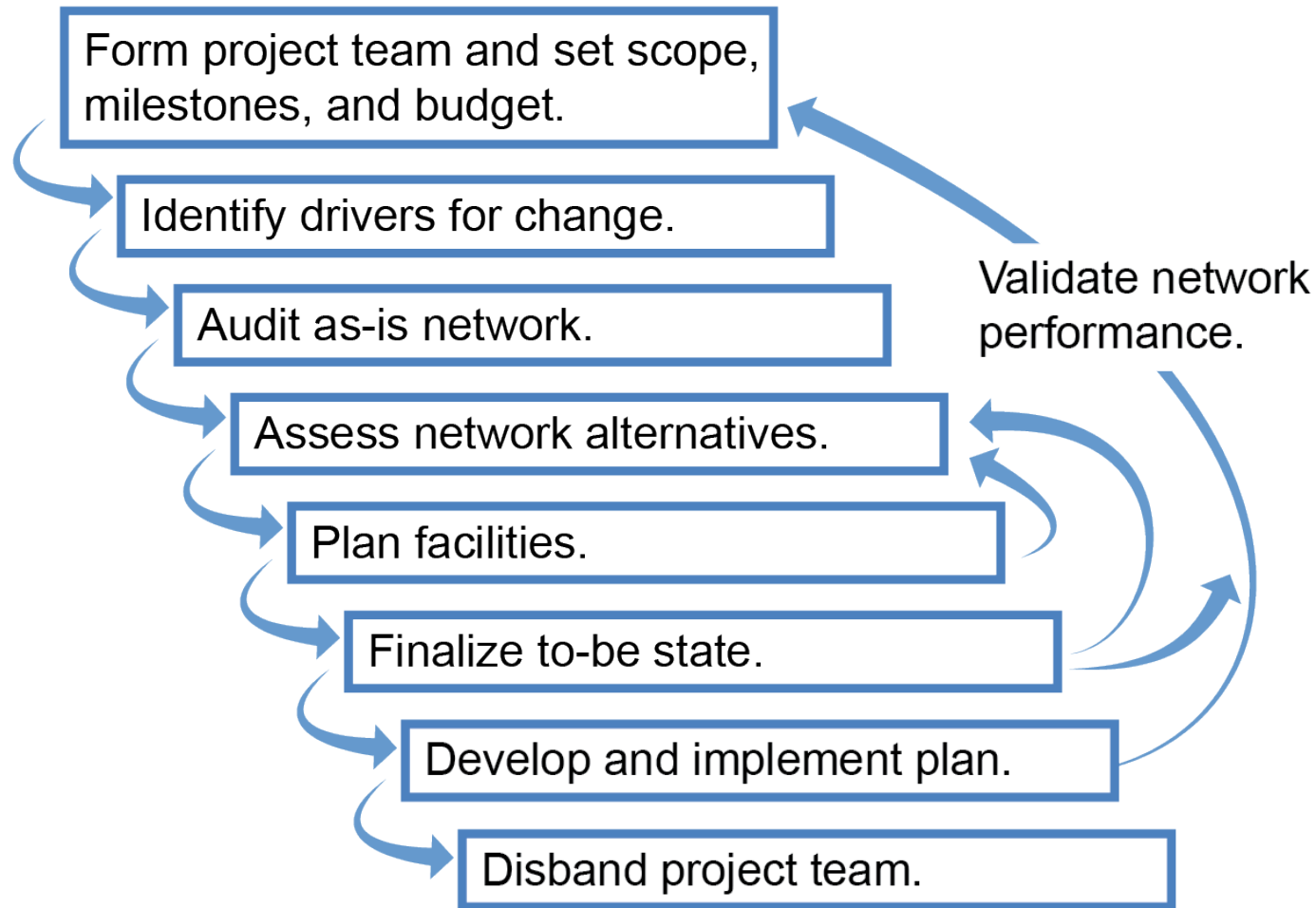
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MODULE 2, SECTION A: FACILITIES PLANNING AND NETWORK DESIGN



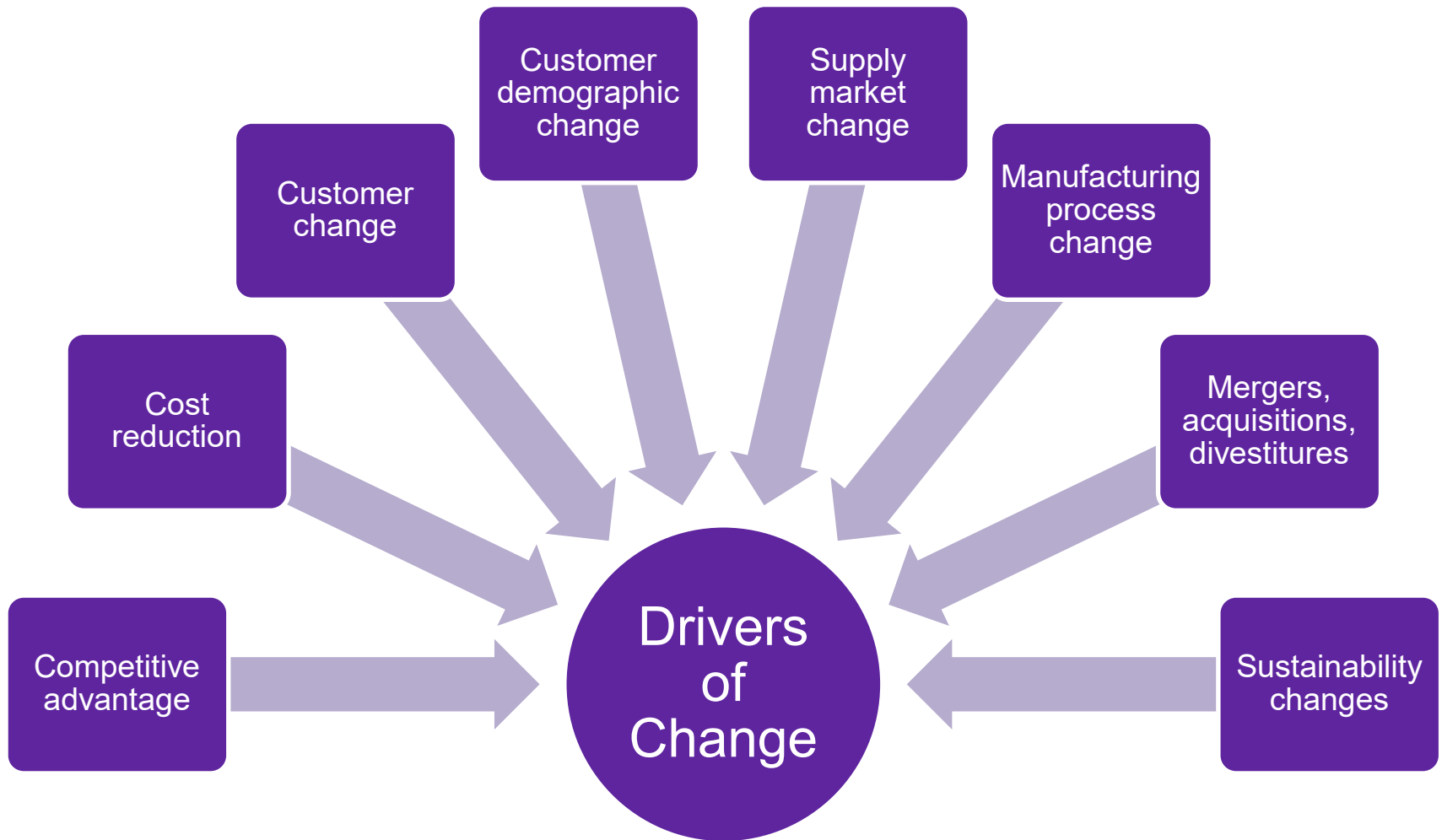
Topic 1: Designing or Redesigning a Logistics Network

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.

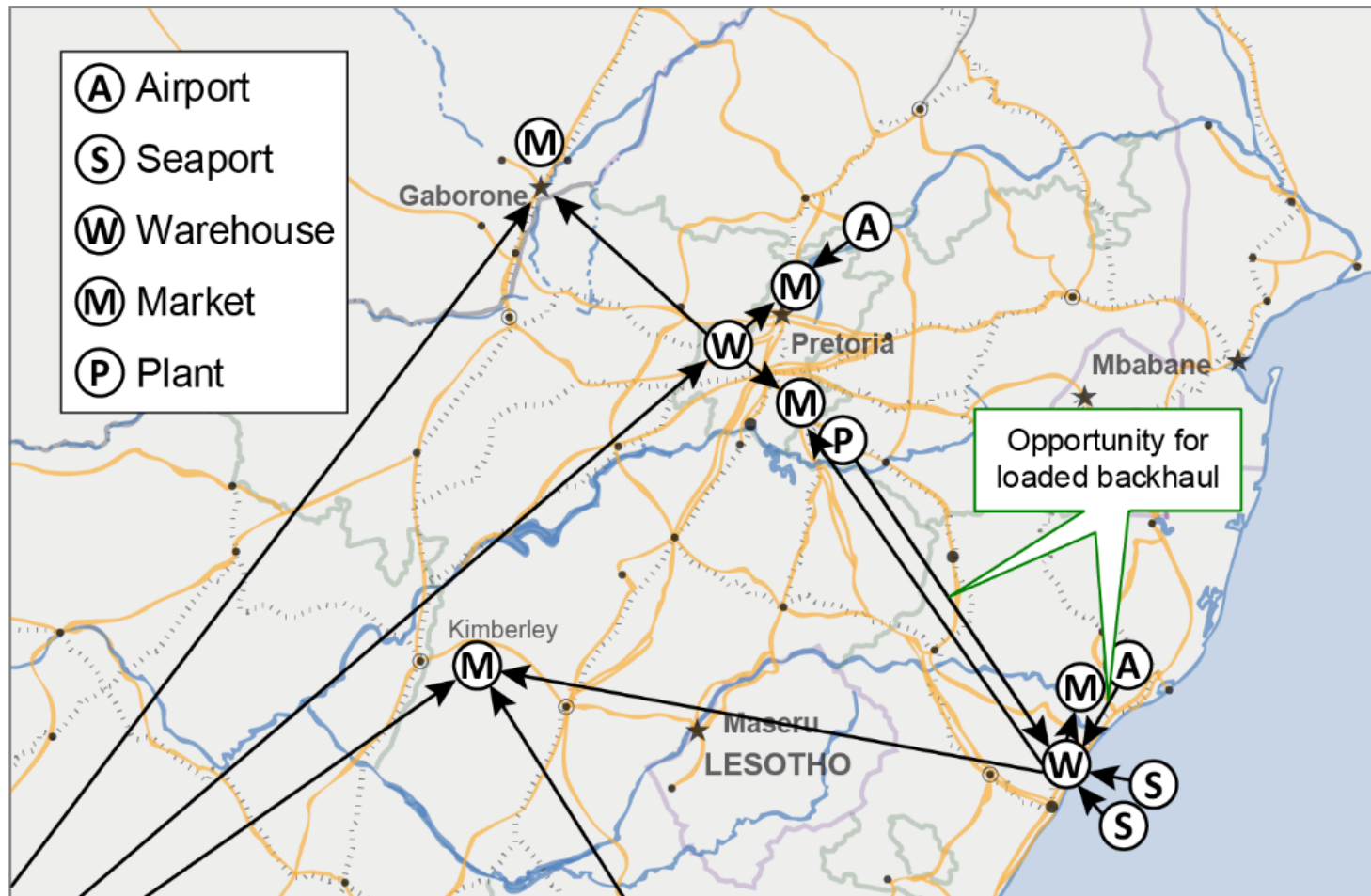
Measure against benchmarks.

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)

Topic 3: Transportation Requirements and Network Size

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.

Topic 3: Transportation Requirements and Network Size

Determine Servicing Expectations



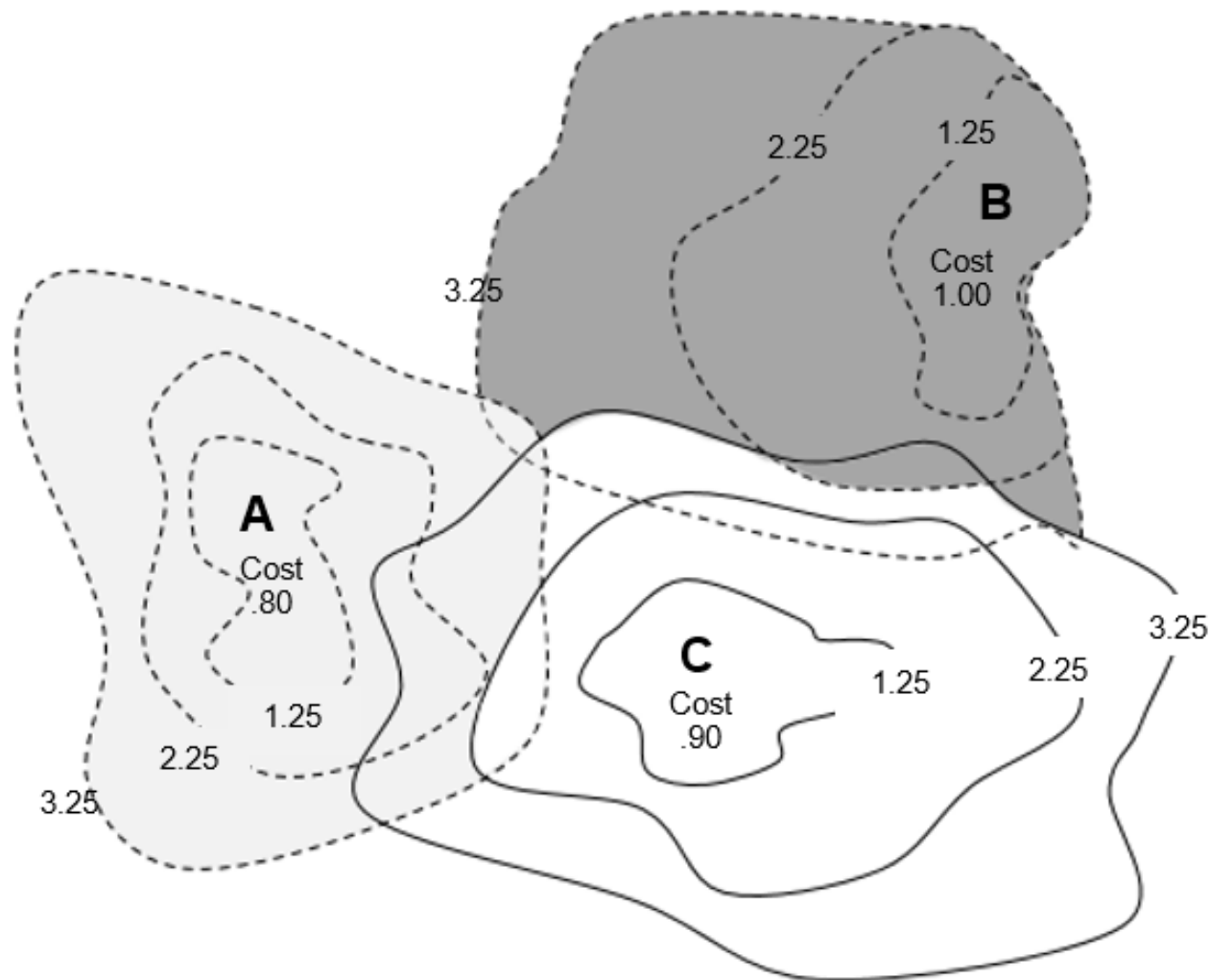
Why is information on customers' acceptable lead times or network servicing frequency so important to network design?

Answer:

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

Topic 3: Transportation Requirements and Network Size

Economic Cost Map



Topic 3: Transportation Requirements and Network Size

Sensitivity Analysis

Marginal analysis impact on service time and cost:

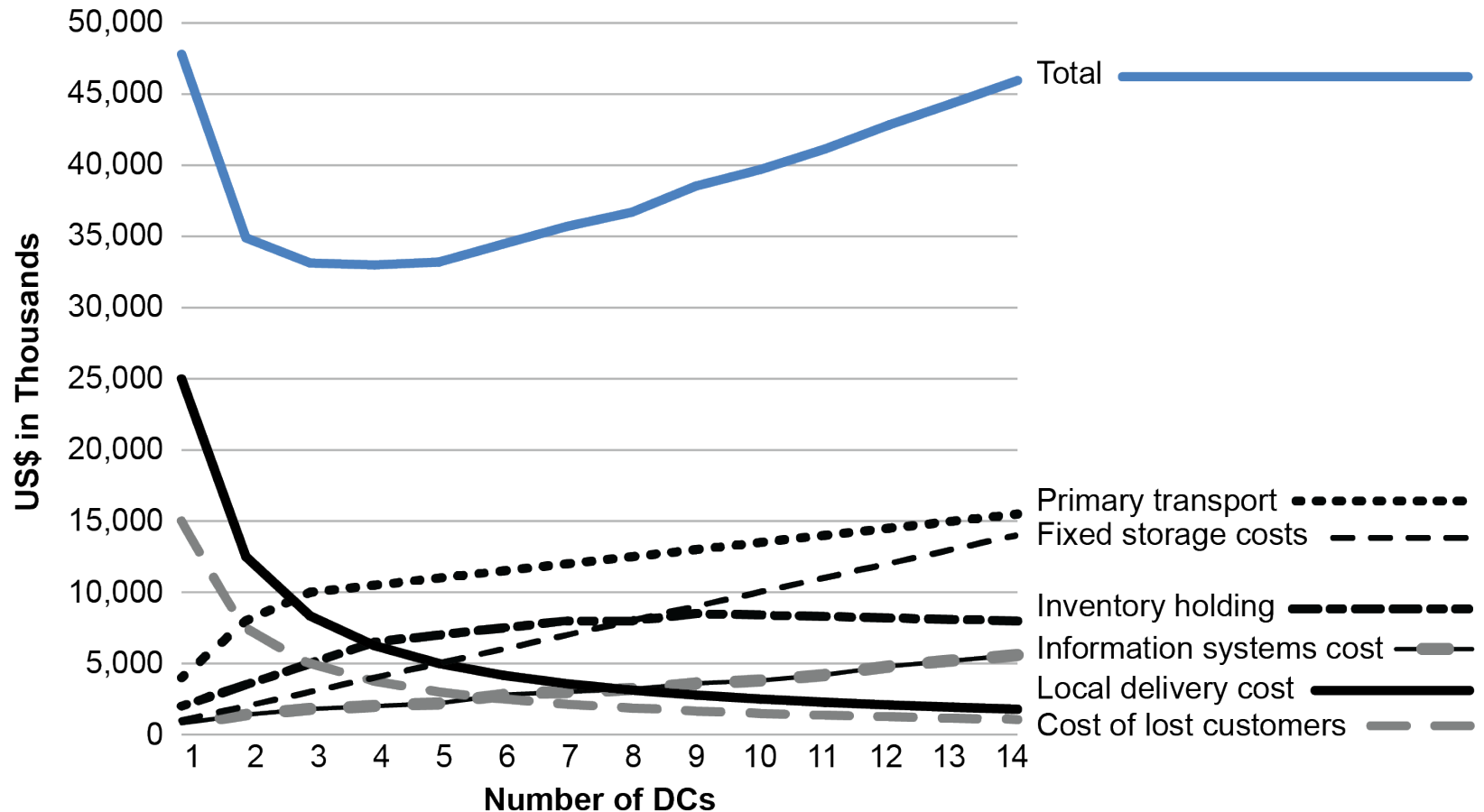
- Adjust number of DCs up and down.
- Then adjust safety stock levels.
- Maister's square root rule (portfolio effect):

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

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

Topic 3: Transportation Requirements and Network Size

Total Cost Analysis for Number of DCs



Topic 3: Transportation Requirements and Network Size

Transportation Requirements Analysis

Average shipments per period

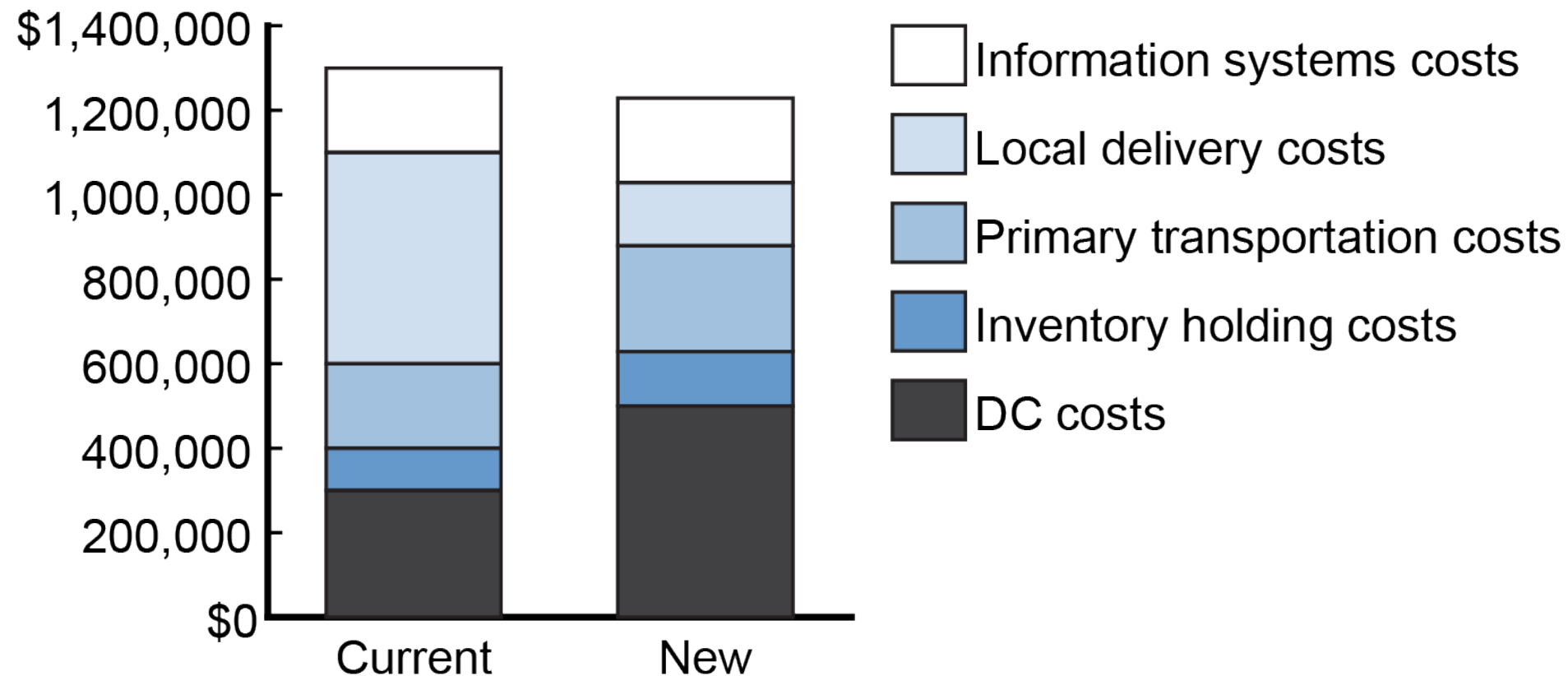
- Product family demand forecast
- Sales and marketing commitments

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

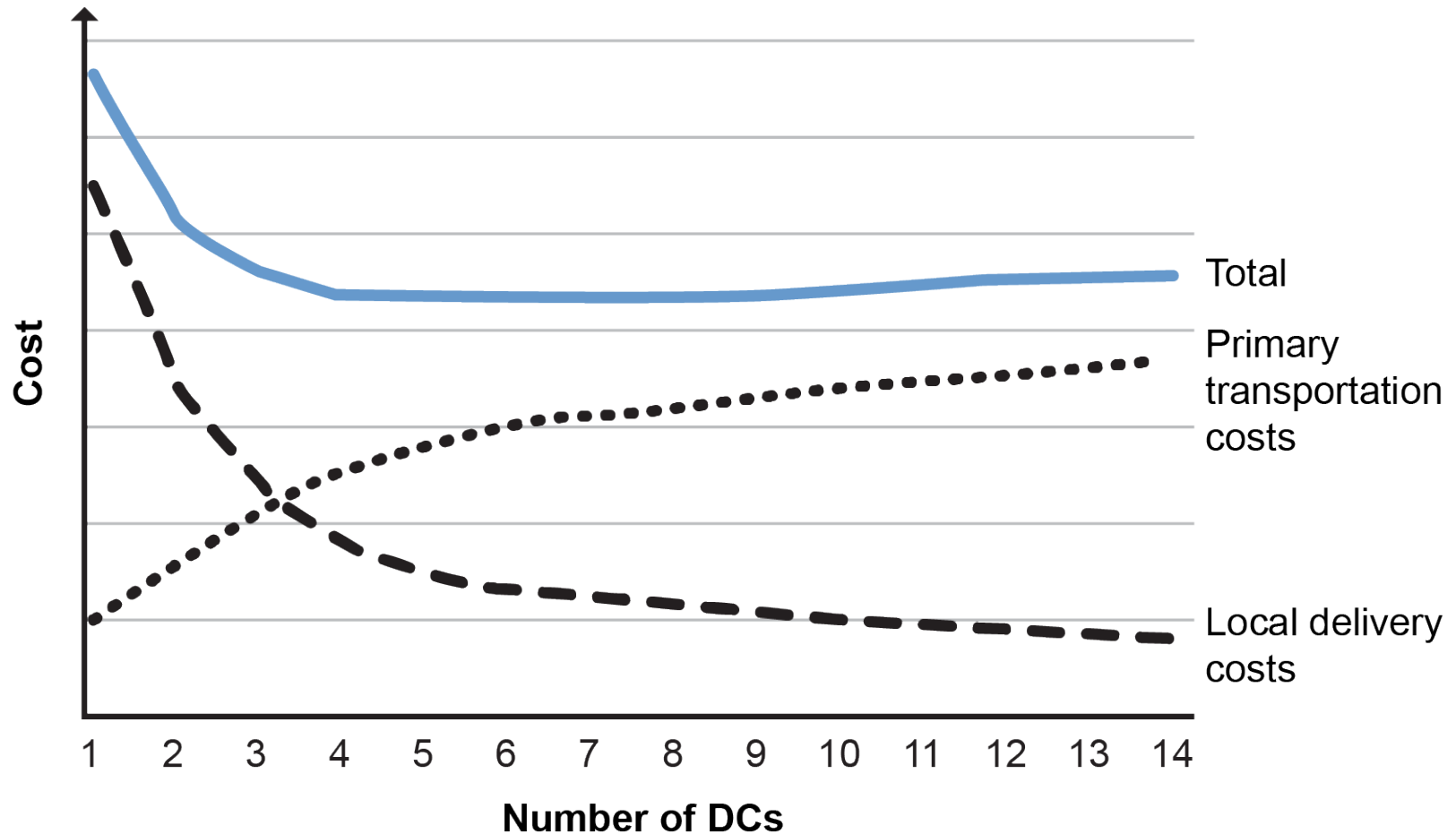
Topic 3: Transportation Requirements and Network Size

Tradeoff Analysis



Topic 3: Transportation Requirements and Network Size

Tradeoffs



Topic 3: Transportation Requirements and Network Size

Use Consolidation/Break-Bulk or Not?

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

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

Topic 3: Transportation Requirements and Network Size

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

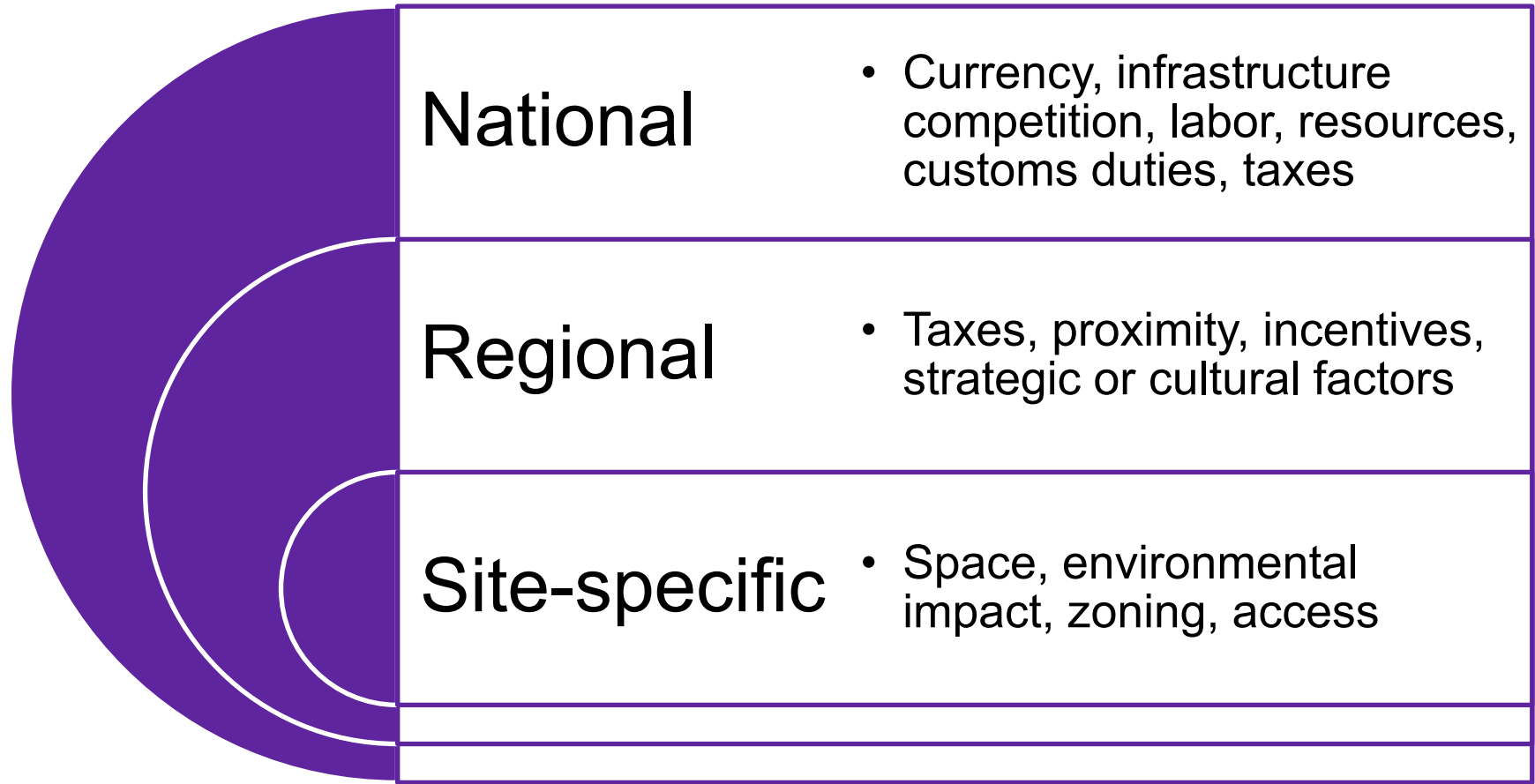
- Space and equipment utilization.
- Infrastructure costs can vary significantly.
- Basic services.
- Access to roadways, ports; congestion.

Incentives

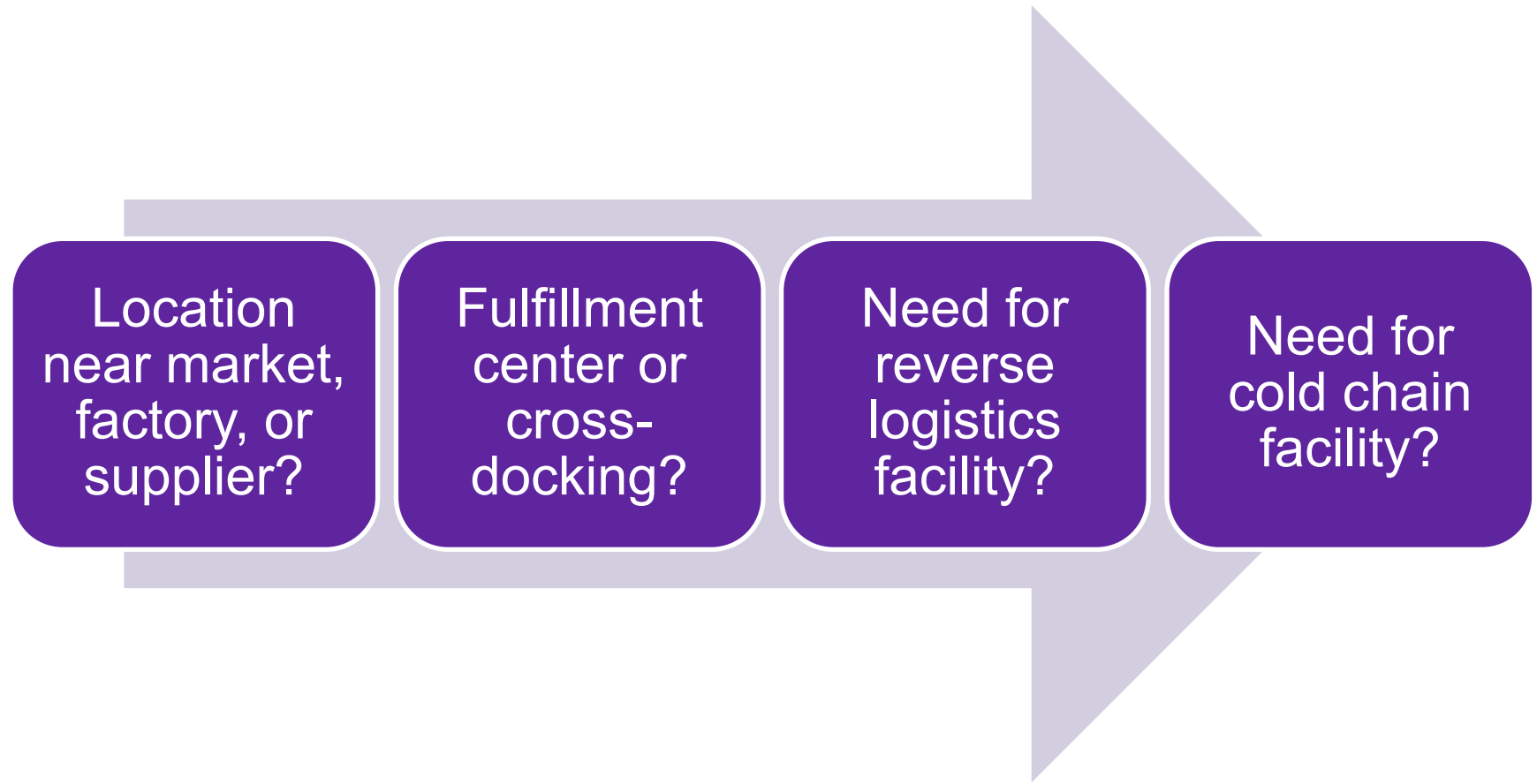
- Sustainability, economic renewal.

Topic 4: Facility Location Decisions and Determining Facility Type

National, Regional, and Site-Specific Decision Factors



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

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

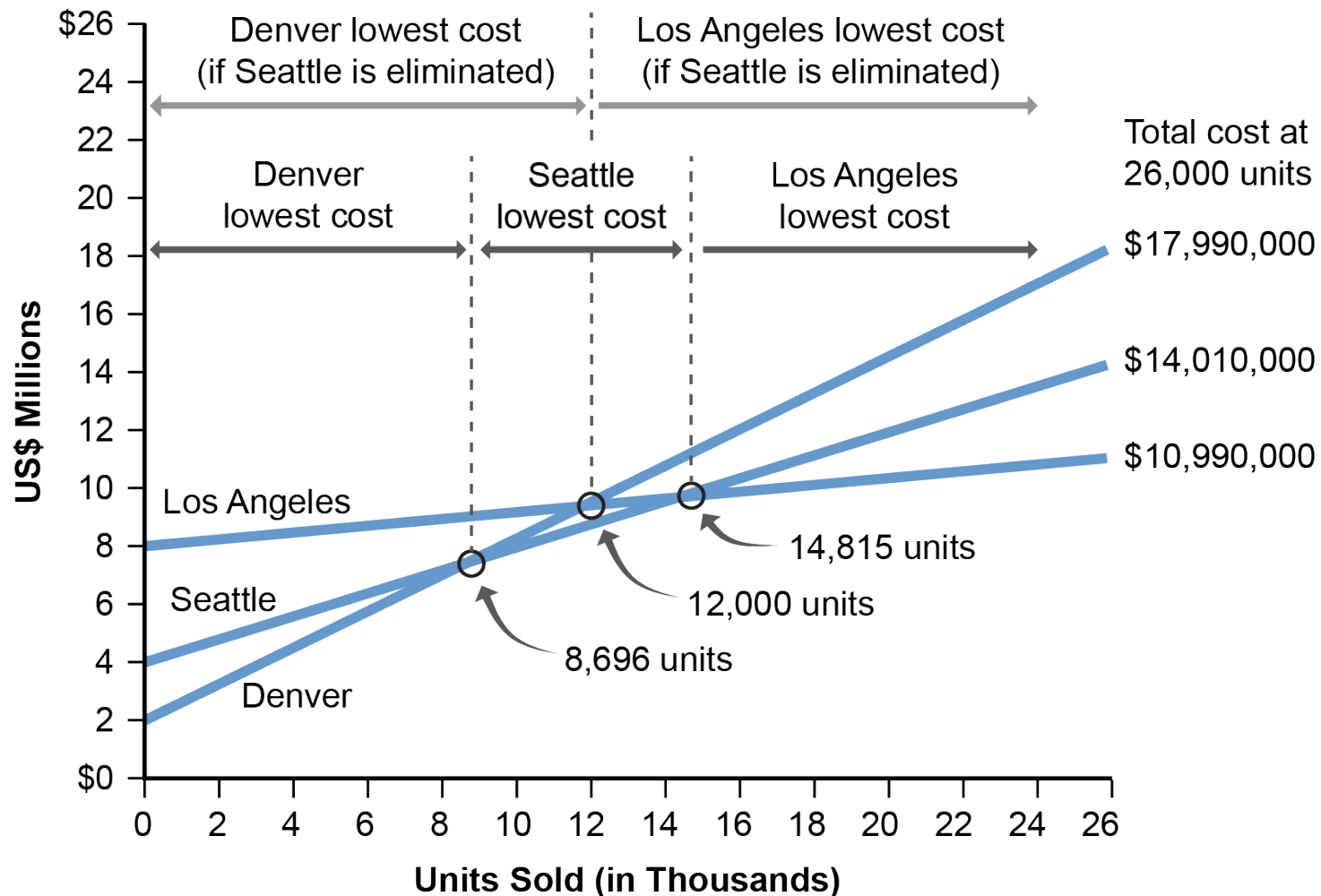
$$\text{Denver-Seattle Crossover Point} = \frac{\$4,000,000 - \$2,000,000}{(\$615/\text{Unit} - \$385/\text{Unit})} = \frac{\$2,000,000}{\$230/\text{Unit}} = 8,696 \text{ Units}$$

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

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

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

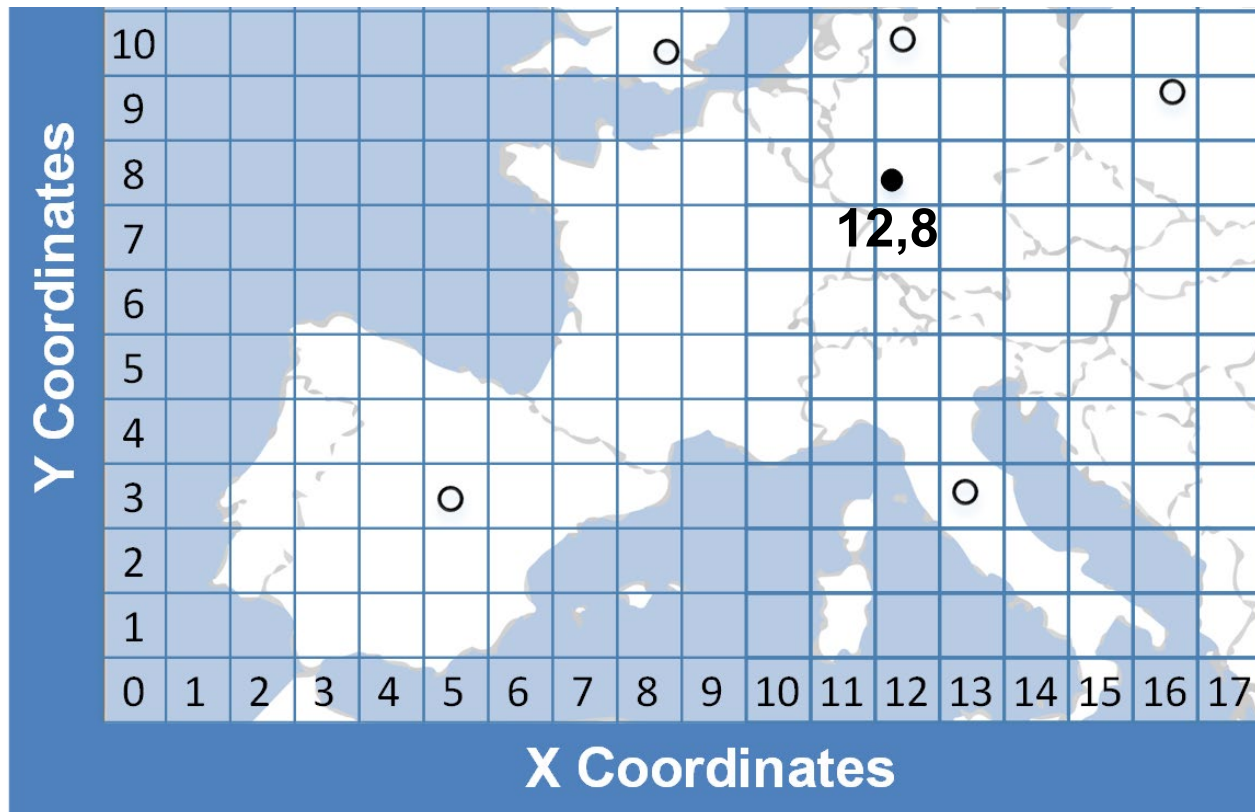
Repeat for y coordinates

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



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
Process risks	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

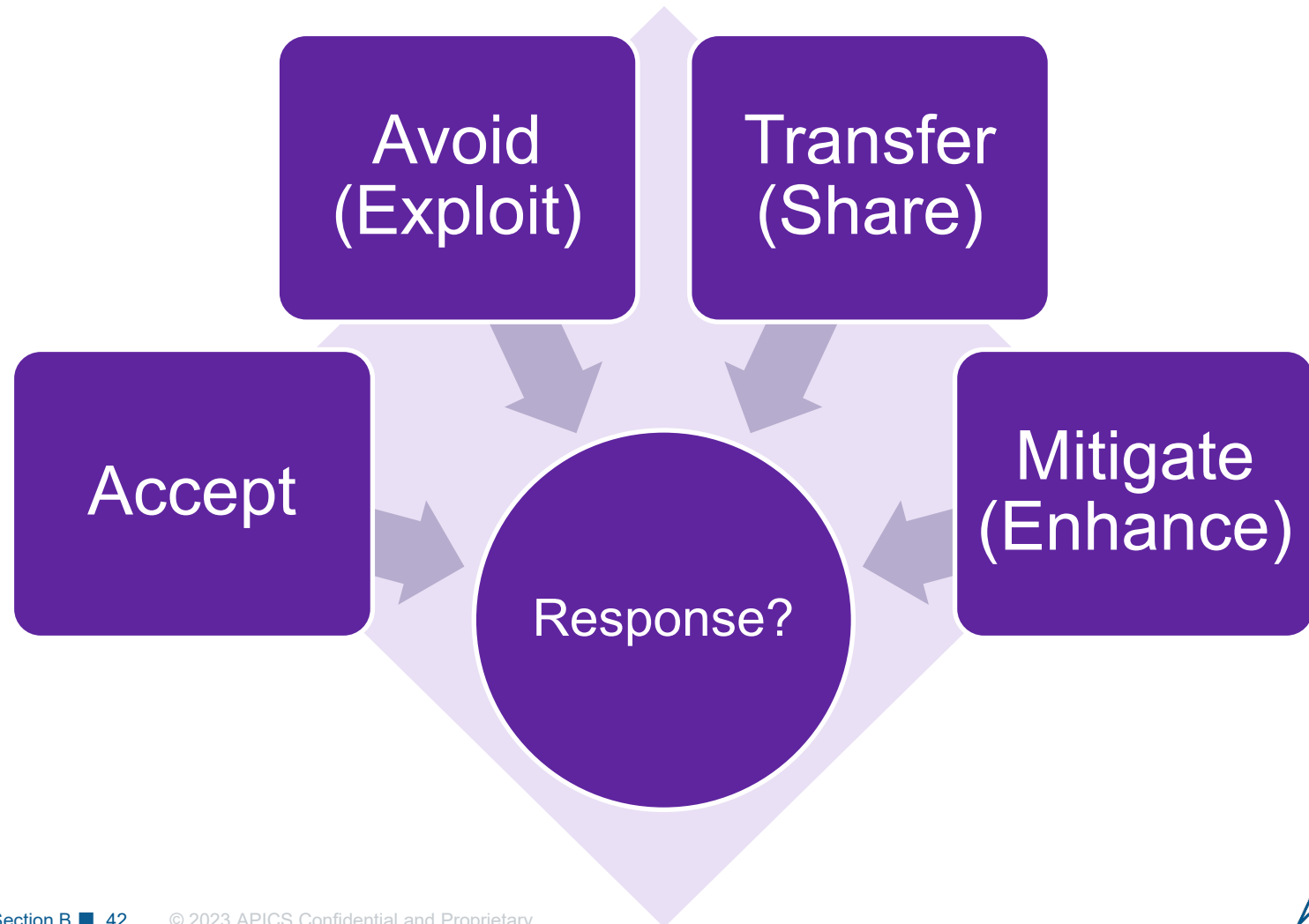
Probability and Impact Matrix

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

		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%

Topic 1: Logistics Risks and the Risk Management Process

Risk Responses



Topic 2: International Security Measures

International Organizations

International
Chamber of
Commerce

Incoterms®
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® 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

