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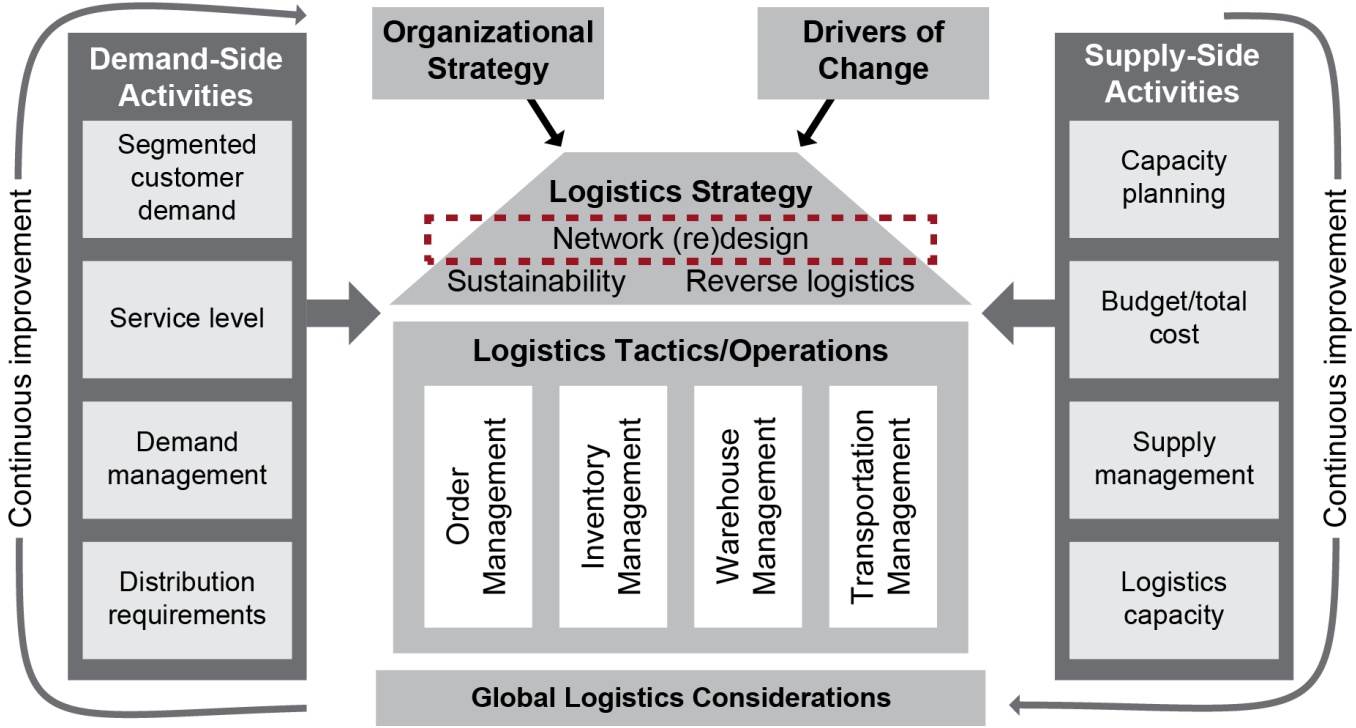
CERTIFIED IN LOGISTICS,
TRANSPORTATION AND DISTRIBUTION

MODULE 2:
LOGISTICS NETWORK DESIGN

APICS

ascm

Module 2 Overview



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TRANSPORTATION AND DISTRIBUTION

MODULE 2, SECTION A: FACILITIES PLANNING AND NETWORK DESIGN

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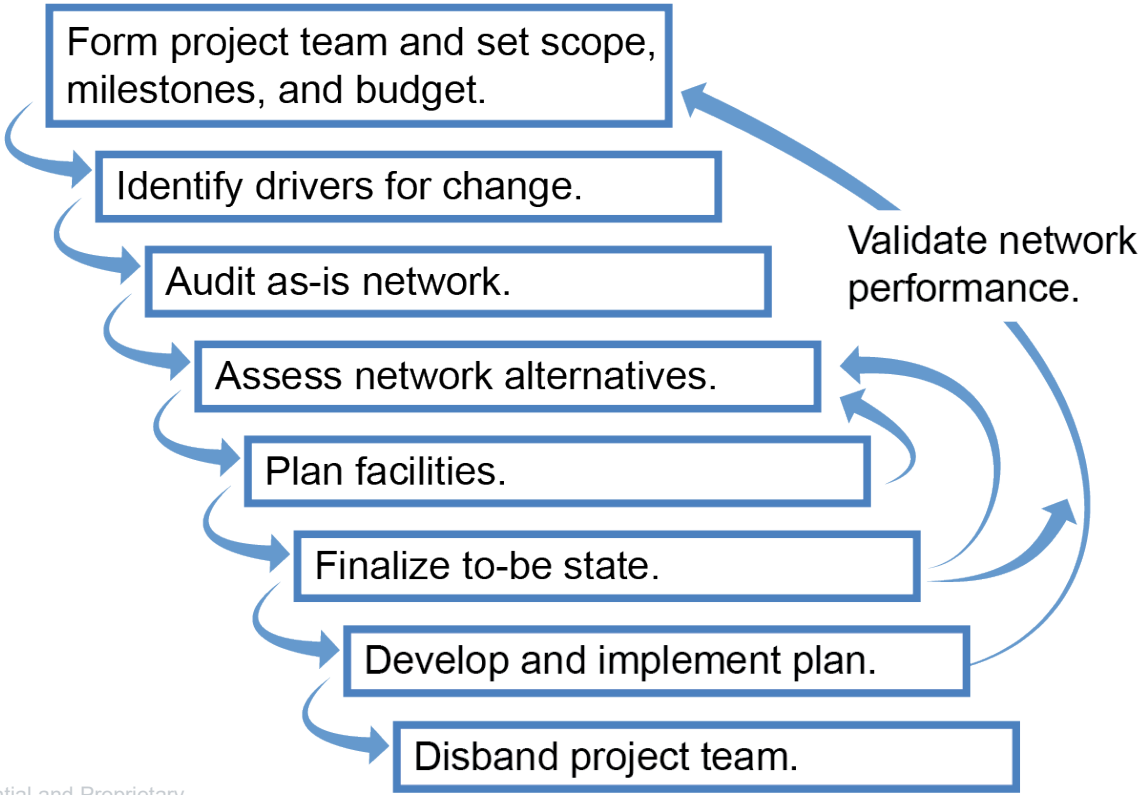
Design Process



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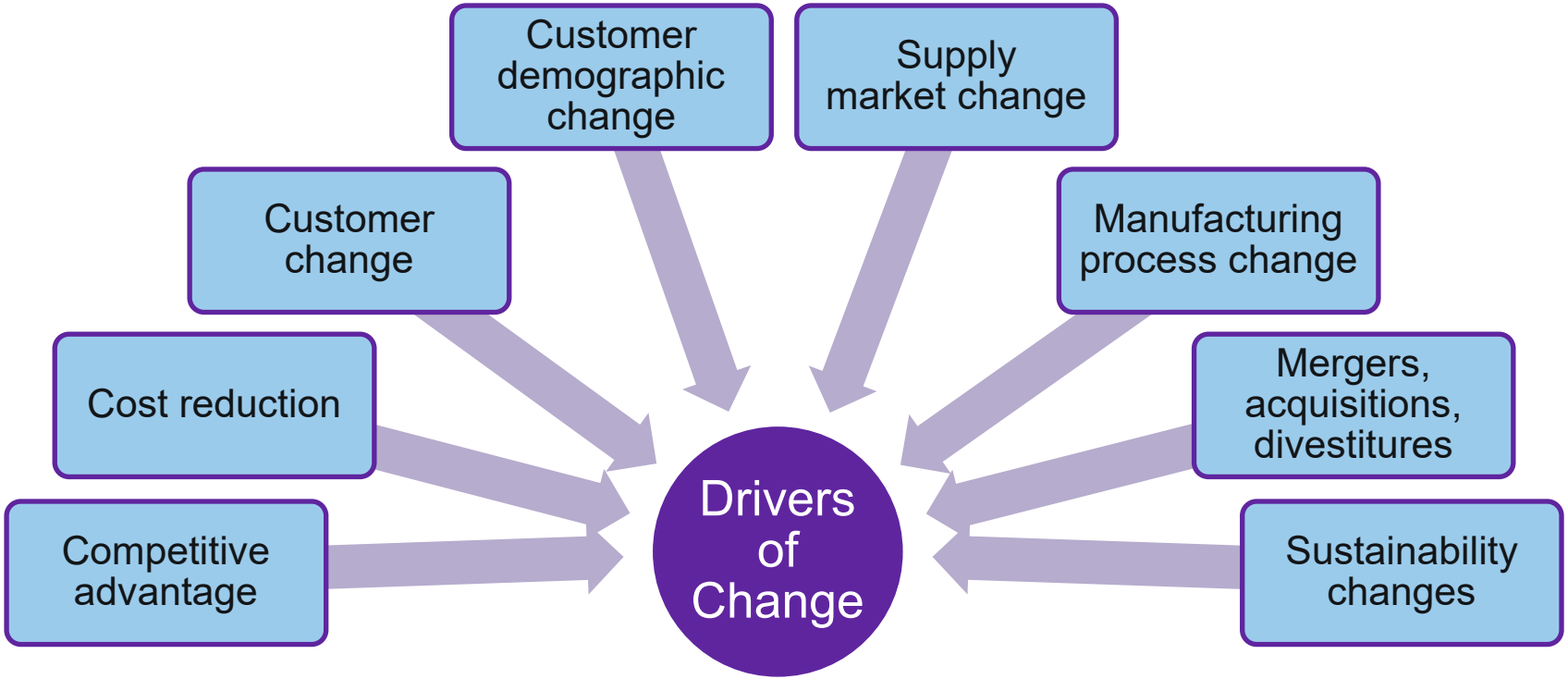
Common Drivers of Change



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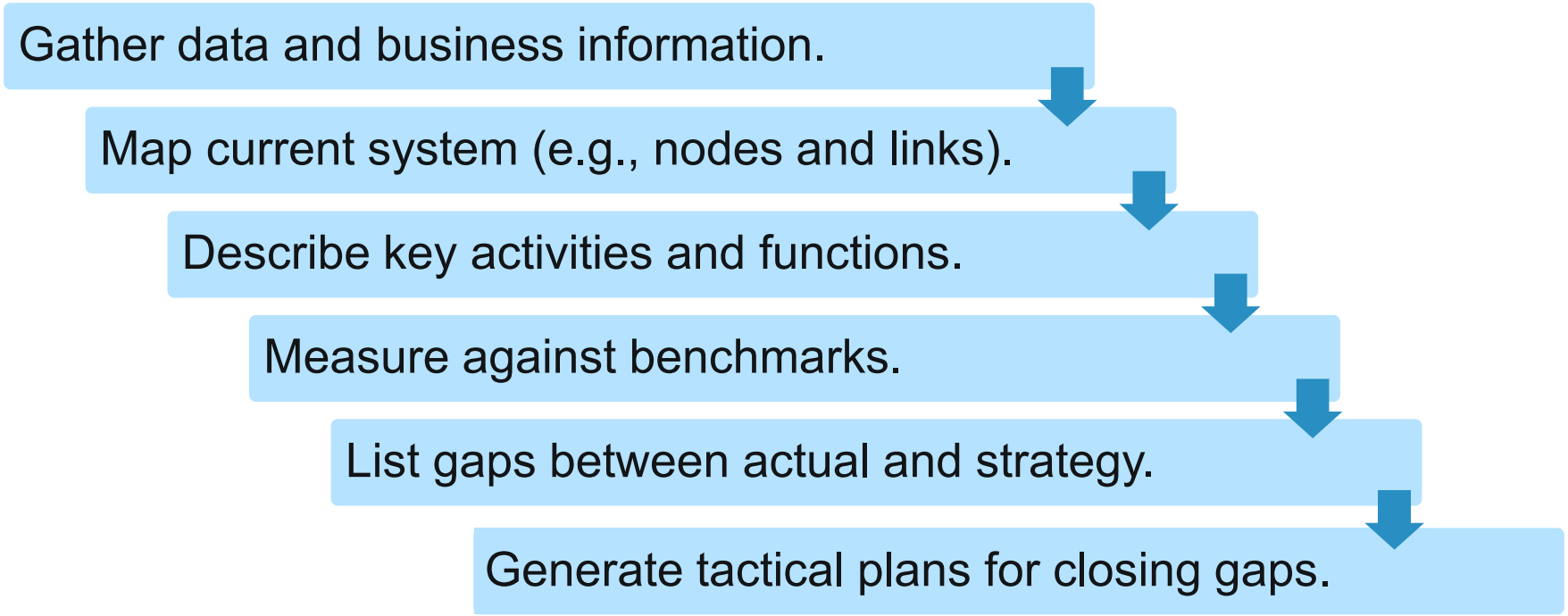
As-Is Audit Steps



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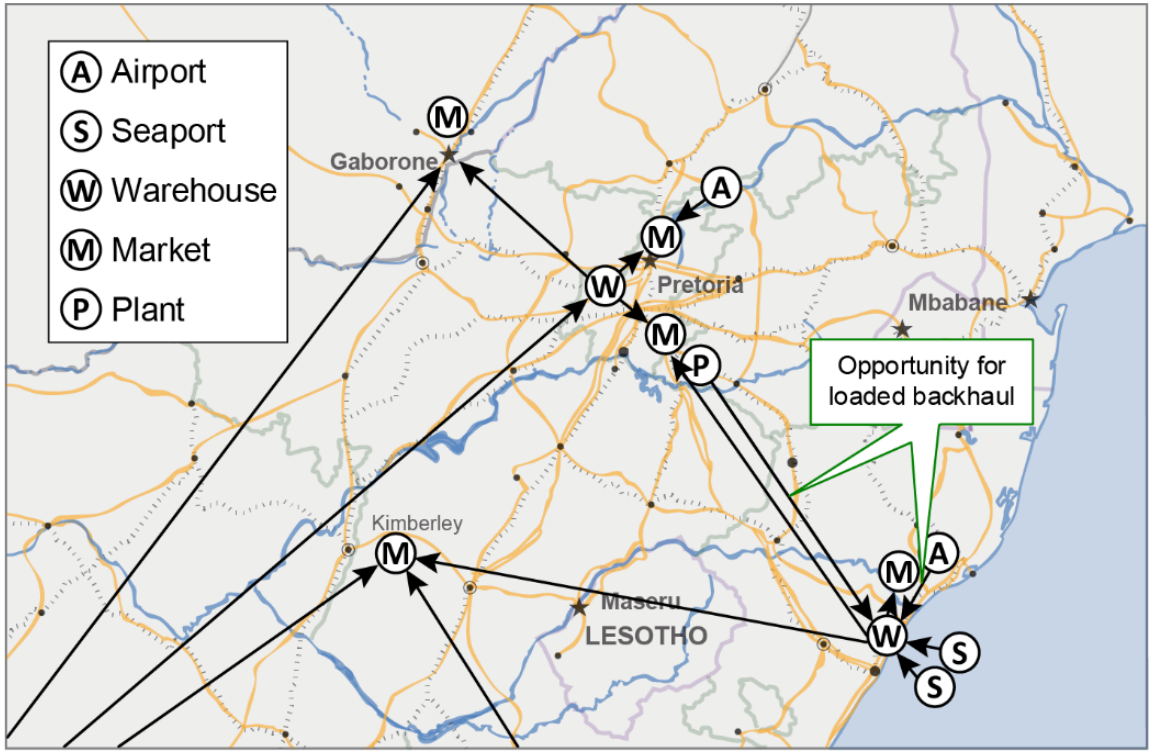
Sample Map of Network Nodes and Links



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Methods of Entry

Consider variables.

- 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

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Exporting and Indirect Exporting

Exporting	Indirect exporting
▪ Agent ▪ Distributor ▪ Marketing subsidiary ▪ Foreign sales corporation	▪ Export trading company (ETC) ▪ Export management company (EMC)

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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.

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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.

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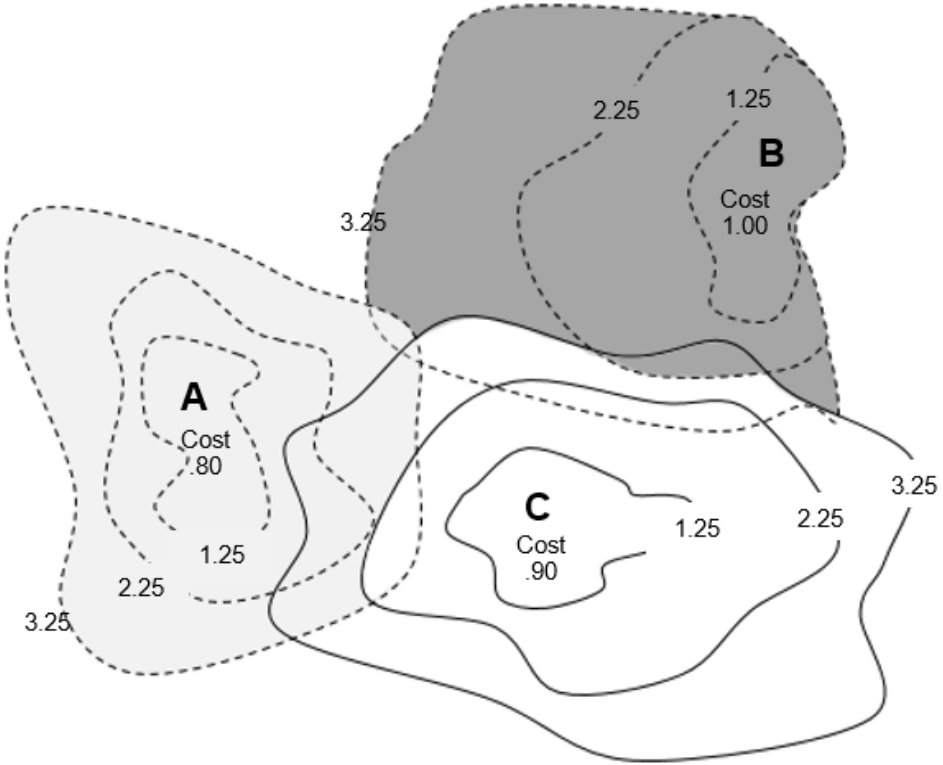
Economic Cost Map



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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):

- New Aggregate Safety Stock

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

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

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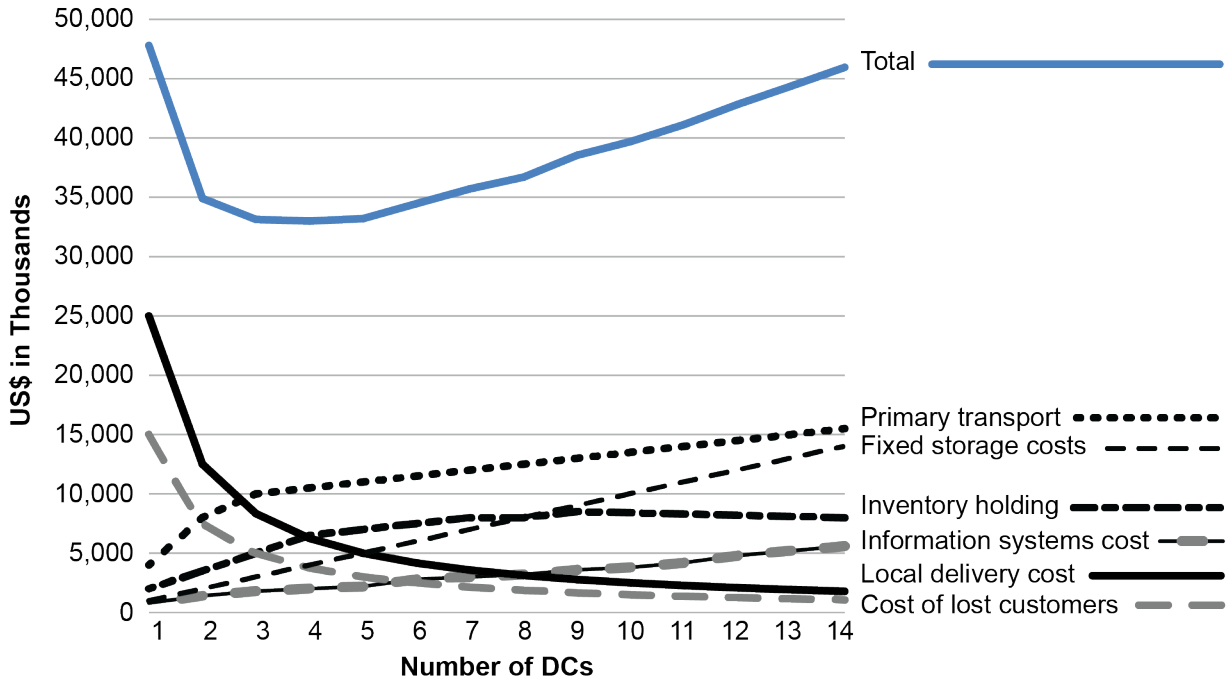
Total Cost Analysis for Number of DCs



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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

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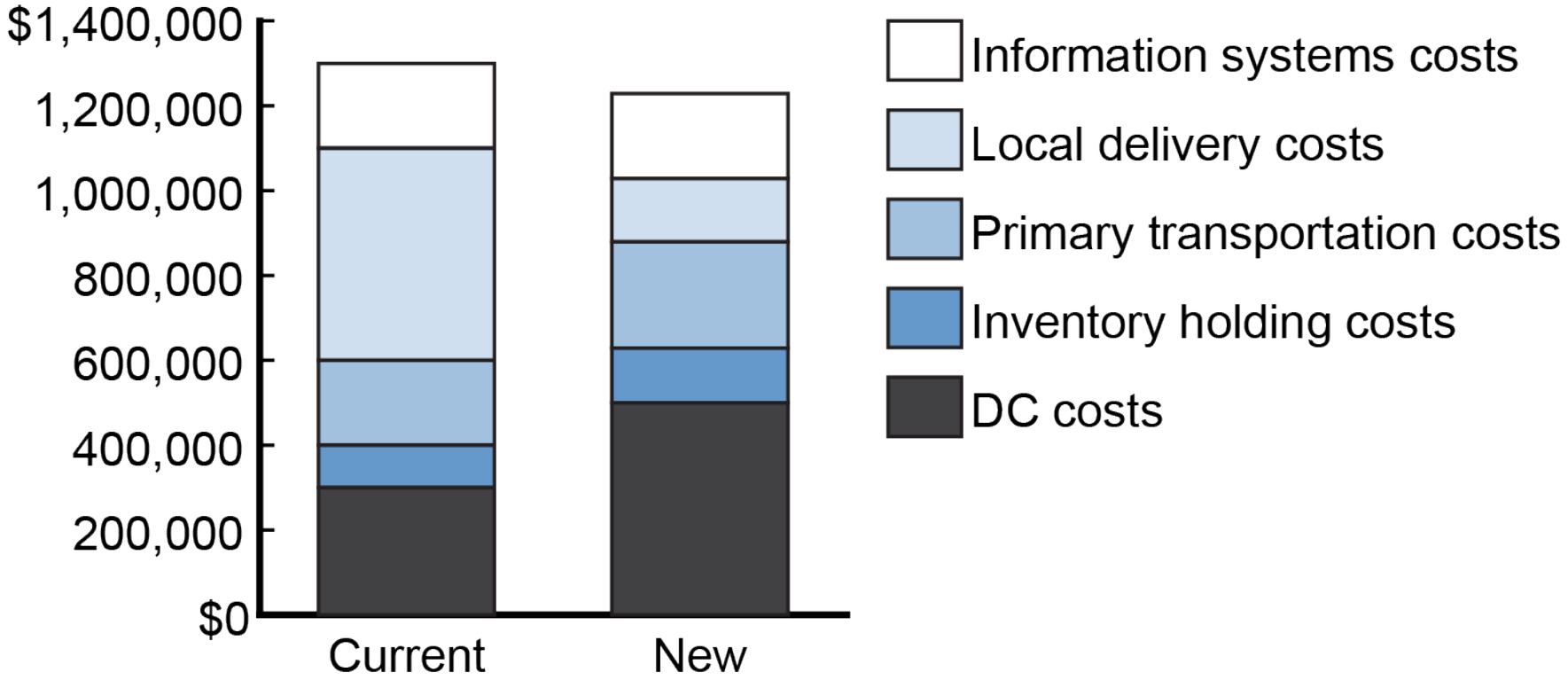
Tradeoff Analysis



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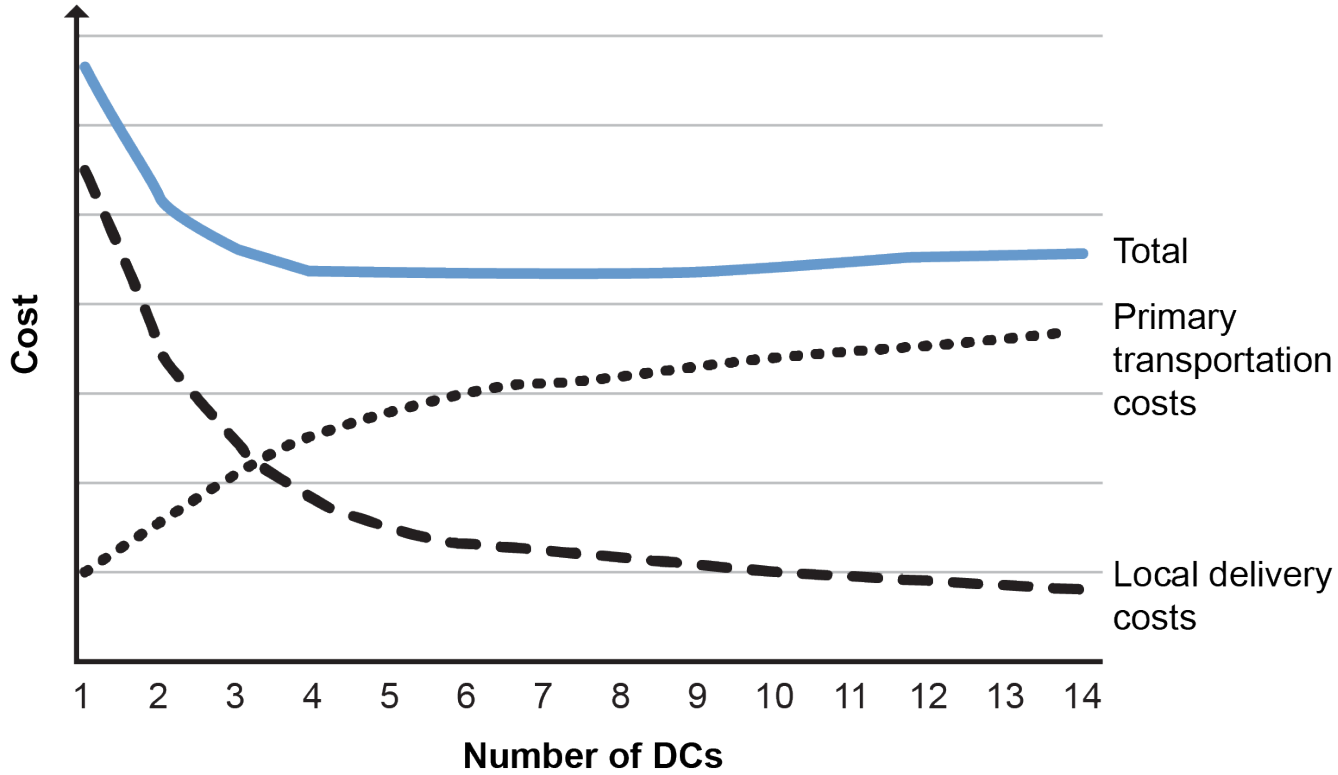
Tradeoffs



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Use Consolidation/Break-Bulk or Not?

- $\sum \frac{\text{TL Transport + TL Processing}}{\text{Average Number of TLs}}$

  + Average Shipment DC Cost + Average Shipment Local Delivery

$$\leq \sum \begin{array}{l} \text{Processing Cost of Average Shipment} \\ + \text{ Direct Freight Cost of Average Shipment} \end{array}$$

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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 =

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

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Deployment Considerations

Proximity	Labor rates	Quality
▪ Weight ▪ Fuel ▪ Average lead time ▪ Demographics	▪ Cost ▪ Labor market	▪ Work ethics ▪ Quality of life

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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.

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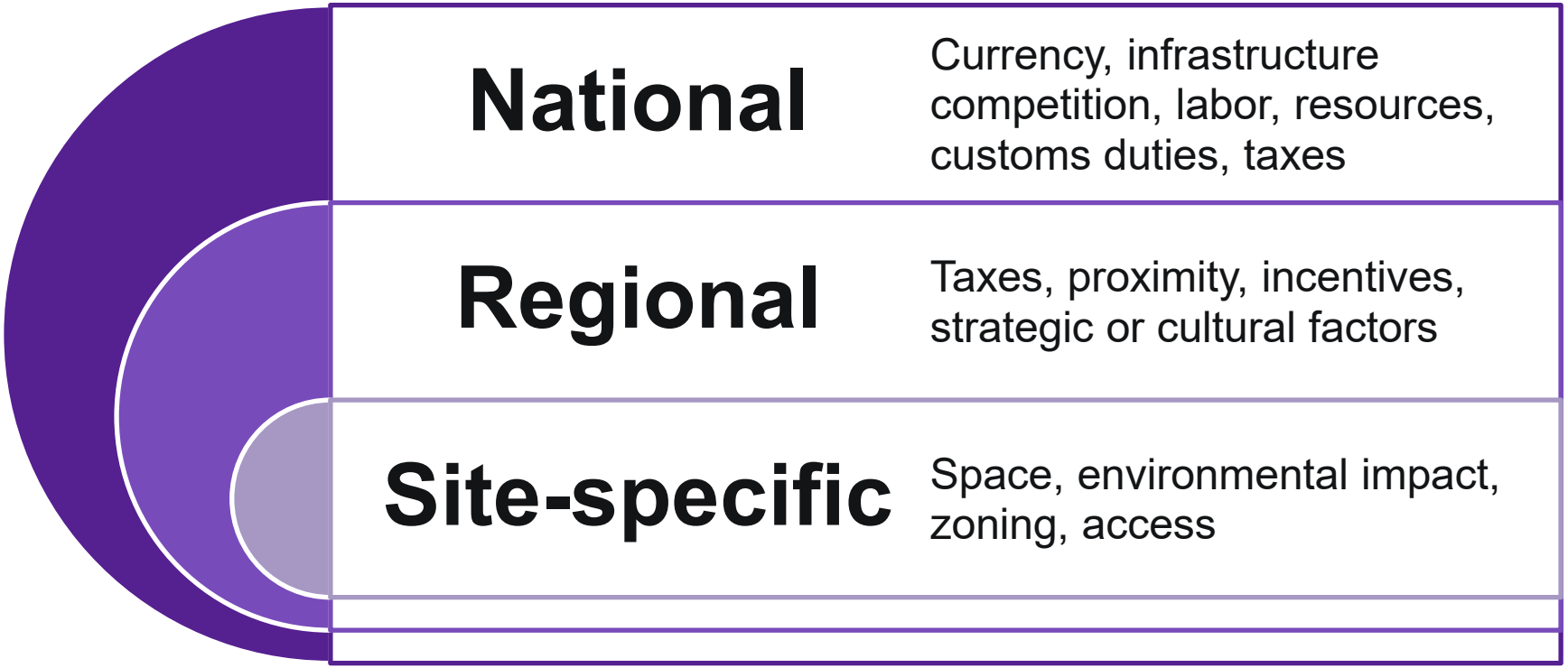
National, Regional, and Site-Specific Decision Factors



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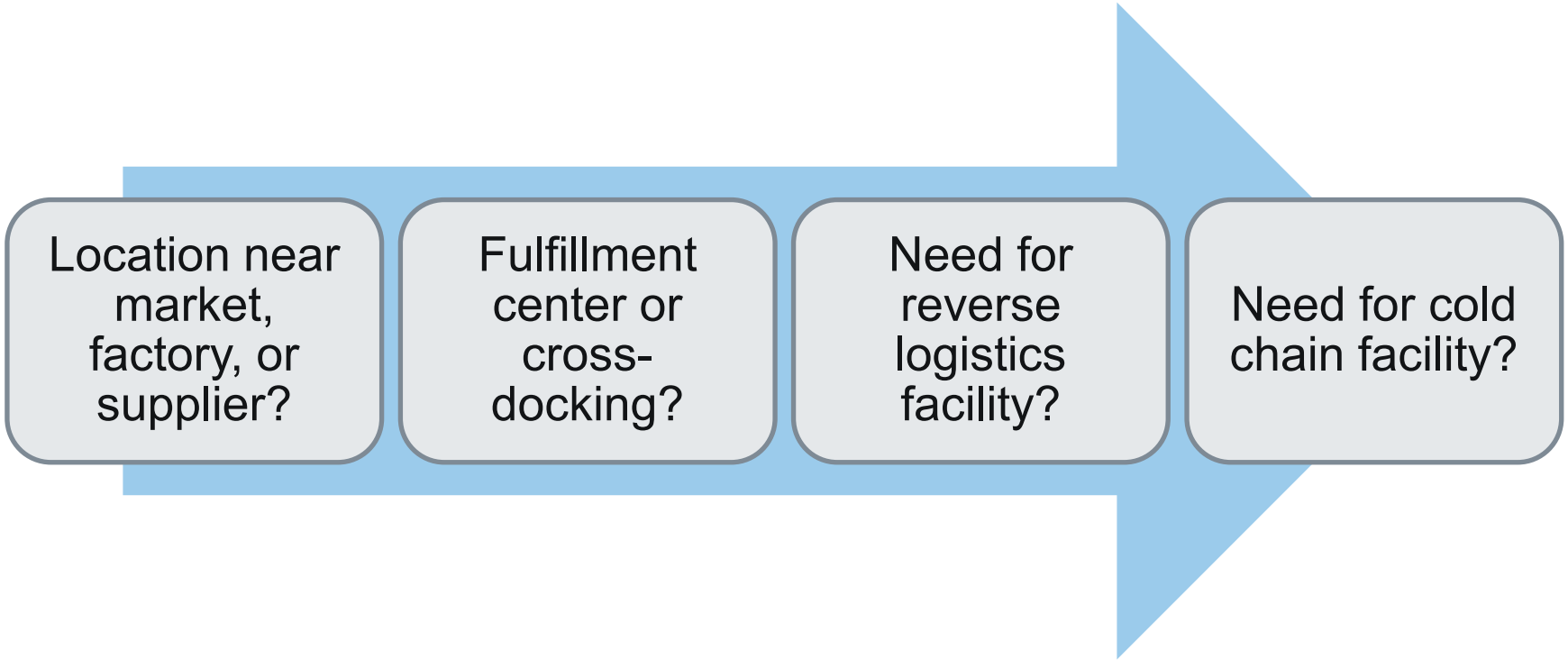
Determining Appropriate Facility Type



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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

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Cost-Volume Analysis

- Total Cost = Fixed Cost + (Variable Cost × Volume)

What is the crossover point?

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

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Cost-Volume Analysis Scenario

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

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

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

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

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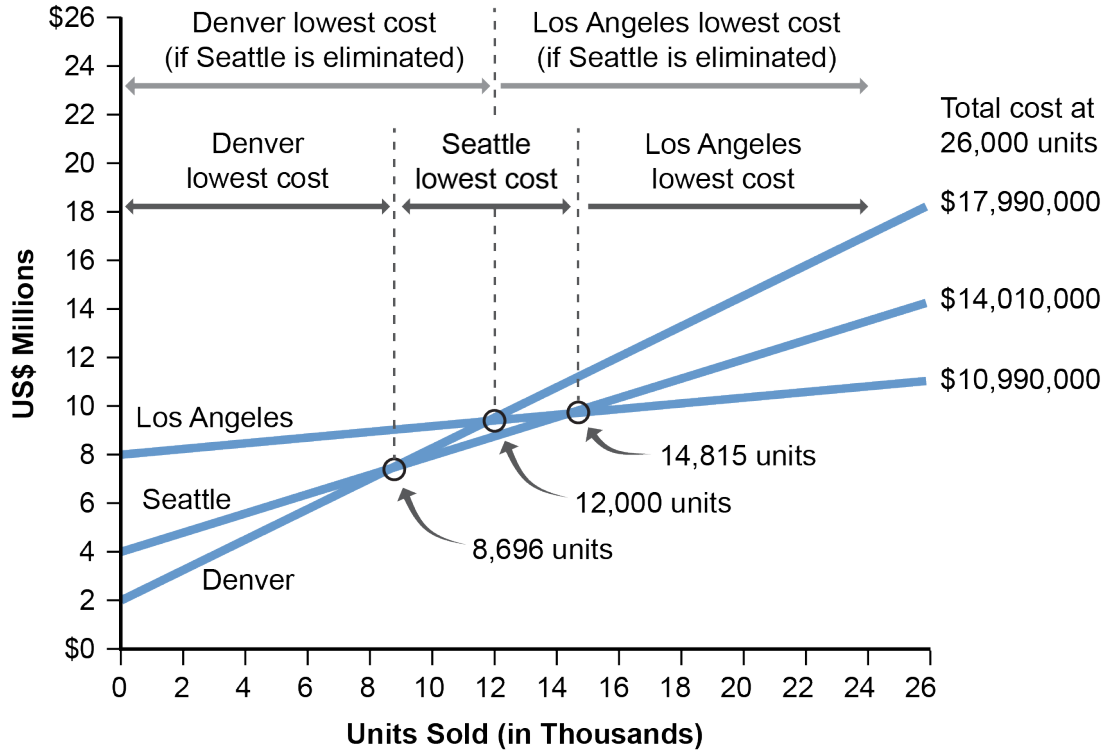
Cost-Volume Analysis Graph



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Other Modeling Methods

Weighted factor rating

- Qualitative and quantitative
- Priority based on weight
- Weight × rating
- Find finalists and use other tools

Center of gravity

- *x-y* map coordinates
- Sum of each (*x* coordinate × shipping volume) ÷ sum of all shipping volumes
- Repeat for *y* coordinates

Regression analysis

Independent variables predict dependent variable

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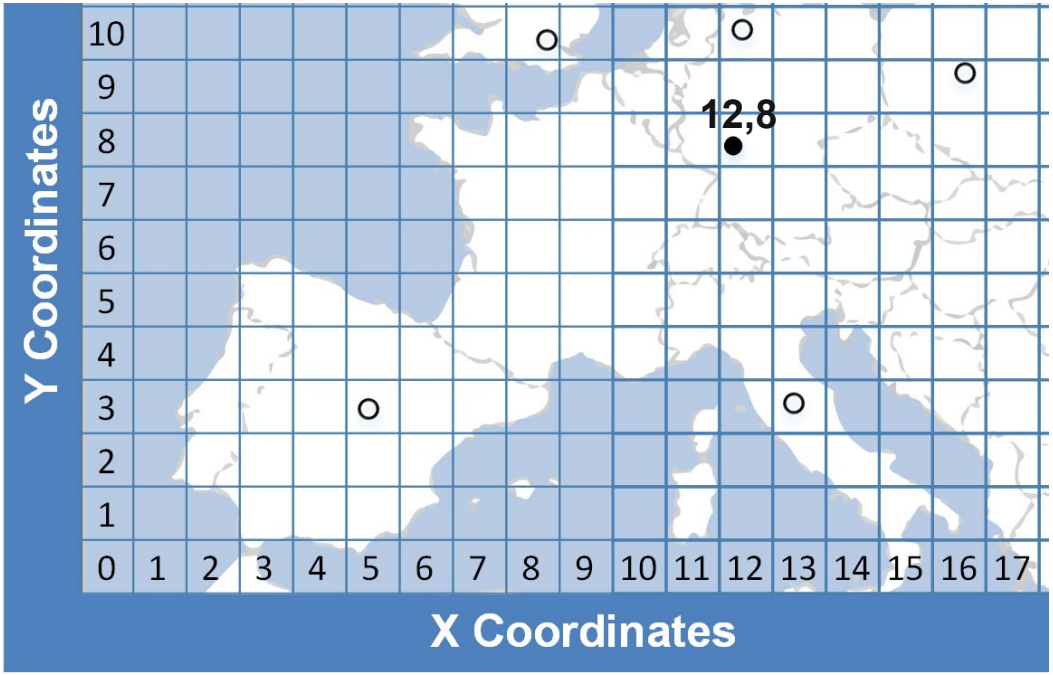
Center-of-Gravity Map



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

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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.

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Simulation

Sensitivity analysis	Scenario analysis	Monte Carlo simulation
One change	"What-if"	Min-max

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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?

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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

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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.

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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.

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Transportation and Warehousing Risks

Transportation	Warehousing
▪ Loss of goods ▪ Mode selection ▪ Carrier selection ▪ Transportation security	▪ Location selection ▪ Security checks and balances ▪ Physical barriers and security equipment

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Financial and Environmental Risks

Financial

- Organization and supplier solvency
- Red flags
  - Quality, long lead times
  - Few investments
  - Payment terms
  - Layoffs, turnover

Environmental

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

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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.

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Risk Management Process

1. Identify and document risks.
2. Categorize and prioritize risks.
3. Quantitatively analyze risk if desired.
   - EMV = Probability × 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.

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Probability and Impact Matrix

Risk Rating = Probability × 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%

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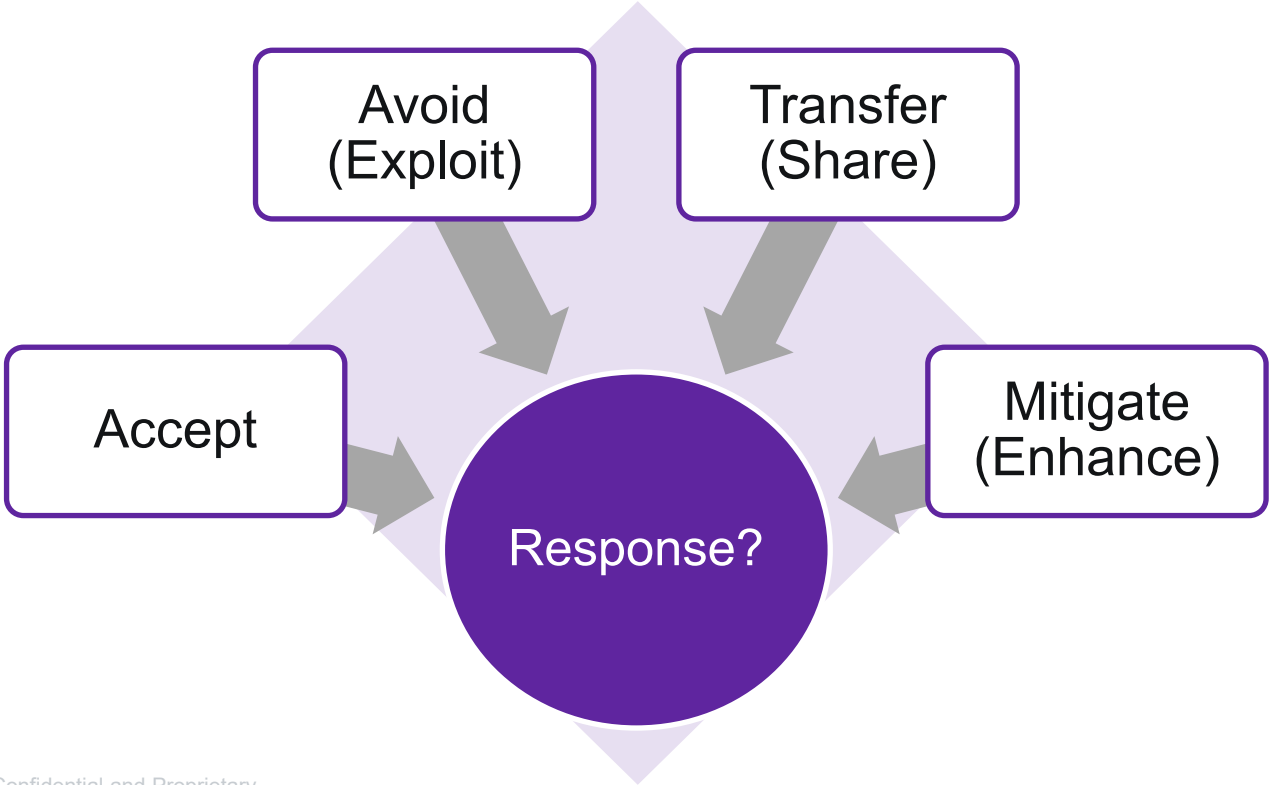
Risk Responses



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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)

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Border Security Partnerships

Authorized Economic Operator (AEO) program

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

EU

Customs-Trade Partnership Against Terrorism (C-TPAT)

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

U.S.

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Business Continuity Planning

Business continuity	Continuity Areas	Logistics' role
Ensures the organizational capability of continuing to deliver products or services at acceptable levels after disruptive incident.	▪ ISO 22301 ▪ Emergency roles ▪ Order for restoring services ▪ Business continuity insurance	▪ In-transit and DC inventory risk ▪ Emergency supplier replacement plans ▪ Logistics information systems restoration

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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

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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.

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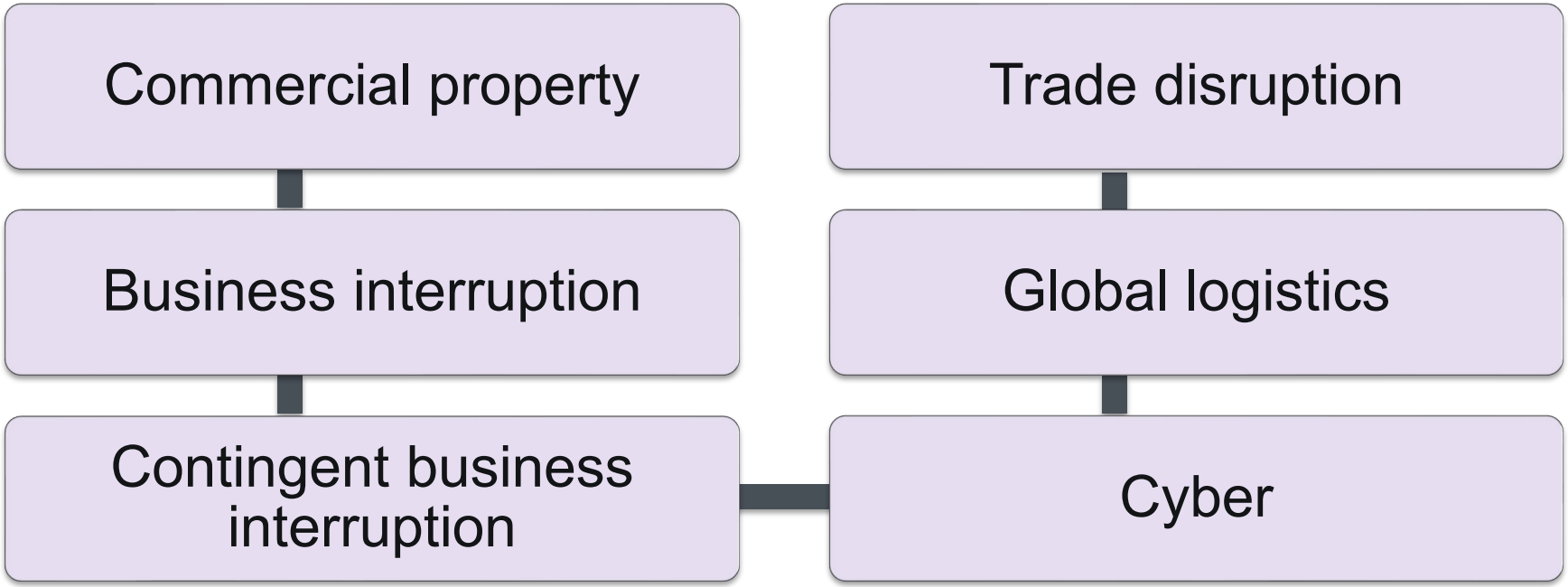
Types of Insurance for Logistics



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