M2D2 Freight Logistics Workshop

Welcome & Introduction

Michigan State University

Advancing Knowledge, Transforming Lives

MICHIGAN STATE UNIVERSITY

- More than 50,000 students each year have access to more than 200 undergraduate and graduate programs in 17 degree-granting colleges including the affiliated MSU College of Law.
- *U.S. News and World Report* recently ranked 24 different academic programs at MSU in the top 25 in the nation.
- MSU has a prolific record of generating national award winning students, with more Rhodes Scholars than any other Big Ten university in the last generation.
- The university is a national leader in sending students to study abroad, with a quarter of all students participating.
- Faculty and students have conducted groundbreaking research in top-rated programs like Bio-Physical Sciences, Packaging, and Supply Chain Management that ***advances knowledge and transforms lives***.

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The Eli Broad College of Business

Spartans Will. Make Business Happen.

- Home to nearly 5,000 undergraduate students and more than 700 graduate students each year.
- Consistently ranked among the top business schools by national recruiters and alumni.
- Houses six departments of study, eight undergraduate concentrations, nine Masters-level programs, five Ph.D. programs and a number of dynamic executive development programs.
- Broad College alumni hold prominent positions as executives and consultants for *Fortune 500* companies all over the world.
- Broad College aspires to be the leader in creating knowledge and developing transformational thinkers and doers who ***make business happen***.

Department of Supply Chain Management

Nationally Recognized

U.S.News & WORLD REPORT

Supply Chain/Logistics Programs

#1 Massachusetts Institute of Tech. (Sloan)
#2 Michigan State University (Broad)
#3 Arizona State University (Carey)
#4 Carnegie Mellon University (Tepper)
#5 Stanford

Supply Chain/Logistics Programs

#1 Michigan State University (Broad)
#2 Massachusetts Institute of Tech. (Sloan)
#3 Arizona State University (Carey)
#4 Ohio State University (Fisher)
#5 Penn State University (Smeal)

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BRIEF INTRODUCTIONS

- Name
- Title, position and/or organization
- Primary responsibilities
- What do you hope to learn from today's session?

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Program Objectives and Structure

OBJECTIVES

- Broaden understanding of today's commercial multi-modal supply chains, including the freight logistics system; and
- Encourage discussion of the benefits of becoming a transportation facilitator, including the role of safety, modal choice, etc.

STRUCTURE

- Supply chain management overview
- Role of supply chain decisions in firm strategy
- How do firms make supply chain decisions
- Industry applications/examples

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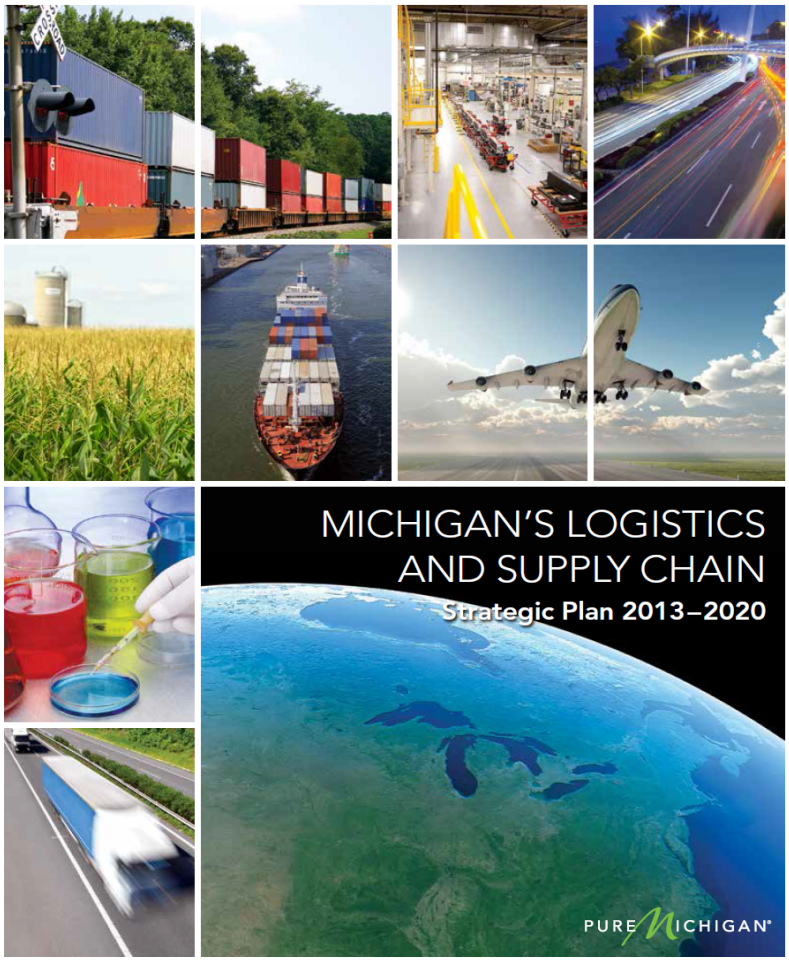
Michigan Economic Development Corporation

MICHIGAN ECONOMIC DEVELOPMENT CORPORATION
MichiganAdvantage.org



PURE MICHIGAN®
Michigan Economic Development Corporation

MDOT
Michigan Department of Transportation

Michigan Department of
AGRICULTURE
& Rural Development

Trade Facts

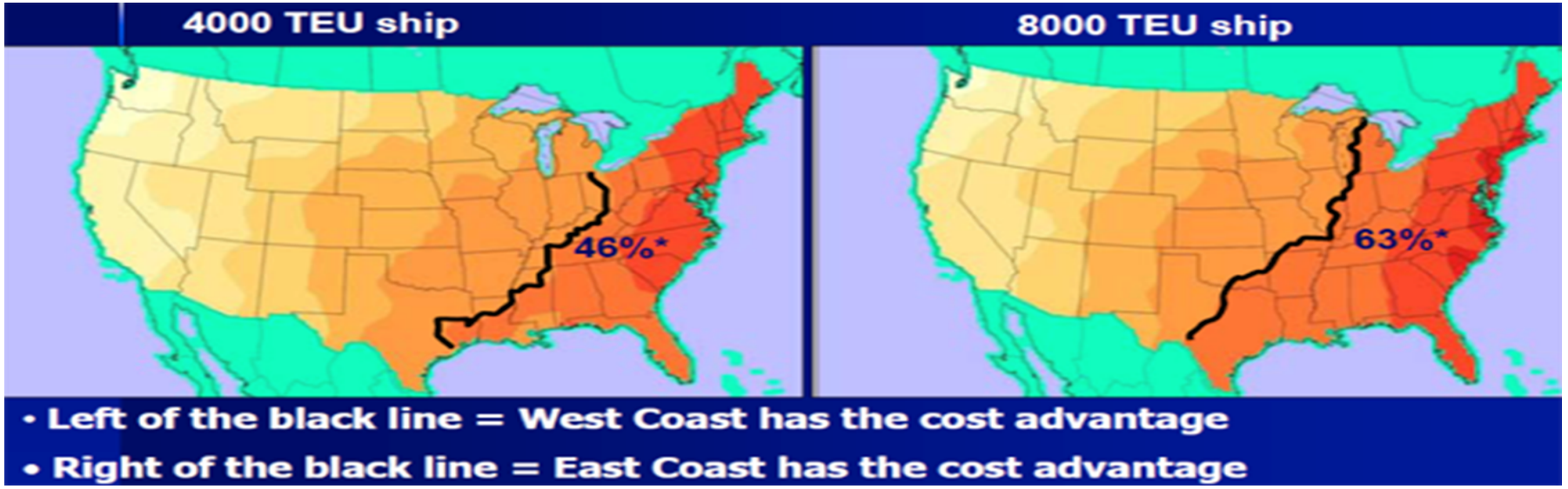
- US/Canadian trade totaled $616 billion in 2012. That value is greater than the GDP of all but the largest 20 countries in the world based on IMF's 2011 GDP ranking

Poland

Belgium

Argentina

Larger Ships, Changing Landscape



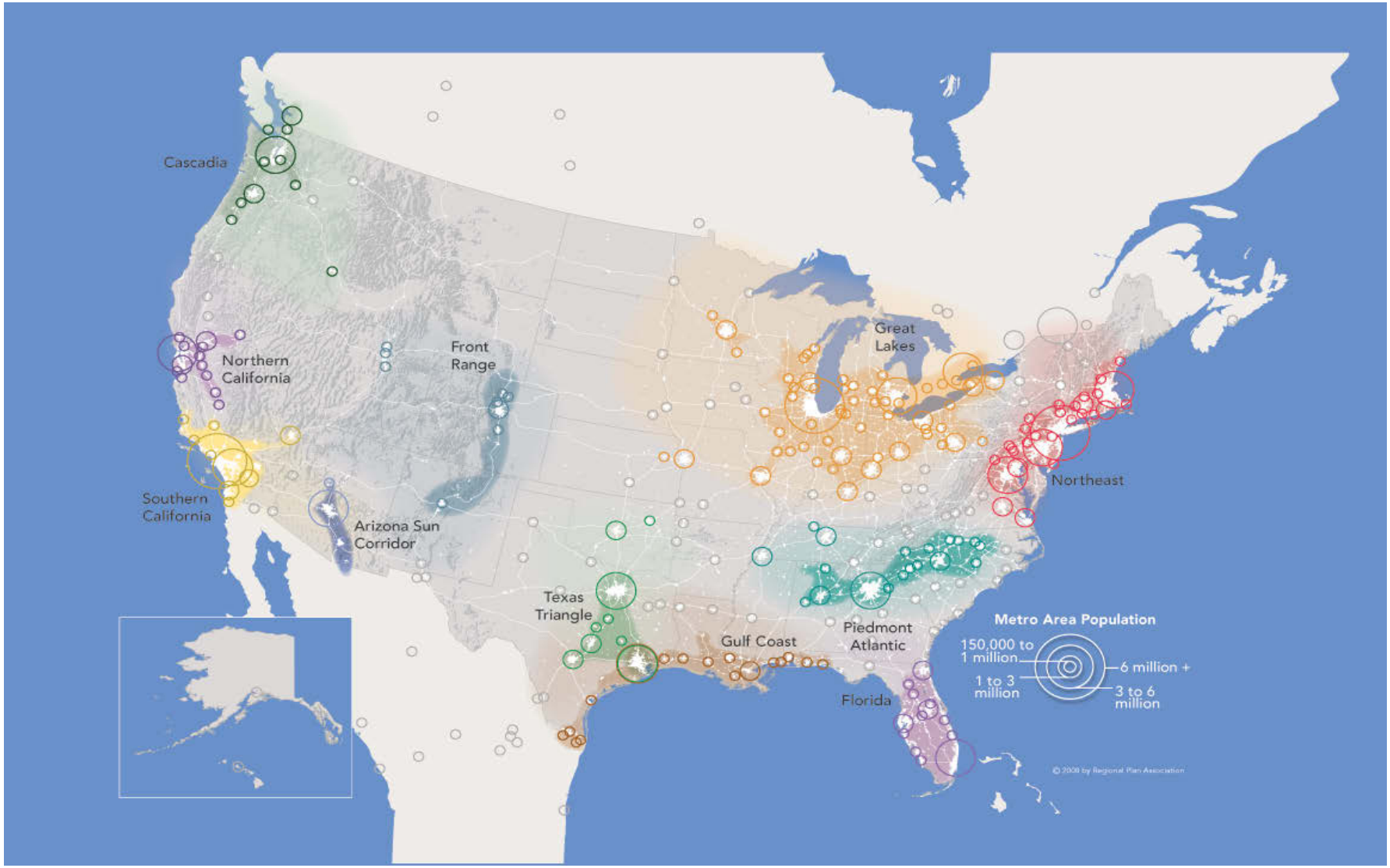
Strategy Attributes

- Business Focused
- Collaboration
- Leverage our Assets

Regional Strategy

- Michigan
- Great Lakes States
- Ontario
- Port Cities

Great Lakes MEGA Region



Multi-Modal

- Surface- Truck and Rail
- Air and Ship
- Intermodal Hubs
- International Border Crossings

Strategy Focus

- Lower Cost
- Reduce Time
- Remove Risk

Competitive Advantages

- Location
- Infrastructure
- Industry
- Supply Chain Capability

Strategy Actions

- Infrastructure
- Business Development

Michigan Logistics & Supply Chain Strategy

Multi-Modal

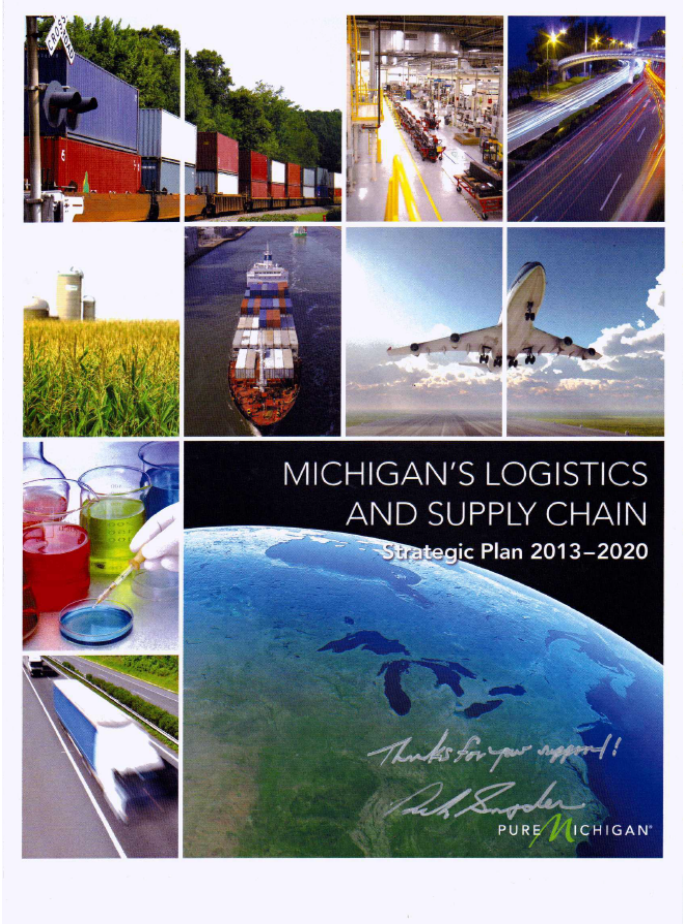
- Truck
- Rail
- Air
- Ship
- Intermodal Hubs
- International Boarder Crossing

Michigan Logistics & Supply Chain Strategy

2013 – 2020 Strategy Actions

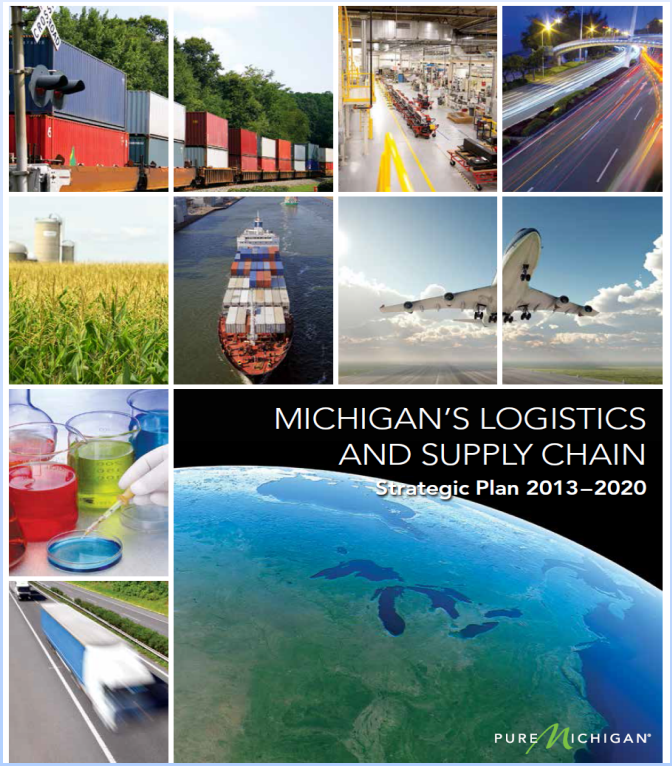
- Construct the New International Trade Crossing between Detroit and Windsor
- Develop, improve and connect intermodal freight hubs at strategic locations in Michigan
- Support the development and improvement of air cargo facilities at strategic airports
- Identify and deliver infrastructure enhancements that capitalize on and support the growth of core Michigan industries
- Identify and promote competitive transportation freight corridors
- Develop a targeted marketing campaign
- Promote and develop logistics and supply chain talent
- Identify niche market opportunities
- Identify and develop innovative supply chain solutions and tools
- Develop a permanent organizational structure to coordinate business, government and academia

Implementation Acceleration Launched October 1, 2013



Questions

- www.michiganbusiness.org/lsc



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Overview of Freight at FDOT

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Supply Chain Management Overview

What is Supply Chain Management

EXAMPLE DEFINITIONS

The design and management of seamless, value-added process across organizational boundaries to meet the real needs of the end customer

Institute for Supply Management

Managing supply and demand, sourcing raw materials and parts, manufacturing and assembly, warehousing and inventory tracking, order entry and order management, distribution across all channels, and delivery to the customer

The Supply Chain Council

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What is Supply Chain Management

Supply Chain Management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all Logistics Management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, Supply Chain Management integrates supply and demand management within and across companies.

Council of Supply Chain Management Professionals

The **On Demand Supply Chain** is a supply chain-integrated end-to-end across the entire operations of a company and with key partners, suppliers, and clients, from opportunity to cash -- that can sense and respond with flexibility and speed to any client demand, market opportunity, or change in the market place -- no matter how frequent or sudden.

IBM Corporation

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Common Definition Themes

- Focus on end-consumer
- Integration within the firm and across supply chain partners
- Requires execution of sequence of functions
- Operates within resource constraints

What is Supply Chain Management

- *Old paradigm* - Firm gained synergy as a vertically integrated organization encompassing the ownership and coordination of several supply chain activities.

- *New paradigm* - Firm in a supply chain focuses activities in its area of specialization and enters into **voluntary** and **trust-based relationships** with supplier and customer firms (need to consider internal and external relationships).

Cost Trade-Offs in Marketing and Logistics

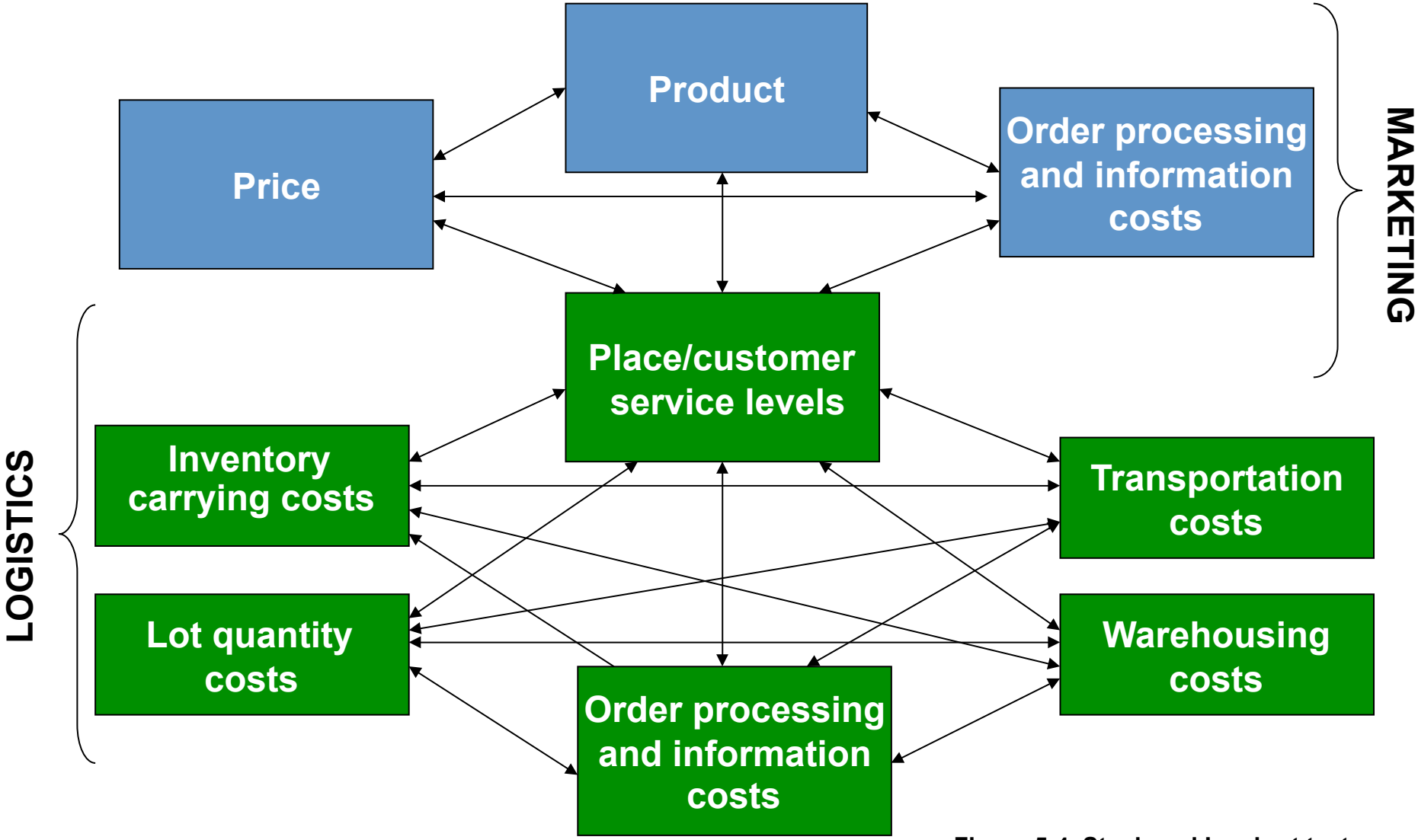

Figure 5-4, Stock and Lambert text

Where the Money Is

- Supply-chain generally accounts for between 60% and 90% of all company costs[1]
- A 2% improvement in process efficiency for supply-chain processes has 30,000% - 50,000% the impact of a 2% improvement in efficiency for… IT… HR… Finance[1]… Sales…
- Any surprise most Process Methodologies or techniques had their origin primarily in Supply-Chain Management?
  - Six-Sigma Lean BPR ERP ISO MRP-II TQM…

Fortune-10 Company Supply-Chain Cost % Total Costs[2]									
GM	Ford	Conoco	Wal-Mart	Chevron	IBM	Exxon	GE	Citi[1]	AIG[1]
94%	93%	90%	90%	88%	77%	75%	63%	0%	0%

1 Exclusive of Financial Services companies
2 Source: Hoovers 2006 Financial Data, Supply-Chain Council 2006 SCM Benchmark data on SCM cost for discrete & process industries

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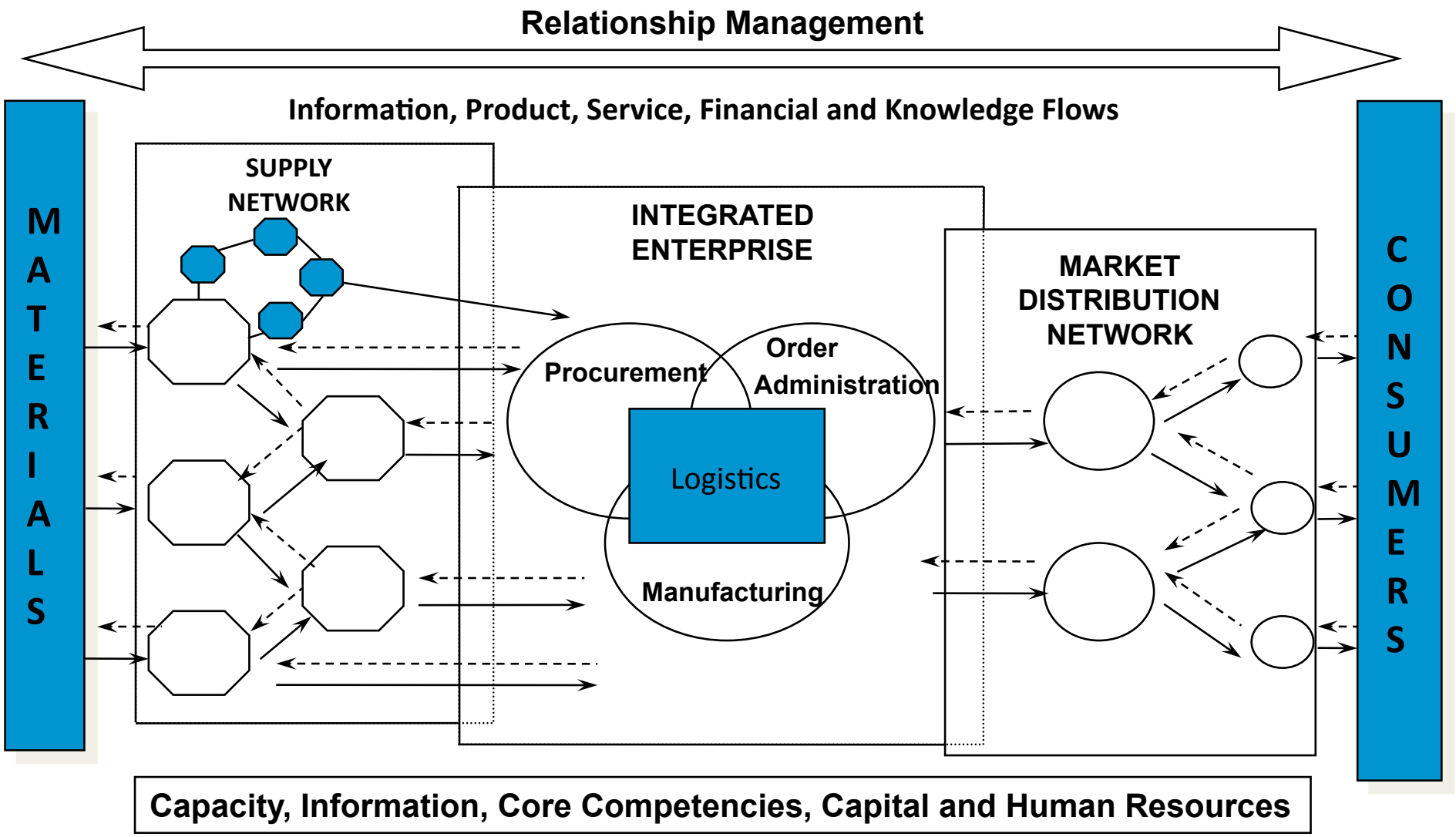
The Integrated Supply Chain Model



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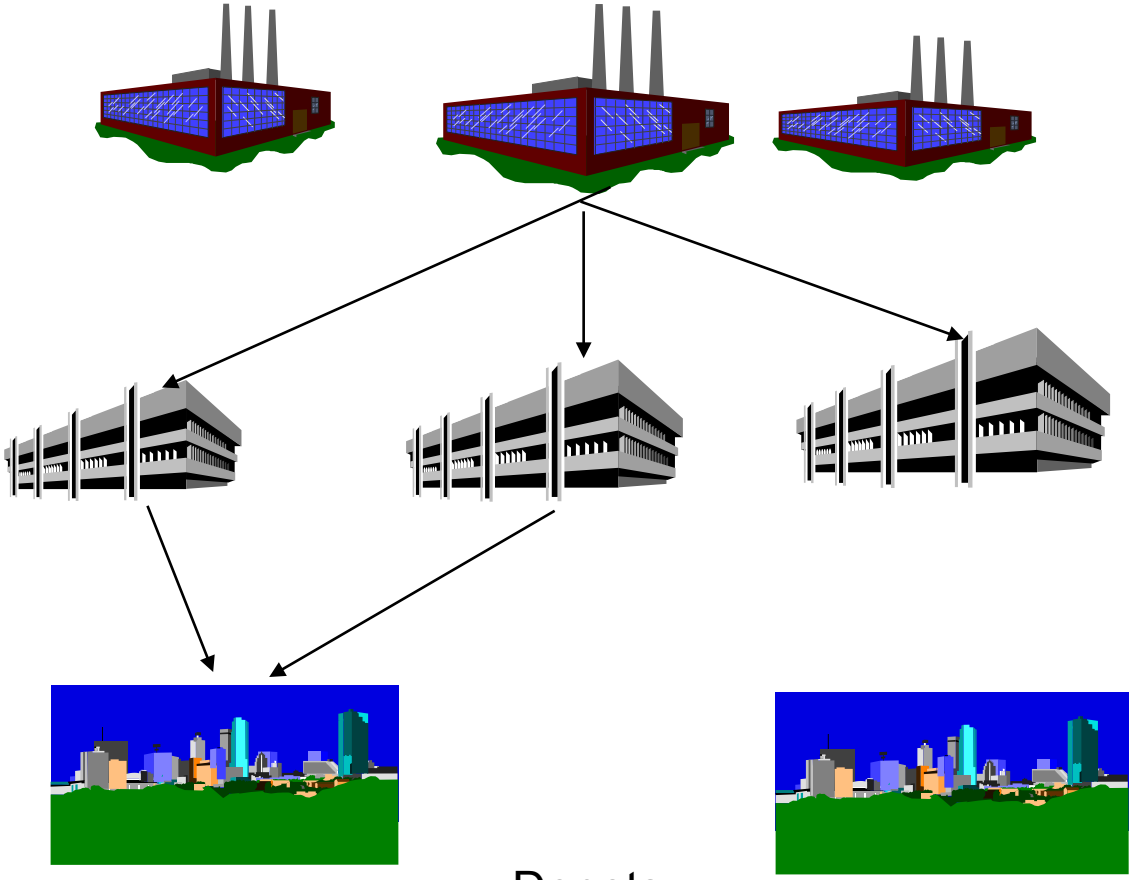
Gartner's Top 25 Supply Chains for 2014

Rank	Company	Comp. Score	Rank	Company	Comp. Score	Rank	Company	Comp. Score
1	Apple	8.85	9	Colgate-Palmolive	4.22	17	Starbucks	3.06
2	McDonald's	6.25	10	Coca-Cola	4.03	18	3M	3.05
3	Amazon.com	6.08	11	Inditex	3.99	19	Qualcomm	2.95
4	Unilever	5.32	12	Nike	3.89	20	Seagate Technology	2.75
5	Procter & Gamble	5.20	13	H&M	3.83	21	Kimberly-Clark	2.65
6	Samsung Electronics	5.13	14	Wal-Mart	3.52	22	Johnson & Johnson	2.65
7	Cisco Systems	4.57	15	Pepsico	3.37	23	Caterpillar	2.43
8	Intel	4.51	16	Lenovo	3.14	24	Cummins	2.34
						25	Nestle	2.30

Source: http://www.gartner.com

Total Cost Analysis Approach



Depots

Expense Components

Sourcing +

Production +

Handling +

Inbound Transport +

DC Handling +

Inventory +

Customer Transport

Total Cost

Returns

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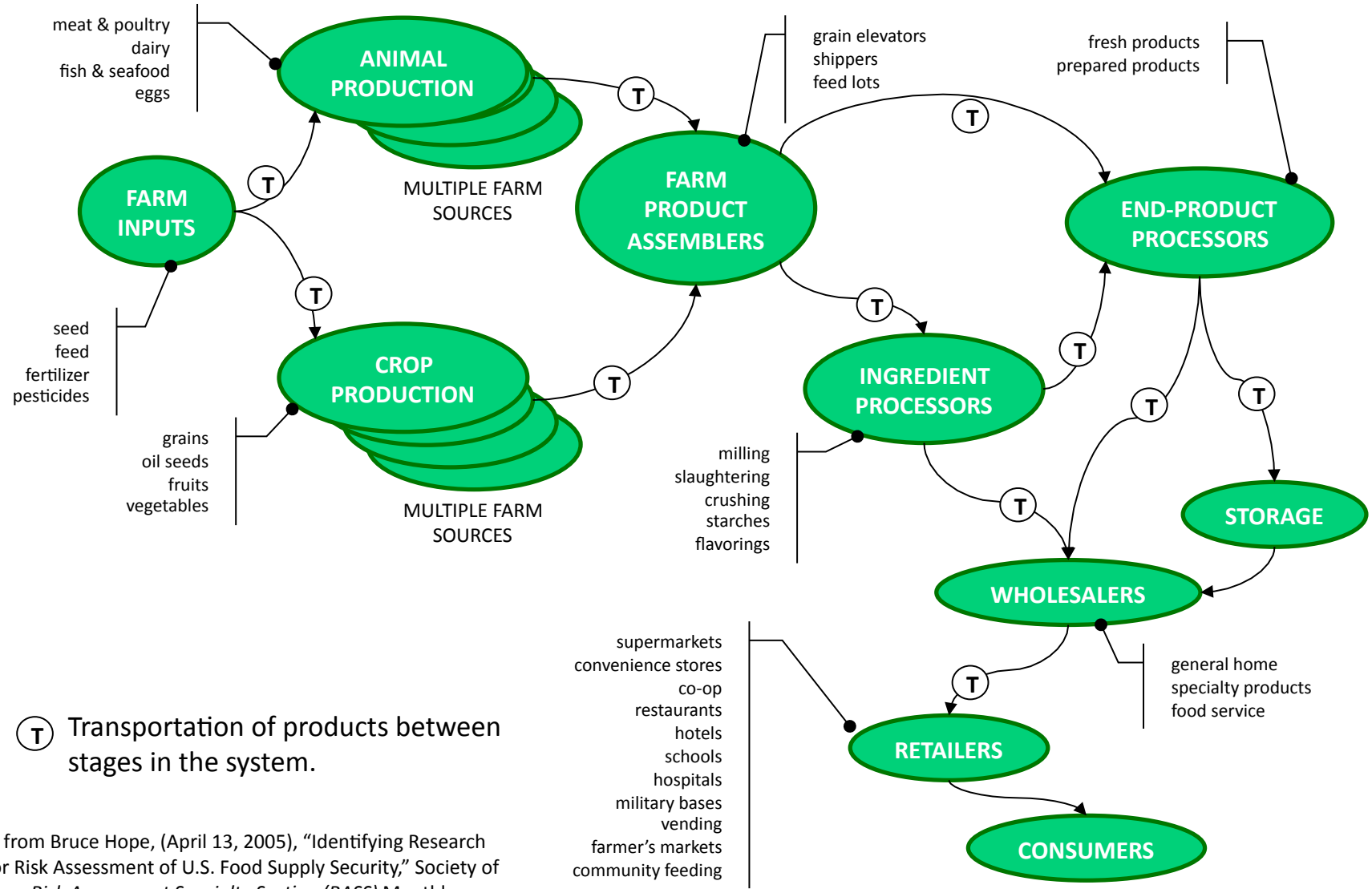
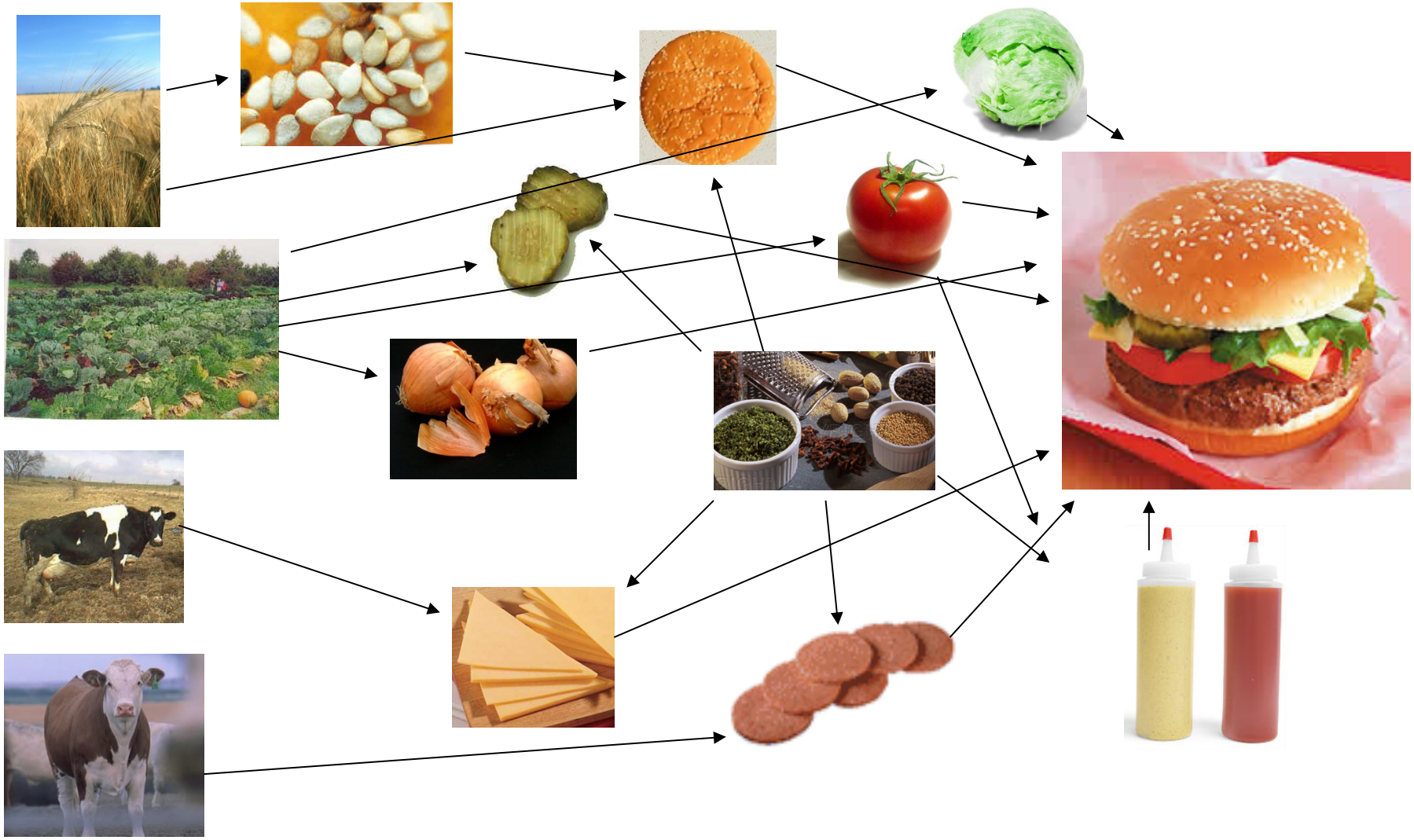
Food System Supply Chain



T Transportation of products between stages in the system.

Adapted from Bruce Hope, (April 13, 2005), "Identifying Research Needs for Risk Assessment of U.S. Food Supply Security," Society of Toxicology - *Risk Assessment Specialty Section (RASS)* Monthly Teleconference.

Food System Supply Chain



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Food System Supply Chain Complexity

One Burger Contains…

baking soda
wheat gluten
calcium propionate
enzymes
bleached wheat flour
mono- and diglycerides
malted barley flour
diacetyl tartaric acid esters
thiamine
ethanol
riboflavin
sorbitol
Niacin
polysorbate 20
folic acid
potassium propionate
reduced iron
sodium stearoyl lactylate
water
corn starch
corn syrup
ammonium chloride
sesame seeds
ammonium sulfate
soybean oil
calcium peroxide
yeast
ascorbic acid
salt
azodicarbonamide
calcium sulfate
calcium carbonate
calcium silicate
soy flour

lettuce

dehydrated onions

Grill Seasoning
Salt
Pepper
cottonseed oil
soybean oil

Milk
milkfat
Water
cream
sodium citrate
salt
sodium phosphate
sorbic acid
artificial color
cheese culture
acetic acid
soy lecithin
Enzymes
starch

Special Sauce
Soybean oil
pickles
distilled vinegar
water
egg yolks
HF corn syrup
sugar
onion powder
corn syrup
spice
spice extractives
salt
xanthan gum
mustard flour
prop. glycol alginate
sodium benzoate
potassium sorbate
mustard bran
garlic powder
hydrolyzed proteins
caramel color
paprika
Turmeric
calcium disodium
EDTA

USDA inspected beef

Cucumbers
water
Vinegar
Salt
calcium chloride
Alum
natural flavorings
polysorbate 80
turmeric

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Supply Chain Costs

- Range from 20-60 percent of revenue
- Majority of firms in range of 20 percent
- Includes
  - Procurement
  - Logistics
  - Planning
- Sometimes includes
  - Manufacturing

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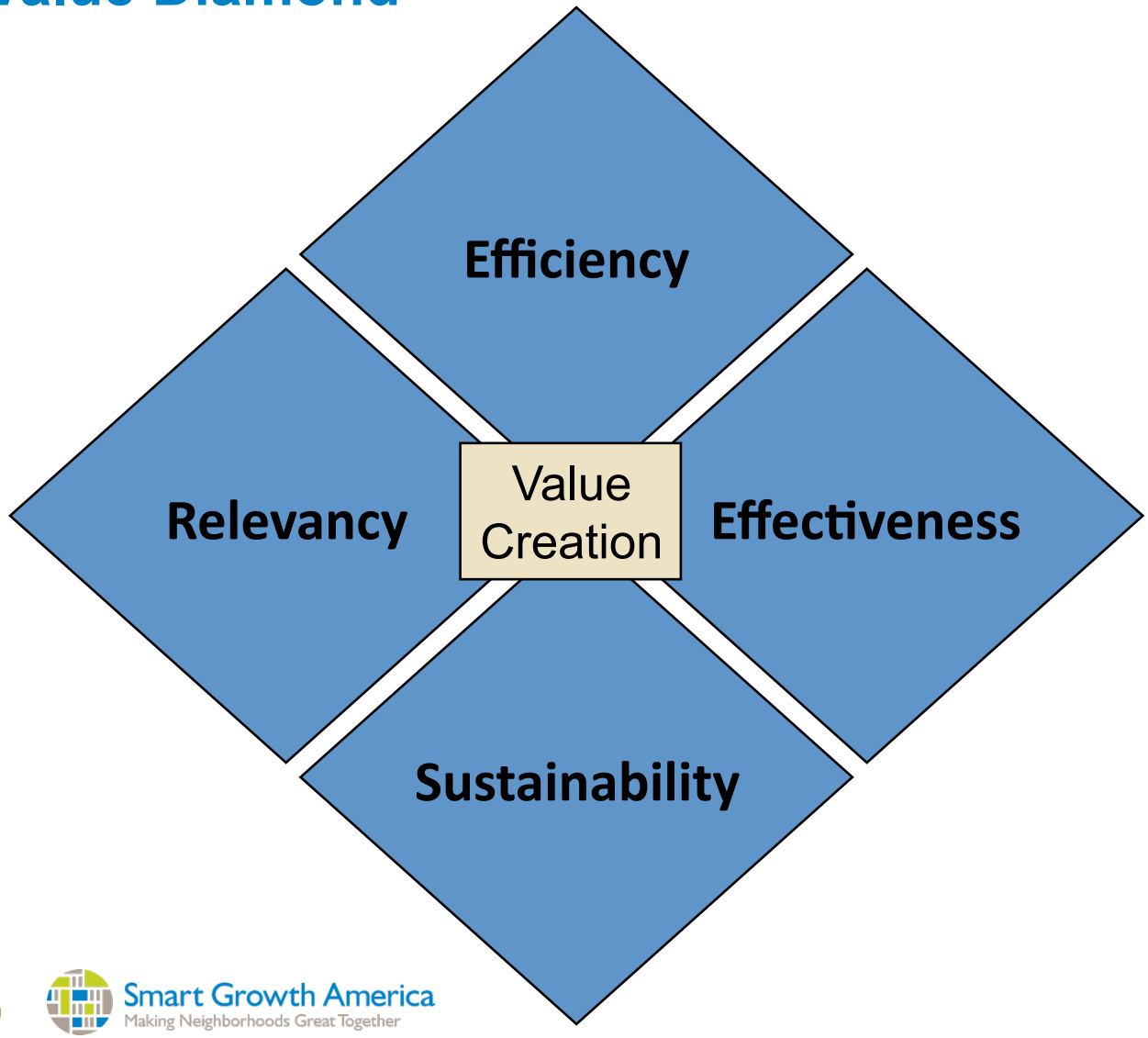
Supply Chain Value Adds

- Reduced operating cost
- Increased revenue
  - Fill rate
  - Extended offerings
    - Location
    - Mix
  - Product/Service/Solution
  - Customization
  - New product introduction
- Asset utilization
  - Facilities
  - Production
  - Transportation

How Does Supply Chain Create Value

EERS Value Diamond



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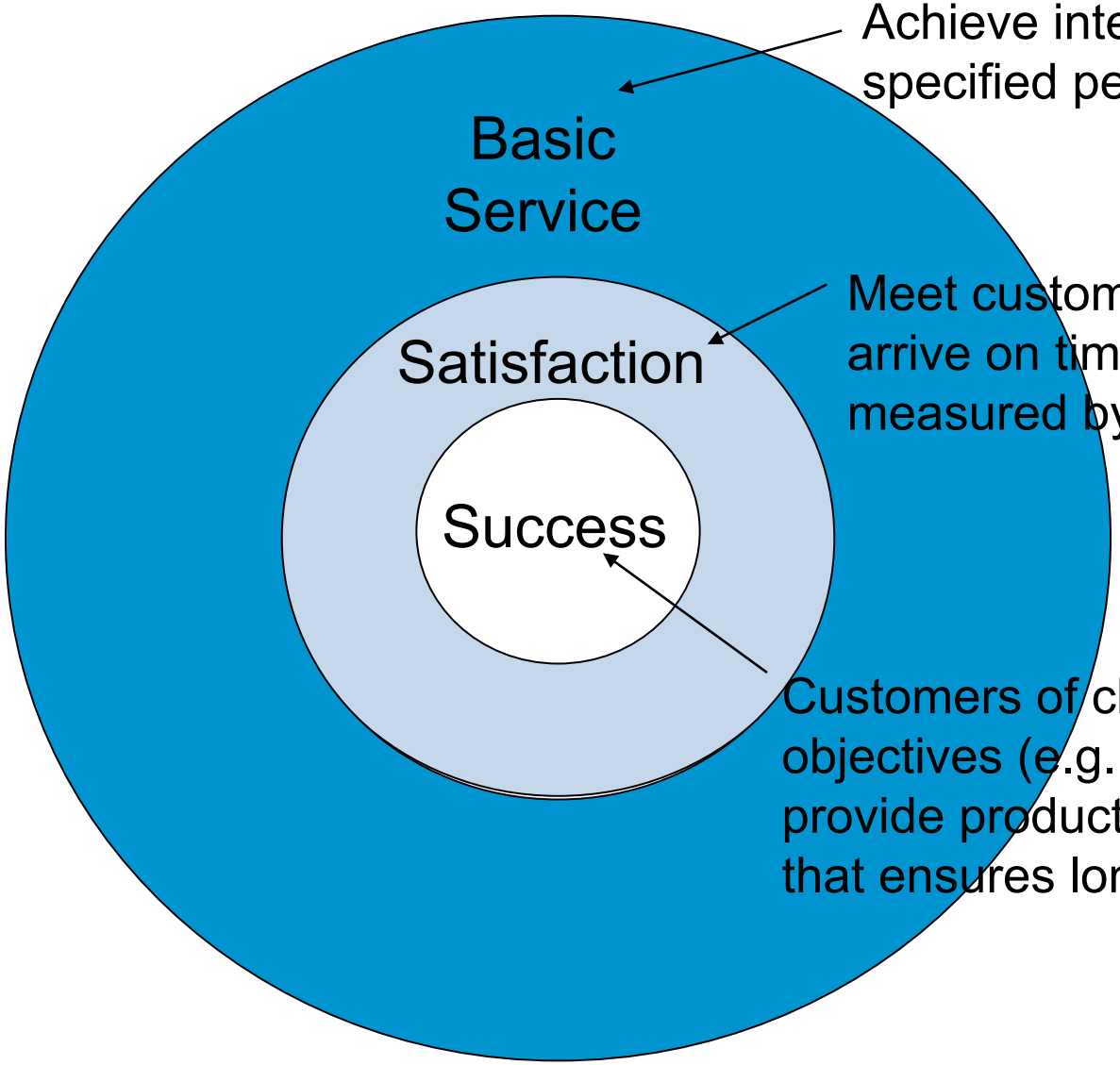
What are the Key Drivers of Success

- Customer service, satisfaction and success
- Segmental supply chains
- Minimize landed cost
- Asset utilization

Three Levels of Customer Focus



Achieve internal standards (e.g., specified performance cycle of fill rate)

Meet customer expectations (e.g., arrive on time with right product as measured by the customer)

Customers of choice achieve their objectives (e.g., logistics operation can provide product and service in a manner that ensures long term customer viability)

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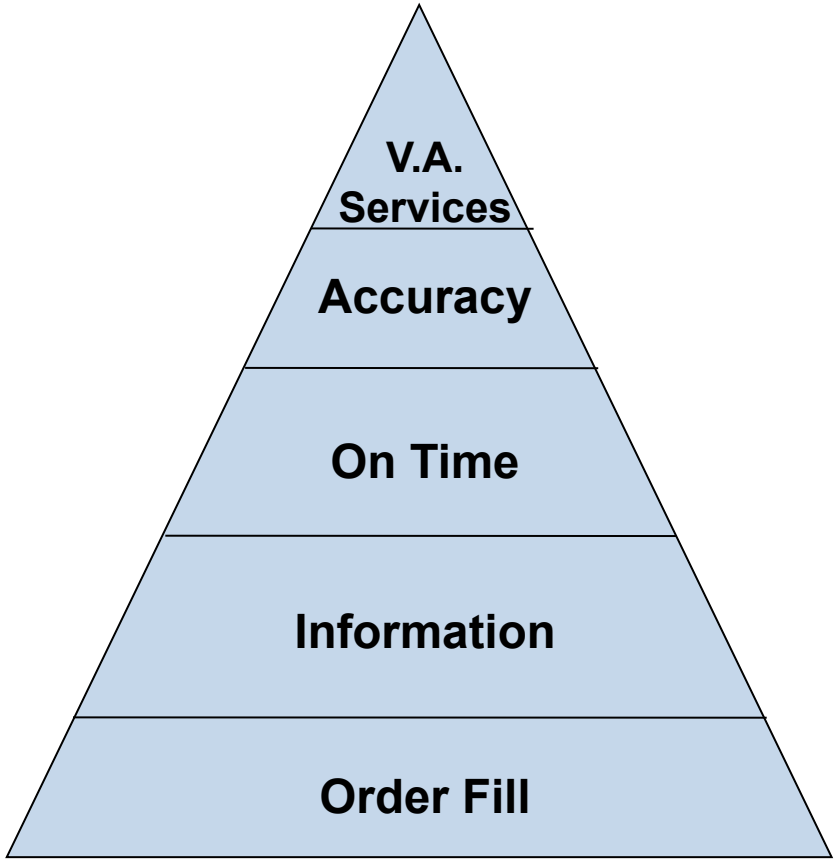
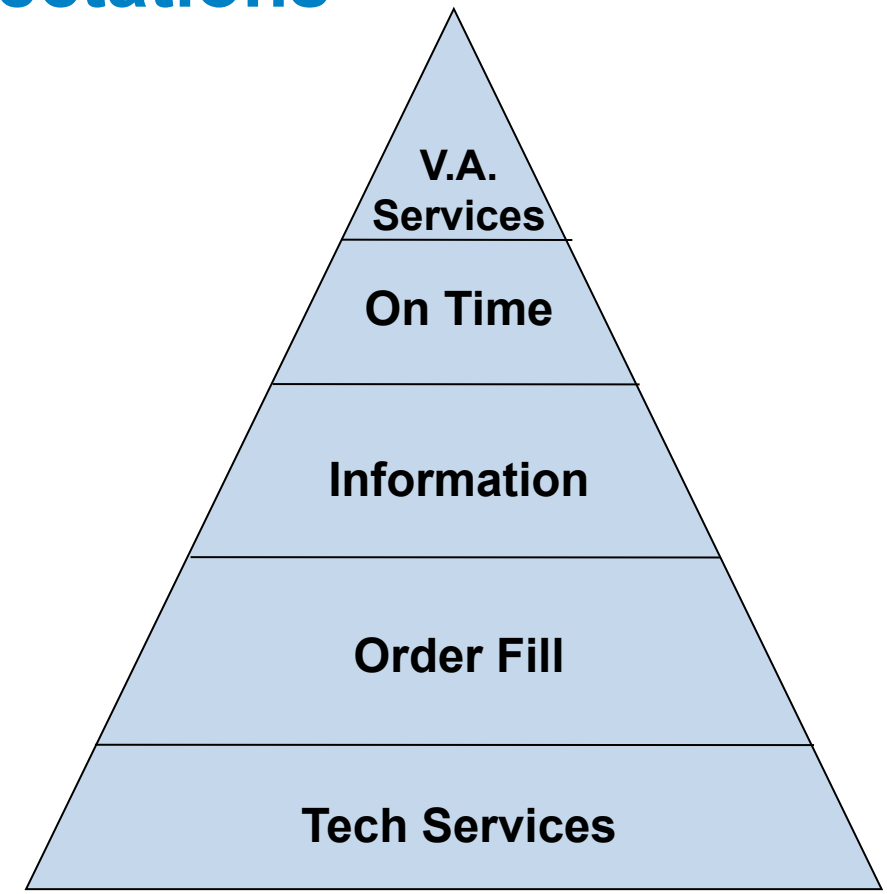
Customers Have Different Objectives, Requirements and Expectations



Customer A



Customer B

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Total Cost-Service Integration

- Minimum total cost assignment
- Threshold service capability
- Cost revenue impact strategies
- From science to art – managing short cuts

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Supply Chain Design Criteria

- Design to minimize landed cost
- Design to maximize asset utilization
- Design to maximize competitive positioning (relevancy)
- Design to minimize risk
- Design to maximize control

Logistics System Design Requirements

Commodity

- Direct bulk or crossdock delivery
- Limited product requirements
- Unique information requirements and capabilities
- Precise management requirements

Integrated Service

- Delivery to customer DC
- Broad product offering
- Range of information requirements and capabilities
- Accept more generic strategies

Customized Service

- Delivery in small quantities
- Select products
- Tracking of individual behavior
- Individual focused strategies

Mass Merchant Comparison

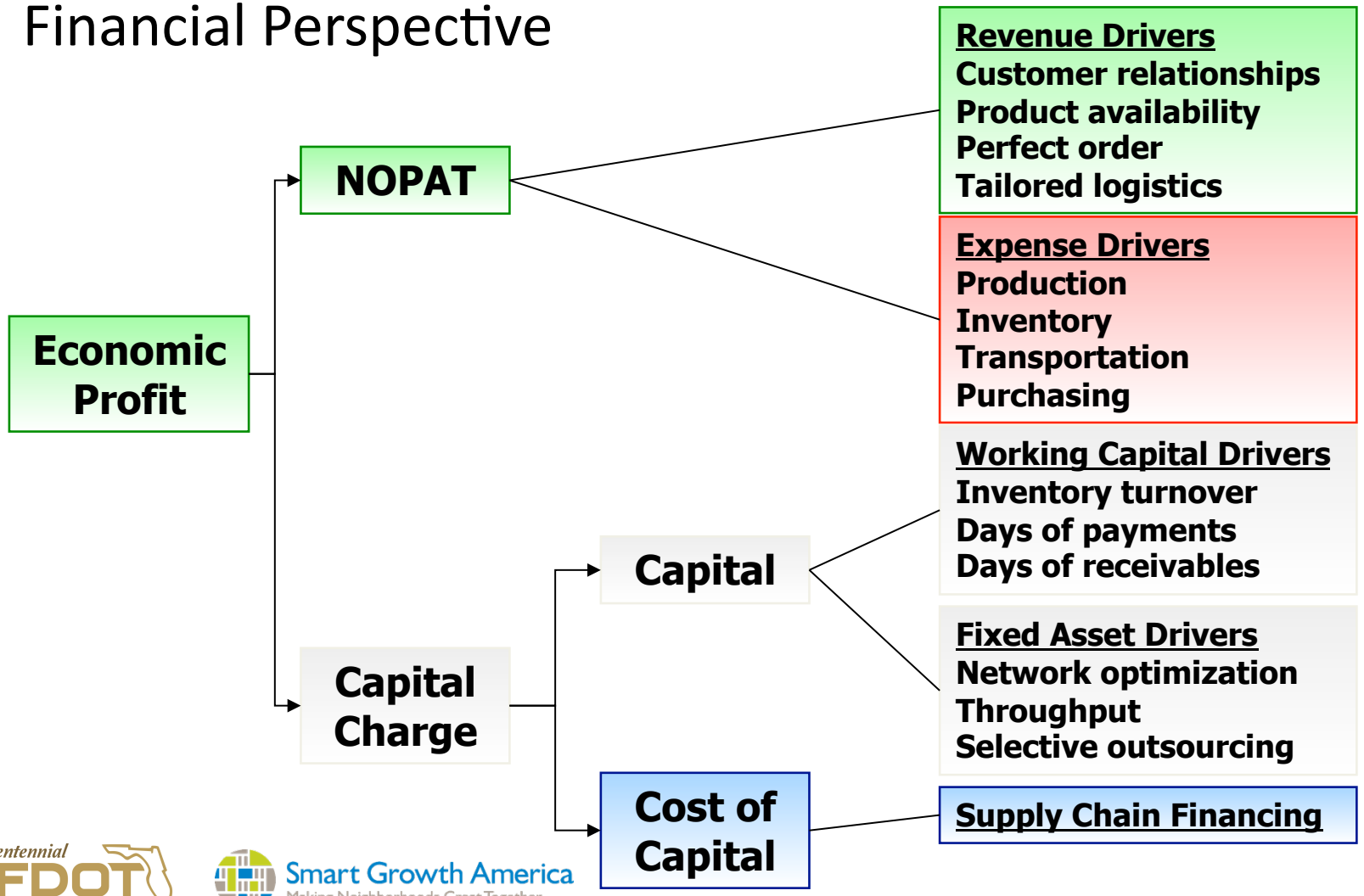
- Target
  - New and unique product offerings
  - Maintain inventory responsibility
  - Maintain forecasting
- Walmart
  - Low cost product
  - Shift inventory management to vendor
  - Collaborative forecasting

Minimize Landed Cost

Supply Chain Cost	Primary Driver
Transportation (Inbound/Outbound)	• Distance • Economies of scale • Mode
Procurement	• Materials • Source • Competitive environment
Production	• Labor content • Technology environment
Inventory carrying cost	• Value of inventory • Risks • Taxes
Handling	• Mechanization • Labor rates
Packaging	• Consumer vs. industrial

Supply Chain Management

Financial Perspective



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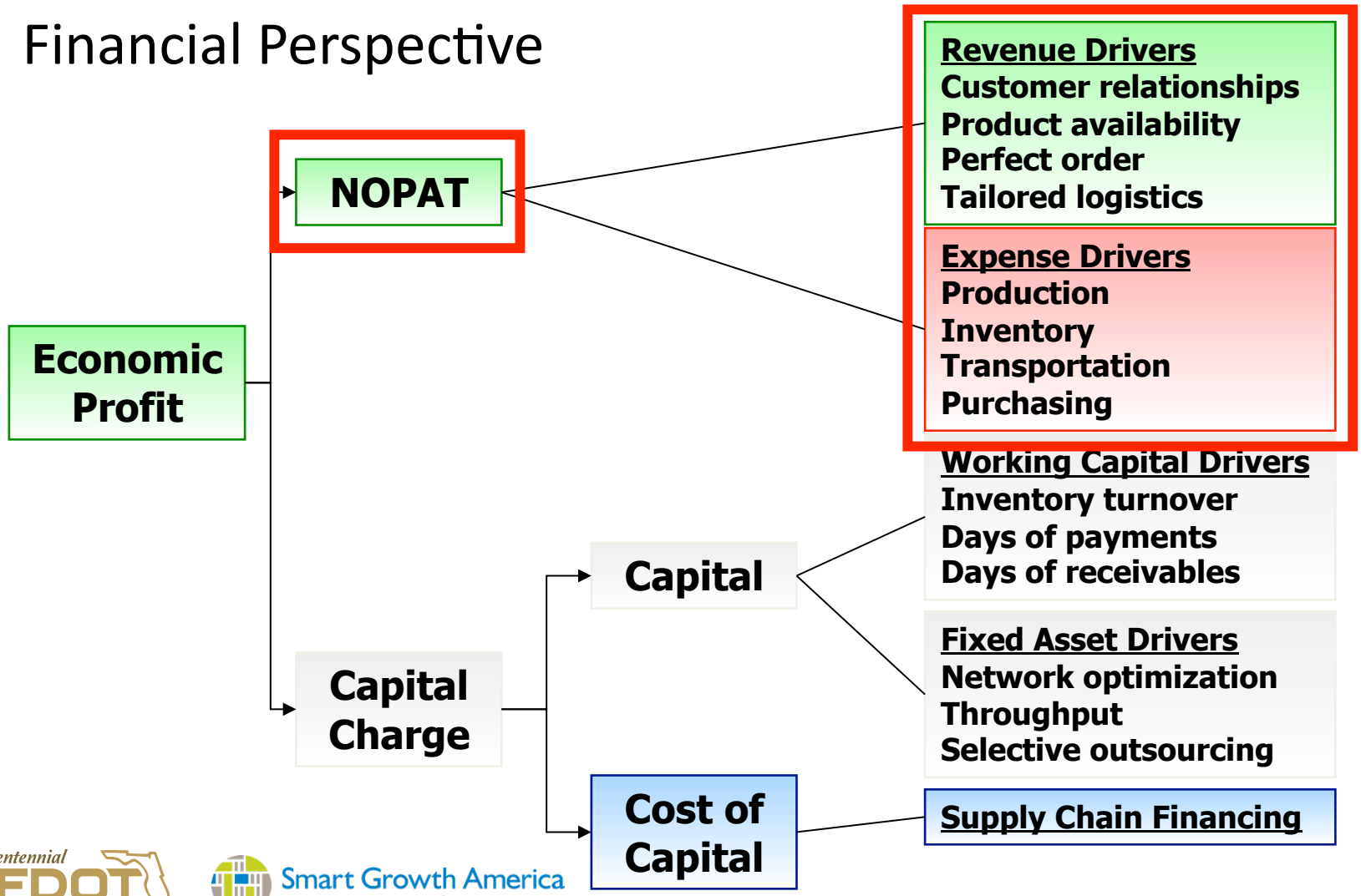
Supply Chain Management

Financial Perspective



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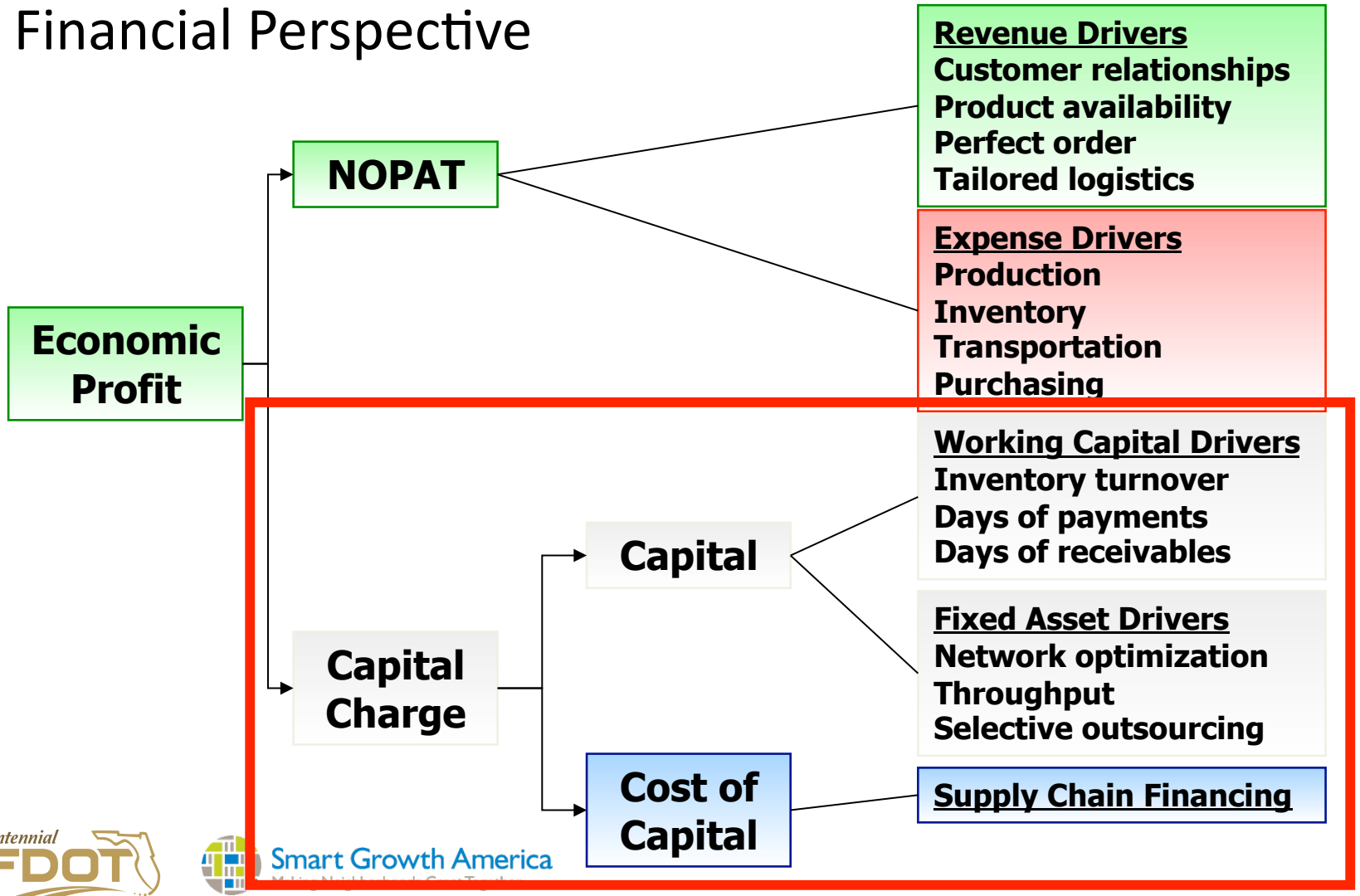
Supply Chain Management

Financial Perspective



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QUESTIONS?

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Role of Supply Chain Decisions
in Firm Strategy

Functional vs. Innovative Products: Differences in Demand

Aspects of Demand	**Functional** (Predictable Demand)	**Innovative** (Unpredictable Demand)
Product life cycle	> 2 yrs	< 1 yr
Contribution margin	5 – 20 %	20 – 60 %
Product variety	Low (10 – 20 variants per category)	High (large number of variants per category)
Average forecast error	10%	40 – 100%
Average stockout rate	1 – 2%	10 – 40%
Average end-of-season markdown	0%	10-25%
Leadtime for MTO products	6 – 12 months	1 – 2 days

Physically Efficient vs. Market Responsive Supply Chains

	Physically Efficient Process	Market-Responsive Process
Primary purpose	Supply predictable demand efficiently	Respond quickly to unpredictable demand to maximize service
Manufacturing focus	Maintain high average utilization rate	Deploy excess buffer capacity
Inventory strategy	Generate high turns and minimize inventory	Deploy significant buffer stocks
Lead-time focus	Shorten leadtime while not increasing cost	Invest in ways to reduce leadtime
Approach to choosing suppliers	Select primarily for cost and quality	Select primarily for speed, flexibility and quality
Product-design strategy	Maximize performance and minimize cost	Use modular design to postpone differentiation

Matching Supply Chains with Products

	Functional Products	Innovative Products
Efficient Supply Chain	Match	Mismatch
Responsive Supply Chain	Mismatch	Match

Customer Related Supply Chain Processes

Process	Description
Demand Planning Responsiveness	The assessment of demand and strategic design to achieve maximum responsiveness to customer requirements.
Customer Relationship Collaboration	The development and administration of relationships with customers to facilitate strategic information sharing, joint planning, and integrated operations.
Order Fulfillment/Service Delivery	The ability to execute superior and sustainable order to delivery performance and related essential services.
Product/Service Development Launch	The participation in product service development and lean launch.
Manufacturing Customization	The support of manufacturing strategy and facilitation of postponement throughout the supply chain.
Supplier Relationship Collaboration	The development and administration of relationships with suppliers to facilitate strategic information sharing, joint planning, and integrated operations.
Life Cycle Support	The repair and support of products during their life cycle. Includes warranty, maintenance, and repair.
Reverse Logistics	The return and disposition of inventories in a cost effective, secure, and responsible manner.

Supply Chain Management Cost Decisions

Customer Service

- Order taking
- Order inquiry
- Customer management

Planning

- Forecasting
- Promotional planning
- Planning and scheduling
- Capacity management
- Expediting

Sourcing

- Design
- Supplier identification
- Negotiation
- Contracting
- Receiving
- Payables
- Raw material management
- Supplier management

Production

- Production scheduling
- Direct and indirect labor
- Equipment maintenance
- WIP inventory management

Distribution

- FG inventory management
- Transportation
- Warehousing
- Packaging

Supply Chain Design Criteria

- 1990
  - Demand
  - Production
  - Material
  - Transportation
- 2012
  - Demand
  - Sustainability
    - Energy
    - Labor
    - Political
  - Taxation
  - Transportation
  - Production
  - Material

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Supply Chain Design Criteria

- 1990
  - Demand
  - Production
  - Material
  - Transportation
- 2015
  - Demand
  - Sustainability
    - Energy
    - Labor
    - Political/Community impact
    - Water
    - Environmental impact
    - Debtors
    - Regulatory
    - Compliance
    - Supplier relationships
    - Commodity availability
    - Cross-sale requirements
  - Taxation (TASC)
  - Transportation
  - Production
  - Material

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Supply Chain Dynamics are Changing

- Firms looking for more balance between scale and reliability
- Infrastructure congestion is becoming increasingly problematic
- Increased energy cost will shift supply chain mode selection and design
- Increasing importance of being able to quantify the value proposition related to supply chain changes

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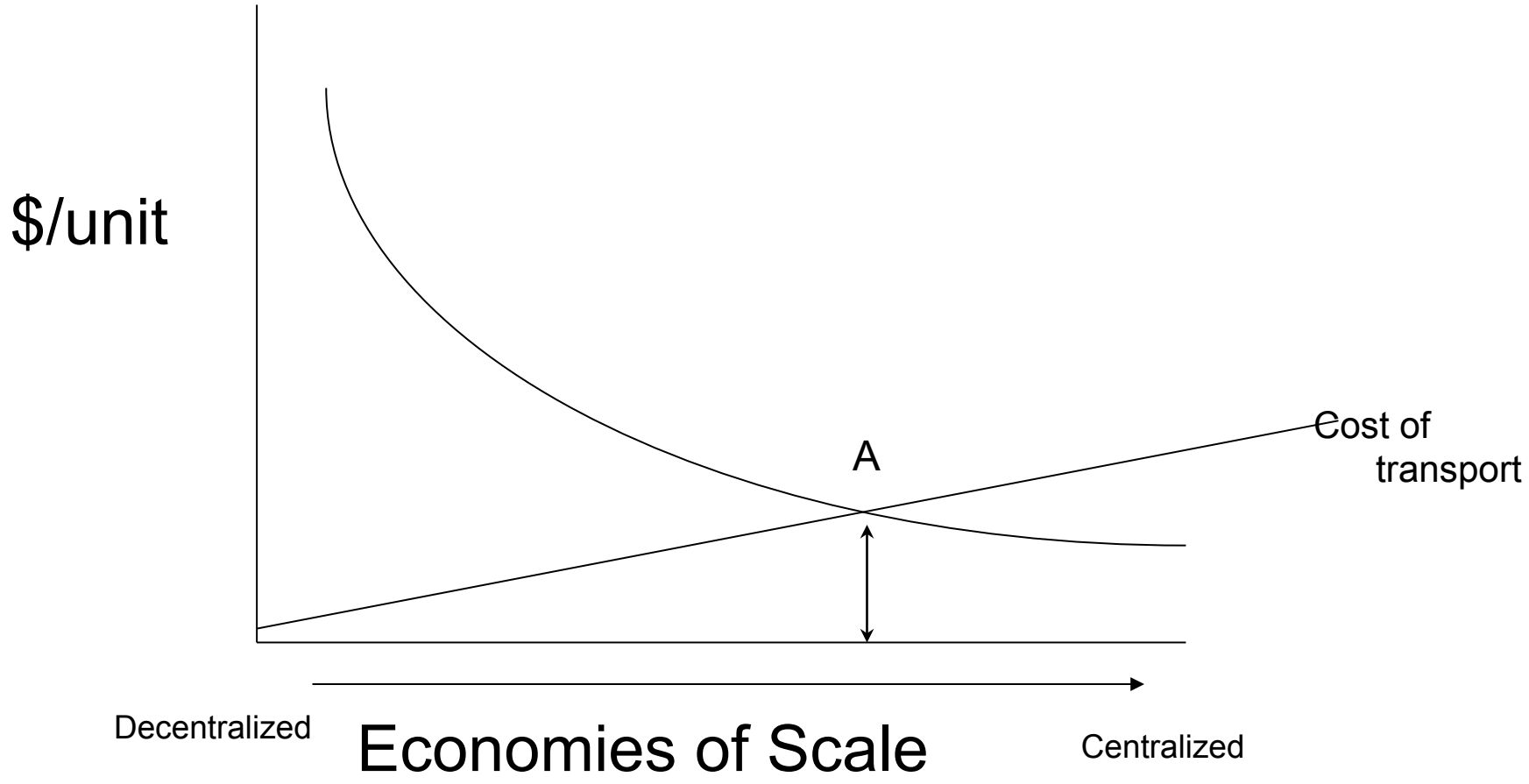
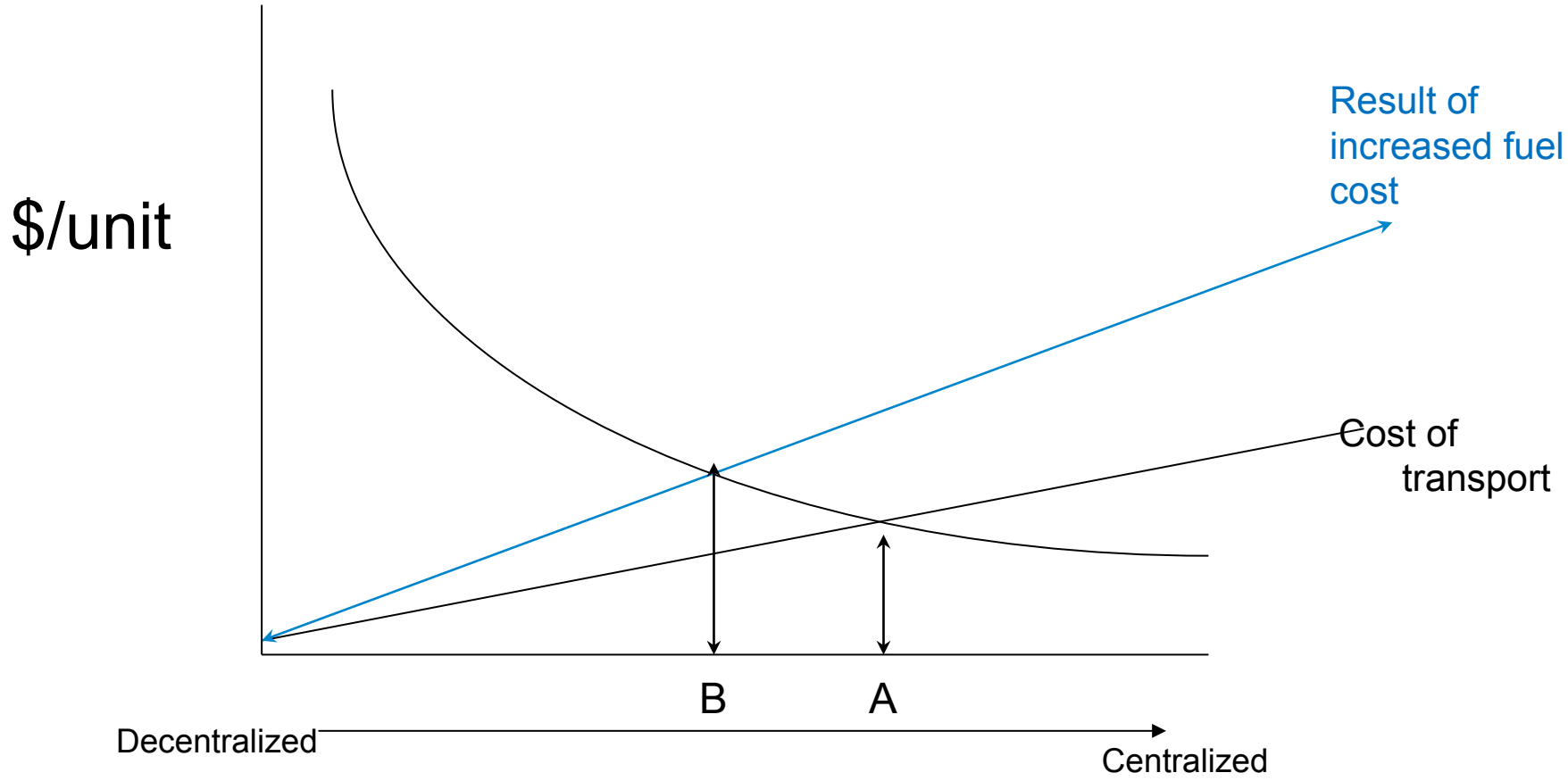
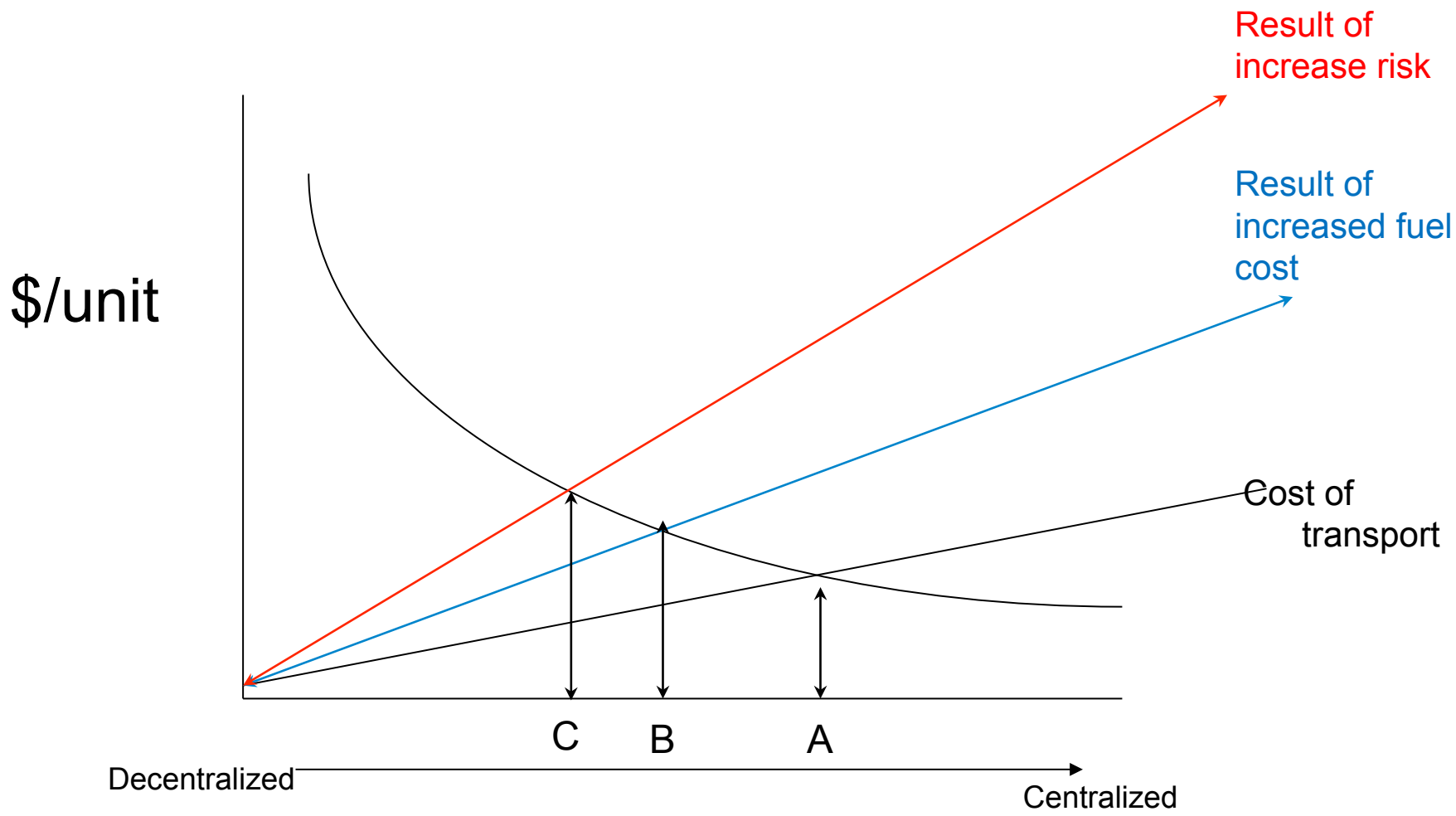
Changing Dynamics of Supply Chain Design



Changing Dynamics of Supply Chain Design



Changing Dynamics of Supply Chain Design



Economies of Scale

QUESTIONS?

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How do Firms Make Supply Chain Decisions?

Supply Chain Design

- Supply chain network analysis
- Supply chain integration

Principles of General Systems Theory

- Total system performance is singularly important
- Individual components don't need to be optimized
  - Emphasis is on the integrated relationship *between* components
- A functional relationship exists between components called a **trade-off**
  - May enhance or hinder total system performance
- Components linked together in a balanced system will produce greater end results than possible through individual performance

A Systems Concept Example

- Customer service is an integral part of total system performance

- However,
  - Customer service must also be balanced against other components
  - Accommodating the customer to the extent that you put yourself out of business is not serving the customer!
  - There must be a balance between cost and customer service
  - Building relationships with customers is key to this balance
    - i.e. customers become a component of the supply chain system

Total Cost Integration

- Initial network of facilities are driven by economic factors
  - Transportation economics
  - Inventory economics

- Cost trade-offs of these individual functions are identified, but
  - A system analysis approach (i.e. total cost integration) is used to identify the least-total-cost for the combined facility network

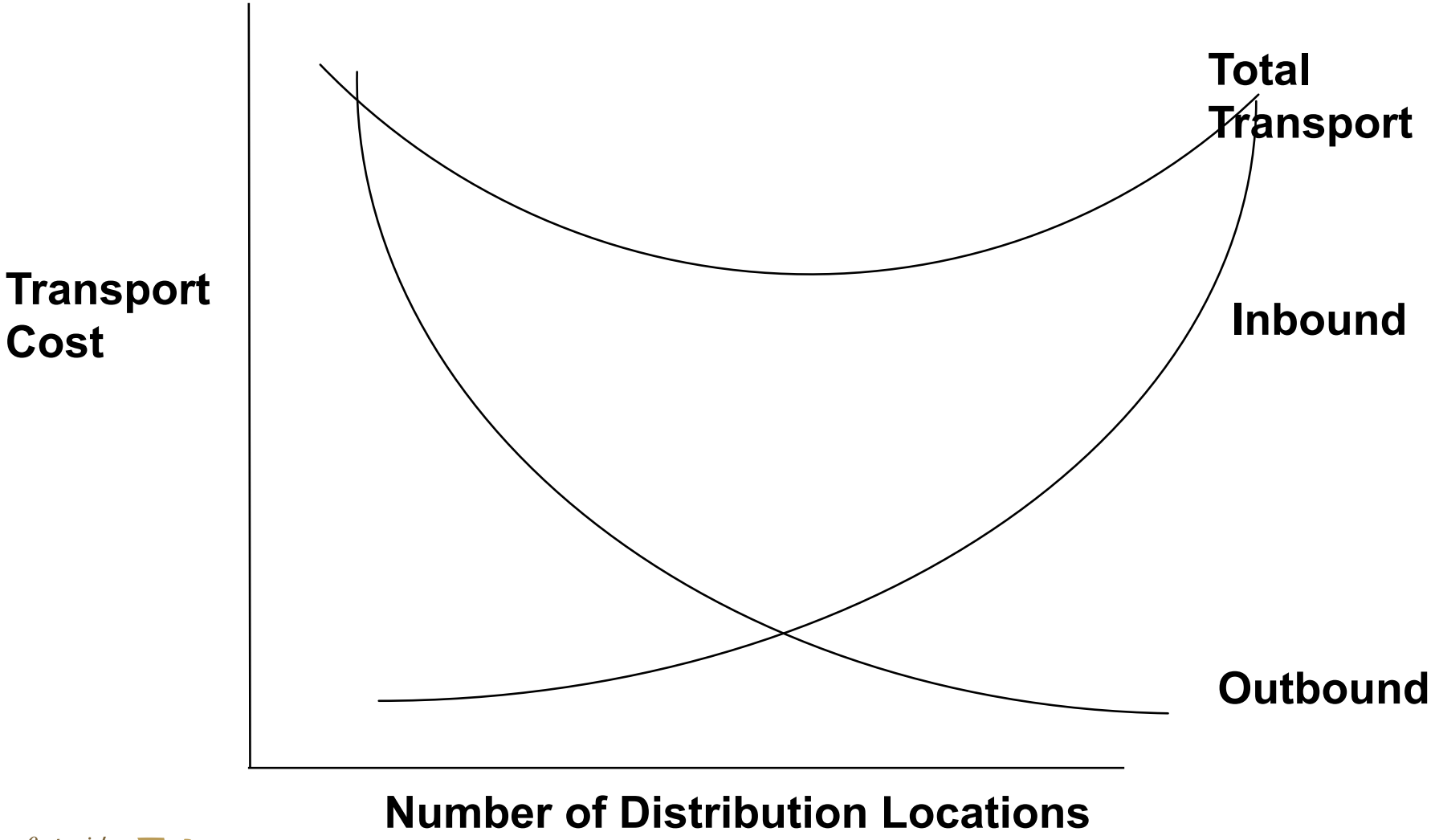
Transportation Cost Integration (Spatial)

- Basic economies
  - Economy of size (quantity discount)
  - Economy of distance (tapering principle)

- Activity based cost
  - Loading and unloading
  - Movement
  - Information

- Generalized relationship

Transportation Cost as a Function of Distribution Locations



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Network Transportation Cost Minimization

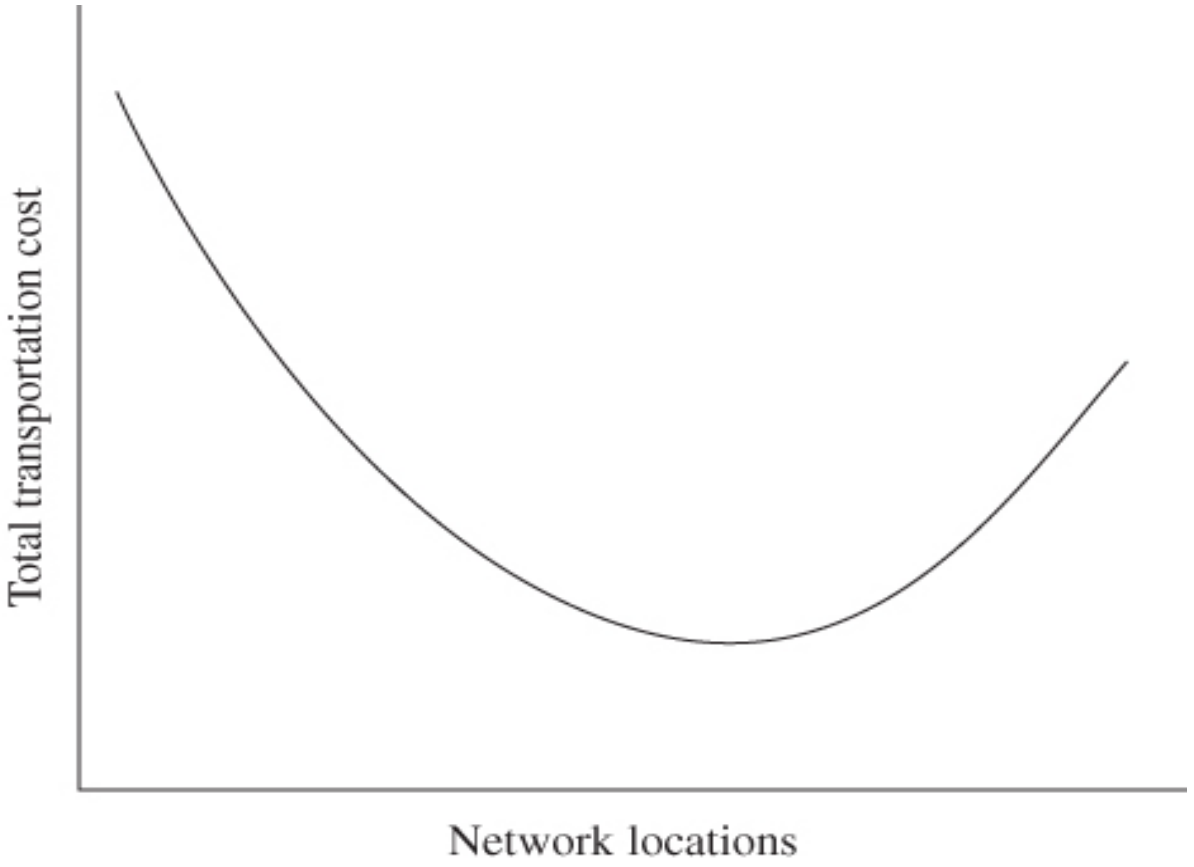


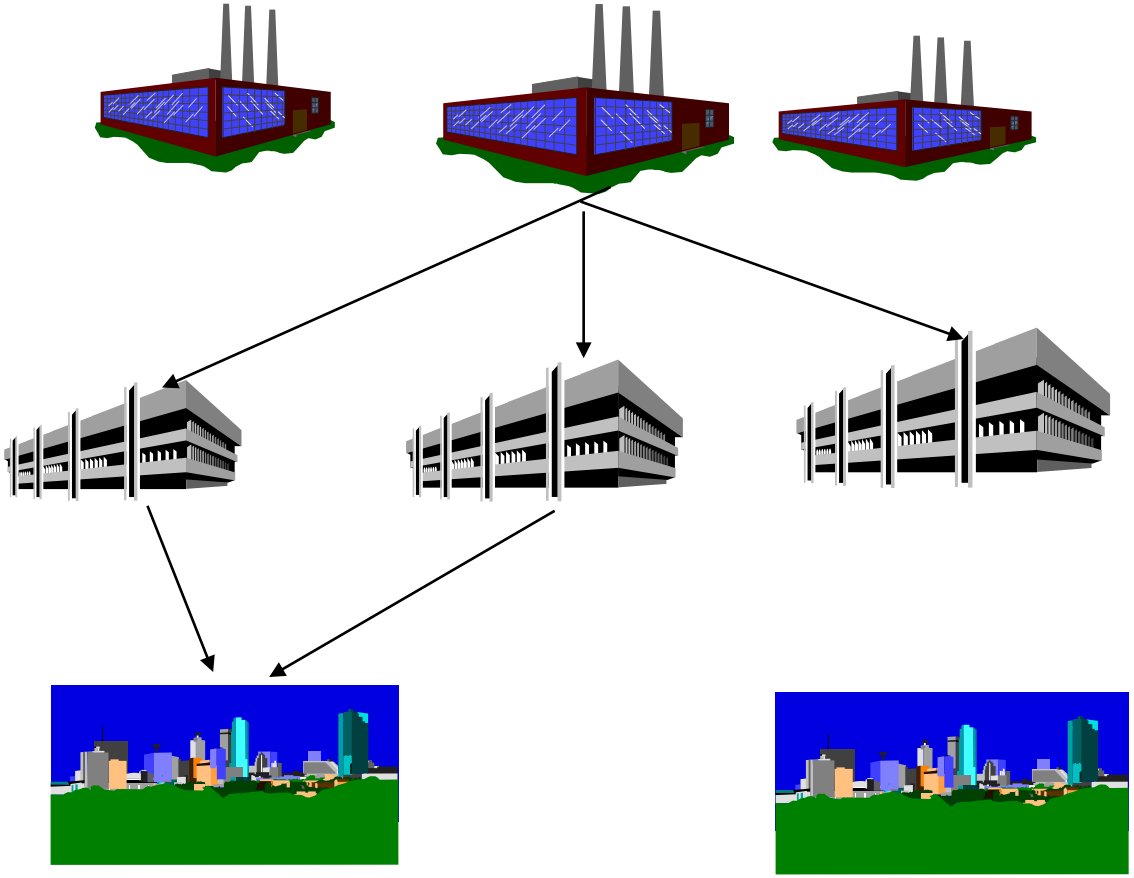
Figure 12.2 Transportation Cost as a Function of the Number of Warehouse Locations

Service-Based Warehouse Justification

- Inventory consists of
  - Base stock
  - Safety stock
  - In-transit stock

- What is the impact of adding warehouses to each of these inventories?
  - Base stock is independent of number of market facing warehouses
  - What about in-transit stock?

Total Cost Analysis Approach



Expense Components

Sourcing +

Production +

Handling +

Inbound Transport +

DC Handling +

Inventory +

Customer Transport

Total Cost

Returns

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What About the Impact on Safety Stock?

- Safety stock is needed to protect against unplanned stockouts during inventory replenishment
- Uncertainty in network is impacted by adding warehouses
  - Performance cycle days are reduced
  - Number of performance cycles increases
    - Prevents aggregation of uncertainty across market areas
- Serving the same market area by adding warehouses will increase uncertainty since each facility has its own replenishment cycle
  - Therefore, more safety stock is needed

Inventory Summary

- Base stock determination is independent of number of market facing warehouses
- In-transit stock will typically decrease with the addition of warehouses to the network
- Safety stock increases with number of warehouses added to the network
  - New performance cycle requires additional safety stock

Network Inventory Cost Minimization

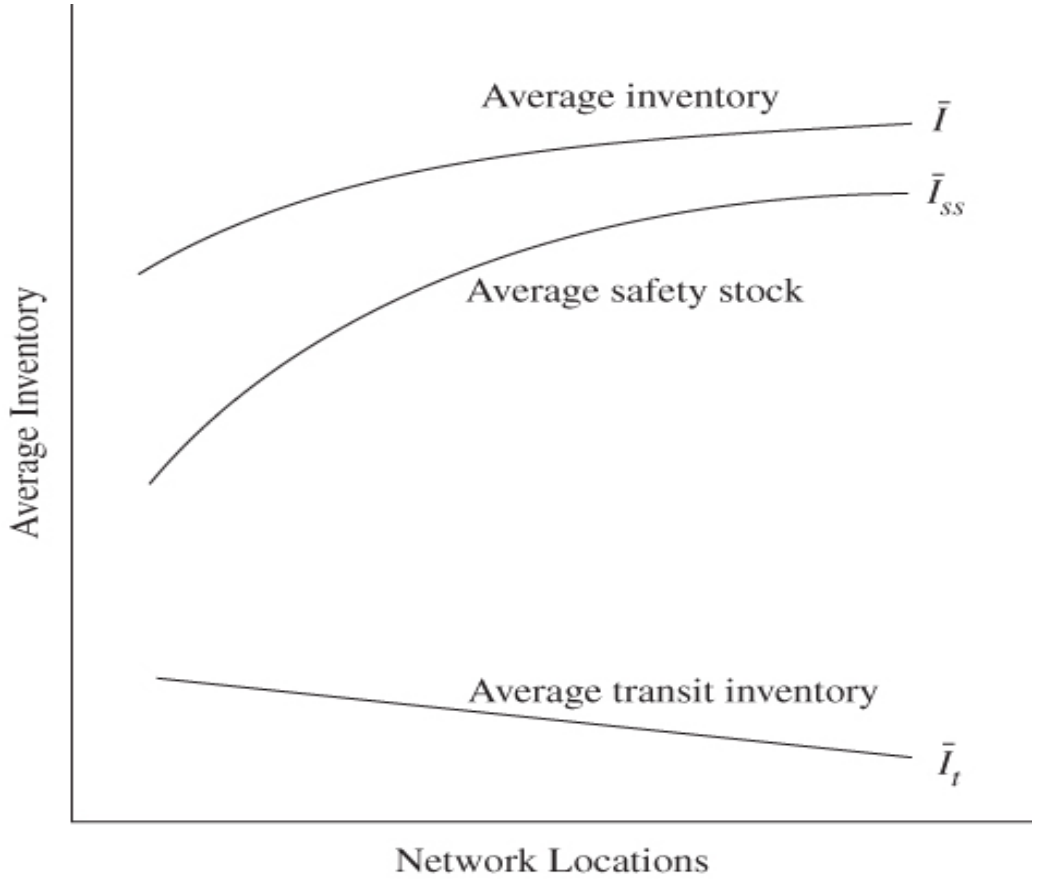

Figure 13.5 Average Inventory as a Function of Number of Warehouse Locations

Total Cost of the Network

- Lowest cost points on each curve
  - For total transportation cost between 7 and 8 facilities
  - For inventory cost it would be a single warehouse
  - For total cost of network it is 6 locations

- Trade-off relationships
  - Minimal total cost point for the system is not at the point of least cost for either transportation or inventory

Illustration of Total Cost Concept for the Overall Logistical System

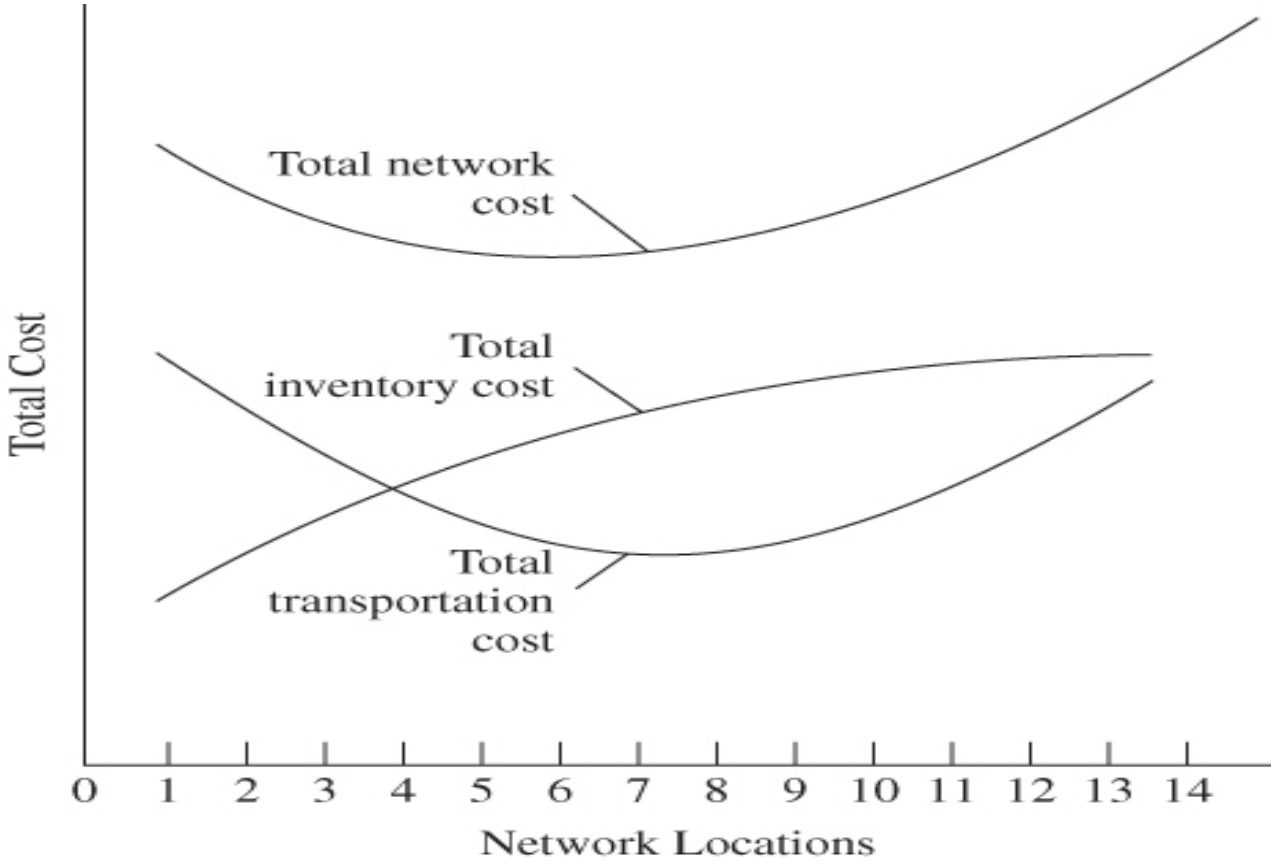

Figure 12.6 Least-Total-Cost Network

Total Cost-Service Integration

- Minimum total cost assignment
- Threshold service capability
- Cost revenue impact strategies
- From science to art – managing short cuts

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Supply Chain Design Criteria

- Design to minimize landed cost
- Design to maximize asset utilization
- Design to maximize competitive positioning (relevancy)
- Design to minimize risk
- Design to maximize control

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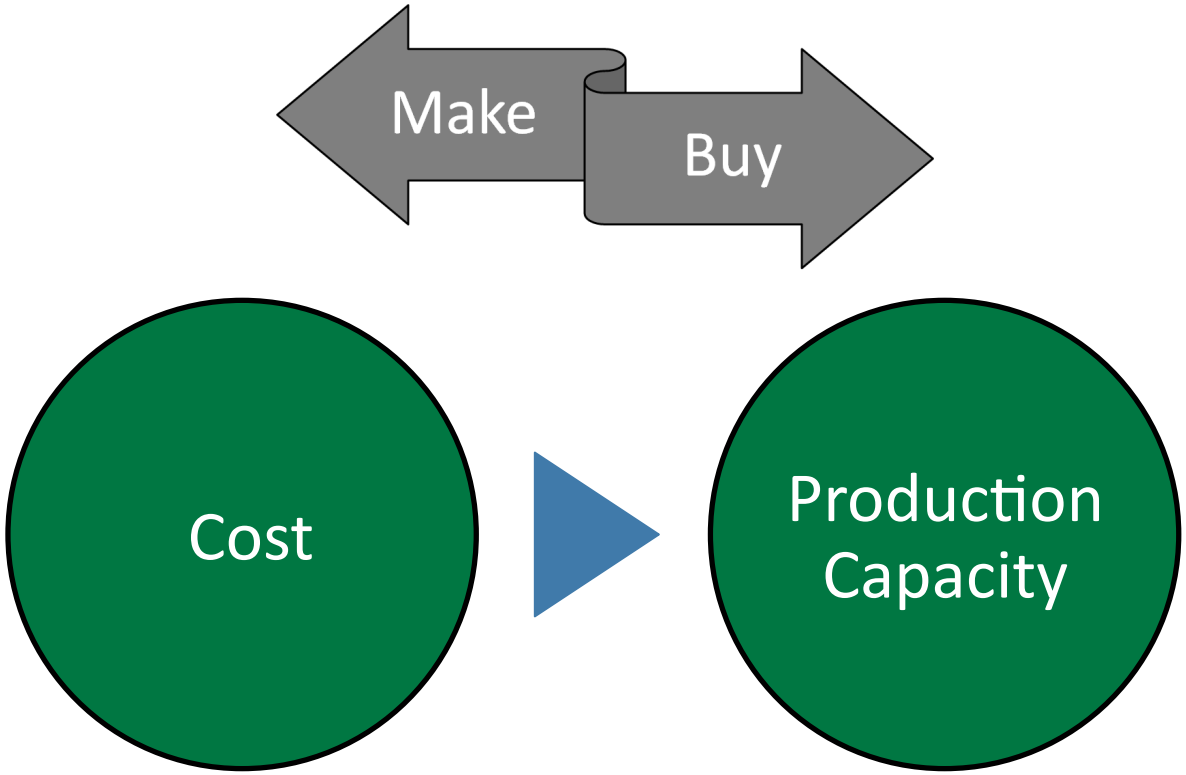
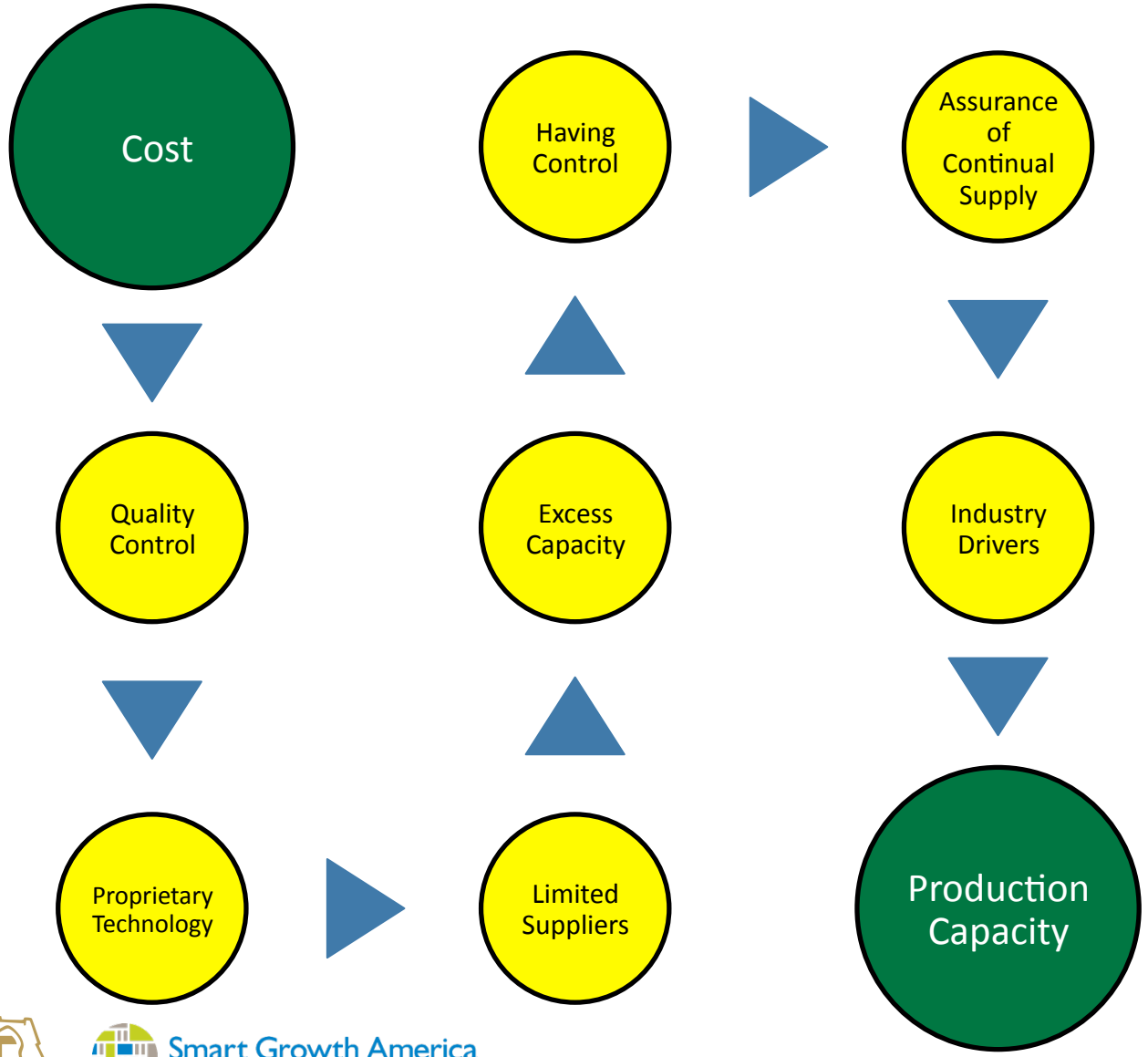
Supply Chain Design

- Make vs. buy of products, services or solutions
- Global optimization
- Technology advances
- Strategic profit model

Supply Chain Design



Operationally Favoring a Make Decision



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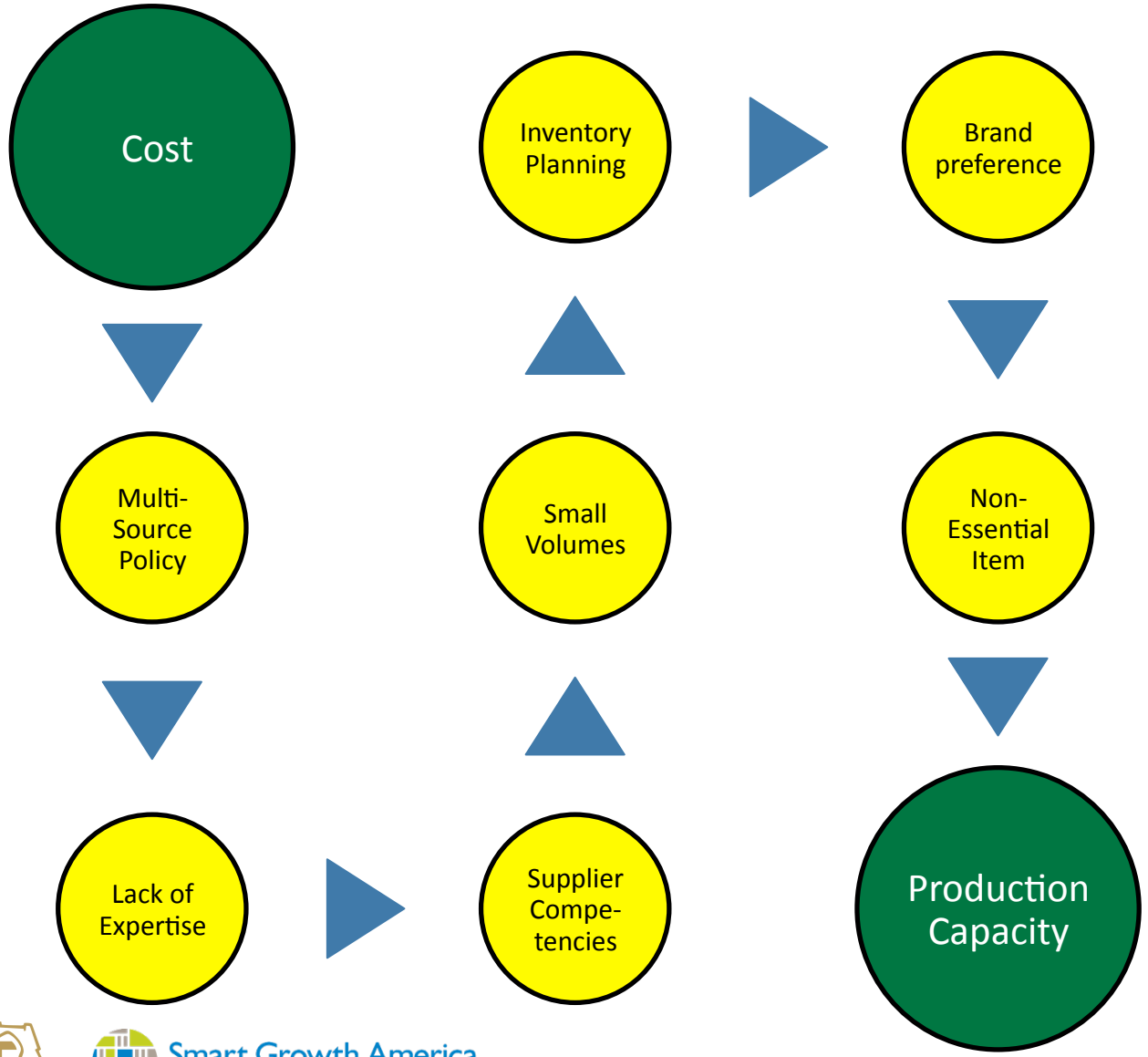
Operationally Favoring a Buy Decision



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Strategic Profit Model

- The strategic profit model framework
- ROA as a key measure
- Understanding the composition of ROA

Profit Margin	x	Asset Turnover	=	Return on Assets
$\frac{\text{Profit}}{\text{Sales}}$	x	$\frac{\text{Sales}}{\text{Assets}}$	=	$\frac{\text{Profit}}{\text{Assets}}$
$\frac{100}{2000}$	x	$\frac{2000}{1000}$	=	$\frac{100}{1000}$
5%	x	2 times	=	10%

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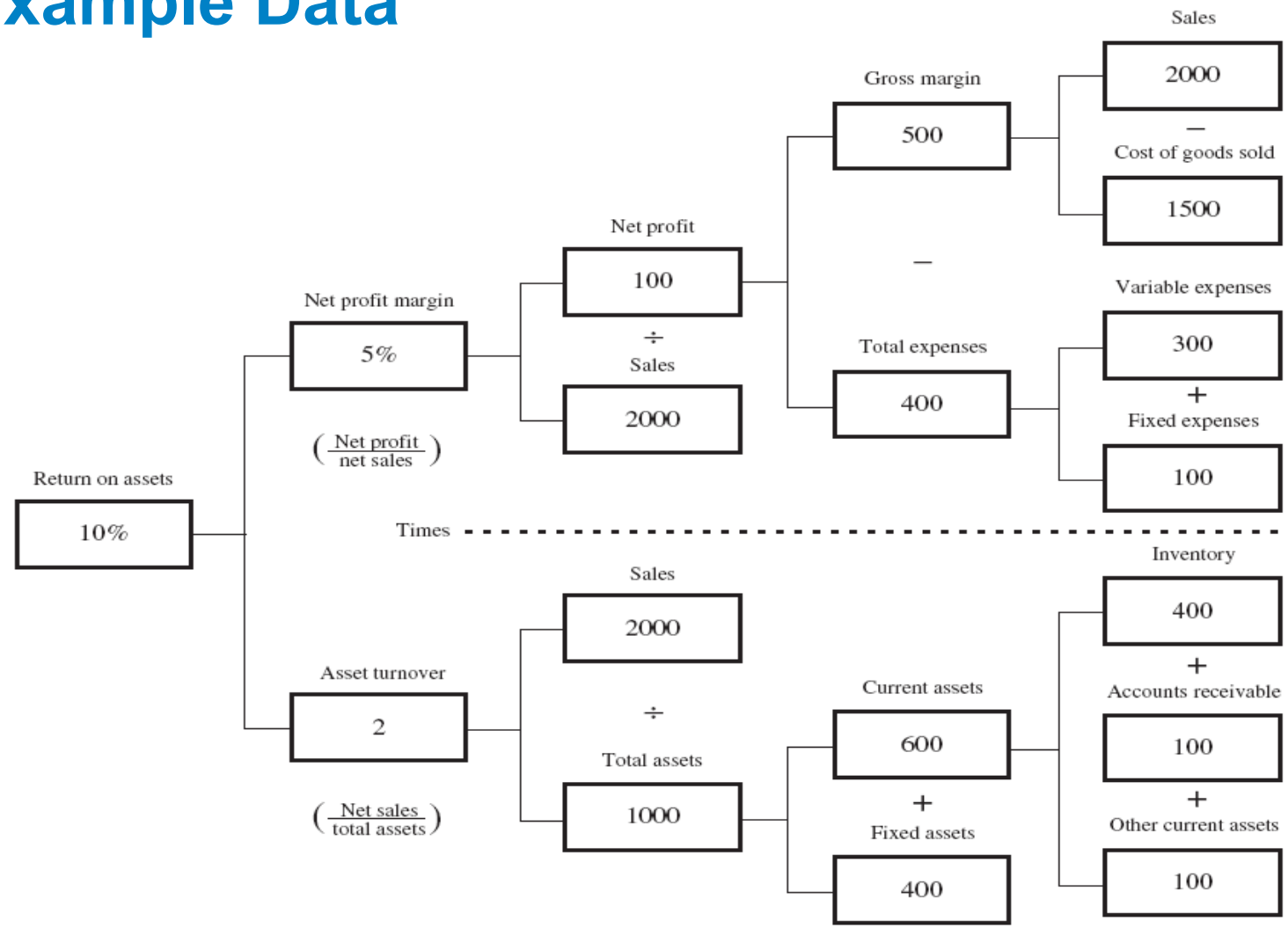
Illustration of Strategic Profit Model with Example Data



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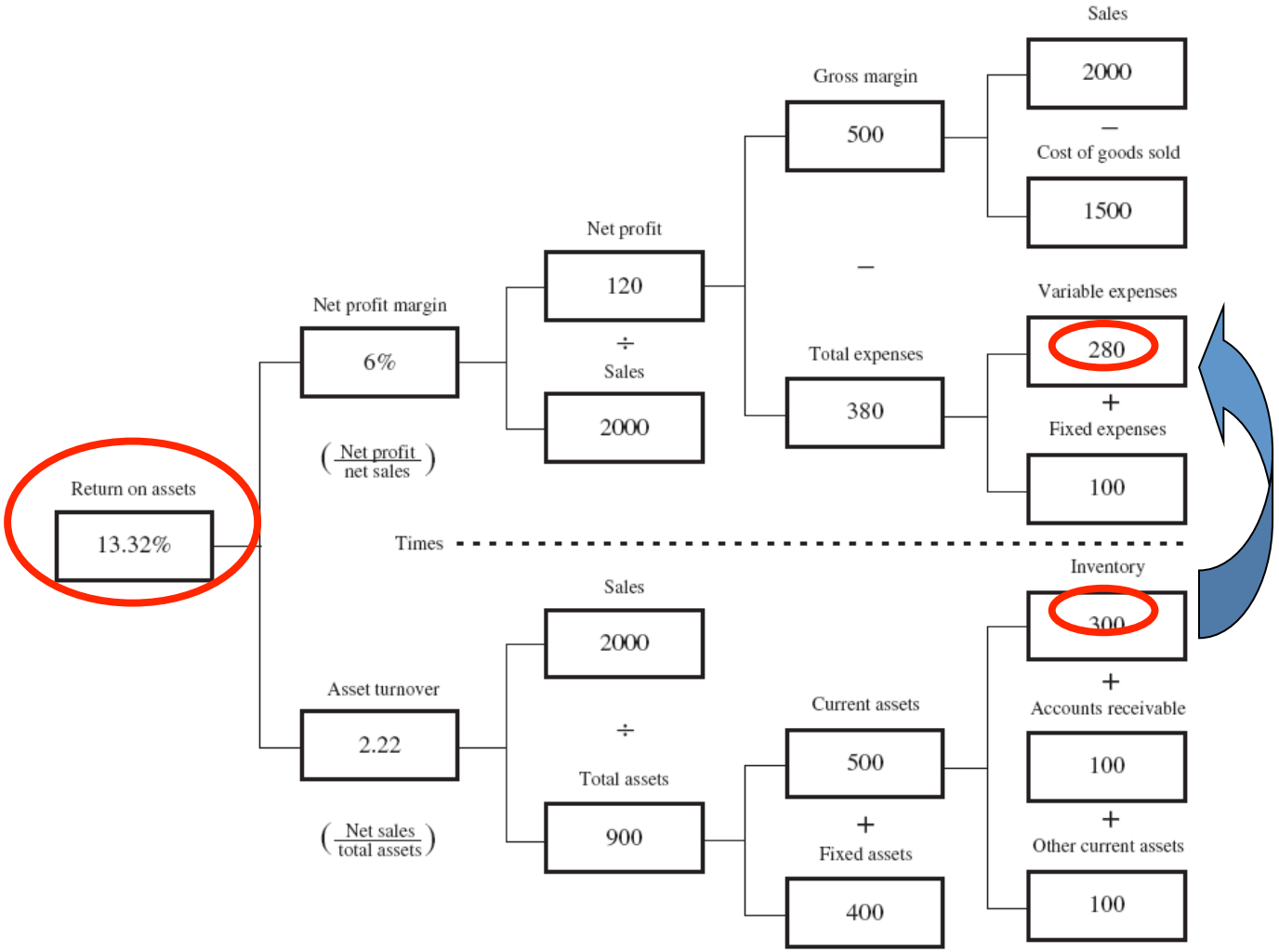
Example Showing ROA Improvement If Inventory Cost Is Reduced To $300



QUESTIONS?

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M2D2 Freight Logistics Workshop

Scenario Discussions

Scenario Discussions

- What would be the appropriate response under a variety of different business scenarios?
- How does freight interact with other users of the transportation system? How might that interaction be optimized?
- How does FDOT interact with the industry? What FDOT standards, practices and guidance are used in that interaction? What elements might be ripe for revision/ augmentation?

Scenario #1 - Electronics

- An existing Florida business is looking to expand by building a new electronics manufacturing facility at a location to be determined. How does the logistics and transportation infrastructure impact this decision? What could FDOT do to help support this location decision?

Scenario #1 - Pharmaceuticals

- An existing Florida business is looking to expand by building a new manufacturing facility at a location to be determined. How does the logistics and transportation infrastructure impact this decision? What could FDOT do to help support this location decision?

Scenario #1 – Medical Equipment

- An existing Florida business is looking to expand by building a new chemical manufacturing facility at a location to be determined. How does the logistics and transportation infrastructure impact this decision? What could FDOT do to help support this location decision?

Scenario #2

- A food processor is looking to source more local produce from Florida. How does the logistics and transportation infrastructure impact this decision? What could FDOT do to help support this sourcing decision?

Scenario #3

- A regional manufacturer is looking to capitalize on the "Made in America" trend by using more local production or local sources. How does the logistics and transportation infrastructure impact this decision? What could FDOT do to help support this location decision?

M2D2 Freight Logistics Workshop

Conclusions & Implications

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Multimodal Development and Delivery (M2D2) is a partnership between the Florida Department of Transportation (FDOT) and Smart Growth America to identify modifications to FDOT policies, guidance, manuals, procedures and general practices needed to implement FDOT's Complete Streets policy in order to promotes safety, quality of life, and economic development in Florida.

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