Supply Chain Management 614

Week 1

https://recipesformen.com/peanut-butter-and-jelly-mix/

Homemade peanut butter

- 15 ounces shelled and skinned AB's Roasted Peanuts, recipe follows
- 1 teaspoon kosher salt
- 1 1/2 teaspoons honey
- 1 1/2 tablespoons peanut oil

1 Place the peanuts, salt and honey into the bowl of a food processor. Process for 1 minute. Scrape down the sides of the bowl. Place the lid back on and continue to process while slowly drizzling in the oil and process until the mixture is smooth, 1 1/2 to 2 minutes. Place the peanut butter in an airtight container and store in the refrigerator for up to 2 months.

Roasted Peanuts:

Yield: Approximately 2 pounds roasted peanuts in shell

2 Preheat the oven to 350 degrees F.

3 Rinse the peanuts under cool water to remove excess dirt. Pat dry and place in a large bowl and toss with the peanut oil and salt until well coated.

4 Place on 2 half sheet pans, making sure to spread them out into a single layer. Roast in the oven for 30 to 35 minutes, rotating the pans halfway through cooking. Once you remove the peanuts from the oven, let them cool slightly before eating. They will continue to "cook" and become crunchy as they cool.

5 If using peanuts to make peanut butter, remove shells and discard. Remove the skin by rubbing the peanuts together in your hands held over a salad spinner, allowing the peanuts and skins to fall into the bowl. Once the skin has been loosened from all of the peanuts close the salad spinner and spin until all of the skin has been separated from the peanuts.

Cook's Note

If eating peanuts roasted right out of the shell, use Virginia or Valencia peanuts. If utilizing roasted peanuts to make peanut butter, use Spanish peanuts as they have a higher oil content.

https://www.foodnetwork.com/recipes/alton-brown/homemade-peanut-butter-recipe-1950478
https://www.agrocrops.com/en/expertise/oil-production

Homemade strawberry jelly

2 pounds strawberries, trimmed and halved (about 5 cups)

4 cups granulated sugar

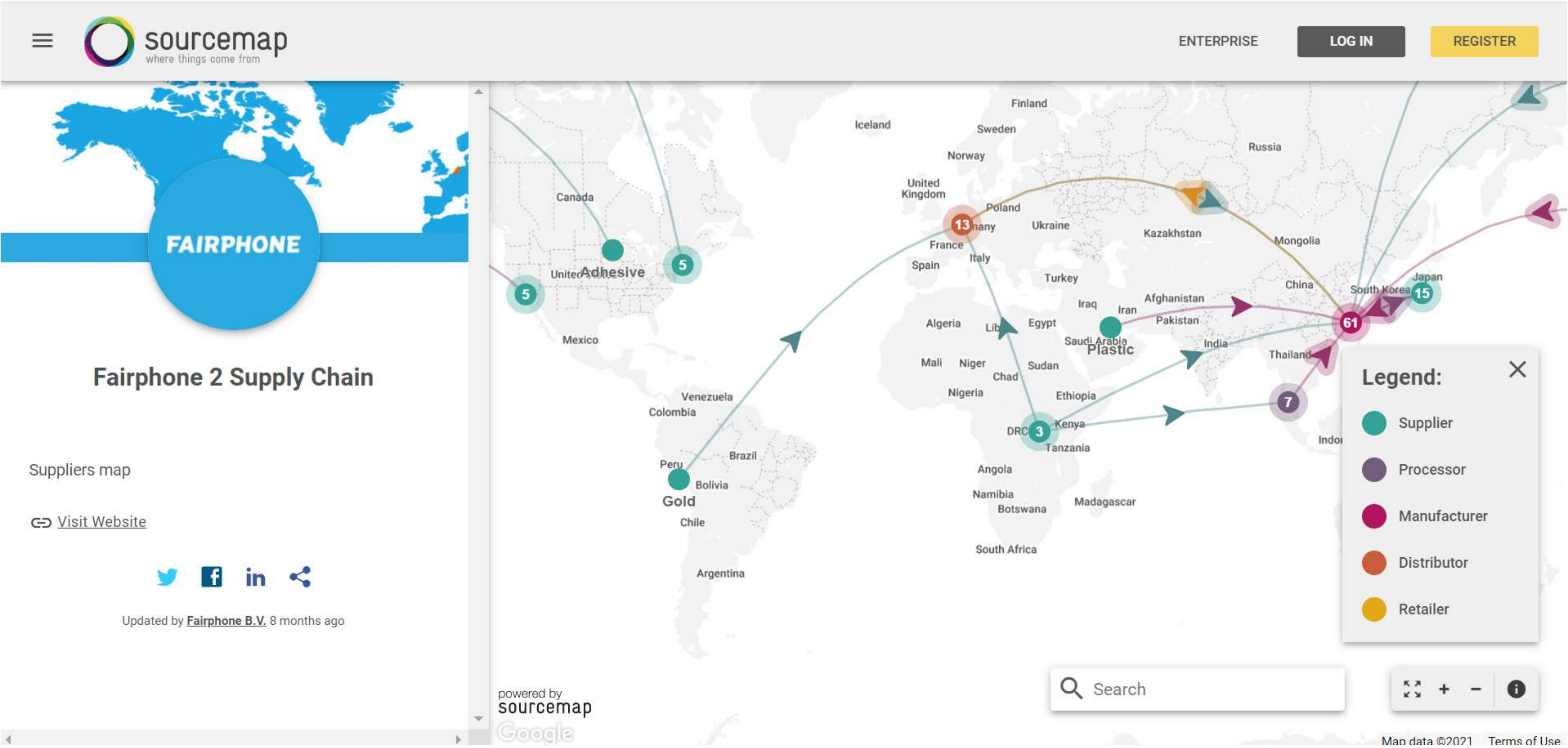
3 tablespoons fresh lemon juice

https://food52.com/recipes/66384-homemade-strawberry-jelly
http://cake.style/2016/09/24/lemon-strawberry-cake/

Directions

1. *To sterilize jars*: Wash jars, lids, and bands with hot, soapy water and let dry. Place jars in a large pot, cover with water, and bring to a simmer. Place lids and bands in a separate pot of hot water. Leave jars and lids in water until ready to fill.
2. *Make the jelly*: Place strawberries in a blender or food processor and blend until smooth; add them to a large nonreactive pot.
3. Add sugar, lemon juice, and pectin to the pot and place over medium-high heat. Start stirring until they dissolve in the mixture.
4. Bring mixture to a boil and cook, stirring frequently, 3 minutes. Reduce heat to low and simmer until mixture darkens and thickens slightly, 3 to 5 minutes more.
5. Turn off the heat and skim off the appearing foam with a spoon.
6. Start filling the mason jars with jelly one at a time with a wide-mouth funnel. Clean the residue from the jar's exterior.
7. Place the center lids on the jars Tip: Make sure to leave a little space at the top of the jar (they will expand as they cool.)
8. Fill the canning pot with water and boil for 10 minutes.
9. Turn off the heat and let the jars cool for five minutes.
10. Using a jar lifter, remove the jars from the hot water and let them sit at room temperature for 24 hours.
11. After 24 hours, check the lids for seal. If sealed properly, store the jars in a pantry or kitchen cabinet.

it's Complicated



https://open.sourcemap.com/maps/57bd640851c05c0a5b5a8be1

Agenda

- Welcome to our class!
- Introduction – a bit about me, a bit about you
- How this class is organized
  - Our BeachBoard site – where is (fill in the blank)?
  - “Flipped classroom” - review video lecture segments, reading prior to class
  - Review syllabus/text
- Course objectives
- Chapter 1: Understanding the SC
- Break
- Case study 1 team formation & brief breakout to exchange information, discuss meeting
- Preparation for next class, plus assignments due

introductions

Plural form of **introduction**

ĭn″trə-dŭk′shən

noun

1. The act or process of introducing or the state of being introduced.
2. A means, such as a personal letter, of presenting one person to another.
3. Something recently introduced; an innovation.

The American Heritage® Dictionary of the English Language, 5th Edition.

More at Wordnik

About me

- Susan.dexter@csulb.edu
  - Allow 48 hours for a response; make sure to put “SCM614 in the title line”
  - Virtual office hours Tuesdays noon-1pm or by appointment
- 30 years industry experience in supply chain/project/program management (aerospace/ automotive)
- Currently writing dissertation on lifecycle assessment of heavy-duty diesel, battery electric, and hydrogen trucks. The question: zero-emission vehicles are good for the community where operations occur, but from a global perspective, it is a good thing?

https://www.mhlnews.com/technology-automation/article/22048798/move-planning-and-doing-meet-in-todays-wms-and-tms

What is it about teaching that drives me?

What is important to me:

- Making it relevant
- Understanding how concepts can be applied in the workplace
- Tool usage (the basics)
- Being efficient
- Reducing carbon

KEEP
CALM
AND
IT'S YOUR
TURN

Course Learning Objectives

CLO1 Explain the strategic role of supply chains.

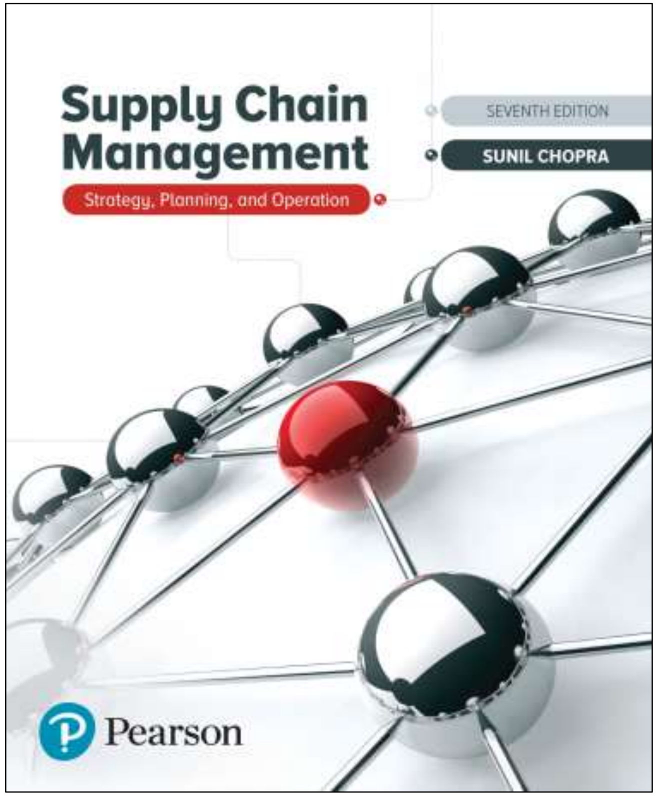
CLO2 Critically appraise and apply appropriate methods and techniques for supply chain analysis.

CLO3 Identify the major drivers and key metrics for supply chain performance.

CLO4 Demonstrate critical awareness of emerging issues in supply chain management.

Our BB site & other tidbits

- Obtain necessary equipment like computer and webcam (yes, I will be requiring you to be on camera during class).
- If you don not already Excel on your device, download it from **Campus Software**. If you have problems, please contact the Technology Help Desk at 562.985.4959
- Purchase the required **Text**
- Become familiar with the homepage information
- Navigate to the Content tab and get familiar with how course materials are organized
- Read the **syllabus**
- Add your picture to your BeachBoard Profile
- Set up BeachBoard Notifications to receive an email when I post in News/Announcements and also to you remind of assignment due dates
- Contact Professor Dexter by the end of the first class if you have any questions or need special accommodations
- Complete the **Week 1 Discussion Board**: What topic is most interesting to you?
- Read the COB's stance on academic integrity at **COB office-of-the-dean academic integrity statement**. Agree to the **Honor Code** by posting your name in Dropbox



Expectations of a flipped classroom

- Before class
  - Read text chapter/articles assigned and listen to videos; be prepared to discuss or do exercises in class on this material. Take quiz to test understanding of key concepts.
  - Complete homework assigned (Individual and/or team)
  - Come to virtual office hours if you need assistance
- In class
  - Participate in lecture by asking questions (this is from reading material/videos) plus active participation in all group discussions/problem solving
  - Work with your teams on case studies/projects

https://clipground.com/flipping-food-in-a-pan-clipart.html

Review of syllabus

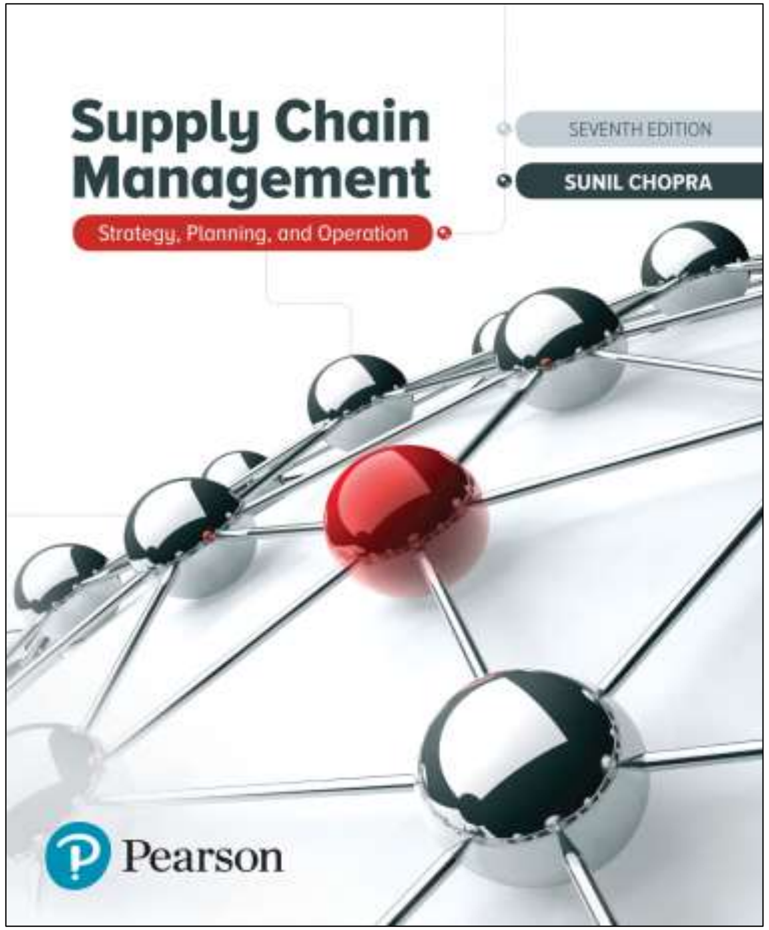
CALIFORNIA STATE UNIVERSITY
LONG BEACH
College of Business

Syllabus for SCM 614: Supply Chain Management
Section 03, Class No. 10343
Spring 2023
Units: 3

Instructor:	Sue Dexter P: She/her/hers
Email:	susan.dexter@csulb.edu
Class Day/Time:	Online Thursdays 7-9:45 p.m.
Office Hours:	Online Tuesday 1 - 2 p.m. or by appointment (request via email) link https://csulb.zoom.us/j/86231744342

Supply Chain Management: Strategy, Planning, and Operation

Seventh Edition



Chapter 1

Understanding the Supply Chain

Learning Objectives

1.1 Discuss the goal of a supply chain and explain the impact of supply chain decisions on the success of a firm.

1.2 Define the three key supply chain decision phases and explain the significance of each one.

1.3 Describe the cycle and push/pull views along with the macro processes of a supply chain.

1.4 Identify important issues and decisions to be addressed in a supply chain.

1.5 Develop skills that employers have identified as critical to success in the workplace.

What Is a Supply Chain? (1 of 3)

- All parties involved, directly or indirectly, in fulfilling a customer request
- Includes manufacturers, suppliers, transporters, warehouses, retailers, and customers
- Within each organization, the supply chain includes all functions involved in receiving and fulfilling a customer request (new product development, marketing, operations, distribution, finance, customer service)

What Is a Supply Chain? (2 of 3)

- Customer is an integral part of the supply chain
- Includes movement of products from suppliers to manufacturers to distributors and information, funds, and products in both directions
- May be more accurate to use the term “supply network” or “supply web”
- Typical supply chain stages: customers, retailers, wholesalers, distributors, manufacturers, suppliers

What Is a Supply Chain? (3 of 3)

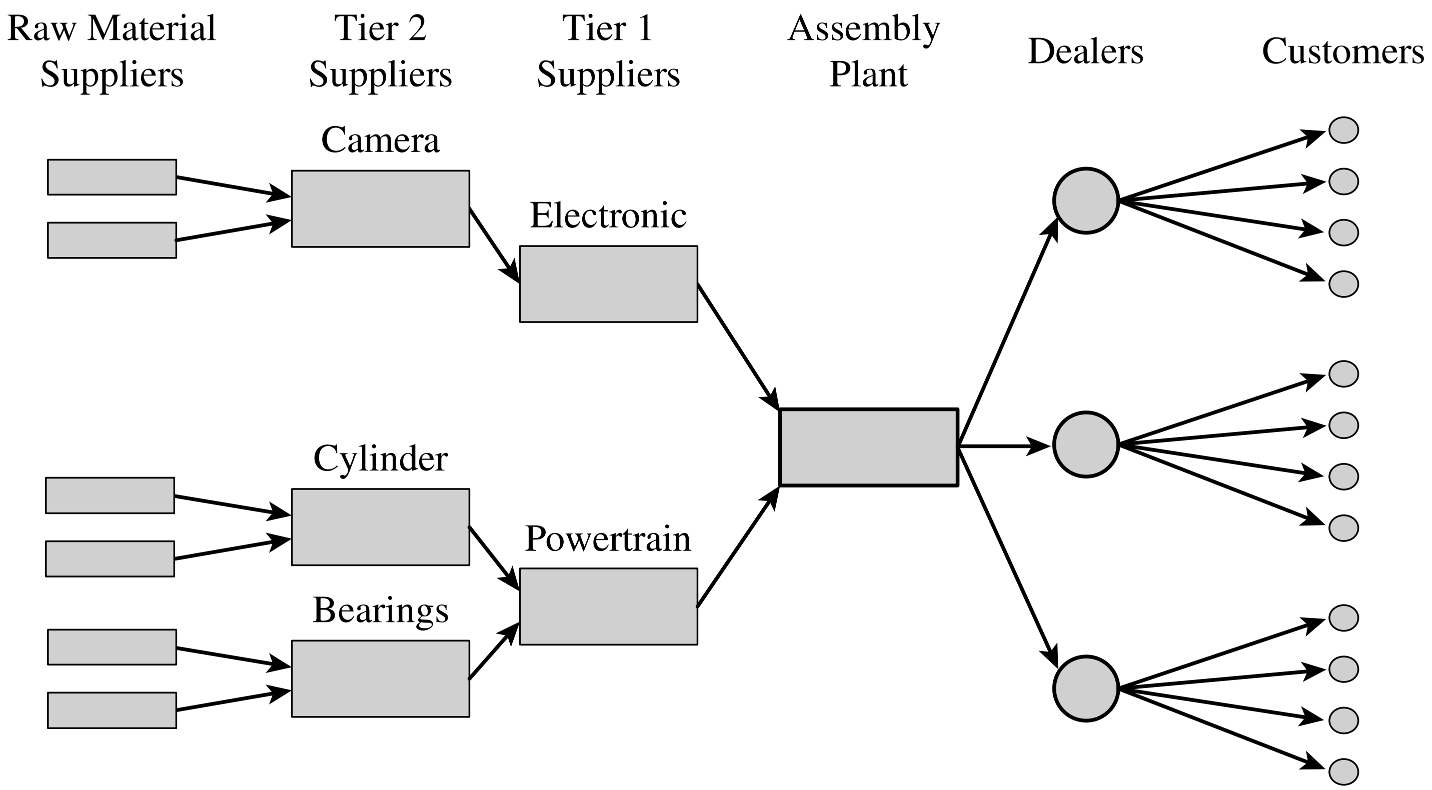


Figure 1-1 Stages of an Automotive Supply Chain

Flows in a Supply Chain

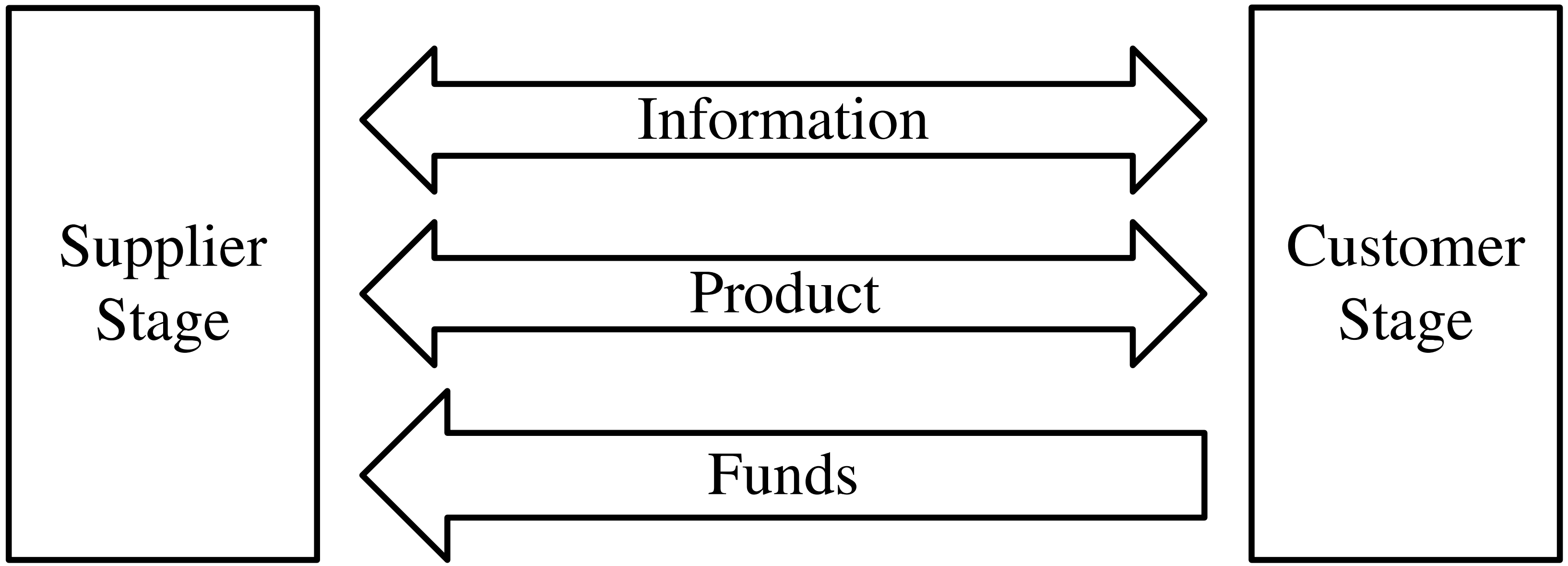


Figure 1-2 The Three Flows in a Supply Chain

The Objective of a Supply Chain (1 of 3)

- Maximize net value generated

Supply Chain Surplus =

Customer Value − Supply Chain Cost

The Objective of a Supply Chain (2 of 3)

Example: a customer purchases a wireless router from Best Buy for $60 (revenue)

Supply chain incurs costs (convey information, produce components, storage, transportation, transfer funds, etc.)

Difference between $60 and the sum of all of these costs is the supply chain profitability

Supply chain profitability is total profit to be shared across all stages of the supply chain

Success should be measured by total supply chain surplus, not profits at an individual stage

The Objective of a Supply Chain (3 of 3)

- Customer the only source of revenue
- Sources of cost include flows of information, products, or funds between stages of the supply chain
- Effective **supply chain management** involves the management of supply chain assets and product, information, and fund flows to grow the total supply chain surplus

Importance of Supply Chain Decisions

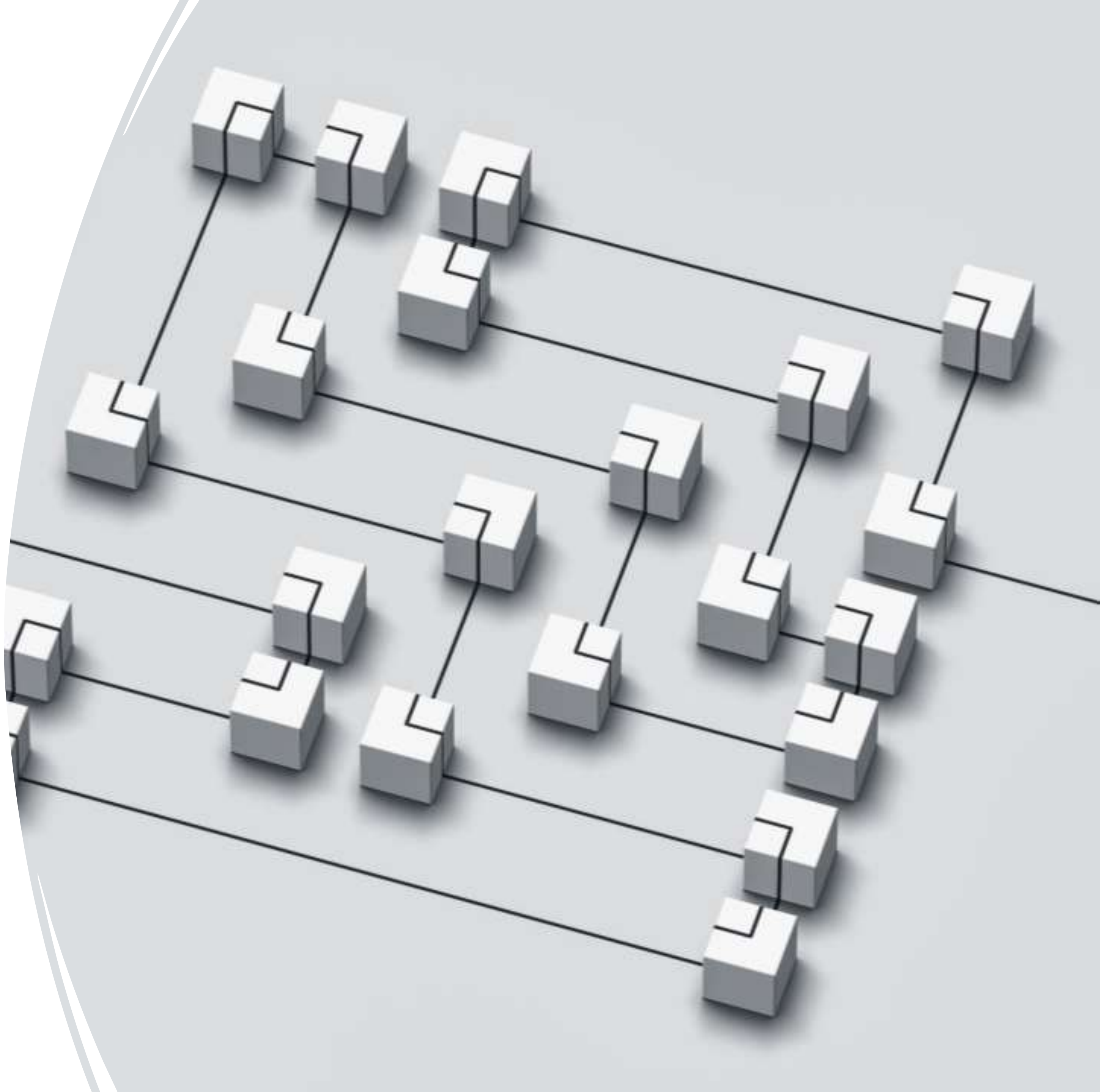
- Wal-Mart, $1 billion sales in 1980 to $482 billion in 2016
- Seven-Eleven Japan, ¥1 billion sales in 1974 to ¥2.7 trillion in 2016
- Webvan folded in two years
- Borders, $4 billion in 2004, declared bankruptcy in 2010
- Dell, $56 billion in 2006, adopted new supply chain strategies

Summary of Learning Objective 1

The goal of a supply chain should be to grow overall supply chain surplus. Supply chain surplus is the difference between the value generated for the customer and the total cost incurred across all stages of the supply chain. A focus on the supply chain surplus increases the size of the overall pie for all members of the supply chain. Supply chain decisions have a large impact on the success or failure of each firm because they significantly influence both the revenue generated and the cost incurred. Successful supply chains manage flows of product, information, and funds to provide a high level of product availability to the customer while keeping costs low.

Decision Phases in a Supply Chain

1. Supply chain strategy or design
   - How to structure the supply chain over the next several years
2. Supply chain planning
   - Decisions over the next quarter or year
3. Supply chain operation
   - Daily or weekly operational decisions



Supply Chain Strategy or Design

- Decisions about the configuration of the supply chain, allocation of resources, and what processes each stage will perform
- Strategic supply chain decisions
  - Outsource supply chain functions
  - Locations and capacities of facilities
  - Products to be made or stored at various locations
  - Modes of transportation
  - Information systems
- Supply chain design must support strategic objectives
- Supply chain design decisions are long-term and expensive to reverse – must take into account market uncertainty

Supply Chain Planning (1 of 2)

DEFINITION OF A SET OF POLICIES THAT GOVERN SHORT-TERM OPERATIONS

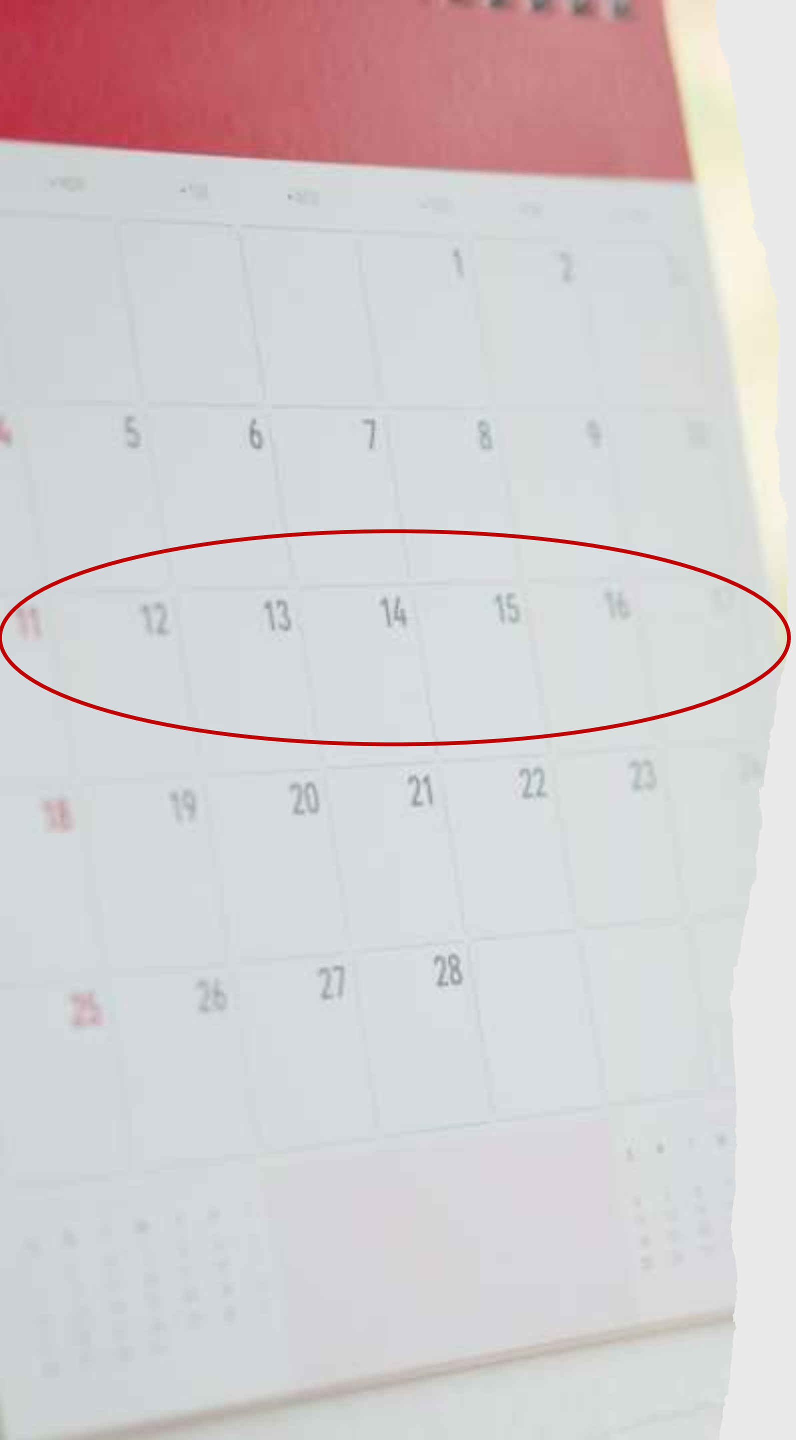
FIXED BY THE SUPPLY CONFIGURATION FROM STRATEGIC PHASE

GOAL IS TO MAXIMIZE SUPPLY CHAIN SURPLUS GIVEN ESTABLISHED CONSTRAINTS

STARTS WITH A FORECAST OF DEMAND IN THE COMING YEAR

Supply Chain Planning (2 of 2)

- Planning decisions:
  - Which markets will be supplied from which locations
  - Planned buildup of inventories
  - Subcontracting
  - Inventory policies
  - Timing and size of market promotions
- Must consider demand uncertainty, exchange rates, competition over the time horizon in planning decisions



Supply Chain Operation

- Time horizon is weekly or daily
- Decisions regarding individual customer orders
- Supply chain configuration is fixed and planning policies are defined
- Goal is to handle incoming customer orders as effectively as possible
- Allocate orders to inventory or production, set order due dates, generate pick lists at a warehouse, allocate an order to a particular shipment, set delivery schedules, place replenishment orders
- Much less uncertainty (short time horizon)

Summary of Learning Objective 2

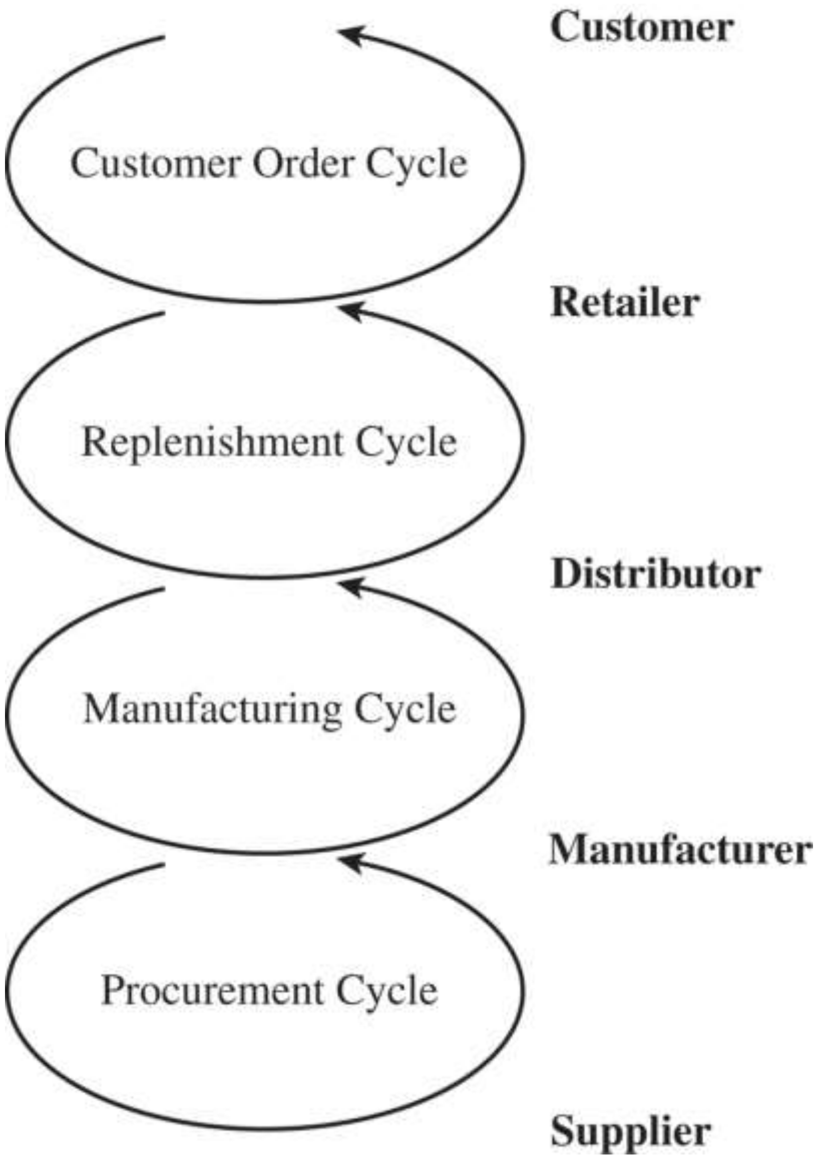
Supply chain decisions may be characterized as strategic (design), planning, or operational, depending on the time horizon over which they apply. Strategic decisions relate to supply chain configuration. These decisions have a long-term impact that lasts for several years. Strategic decisions define the constraints for planning decisions, and planning decisions define the constraints for operational decisions. Planning decisions cover a period of a few months to a year and include decisions regarding production plans, subcontracting, and promotions over that period. Operational decisions span from minutes to days and include sequencing production and filling specific orders.

Process Views of a Supply Chain

1. **Cycle View:** The processes in a supply chain are divided into a series of cycles, each performed at the interface between two successive stages of the supply chain.
2. **Push/Pull View:** The processes in a supply chain are divided into two categories, depending on whether they are executed in response to a customer order or in anticipation of customer orders. **Pull** processes are initiated by a customer order, whereas **push** processes are initiated and performed in anticipation of customer orders.

Cycle View of Supply Chain Processes (1 of 2)

Figure 1-3 Supply Chain Process Cycles



Cycle View of Supply Chain Processes (2 of 2)

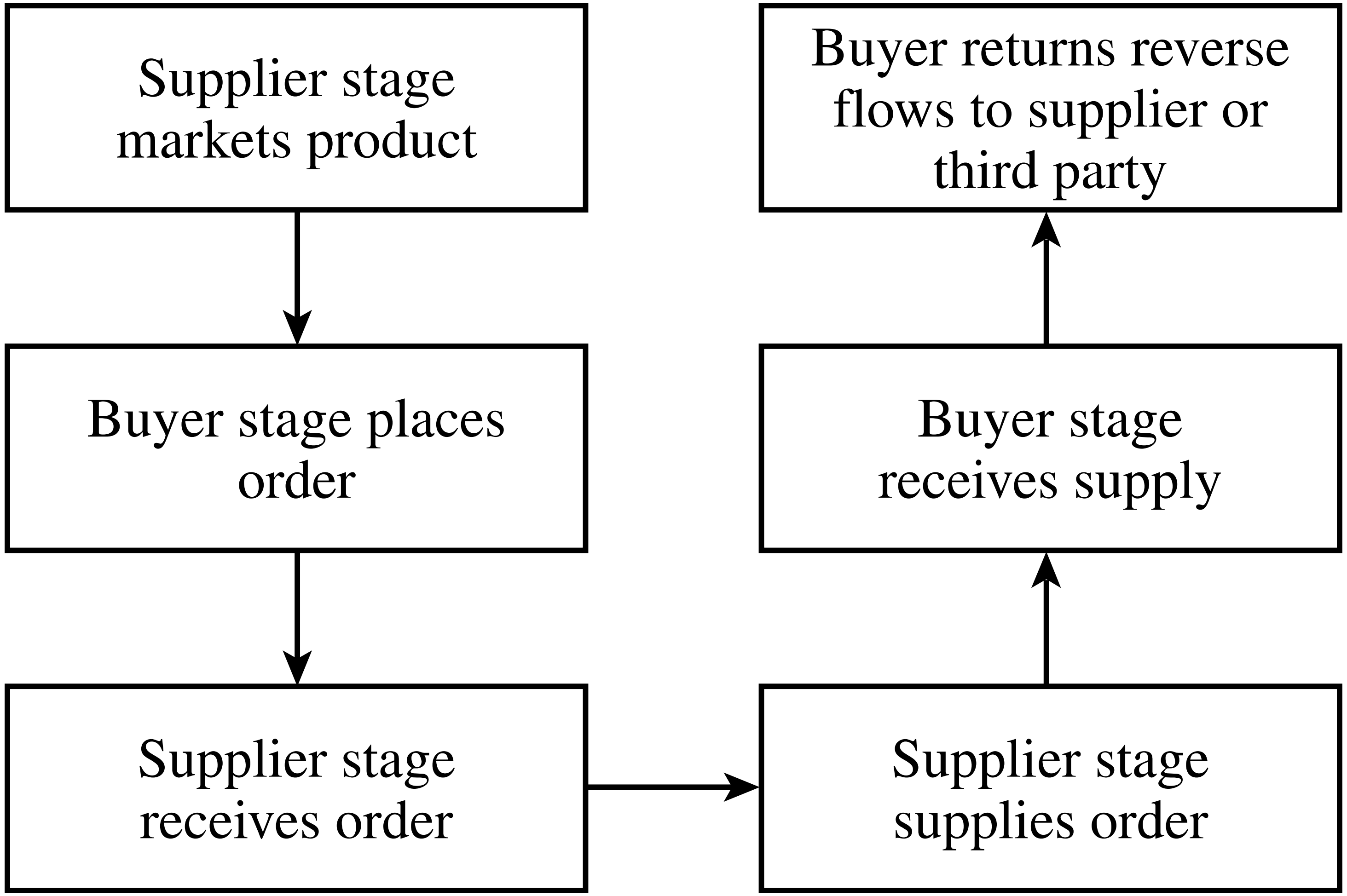
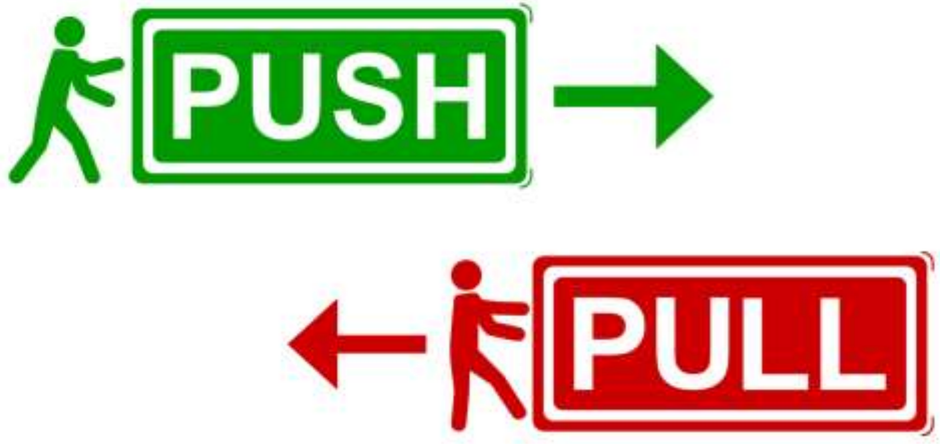


Figure 1-4 Subprocesses in Each Supply Chain Process Cycle

Push/Pull View of Supply Chain Processes

- Supply chain processes fall into one of two categories depending on the timing of their execution relative to customer demand
- Pull: execution is initiated in response to a customer order (**reactive**)
- Push: execution is initiated in anticipation of customer orders (**speculative**)
- **Push/pull boundary** separates push processes from pull processes



https://studiok40.com/using-push-pull-classes-with-visual-composer/

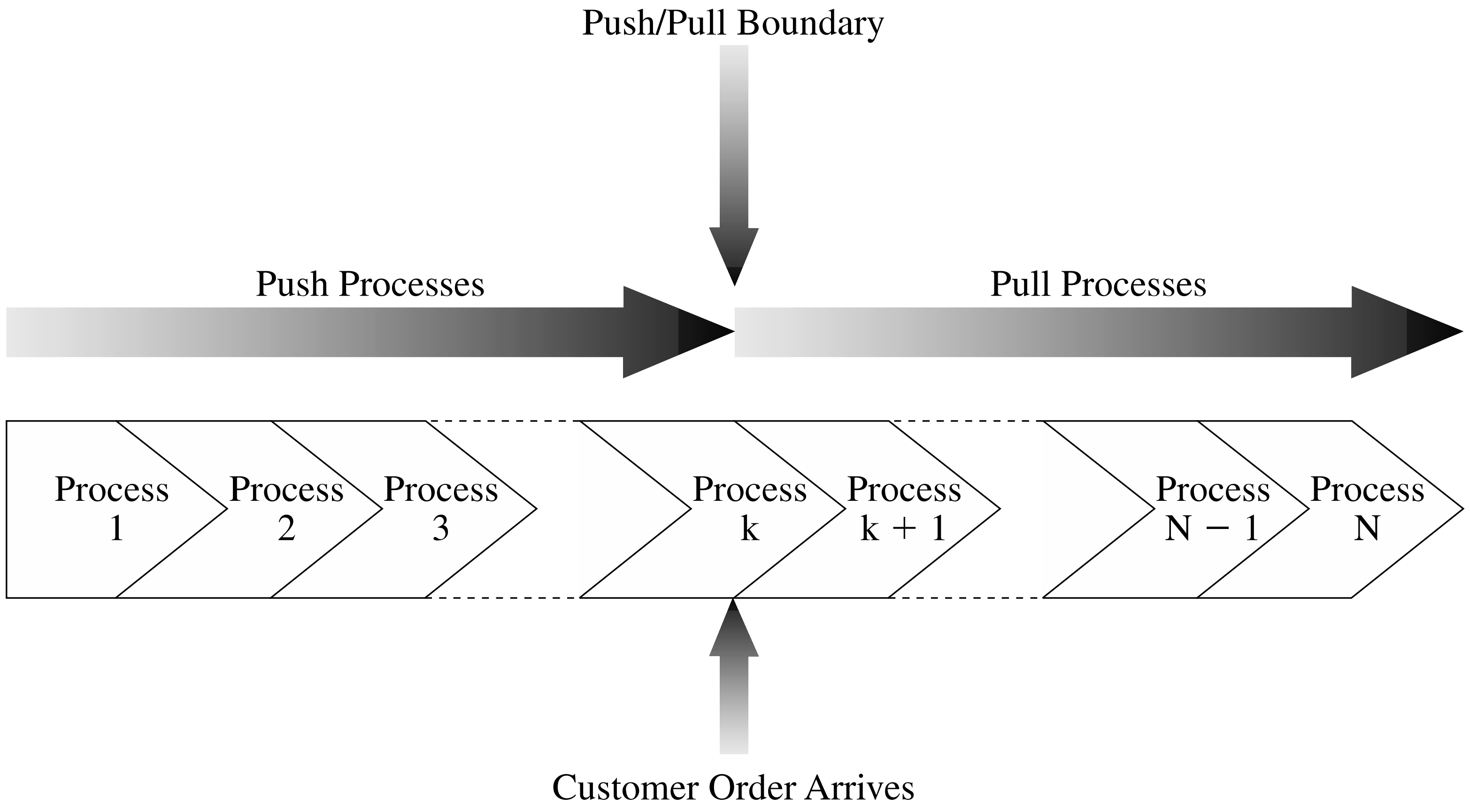
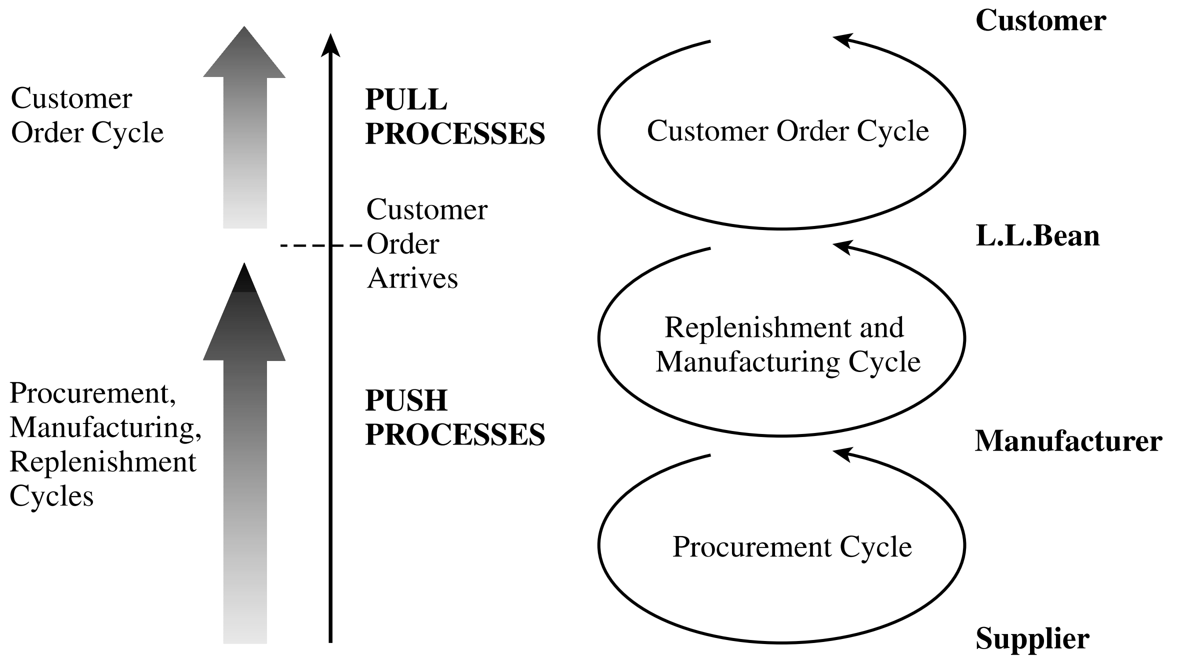


Figure 1-5 Push/Pull View of Supply Chains

Push/Pull View –> L . L. Bean

Figure 1-6 Push/Pull Processes for the L. L. Bean Supply Chain



Push/Pull View –> Ethan Allen

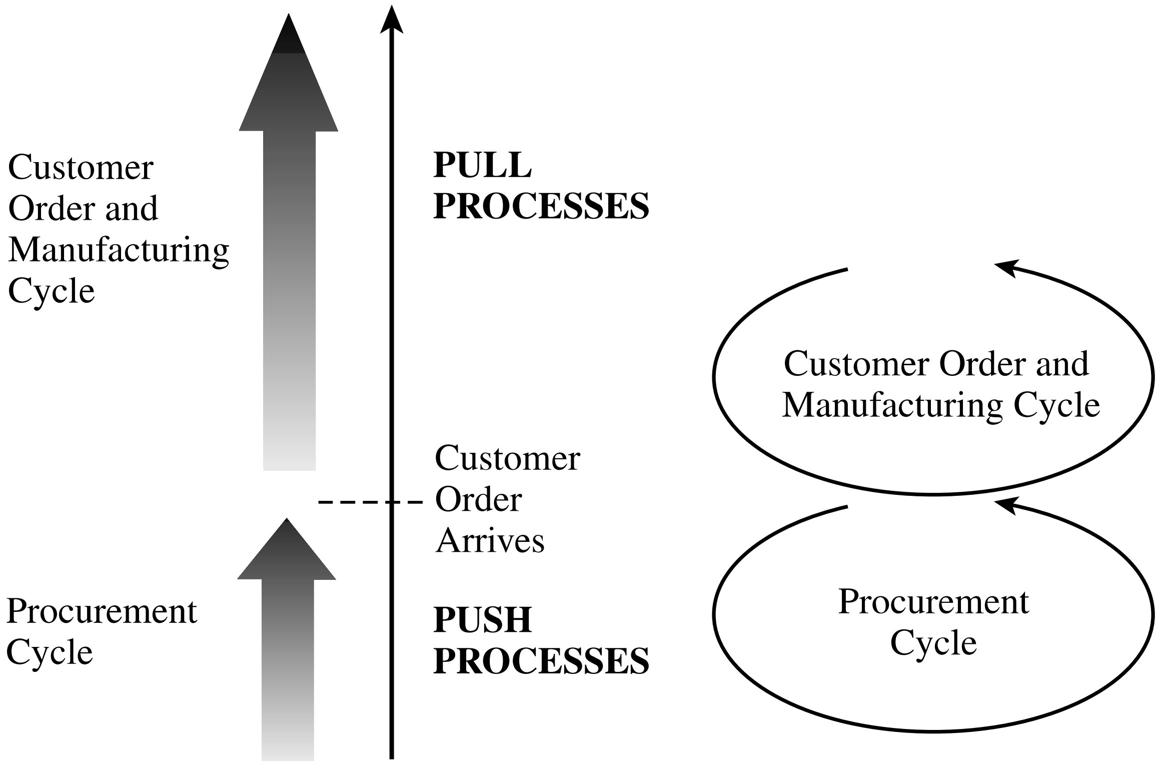


Figure 1-7 Push/Pull Processes for Ethan Allen Supply Chain for Customized Furniture

Supply Chain Macro Processes

Supply chain processes discussed in the two views can be classified into

1. Customer Relationship Management (C R M):

- all processes at the interface between the firm and its customers

2. Internal Supply Chain Management (I S C M):

- all processes that are internal to the firm

3. Supplier Relationship Management (S R M):

- all processes at the interface between the firm and its suppliers

Supplier	Firm	Customer
SRM	ISCM	CRM

SRM
- Source
- Negotiate
- Buy
- Design Collaboration
- Supply Collaboration

ISCM
- Strategic Planning
- Demand Planning
- Supply Planning
- Fulfillment
- Field Service

CRM
- Market
- Price
- Sell
- Call Center
- Order Management

Figure 1-8 Supply Chain Macro Processes

Summary of Learning Objective 3

The cycle view divides processes into cycles, each performed at the interface between two successive stages of a supply chain. Each cycle starts with an order placed by one stage of the supply chain and ends when the order is received from the supplier stage. A push/pull view of a supply chain characterizes processes based on their timing relative to that of a customer order. Pull processes are performed in response to a customer order, whereas push processes are performed in anticipation of customer orders.

All supply chain processes within a firm can be classified into three macro processes: CRM, ISCM, and SRM. The CRM macro process consists of all processes at the interface between the firm and the customer that work to generate, receive, and track customer orders. The ISCM macro process consists of all supply chain processes that are internal to the firm and work to plan for and fulfill customer orders. The SRM macro process consists of all supply chain processes at the inter-face between the firm and its suppliers that work to evaluate and select suppliers and then source goods and services from them. Integration among the three macro processes is crucial for successful supply chain management.

https://oneeducatorsopinion.wordpress.com/2014/02/26/brain-breaks-are-good-for-teachers-too/

Examples of Supply Chains

- Gateway & Apple
- Zara
- W.W. Grainger & McMaster-Carr
- Toyota
- Amazon
- Macy’s

Gateway (Acer) and Apple

1. Why did Gateway choose not to carry any finished-product inventory at its retail stores? Why did Apple choose to carry inventory at its stores?
2. What are the characteristics of products that are most suitable to be carried in finished-goods inventory in a retail store? What characterizes products that are best manufactured to order?
3. How does product variety affect the level of inventory a retail store must carry?
4. Is a direct selling supply chain without retail stores always less expensive than a supply chain with retail stores?
5. What factors explain the success of Apple retail and the failure of Gateway Country stores?

Gateway

Zara

1. What advantage does Zara gain against the competition by having a very responsive supply chain?
2. Why has Inditex chosen to have both in-house manufacturing and outsourced manufacturing? Why has Inditex maintained manufacturing capacity in Europe even though manufacturing in Asia is much cheaper?
3. Why does Zara source products with uncertain demand from local manufacturers and products with predictable demand from Asian manufacturers?
4. What advantage does Zara gain from replenishing its stores multiple times a week compared to a less frequent schedule?
5. Do you think Zara's responsive replenishment infrastructure is better suited for online sales or retail sales?

W.W. Grainger and McMaster-Carr

1. How many DCs should be built and where should they be located?
2. How should product stocking be managed at the DCs? Should all DCs carry all products?
3. What products should be carried in inventory and what products should be left with the supplier to be shipped directly in response to a customer order?
4. What products should W.W. Grainger carry at a store?
5. How should markets be allocated to DCs in terms of order fulfillment? What should be done if an order cannot be completely filled from a DC? Should there be specified backup locations? How should they be selected?

Toyota

1. Where should the plants be located, and what degree of flexibility should be built into each? What capacity should each plant have?
2. Should plants be able to produce for all markets or only for specific contingency markets?
3. How should markets be allocated to plants and how frequently should this allocation be revised?
4. How should the investment in flexibility be valued?

Amazon

1. Why is Amazon building more warehouses as it grows? How many warehouses should it have, and where should they be located?
2. Should Amazon stock every product it sells?
3. What advantage can online players derive from setting up a brick-and-mortar location? How should they use the two channels to gain maximum advantage?
4. What advantages and disadvantages does the online channel enjoy in the sale of shoes and diapers relative to a retail store?
5. For what products does the online channel offer the greater advantage relative to retail stores? What characterizes these products?

Macy’s and W.W. Grainger

1. Should online orders be filled from stores or fulfillment centers? What role(s) should each facility play?
2. How should store inventories be managed in an omni-channel setting?
3. Should returns be kept at a store or sent to a fulfillment center?

Group breakout instructions

- For your assigned company(ies), do a quick investigation of the supply chain(s)
- Answer the questions posed considering:
  - Where to locate facilities? How to size them?
  - Where is the push/pull boundary?
  - What modes of transport to use?
  - How much inventory to carry? In what form?
  - Where to source from?

https://www.etsy.com/hk-en/listing/555248235/break-dance-clipart-vector-svg-break

Summary of Learning Objective 4

At a strategic level, a supply chain designer must decide whether to build a responsive supply chain like Zara or focus on lower costs. A decision must be made on the location and capacity of each facility and whether it will be dedicated or flexible in terms of the products it produces and markets it serves. The designer must decide whether products will be sold directly to customers, through distributors like Grainger, or through brick-and-mortar retailers like Macy’s. If opting for omni-channel retail, the designer must decide which facilities will fulfill different customer orders.

The planner must then decide on the production levels at each production site and inventory levels at each D C and retail store. As customer orders arrive, the operations manager must decide how each order will be fulfilled given the available inventory and production schedule. The goal when making all these decisions is to maximize the supply chain surplus.

Developing Skills for Your Career

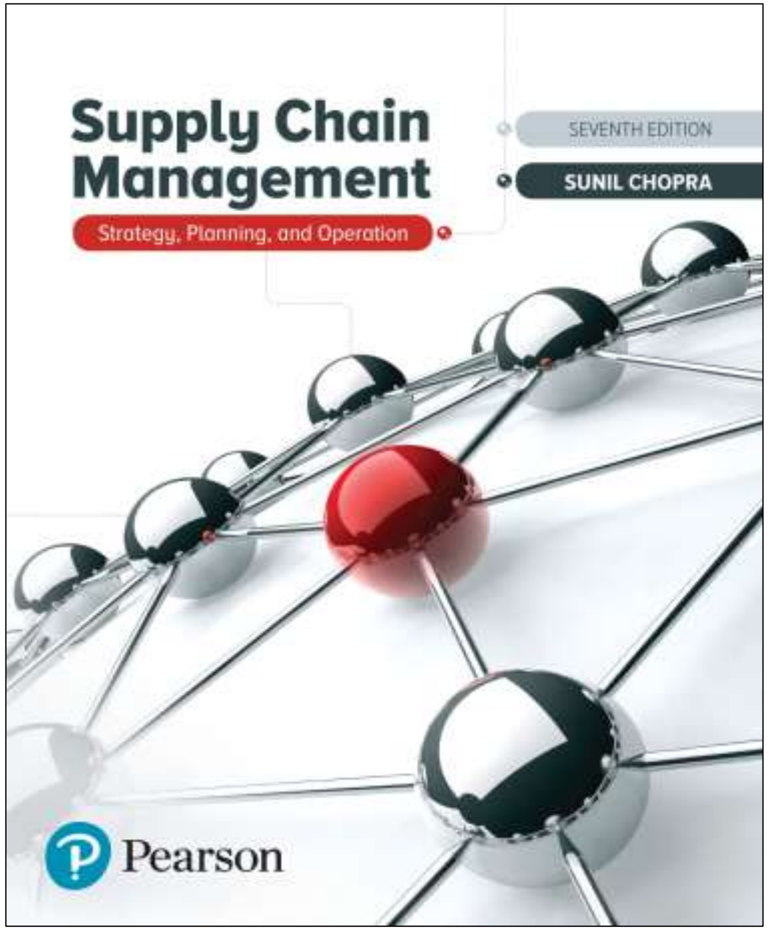
- Lessons learned in this book will help develop career skills no matter what path you take
- Employers have identified communication, critical thinking, collaboration, knowledge application and analysis, business ethics and social responsibility, data literacy, and information technology application and computing skills as critical
- Link between strategic decision making and analytics

Summary of Learning Objective 5

Skills learned in this book will be of great use no matter what path students choose to follow. The book is developed with the premise that good strategic decisions cannot be made without access to relevant analytics, and all analytics should be designed to support decision making. As a result, students will develop critical thinking, the ability to formulate and analyze problems, and support their recommendations with analytics that uses data literacy and computing skills.

Supply Chain Management: Strategy, Planning, and Operation

Seventh Edition



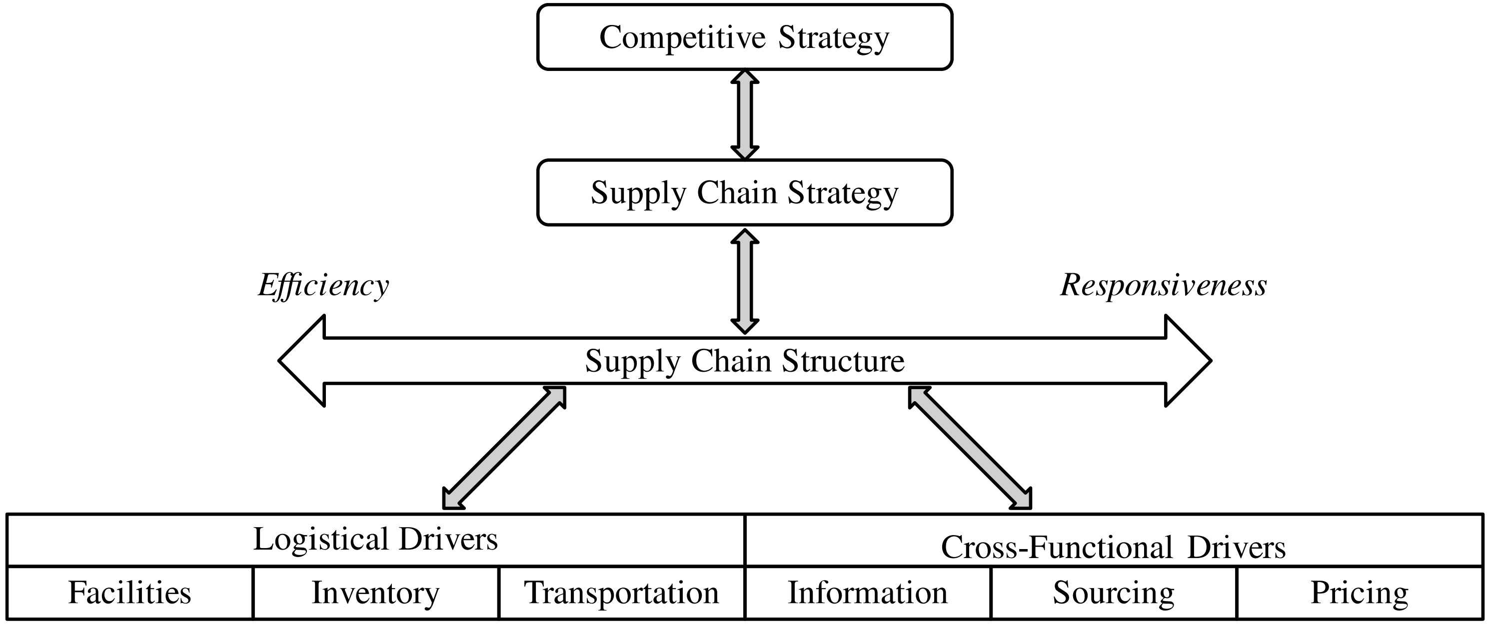
Chapter 3

Supply Chain Drivers and Metrics

See video posted module 1

Framework for Supply Chain Decisions

Figure 3-1 Supply Chain Decision-Making Framework



Facilities (1 of 3)

- Role in the supply chain
  - Production sites and storage sites
  - Increase responsiveness by increasing the number of facilities, making them more flexible, or increasing capacity
- Tradeoffs between facility, inventory, and transportation costs
  - Increasing number of facilities increases facility and inventory costs, decreases transportation costs and reduces response time
  - Increasing the flexibility or capacity of a facility increases facility costs but decreases inventory costs and response time

Facilities (2 of 3)

- Components of facilities decisions
  - **Capability**
    - Flexible, dedicated, or a combination of the two
    - Product focus or a functional focus
  - **Location**
    - Where a company will locate its facilities
    - Centralize for economies of scale, decentralize for responsiveness
    - Consider macroeconomic factors, quality of workers, cost of workers and facility, availability of infrastructure, proximity to customers, location of other facilities, tax effects
  - **Capacity**
    - A facility's capacity to perform its intended function or functions
    - Excess capacity – responsive, costly
    - Little excess capacity – more efficient, less responsive
  - **Demand Allocation**
    - Markets each facility will serve
    - Revisited as conditions change

Facilities (3 of 3)

- **Facility-Related Metrics**
  - Capacity
  - Utilization
  - Processing/setup/down/idle time
  - Quality losses
  - Production cost per unit
  - Theoretical flow/cycle time of production
  - Actual average flow/cycle time
  - Product variety
  - Volume contribution of top 20 percent S K U ' s and customers
  - Average production batch size
  - Production service level

Inventory

- **Role in the Supply Chain**
  - Mismatch between supply and demand
  - Exploit economies of scale
  - Reduce costs
  - Improve product availability
  - Affects assets, costs, responsiveness, material flow time
- **Overall Trade-Off**
  - Increasing inventory generally makes the supply chain more responsive
  - A higher level of inventory facilitates a reduction in production and transportation costs because of improved economies of scale
  - Inventory holding costs increase

Components of Inventory Decisions (1 of 3)

Cycle Inventory

- Average amount of inventory used to satisfy demand between supplier shipments
- Function of lot size decisions

Safety Inventory

- Inventory held in case demand exceeds expectations
- Costs of carrying too much inventory versus cost of losing sales

Components of Inventory Decisions (2 of 3)

- **Seasonal Inventory**
  - Inventory built up to counter predictable variability in demand
  - Cost of carrying additional inventory versus cost of flexible production
- **Level of Product Availability**
  - The fraction of demand that is served on time from product held in inventory
  - Trade off between customer service and cost
- **Inventory-Related Metrics**
  - C 2 C cycle time
  - Average inventory
  - Inventory turns
  - Products with more than a specified number of days of inventory
  - Average replenishment batch size

Components of Inventory Decisions (3 of 3)

- Average safety inventory
- Seasonal inventory
- Fill rate
- Fraction of time out of stock
- Obsolete inventory

Transportation (1 of 4)

- **Role in the Supply Chain**
  - Moves inventory between stages in the supply chain
  - Affects responsiveness and efficiency
  - Faster transportation allows greater responsiveness but lower efficiency
  - Also affects inventory and facilities
  - Allows a firm to adjust the location of its facilities and inventory to find the right balance between responsiveness and efficiency

Transportation (2 of 4)

- **Components of Transportation Decisions**
  - **Design of transportation network**
    - Modes, locations, and routes
    - Direct or with intermediate consolidation points
    - One or multiple supply or demand points in a single run
  - **Choice of transportation mode**
    - Air, truck, rail, sea, and pipeline
    - Information goods via the Internet
    - Different speed, size of shipments, cost of shipping, and flexibility

Transportation (3 of 4)

- **Transportation-Related Metrics**
  - Average inbound transportation cost
  - Average income shipment size
  - Average inbound transportation cost per shipment
  - Average outbound transportation cost
  - Average outbound shipment size
  - Average outbound transportation cost per shipment
  - Fraction transported by mode

Transportation (4 of 4)

- **Overall Trade-off: Responsiveness Versus Efficiency**
  - The *cost* of transporting a given product (efficiency) and the *speed* with which that product is transported (responsiveness)
  - Using fast modes of transport raises responsiveness and transportation cost but lowers the inventory holding cost

Information

- **Role in the Supply Chain**
  - Improve the utilization of supply chain assets and the coordination of supply chain flows to increase responsiveness and reduce cost
  - Information is a key driver that can be used to provide higher responsiveness while simultaneously improving efficiency
- **Role in the Competitive Strategy**
  - Improves visibility of transactions and coordination of decisions across the supply chain
  - Right information can help a supply chain better meet customer needs at lower cost
  - More information increases complexity and cost of both infrastructure and analysis exponentially while marginal value diminishes
  - Share the minimum amount of information required to achieve coordination

Components of Information Decisions (1 of 2)

- **Demand Planning**
  - Best estimate of future demand
  - Include estimation of forecast error
- **Coordination and Information Sharing**
  - **Supply chain coordination,** all stages of a supply chain work toward the objective of maximizing total supply chain profitability based on shared information
  - Critical for success

Components of Information Decisions (2 of 2)

- **Sales and Operations Planning** (S & O P)
  - The process of creating an overall supply plan (production and inventories) to meet the anticipated level of demand (sales)
  - Can be used to plan supply chain needs and project revenues and profits
- **Information-Related Metrics**
  - Forecast horizon
  - Frequency of update
  - Forecast error
  - Variance from plan
  - Ratio of demand variability to order variability

Sourcing

- **Role in the Supply Chain**
  - Set of business processes required to purchase goods and services
  - Will tasks be performed by a source internal to the company or a third party
  - Should increase the size of the total surplus to be shared across the supply chain
- **Role in the Competitive Strategy**
  - Sourcing decisions are crucial because they affect the level of efficiency and responsiveness in a supply chain
  - Outsource to responsive third parties if it is too expensive to develop their own
  - Keep responsive process in-house to maintain control

Components of Sourcing Decisions (1 of 2)

- **In-House or Outsource**
  - Perform a task in-house or outsource it to a third party
  - Outsource if it raises the supply chain surplus more than the firm can on its own
  - Keep function in-house if the third party cannot increase the supply chain surplus or if the outsourcing risk is significant
- **Supplier Selection**
  - Number of suppliers, criteria for evaluation and selection
- **Procurement**
  - Obtain goods and service within a supply chain
  - Goal is to decrease total cost of ownership and increase supply chain surplus

Components of Sourcing Decisions (2 of 2)

- **Sourcing-Related Metrics**
  - Days payable outstanding
  - Average purchase price
  - Range of purchase price
  - Average purchase quantity
  - Supply quality
  - Supply lead time
  - Percentage of on-time deliveries
  - Supplier reliability

Pricing

- **Role in the Supply Chain**
  - Pricing determines the amount to charge customers for goods and services
  - Affects the supply chain level of responsiveness required and the demand profile the supply chain attempts to serve
  - Pricing strategies can be used to match demand and supply
  - Objective should be to increase firm profit

Components of Pricing Decisions (1 of 2)

- **Pricing and Economies of Scale**
  - The provider of the activity must decide how to price it appropriately to reflect economies of scale
- **Everyday Low Pricing Versus High-Low Pricing**
  - Different pricing strategies lead to different demand profiles that the supply chain must serve
- **Fixed Price Versus Menu Pricing**
  - If marginal supply chain costs or the value to the customer vary significantly along some attribute, it is often effective to have a pricing menu
  - Can lead to customer behavior that has a negative impact on profits

Components of Pricing Decisions (2 of 2)

- **Pricing-Related Metrics**
  - Profit margin
  - Days sales outstanding
  - Incremental fixed cost per order
  - Incremental variable cost per unit
  - Average sale price
  - Average order size
  - Range of sale price
  - Range of periodic sales

Case study 1: 7 Eleven

- Announce teams for case
- Assignment
    - Read case in text pages 61-67 and answer questions on page 67
    - Responses to be in narrative format
    - Include all referenced works; supplemental info welcomed but not required (use APA or MLA format)
    - Include team member names on document
    - Team lead: coordinate meeting, insure posted on BB
    - Rubric posted (content/module 1/week 1/assignments)
- Due before class on 3/23

Would you buy sushi at 7-11?

https://www.firstcoastnews.com/article/news/local/people-are-more-concerned-that-walgreens-sells-sushi-than-they-are-about-listeria-recall/77-62e4bacf-7558-4f89-84cb-c245232b22e1

Group 1

Last Name ▲ , First Name, Username, Org Defined ID
Ahadiat, Parisa, parisa.ahadiat.6508A6D578A7N5, 029365867 ★
Alfaro, Marugenia, marugenia.alfaro.8495B2D543B1S5, 016885321
Alramahi, Ehab, ehab.alramahi.7501E9D57932N3, 029373992
Ang, Paul, paul.ang.850AB1D57994N6, 029386914

Group 2

Last Name ▲ , First Name, Username, Org Defined ID
Beisecker, Kelsey, kelsey.beisecker.949735D49168L7, 011197158 ★
Bui, Cindy, cindy.bui.050159D566D8K0, 028000698
Collier, Nicole, nicole.collier.550593D56723O1, 028451733
Contreras, Stephanie, stephanie.contreras.449360D50573N8, 012348503

Group 3

Last Name ▲ , First Name, Username, Org Defined ID
Dizon, Ric, ric.dizon.8509B7D54767Q8, 026688777 ★
Euceda Iscoa, Marlon, marlon.eucedaiscoa.850509D570C0N1, 029381090
Freeman, Annie, annie.freeman.649D92D49644Q3, 011663624
Galleta, Beda, beda.galleta.749388D52088Q6, 014676088

Group 4

Last Name ▲ , First Name, Username, Org Defined ID
Ghazaryan, Shushanik, shushanik.ghazaryan.850864D57668N0, 029380648 ★
Gonzalez-Aguayo, Gisela, gisela.gonzalezaguayo.8487E9D53903P4, 005584993
Guelff, Michelle, michelle.guelff.8501B6D57355N3, 029383365
Han, Chris, chris.han.850499D577B7N6, 029386797

Group 5

Last Name ▲ , First Name, Username, Org Defined ID
Joshua, Jonathan, jonathan.joshua.850F60D57345N8, 029388305 ★
Kariuki, Janet, janet.kariuki.849B95D55265R1, 017781255
Khachatryan, Marieta, marieta.khachatryan.850688D57553N0, 029380583
Khafajizadeh, Bina, bina.khafajizadeh.549681D524F0T9, 014959410

Group 6

Last Name ▲ , First Name, Username, Org Defined ID
Lopez, Ruben, ruben.lopez.649919D49673M4, 011264693 ★
Magallon, Dominick, dominick.magallon.349915D539C7Q6, 015636957
Matthews, Olivia, olivia.matthews.0481A8D525C6M2, 004202586
Nguyen, Jessica, jessica.nguyen.248767D577B3M5, 009225773

Group 7

Last Name ▲ , First Name, Username, Org Defined ID
Perez, Melissa, melissa.perez.850408D572F8N4, 029384288 ★
Ramirez, Lizbeth, lizbeth.ramirez.849AC2D547B8S9, 016889728
Redfearn, Joe, joe.redfearn.350544D56725L8, 028138745
Rodgers, Samuel, samuel.rodgers.050771D56493K1, 028001413

Group 8

Last Name ▲ , First Name, Username, Org Defined ID
Sampson, Ivy, ivy.sampson.849382D52231M9, 014289221 ★
Vidovich, Mikaela, mikaela.vidovich.549925D54574N1, 016351554
Wand, Kelly, kelly.wand.849E42D49325L2, 011182325
Weiss-Varela, Samantha, samantha.weissvarela.0499F8D51390L9, 013109380

To do before next class

Homework

- Academic Integrity stmt – read and post your name in dropbox, due 3/17
- Discussion board "get to know you", due 3/17

Team Project: Case Study

- 7-11 Team case study (text, p.61-67)
  - Meet with your team to discuss and answer questions on page 67
  - Team lead post response before next class on 3/23

Prepare for Module 4/ week 9

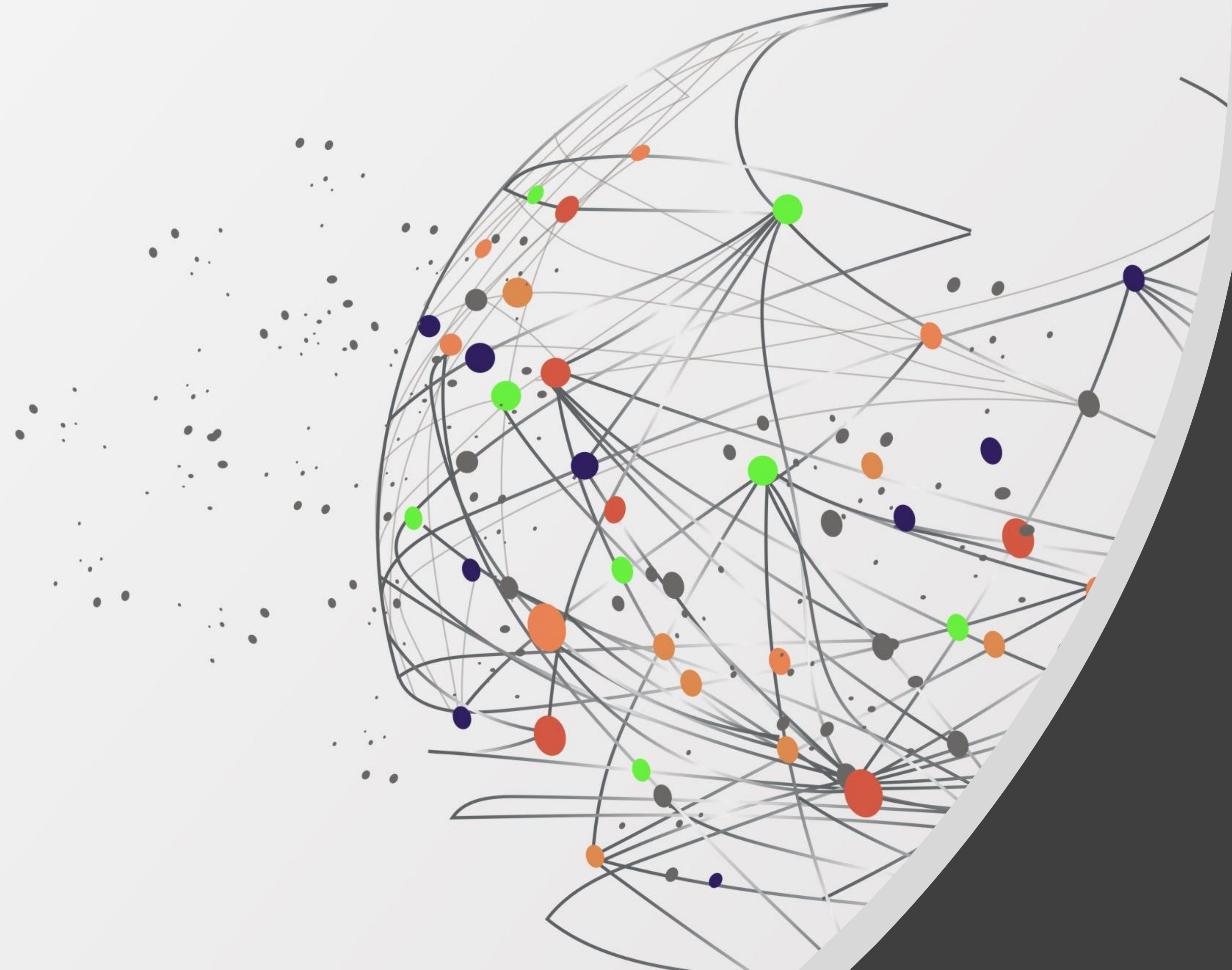
- Skim chapter 7 FCing); take quiz (will be posted by Sunday night)
- View chapter 3 video
- Read articles:
  - Managing Risk To Avoid Supply-Chain Breakdowns
  - What is the Right Supply Chain for Your Product?
  - Integrating Supply and Demand

I am available to answer your questions! Please drop in my office hrs Tues 1-2pm or schedule time.

TEAM MEETINGS

https://brooksgroup.com/sales-training-blog/sales-coaching-best-practices-series-team-meetings

Copyright



Coordinating Demand & Supply

SCM614

Week 2

Agenda

- Breakout (postponed from week 1) - PP
- Chapter 3: Financial measures of performance
- Case study 7-11 discussion
- Chapter 7: demand forecasting & accuracy with some problems
- Break
- Breakout into teams for next case study
- Summary of upcoming class activities

Examples of Supply Chains

- Gateway & Apple
- Zara
- W.W. Grainger & McMaster-Carr
- Toyota
- Amazon
- Macy’s

Gateway (Acer) and Apple

1. Why did Gateway choose not to carry any finished-product inventory at its retail stores? Why did Apple choose to carry inventory at its stores?
2. What are the characteristics of products that are most suitable to be carried in finished-goods inventory in a retail store? What characterizes products that are best manufactured to order?
3. How does product variety affect the level of inventory a retail store must carry?
4. Is a direct selling supply chain without retail stores always less expensive than a supply chain with retail stores?
5. What factors explain the success of Apple retail and the failure of Gateway Country stores?

Zara

1. What advantage does Zara gain against the competition by having a very responsive supply chain?
2. Why has Inditex chosen to have both in-house manufacturing and outsourced manufacturing? Why has Inditex maintained manufacturing capacity in Europe even though manufacturing in Asia is much cheaper?
3. Why does Zara source products with uncertain demand from local manufacturers and products with predictable demand from Asian manufacturers?
4. What advantage does Zara gain from replenishing its stores multiple times a week compared to a less frequent schedule?
5. Do you think Zara’s responsive replenishment infrastructure is better suited for online sales or retail sales?

W.W. Grainger and McMaster-Carr

1. How many DCs should be built and where should they be located?
2. How should product stocking be managed at the DCs? Should all DCs carry all products?
3. What products should be carried in inventory and what products should be left with the supplier to be shipped directly in response to a customer order?
4. What products should W.W. Grainger carry at a store?
5. How should markets be allocated to DCs in terms of order fulfillment? What should be done if an order cannot be completely filled from a DC? Should there be specified backup locations? How should they be selected?

Toyota

1. Where should the plants be located, and what degree of flexibility should be built into each? What capacity should each plant have?
2. Should plants be able to produce for all markets or only for specific contingency markets?
3. How should markets be allocated to plants and how frequently should this allocation be revised?
4. How should the investment in flexibility be valued?

Amazon

1. Why is Amazon building more warehouses as it grows? How many warehouses should it have, and where should they be located?
2. Should Amazon stock every product it sells?
3. What advantage can online players derive from setting up a brick-and-mortar location? How should they use the two channels to gain maximum advantage?
4. What advantages and disadvantages does the online channel enjoy in the sale of shoes and diapers relative to a retail store?
5. For what products does the online channel offer the greater advantage relative to retail stores? What characterizes these products?

Macy’s and W.W. Grainger

1. Should online orders be filled from stores or fulfillment centers? What role(s) should each facility play?
2. How should store inventories be managed in an omni-channel setting?
3. Should returns be kept at a store or sent to a fulfillment center?

Group breakout instructions

- For your assigned company(ies), do a quick investigation of the supply chain(s)
- Answer the questions posed considering:
  - Where to locate facilities? How to size them?
  - Where is the push/pull boundary?
  - What modes of transport to use?
  - How much inventory to carry? In what form?
  - Where to source from?

These are in Content/Module 1/Week 1/lecture/SCM614 week1 breakout

https://www.etsy.com/hk-en/listing/555248235/break-dance-clipart-vector-svg-break

Chapter 3: Financial Measures of Performance

- From a shareholder perspective, return on equity (ROE) is the main summary measure of a firm's performance

$$\textbf{ROE} = \frac{\textbf{Net Income}}{\textbf{Average Shareholder Equity}}$$

https://www.pymnts.com/news/fintech-investments/2018/goldman-sachs-buys-personal-finance-app-clarity-money-marcus/

- Return on assets (ROA) measures the return earned on each dollar invested by the firm in assets

$$\textbf{ROA} = \frac{\textbf{Earnings before interest}}{\textbf{Average Total Assets}}$$
$$= \frac{\textbf{Net Income} + [\textbf{Interest Expense} \times (1 - \textbf{Tax Rate})]}{\textbf{Average Total Assets}}$$

$$\textbf{ROA} = \frac{\textbf{Earnings before interest}}{\textbf{Sales Revenue}} \times \frac{\textbf{Sales Revenue}}{\textbf{Total Assets}}$$
$$= \textbf{Profit Margin} \times \textbf{Asset Turnover}$$

ROA can be written as the product of two ratios – profit margin and asset turnover

Financial Measures of Performance (2 of 3)

- An important ratio that defines financial leverage is accounts payable turnover (APT)

$$\mathbf{APT} = \frac{\textbf{Cost of Goods Sold}}{\textbf{Accounts Payable}}$$

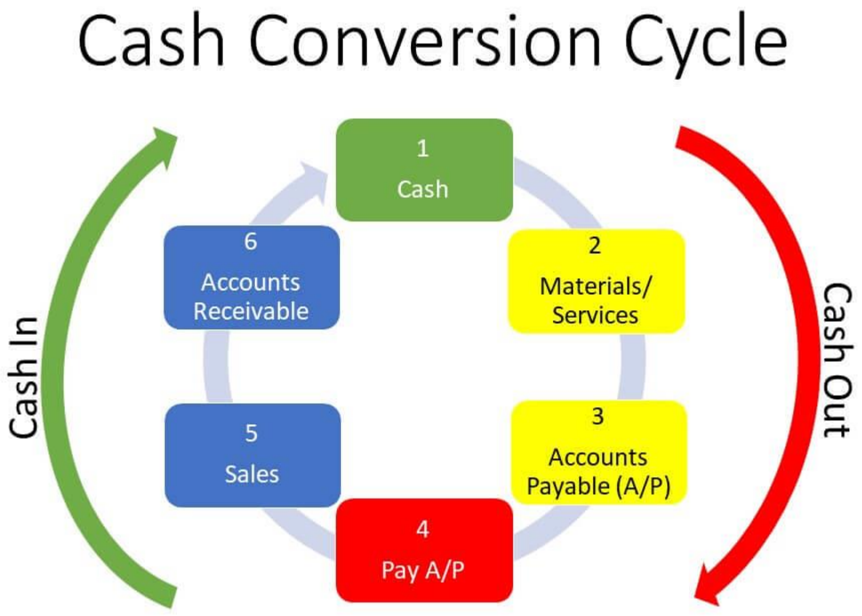
- Key components of asset turnover are accounts receivable turnover (ART); inventory turnover (INVT); and property, plant, and equipment turnover (PsonET)

$$\mathbf{ART} = \frac{\textbf{Sales Revenue}}{\textbf{Accounts Receivable}}; \quad \mathbf{INVT} = \frac{\textbf{Cost of Goods sold}}{\textbf{Inventories}};$$

$$\mathbf{PPET} = \frac{\textbf{Sales Revenue}}{\textbf{PP\&E}}$$

Financial Measures of Performance (3 of 3)

- Cash-to-cash (C2C) cycle roughly measures the average amount time from when cash enters the process as cost to when it returns as collected revenue



$$
\begin{aligned}
\text{C2C} = & -\text{Weeks Payable}\left(\frac{1}{\text{APT}}\right) \\
& +\text{Weeks in Inventory}\left(\frac{1}{\text{INVT}}\right) \\
& +\text{Weeks Receivable}\left(\frac{1}{\text{ART}}\right)
\end{aligned}
$$

https://cfoperspective.com/free-your-cash-trapped-in-the-cash-conversion-cycle/

7-Eleven Case study

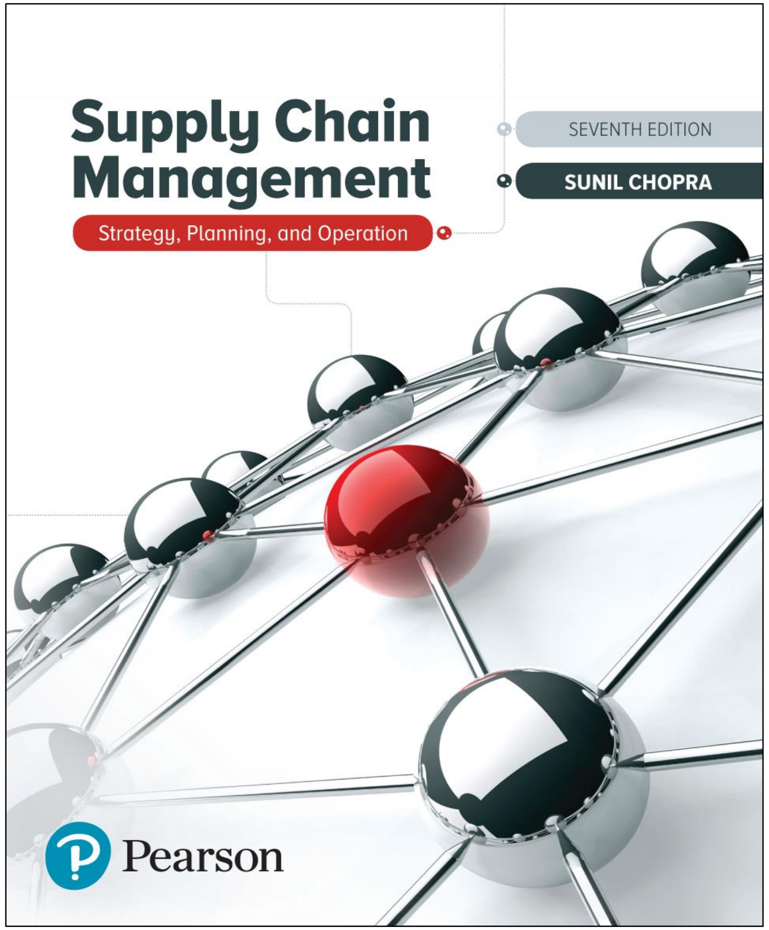
- What was the most surprising thing you learned in this study?
- What is the strategy of 7-11 Japan?
- How does the distribution network of 7-11 Japan support its strategy?
- What came first: the strategy or the distribution model?
- Could this work in the US?
- How does 7-11 balance responsiveness, cost, and risks?
- Multi-use locations: food, consumer products, parcel pick up, pay bills, buy concert tickets. Some have gathering places for seniors. How to carve up space?

A 7-Eleven clerk at a store in Tokyo stocks one of the food shelves. (Gary Ambrose / For The Times)

https://www.latimes.com/sports/olympics/story/2021-08-07/7-elevens-convenience-stores-tokyo-japan-olympics

Supply Chain Management: Strategy, Planning, and Operation

Seventh Edition



Chapter 7

Demand Forecasting in a Supply Chain

Role of Forecasting in a Supply Chain

- The basis for all planning decisions in a supply chain
- Used for both push and pull processes
  - Production scheduling, inventory, aggregate planning
  - Sales force allocation, promotions, new production introduction
  - Plant/equipment investment, budgetary planning
  - Workforce planning, hiring, layoffs
- All of these decisions are interrelated

https://www.suretysystems.com/

Characteristics of Forecasts

1. Forecasts are always inaccurate and should thus include both the expected value of the forecast and a measure of forecast error
2. Long-term forecasts are usually less accurate than short-term forecasts
3. Aggregate forecasts are usually more accurate than disaggregate forecasts
4. In general, the farther up the supply chain a company is, the greater is the distortion of information it receives

https://caseyzemanonline.com/2010/07/how-to-create-a-successful-internet-business/

Components and Methods (1 of 2)

- Companies must identify the factors that influence future demand and then ascertain the relationship between these factors and future demand
  - Past demand
  - Lead time of product replenishment
  - Planned advertising or marketing efforts
  - Planned price discounts
  - State of the economy
  - Actions that competitors have taken

https://tradingeconomics.com/commodity/orange-juice

Components and Methods (2 of 2)

- Qualitative
  - Primarily subjective
  - Rely on judgment
- Time Series
  - Use historical demand only
  - Best with stable demand
- Causal
  - Relationship between demand and some other factor
- Simulation
  - Imitate consumer choices that give rise to demand

Delphic tripod. Paestan red-figured bell-krater, ca. 330 BC., British Museum collections

Components of An Observation

Observed demand (*O*) = systematic component (*S*) + random component (*R*)

- **Systematic component** – expected value of demand
  - **Level** (current deseasonalized demand)
  - **Trend** (growth or decline in demand)
  - **Seasonality** (predictable seasonal fluctuation)
- **Random component** – part of forecast that deviates from systematic part
- **Forecast error** – difference between forecast and actual demand

From: US Department of Commerce, International Trade Division

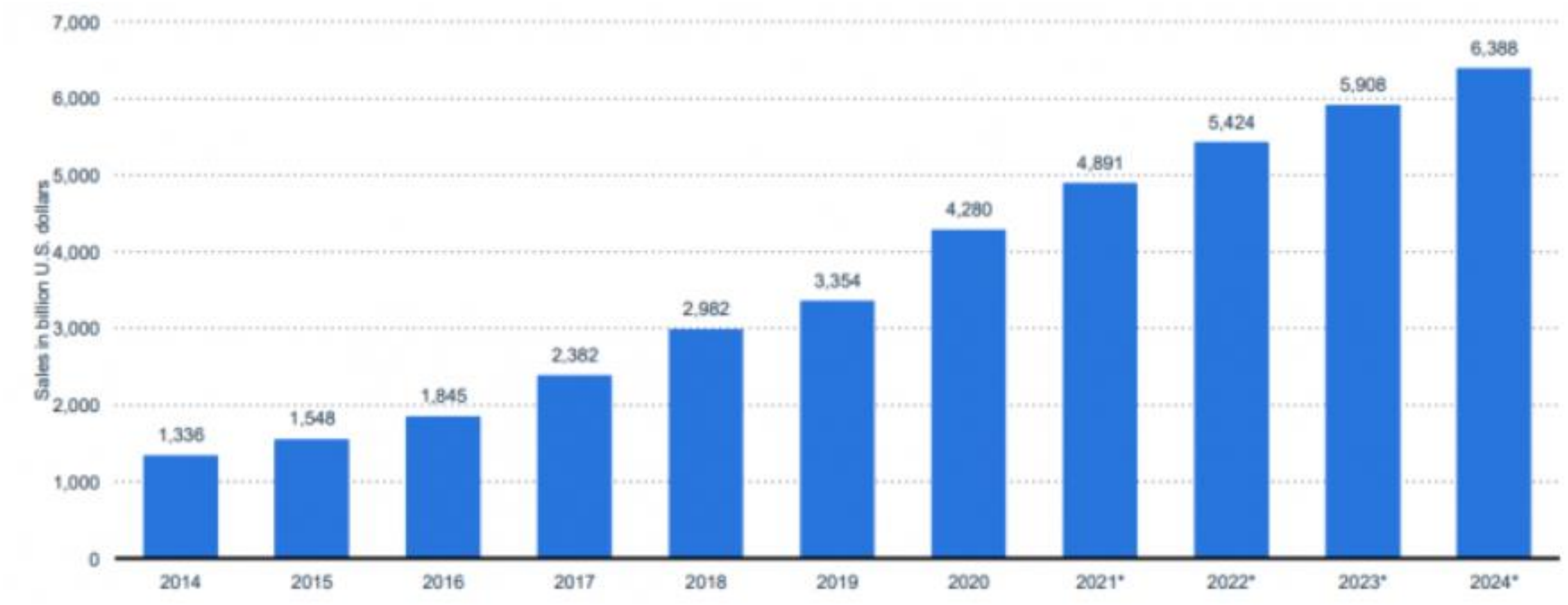


CHART: Global retail ecommerce sales worldwide from 2014 to 2024 (in billion USD)

https://www.trade.gov/ecommerce-sales-size-forecast

U.S. retail e-commerce sales for the second quarter of 2020 totaled $200.7 billion, an increase of 37.0 percent (±1.2%) from the first quarter of 2020

Times-Series Forecasting: static

- Assumes estimates of level, trend, seasonality do not vary with new demand points
- Use the same for all future time periods (we do not go back and recalculate the FC
- Systematic component = (level + trend) × seasonal factor

$$F_{t+l} = [L + (t + l)T]S_{t+l}$$

- Where

L = estimate of level at t = 0
T = estimate of trend
S_t= estimate of seasonal factor for Period t
D_t = actual demand observed in Period t
F_t= forecast of demand for Period t

Times-Series Forecasting: adaptive

- The estimates of level, trend, and seasonality are updated after each demand observation
- Estimates incorporate all new data that are observed

$$F_{t+1} = (L_t + lT_t)S_{t+1}$$

Where

L_t = estimate of level at the end of Period t
T_t = estimate of trend at the end of Period t
S_t = estimate of seasonal factor for Period t
F_t = forecast of demand for Period t (made Period t – 1 or earlier)
D_t = actual demand observed in Period t
E_t = F_t – D_t = forecast error in Period t

Times-Series Forecasting - Linear Trend

- A simple data plot can reveal the existence and nature of a trend
- Linear trend equation

$$F_t = a + bt$$

where

F_t = Forecast for period t

a = Value of F_t at $t = 0$

b = Slope of the line

t = Specified number of time periods from $t = 0$

Tahoe Salt example (text - Static)

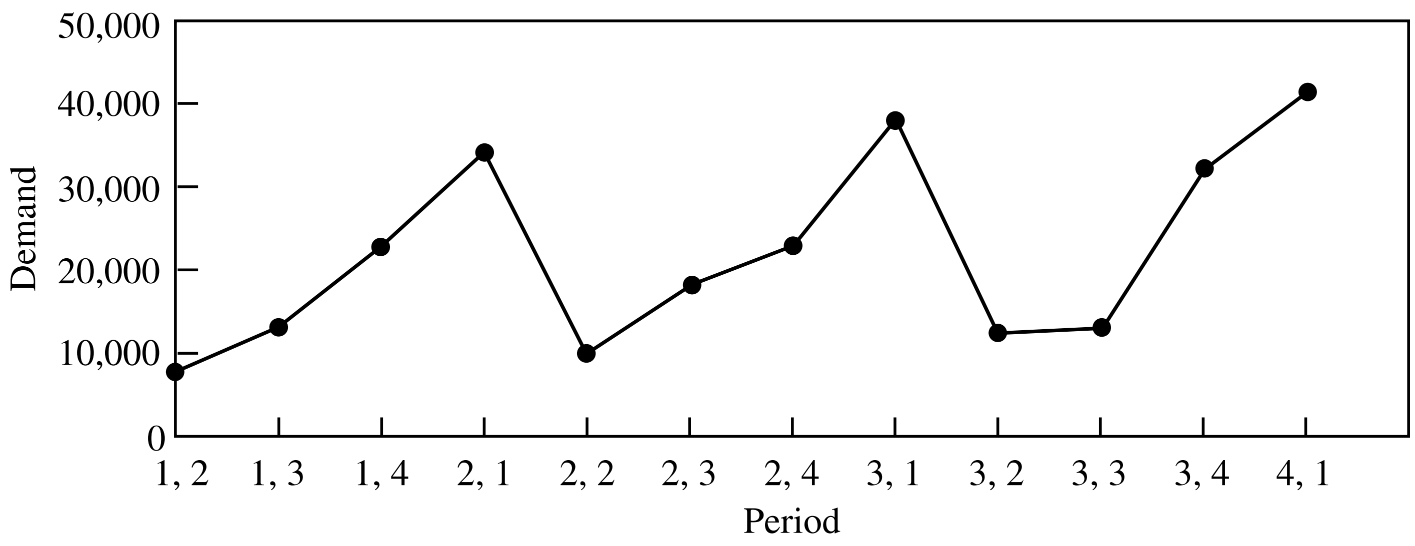


Figure 7-1 Quarterly Demand at Tahoe Salt

1. Deseasonalize demand and run linear regression to estimate level and trend
2. Estimate seasonal factors

Step 1: Deseasonalize

Estimate Level and Trend

Periodicity $p = 4$, $t = 3$

$$\bar{D}_t = \begin{cases} \dfrac{\left[D_{t-\left(\frac{p}{2}\right)} + D_{t+\left(\frac{p}{2}\right)} + \displaystyle\sum_{i=t+1-\left(\frac{p}{2}\right)}^{t-1+\left(\frac{p}{2}\right)} 2D_i \right]}{(2p)} \text{ for } p \text{ even} \\[2ex] \dfrac{\displaystyle\sum_{i=t-\left[\frac{(p-1)}{2}\right]}^{t+\left[\frac{(p-1)}{2}\right]} D_i}{p} \text{ for } p \text{ odd} \end{cases}$$

Estimate Level and Trend (cont.)

$$\bar{D}_t = \frac{\left[D_{t-\left(\frac{p}{2}\right)} + D_{t+\left(\frac{p}{2}\right)} + \sum_{i=t+1-\left(\frac{p}{2}\right)}^{t-1+\left(\frac{p}{2}\right)} 2D_i \right]}{(2p)}$$

$$= \frac{D_1 + D_5 + \sum_{i=2}^{4} 2D_i}{8}$$

Tahoe Salt (cont.)

	A	B	C
1	*Period* *t*	*Demand* D_t	*Deseasonalized Demand*
2	1	8,000	
3	2	13,000	
4	3	23,000	19,750
5	4	34,000	20,625
6	5	10,000	21,250
7	6	18,000	21,750
8	7	23,000	22,500
9	8	38,000	22,125
10	9	12,000	22,625
11	10	13,000	24,125
12	11	32,000	
13	12	41,000	

Cell	Cell Formula	Equation	Copied to
C4	=(B2+B6+2*SUM(B3:B5))/8	7.2	C5:C11

Figure 7-2 Excel Workbook with Deseasonalized Demand for Tahoe Salt

Tahoe Salt (cont.)

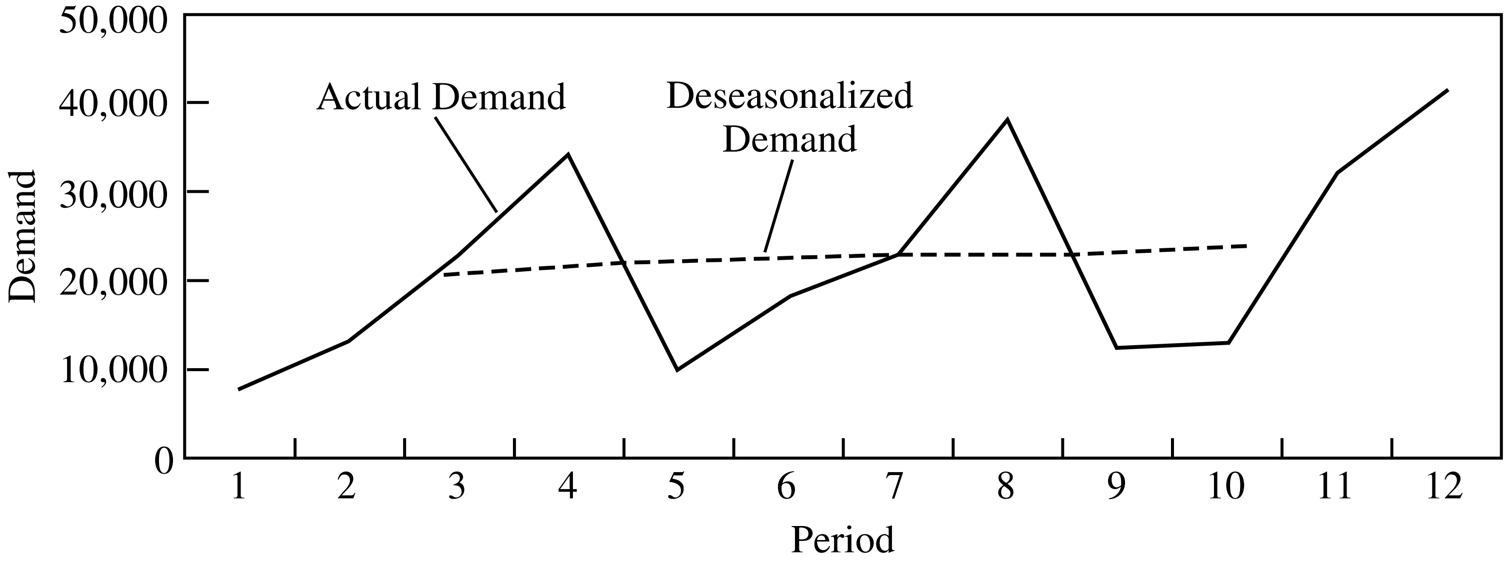


Figure 7-3 Deseasonalized Demand for Tahoe Salt

A linear relationship exists between the deseasonalized demand and time based on the change in demand over time

$$\bar{D}_t = L + T_t$$

Estimating Seasonal Factors for Tahoe Salt

$$S_i = \frac{\sum_{j=0}^{r-1} \bar{S}_{jp+i}}{r}$$

$$S_1 = \frac{(\bar{S}_1 + \bar{S}_5 + \bar{S}_9)}{3} = \frac{(0.42 + 0.47 + 0.52)}{3} = 0.47$$

$$S_2 = \frac{(\bar{S}_2 + \bar{S}_6 + \bar{S}_{10})}{3} = \frac{(0.67 + 0.83 + 0.55)}{3} = 0.68$$

$$S_3 = \frac{(\bar{S}_3 + \bar{S}_7 + \bar{S}_{11})}{3} = \frac{(1.15 + 1.04 + 1.32)}{3} = 1.17$$

$$S_4 = \frac{(\bar{S}_4 + \bar{S}_8 + \bar{S}_{12})}{3} = \frac{(1.66 + 1.68 + 1.66)}{3} = 1.67$$

$$F_{13} = (L + 13T)S_{13} = (18,439 + 13 \times 524)0.47 = 11,868$$

$$F_{14} = (L + 14T)S_{14} = (18,439 + 14 \times 524)0.68 = 17,527$$

$$F_{15} = (L + 15T)S_{15} = (18,439 + 15 \times 524)1.17 = 30,770$$

$$F_{16} = (L + 16T)S_{16} = (18,439 + 16 \times 524)1.67 = 44,794$$

Time-Series Forecasting - Naïve Forecast

- **Naïve forecast**
  - Uses a single previous value of a time series as the basis for a forecast
  - Can be used with
    - A stable time series: FC = previous time period value
    - Trend: FC = last value of the series +/- difference between last two values
    - Seasonal variations: use of the two above

Time-Series Forecasting - Averaging

- These techniques work best when a series tends to vary about an average
  - Averaging techniques smooth variations in the data
  - Minor variations treated as random variations
  - They can handle step changes or gradual changes in the level of a series
  - Techniques
    1. Moving average
    2. Weighted moving average
    3. Exponential smoothing

Moving Average

- Technique that averages a number of the most recent actual values in generating a forecast

$$F_t = \mathrm{MA}_n = \frac{\sum_{i=1}^{n} A_{t-i}}{n} = \frac{A_{t-n} + \ldots + A_{t-2} + A_{t-1}}{n}$$

where

F_t = Forecast for time period t

MA_n = n period moving average

A_{t-i} = Actual value in period $t-i$

n = Number of periods in the moving average

Weighted Moving Average

- The most recent values in a time series are given more weight in computing a forecast
  - The choice of weights, *w*, is somewhat arbitrary and involves some trial and error

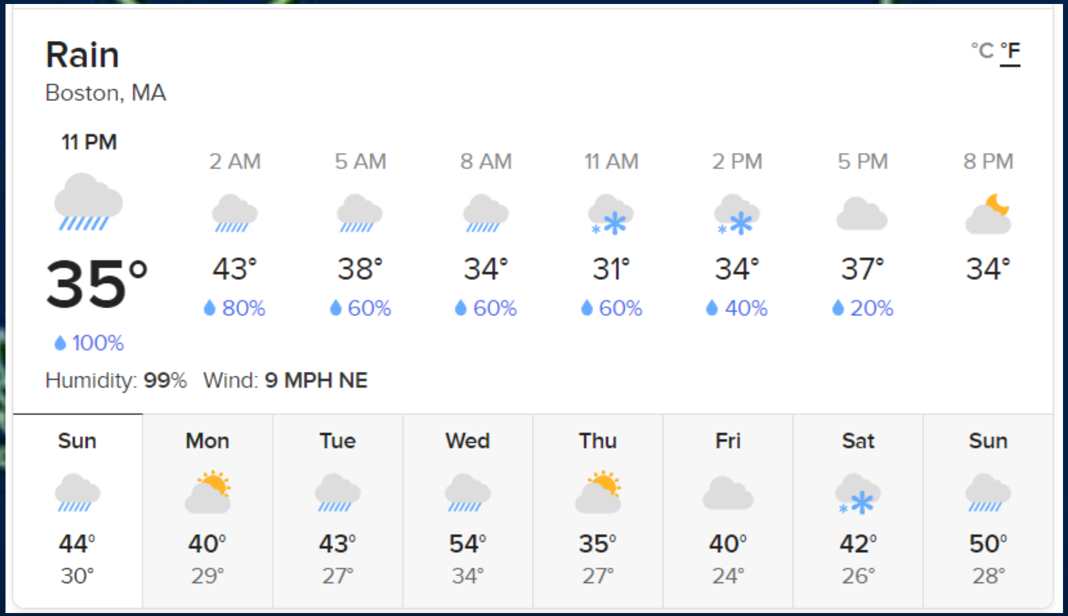
$$F_t = w_t(A_t) + w_{t-1}(A_{t-1}) + \ldots + w_{t-n}(A_{t-n})$$

where

w_t = weight for period t, w_{t-1} = weight for period $t-1$, etc.

A_t = the actual value for period t, A_{t-1} = the actual value for period $t-1$, etc.

IBM-SAP demand forecasting



- Read in the news: https://www.forbes.com/sites/ibm/2019/11/27/the-science-of-ibms-holiday-retail-forecast-and-why-companies-count-on-it/#6e4418fca248
- Watch: https://www.youtube.com/watch?v=vl15KgRUdyI
- Think about
  - How do weather related forecasts predict buyer behavior?
  - What other factors are considered in IBM's holiday forecasting models for retailers? What has helped improve their accuracy in recent years?

Exponential Smoothing

- A weighted averaging method that is based on the previous forecast plus a percentage of the forecast error

$$F_t = F_{t-1} + \alpha(A_{t-1} - F_{t-1})$$

where

F_t = Forecast for period t

F_{t-1} = Forecast for the previous period

α = Smoothing constant

A_{t-1} = Actual demand or sales from the previous period

Year	Enrollment
1	1900
2	2300
3	2800
4	3300

Month	Number of Visits
April	100
May	140
June	110
July	150
August	120
September	160

Naïve, MA, WA, expo FC examples

class examples MAD MSE MAPE week 2.xlsx

https://oneeducatorsopinion.wordpress.com/2014/02/26/brain-breaks-are-good-for-teachers-too/

Forecast Accuracy and Control

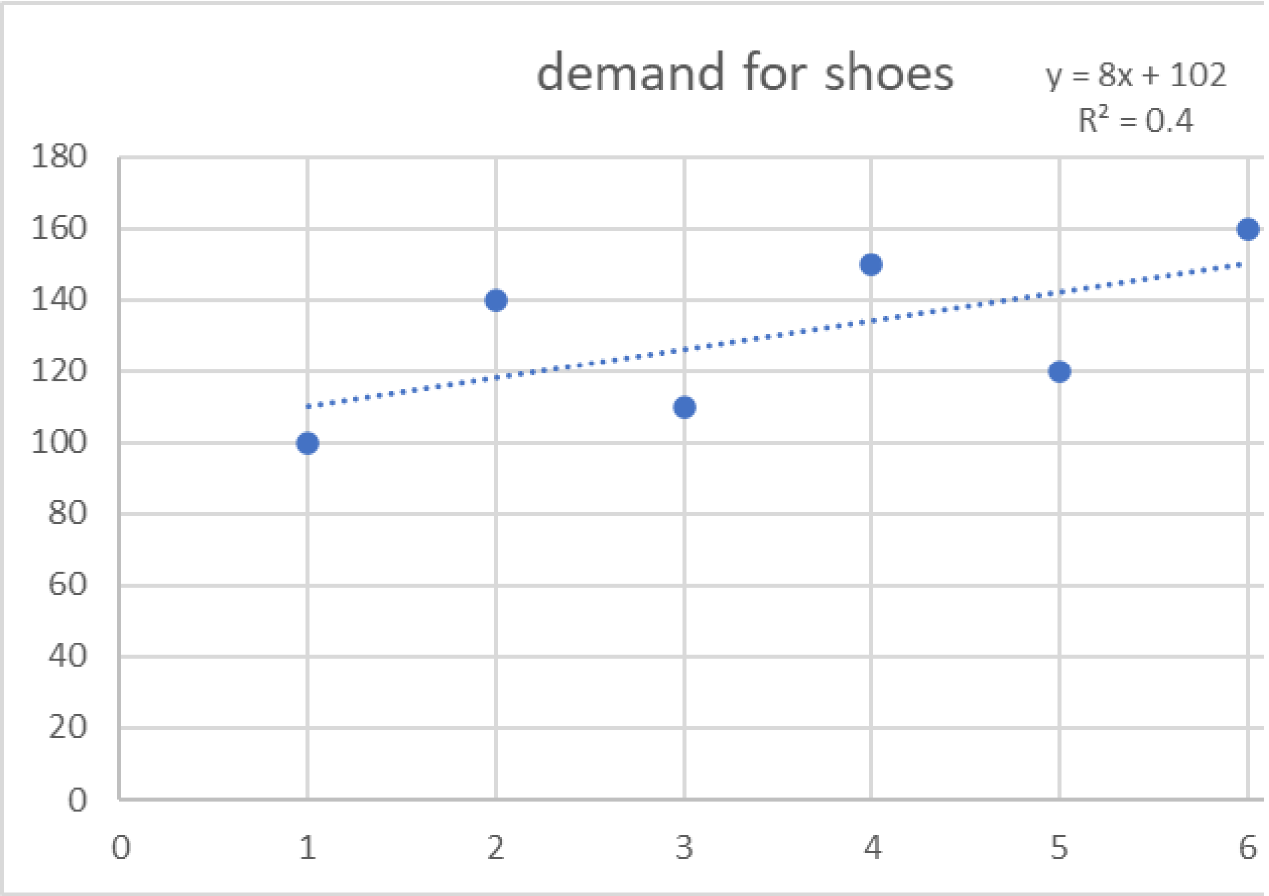
Allowances should be made for forecast errors

- It is important to provide an indication of the extent to which the forecast might deviate from the value of the variable that actually occurs

Forecast errors should be monitored

- Error = Actual – Forecast
- If errors fall beyond acceptable bounds, corrective action may be necessary

https://www.seekpng.com/ipng/u2e6a9y3o0e6r5a9_error-icon-download-attention-symbol/



How good is my linear trend?

- r^2, square of the correlation coefficient
  - A measure of the percentage of variability in the values of *y* that is "explained" by the independent variable
  - Ranges between 0 (no correlation) and 1.00 (perfect correlation)

Forecast Accuracy Metrics

$$\text{MAD} = \frac{\sum \left|\text{Actual}_t - \text{Forecast}_t\right|}{n}$$

MAD = mean absolute deviation
weights all errors evenly

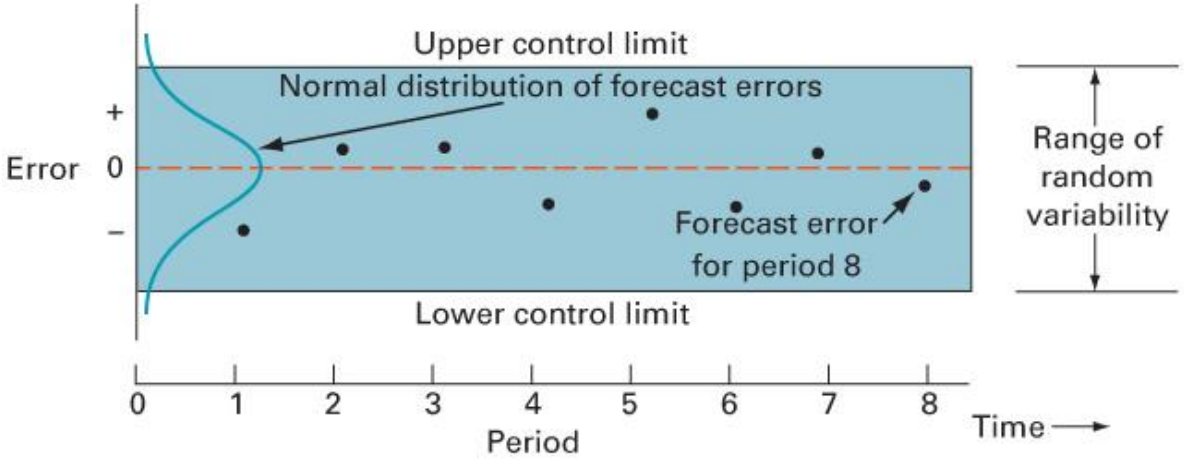
$$\text{MSE} = \frac{\sum \left(\text{Actual}_t - \text{Forecast}_t\right)^2}{n-1}$$

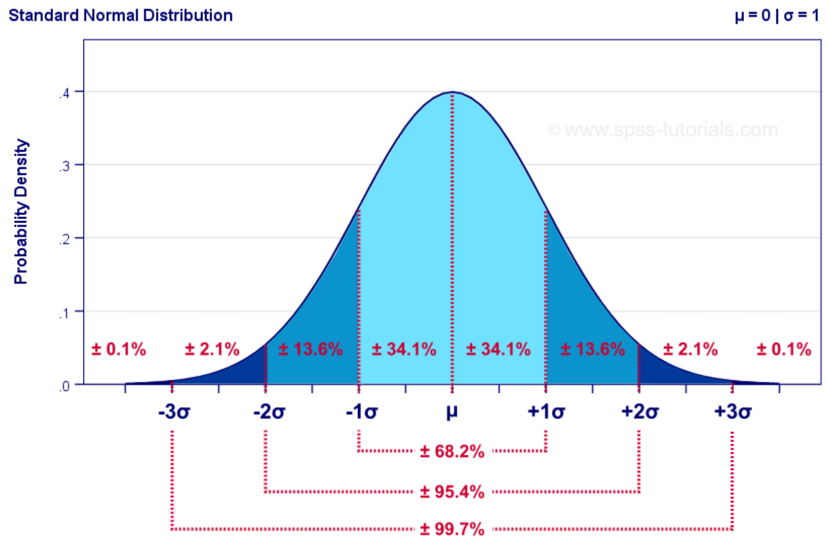
MSE = mean squared error
weights errors according to their squared values

$$\text{MAPE} = \frac{\sum \frac{\left|\text{Actual}_t - \text{Forecast}_t\right|}{\text{Actual}_t} \times 100}{n}$$

MAPE = mean absolute percent error
weights errors according to relative error

Control Chart Construction for monitoring forecasts





https://www.spss-tutorials.com/normal-distribution/

1. Compute the MSE.
2. Estimate of standard deviation of the distribution of errors

$$s = \sqrt{\text{MSE}}$$

3. $\text{UCL} : 0 + z\sqrt{\text{MSE}}$
4. $\text{LCL} : 0 - z\sqrt{\text{MSE}}$

where z = Number of standard deviations from the mean

FC Accuracy Examples in Excel

Blueberry Muffins	naïve	3 WA	expo .5
30			
34	30		30.0
32	34		32.0
34	32	32.0	32.0
35	34	33.3	33.0
30	35	33.7	34.0
34	30	33.0	32.0
36	34	33.0	33.0
29	36	33.3	34.5
31	29	33.0	31.8
35	31	32.0	31.4
31	35	31.7	33.2
37	31	32.3	32.1
34	37	34.3	34.5
33	34	34.0	34.3

class examples MAD MSE MAPE week 2.xlsx

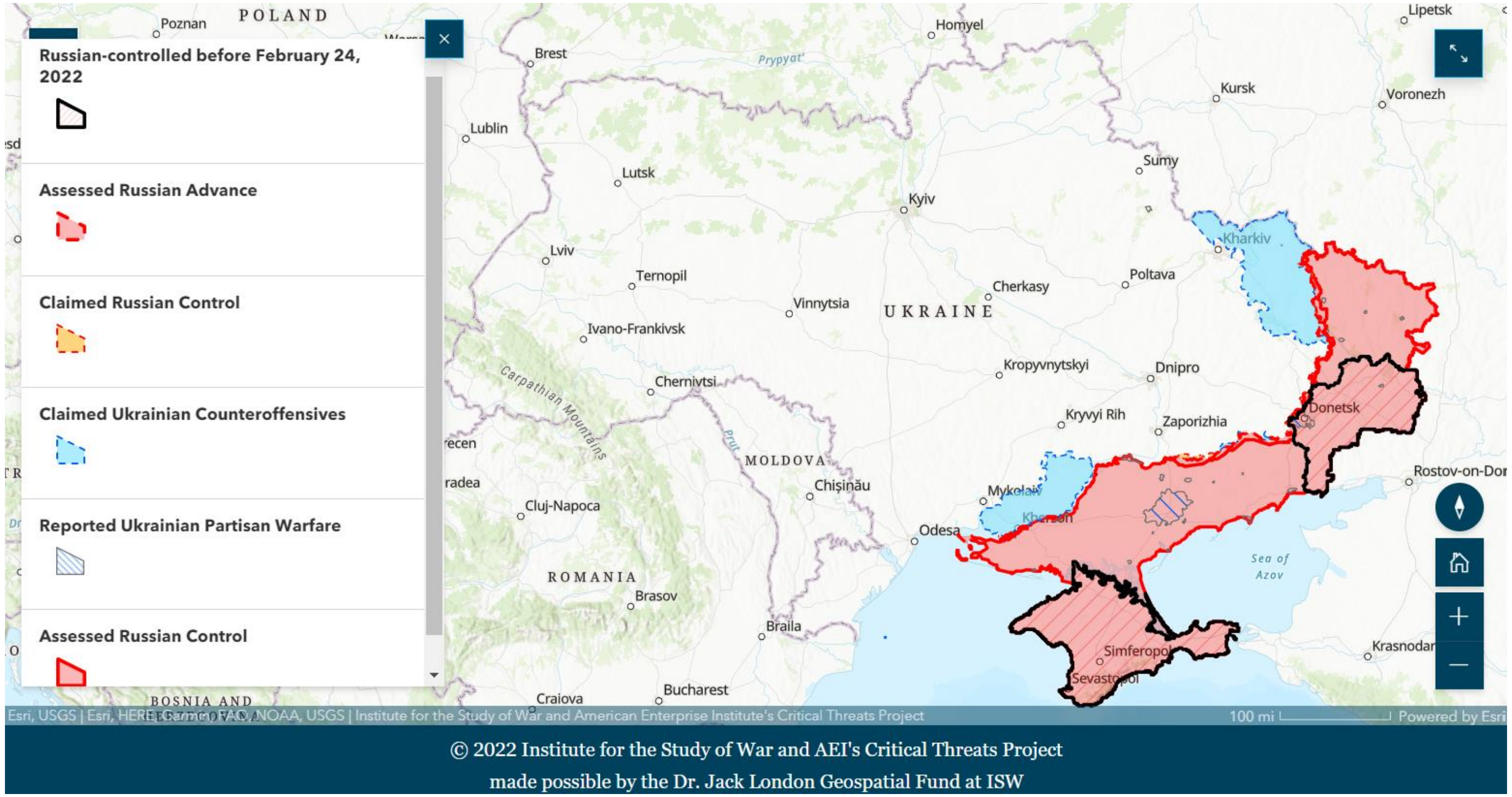
Choosing a Forecasting Technique

- Factors to consider
  - Cost
  - Accuracy
  - Availability of historical data
  - Availability of forecasting software
  - Time needed to gather and analyze data and prepare a forecast
  - Forecast horizon

From Indiana Jones and the Last Crusade

Ukraine case study (teams)

- Pick a commodity to research
- Report:
  - Discuss the disruption of the global supply chains and trade of the commodity chosen caused by the war in Ukraine
  - Define the supply chain (diagram with narrative) pre-war and currently. Who are the players?
  - What is the impact? (local/global)
  - What risk mitigation could firms take in advance or during such a disruption? How have firms responded to the disruption? What type of data is required to analyze risks or trigger a supply chain risk response?
  - 4-5 pages doubled spaced including tables/diagrams/ narrative; include all referenced works. Due 2/9.



- References posted on BB
  - LSE Expertise: Ukraine and the global response
  - KPMG white paper on the impact of Russia's invasion of Ukraine on the global economy
  - Global economic consequences of the war in Ukraine
  - Russia-Ukraine conflict and its implications on global food supply chains

Teams for Ukraine case study

name	Ukraine teams
Alfaro, Marugenia	1
Beisecker, Kelsey	1
Dizon, Ric	1
Ghazaryan, Shushanik	1
Ahadiat, Parisa	2
Bui, Cindy	2
Euceda Iscoa, Marlon	2
Gonzalez-Aguayo, Gisela	2
Alramahi, Ehab	3
Collier, Nicole	3
Freeman, Annie	3
Guelff, Michelle	3
Ang, Paul	4
Contreras, Stephanie	4
Galleta, Beda	4
Han, Chris	4

name	Ukraine teams
Kariuki, Janet	5
Lopez, Ruben	5
Perez, Melissa	5
Sampson, Ivy	5
Joshua, Jonathan	6
Magallon, Dominick	6
Ramirez, Lizbeth	6
Vidovich, Mikaela	6
Khachatryan, Marieta	7
Matthews, Olivia	7
Redfearn, Joe	7
Wand, Kelly	7
Khafajizadeh, Bina	8
Nguyen, Jessica	8
Rodgers, Samuel	8
Weiss-Varela, Samantha	8

RED = team leader for this assignment

Assignment week 2

- Homework 1. Due before next class
  - Chapter 7, forecasting
    - What problem have you seen personally from poor demand forecasting? What could have been done to improve it?
    - Page 200-201, exercises:
      - 1 using static seasonal (no bias, TS)
      - 2 using static naïve, WA, expo, linear (no bias, TS)
      - 5
      - 8 using static WA, expo (no bias, TS)

Agg Planning & Sustainability

SCM614

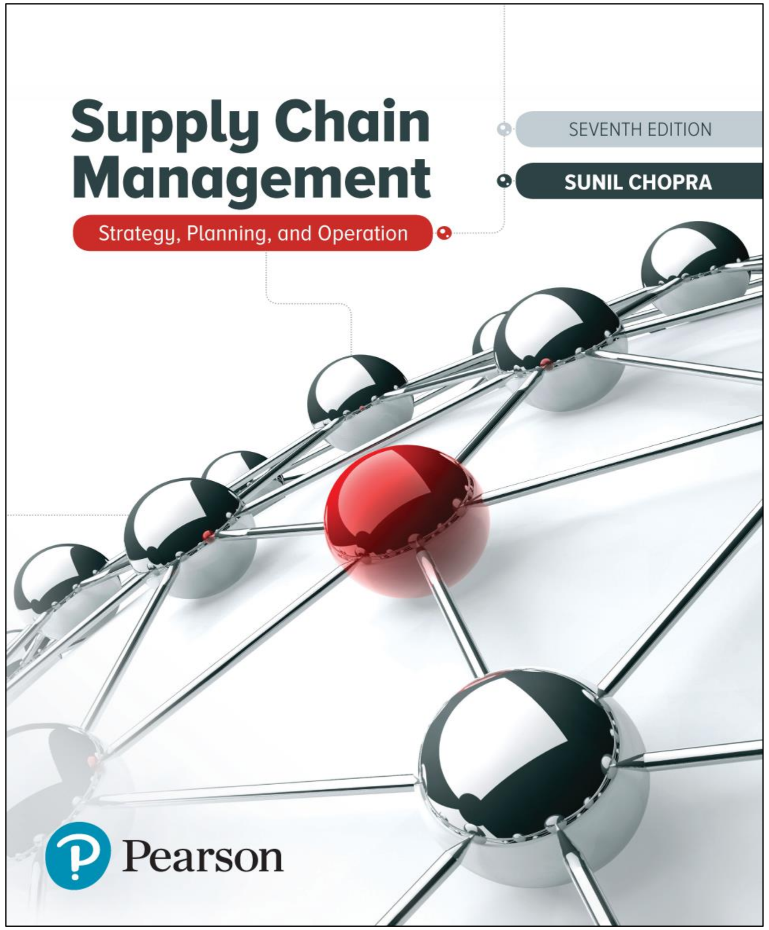
Week 3

Agenda

- Chapter 15: Sourcing (recap)
- Chapter 8: Agg planning, Linear Programming with Excel
- Break
- Chapter 17: Sustainability
  - Clean Trucks – my research focus
- Breakout (PP)
- Summary of upcoming class activities

Supply Chain Management: Strategy, Planning, and Operation

Seventh Edition



Chapter 15

Sourcing Decisions in a Supply Chain

Onshoring
(Same country)

Nearshoring
(Neighboring country)

Offshoring
(Distant country)

Designing a Sourcing Portfolio: Tailored Sourcing (3 of 4)

Table 15.4 Factors Favoring Onshoring, Near-Shoring, or Offshoring

	Onshore	**Near-Shore**	**Offshore**
Rate of innovation/product variety	High	Medium to High	Low
Demand volatility	High	Medium to High	Low
Labor content	Low	Medium to High	High
Volume or weight-to-value ratio	High	High	Low
Impact of supply chain disruption	High	Medium to High	Low
Inventory costs	High	Medium to High	Low
Engineering/management support	High	High	Low

https://technofaq.org/posts/2020/08/why-nearshoring-is-an-effective-route-to-agile-development/

Product Categorization

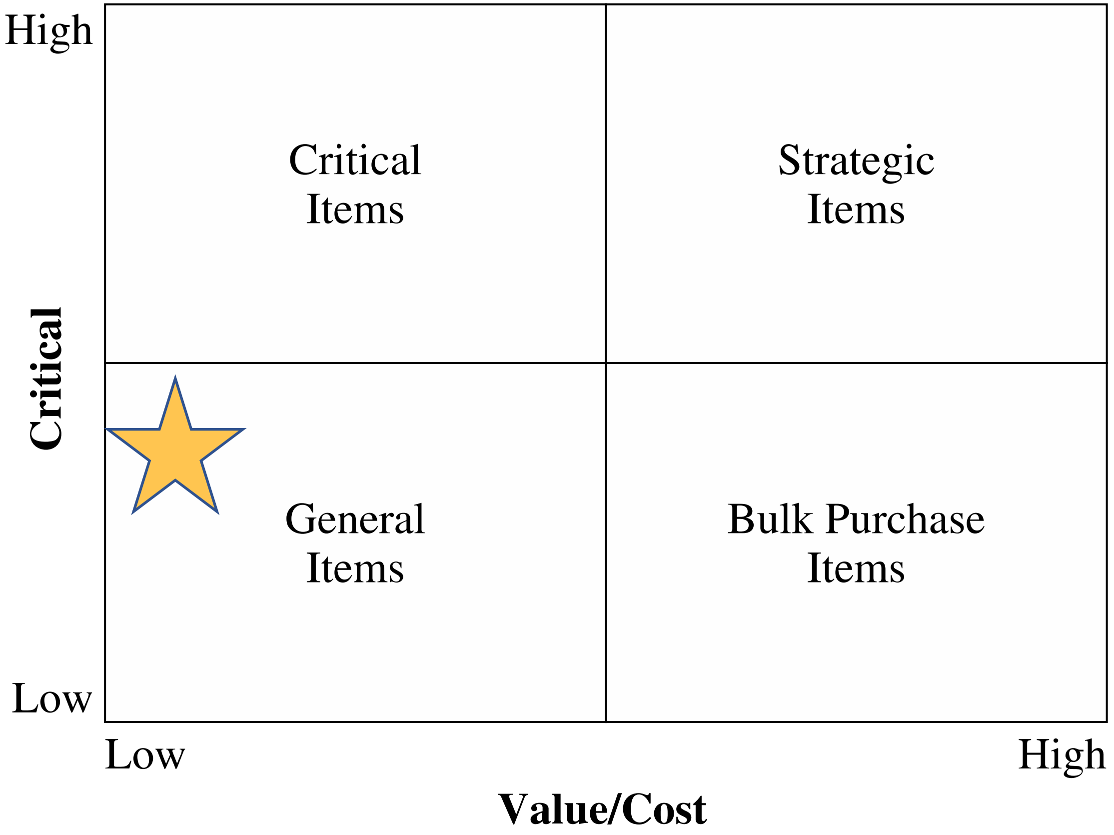
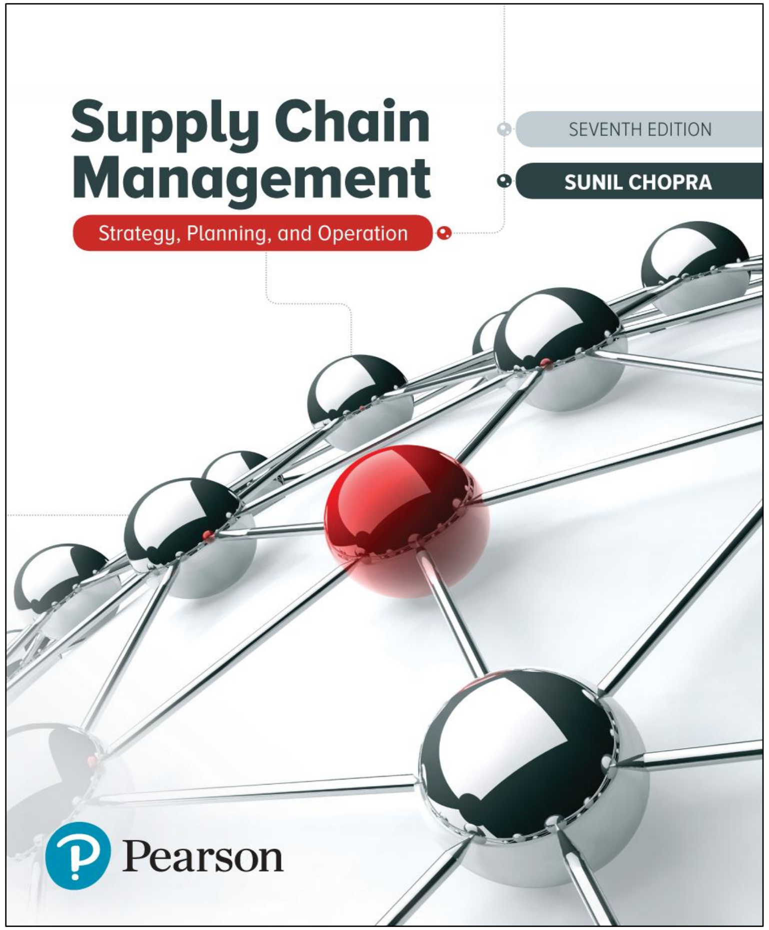


Figure 15-1 Product Categorization by Value and Criticality

Supply Chain Management: Strategy, Planning, and Operation

Seventh Edition



Chapter 8

Aggregate Planning in a Supply Chain

https://singularityhub.com/2021/03/28/watch-a-robot-3d-printing-the-rocket-for-relativity-spaces-first-orbital-launch/?amp=1

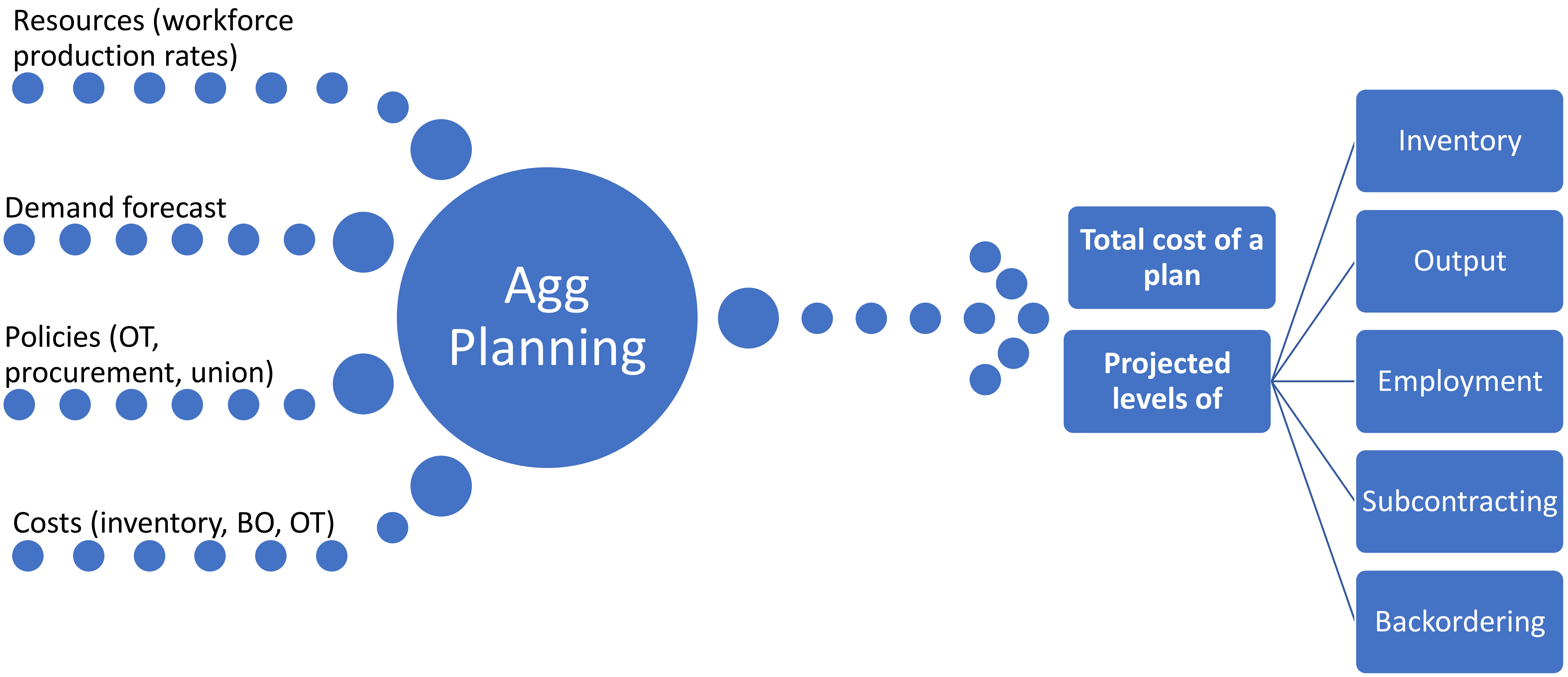
Role of Aggregate Planning in a Supply Chain

- Identify operational parameters over the specified time horizon
  - Production rate
  - Workforce
  - Overtime
  - Machine capacity level
  - Subcontracting
  - Backlog
  - Inventory on hand
- All supply chain stages should work together on an aggregate plan that will optimize supply chain performance

The Aggregate Planning Problem

- Given the demand forecast for each period in the planning horizon, determine the production level, inventory level, and the capacity level for each period that maximizes the firm’s (supply chain’s) profit over the planning horizon
- Specify the planning horizon (typically 3-18 months)
- Specify the duration of each period
- Specify key information required to develop an aggregate plan

Aggregate Planning
Inputs & outputs



Aggregate Planning
Pure Strategies

- **Level capacity strategy:**
    - Maintaining a steady rate of regular-time output while meeting variations in demand by a combination of options:
        - Inventories, overtime, part-time workers, subcontracting, and back orders
- **Chase demand strategy:**
    - Matching capacity to demand; the planned output for a period is set at the expected demand for that period

https://www.marcopromos.com/product/magnetic-torpedo-level-9/od-15024?code=PPCProdCampaign&ex_phone=866.718.5692&gclid=Cj0KCQjw8fr7BRDSARIsAK0Qqr5eO1X-ZoXTyxPJwSPsjyrIDGspCVgOyynjNgNRd9IMtiGJGZCxT70aAnDrEALw_wcB, https://www.123rf.com/stock-photo/chasing.html?sti=m56rd084sbbxc00bsy|

Chase Approach

- Capacities are adjusted to match demand requirements over the planning horizon
  - **Advantages**
    - Investment in inventory is low
    - Labor utilization in high
  - **Disadvantages**
    - The cost of adjusting output rates and/or workforce levels

Level Approach

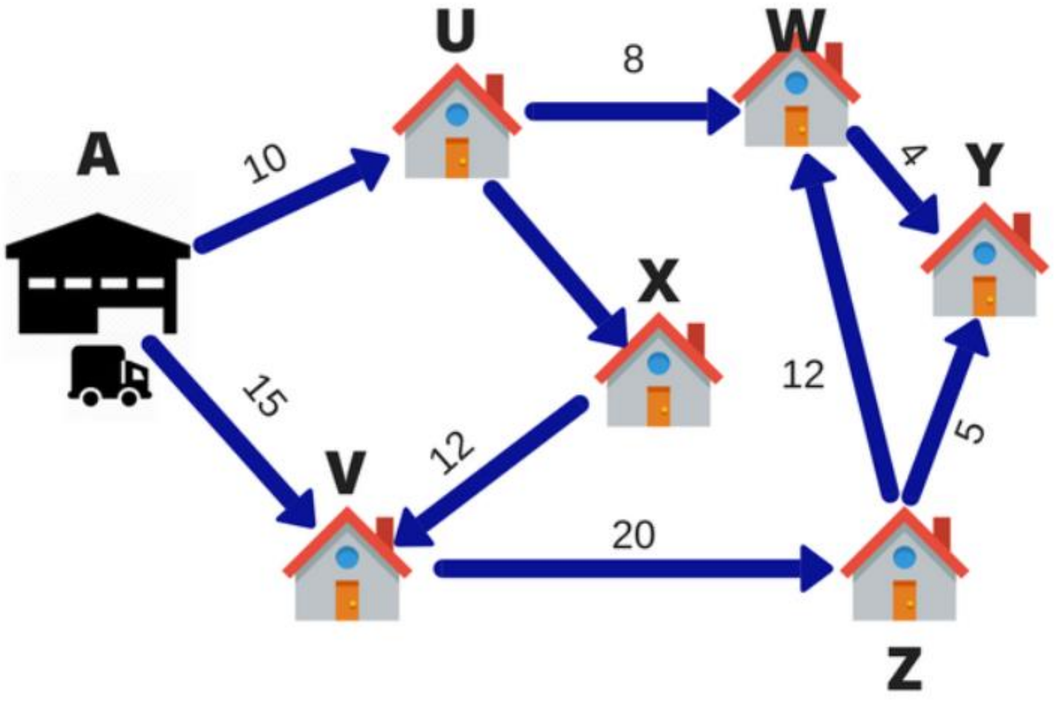
- Capacities are kept constant over the planning horizon
  - **Advantages**
    - Stable output rates and workforce
  - **Disadvantages**
    - Greater inventory costs
    - Increased overtime and idle time
    - Resource utilizations vary over time

AGGREGATE PLANNING EXAMPLES!

	1	2	3	4
	200	200	300	400
	300	300	300	300
	100	100	0	-100
	0	100	200	200
	100	200	200	100
	50.0	150.0	200.0	150.0
	0	0	0	0
per unit				

Linear Programming for planning

- Developed in WWII for army logistics
- Leads to an optimal solution (if one exists) for problems with restrictions or limitations
- Uses
  - Food and agriculture
  - Transportation optimization
  - Manufacturing/supply chain
- Problems
  - Optimal mix/blends
  - Aggregate planning
  - Location analysis



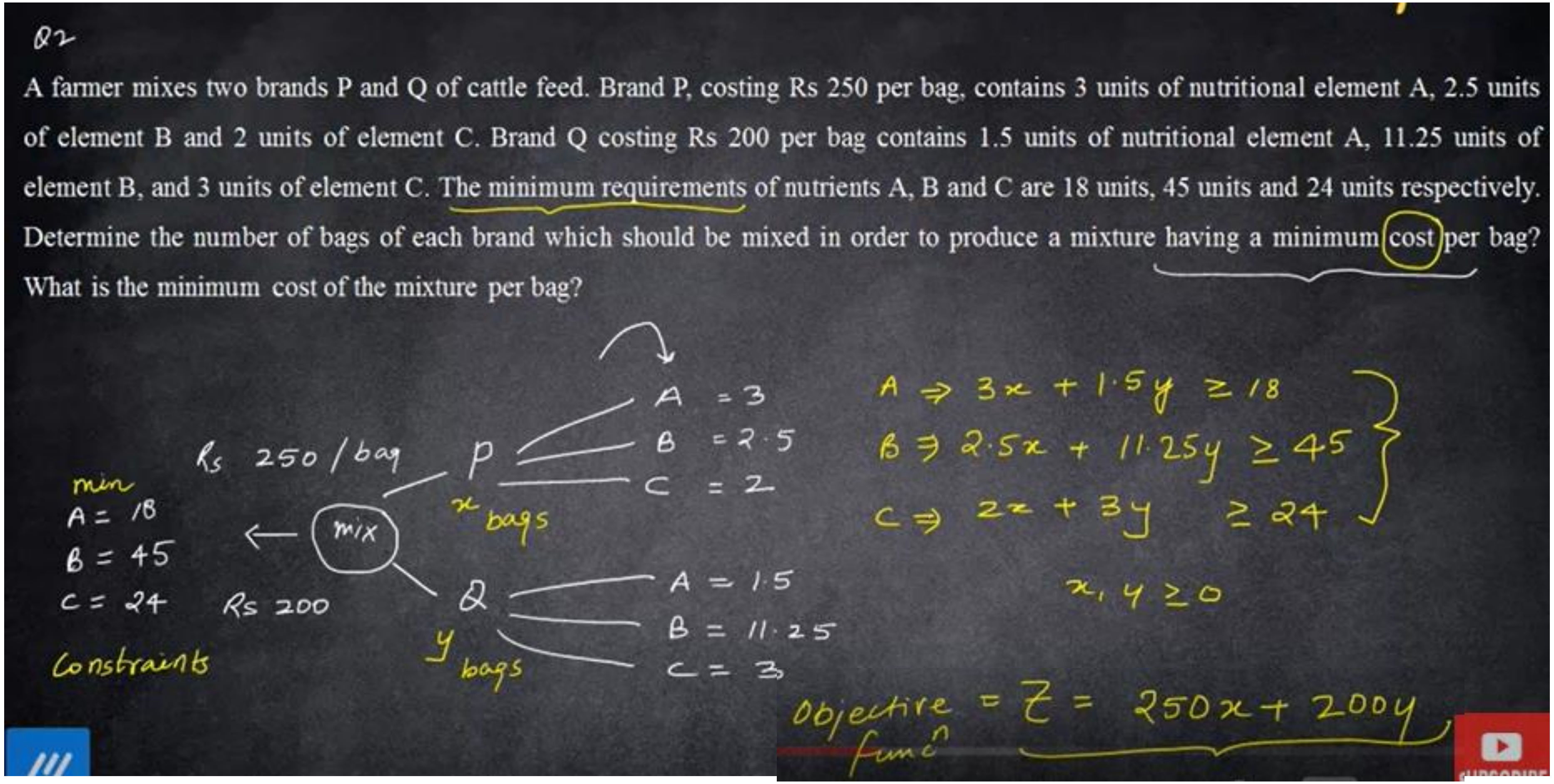
https://www.analyticsvidhya.com/blog/2017/02/lintroductory-guide-on-linear-programming-explained-in-simple-english/

LP Models

$$
\begin{aligned}
\text{maximize} \quad & z = x + 2y \\
\text{subject to:} \quad & 2x + y \leq 20 \\
& -4x + 5y \leq 10 \\
& -x + 2y \geq -2 \\
& x \geq 0 \\
& y \geq 0
\end{aligned}
$$

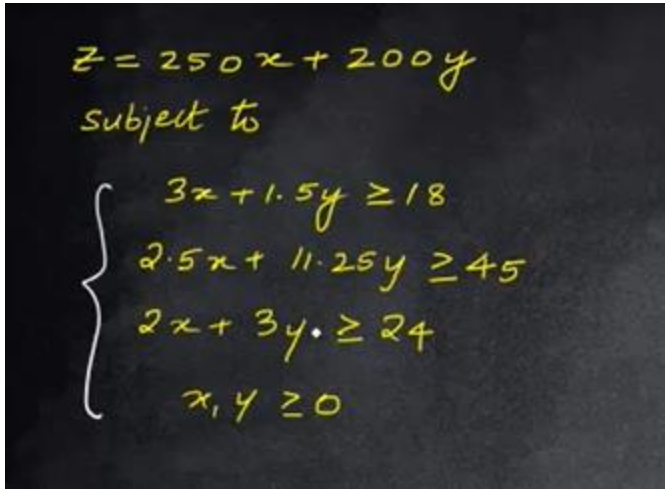
- Mathematical representations of constrained optimization problems
- LP model components:
  - **Objective function**
    - A mathematical statement of profit (or cost, etc.) for a given solution
  - **Decision variables**
    - Amounts of either inputs or outputs
  - **Constraints**
    - Limitations that restrict the available alternatives

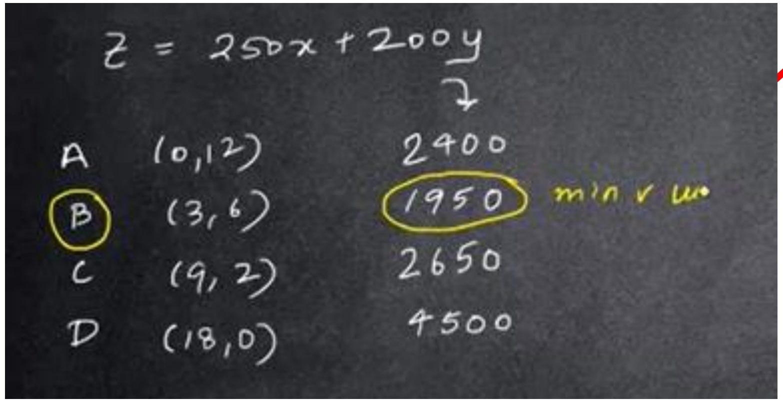
Example of LP: Diet

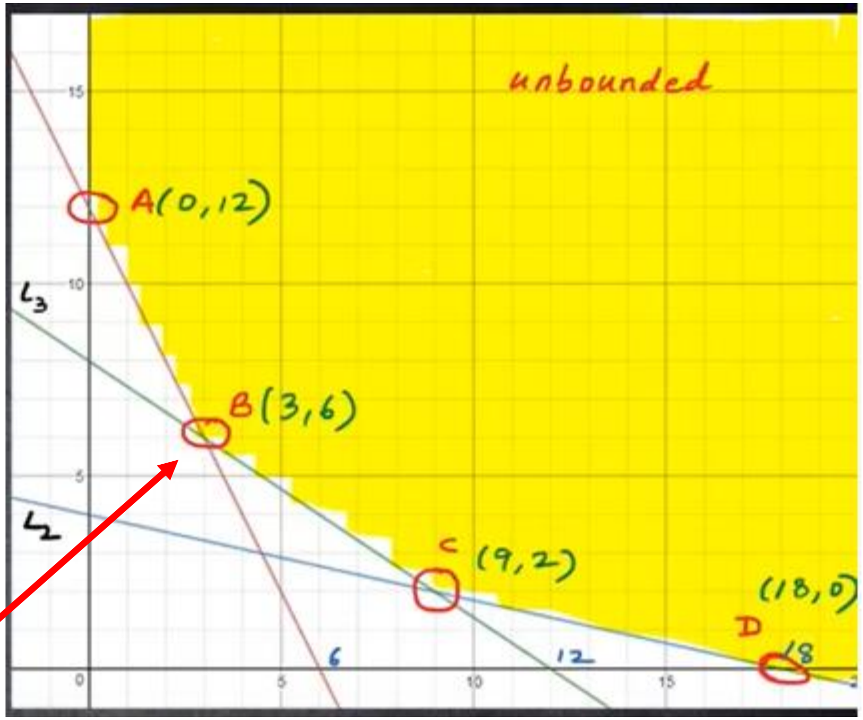


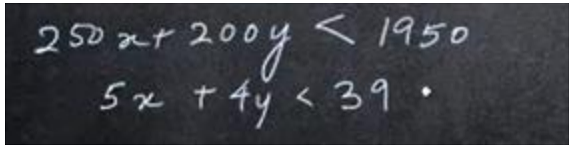
https://www.youtube.com/watch?v=AOpTPFjG8ug

Example of LP: Diet









https://www.youtube.com/watch?v=AOpTPFjG8ug

Example – LP Formulation

$$\text{Decision Variables} \quad \begin{cases} x_1 = \text{Quantity of product 1 to produce} \\ x_2 = \text{Quantity of product 2 to produce} \\ x_3 = \text{Quantity of product 3 to produce} \end{cases}$$

$$\begin{array}{lll} \text{Maximize} & 5x_1 + 8x_2 + 4x_3 \text{ (profit)} & \textbf{(Objective function)} \\ \text{Subject to} & & \\ \text{Labor} & 2x_1 + 4x_2 + 8x_3 \le 250 \text{ hours} & \textbf{(Constraints)} \\ \text{Material} & 7x_1 + 6x_2 + 5x_3 \le 100 \text{ pounds} & \\ \text{Product1} & x_1 \qquad\qquad\quad \le 10 \text{ units} & \\ & x_1, x_2, x_3 \ge 0 & \textbf{(Nonnegativity constraints)} \end{array}$$

Graphical LP

- A method for finding optimal solutions to two-variable problems
- Procedure
  1. Set up the objective function and the constraints in mathematical format
  2. Plot the constraints
  3. Identify the feasible solution space
     - The set of all feasible combinations of decision variables as defined by the constraints
  4. Plot the objective function
  5. Determine the optimal solution

Example – Graphical LP: Step 1, translate to math

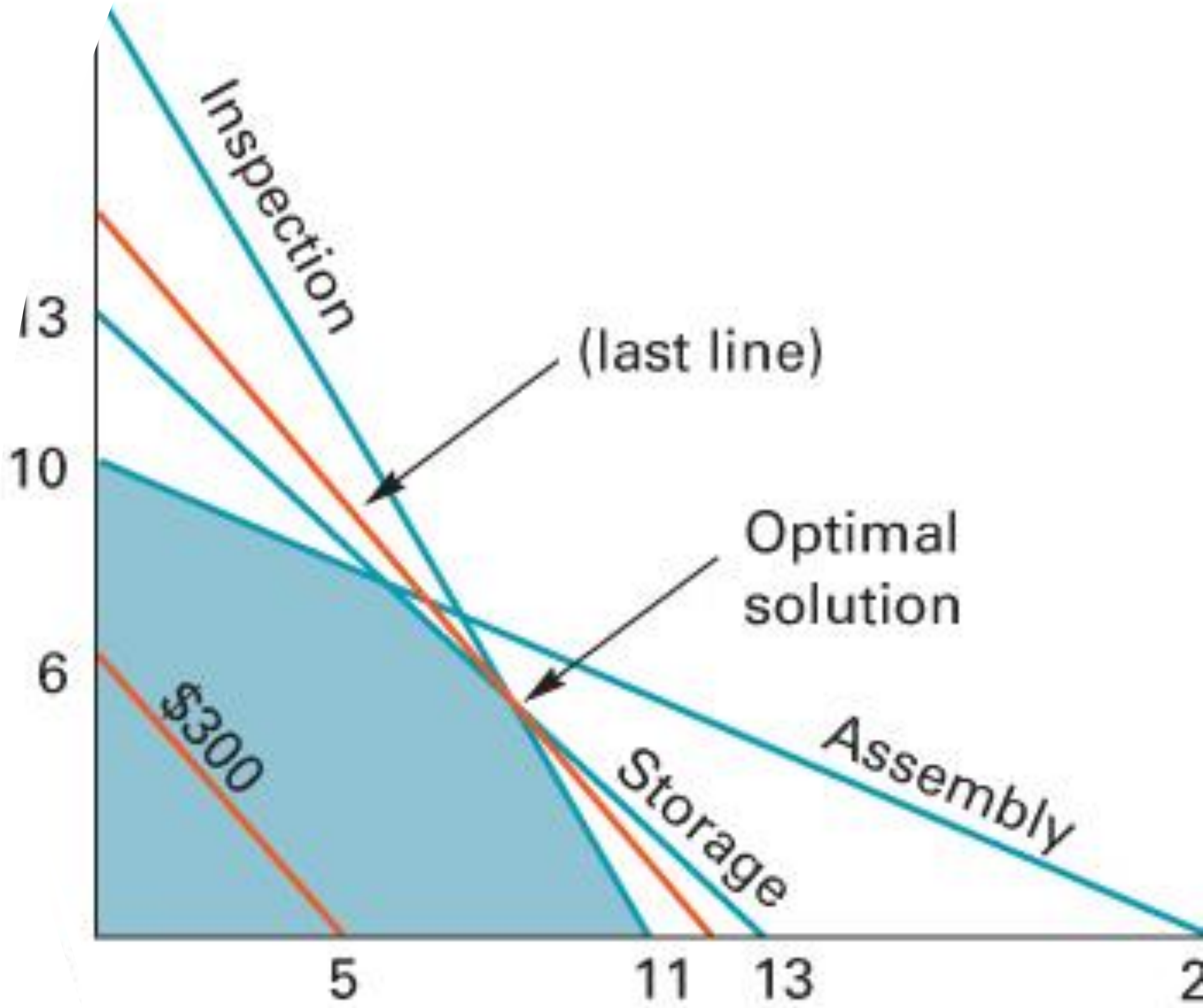
Firm ABC assembles computers and will be producing two new products next month. The firm can sell as much as it can make of both machines. Each requires assembly & inspection time, as well as storage space. Profit of x1=$60 and x2=$50. Determine the optimal mix of x1 and x2 to max profit. x1 takes 4 hours to assemble, 2 hours to inspect, and 3 cubic feet of storage. x2 takes 10 hours to assemble, 1 hour to inspect, and also uses 3 cubic feet of storage.

$$\text{Decision Variables} \quad \begin{cases} x_1 = \text{quantity of type 1 to produce} \\ x_2 = \text{quantity of type 2 to produce} \end{cases}$$

$$\begin{aligned}
&\text{Maximize} && 60x_1 + 50x_2 \\
&\text{Subject to} && \\
&\text{Assembly} && 4x_1 + 10x_2 \le 100 \text{ hours} \\
&\text{Inspection} && 2x_1 + 1x_2 \le 22 \text{ hours} \\
&\text{Storage} && 3x_1 + 3x_2 \le 39 \text{ cubic feet} \\
& && x_1, x_2 \ge 0
\end{aligned}$$

Example – Graphical LP

- Where is the optimal solution?
  - The optimal solution occurs at the furthest point (for a maximization problem) from the origin the isoprofit can be moved and still be touching the feasible solution space
  - This optimum point will occur at the intersection of two constraints:
    - Solve for the values of x_1 and x_2 where this occurs



Example – Graphical LP: determine opt soln

2x + y <= 22 hrs.
3x + 3y <= 39 cu ft

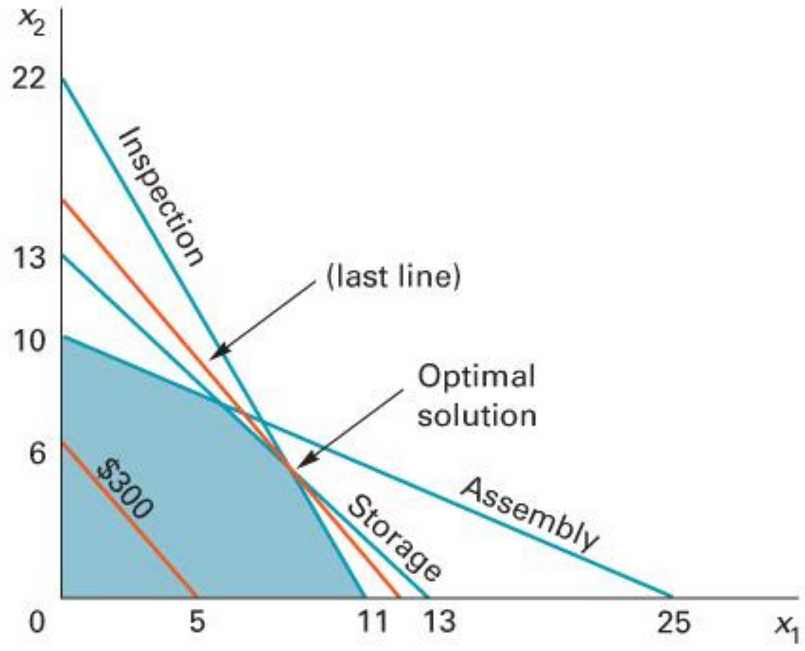
To get rid of x's, we could multiply the first by 3 and second by 2, but that would mean altering both.
Y is out better choice: multiple the first by -3

-6x -3y = -66
3x + 3y = 39

-3x +0 = -27; x = 9

Put back x=9 into either of the equations and solve for y since this is at the intersection of the two lines
2*9 +y = 22
18 + y = 22
Y = 22-18 = 4

Solution (9,4)
Put this into the objective function 60x + 50y
60*9 + 50*4 = 540+ 200 = 740



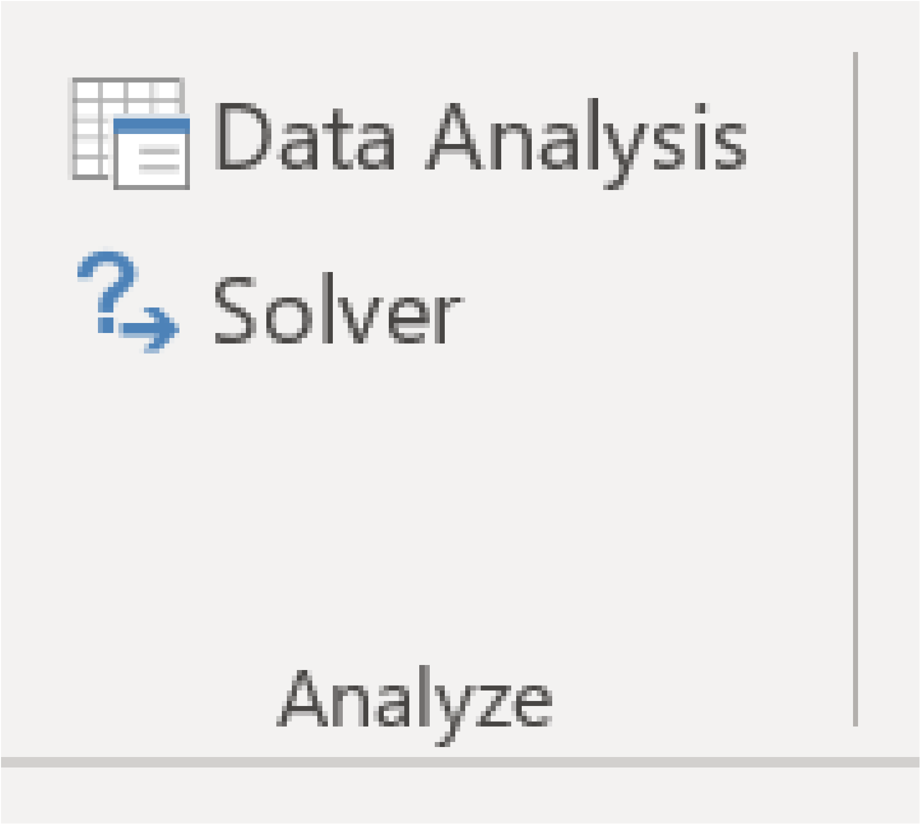
Slack and Surplus

Binding constraint	Surplus	Slack
• If a constraint forms the optimal corner point of the feasible solution space, it is binding • It effectively limits the value of the objective function • If the constraint could be relaxed, the objective function could be improved	• When the value of decision variables are substituted into a ≥ constraint the amount by which the resulting value exceeds the right-hand side value	• When the values of decision variables are substituted into a ≤ constraint, the amount by which the resulting value is less than the right-hand side

Computer Solutions so much easier!

- MS Excel can be used to solve LP problems using its Solver routine
  - Enter the problem into a worksheet
  - You must designate the cells where you want the optimal values for the decision variables
  - Can solve for 2 or more variables

Excel Solver: load and practice

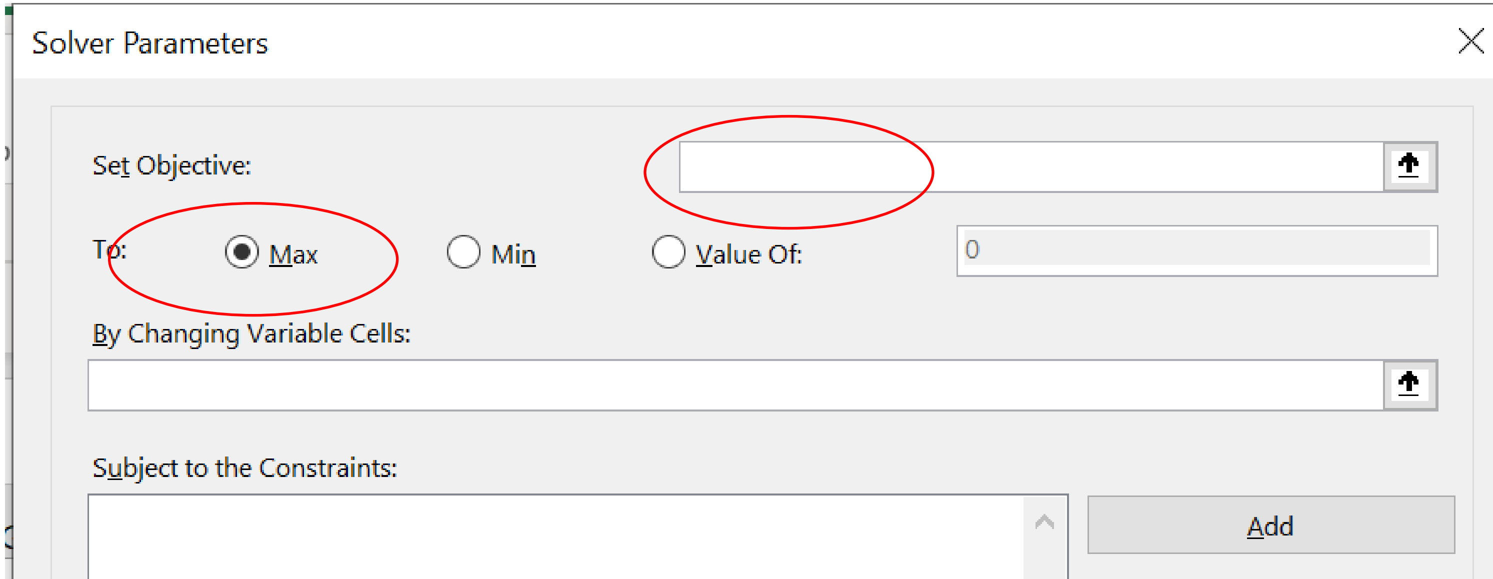


- Linear programming solver
  - https://www.excel-easy.com/data-analysis/solver.html
  - Developer/Excel Adds Ins/Solver (can then see in Data tab far right)
  - How to use:
    - https://www.youtube.com/watch?v=RicajFzoenk
    - Another for reference: https://www.youtube.com/watch?v=rQt_SWrOktg

There are lots of You Tube videos on this if you need more examples!

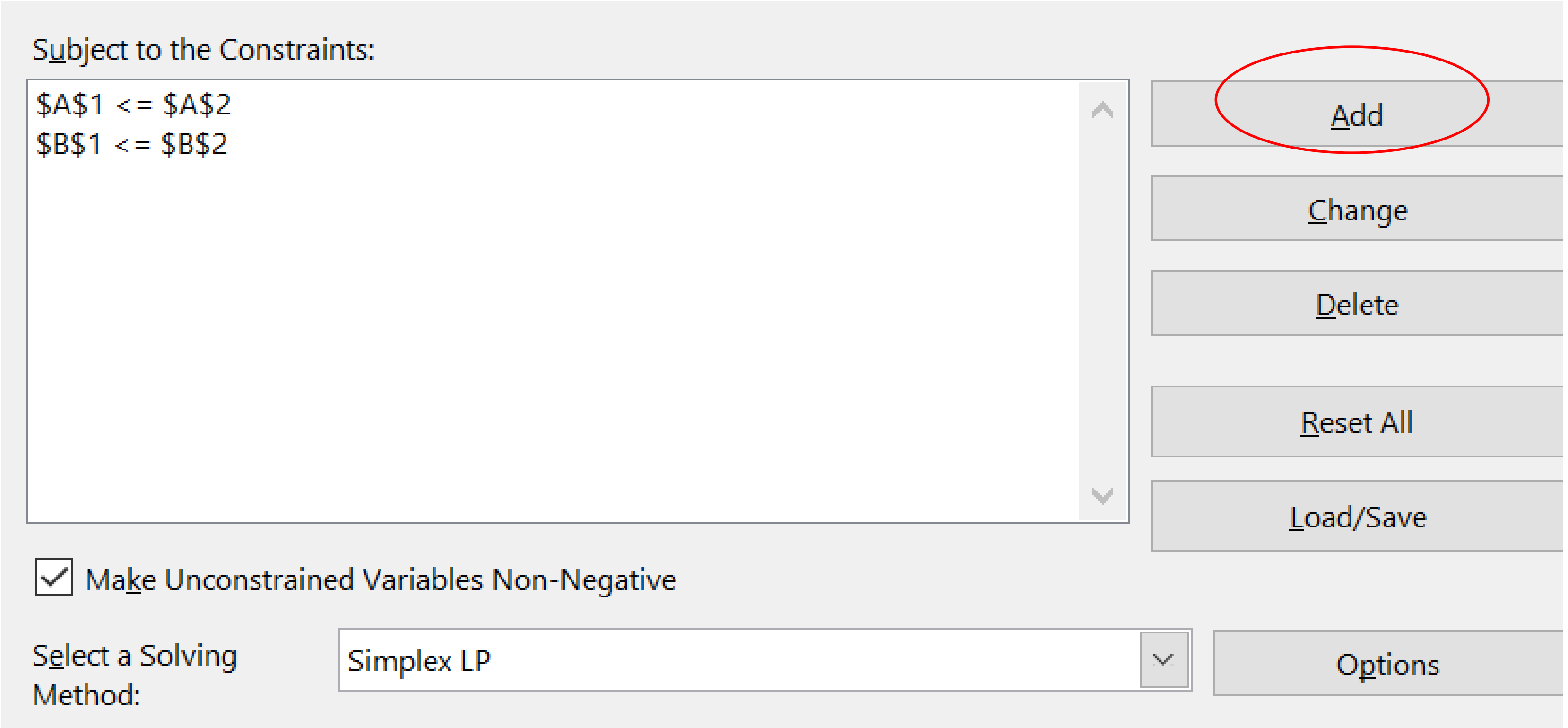
Excel Solver

- Click on Data/Solver
- Begin by setting the Target Cell
  - This is where you want the optimal objective function value to be recorded
  - Highlight Max (if the objective is to maximize)
  - The changing cells are the cells where the optimal values of the decision variables will appear



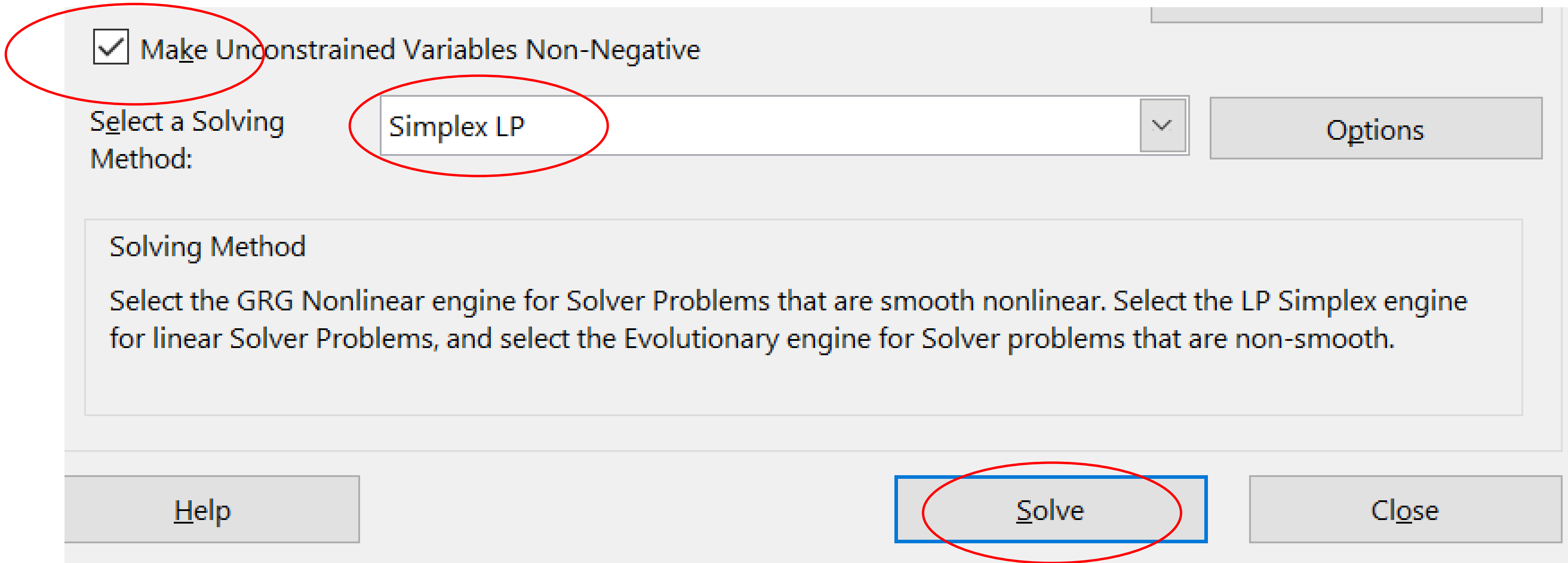
Excel Solver (cont..)

- Add a constraint, by clicking Add
  - For each constraint, enter the cell that contains the left-hand side for the constraint
  - Select the appropriate relationship sign (≤, ≥, or =)
  - Enter the RHS value or click on the cell containing the value
- Repeat the process for each system constraint



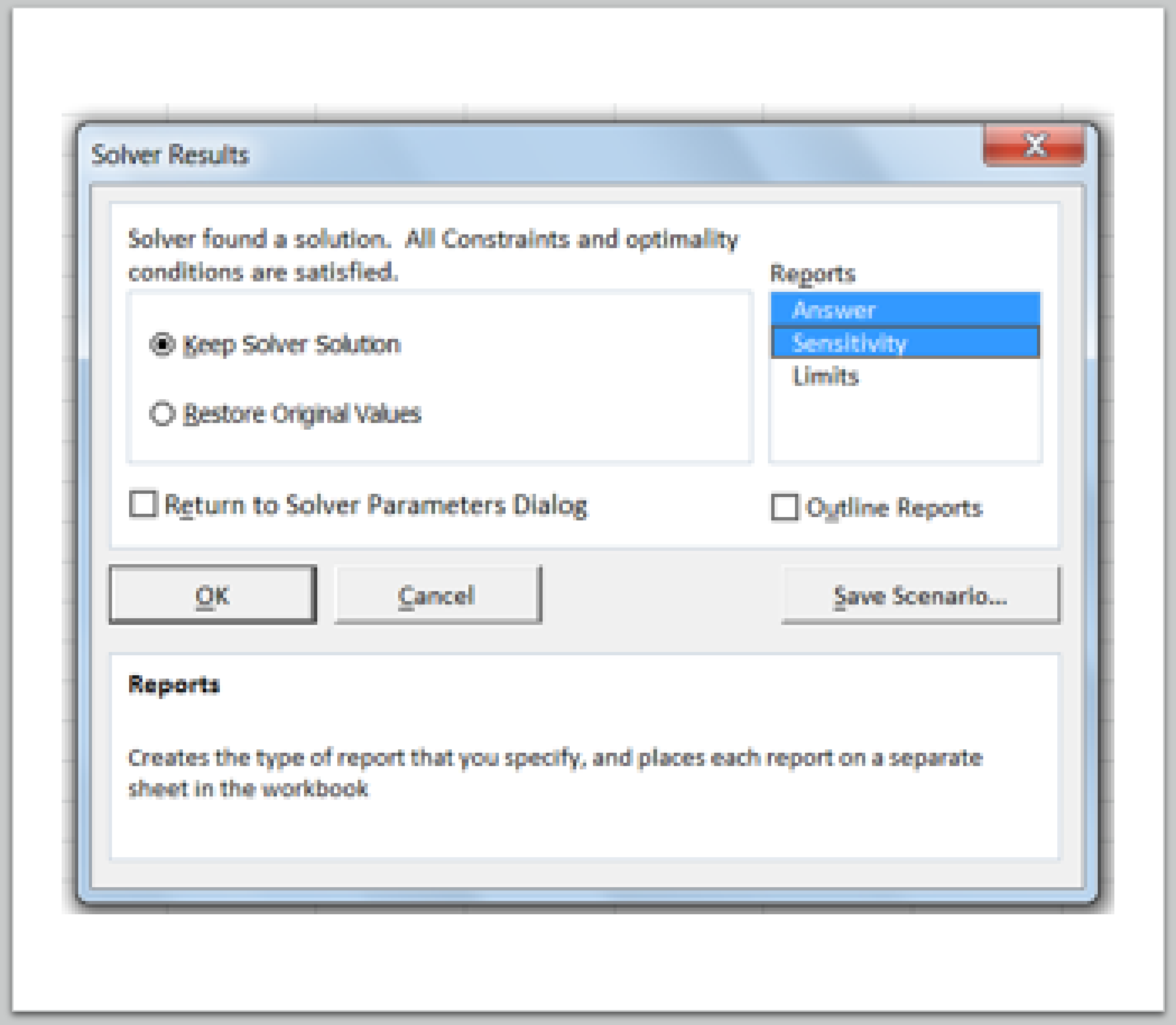
Excel Solver (cont..)

- For the non-negativity constraints, check the checkbox to Make Unconstrained Variables Non-Negative
- Select Simplex LP as the Solving Method
- Click Solve



Solver Results

- The Solver Results menu will appear
    - You will have one of two results
        - A **Solution**
            - In the Solver Results menu Reports box
                - Highlight Answer
                - Click OK
        - An **Error** message
            - Make corrections and click solve



Solver Results (cont..)

- Solver will incorporate the optimal values of the decision variables and the objective function into your original layout on your worksheets
- Time to practice!

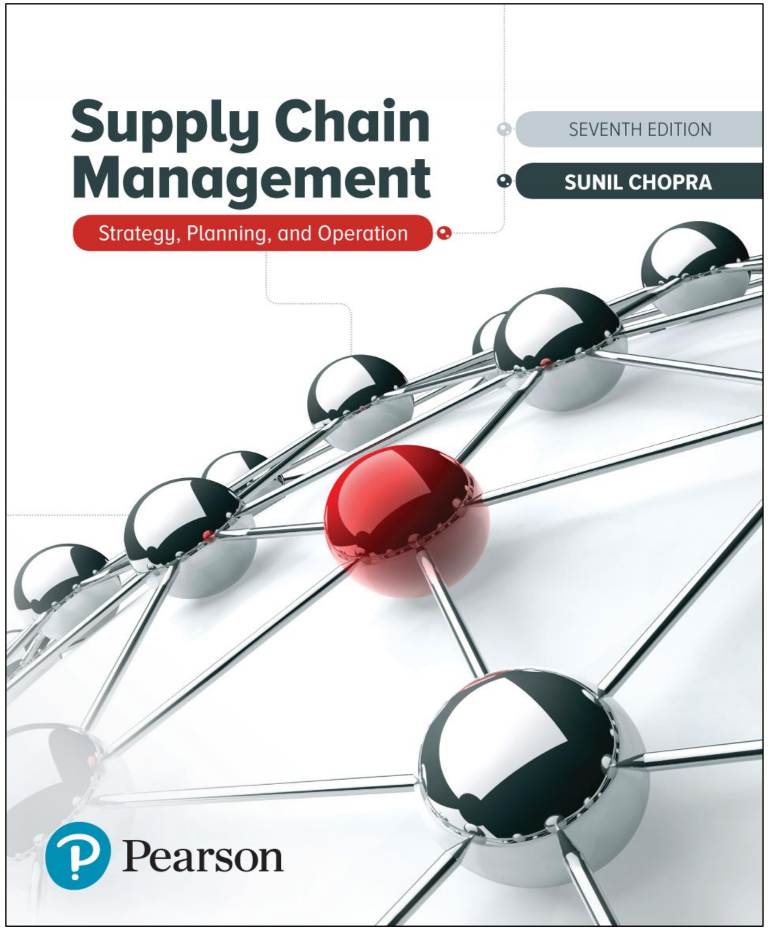
ct						
		H	W			
	solver soln	132	36			
	Unit Profit	40	30			
	Total profit	6360				
				<=	H	W
	Fabrication	600	600		4	2
	Assembly	480	480		2	6

https://www.microsoft.com/en-us/microsoft-365/p/excel/CFQ7TTC0HR4R?ef_id=6fa0d2be82fc1b58e488b3344ce28ef7%3aG%3as&activetab=pivot%3aoverviewtab

https://oneeducatorsopinion.wordpress.com/2014/02/26/brain-breaks-are-good-for-teachers-too/

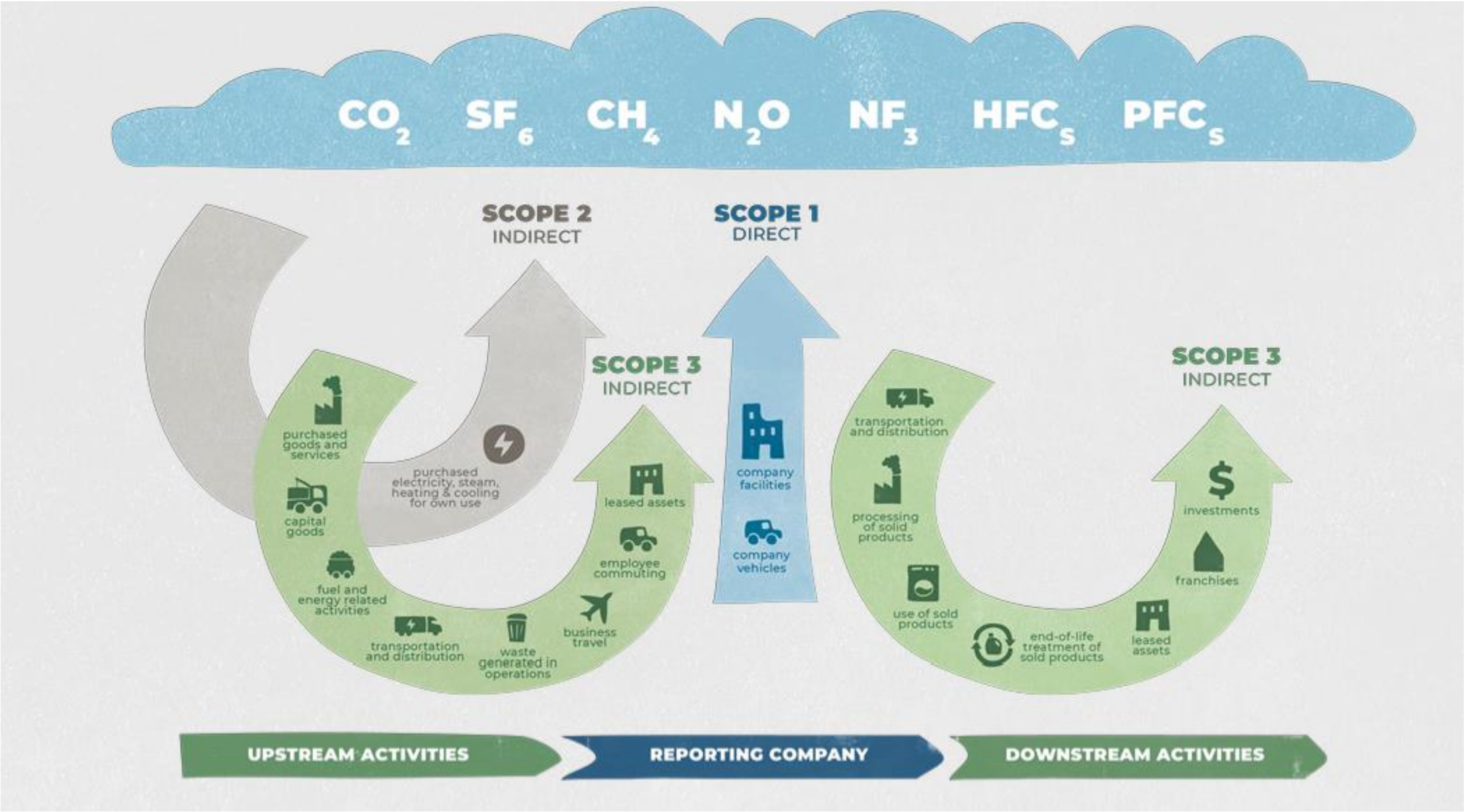
Supply Chain Management: Strategy, Planning, and Operation

Seventh Edition



Chapter 17

Sustainability and the Supply Chain



From: Corporate Value Chain (Scope 3) Accounting and Reporting Standard by WRI and WBCSD

Apple has set an ambitious goal to be carbon neutral across its global supply chain by 2030

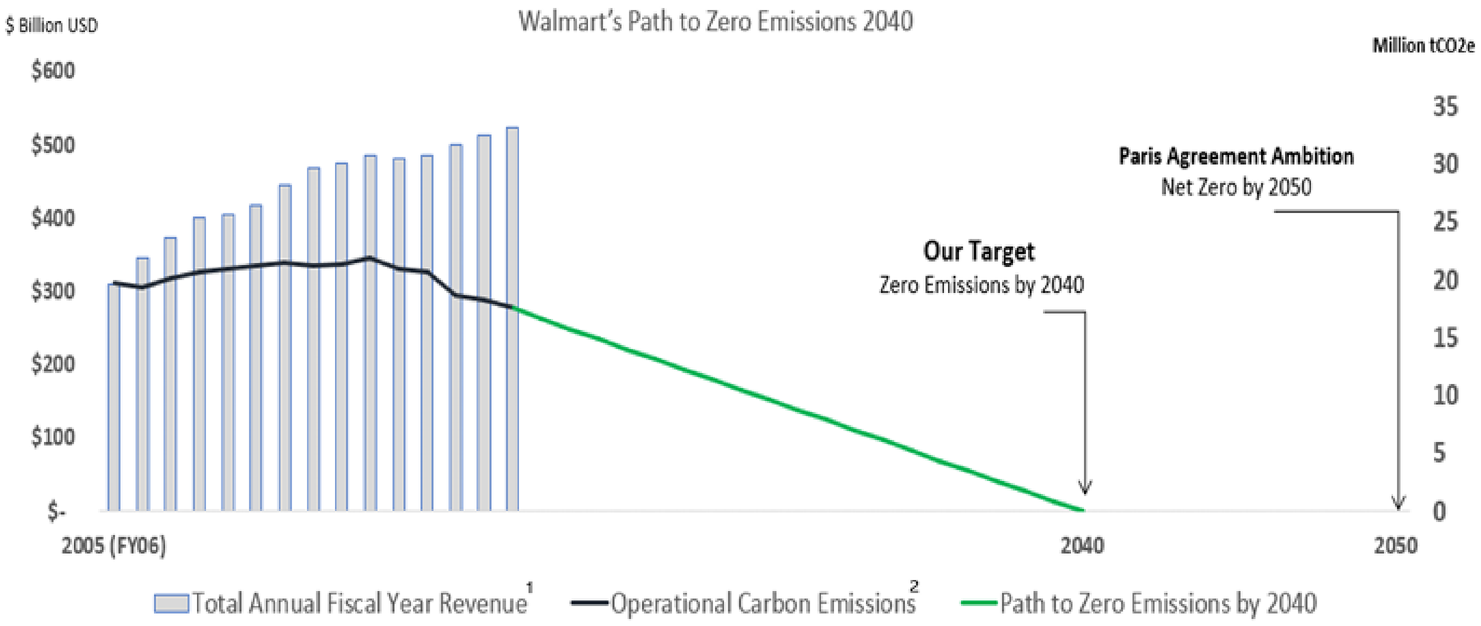
200+ suppliers
committed to using clean energy like wind or solar for their Apple production

3,000 GWh
of new renewable energy across Europe per year by 2030 to address the electricity used by Apple devices on the continent

1 million metric tons
of carbon forecast to be removed in 2025 through Apple's Restore Fund

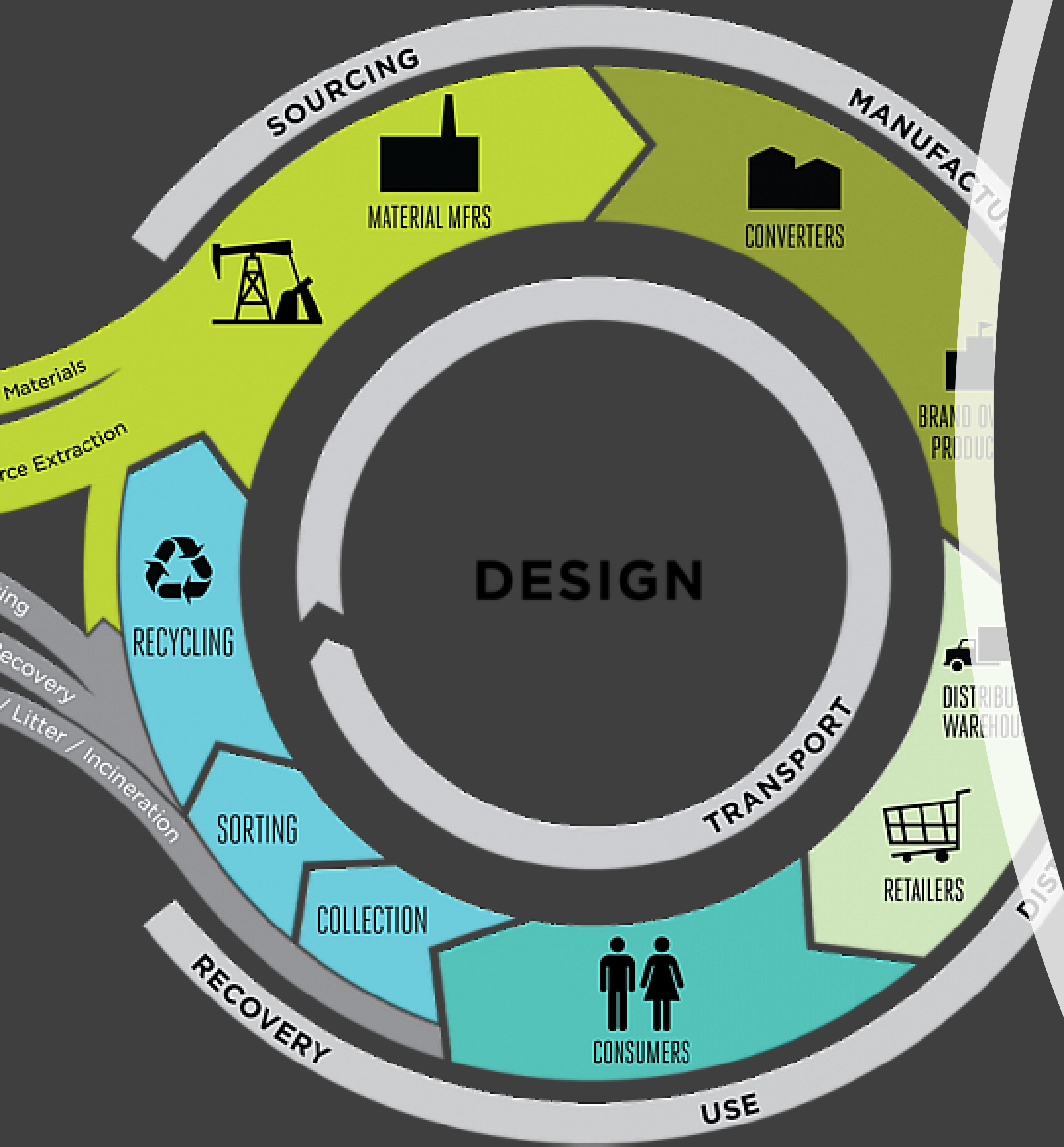
Supply Chain Emissions Reduction Goal

By the end of 2030, reduce emissions intensity (per metric ton of food and packaging) by 31% across our supply chain from 2015 levels.



Role of Sustainability in a Supply Chain (1 of 2)

- The health and survival of every supply chain depends on the health of the surrounding world
- Expand the goal of a supply chain beyond the interests of its participants
- **Sustainable development** – development that meets the needs of the present without compromising the ability of future generations to meet their own needs
- Three pillars of sustainable development
  - Economic sustainability
  - Environmental sustainability
  - Social sustainability
- Factors
  - Reducing risk and improving the financial performance of the supply chain
  - Community pressures and government incentives and mandates
  - Attracting customers that value sustainability



Role of Sustainability in a Supply Chain (2 of 2)

- Most effort expended in reducing risk and improving financial performance
- Activity slow as actions may require upfront investment
- Barriers to increased focus on sustainability
  - Insufficient return on investment
  - Customers’ unwillingness to pay a premium for green products
  - Difficulty evaluating sustainability across a product life cycle

Tragedy of the Commons

- Dilemma arising when the common good does not align perfectly with the good of individual entities
- Every company and supply chain faces the challenge of the tragedy of the commons as it operates in a global environment
- Difficult to imagine a sustainable solution emerging without some intervention
- Solutions
    - Choose from options that are unlikely to be supported by all of their own free will
    - Mutual coercion – social arrangements or mechanisms coerce all participants to behave in a way that helps the common good
        - Command-and-control approach: Government/ regulators set standards
        - Market mechanisms: Cap-and-trade, taxes

Image: David Cutler

https://medium.com/openforests/the-core-concept-of-sustainability-8facc0811f4f

Key Pillars of Corporate Social Responsibility

- Measuring performance along all three pillars may be required to evaluate the impact of sustainability-related efforts
  - Environmental
  - Social
  - Governance
- Two fundamental challenges
  - Scope of measurement
  - Absolute of relative measures

Environmental Pillar

- Firm's impact on the environment, including air, land, water, and ecosystems
  - Resource reduction
  - Emission reduction
  - Product innovation
- Not all "green" claims are valid
  - **Greenwashing**

https://sciencetrends.com/earths-many-different-types-ecosystems/

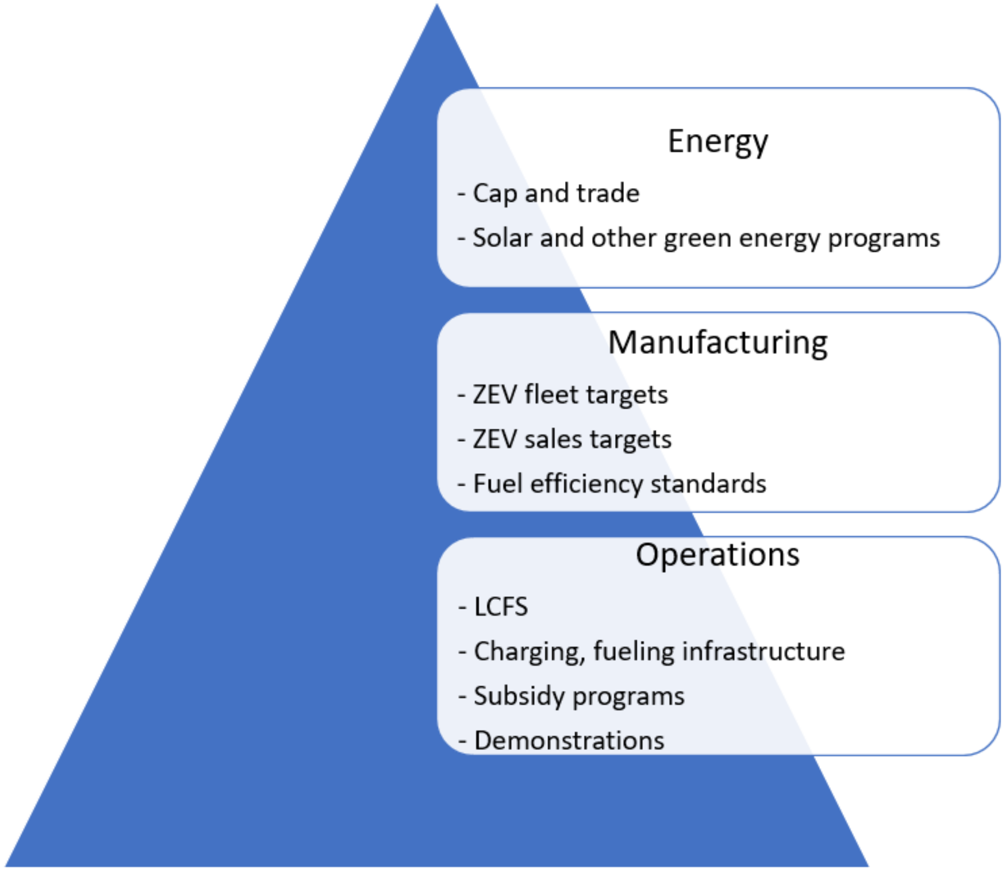
Social Pillar

- A firm’s ability to address issues that are important for its workforce, customers, and society
- Audit and support suppliers
    - Supplier collaboration and capability building strongly associated with social and environmental responsibility performance improvement and lower operating costs
    - Benefits accrue to all customers of the supplier

https://globalcastaway.com/visiting-luxor-egypt/

Governance Pillar

- Firm's governance style based on best management practices
- Vision and strategy for environmental and social improvements must align with economic performance
- Hard to implement



California Heavy-duty Truck Emission Mandates

Facilities

Illustration by Skanska USA

- Consumers of energy and water and emitters of waste and greenhouse gases
- Separate the improvement opportunities into those that generate positive cash flows and those that do not
- Facilities often offer the best opportunity to simultaneously improve the environmental and financial performances through innovation

Inventory

- Most supply chains focus on raw materials, work in process, finished goods
- Inventory in a landfill
- Cost borne collectively by society
- Reduce harmful inventory, unlock unused value
- “Cradle to cradle” design

Transportation

- Improve environmental performance through resource and emission reduction
- Product design can play a significant role

https://www.latimes.com/local/california/la-me-california-commute-20150317-story.html

Sourcing

- Greatest social and environmental impact occurs in the extended supply chain
- Impact has grown with increased global sourcing
- Verifying and tracking supplier performance with regard to sustainability a major challenge

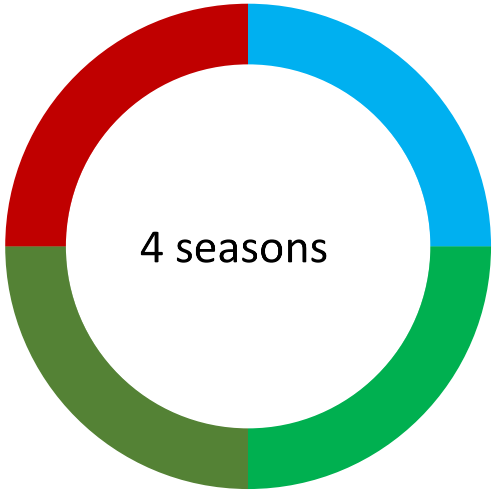
https://sourcingjournal.com/sustainability/sustainability-news/sustainable-sourcing-key-concern-brands-retailers-td-49539/

Pricing

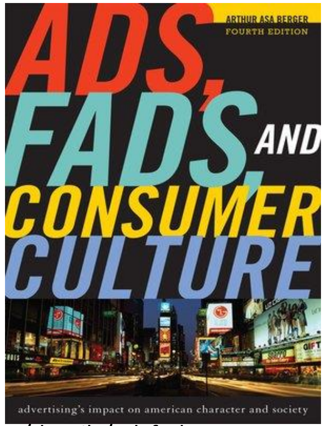
- Differential pricing can improve the utilization of assets, leading to resource reduction
  - Delays the need for additional capacity
- Consumption visibility and differential pricing potentially lead to reduce resource consumption
- Biggest challenge is changing the customer’s willingness to pay
- Government incentives can encourage customers and firms

Design & process: a fast fashion example

What's Fast Fashion?



Before 1990 | 1990 +



https://archive.org/details/adsfadsconsumerc0000berg_p3s3

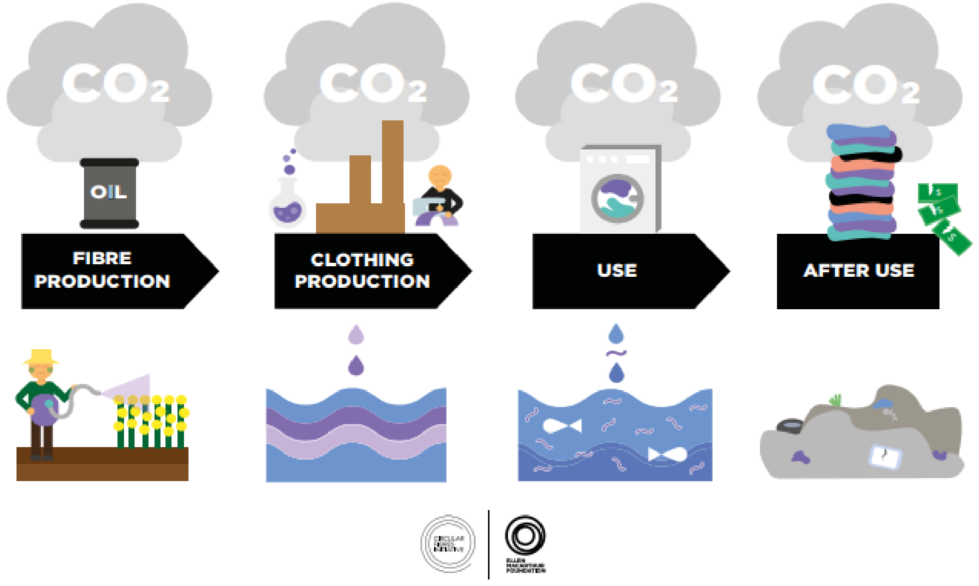
https://mopify.com/blog/fast-fashion

Design & process: a fast fashion example

The fashion industry produces 10% of all humanity's carbon emissions, is the second-largest consumer of the world's water supply and pollutes the oceans with microplastics.

It takes about 700 gallons of water to produce **one cotton shirt**. That's enough water for one person to drink at least eight cups per day for three-and-a-half years.

FIGURE 2: TODAY'S CLOTHING SYSTEM PUTS PRESSURE ON RESOURCES, POLLUTES THE ENVIRONMENT, AND CREATES NEGATIVE SOCIETAL IMPACTS



Washing clothes, meanwhile, releases 500,000 tons of microfibers into the ocean each year — the equivalent of 50 billion plastic bottles.

https://www.businessinsider.com/fast-fashion-environmental-impact-pollution-emissions-waste-water-2019-10?op=1
https://www.weforum.org/agenda/2018/08/clothing-rental-could-be-the-key-to-a-stylishly-sustainable-fashion-industry

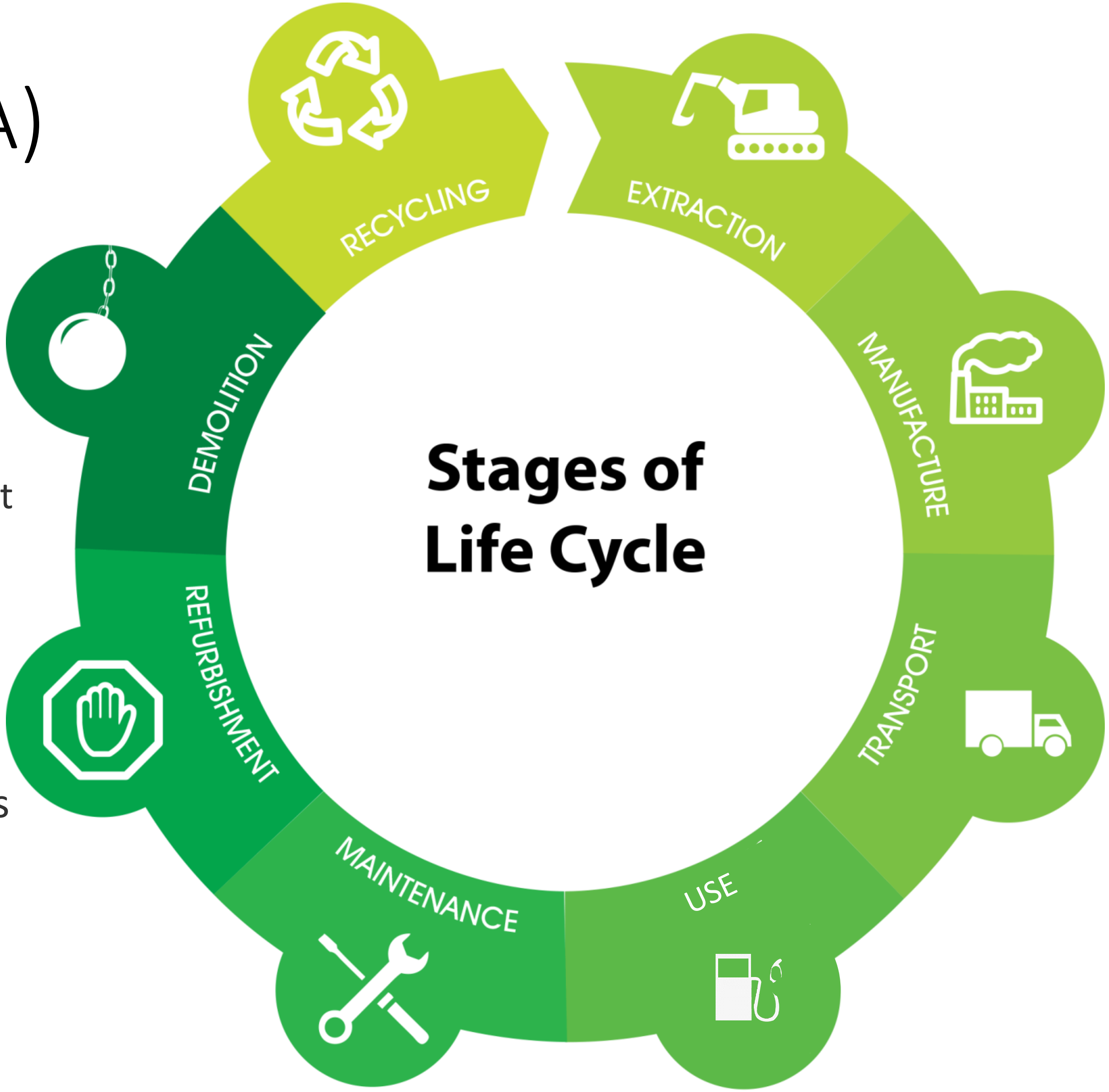
Breakout (PP)
Supply Chain Initiatives: Focus on Sustainability

- Investigate these resources in your teams and prepare to report back to the class.
    - What is CDP? What do they offer? What are the reasons they list for starting the sustainability journey? What areas do they focus on? Look up an “A” business. Any surprise you? https://www.cdp.net/en/
    - Report out on the Sustainable Development Goals (SDGs) from the UN. (I recommend showing the diagram) How can firms work towards these goals? https://sdgs.un.org/goals
    - Read the Clif Bar case study. What did they do and what was their outcome? What are they working with their suppliers to achieve? See content/module 3/week 3/reading
    - Find a company that is actively working to address sustainability. Describe the firm and its supply chain (briefly) and what specific actions have taken place, measurements, and results.

https://www.netclipart.com/isee/hmhJiJ_team-huddle-clip-art-huddle-clip-art/

Life cycle analysis (LCA)

- Cradle-to-grave approach for assessing the environmental impacts
  - It is not just about the use cycle!
  - What is the overall impact of a particular product
- Gain a broad and comprehensive perspective about a product footprint
- Ensures that an improvement in one area does not suboptimize the whole
- Compare between different materials, processes
- Everyone in the supply/use chain has a responsibility for environmental impacts
- Having standards can provide information to consumers, companies, and governments



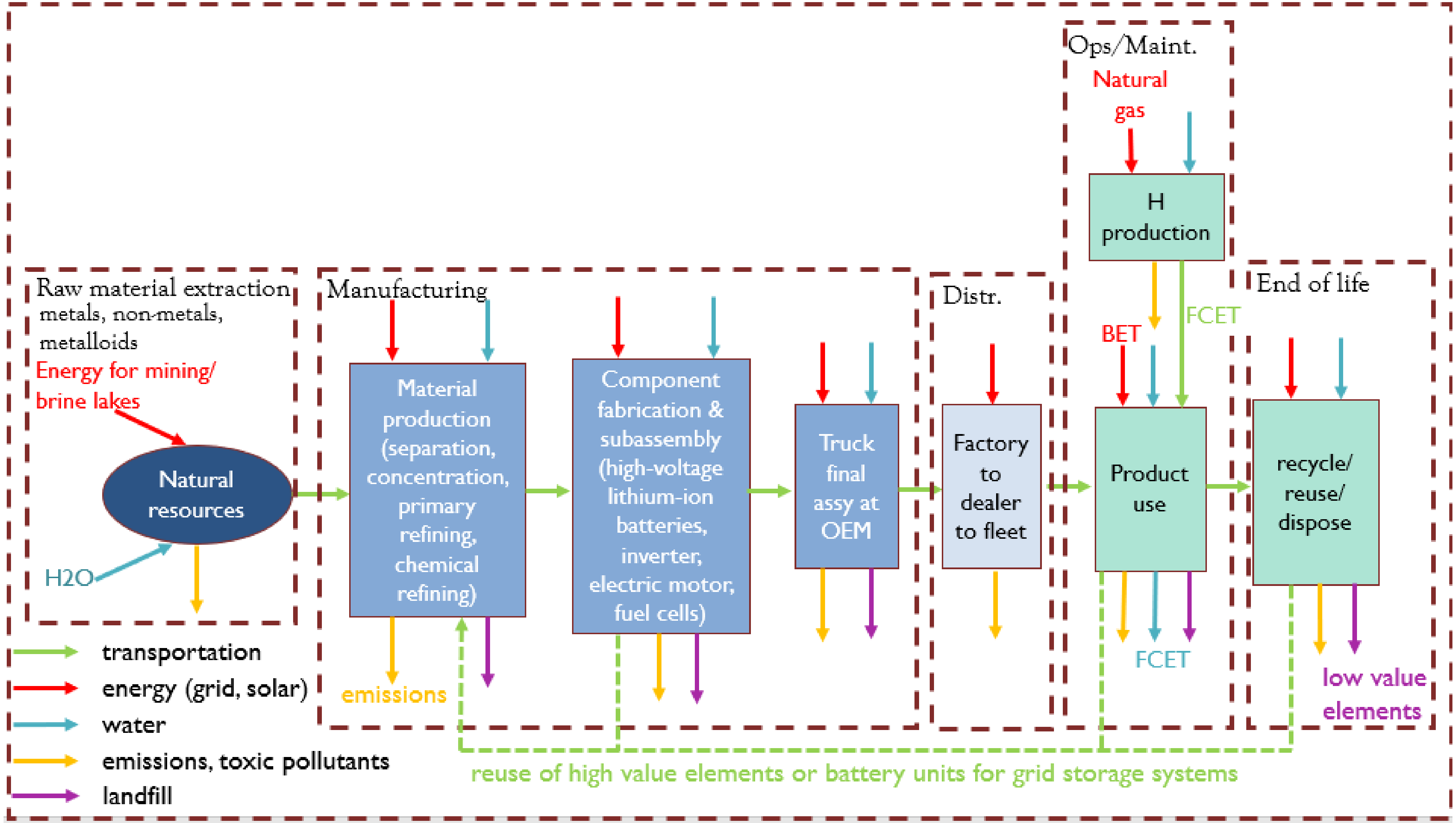
https://i.pinimg.com/originals/5f/dc/9c/5fdc9cf81640f9d1d0fae64439854ac6.png

Dissertation research problem

- **Research question: which type of engine/powertrain has the lowest carbon footprint? Electric (EV) or hydrogen fuel cell (FCV)?**
- Understand the life cycle impacts from all phases of alternative technology heavy-duty trucks
  - Compare all phases of the lifecycle
  - Mining, manufacturing, distribution, operation, and retirement/recycling
  - Focus on components which are different between models, not those items which are the same (e.g., a tire is a tire)
- Functional unit = 1 mile driven
- Main assumptions
  - Both class-8 trucks used in same region with same number of miles (48,360/yr., 10-year life, 300-mile range)
  - Information on vehicles gleaned from various sources since not in production
    - Kenworth/Toyota T680 in demonstration (CARB grant)
    - Tesla running tests, but access to test Semi not available to outside entities

EV Tesla Semi
vs.
FCV Kenworth/Toyota T680

System flow diagram & boundary (BET & FCT)

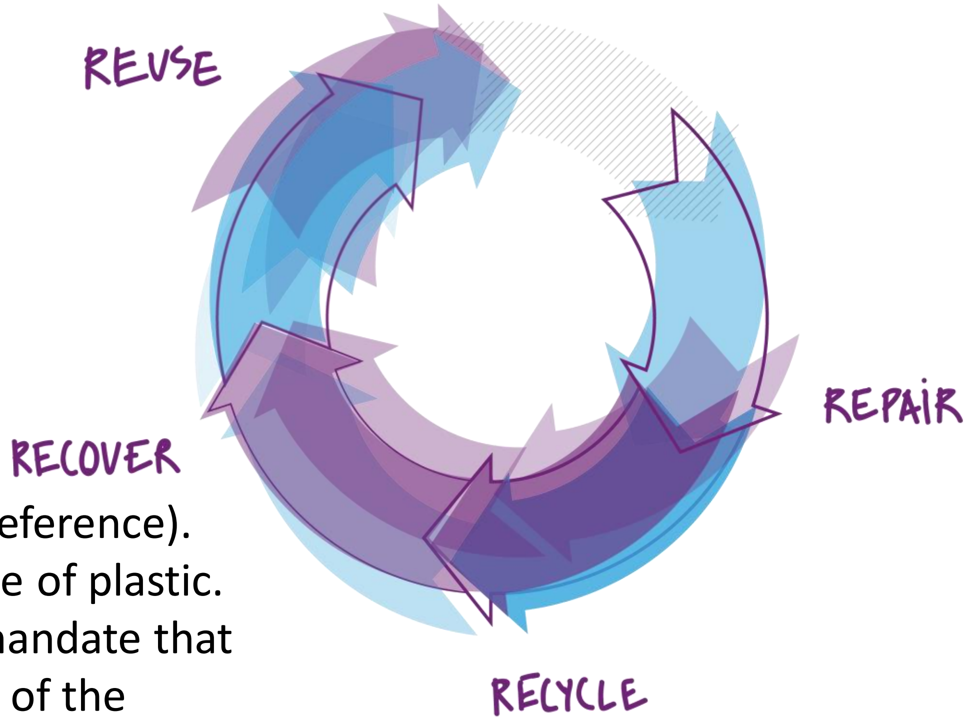


Summary of drivers to improve supply chain sustainability

- Facilities redesigned to reduce energy use and emissions
- Products designed to:
  - Decrease landfill inventory
  - Increase the reuse of material
  - Limit packaging
  - Improve transportation density (leading to cost reduction and lower emissions)
- Individual firms with great reach exert influence on their extended supply chains to improve sustainability
- Clearly defined standards for measurement and reporting of performance
- Customers' willingness to reward successful supply chains

https://thebossmagazine.com/green-supply-chain/

Case 3: Circularity Due 4/27



http://designfordemand.forumforthefuture.org/section/1-1-why-we-need-your-help-to-create-a-more-circular-economy/

- The report should be 5-6 pages in length, plus references.
- Include tables/charts/figures and explain calculations.
- Feel free to add information as necessary to make your case.

- Read the Oxford case on Dell Circular Case Study (go to content/cases/reference).
  - You work for a company that could benefit from the recycling/reuse of plastic. Assume that the Board of Directors of this company has issued a mandate that sustainability efforts begin in earnest within the year for all phases of the manufacturing/distribution of products containing plastic. Your team has been assembled to analyze the problem. (The team is not constrained to plastic and may choose another commodity.)
- To accomplish this goal, write a recommendation report for senior management on the supply chain transformation. Discuss:
  - What makes a circular economy possible? Who are the players? What type of cooperation is needed?
  - Why is circularity important to this company/industry? Be specific.
  - For a specific commodity/product, investigate the lifecycle and current end-of-life processes.
  - Discuss which phase(s) should be transformed and why.
  - What problems must be overcome to make your idea(s) work?
  - Determine the steps needed to reach this goal, including a cost-benefit analysis to sell the idea to senior management. (Not asking for detailed $ but directionality and considerations)

Case 3 Teams

Alramahi, Ehab	1
Euceda Iscoa, Marlon	1
Han, Chris	1
Lopez, Ruben	1
Galleta, Beda	2
Ghazaryan, Shushanik	2
Khachatryan, Marieta	2
Magallon, Dominick	2
Collier, Nicole	3
Dizon, Ric	3
Ramirez, Lizbeth	3
Wand, Kelly	3
Ahadiat, Parisa	4
Guelff, Michelle	4
Matthews, Olivia	4
Vidovich, Mikaela	4

Freeman, Annie	5
Joshua, Jonathan	5
Rodgers, Samuel	5
Sampson, Ivy	5
Bui, Cindy	6
Kariuki, Janet	6
Nguyen, Jessica	6
Redfearn, Joe	6
Alfaro, Marugenia	7
Contreras, Stephanie	7
Gonzalez-Aguayo, Gisela	7
Khafajizadeh, Bina	7
Ang, Paul	8
Beisecker, Kelsey	8
Perez, Melissa	8
Weiss-Varela, Samantha	8

Assignments

- Listen to sourcing video if you haven't already done so
- Team case study on Ukraine
  - Due 4/13 to dropbox (prior to class)
  - Team eval due 4/14 to dropbox (individual)
  - Next class team leader to report out on:
    - What commodity studied
    - Findings on SC disruption/impact
    - Surprises?
- Homework 2
  - Due 4/20 before class
  - Agg planning, LP, cycle stock, safety stock, EOQ, qty discounts, ROP
  - Can find questions in content/module 4/week 4/assignments

Office hours! Please join me on Tuesdays 1-2pm or by appointment!

Planning and Managing Inventories

SCM614

WEEK 4

Agenda

Ukraine cases – share info

PP on sustainability

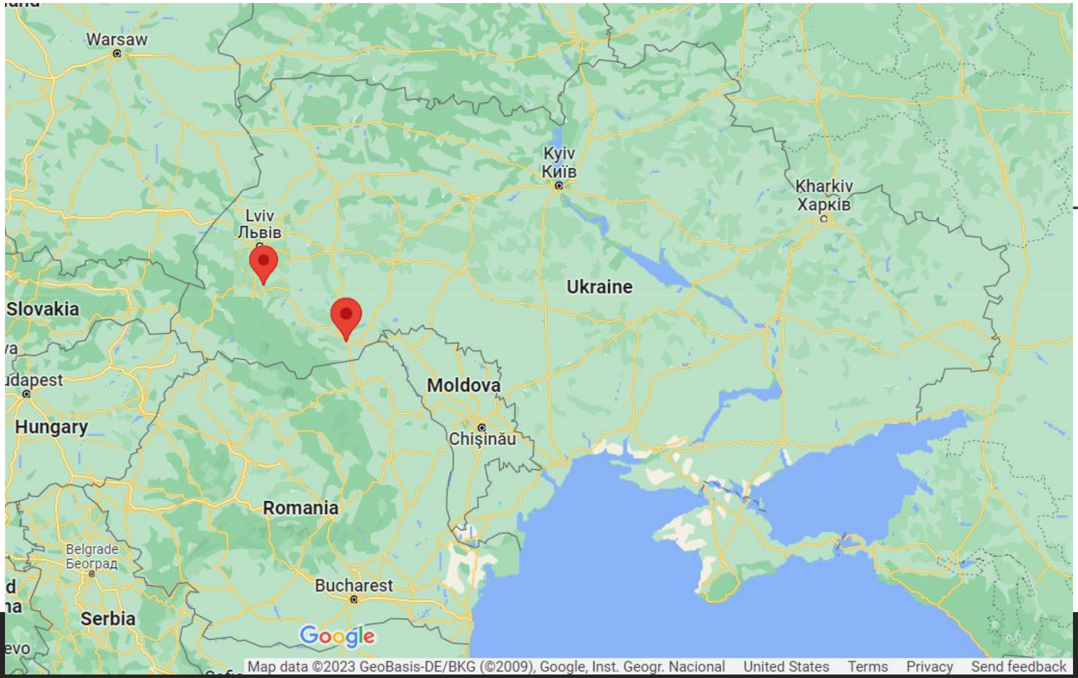
Lecture & Excel

- Inventory types/functions/goals
- Inventory cycle/costs
- Economic Order Quantity
- Economic Production Quantity
- Quantity Discounts
- Reorder Point: many wonderful iterations of such!

What's next: homework

Ukraine's wedding dress industry

- A product that just cannot be late
- Made to order gown LT = 1 yr. from order to fit (standard)
- Interrupted at start of war due to workers fleeing
  - Chernivtsi employees have returned to area/work
  - Lviv Milla Nova moved some production to Warsaw
- Export through Romania or Poland with no change in outbound SC
- Import materials: silk China, lace France, crystals Austria
- In 2014, shifted exports from Russia to EU/NA
  - Crimea invasion, ruble drop, working relationships deteriorated



GIOVANNA ALESSANDRO
WEDDING DRESSES

Breakout (PP)
Supply Chain Initiatives: Focus on Sustainability

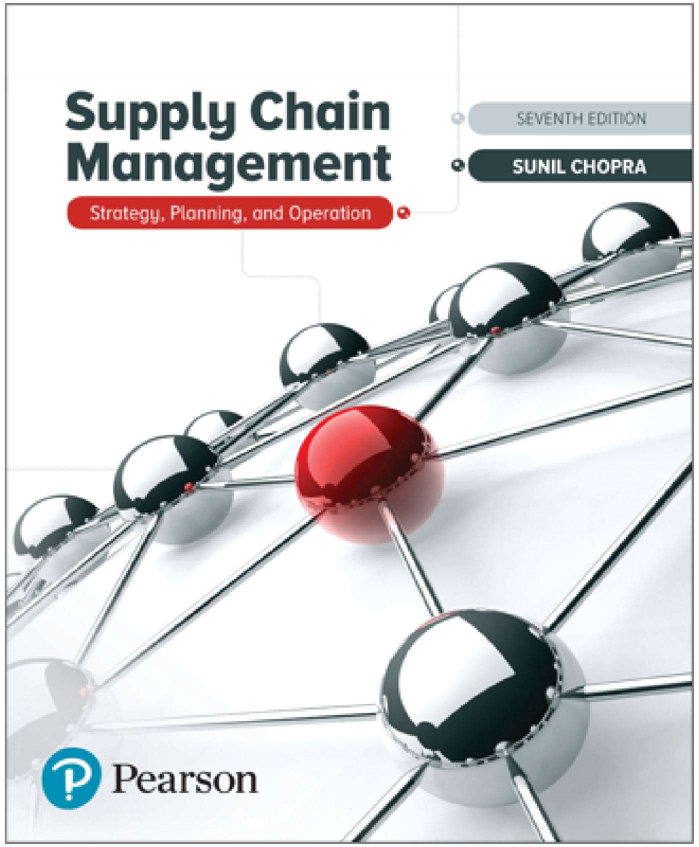
Investigate these resources in your teams and prepare to report back to the class.

- What is CDP? What do they offer? What are the reasons they list for starting the sustainability journey? What areas do they focus on? Look up an "A" business. Any surprise you? https://www.cdp.net/en/
- Report out on the Sustainable Development Goals (SDGs) from the UN. (I recommend showing the diagram) How can firms work towards these goals? https://sdgs.un.org/goals
- Read the Clif Bar case study. What did they do and what was their outcome? What are they working with their suppliers to achieve? See content/module 3/week 3/reading
- Find a company that is actively working to address sustainability. Describe the firm and its supply chain (briefly) and what specific actions have taken place, measurements, and results.

https://www.netclipart.com/isee/hmhJiJ_team-huddle-clip-art-huddle-clip-art/

Supply Chain Management: Strategy, Planning, and Operation

Seventh Edition



Chapter 11

Managing Economies of Scale in a Supply Chain Cycle Inventory

Inventory

Inventory

- A stock or store of goods

Independent demand items

- Items that are ready to be sold or used

https://www.reviso.com/blog/inventory-management/

Inventories are a vital part of business because:

(1) necessary for operations

(2) contribute to customer satisfaction

A "typical" firm has roughly 30% of its current assets and as much as 90% of its working capital invested in inventory

Types of Inventory

Cycle inventory

Raw materials and purchased parts

Work-in-process (WIP)

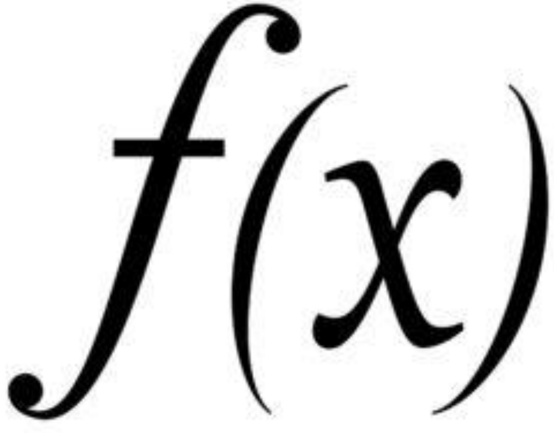
Finished goods inventories or merchandise

Tools and supplies

Maintenance and repairs (MRO) inventory

Goods-in-transit to warehouses or customers (pipeline inventory)

Inventory Functions



Inventories serve a number of functions such as:

1. To meet anticipated customer demand
2. To smooth production requirements
3. To decouple operations
4. To protect against stockouts
5. To take advantage of order cycles
6. To hedge against price increases
7. To permit operations
8. To take advantage of quantity discounts

Objectives of Inventory Control

Inventory management has two main concerns:

1. Level of customer service
   - Having the right goods available in the right quantity in the right place at the right time (+ right quality)
2. Costs of ordering and carrying inventories
   - The overall objective of inventory management is to achieve satisfactory levels of customer service while keeping inventory costs within reasonable bounds
     - Measures of performance
     - Customer satisfaction
       - ✓ Number and quantity of backorders
       - ✓ Customer complaints
     - Inventory turnover

Effective Inventory Management

Requires:

1. A system keep track of inventory
2. A reliable forecast of demand
3. Knowledge of lead time and lead time variability
4. Reasonable estimates of
    - Holding costs
    - Ordering costs
    - Shortage costs
5. A classification system for inventory items

https://www.shopkeep.com/blog/how-to-keep-track-of-inventory

Inventory Counting Systems

Periodic system

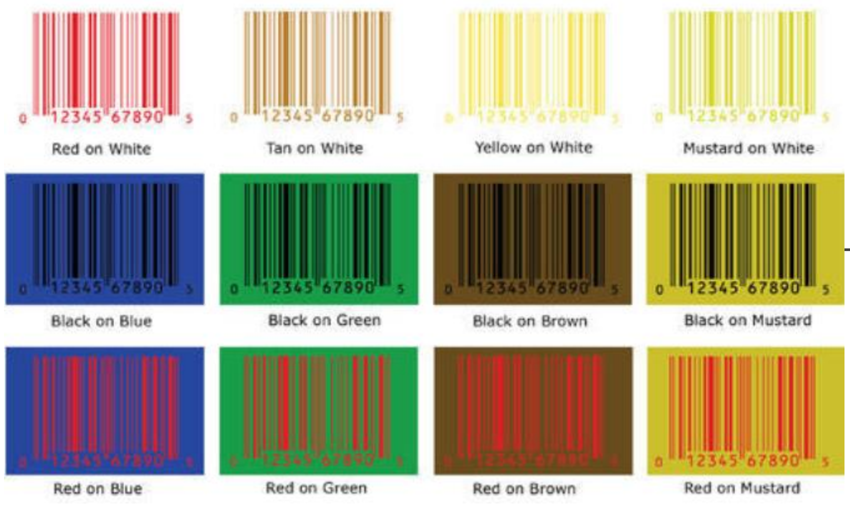
- Physical count of items in inventory made at periodic intervals

Perpetual inventory system

- System that keeps track of removals from inventory continuously, thus monitoring current levels of each item
    - An order is placed when inventory drops to a predetermined minimum level
        - ✓ Two-bin system (Kanban)
            - Two containers of inventory; reorder when the first is empty

https://www.horiba.com/en_en/products/detail/action/show/Product/batch-processing-1681/; https://www.creativemechanisms.com/gears

Inventory Counting Technologies



https://www.indiamart.com/proddetail/upc-non-scannable-barcode-label-

https://www.rfsmart.com/blog/you-down-with-rfid-yeah-you-know-me

Universal product code (UPC)

- Bar code printed on a label that has information about the item to which it is attached

Radio frequency identification (RFID) tags

- A technology that uses radio waves to identify objects, such as goods, in supply chains

Inventory Costs

Purchase cost: The amount paid to buy the inventory

Holding (carrying) costs: Cost to carry an item in inventory for a length of time, usually a year

Ordering costs: Costs of ordering and receiving inventory

Setup costs: The costs involved in preparing equipment for a job

- Analogous to ordering costs

Shortage costs: Costs resulting when demand exceeds the supply of inventory; often unrealized profit per unit

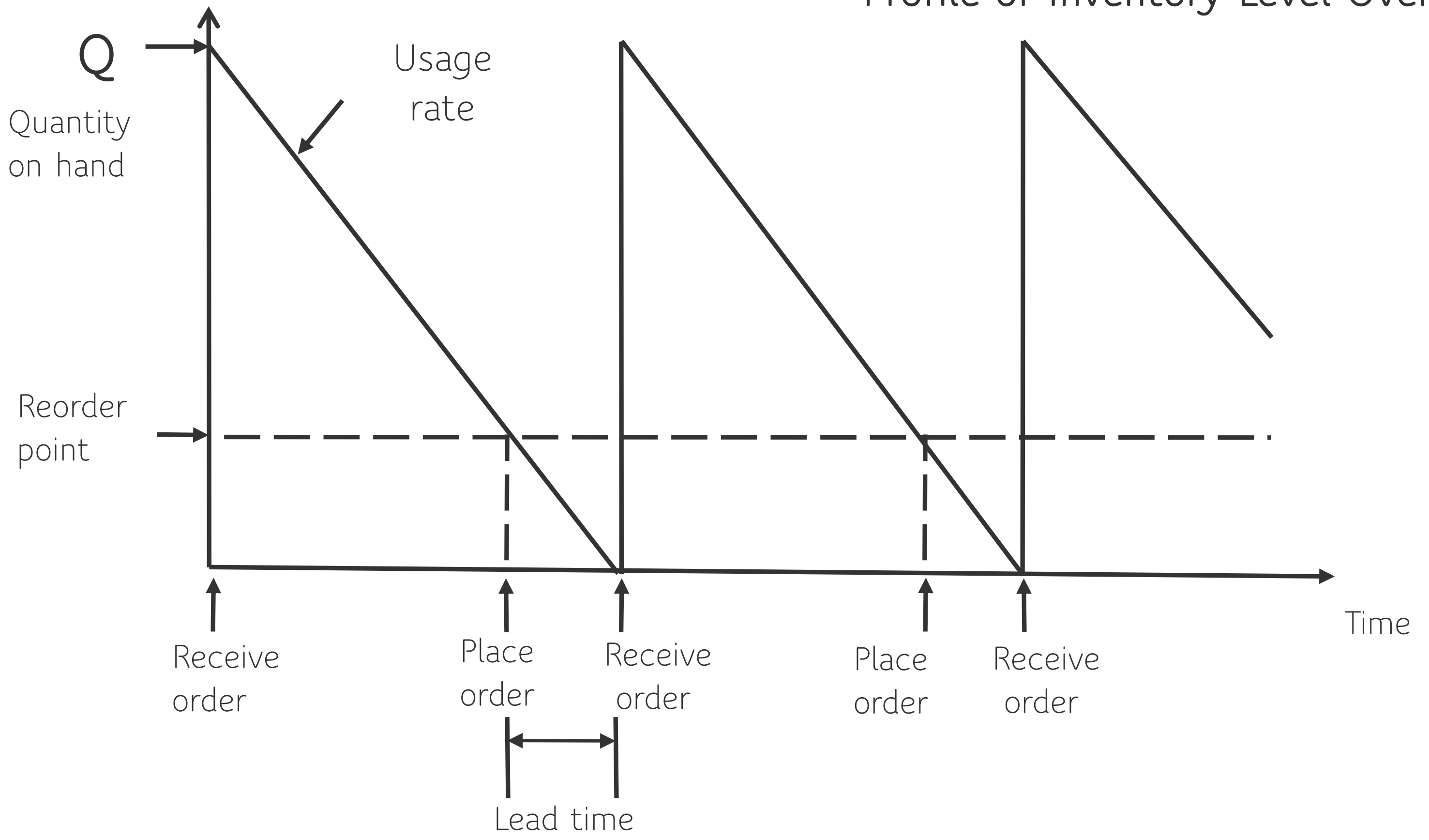
https://www.flaticon.com/free-icon/bag-with-dollar-sign_1349

The Inventory Cycle

$$\text{Average inventory} = \frac{Q}{2}$$

$$\text{Length of order cycle} = \frac{Q}{D}$$

Profile of Inventory Level Over Time



Total Annual Cost

$$\text{Total Cost} = \text{Annual Holding Cost} + \text{Annual Ordering Cost}$$

$$= \frac{Q}{2}H + \frac{D}{Q}S$$

where

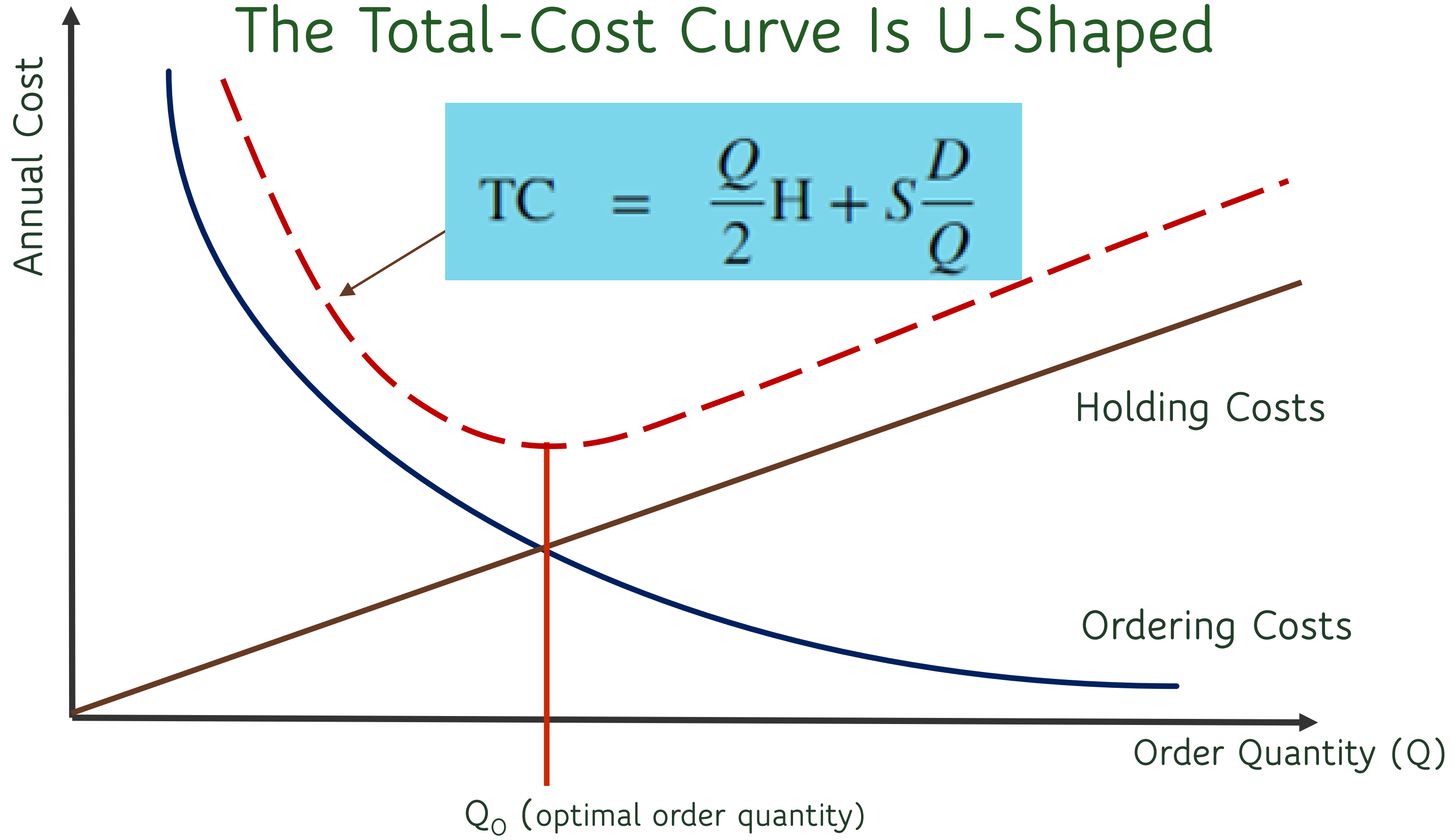
Q = Order quantity in units

H = Holding (carrying) cost per unit, usually per year

D = Demand, usually in units per year

S = Ordering cost per order

Goal: Total Cost Minimization



How Much to Order: EOQ Models

Economic order quantity models identify the optimal order quantity by minimizing the sum of annual costs that vary with order size and frequency

1. The basic economic order quantity model
2. The economic production quantity model
3. The quantity discount model

Basic EOQ Model

The basic EOQ model is used to find a fixed order quantity that will minimize total annual inventory costs

Assumptions:

1. Only one product is involved
2. Annual demand requirements are known
3. Demand is even throughout the year
4. Lead time does not vary
5. Each order is received in a single delivery
6. There are no quantity discounts

Deriving EOQ

Using calculus, we take the derivative of the total cost function and set the derivative (slope) equal to zero and solve for *Q*.

The total cost curve reaches its minimum where the carrying and ordering costs are equal.

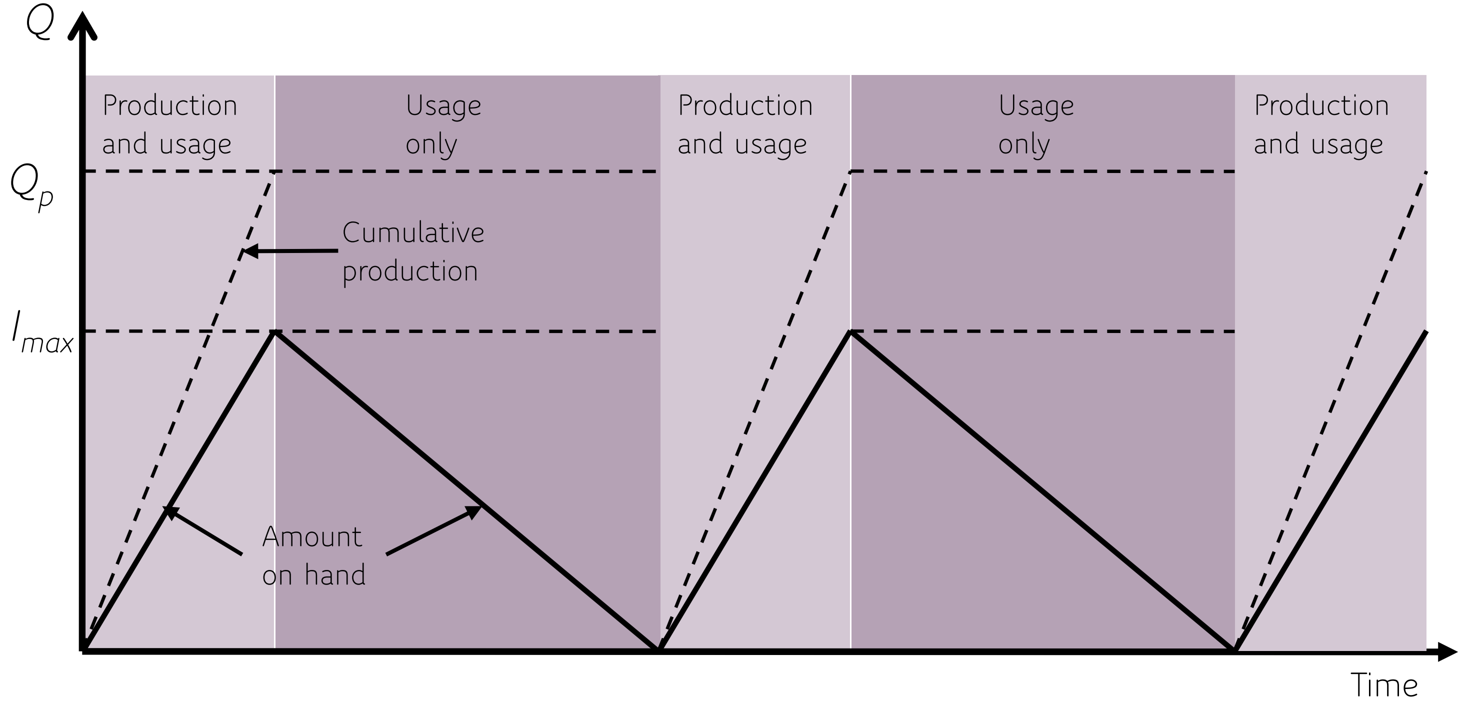
$$Q_{\mathrm{O}} = \sqrt{\frac{2DS}{H}} = \sqrt{\frac{2(\text{annual demand})(\text{order cost})}{\text{annual per unit holding cost}}}$$

Economic Production Quantity (EPQ)

The batch mode is widely used in production. In certain instances, the capacity to produce a part exceeds its usage (demand rate).

- Assumptions
  1. Only one item is involved
  2. Annual demand requirements are known
  3. Usage rate is constant
  4. Usage occurs continually, but production occurs periodically
  5. The production rate is constant
  6. Lead time does not vary
  7. There are no quantity discounts

EPQ: Inventory Profile



EPQ – total cost, run size Q_p

$$TC_{\min} = \text{Carrying Cost} + \text{Setup Cost}$$
$$= \left(\frac{I_{\max}}{2}\right)H + \frac{D}{Q}S$$

where

$$I_{\max} = \text{Maximum inventory}$$
$$= \frac{Q_p}{p}(p-u)$$
$$p = \text{Production or delivery rate}$$
$$u = \text{Usage rate}$$

$$Q_p = \sqrt{\frac{2DS}{H}}\sqrt{\frac{p}{p-u}}$$

Cycle time	=	$\frac{Q}{u}$
Run time	=	$\frac{Q}{p}$
$I_{\max}$	=	$\frac{Q_0}{p}(p-u)$
Average inventory	=	$\frac{I_{\max}}{2}$

Practice!

Let’s do an LP example (PP)

Harry & David sells boxed fruit. Maybe you have heard of them. They offer 4 different boxes as follows:

Box name	**Profit ($/box)**	**Envy apple**	**Granny Smith apple**	**Bosch Pear**	**Tangerine**	**Lemon**
qty	--	200	400	150	150	300
Surprise!	10	1	1	1	1	1
Tangy	12		2		2	1
Martini garnish	13			1	1	3
An Apple a day	12	2	3			

Make boxes with the mixes as shown to maximize profits.

- Set up the objective function and constraint equations
- Post in dropbox PP #3

https://www.harryanddavid.com/h/fruit-gift/fruit-combos/1156

Quantity Discount Model

Quantity discount

- Price reduction for larger orders offered to customers to induce them to buy in large quantities

$$\text{Total Cost} = \text{Carrying Cost} + \text{Ordering Cost} + \text{Purchasing Cost}$$

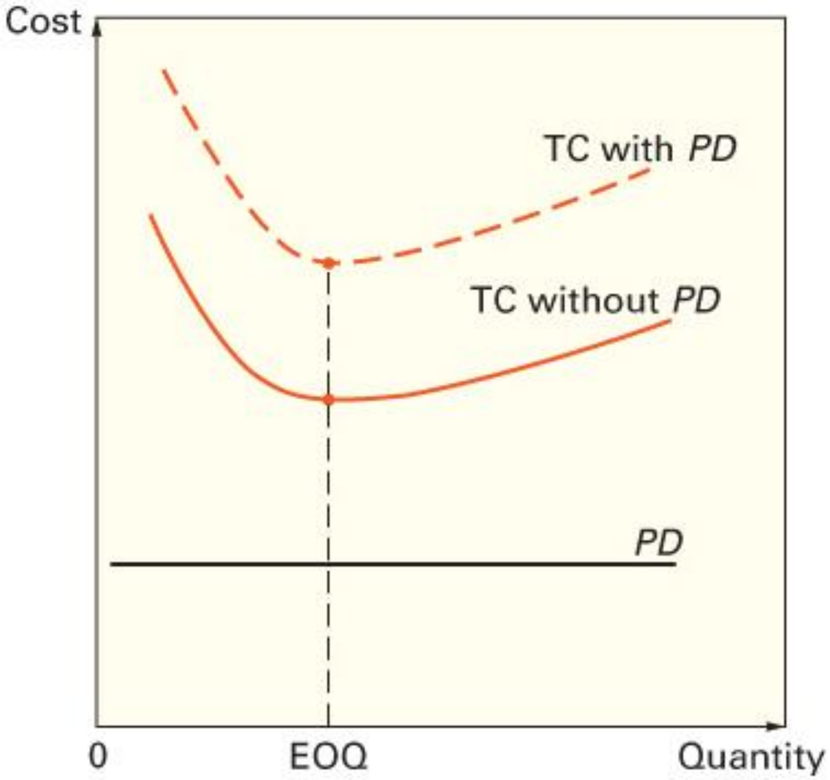
$$= \frac{Q}{2}H + \frac{D}{Q}S + PD$$

where

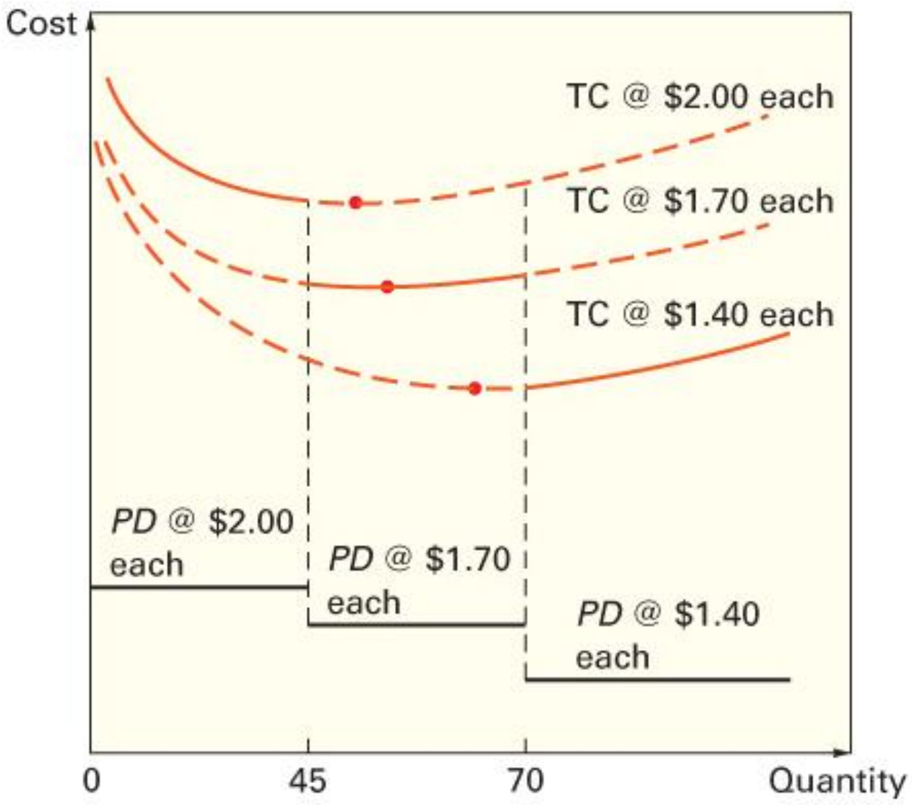
$P = \text{Unit price}$

Quantity Discounts

Adding *PD* does not change EOQ



Quantity Discounts (cont.)



The total-cost curve with quantity discounts is composed of a portion of the total-cost curve for each price

Practice!

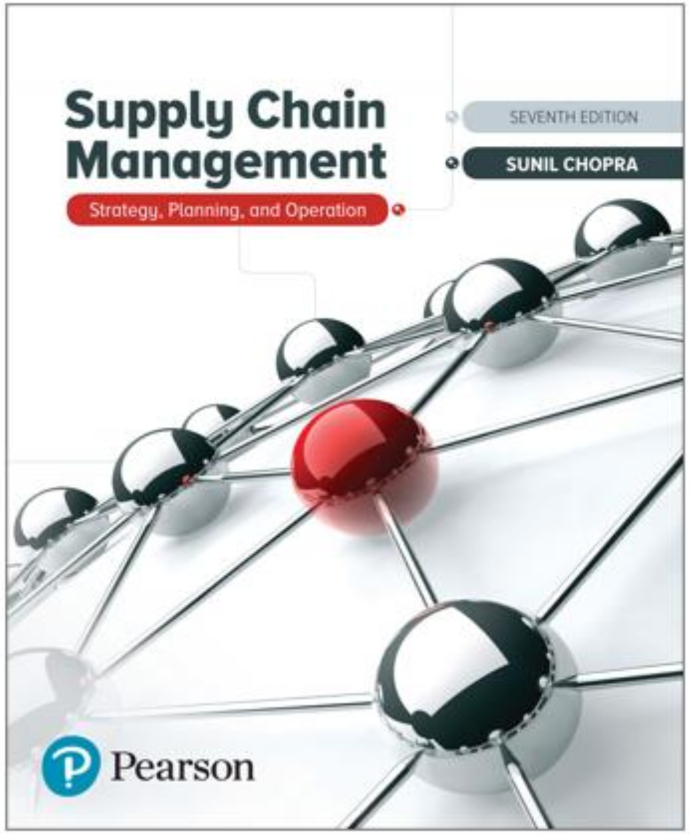
Managerial Levers to Reduce Cycle Inventory

- Factors driving lot sizing decisions: fixed costs & qty discounts
- If buildup is due to large lots associated with fixed costs – reduce fixed costs
  - Decrease changeover times
- If buildup is due to transportation – facilitate aggregation
  - Coordinating orders
  - Using intermediate locations to aggregate from multiple suppliers
  - Use milk runs for pickup and delivery
- If buildup is due to order placement and receiving – employ appropriate technologies
  - Electronic order placement
  - Advanced shipping notices
  - R F I D
- If buildup is due to lot sizing decisions – check supplier's fixed costs
  - Reduce fixed costs
  - Employ volume-based discounts

https://oneeducatorsopinion.wordpress.com/2014/02/26/brain-breaks-are-good-for-teachers-too/

Supply Chain Management: Strategy, Planning, and Operation

Seventh Edition



Chapter 12

Managing Uncertainty in a Supply Chain Safety Inventory

Pearson

The Role of Safety Inventory

- **Safety inventory** is carried to satisfy demand that exceeds the amount forecasted OR takes longer to arrive from supplier than expected
  - Raising the level of safety inventory increases product availability and thus the margin captured from customer purchases
  - Raising the level of safety inventory increases inventory holding costs

Questions:

1. What is the appropriate level of product availability?
2. How much safety inventory is needed for the desired level of product availability?
3. What actions can be taken to reduce safety inventory without hurting product availability?

The Role of Safety Inventory

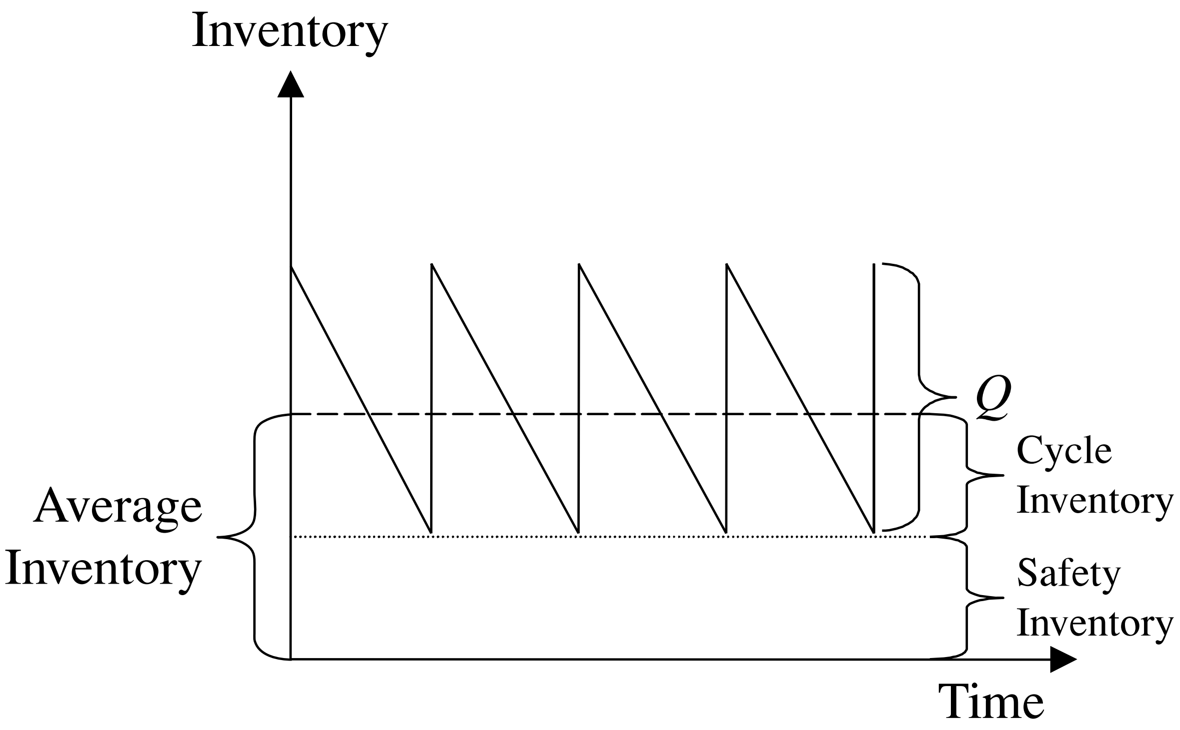


Figure 12-1 Inventory Profile with Safety Inventory

Factors Affecting the Level of Safety Inventory

- The desired level of product availability
- The uncertainty of demand
- The uncertainty of supply
- Inventory replenishment policies

Safety Stock?

As the amount of safety stock carried increases, the risk of stockout decreases.

- This improves customer service level

Service level

- The probability that demand will not exceed supply during lead time
- Service level = 100% - stockout risk

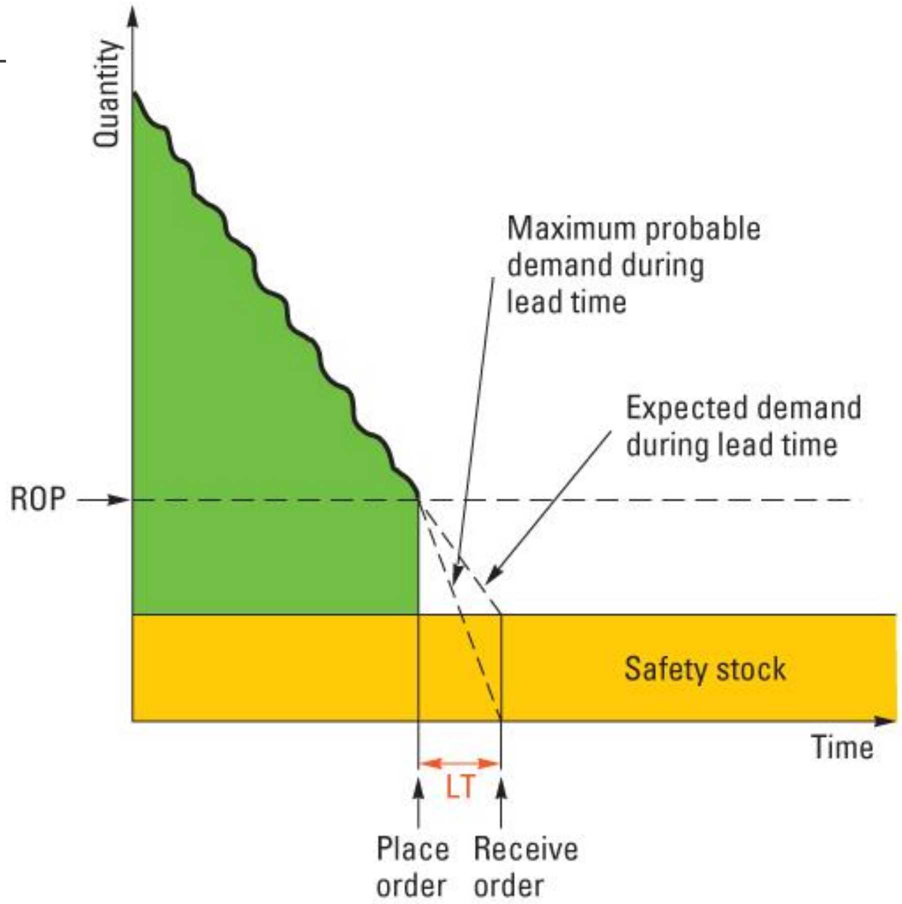
When to Reorder

https://www.slimstock.com/en/inventory-management-solutions/inventory-optimisation-supply-chain/economic-order-quantity/

Reorder point

- When the quantity on hand of an item drops to this amount, the item is reordered.
- Determinants of the reorder point
  1. The rate of demand
  2. The lead time
  3. The extent of demand and/or lead time variability
  4. The degree of stockout risk acceptable to management

Safety Stock



Reorder Point: Under Certainty

$$\text{ROP} = d \times \text{LT}$$

where

d = Demand rate (units per period, per day, per week)

LT = Lead time (in same time units as d)

Reorder Point: Under Uncertainty

Demand or lead time uncertainty creates the possibility that demand will be greater than available supply

To reduce the likelihood of a stockout, it becomes necessary to carry safety stock

- Safety stock
  - Stock that is held in excess of expected demand due to variable demand and/or lead time
  - **Lead time** (*LT*) is the gap between when an order is placed and when it is received

$$\text{ROP} = \begin{matrix}\text{Expected demand}\\ \text{during lead time}\end{matrix} + \text{Safety Stock}$$

Safety Stock equation for ROP: expected demand during the LT & its s.d. is known

The amount of safety stock that is appropriate for a given situation depends upon:

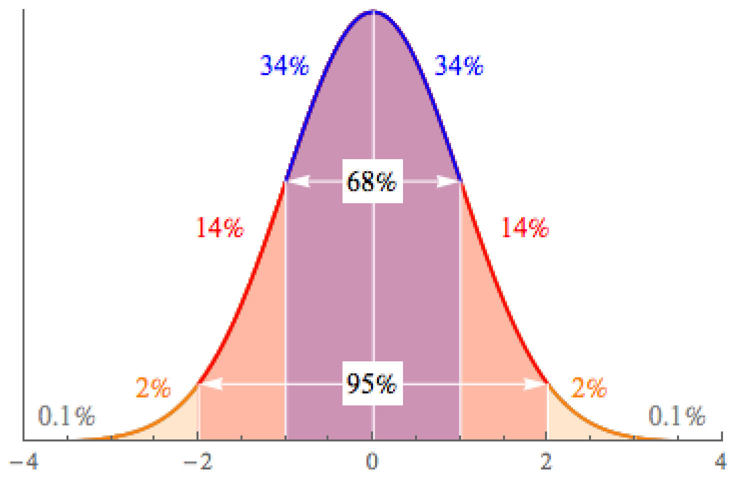
1. The average demand rate and average lead time
2. Demand and lead time variability
3. The desired service level

$$\text{ROP} = \begin{array}{c}\text{Expected demand}\\ \text{during lead time}\end{array} + z\sigma_{d\text{LT}}$$

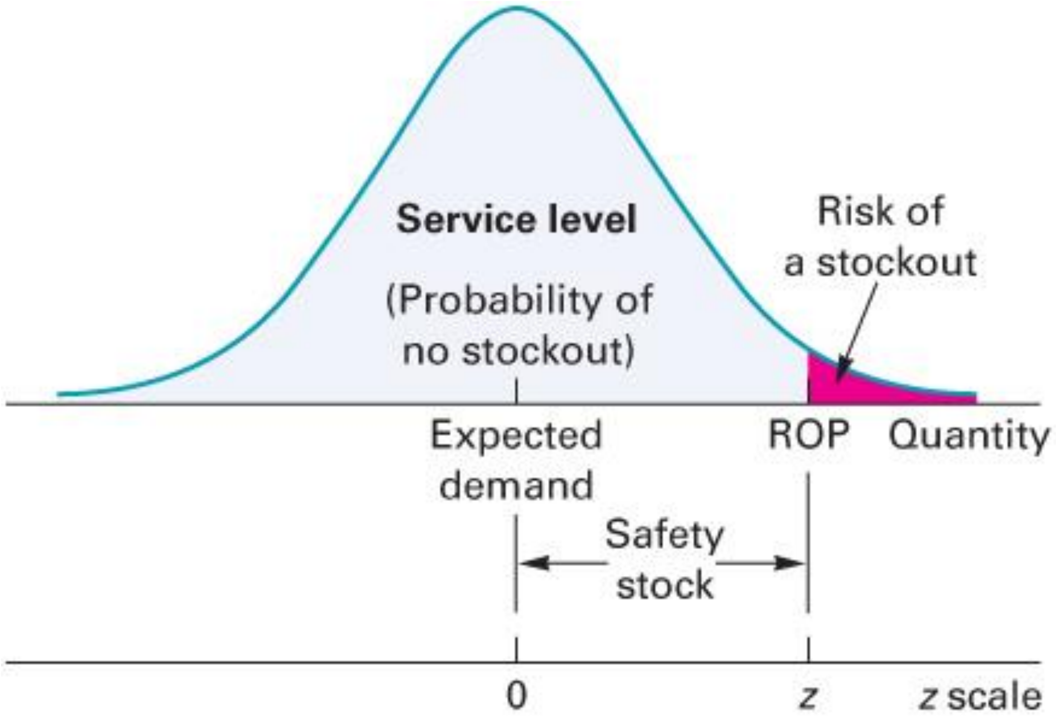
where

z = Number of standard deviations

$\sigma_{d\text{LT}}$ = The standard deviation of lead time demand



Reorder Point



The ROP based on a normal distribution of lead time demand

$$\text{ROP} = \begin{matrix}\text{Expected demand} \\ \text{during lead time}\end{matrix} + z\sigma_{d\text{LT}}$$

where

$$z = \text{Number of standard deviations}$$

$$\sigma_{d\text{LT}} = \text{The standard deviation of lead time demand}$$

Z table

If service level = 97%, then find in table.

Closest is under column .08, row 1.8

The z score is = 1.88 (add row 1.8 with .08)

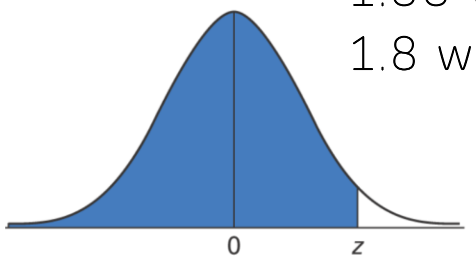


TABLE AREAS UNDER THE STANDARDIZED NORMAL CURVE, FROM $-\infty$ TO $+Z$

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857

4. Reorder point under:		
a. Constant demand and lead time	$ROP = d(LT)$	
b. Variable demand rate	$ROP = \bar{d}LT + z(\sigma_d)\sqrt{\overline{LT}}$	
c. Variable lead time	$ROP = d\overline{LT} + z(\sigma_{LT})d$	
d. Variable lead time and demand	$ROP = \overline{\bar{d}LT} + z\sqrt{\overline{LT}\sigma^2_d + \bar{d}^2\sigma^2 LT}$	

ROP = Quantity on hand at reorder point
d = Demand rate
LT = Lead time
$\bar{d}$ = Average demand rate
σ_d = Standard deviation of demand rate
z = Standard normal deviation
$\overline{LT}$ = Average lead time
σ_{LT} = Standard deviation of lead time

Reorder Point: Lots of various formulas!

Practice!

The Impossible Burger: Inventory Management

Source image: https://www.softwaresuggest.com/blog/inventory-management-practices-streamline-ecommerce-store/

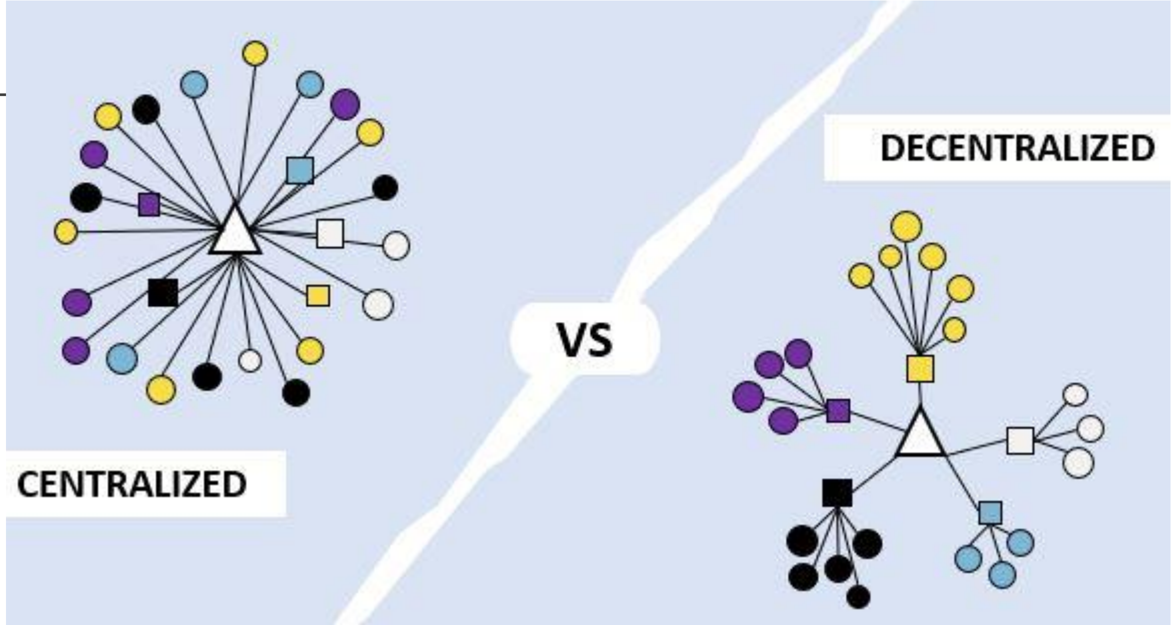
Watch: https://www.youtube.com/watch?v=ng4C2HMH664

Read in the news: https://www.cnn.com/2019/05/14/business/impossible-whopper-new-markets-trnd/index.html

- As more places (including Canada) are introducing the impossible burger with high demand (sometimes more than supply), how can Burger King better manage the Impossible Burger product?
- Vice versa, if demand suddenly drops?

To centralize or not centralize – that is the question (definitively not Hamlet)

Advantages	Disadvantages
Lower overall network safety stock → lower facility costs, holding costs	Increase response time for customer order
Can keep additional depth of inventory (slower moving parts at master WH)	Increase transportation cost to customer
Improves product availability without adding to inventories	Increase GHG emissions



https://www.innovisor.com/2020/09/17/the-journey-to-successful-decentralization-starts-with-data/

Impact of Coefficient of Variation on Value of Aggregation

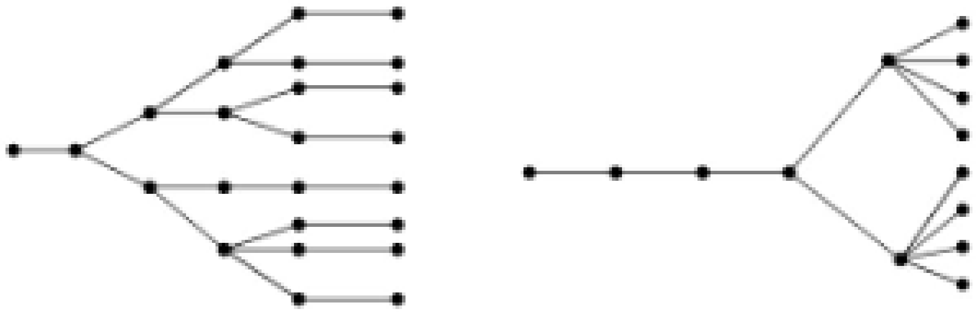
Table 12-4 Value of Aggregation at W.W. Grainger

	Motors	Cleaner
Inventory is stocked in each store		
Mean weekly demand per store	20	1,000
Standard deviation	40	100
Coefficient of variation	2.0	0.1
Safety inventory per store	132	329
Total safety inventory	211,200	526,400
Value of safety inventory	$105,600,000	$15,792,000
Inventory is aggregated at the DC		
Mean weekly aggregate demand	32,000	1,600,000
Standard deviation of aggregate demand	1,600	4,000
Coefficient of variation	0.05	0.0025
Aggregate safety inventory	5,264	13,159
Value of safety inventory	$2,632,000	$394,770

Postponement

Delay product differentiation or customization until closer to the time the product is sold

- Upstream operations can be standardized (common components, tooling)
- Move product differentiation as close to customer as possible
- Can occur at different stages
  - Manufacturing
  - Assembly
  - Packaging
  - Labeling



Managerial Levers to Reduce Safety Inventory

Reduction of supply uncertainty

- Sharing information
- Coordinated demand

Reduction of lead times

- Delays contribute more to lead time than production and transportation time

Reduction of demand uncertainty

- Reduce information distortion through sharing
- Aggregate demand

Assignments

Homework 2 – due 2/16

- Chapter 8: agg planning (rescheduled from HW1)
  - 1 a/b/c compare level and chase strategies
- See LP exercises in content/module 4/week 4/assignment
- Chapter 11: cycle stock, safety stock, EOQ, qty discounts
  - 3, 6, 7, 16
- Chapter 12: ROP
  - 6 (no CSL), 9, 11 + one other ROP in content/module 4/week 4/assignment

SCOR – get familiar with tool

- Complete training through ASCM https://www.ascm.org/corporate-transformation/standards-tools/scor-ds/#freecourse
- Post screen print showing completion to dropbox/SCOR training

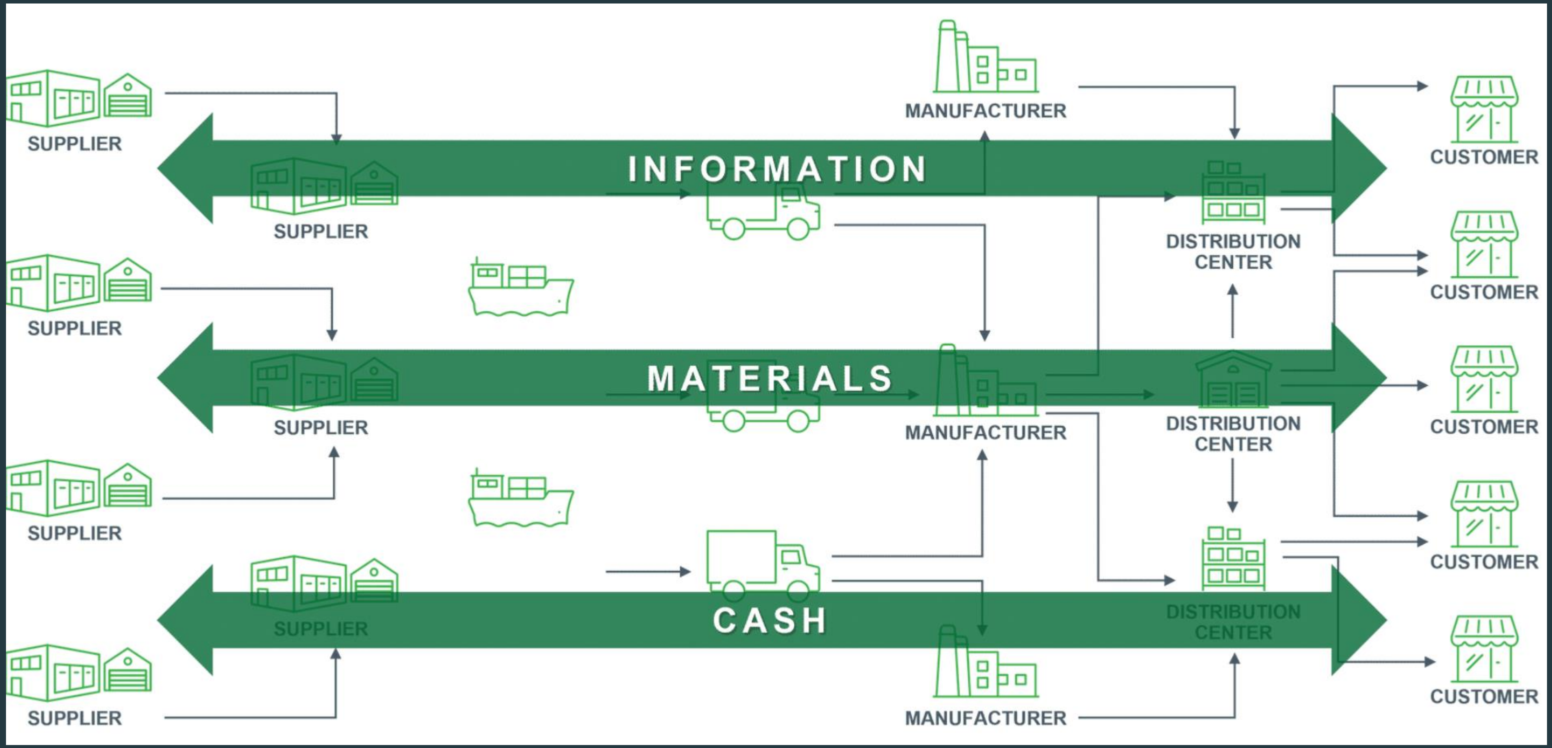
SCOR

SCM614

Week 5

AGENDA

- SC history
- SCOR & supply chains
- SCOR model
- Case 3
- Case 3 team breakout
  - *Check in with SD re: company*
- Review homework solutions (optional)



https://www.ascm.org/corporate-transformation/standards-tools/scor-ds/#freecourse

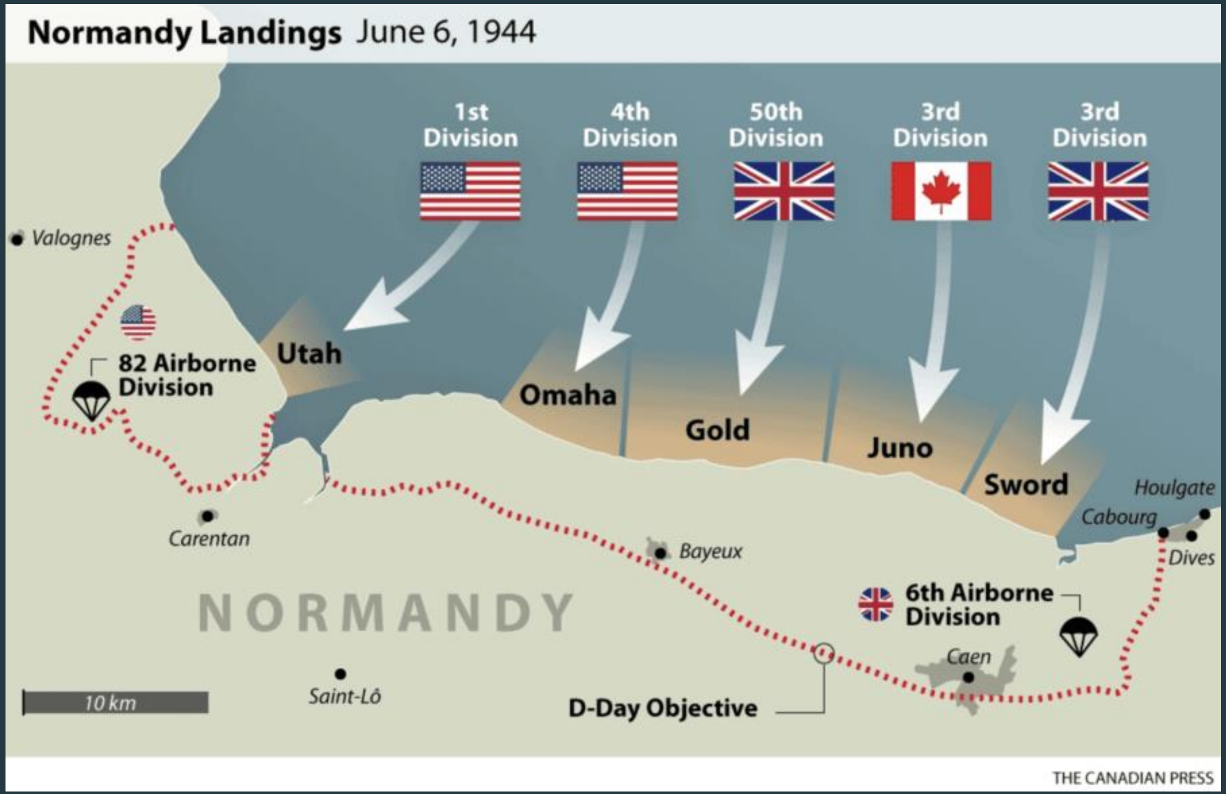
HISTORY OF SUPPLY CHAINS

A relief at the temple of the female pharaoh Hatshepsut in Luxor, Egypt, carved ca. 1480 B.C., shows a merchant ship on a trading expedition. Vessel artifacts match this depiction. (Ferrebee, n.d.)

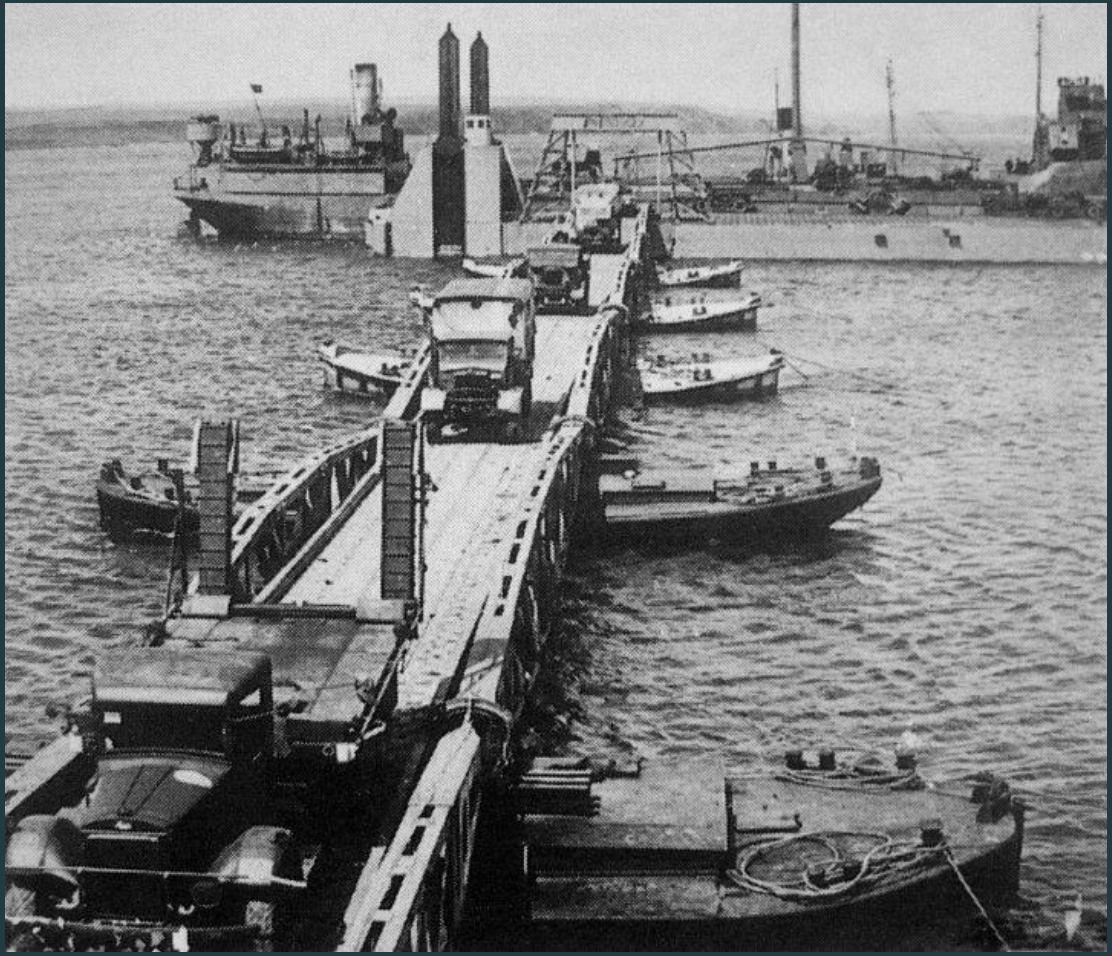
The red line shows the over the land route from the Nile to Mersa Gawasis. (K. Bard & Fattovich, 2008)

https://asn.am/atlas/africa/states/egypt.php

HISTORY OF SUPPLY CHAINS

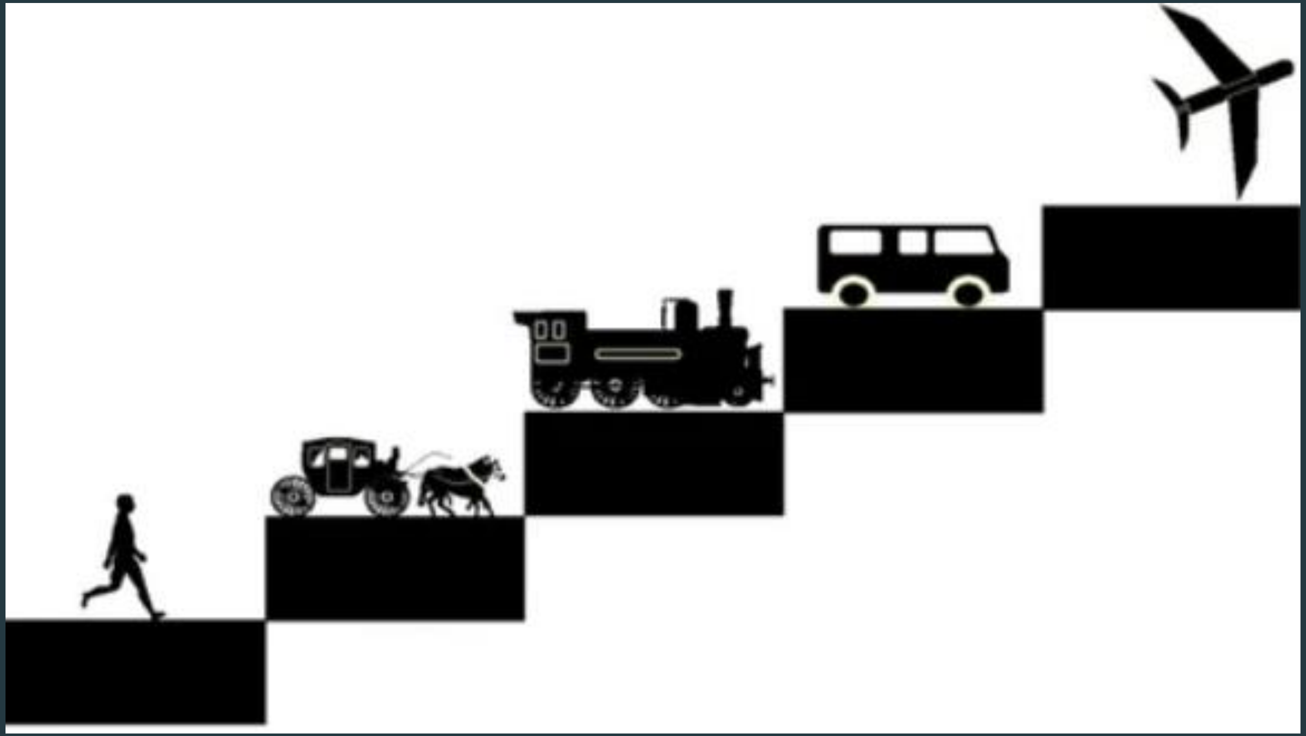


https://www.towntalkradio.com/june-6-d-day-allies-storm-normandys-coast/



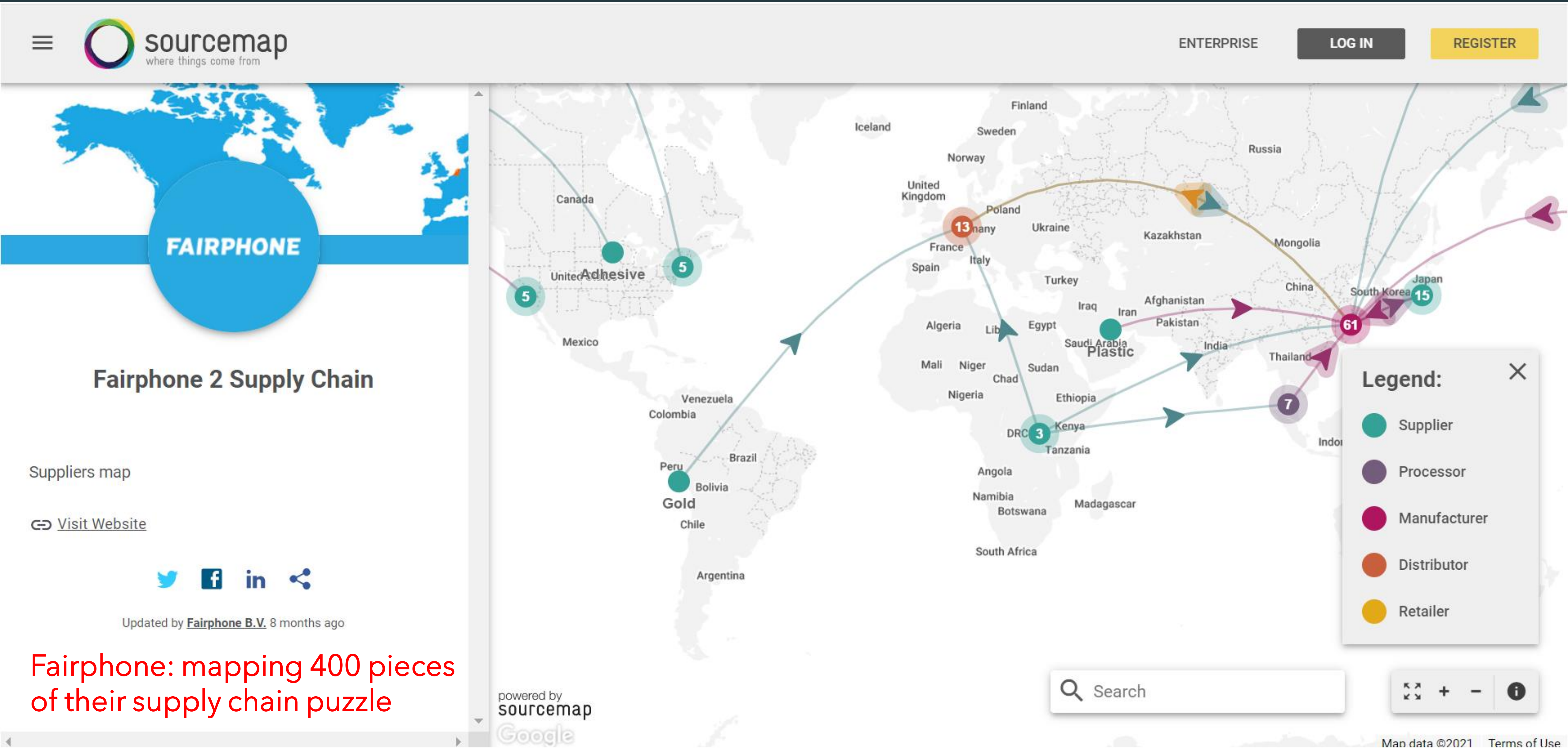
Mulberry road with jetty in the background. Normandy, France. 1944. ("Arromanches-Mulberry Harbour - Submerged," n.d.)

LEADING US TO MODERN DAY LOGISTICS AND COMPLEX SUPPLY CHAINS



SOURCEMAP EXAMPLE: FAIRPHONE

https://open.sourcemap.com/maps/57bd640851c05c0a5b5a8be1



Fairphone: mapping 400 pieces of their supply chain puzzle

HOW COMPANIES USE SCOR

The adoption of SCOR as the end-to-end process blueprint dramatically increases the use of standard system functionality and enables more targeted investments in digital capabilities. By combining elements of business process engineering, leading practices, benchmarking, people skills and a variety of metrics into a succinct framework, SCOR makes it possible to pinpoint core process areas that require optimization to further organizational goals.

https://www.ascm.org/corporate-transformation/standards-tools/scor-ds/#freecourse

https://blog.contactcenterpipeline.com/2015/01/3-tips-for-driving-process-excellence/
ILLUSTRATION BY MAREK POLAKOVIC

COURSE ON-LINE

Learning Objectives

- Describe the parts and flows of a simple supply chain
- Explain the purpose and structure of the Supply Chain Operations Reference Digital Standard (SCOR DS) framework.
- Discuss the importance of SCOR performance metrics.
- Identify and organize the seven processes of the SCOR model.
- Recognize the ways in which SCOR practices can advance organizations and their supply chains.
- Recognize the five levels of SCOR people competencies.
- Identify the five stages of a SCOR-DS improvement program.

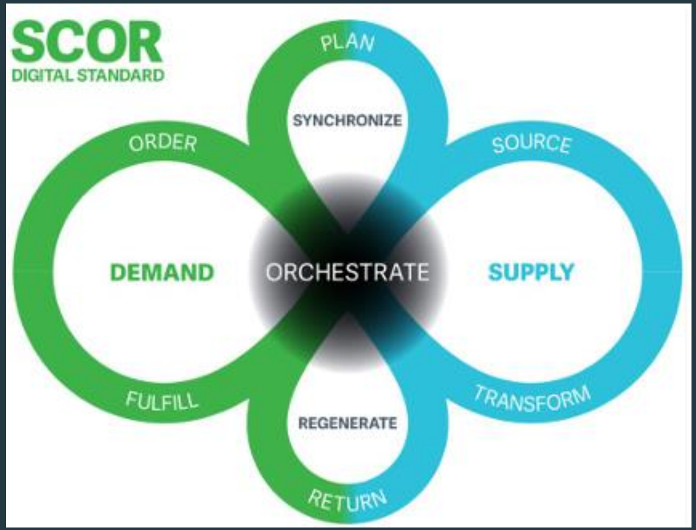
https://www.ascm.org/corporate-transformation/standards-tools/scor-ds/#freecourse

https://www.pngwing.com/en/free-png-mwpie

- The purpose and structure of the Supply Chain Operations Reference Digital Standard (SCOR DS) framework.
- The importance of SCOR performance metrics.
- How to identify and organize the seven processes of the SCOR model.
- How SCOR practices can advance organizations and their supply chains.
- About the five stages of a SCOR-DS improvement program.

KEY POINTS: SCOR

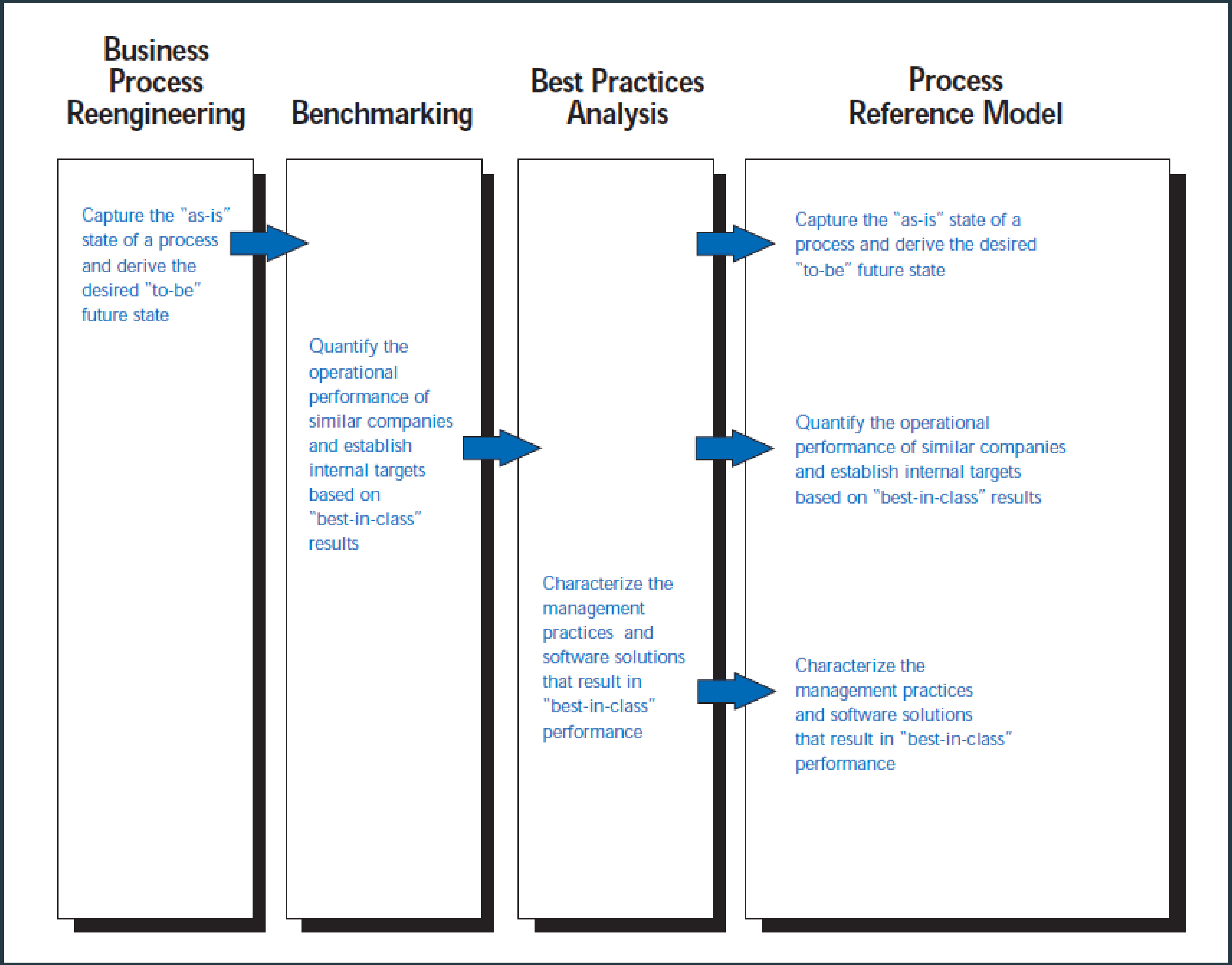
- Excludes sales and marketing, including demand generation, product development, and research and development.
- Access: https://scor.ascm.org/processes/introduction
- Goal: to develop supply chains that focus on satisfying customer demand
- Uses:
  - *Analyze current strategies and quantify performance*
  - *Identify targets for supply chain improvement*
  - *Solving business problems*



https://www.ascm.org/corporate-transformation/standards-tools/scor-ds/#freecourse

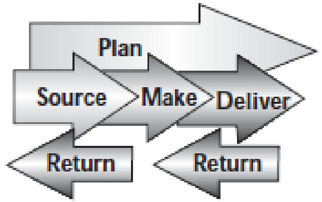
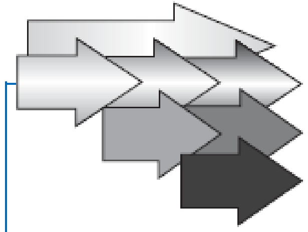
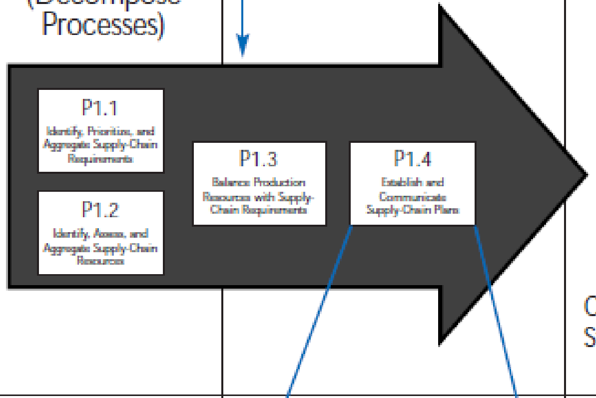
SCOR FRAMEWORK

https://www.ascm.org/corporate-transformation/standards-tools/scor-ds/#freecourse



Supply-Chain Operations Reference-model
Overview of SCOR Version 6.0, ASCM.

SCOR Contains
Three Levels of Process Detail

	Level		Schematic	Comments
	#	Description		
Supply-Chain Operations Reference-model	1	Top Level (Process Types)		Level 1 defines the scope and content for the Supply Chain Operations Reference-model. Here basis of competition performance targets are set.
	2	Configuration Level (Process Categories)		A company's supply chain can be "configured-to-order" at Level 2 from the core "process categories." Companies implement their operations strategy through the configuration they choose for their supply chain.
	3	Process Element Level (Decompose Processes)		Level 3 defines a company's ability to compete successfully in its chosen markets, and consists of: • Process element definitions • Process element information inputs, and outputs • Process performance metrics • Best practices, where applicable • System capabilities required to support best practices • Systems/tools Companies "fine tune" their Operations Strategy at Level 3.

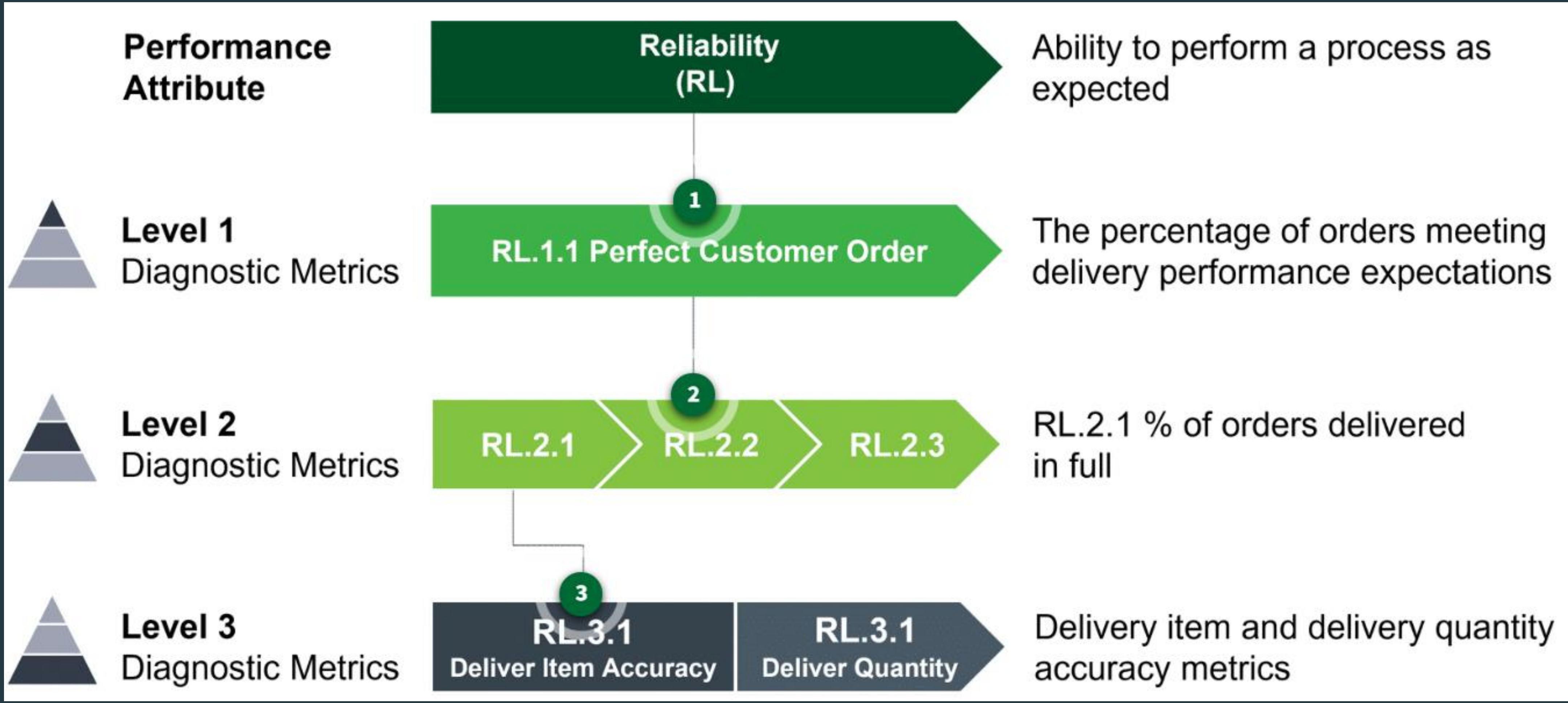
Supply-Chain Operations Reference-model
Overview of SCOR Version 6.0, ASCM.

PERFORMANCE ATTRIBUTES

	Performance Attributes	Definition
Resilience	Reliability (RL)	The ability to perform tasks as expected. Reliability focuses on the predictability of the outcome of a process. Typical metrics for the Reliability attribute include delivering a product on time, in the right quantity, and at the right quality level.
	Responsiveness (RS)	The speed at which tasks are performed and the speed at which a supply chain provides products to the customer. Examples include cycle-time metrics.
	Agility (AG)	The ability to respond to external influences and marketplace changes to gain or maintain a competitive advantage.
Economic	Costs (CO)	The cost of operating the supply chain processes. This includes labor costs, material costs, and management and transportation costs.
	Profit (PR)	The Profit attribute describes the financial benefit realized when the revenue generated from a business activity exceeds the expenses, costs, and taxes involved in sustaining the activity.
	Assets (AM)	The ability to efficiently utilize assets. Assets' strategies in a supply chain include inventory reduction and insourcing rather than outsourcing.
Sustainability	Environmental (EV)	The Environmental attribute describes the ability to operate the supply chain with minimal environmental impact, including materials, water, and energy.
	Social (SC)	The Social attribute describes the ability to operate the supply chain aligned with the organization's social values, including diversity and inclusion, wage, and training metrics.

https://www.ascm.org/corporate-transformation/standards-tools/scor-ds/#freecourse

METRICS CODIFICATION

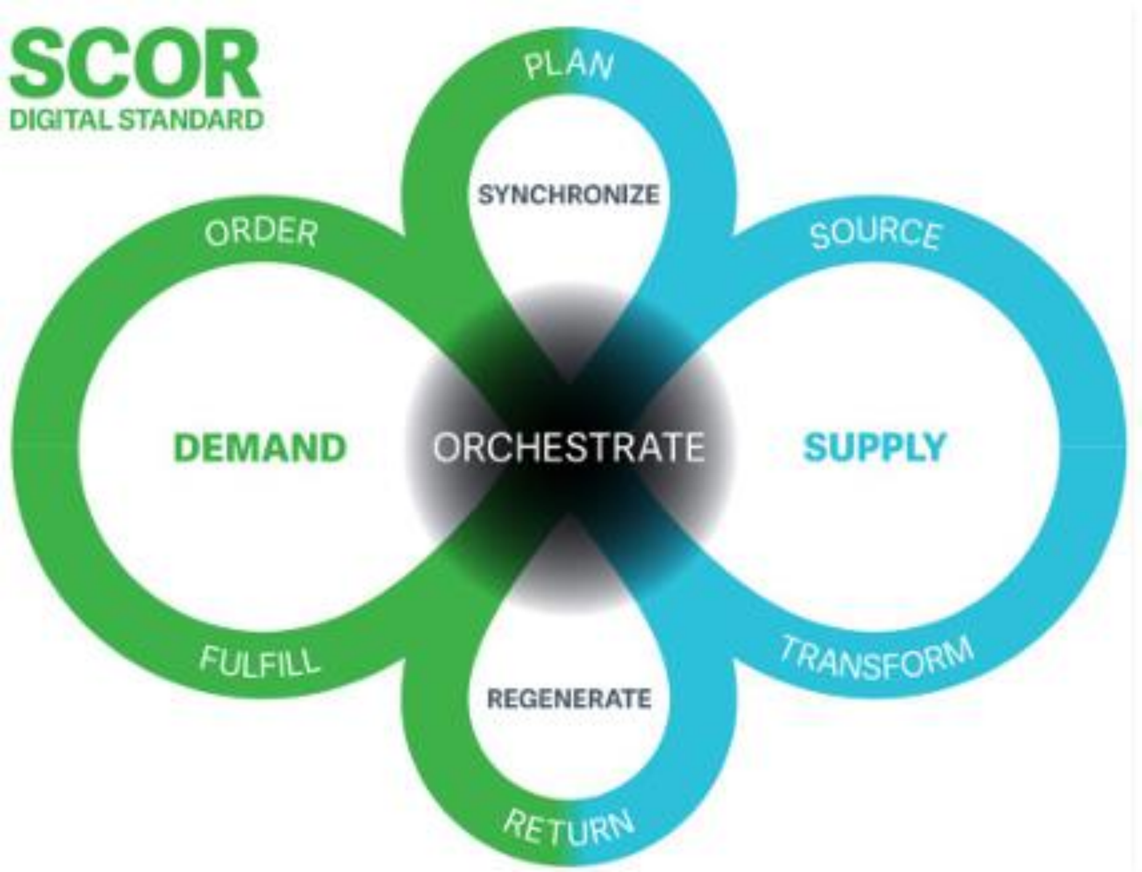



BREAKOUT
https://brooksgroup.com/sales-training-blog/sales-coaching-best-practices-series-team-meetings

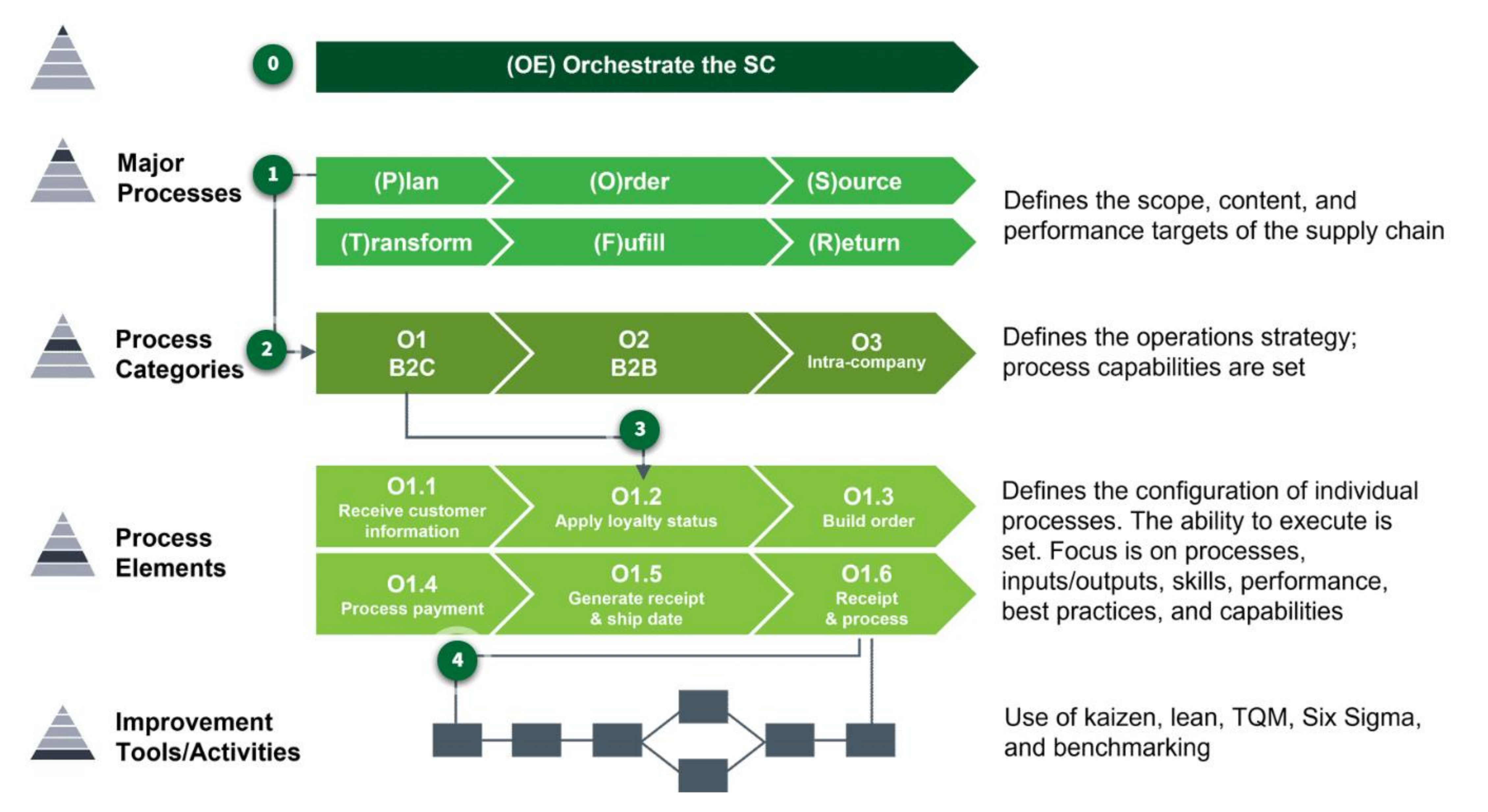
ducatorsopinion.wordpress.c
02/26/brain-breaks-are-good-
chers-too/

PROCESS OBJECTIVES

- As-is
  - *What are we doing and where?*
  - *How do we do this?*
- What-if
  - *Test different scenarios.*
- To-be
  - *What will we do and where?*
  - *How will we do this going forward?*



https://www.ascm.org/corporate-transformation/standards-tools/scor-ds/#freecourse



https://www.ascm.org/corporate-transformation/standards-tools/scor-ds/#freecourse

PRACTICE

- Practices are linked to SCOR processes
- Purpose includes:
  - *Standardize*
  - *ID alternatives through benchmarking others*
  - *Determining what to change (wish list)*
  - *Ditching items on the "blacklist" ***
- Levels
  - *Level 1 → just 1 (best practices)*
  - *Level 2 → 280 different ones!*
    - With so many how do you choose?? Benchmark

https://www.ascm.org/corporate-transformation/standards-tools/scor-ds/#freecourse

PEOPLE!

- Skills (HS)
- Experience (HE)
- Training (HT)
- Competency

https://www.ascm.org/corporate-transformation/standards-tools/scor-ds/#freecourse

CONTINUOUS IMPROVEMENT NEVER ENDS

https://www.ascm.org/corporate-transformation/standards-tools/scor-ds/#freecourse

SPOT

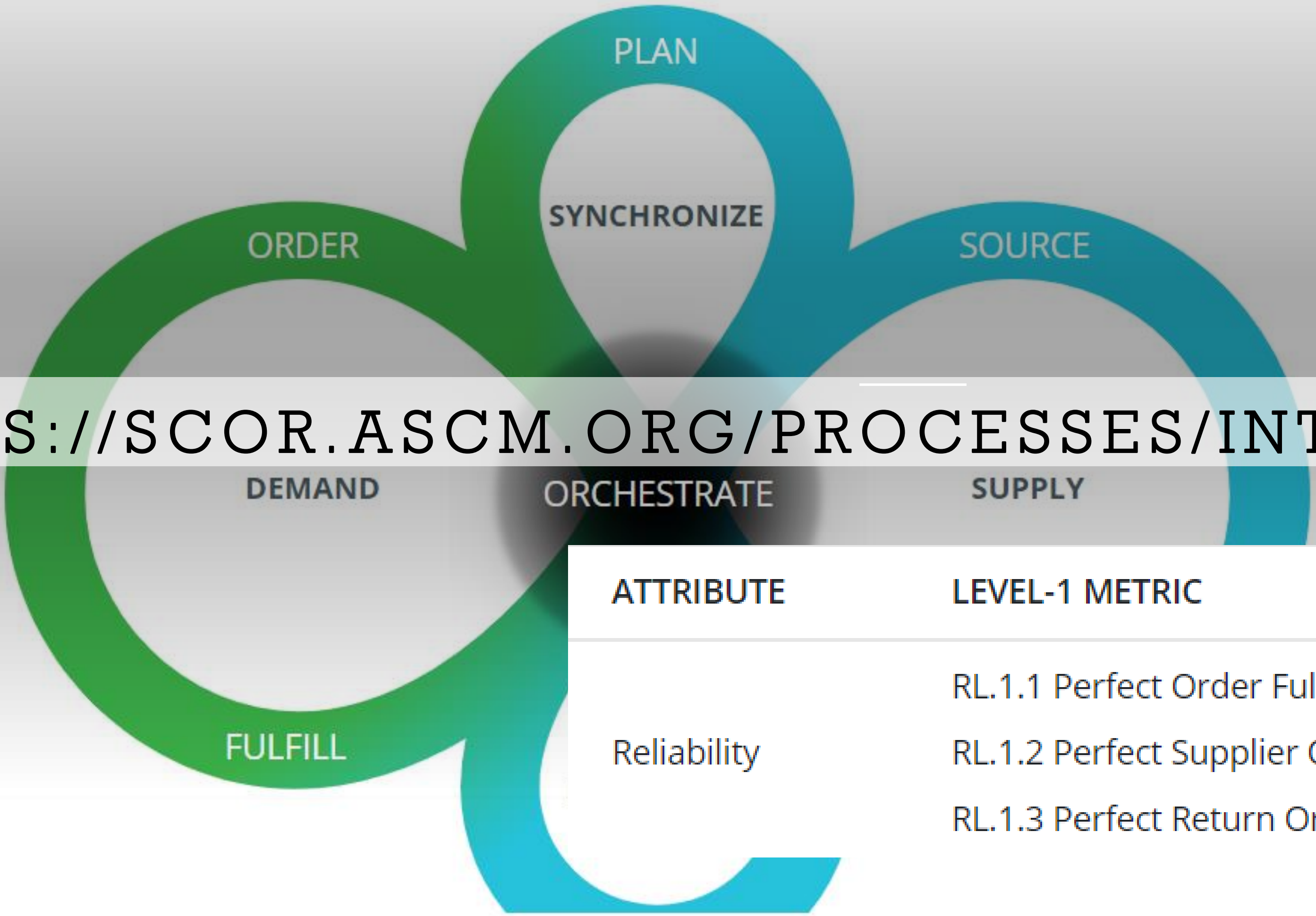
COURSE

EVALUATIONS

ASSOCIATION FOR SUPPLY CHAIN MANAGEMENT SCOR DIGITAL STANDARD

Processes | Performance | People | Practices | Special Applications and Resources

Introduction | Orchestrate | Plan | Order | Source | Transform | Fulfill | Return



HTTPS://SCOR.ASCM.ORG/PROCESSES/INTRODUCTION

ATTRIBUTE	LEVEL-1 METRIC
Reliability	RL.1.1 Perfect Order Fulfillment RL.1.2 Perfect Supplier Order RL.1.3 Perfect Return Order Fulfilment

Introduction to Pro

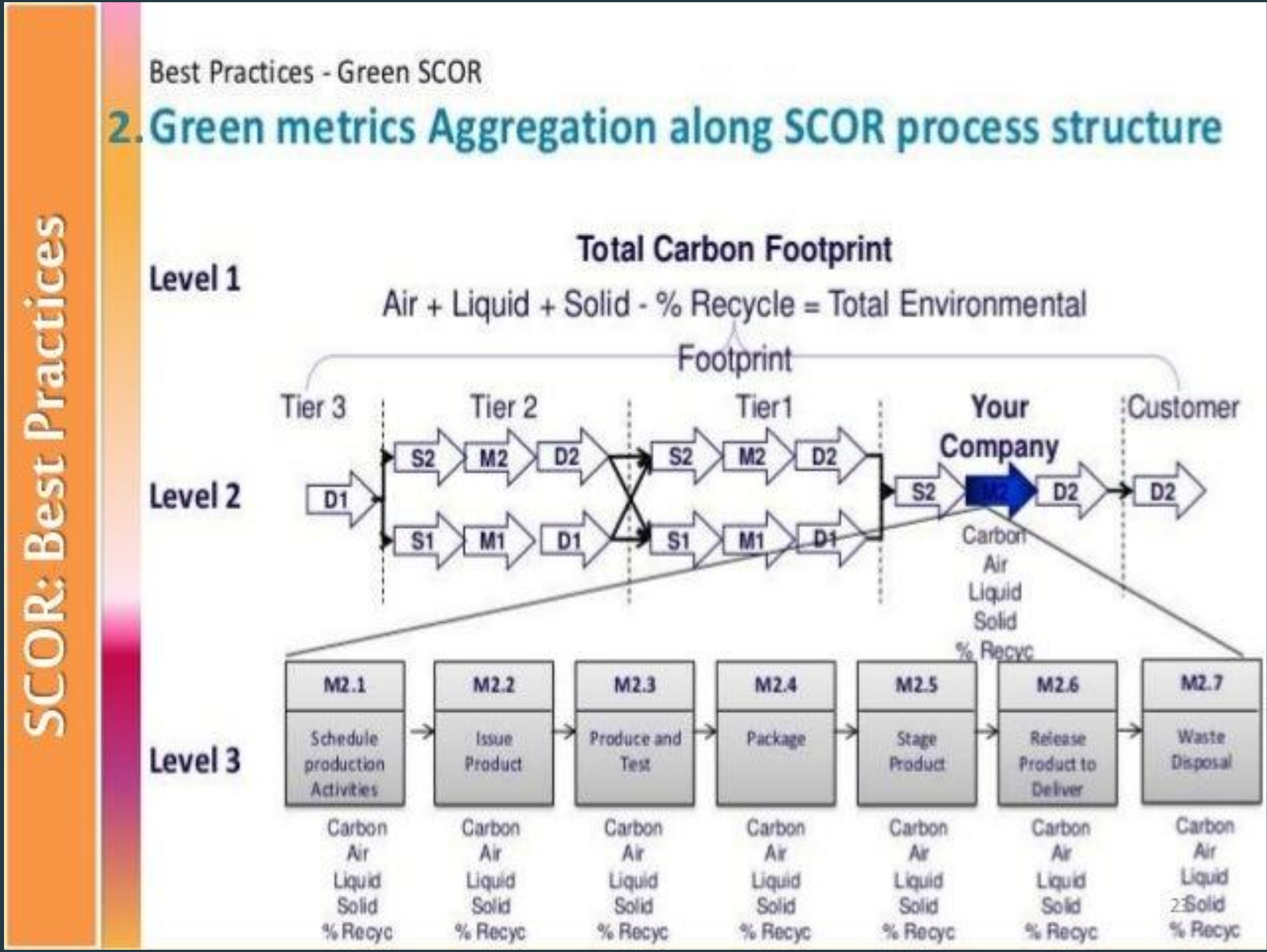
A process is a unique activity p
predefined outcomes. The SCO
that a supply chain must execu
primary objective of fulfilling c
each unique process, SCOR on
representation.

At the top of the SCOR Process
Orchestrate – a Level-0 proces
SCOR section that has a Level
at the Strategy level and inform
the levels below it.

After the Level-0 process, SCO
Level-1 processes — Plan, Ord
Fulfill, and Return.

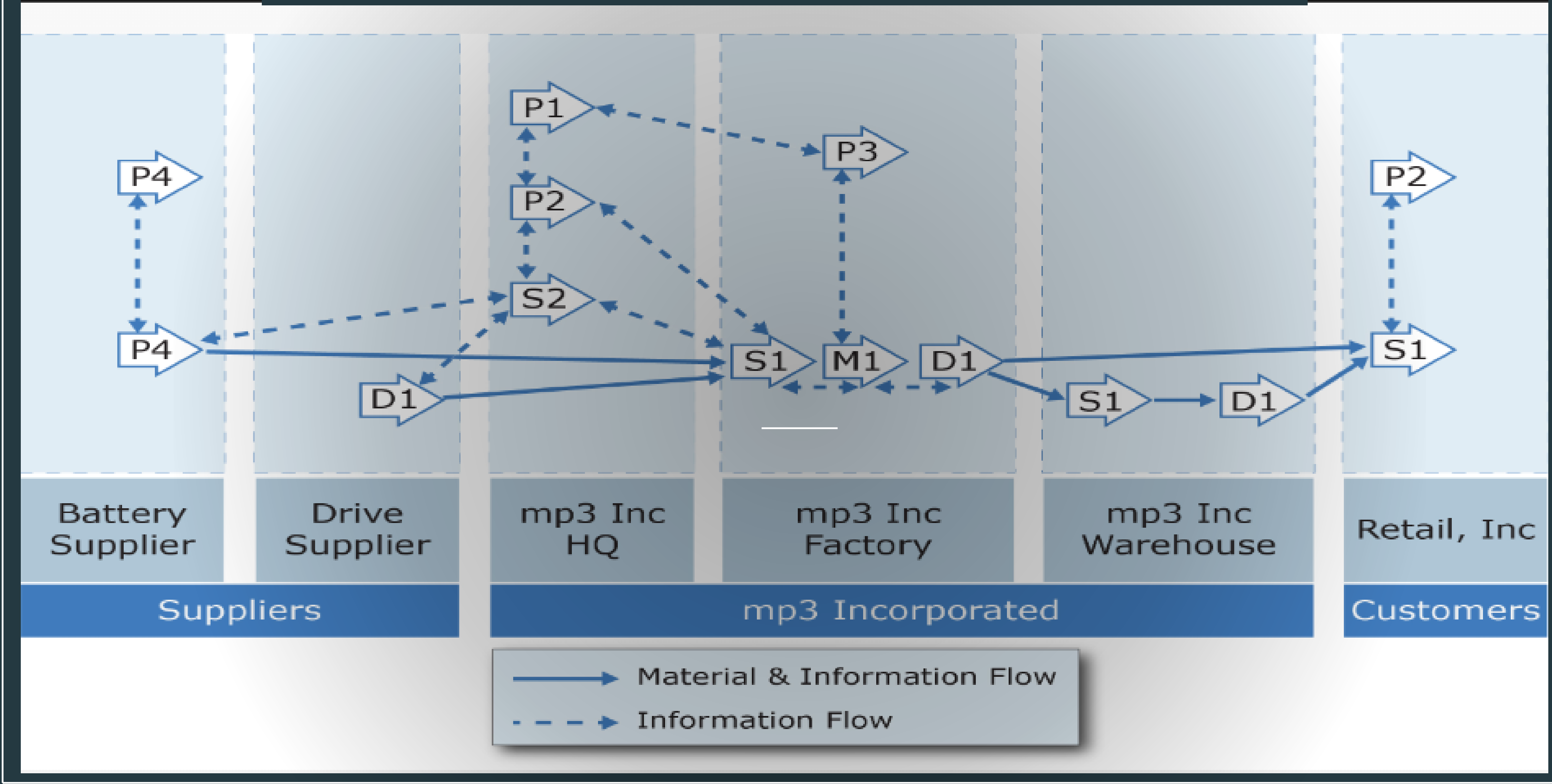
Orchestrate Supply Chain

The Orchestrate Supply Chain proces
associated with the integration and e
strategies. These include the creation

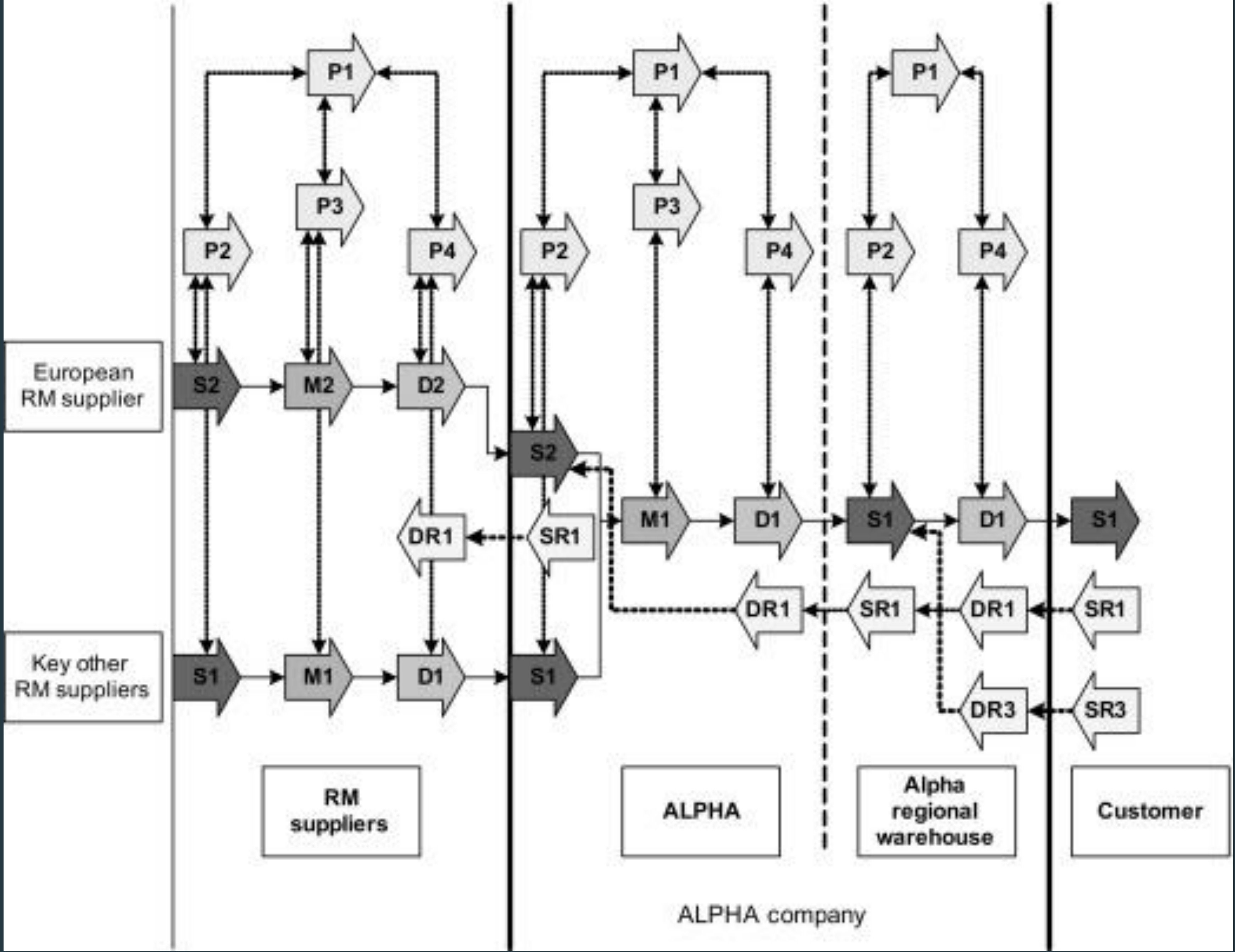


https://www.slideshare.net/mmr787/scor-model-63109717

THREAD DIAGRAM EXAMPLE



https://icatalog.dau.edu/mobile/CLL037/DAU_Supply_Chain_Atlas/010113/010113000120.html



Paul Harmon, "Chapter 6 - Process management."
Business Process Change (Fourth Edition), Edited by
Paul Harmon, Morgan Kaufmann, 2019, pps 125-150.

SCOR EXAMPLE

From: 'Keeping SCOR in Your Supply Chain'

by Richard J. Sherman, Emeritus
Supply Chain Council

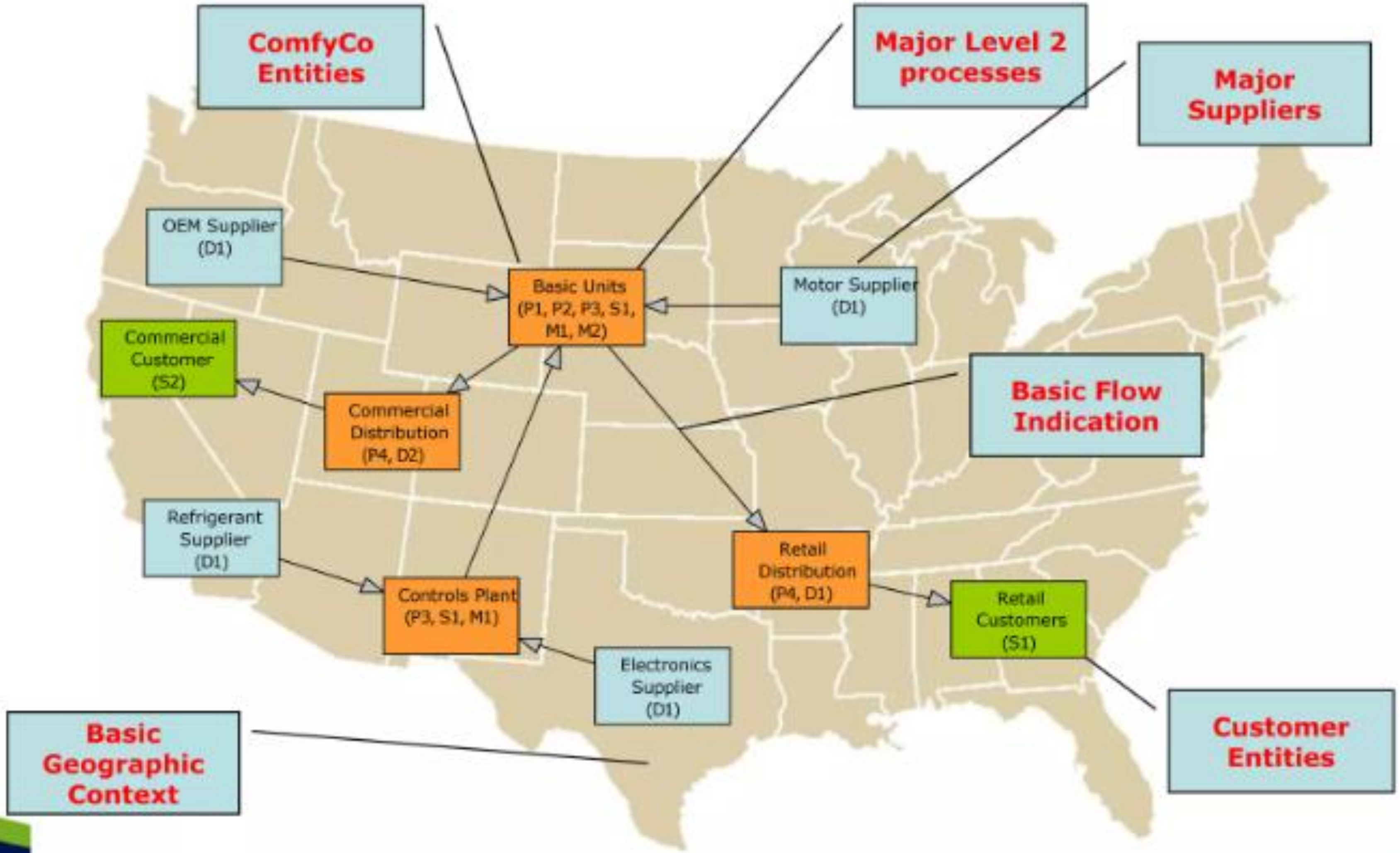
1/2011

Define Business Scope

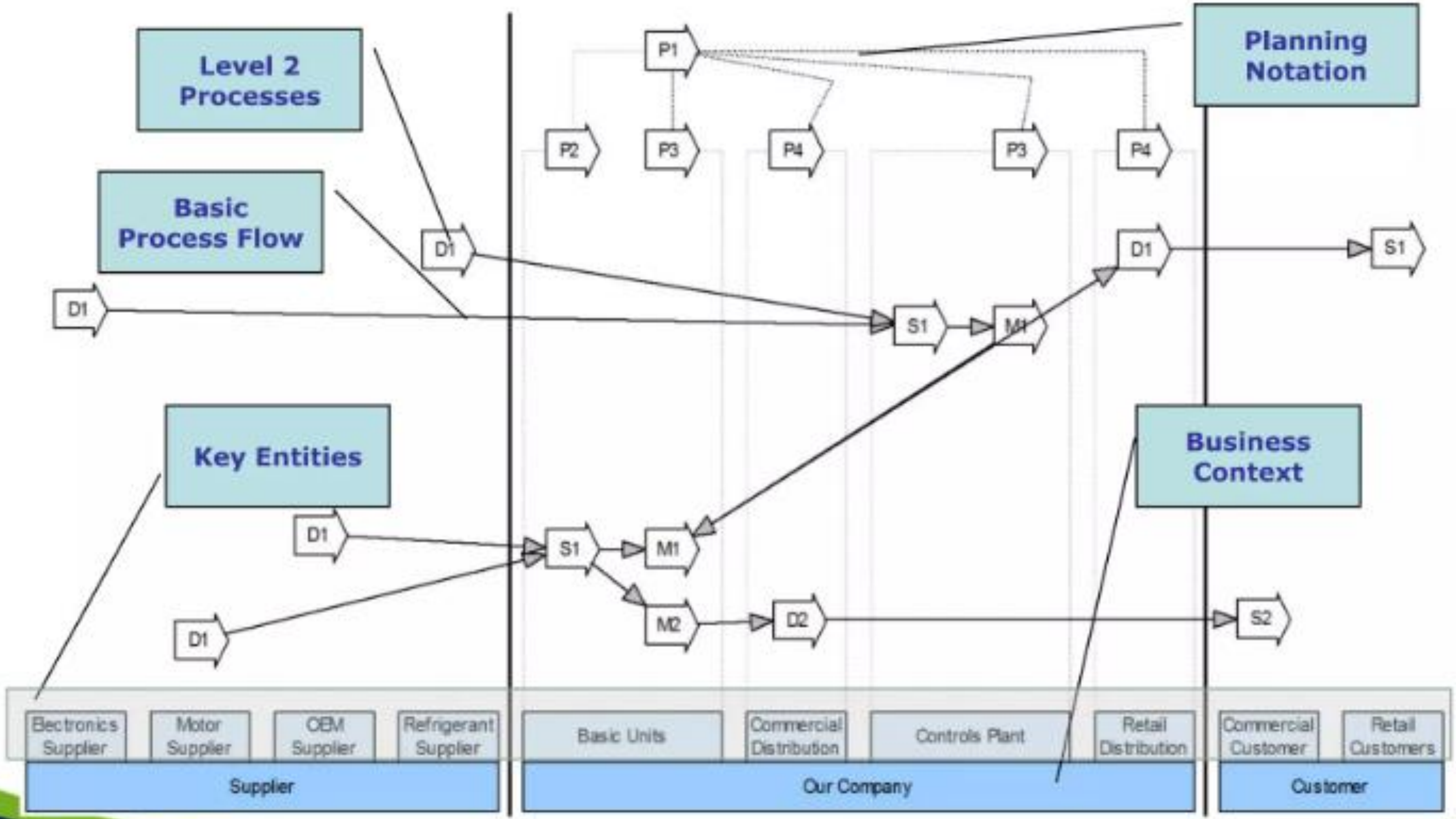
Suppliers	ComfyCo		Customer
OEM Supplier			
Motor Supplier	Basic Unit Plant	Retail Warehouse	Retail Customer
Refrigerant Supplier	Controls Plant	Commercial Warehouse	Commercial Customer
Electronics Supplier			

Scoping identifies all parties involved in program

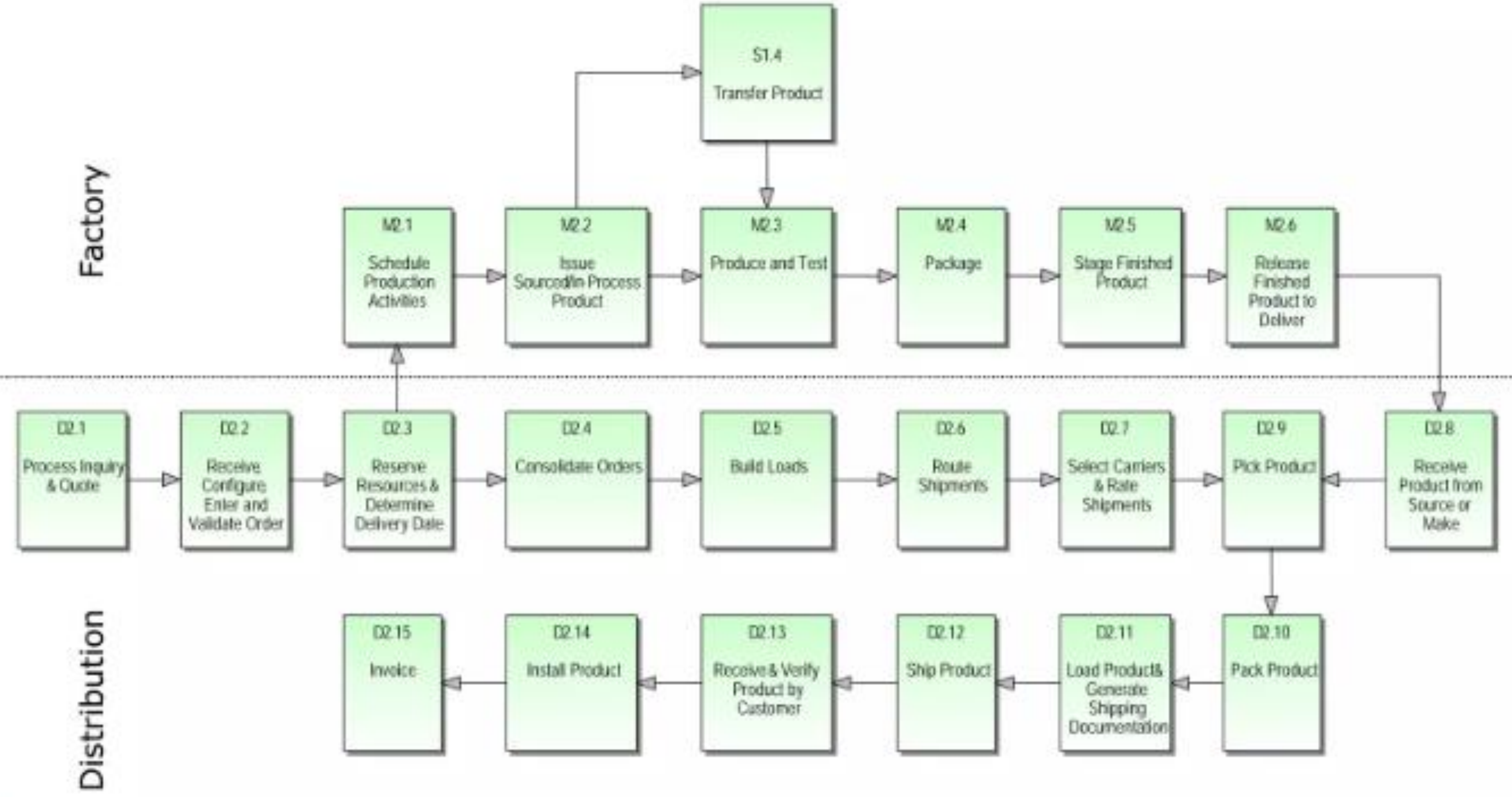
Create a Geo Map of ComfyCo (US)



Develop a SCOR Thread Diagram



Captured SCOR Level-3 Model



Benchmark to Identify Process Parity, Advantage, or Superiority

Attribute	Metric (level 1)	Company	Parity	Adv	Superior	Parity Gap	Req Gap
Reliability	Perfect Order Fulfillment	98%	92%	96%	98%	-6%	
Responsiveness	Order Fulfillment Cycle Time	14 days	8 days	6 days	4 days	6 days	8 days
Flexibility	Ups. Supply Chain Flexibility	62 days	80 days	62 days	40 days	-18 days	
Cost	Supply Chain Mgmt Cost	10.1%	10.8%	10.4%	10.2%	-0.7%	
Assets	Cash-to-Cash Cycle Time	22 days	45 days	30 days	20 days	-23 days	

Scoping Identifies one or more targeted metrics for improvement

Potential Outsource Opportunity

Parity	**Median of Statistical Sample**
Advantage	**Midpoint of Parity and Superior**
Superior	**90^{th} percentile of population**

SCOR Provides Analytic Framework for Outsourcing Business Processes

SCOR enables you to map, measure, benchmark and analyze your processes.

- When and how should you outsource?

	Low Expertise	High Expertise
High Value	*Performance Based Opportunity*	*Core Competency/ High IP*
Low Value	*Traditional 3PL*	*Can a Third Party Perform at a Lower Cost?*

How to determine fit?

- For each business process
  - Determine expertise
  - Determine value
- Pin in the quadrant

- Outsource or implement best practice IF it makes sense for your specific processes, business, or industry.

SCOR/PBL Project – Baseline

- The SCOR perspective of "supplier's supplier" through "customer's customer" is measured by the degree of integration
  - Internal Integration
  - External Integration
  - Enterprise Optimization
- Performance Based Logistics (PBL) maturity is measured in the same way
  - Partnerships between suppliers and customers
  - Managed by metrics, enabled by processes and innovation
- The SCOR model provides a toolkit to design and implement, manage, and measure PBL processes throughout the life cycle of the relationship.

YOUR TURN (PP)

- Go to OE, pick 1
- Using OE, pick associated performance attribute & metric
- Pick level-1 major process (plan, order, transform, etc.)
- Using major process, pick level-2 process category
- Using process category, pick level-3 process element
- Using process element, select practice & skill

https://scor.ascm.org/processes/introduction

- Create a simple flowchart showing the "peeling of the onion" with labels & description of the performance attribute (metric)/process/ practice/skill.
- Why is this process and associated bits important to a company's supply chain?
- In your current or a former position, could you drill down in this manner to assess the current "as is" situation? Be specific – I want more than a yes/no answer.
- Post your response in dropbox under Week 5 class work

PP week 5: SCOR

Find this here: content/module 5/week 5/lecture/SCOR class PP
Post to dropbox: PP 4-20 SCOR

Performance attribute, metric (level 1 or 2) – why?

Major process

Process category

Process element

Practice & skill

SCOR PROJECT ROADMAP

Analyze Competition — Ops Strategy

- Competitive performance rqmts
- Performance metrics
- Scorecard
- Gap Analysis/Plan

Configure SC — Material Flow

- As-is Geographic Map, Thread Diagram
- Design Specs
- To-be Thread Diagram, Geographic Map

Align Performance & Practice — Information & Workflow

- As-is Level 2, 3, and 4 Maps
- Disconnects
- Design Specs
- To-be Level 2, 3, and 4 Maps

Imple-ment SC processes — Develop, Test, & Roll Out

- Organization/People
- Technology/Automation
- Practices
- Standardize

Modified from: The SCOR project roadmap (Stephens, 2001)

ASSIGNMENTS

- Case 3 team project due before class on 4/27
- Prepare for week 6: Network Design
  - *Read chapters 4, 5, 6 (don't worry about the math detail; understand the concepts and relationships)*
  - *Take no-point quiz*
- Case 4 (due 5/4)
  - *Next week teams will choose their topic (also posted)*
  - *See content/case study for info*

Office hours! Please join me on Tuesdays 1-2pm or by appointment!

HOMEWORK REVIEW (OPTIONAL)

- Forecasting
- EOQ/EPQ
- ROP
- Safety stock
- Quantity discounts
- Aggregate planning
- LP

NETWORK DESIGN

Module 6 Week 6

SCM 614

TIFFANY & CO.

Major jewellers to cease buying Russian-origin diamonds after increased

In USD millions except per share amounts	Trend	<	2016	2015	2014	2013	2012	2011
Period Ended			*2016-01-31*	*2015-01-31*	*2014-01-31*	*2013-01-31*	*2012-01-31*	*2011-01-31*
Operating Revenue			4,104.9	4,249.9	4,031.1	3,794.2	3,642.9	3,085.3
Cost of Revenue			1,613.6	1,712.7	1,690.7	1,631.0	1,491.8	1,263.0
Gross Profit			**2,491.3**	**2,537.2**	**2,340.4**	**2,163.3**	**2,151.2**	**1,822.3**

diamonds-after-increased-scrutiny

In USD millions except per share amounts	Trend	<	2020	2019	2018	2017	2016	2015
Period Ended			*2020-01-31*	*2019-01-31*	*2018-01-31*	*2017-01-31*	*2016-01-31*	*2015-01-31*
Operating Revenue			4,424.0	4,442.1	4,169.8	4,001.8	4,104.9	4,249.9
Cost of Revenue			1,662.1	1,631.1	1,559.1	1,502.8	1,613.6	1,712.7
Gross Profit			**2,761.9**	**2,811.0**	**2,610.7**	**2,499.0**	**2,491.3**	**2,537.2**

- $4.4B revenue annually; average gross profit $2.5B over last 10 years
- Revenue growth from 2009 to 2019 63.27%

Agenda

- Case #4: Teams choose case
- Chapter 4: Designing Distribution Networks
- Chapter 5: Network Design in the Supply Chain (skip modeling details)
- Lexus network study (network optimization project)
- ~~Chapter 6: Design Global SC Networks: Cost, Risk, Decision Trees~~ See video
- What’s up for next week

Case #4 Teams

Ang, Paul	1
Collier, Nicole	1
Euceda Iscoa, Marlon	1
Magallon, Dominick	1
Alramahi, Ehab	2
Gonzalez-Aguayo, Gisela	2
Kariuki, Janet	2
Rodgers, Samuel	2
Alfaro, Marugenia	3
Han, Chris	3
Khachatryan, Marieta	3
Sampson, Ivy	3
Ahadiat, Parisa	4
Ghazaryan, Shushanik	4
Khafajizadeh, Bina	4
Redfearn, Joe	4

Beisecker, Kelsey	5
Freeman, Annie	5
Joshua, Jonathan	5
Matthews, Olivia	5
Contreras, Stephanie	6
Guelff, Michelle	6
Ramirez, Lizbeth	6
Weiss-Varela, Samantha	6
Galleta, Beda	7
Nguyen, Jessica	7
Perez, Melissa	7
Vidovich, Mikaela	7
Bui, Cindy	8
Dizon, Ric	8
Lopez, Ruben	8
Wand, Kelly	8

Case #4

- Pick one project
  - Multiple teams can work on the same study (2 max)
  - Your team has been tasked to make recommendations and present a report to exec mgmt.
- Deliverables
  - 5-6 page report, plus references
  - Tables/charts; explain any calculations
  - Record presentation – will show on 5/11 before final
    - 5 minutes!! Very short
    - Everyone should contribute
    - Post to dropbox (file or link)
    - Brief Q&A will follow

Case #4

Network design for solar panels

Your solar panel company has 90% of its product sourced from China. No production is done in the US currently. Sourcing decisions were made over 20 years ago when China was a low-cost labor country. As costs have risen (manufacturing, labor, transportation), margins are taking a hit, and profits are down. Supply chain disruptions caused by the pandemic have led to lost sales from long-standing customers – customers that were hard-won in the first place. Adding to supply chain uncertainty and cost escalation, the Defense Production Act is expected to create additional challenges in future supply.

Your team has been tasked with heading up a review of the global network design and sourcing strategy. The deliverables include a *report to senior management* which includes:

- Recommendations for source changes (why/where). Do changes impact other logistical functions? Explain.
- Impacts of changes on cost/profits/fill rate/inventory/etc. for a product line. (Not asking for detailed $ but directionality and considerations)
- Project plan for changes.

https://inhabitat.com/new-photovoltaic-solar-technology-boosts-efficiency-to-50/solar-panels-stock-photo/

Case #4

Vulnerable supply chains in America

"On February 24, 2021, the President signed EO 14017, directing a whole-of-government approach to assessing vulnerabilities in, and strengthening the resilience of, critical supply chains." (https://www.whitehouse.gov/briefing-room/statements-releases/2021/06/08/fact-sheet-biden-harris-administration-announces-supply-chain-disruptions-task-force-to-address-short-term-supply-chain-discontinuities/) Biden's appointed research team found four categories that required immediate action to promote economic and national security: semiconductors, large-scale batteries, pharmaceuticals, and rare earth elements. Your team works for ABC Minerals, which has just found a new store of rare earths on US soil. (The company can be existing or fictitious – your choice. Several different companies have made findings recently.) Write a *report for senior management* that includes the following:

- An investigation of the current supply chain(s) and why it is critical to near shore.
- Potential "to-be" supply chains and challenges.
- Measures to limit environmental impacts in the physical mining and logistics functions.
- Cost/benefit analysis of nearshoring supply. (Not asking for detailed $ but directionality and considerations) Will the undertaking require incentives from the government?

(If rare earth minerals are not your gig, the team may choose batteries, semiconductors, or pharmaceuticals. Similar questions, but for different commodity(ies) – adjust as necessary.)

https://www.marioncountyky.com/service/extraction/

Case #4

Nissan – building resiliency

Nissan and other Japanese auto manufacturers were severely impacted by the tsunami in 2011. The earthquake and flooding took lives and devastated businesses leading to global supply chain disruptions. (See case study.)

Your team has been hired by another vehicle manufacturer and wants to know how Nissan responded to the event and risk mitigation going forward. Write a *report for their senior management* answering questions 1-5 at the end of the case, making sure to include the following:

- Any missing responses or future risk mitigation efforts that auto manufacturers should include for supply chain resilience.
- What should firms (in general, not just automotive) include in their risk management planning?
- If an incident has a low potential for occurring, do firms need to address it?
- What is the cost and benefit of risk mitigation? (Not asking for detailed $ but directionality and considerations)

https://www.nissanusa.com/

https://www.gartner.com/peer-insights/home

The best of the best

Your team works for a medium-sized consumer products company that sources globally and distributes products in the US and Canada. Senior management wants a game plan for improving the supply chain. The team has leeway here to "create" a fictitious company, product(s), and supply chain; just be realistic and descriptive. (Feel free to model it based on an existing company making sure to include references.)

Gardner publishes lists of companies with outstanding supply chains yearly. (See https://www.gartner.com/en/articles/the-gartner-supply-chain-top-25-for-2022) Examine what makes them great taking this list *as a starting point*. (The team might decide that other companies are better suited to provide benchmarking for this project/industry – your choice – just back it up.) Write a *report for senior management* on what steps the firm should make in the near-term (1 year) and long term (3+ years) with the ultimate goal of being one of the "great" supply chain firms. Make sure to:

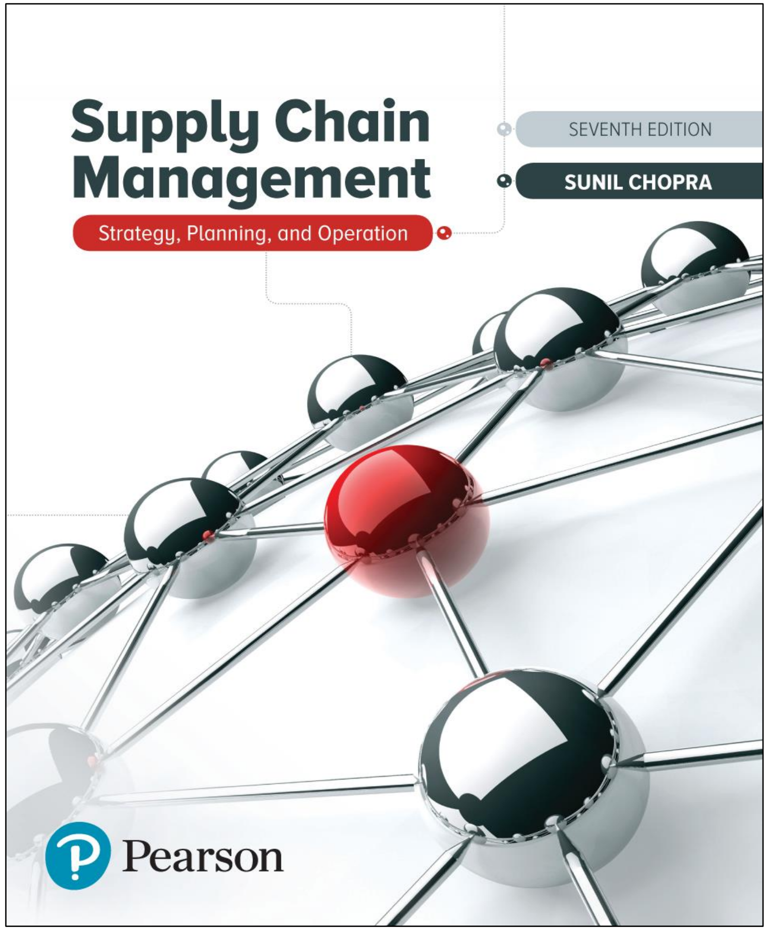
- Break into long- and short-term objectives (plus connections between the two).
- Include climate change/sustainability.
- Make a SWOT analysis of the company (to help focus the discussion).
- Identify the objectives and describe the process(es) required for change/improvement. Be specific and include what metrics the team recommends for tracking progress.

Case 4 team breakout: decide on project (rank 1-3)

https://967theeagle.net/wheel-of-fortune-contestant-solves-after-two-letters-what-video/

Supply Chain Management: Strategy, Planning, and Operation

Seventh Edition



Chapter 4

Designing Distribution Networks and Applications to Omni-Channel Retailing

Distribution Network Design in the Supply Chain

- **Distribution** – the steps taken to move and store a product from the supplier stage to the customer stage in a supply chain
- Drives profitability by directly affecting supply chain cost and the customer value
- Choice of distribution network can achieve supply chain objectives from low cost to high responsiveness

Factors Affecting Distribution Network Design

(1 of 2)

- Distribution network performance evaluated along two dimensions
    1. Value provided to the customer
    2. Cost of meeting customer needs
- Evaluate the impact on customer service and cost for different distribution network options
- Profitability of the delivery network determined by revenue from met customer needs and network costs

Factors Affecting Distribution Network Design

(2 of 2)

- Elements of customer service influenced by network structure:
    - Response time
    - Product variety
    - Product availability
    - Customer experience
    - Time to market
    - Order visibility
    - Returnability
- Supply chain costs affected by network structure:
    - Inventories
    - Transportation
    - Facilities
    - Information

Desired Response Time and Number of Facilities

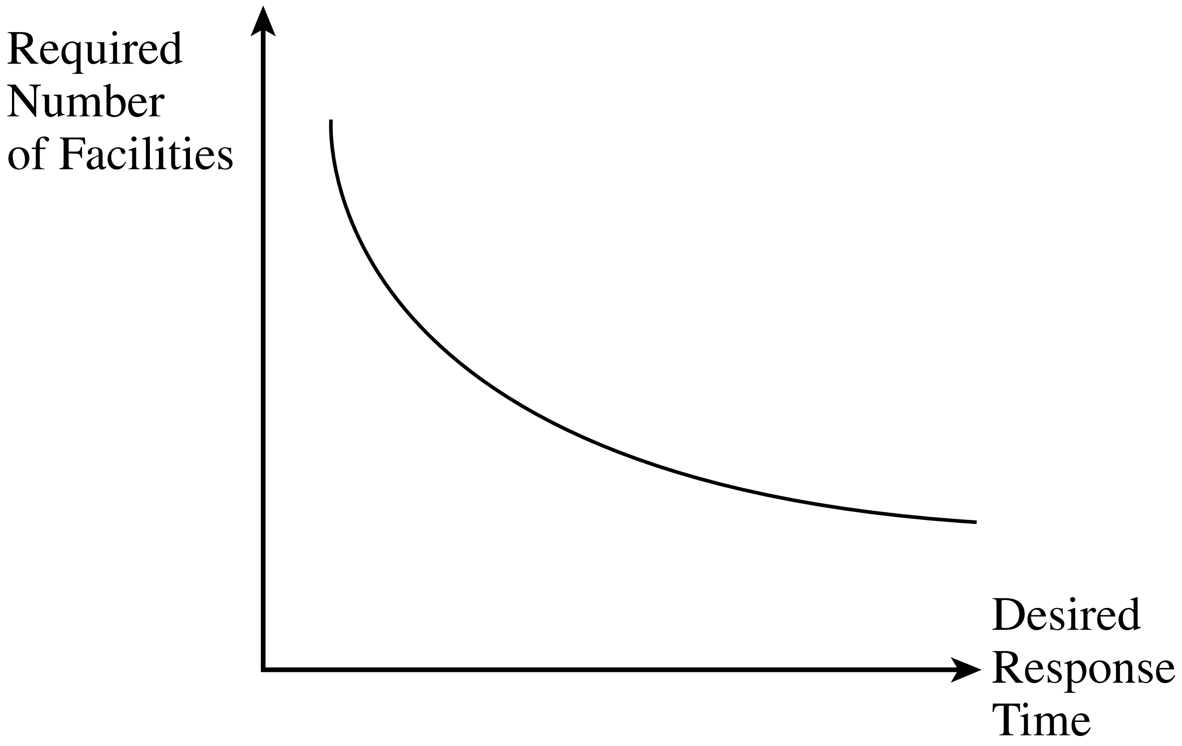


Figure 4-1 Relationship Between Desired Response Time and Number of Facilities

Inventory Costs and Number of Facilities

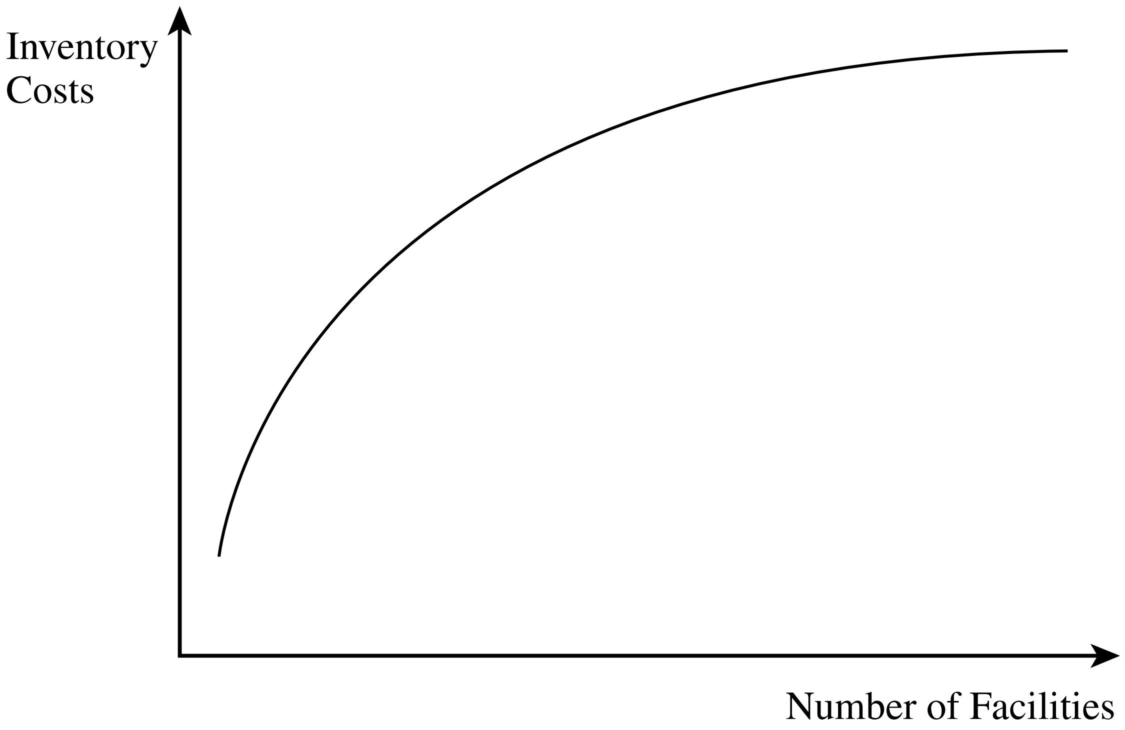


Figure 4-2 Relationship Between Number of Facilities and Inventory Costs

Transportation Costs and Number of Facilities

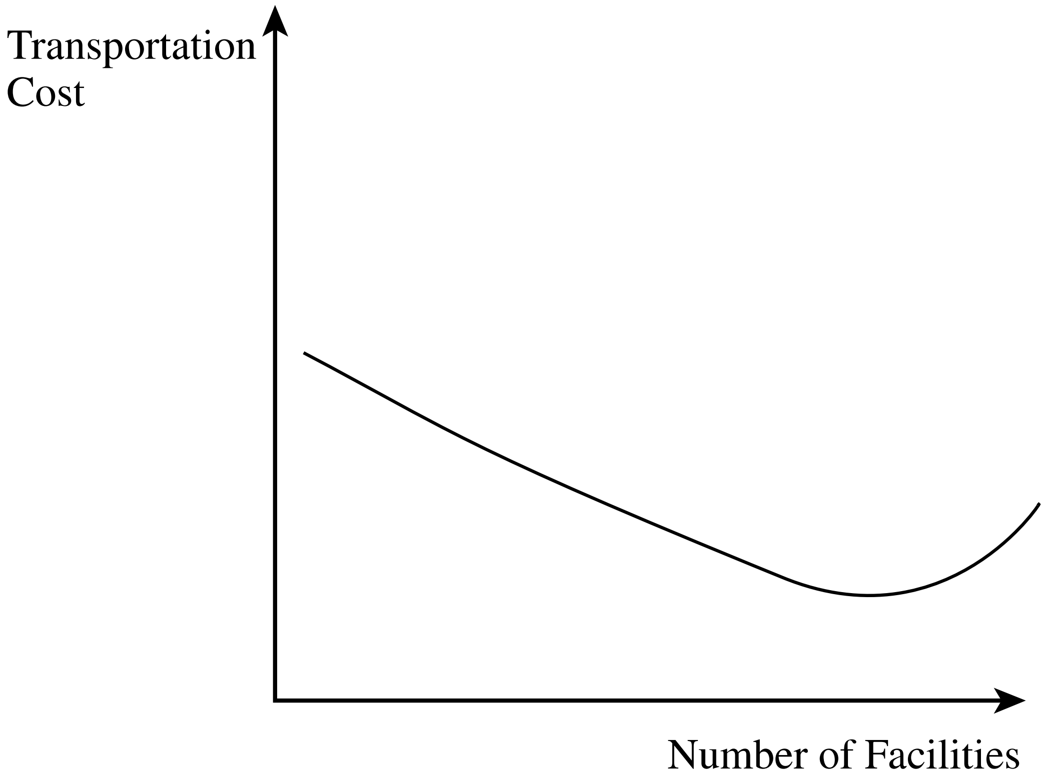


Figure 4-3 Relationship Between Number of Facilities and Transportation Cost

Facility Costs and Number of Facilities

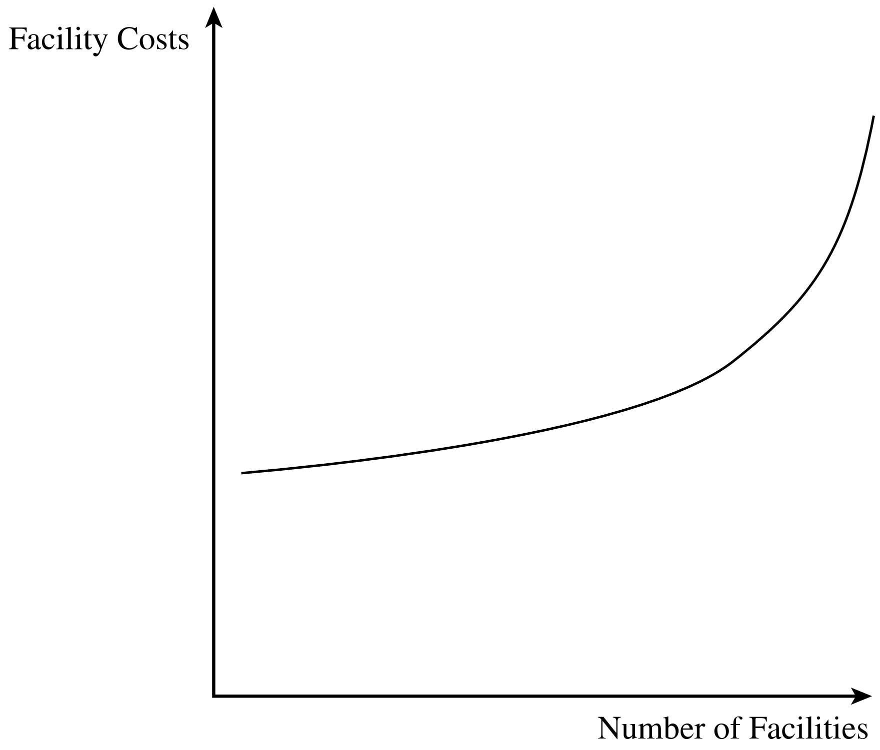


Figure 4-4 Relationship Between Number of Facilities and Facility Costs

Logistics Cost, Response Time, and Number of Facilities

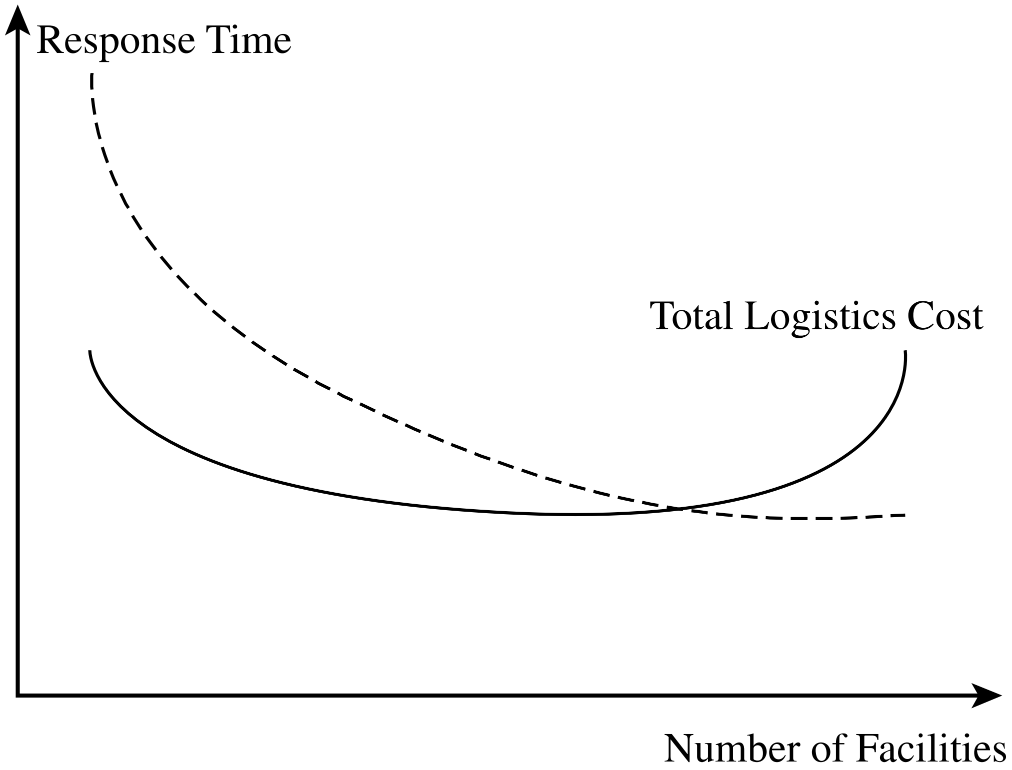
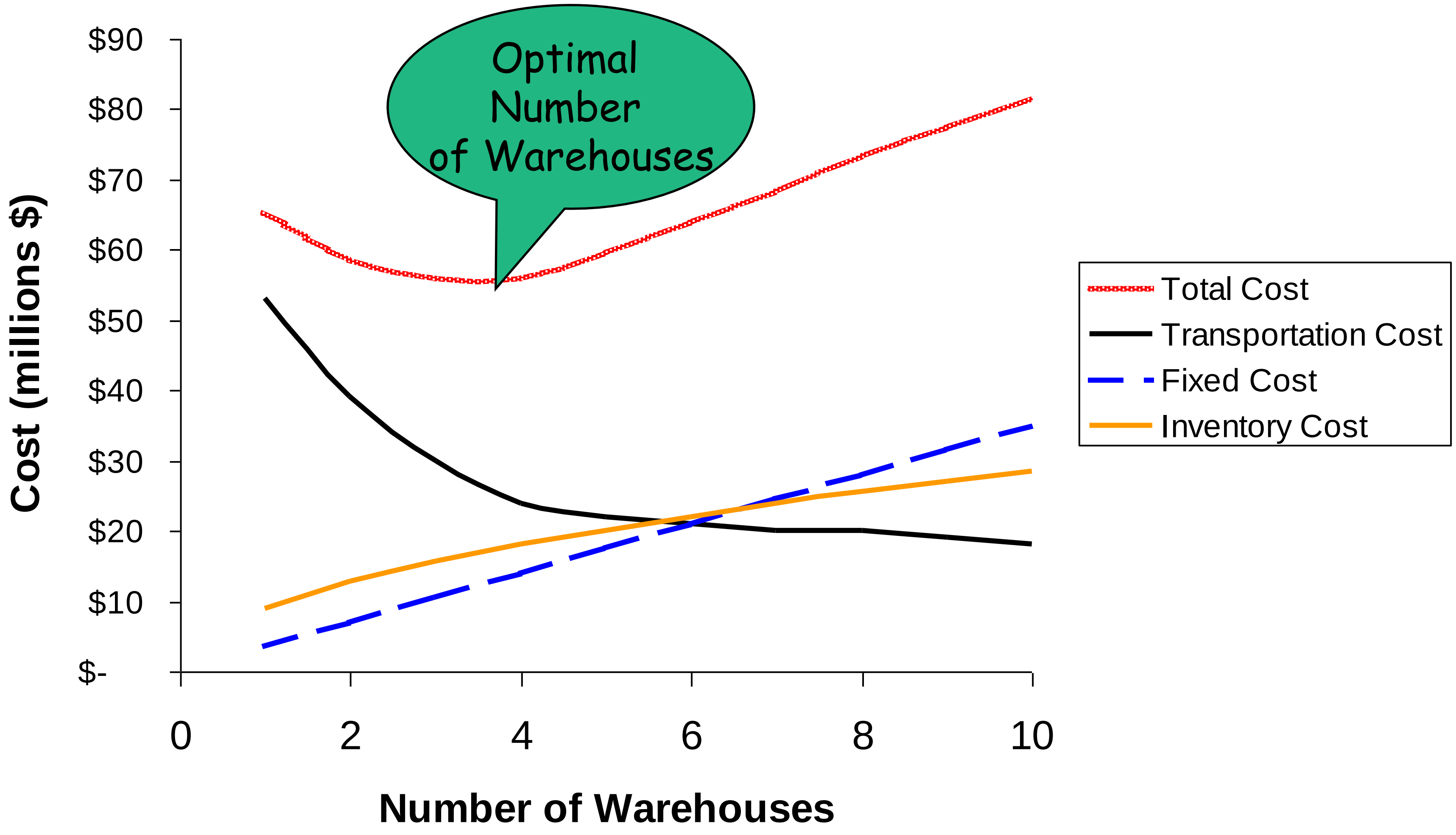


Figure 4-5 Variation in Logistics Cost and Response Time with Number of Facilities

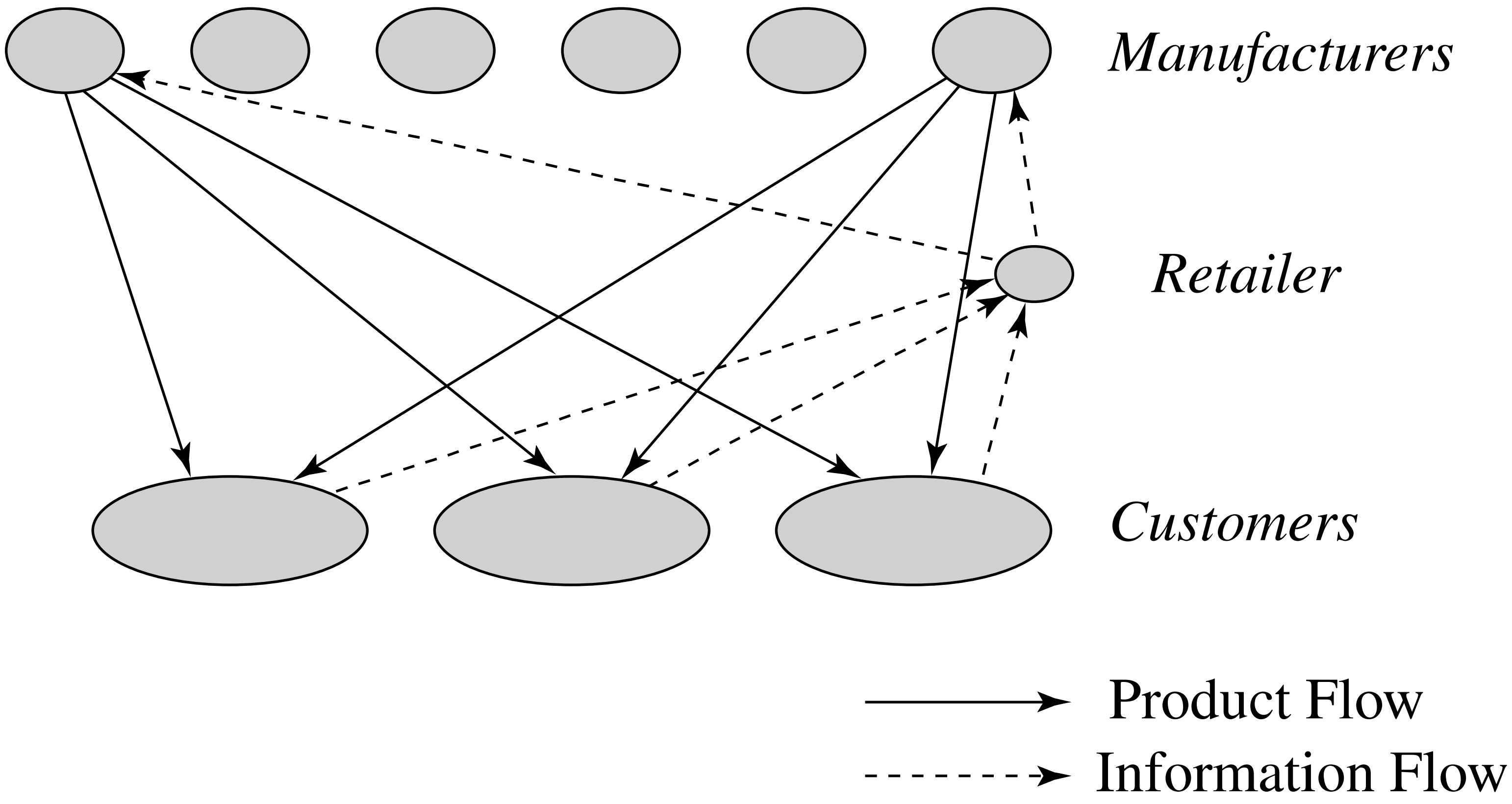
Minimize the cost of your logistics network without compromising your service levels



Design Options for a Distribution Network

- Distribution network choices from the manufacturer to the end consumer
- Two key decisions
  1. Will product be delivered to the customer location or picked up from a prearranged site?
  2. Will product flow through an intermediary (or intermediate location)?
- One of six designs may be used
  1. Manufacturer storage with direct shipping
  2. Manufacturer storage with direct shipping and in-transit merge
  3. Distributor storage with carrier delivery
  4. Distributor storage with last-mile delivery
  5. Manufacturer/distributor storage with customer pickup
  6. Retail storage with customer pickup

Figure 4-6 Manufacturer Storage with Direct Shipping



Manufacturer Storage with Direct Shipping Network (1 of 2)

Table 4-1 Performance Characteristics of Manufacturer Storage with Direct Shipping Network

Cost Factor	Performance
Inventory	Lower costs because of aggregation. Benefits of aggregation are highest for low-demand, high-value items. Benefits are large if product customization can be postponed at the manufacturer.
Transportation	Higher transportation costs because of increased distance and disaggregate shipping.
Facilities and handling	Lower facility costs because of aggregation. Some saving on handling costs if manufacturer can manage small shipments or ship from production line.
Information	Significant investment in information infrastructure to integrate manufacturer and retailer.

Manufacturer Storage with Direct Shipping Network (2 of 2)

Table 4-1 [Continued]

Service Factor	Performance
Response time	Long response time of one to two weeks because of increased distance and two stages for order processing. Response time may vary by product, thus complicating receiving.
Product variety	Easy to provide a high level of variety.
Product availability	Easy to provide a high level of product availability because of aggregation at manufacturer.
Customer experience	Good in terms of home delivery but can suffer if order from several manufacturers is sent as partial shipments.
Time to market	Fast, with the product available as soon as the first unit is produced.
Order visibility	More difficult but also more important from a customer service perspective.
Returnability	Expensive and difficult to implement.

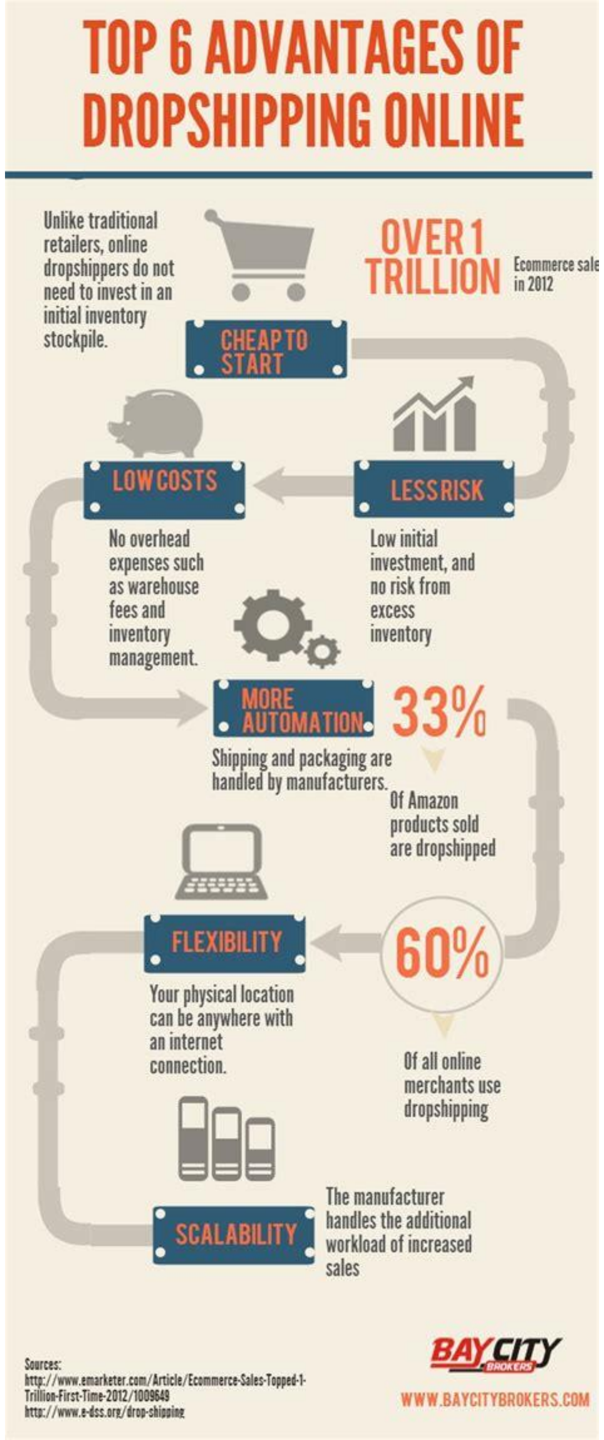
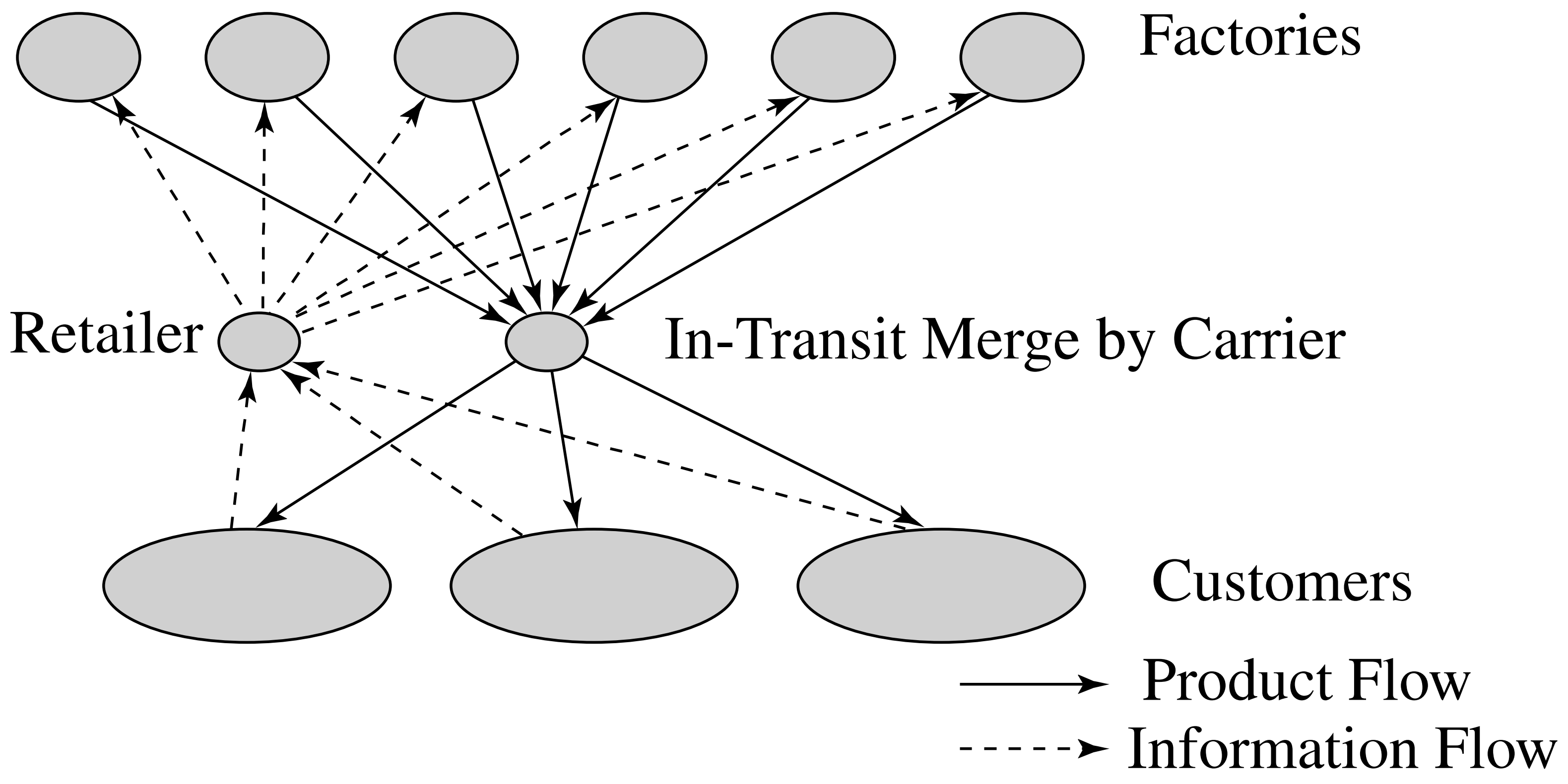

TOP 6 ADVANTAGES OF DROPSHIPPING ONLINE
Unlike traditional retailers, online dropshippers do not need to invest in an initial inventory stockpile.
OVER 1 TRILLION
Ecommerce sale in 2012
CHEAP TO START
LOW COSTS
LESS RISK
No overhead expenses such as warehouse fees and inventory management.
Low initial investment, and no risk from excess inventory
MORE AUTOMATION
33%
Shipping and packaging are handled by manufacturers.
Of Amazon products sold are dropshipped
FLEXIBILITY
60%
Your physical location can be anywhere with an internet connection.
Of all online merchants use dropshipping
SCALABILITY
The manufacturer handles the additional workload of increased sales
Sources:
http://www.emarketer.com/Article/Ecommerce-Sales-Topped-1-Trillion-First-Time-2012/1009649
http://www.e-dss.org/drop-shipping
BAY CITY BROKERS
WWW.BAYCITYBROKERS.COM

Figure 4-7 In-Transit Merge Network



In-Transit Merge (1 of 2)

Table 4-2 Performance Characteristics of In-Transit Merge

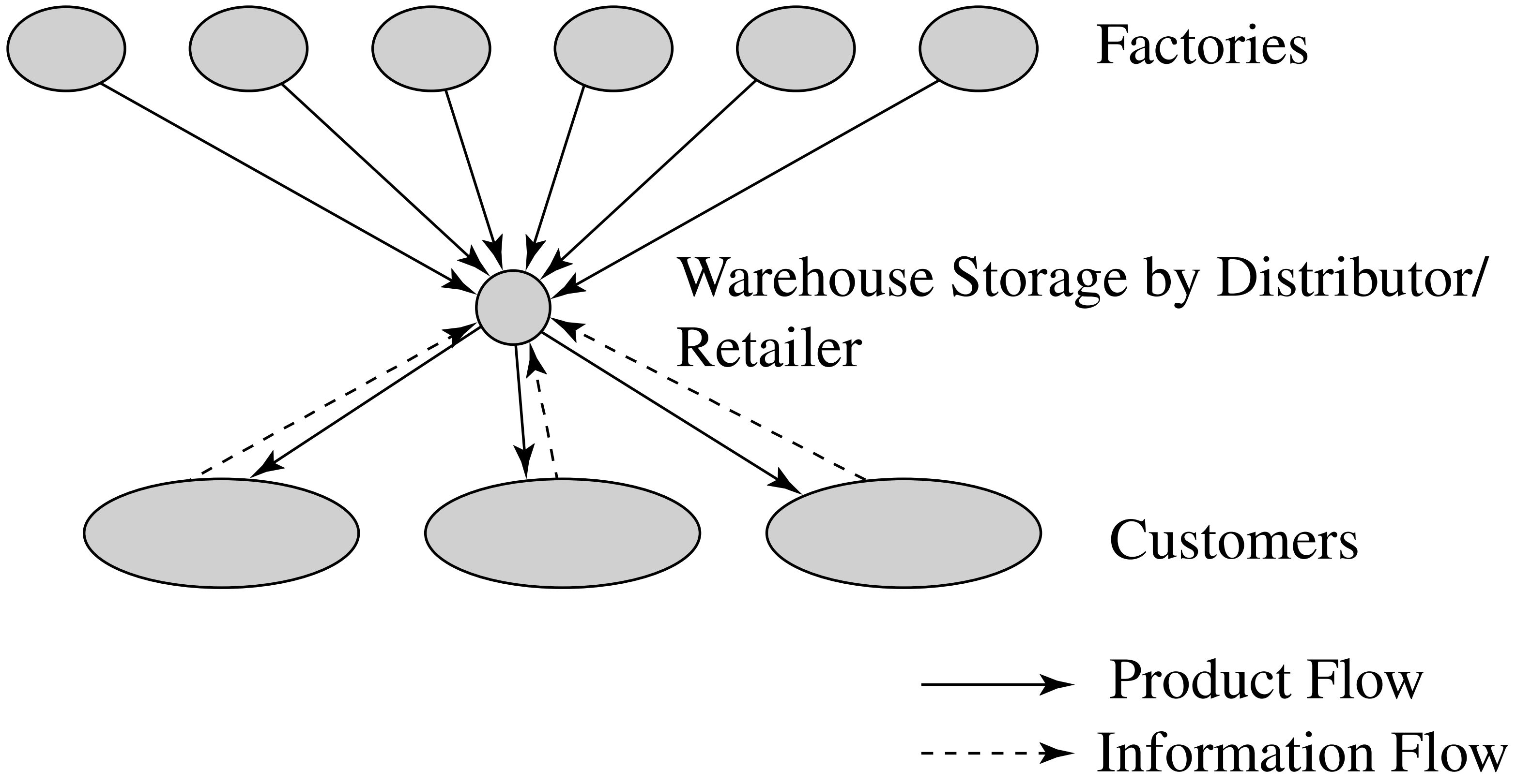
Cost Factor	Performance
Inventory	Similar to drop-shipping.
Transportation	Somewhat lower transportation costs than drop-shipping.
Facilities and handling	Handling costs higher than drop-shipping at carrier; receiving costs lower at customer.
Information	Investment is somewhat higher than for drop-shipping.

In-Transit Merge (2 of 2)

Table 4-2 [Continued]

Service Factor	Performance compared to drop-shipping
Response time	
Product variety	
Product availability	
Customer experience	
Time to market	
Order visibility	
Returnability	

Figure 4-8 Distributor Storage with Carrier Delivery



Distributor Storage with Carrier Delivery (1 of 2)

Table 4-3 Performance Characteristics of Distributor Storage with Carrier Delivery

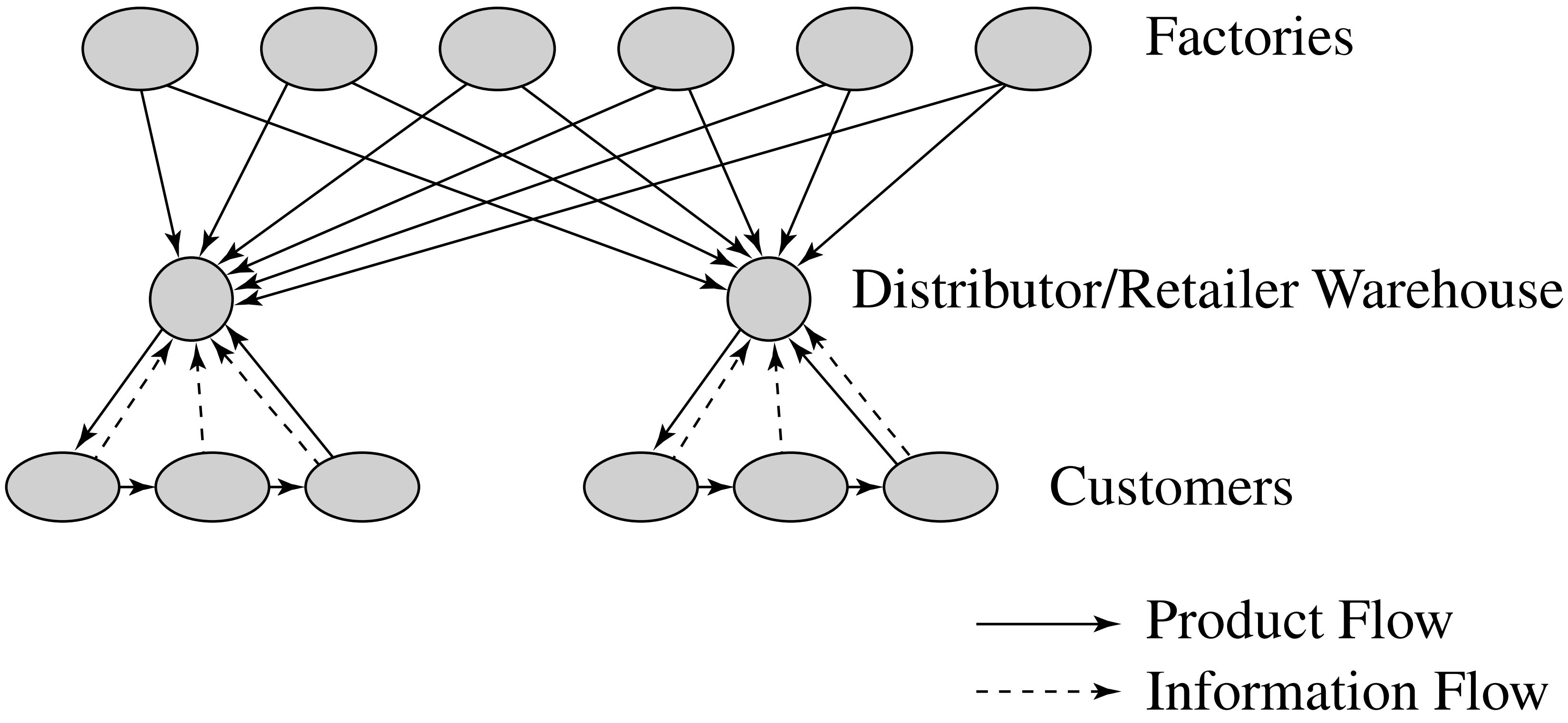
Cost Factor	Performance
Inventory	Higher than manufacturer storage. Difference is not large for faster-moving items but can be large for very slow-moving items.
Transportation	Lower than manufacturer storage. Reduction is highest for faster-moving items.
Facilities and handling	Somewhat higher than manufacturer storage. The difference can be large for very-slow-moving items.
Information	Simpler infrastructure compared to manufacturer storage.

Distributor Storage with Carrier Delivery (2 of 2)

Table 4-3 [Continued]

Service Factor	Performance
Response time	Faster than manufacturer storage.
Product variety	Lower than manufacturer storage.
Product availability	Higher cost to provide the same level of availability as manufacturer storage.
Customer experience	Better than manufacturer storage with drop-shipping.
Time to market	Higher than manufacturer storage.
Order visibility	Easier than manufacturer storage.
Returnability	Easier than manufacturer storage.

Figure 4-9 Distributor Storage with Last Mile Delivery



Distributor Storage with Last Mile Delivery (1 of 2)

Table 4-4 Performance Characteristics of Distributor Storage with Last-Mile Delivery

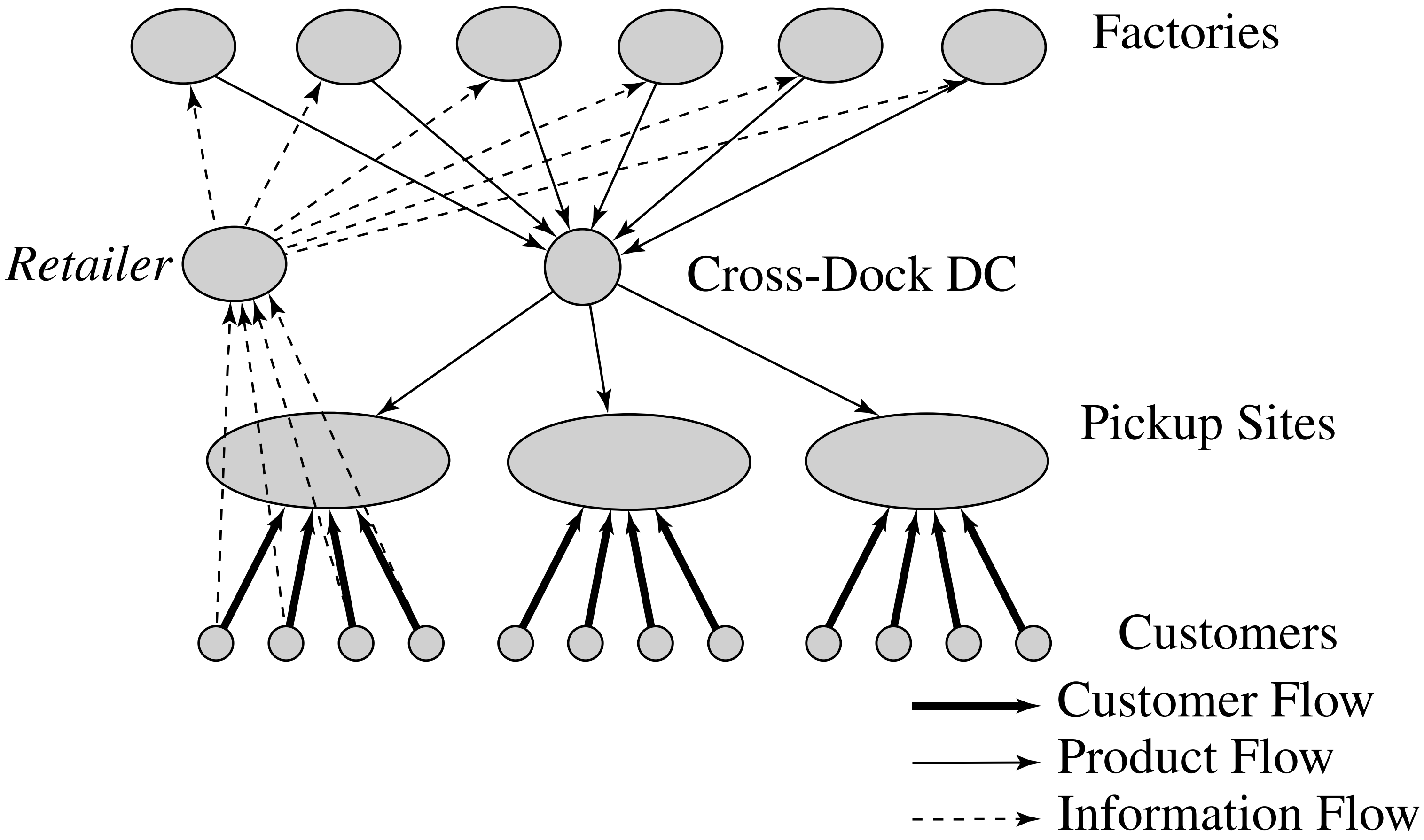
Cost Factor	Performance
Inventory	Higher than distributor storage with package carrier delivery.
Transportation	Very high cost given minimal scale economies. Higher than any other distribution option.
Facilities and handling	Facility costs higher than manufacturer storage or distributor storage with package carrier delivery, but lower than a chain of retail stores.
Information	Similar to distributor storage with package carrier delivery.

Distributor Storage with Last Mile Delivery (2 of 2)

Table 4-4 [Continued]

Service Factor	Performance
Response time	Very quick. Same day to next-day delivery.
Product variety	Somewhat less than distributor storage with package carrier delivery but larger than retail stores.
Product availability	More expensive to provide availability than any other option except retail stores.
Customer experience	Very good, particularly for bulky items.
Time to market	Slightly longer than distributor storage with package carrier delivery.
Order visibility	Less of an issue and easier to implement than manufacturer storage or distributor storage with package carrier delivery.
Returnability	Easier to implement than other previous options. Harder and more expensive than a retail network.

Figure 4-10 Manufacturer or Distributor Storage with Customer Pickup



Manufacturer or Distributor Storage with Customer Pickup (1 of 2)

Table 4-5 Performance Characteristics of Network with Customer Pickup Sites

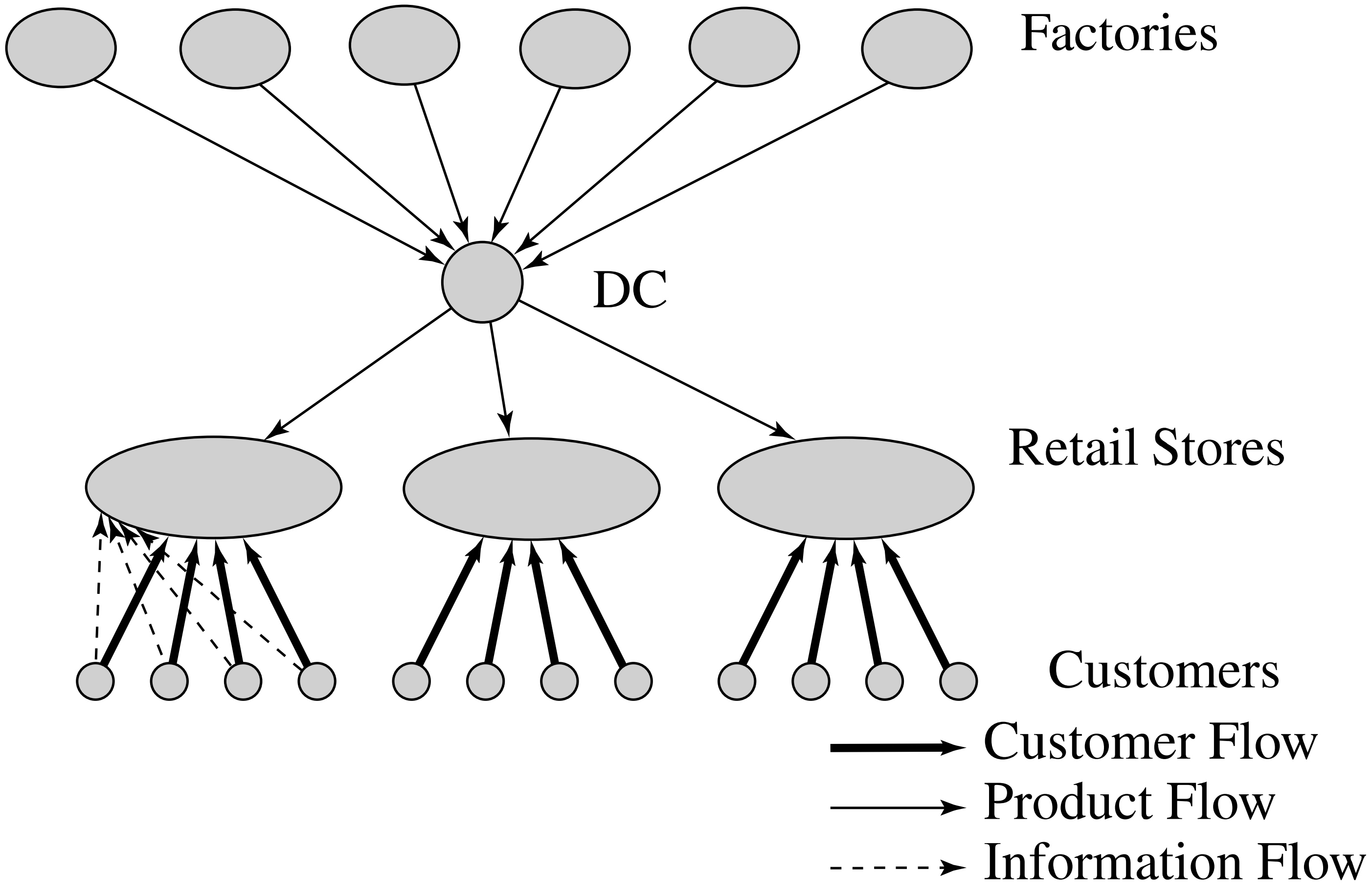
Cost Factor	Performance
Inventory	Can match any other option, depending on the location of inventory.
Transportation	Lower than the use of package carriers, especially if using an existing delivery network.
Facilities and handling	Facility costs can be high if new facilities have to be built. Costs are lower if existing facilities are used. The increase in handling cost at the pickup site can be significant.
Information	Significant investment in infrastructure required.

Manufacturer or Distributor Storage with Customer Pickup (2 of 2)

Table 4-5 [Continued]

Service Factor	Performance
Response time	Similar to package carrier delivery with manufacturer or distributor storage. Same-day pickup is possible for items stored at regional DC.
Product variety	Similar to other manufacturer or distributor storage options.
Product availability	Similar to other manufacturer or distributor storage options.
Customer experience	Lower than other options because of the lack of home delivery. Experience is sensitive to capability of pickup location.
Time to market	Similar to manufacturer or distributor storage options.
Order visibility	Difficult but essential.
Returnability	Somewhat easier, given that pickup location can handle returns.

Figure 4-11 Retail Storage with Customer Pickup



Retail Storage with Customer Pickup (1 of 2)

Table 4-6 Performance Characteristics of Retail Storage with Customer Pickup Sites

Cost Factor	Performance
Inventory	Higher than all other options.
Transportation	Lower than all other options.
Facilities and handling	Higher than other options. The increase in handling cost at the pickup site can be significant for online and phone orders.
Information	Some investment in infrastructure required for online and phone orders.

Retail Storage with Customer Pickup (2 of 2)

Table 4-6 [Continued]

Service Factor	Performance
Response time	Same-day (immediate) pickup possible for items stored locally at pickup site.
Product variety	Lower than all other options.
Product availability	More expensive to provide than all other options.
Customer experience	Related to whether shopping is viewed as a positive or negative experience by customer.
Time to market	Highest among distribution options.
Order visibility	Trivial for in-store orders. Difficult, but essential, for online and phone orders.
Returnability	Easier than other options because retail store can provide a substitute.

https://oneeducatorsopinion.wordpress.com/2014/02/26/brain-breaks-are-good-for-teachers-too/

Comparative Performance of Delivery Network Designs (1 of 3)

Table 4-7 Comparative Performance Rank of Delivery Network Designs

	Retail Storage with Customer Pickup	Manufacturer Storage with Direct Shipping	Manufacturer Storage with In-Transit Merge	Distributor Storage with Package Carrier Delivery	Distributor Storage with Last-Mile Delivery	Manufacturer/ Distributor Storage with Customer Pickup
Response time	1	4	4	3	2	4
Product variety	4	1	1	2	3	1
Product availability	4	1	1	2	3	1

Key: 1 corresponds to the best performance and 6 the worst performance.

Comparative Performance of Delivery Network Designs (2 of 3)

Table 4-7 [Continued]

	Retail Storage with Customer Pickup	Manufacturer Storage with Direct Shipping	Manufacturer Storage with In-Transit Merge	Distributor Storage with Package Carrier Delivery	Distributor Storage with Last-Mile Delivery	Manufacturer / Distributor Storage with Customer Pickup
Customer experience	Varies From 1 to 5	4	3	2	1	5
Time to market	4	1	1	2	3	1
Order visibility	1	5	4	3	2	6
Returnability	1	5	5	4	3	2

Key: 1 corresponds to the best performance and 6 the worst performance.

Comparative Performance of Delivery Network Designs (3 of 3)

Table 4-7 [Continued]

	Retail Storage with Customer Pickup	Manufacturer Storage with Direct Shipping	Manufacturer Storage with In-Transit Merge	Distributor Storage with Package Carrier Delivery	Distributor Storage with Last-Mile Delivery	Manufacturer/ Distributor Storage with Customer Pickup
Inventory	4	1	1	2	3	1
Transportatio n	1	4	3	2	5	1
Facility and handling	6	1	2	3	4	5
Information	1	4	4	3	2	5

Key: 1 corresponds to the best performance and 6 the worst performance.

Delivery Networks for Different Product/ Customer Characteristics (1 of 2)

Table 4-8 Performance of Delivery Networks for Different Product/Customer Characteristics

	Retail Storage with Customer Pickup	Manufacturer Storage with Direct Shipping	Manufacturer Storage with In-Transit Merge	Distributor Storage with Package Carrier Delivery	Distributor Storage with Last-Mile Delivery	Manufacturer/ Distributor Storage with Customer Pickup
High-demand product	+2	−2	−1	0	+1	−1
Medium-demand product	+1	−1	0	+1	0	0
Low-demand Product	−1	+1	0	+1	−1	+1

Delivery Networks for Different Product/ Customer Characteristics (2 of 2)

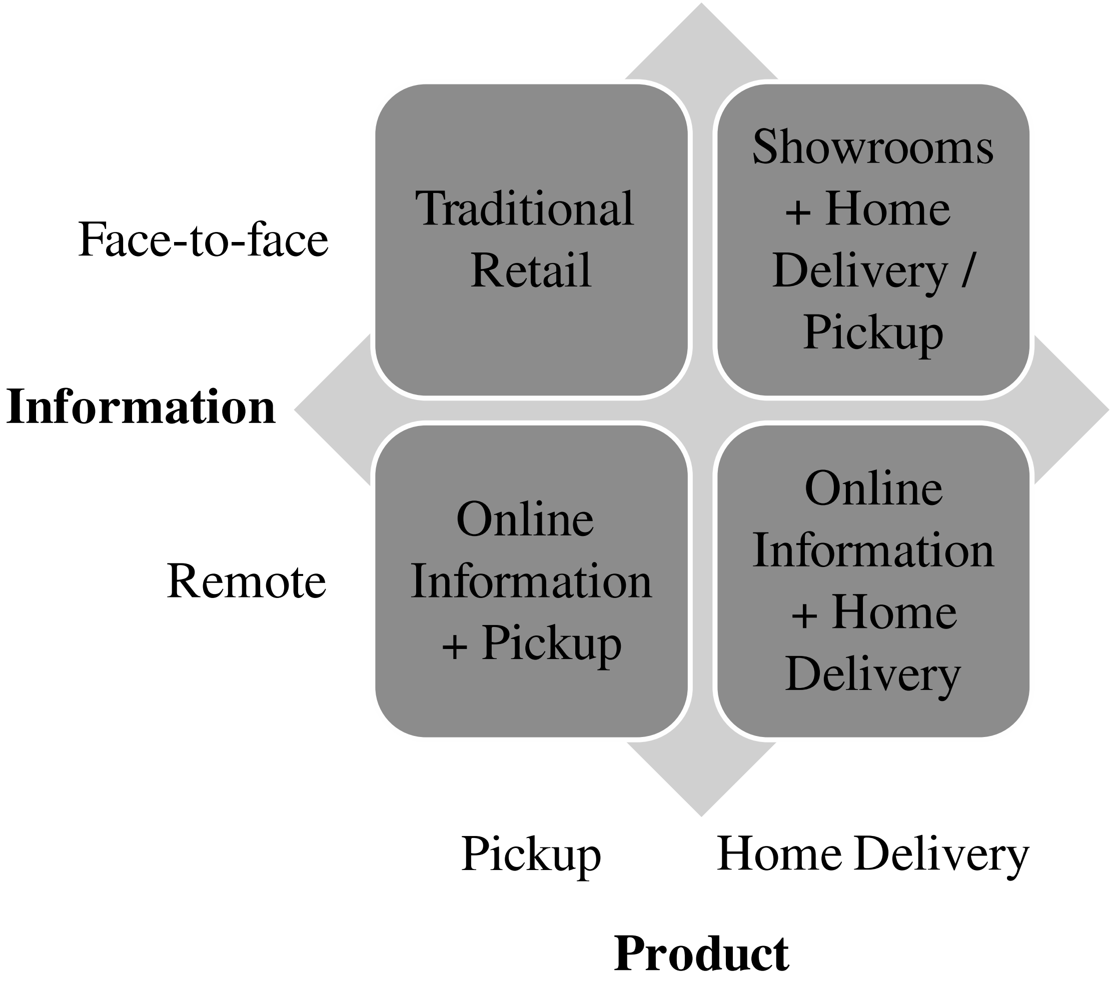
Table 4-8 [Continued]

	Retail Storage with Customer Pickup	Manufacturer Storage with Direct Shipping	Manufacturer Storage with In-Transit Merge	Distributor Storage with Package Carrier Delivery	Distributor Storage with Last-Mile Delivery	Manufacturer / Distributor Storage with Customer Pickup
Very-low-demand product	−2	+2	+1	0	−2	+1
High product value	−1	+2	+1	+1	0	+2
Quick desired response	+2	-2	−2	−1	+1	-2
High product variety	−1	+2	0	+1	0	+2
Low customer effort	−2	+1	+2	+2	+2	−1

Key: +2 = very suitable; +1 = somewhat suitable; 0 = neutral; −1 = somewhat unsuitable; −2 = very unsuitable.

Online Sales and Omni-Channel Retailing

- Omni-channel retailing
  - The use of multiple channels to interact with customers and fulfill their orders
  - Three flows
    - Information
    - Products
    - Funds



Performance of Channels (1 of 3)

- Response time to customers
  - Picking up physical products faster than other channels
  - Online channel may be fastest for information goods
- Product variety
  - Easier to offer larger selection remotely
- Product availability
  - Aggregating inventory improves product availability

Performance of Channels (2 of 3)

- Customer experience
  - Channels have complementarity strengths
- Faster time to market
  - Online/showrooms are quicker than retailing
- Order Visibility
  - Critical for showrooms or online
  - Automatic in retail

Performance of Channels (3 of 3)

- Returnability
  - Easier with physical locations
  - Proportion of returns likely to be higher when information exchange is remote
- Direct Sales to Customers
  - Manufacturers can use remote information exchange for direct access to customers
- Efficient Funds Transfer
  - Internet and smartphones

Performance of Channels in Terms of Cost

- Inventory
  - Lower inventory levels if customers will wait
  - Postpone variety until after the customer order is received
- Facilities
  - Costs related to the physical facilities in a network
  - Costs associated with the operations in these facilities
- Transportation
  - Lower cost of “transporting” information goods in digital form
  - For nondigital, aggregating inventories increases outbound transportation
- Information
  - Investment higher for channels that provide information remotely

Relative Costs for Omni-Channel Alternatives

Table 4-9 Relative Costs for Omni-Channel Alternatives

	Traditional Retail	Showrooms + Home Delivery	Online Information + Home Delivery	Online Information + Pickup
Inventory	High	Low - Medium	Low	Low - Medium
Facilities	High	Medium	Low	Low - Medium
Transportation by retailer	Low	High	High	Medium
Transportation by customer	High	High	Low	Medium
Information	Low	High	High	High

Framework for Omni-Channel Retailing

(1 of 4)

- Product characteristics and customer needs influence choice of channel
- Product dimensions
  - Demand uncertainty
  - Value
  - Information complexity
- Customer dimensions
  - Willingness to pay
    - Price conscious/service conscious

Framework for Omni-Channel Retailing
(2 of 4)

Table 4-10 Product Demand Uncertainty and Omni-Channel Retailing

	Predictable Demand Product	Unpredictable Demand Product
Traditional Retail	Compete on price	Compete on service for high information complexity products
Showrooms	Not suitable	Compete on price and variety for high information complexity products
Online Information + Home Delivery	Compete on service	Compete on price and variety
Online Information + Pickup	Compete on ability to provide service at a lower price	More competitive on price than home delivery option

Framework for Omni-Channel Retailing

Table 4-11 Product Value and Omni-Channel Retailing

	Low Value Product	**High Value Product**
Traditional Retail	Compete on price for predictable demand products	Compete on service for products with uncertain demand and high information complexity
Showrooms	Compete on high variety at reasonable price for high information complexity Products	Compete on price for customizable, high information complexity products
Online Information + Home Delivery	Compete on service	Compete on price and variety
Online Information + Pickup	Compete on ability to provide service at a lower price	More competitive on price than home delivery option

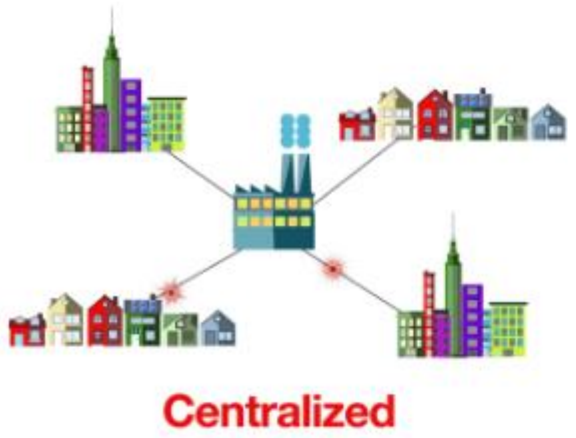
Framework for Omni-Channel Retailing
(4 of 4)

Table 4-12 Product Information Complexity and Omni-Channel Retailing

	Low Information Complexity Product	High Information Complexity Product
Traditional Retail	Compete on price for predictable demand products	Compete on service for uncertain demand products
Showrooms	Not suitable	Compete on price for uncertain demand products
Online Information + Home Delivery	Compete on price for uncertain demand products	Compete on service in terms of variety and availability for uncertain demand products
Online Information + Pickup	Compete on price for uncertain demand products	A slightly cheaper option to compete on service in terms of variety and availability for uncertain demand products

In-class breakout

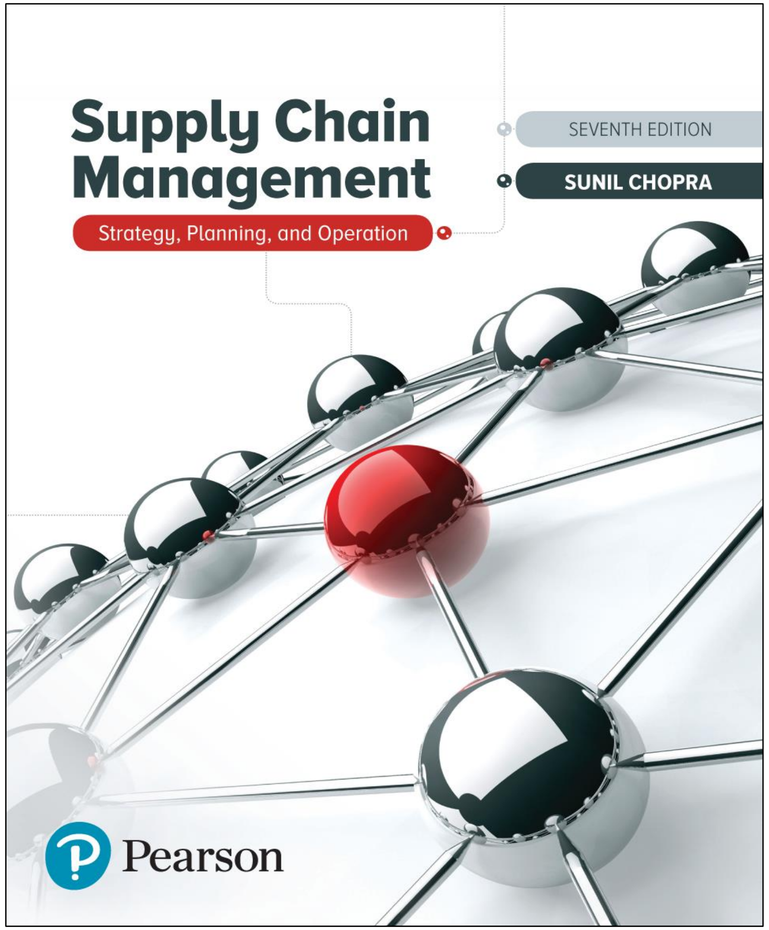
- You have an existing product that will now be customizable (for an extra fee). Marketing estimates that this will increase sales by 50% in the near term and profit per unit (custom only) by 35%. This takes extra materials and 3 minutes to do (labor and small tools only). Your firm currently has an online presence and retail locations. Should the firm:
    - Offer online only
    - Offer in retail stores only
    - Offer both online and retail options
    - Wildcard: Offer through another distribution channel/ model (Which one? Why?)
- What are the pros and cons of the approach you chose? (Why or why not)
- Answer Zoom poll



https://e2e.ti.com/blogs_/archives/b/smartgrid/posts/engineering-a-smarter-grid

Supply Chain Management: Strategy, Planning, and Operation

Seventh Edition



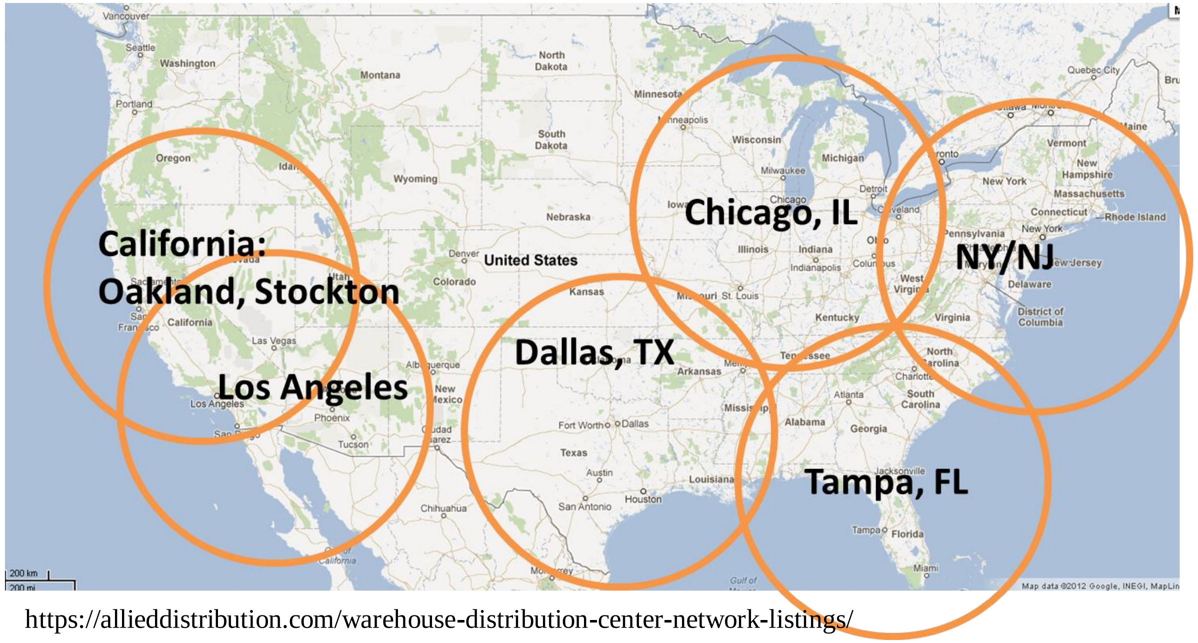
Chapter 5

Network Design in the Supply Chain

The Role of Network Design

- Network design decisions
  - How many manufacturing plants, production lines, distribution centers, cross-docking facilities?
  - Where should facilities be located?
  - How much capacity at each facility?
  - Which products?
  - What markets?

- Revisit design decisions after market changes, mergers, or factor cost changes



https://allieddistribution.com/warehouse-distribution-center-network-listings/

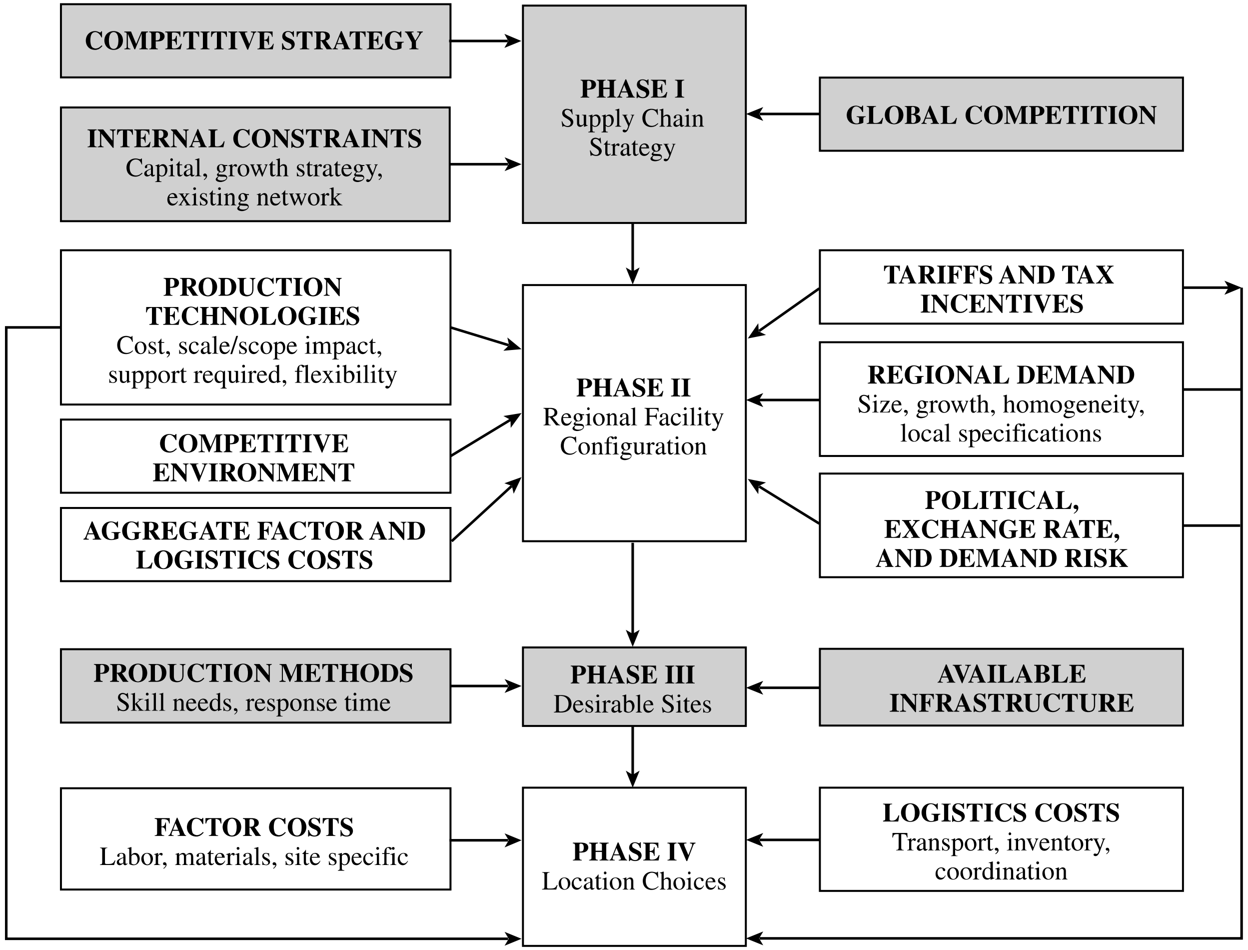
Factors Influencing Network Design Decisions

- Strategic Factors
- Competitive Factors
  - Positive externalities
  - Locating to split the market
- Political Factors
- Infrastructure Factors
- Customer Response Time and Service Level
- Total Logistics Cost
- Macroeconomic Factors
  - Tariffs and tax incentives
  - Exchange-rate and demand risk

Framework for Network Design Decisions

- Maximize the overall profitability of the supply chain network while providing customers with the appropriate responsiveness
- Many trade-offs during network design
- Network design models used
  - to decide on locations and capacities
  - to assign current demand to facilities and identify transportation lanes

Figure 5-2 Framework for Network Design Decisions



Framework for Network Design Decisions
(1 of 3)

- **Phase I: Define a Supply Chain Strategy/Design**
  - Clear definition of the firm's competitive strategy
  - Forecast the likely evolution of global competition
  - Identify constraints on available capital
  - Determine broad supply strategy

Framework for Network Design Decisions
(2 of 3)

- **Phase II: Define the Regional Facility Configuration**
  - Forecast of the demand by country or region
  - Identify fixed and variable costs, economies of scale or scope
  - Identify regional tariffs, requirements for local production, tax incentives, and export or import restrictions
  - Identify competitors
  - Identify demand risk, exchange-rate risk, political risk

Framework for Network Design Decisions
(3 of 3)

- **Phase III: Select a Set of Desirable Potential Sites**
  - Hard infrastructure requirements
  - Soft infrastructure requirements
- **Phase IV: Location Choices and Market Allocation**

Models for Designing a Regional Network Configuration

- Inputs Required By Region
  - Demand
  - Desired response time
  - Fixed cost of opening a facility
  - Variable cost of labor and material
  - Inventory holding cost
  - Transportation cost between pairs of regions
  - Sale price of product
  - Taxes and tariffs
  - Potential facility capacity

Locational Models

- Capacitated Plant Location Model (with or without taxes, tariffs, fill rate objective)
- Identifying Potential Sites – gravity model
- Demand Allocation and Plant Location
- Locating Plants and Warehouses Simultaneously

Lexus case study

Assignments

- Case 4 due next week
  - Write up
  - Recorded presentation due May 11
- Prepare for week 7:
  - Read chapter 14
  - Watch video on chapter 6
  - Take no-point quiz
- Next week
  - Will discuss final exam
  - Have review session
  - If you have ANY questions about homework, please ask! Your understanding of the HW problems are critical for being successful on the final.

Office hours! Please join me on Tuesdays 1-2pm or by appointment!

TEAM MEETING

https://brooksgroup.com/sales-training-blog/sales-coaching-best-practices-series-team-meetings

Transportation & Supply Chain Trends

SCM614

WEEK 7

Agenda

- Transportation, chapter 14
- SC trends, 5 Levers
- Final review

Transportation Modes and Their Role in a Supply Chain

- Movement of product from one location to another
- Products rarely produced and consumed in the same location
- Significant cost component
- **Shipper** requires the movement of the product
- **Carrier** moves or transports the product

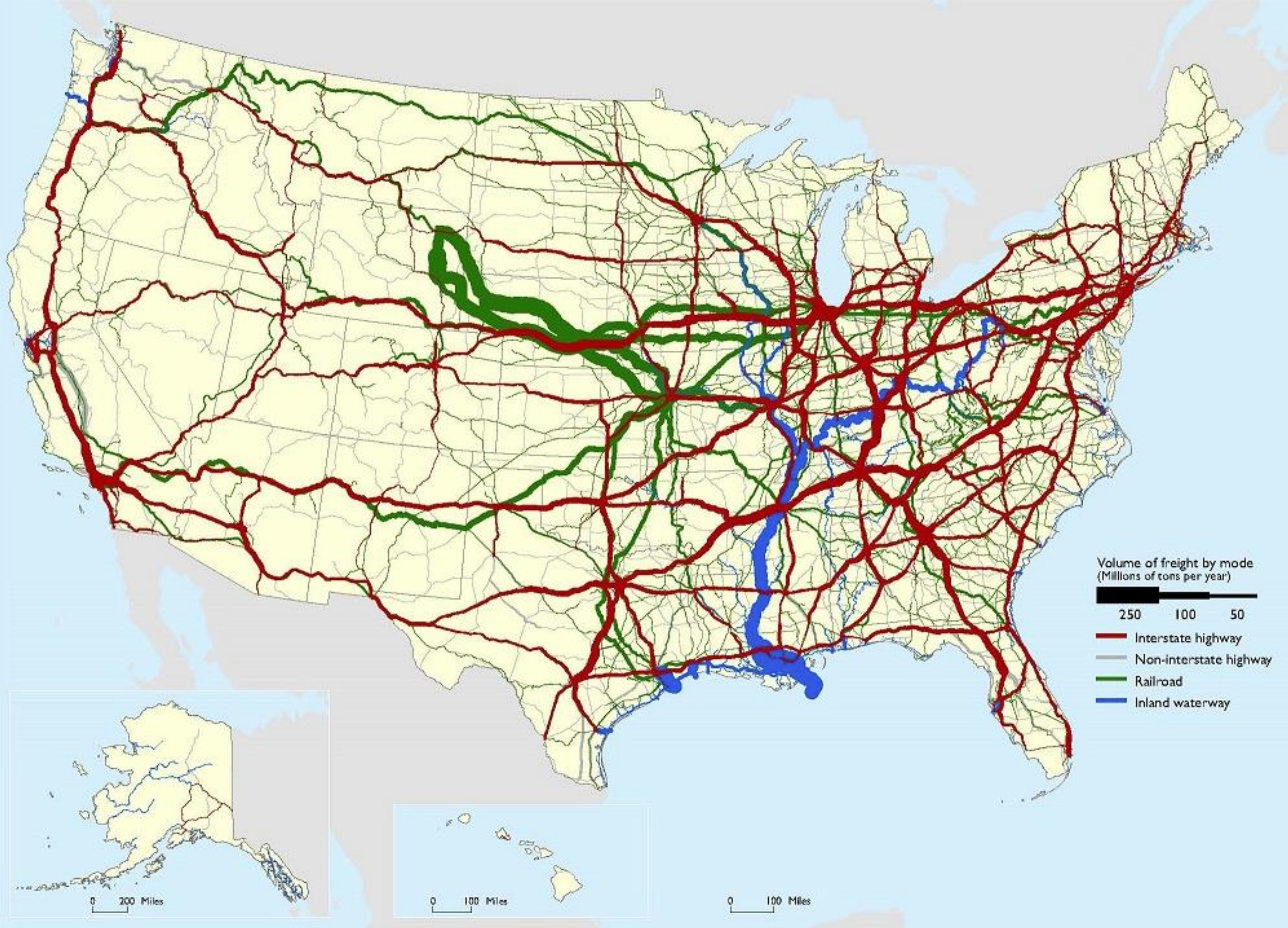
Modes of Transportation and Their Performance Characteristics

- Air
- Package carriers
- Truck
- Rail
- Water
- Pipeline
- Intermodal

Domestic Mode	Weight (thousands of tons)	Value (millions of current dollars)
Truck	11,520,318	12,421,511
Rail	1,738,346	690,459
Water	766,322	363,500
Air (including truck-air)	5,871	591,253
Multiple modes and mail	495,680	2,328,112
Pipeline	3,049,857	942,007
Other and unknown	39,210	97,633
No domestic mode	208,676	66,410
Total (All modes)	17,824,281	17,500,885

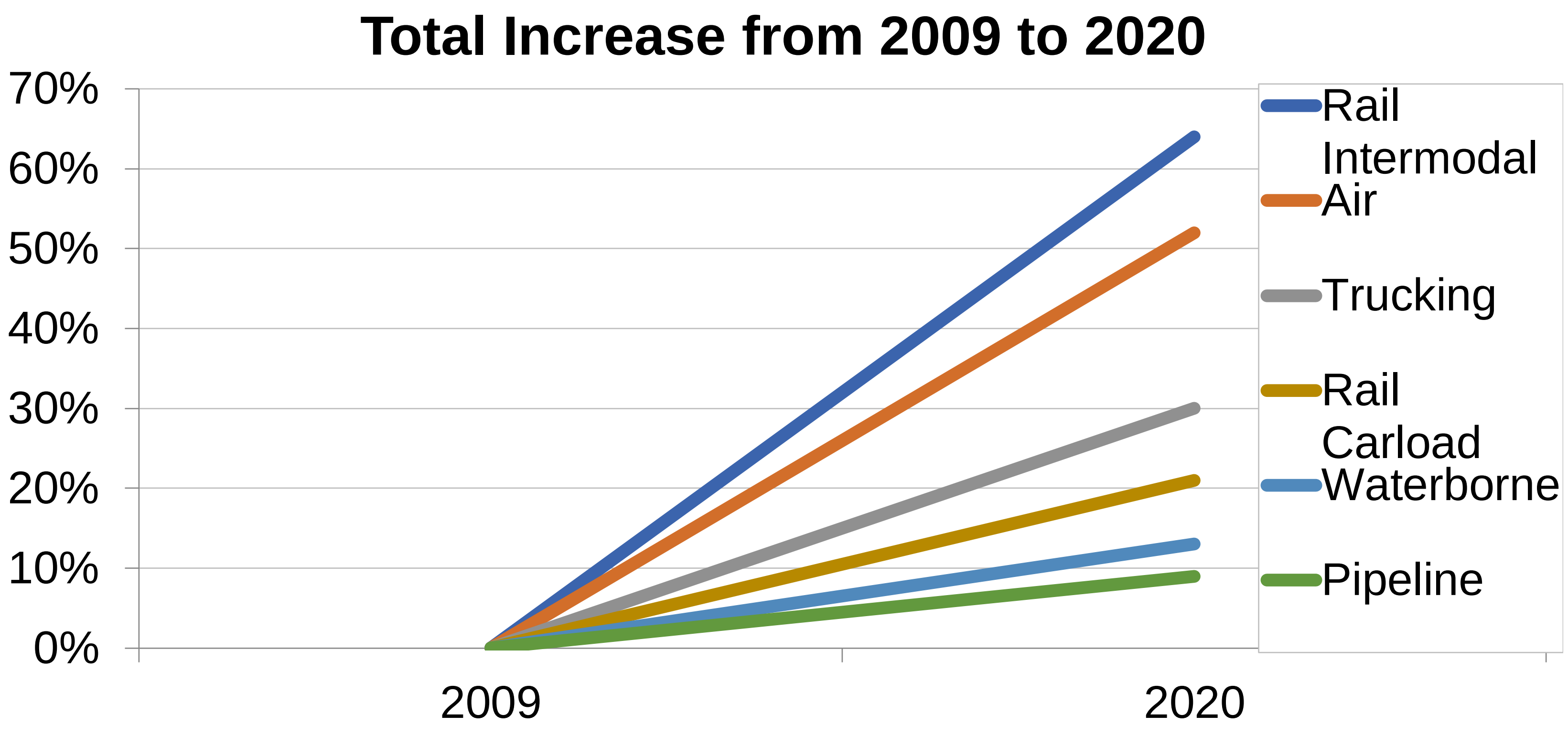
SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics and Federal Highway Administration, Freight Analysis Framework, version 4.5, 2019.

Freight Flows by Highway, rail, & water (2012)



https://www.bts.gov/content/freight-flows-highway-railroad-and-waterway-2012

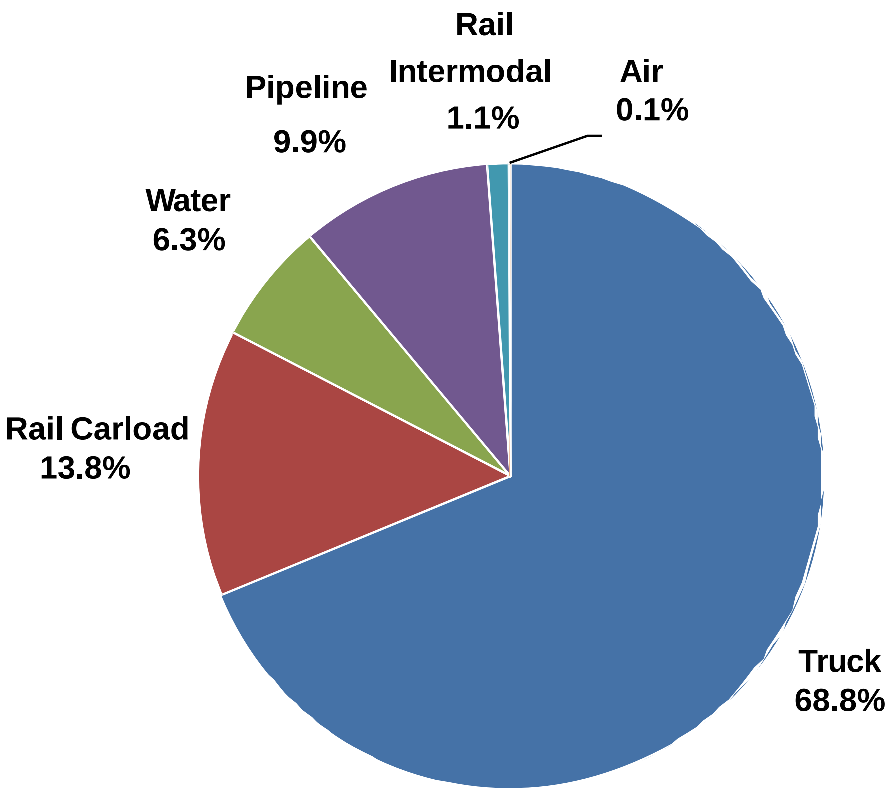
Growth in tonnage



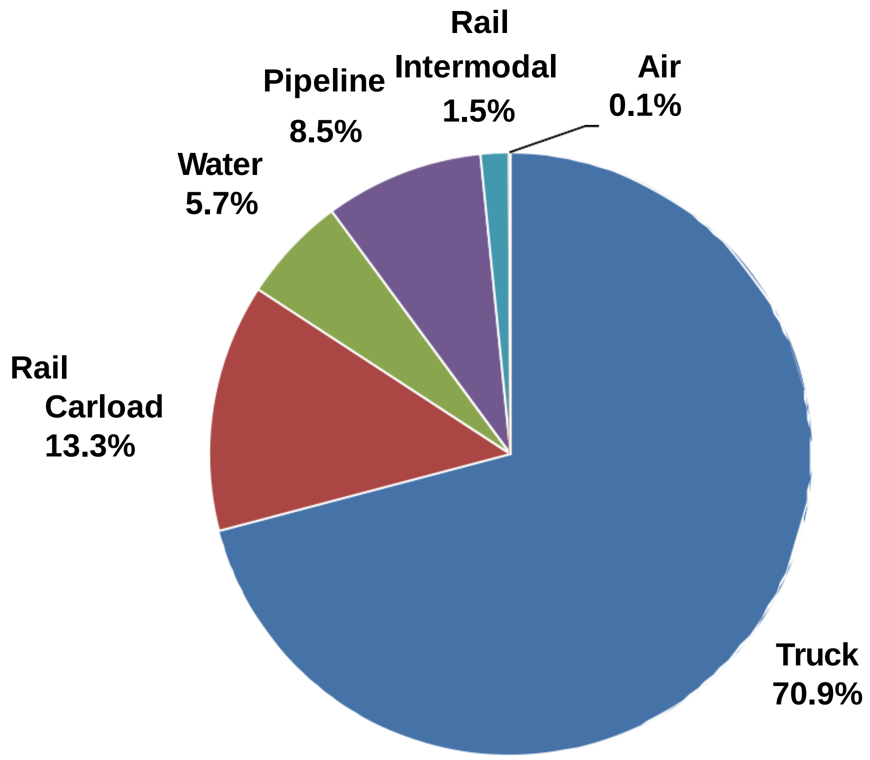
Source: IHS Global Insight and ATA.

Distribution of tonnage by mode: 2008 vs. 2020

2008



2020



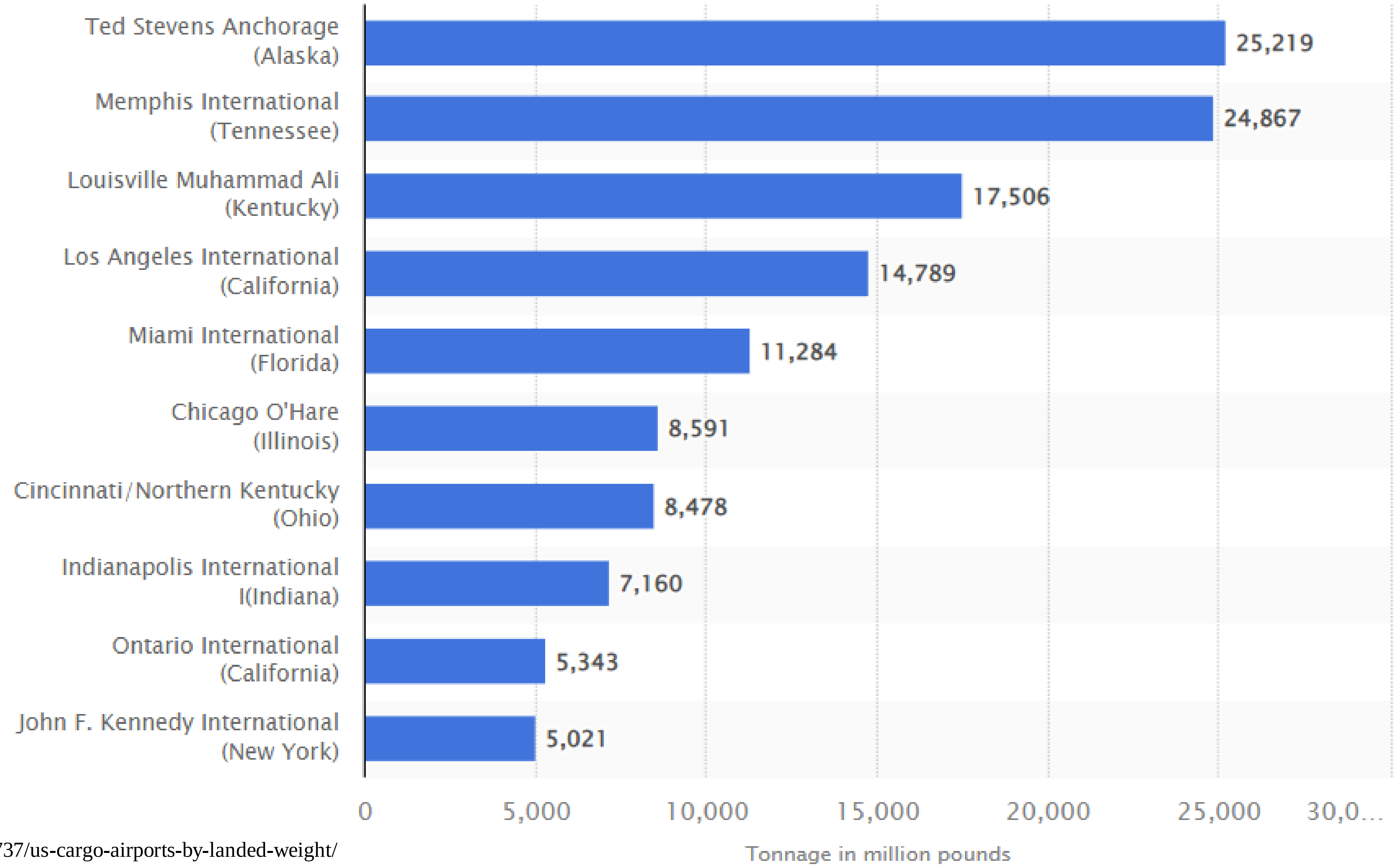
Source: U.S. Freight Transportation Forecast to...2020.

Air

- Cost components
  - Fixed infrastructure and equipment
  - Labor and fuel
  - Variable depending on passenger/cargo
- Key issues
  - Location/number of hubs
  - Fleet assignment
  - Maintenance schedules
  - Crew scheduling
  - Prices and availability

Air: Top 10 North American cargo airports in 2021

(tonnage in million pounds)



https://www.statista.com/statistics/524737/us-cargo-airports-by-landed-weight/

Package Carriers

- Small packages up to about 150 pounds
- Expensive
- Rapid and reliable delivery
- Small and time-sensitive shipments
- Provide other value-added services
- Consolidation of shipments a key factor

Truck

- Significant fraction of the goods moved
- Truckload (T L)
    - Low fixed cost
    - Imbalance between flows
- Less than truckload (L T L)
    - Small lots
    - Hub and spoke system
    - May take longer than T L
- Fatigue-related accidents


Image Credit: Volvo Trucks, Volvo LIGHTS electric trucks

Rail

- Move commodities over large distances
- High fixed costs in equipment and facilities
- Scheduled to maximize utilization
- Transportation time can be long
  - Trains ‘built’ not scheduled

BNSF Container train in the Cajon Pass - by "GGG" via http://www.roadfood.com/Forums

Railroads: Impacts of deregulation

Number of railroads

1976

- 63 Class I Railroads

2008

- 7 Class I Railroads
  - BNSF
  - CSX
  - CN US Operations
  - KCS
  - NS
  - CP
  - UP
- Proposal to merge CN & BNSF rejected in 2000, reverses trend

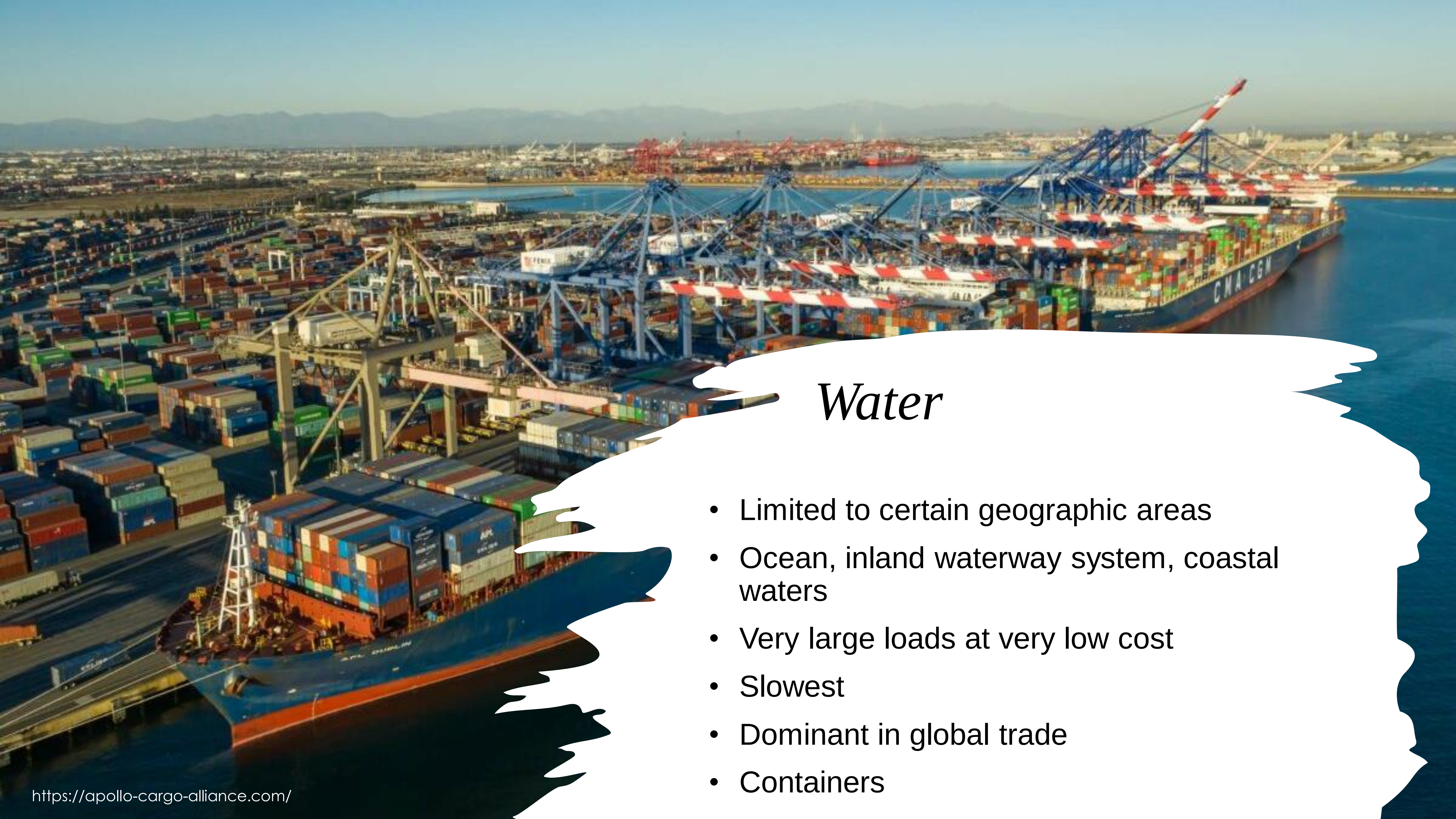
Route miles operated

1970

- Class I's operated 206,000 route miles of track

2008

- Class I's operated 140,810 route miles of track
- No Class I has an inter-continental network: requires switching & often results in congestion (Chicago)

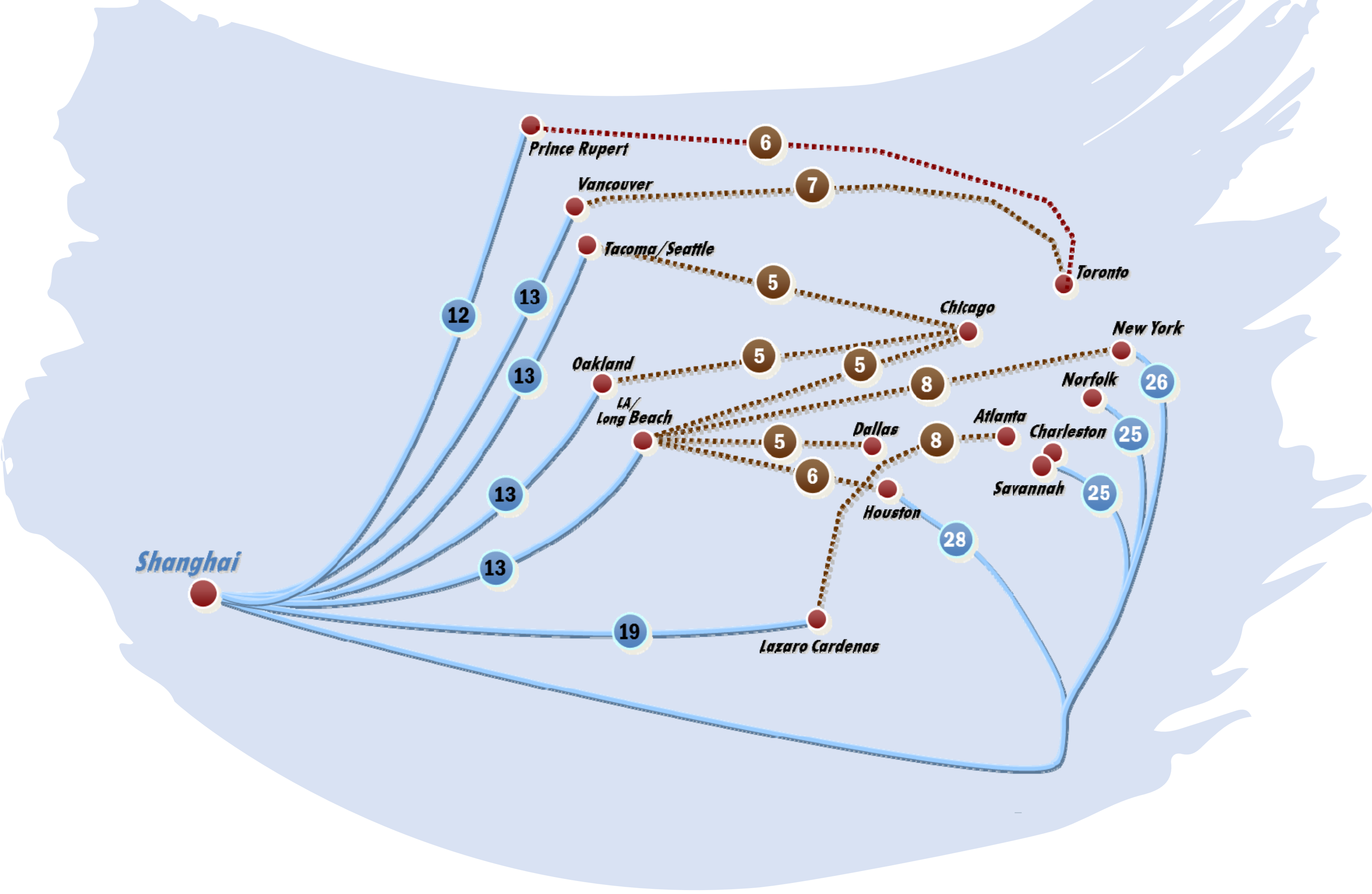


https://apollo-cargo-alliance.com/

Water

- Limited to certain geographic areas
- Ocean, inland waterway system, coastal waters
- Very large loads at very low cost
- Slowest
- Dominant in global trade
- Containers

Water: Transit times



Water: America's marine highways

Water

- The combined capacity of the top 10 ocean carriers is 18 million TEUs in 2018
  - Danish carrier **Maersk Line** retained its overall lead with capacity of 4.1 million TEUs; market share at 17.7% (https://cargofive.com/top-10-ocean-carriers-around-the-world/)
- As of January 2018, 53,732 ships were in the world's merchant fleet (https://www.statista.com/statistics/264024/number-of-merchant-ships-worldwide-by-type/)

Port Name	2018 Total Container Volume (TEUs)	% of Traffic	Annual Change 2018 vs 2017	2017 Total Container Volume (TEUs)	Comments
Los Angeles	9,458,751	19.8%	1.24%	9,343,192	Combined with Long Beach = 17.5M TEUs in 2018 (up 3.9% yoy). Ranked #9 in the world.
Import Volume	*4,870,585*	*21.9%*	*3.28%*	*4,716,089*	*Port of Los Angeles moved more cargo in 2018 than any time in its 111-year history.*
Export Volume	*1,904,054*	*15.1%*	*0.22%*	*1,899,934*	
Long Beach	8,091,029	16.9%	7.24%	7,544,514	Combined with Los Angeles = 17.5M TEUs in 2018 (up 3.9% yoy). Ranked #9 in the world. Surpassed 8 million TEUs for the first time in its history.
Import Volume	*4,097,379*	*18.4%*	*6.06%*	*3,863,189*	*Nearly 70% of the port's import containers come from China.*
Export Volume	*1,523,011*	*12.1%*	*3.57%*	*1,470,517*	
New York/New Jersey	7,179,792	15.0%	6.99%	6,710,817	Surpassed 7M TEUs for first time in its history, which dates back to the 1950s.
Import Volume	*3,676,113*	*16.5%*	*8.23%*	*3,396,469*	*Port handled one third of all containers on the East Coast of North America.*
Export Volume	*1,476,780*	*11.7%*	*4.34%*	*1,415,322*	
Savannah, GA	4,351,976	9.1%	7.56%	4,046,216	Highest annual volume ever. Nine of the port's 10 busiest months were in 2018.
Import Volume	*2,081,368*	*9.3%*	*10.96%*	*1,875,833*	*In December alone, the Port of Savannah handled 351,366 TEUs, an increase of 8.7%.*
Export Volume	*1,444,403*	*11.4%*	*5.24%*	*1,372,453*	

http://blog.cushwake.com/wp-content/uploads/2019/03/Top-US-Seaports-YE-2018.pdf

Pipeline

- High fixed cost
- Primarily for crude petroleum, refined petroleum products, natural gas
- Best for large and stable flows
- Pricing structure encourages use for predicable component of demand

https://www.britannica.com/technology/pipeline-technology/Oil-pipelines

Intermodal

- Use of more than one mode of transportation to move a shipment
- Grown considerably with increased use of containers
- May be the only option for global trade
- More convenient for shippers – one entity
- Key issue – exchange of information to facilitate transfer between different modes

https://www.intekfreight-logistics.com/intermodal

Design Options for a Transportation Network

- When designing a transportation network
  1. Should transportation be direct or through an intermediate site?
  2. Should the intermediate site stock product or only serve as a cross-docking location?
  3. Should each delivery route supply a single destination or multiple destinations?

Direct Shipment Network to Single Destination

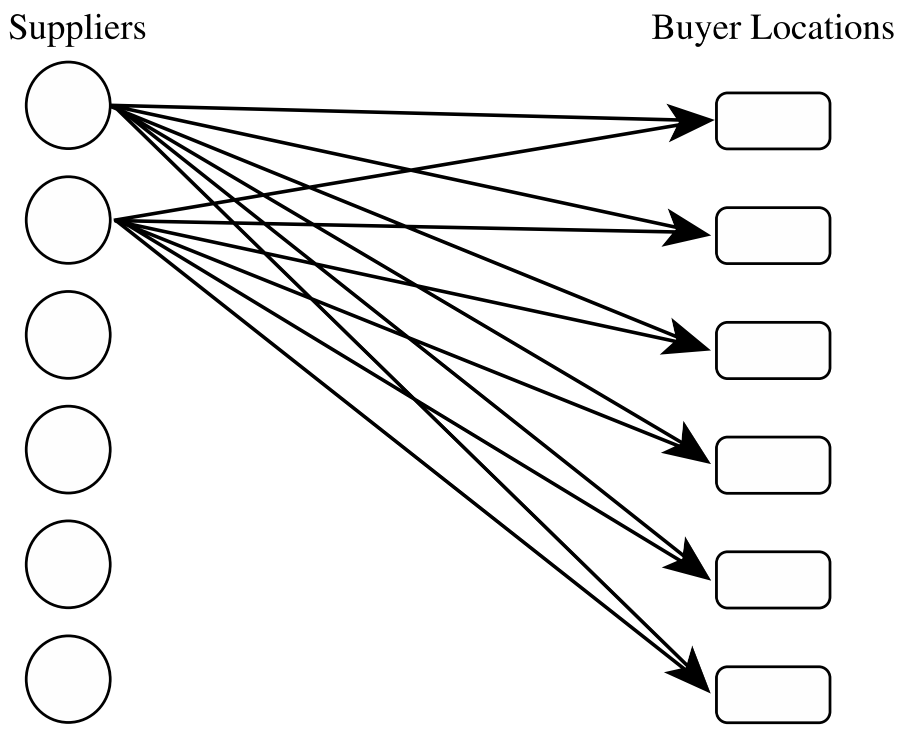


Figure 14-2 Direct Shipment Network

Direct Shipping with Milk Runs

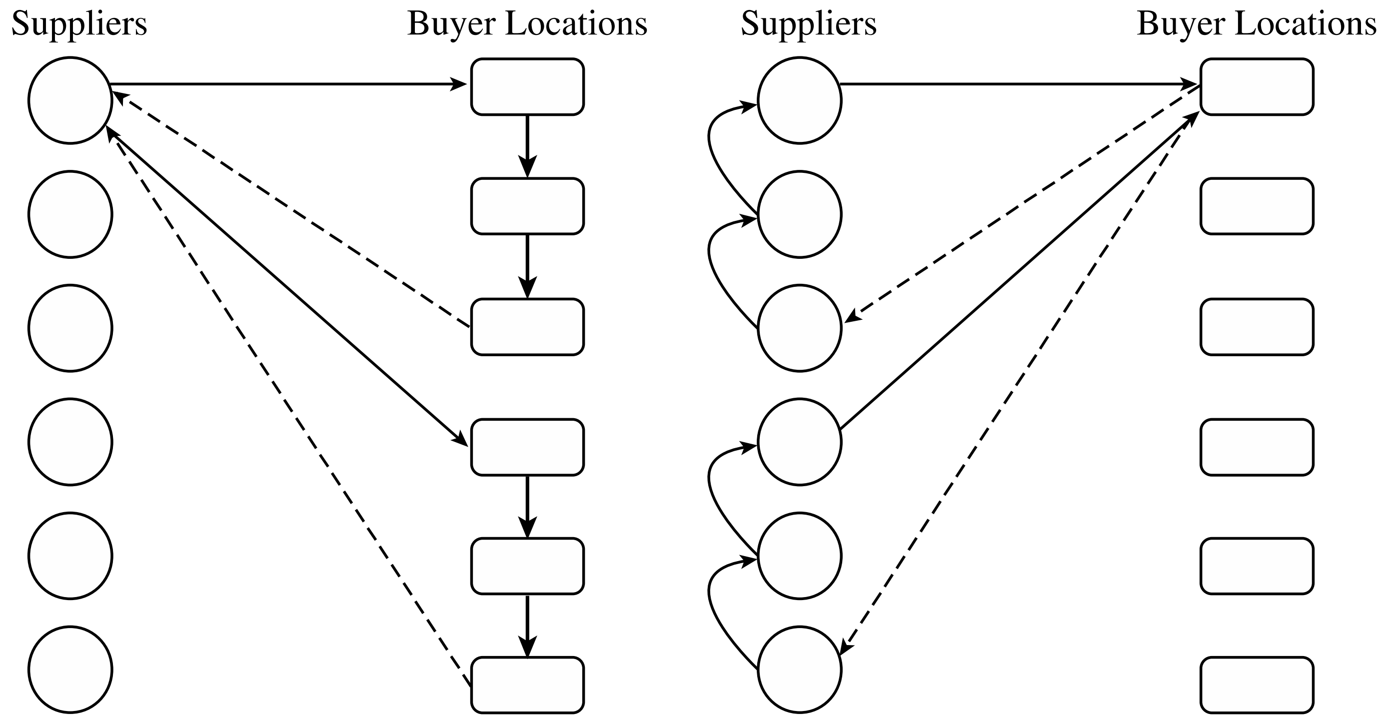


Figure 14-3 Milk Runs from Multiple Suppliers or to Multiple Buyer Locations

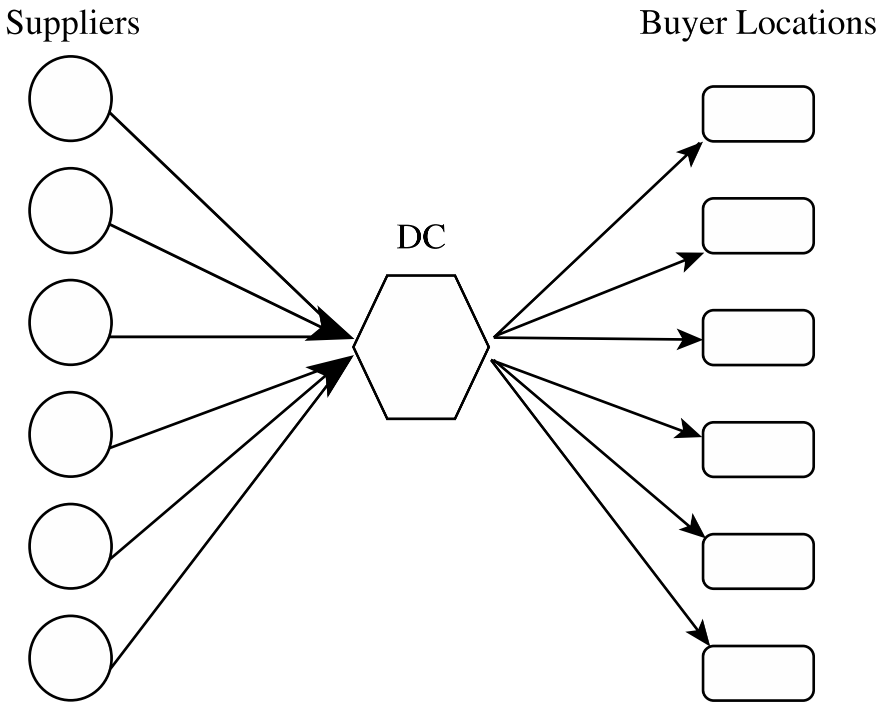


Figure 14-4 All Shipments via D C

All Shipments Via Intermediate Distribution Center with Storage

All Shipments Via Intermediate Transit Point with Storage

- Suppliers send their shipments to a central distribution center
- Stored until needed by buyers
- Shipped to each buyer location

All Shipments Via Intermediate Transit Point with Cross-Docking

- Suppliers send their shipments to an intermediate transit point
- They are cross-docked and sent to buyer locations without storing them

Tailored Network

Table 14-2 Pros and Cons of Different Transportation Networks

Network Structure	Pros	Cons
Direct shipping	No intermediate warehouse Simple to coordinate	High inventories (due to large lot size)
Direct shipping with milk runs	Lower transportation costs for small lots Lower inventories	Increased coordination complexity
All shipments via central DC with inventory storage	Lower inbound transportation cost through consolidation	Increased inventory cost Increased handling at DC
All shipments via central DC with cross-dock	Low inventory requirement Lower transportation cost through consolidation	Increased coordination complexity
Shipping via D C using milk runs	Lower outbound transportation cost for small lots	Further increase in coordination complexity
Tailored network	Transportation choice best matches needs of individual product and store	Highest coordination complexity

Mumbai Dabbawalas

- Lunchbox delivery system
- Factors facilitating success
  1. Low uncertainty of demand
  2. Temporal aggregation of demand
  3. Use of transportation resources when they are underutilized

https://www.triphobo.com/tours/dabbawala-tour-the-art-of-delivering-lunch-box

Trade-Offs in Transportation Design

Table 14-3 Ranking of Transportation Modes in Terms of Supply Chain Performance (Read Vertically, 1 = Lowest, 6 = Highest)

Mode	Cycle Inventory	Safety Inventory	In-Transit Cost	Transportation Cost	Transportation Time
Package	1	1	1	6	1
Air	2	2	2	5	2
LTL	3	3	3	4	4
TL	4	4	4	3	3
Rail	5	5	5	2	5
Water	6	6	6	1	6

Inventory Aggregation

- Can significantly reduce safety inventories
- Transportation costs generally increase
- Use
  - When inventory and facility costs form a large fraction of a supply chain’s total costs
  - For products with a large value-to-weight ratio
  - For products with high demand uncertainty

Trade-Off between Transportation Cost and Customer Responsiveness

- Closely linked to degree of responsiveness
  - High responsiveness, high transportation costs
  - Decreased responsiveness, lower transportation costs
- **Temporal aggregation** – combining orders across time

Tailored Transportation *(1 of 3)*

- The use of different transportation networks and modes based on customer and product characteristics
- Factors affecting tailoring
  - Customer density and distance
  - Customer size
    - Transportation cost based on total route distance
    - Delivery cost based on number of deliveries
  - Product demand and value

Tailored Transportation *(2 of 3)*

Table 14-10 Transportation Options Based on Customer Density and Distance

	Short Distance	**Medium Distance**	**Long Distance**
High density	Private fleet with milk runs	Cross-dock with milk runs	Cross-dock with milk runs
Medium density	Third-party milk runs	LTL carrier	LTL or package carrier
Low density	Third-party milk runs or LTL carrier	LTL or package carrier	Package carrier

Tailored Transportation *(3 of 3)*

Table 14-11 Aggregation Strategies Based on Value/Demand

Product Type	High Value	Low Value
High demand	Disaggregate cycle inventory. Aggregate safety inventory. Inexpensive mode of transportation for replenishing cycle inventory and fast mode when using safety inventory.	Disaggregate all inventories and use inexpensive mode of transportation for replenishment.
Low demand	Aggregate all inventories. If needed, use fast mode of transportation for filling customer orders.	Aggregate only safety inventory. Use inexpensive mode of transportation for replenishing cycle inventory.

Qualitative checklist of alternative transportation modes

	Truck	Rail	Air	Water	Pipeline
Capacity	Moderate	High	Moderate	Very high	High
Variable cost	Moderate	Low	High	Low	Very low
Fixed cost	Low	High	Low	Moderate	High
Lead time	Moderate	Long	Short	Long	Moderate
Lead time reliability	Moderate	Low	High	Moderate	Very high
Availability of service	High	Moderate	Moderate	Moderate	Low
Typical products and shipment distances	Wide variety of products shipped over a wide range of distances	Raw materials, autos, machinery shipped over long distances (e.g., >500 miles)	Small, high-value, perishable, or time-sensitive product shipped over long distances (e.g., >500 miles)	Inland: raw materials shipped over long distances (e.g., >300 miles) Ocean: wide variety shipped over long distances	Liquids and gasses shipped over a range of distances

Source: Transportation Management Elements and Insights (Chapter 10).

PP: How would you ship?

Dropbox PP week 7:
1) What commodity
2) Mode and why (be specific for route)
3) Pros and cons of mode selected

commodity	from	to
TV	Malaysia	Dallas
Zara clothing	Spain	San Diego
couture dress	New York	Mumbai
baby shampoo	midwest	LA
coffee	Columbia	Seattle
iPhone	China	Long Beach
cheese	France	Chicago

Images:
https://www.tomsguide.com/us/sony-x690e-70-inch-tv,review-5333.html
https://www.publicdomainpictures.net/en/view-image.php?image=136500&picture=coffee-beans
https://www.behance.net/gallery/15837939/ZARA-logo-redesign
https://christiansiriano.com/collections/dresses
https://www.mousetrapcheese.co.uk/brie-de-meaux-cheese-strong-smelly-french-brie-110-p.asp
https://digitalbachat.in/tech-news/apple-iphone-13-mini-price-in-india/
https://www.mahalaxmimedicos.com/product-details/johnsons-baby-shampoo


BREAK

2019 Top Ten Global Supply Chain Risks

https://www.resilience360.dhl.com/resilienceinsights/resilience360-annual-risk-report-2018/

Then we had Covid…
2021 Top Global Supply Chain Trends

1. Shorter, more localized supply chains
2. Insolvencies among smaller and more specialized suppliers
3. Continued cyber attacks on production sites and logistics operators
4. Persistent air cargo constraints
5. Increasing use of multimodal solutions

https://www.everstream.ai/wp-content/uploads/2021/04/20210408-Everstream-Analytics-Annual-Risk-Report.pdf

Other Supply Chain Problems

- Some emerging markets lack suitable distribution systems, i.e., roads, rail systems
- Existing ports may be inadequate
- Market instability, political instability

Congestion

- Congestion at capacity bottlenecks represents **40%** of all congestion delay.
- In 1982: **35%** of the major road system was congested
- By 2003: that figure rose to **65%**.
- By 2020: 29% of urban NHS routes congested or exceed capacity for much of the day, **42%** during peak periods.

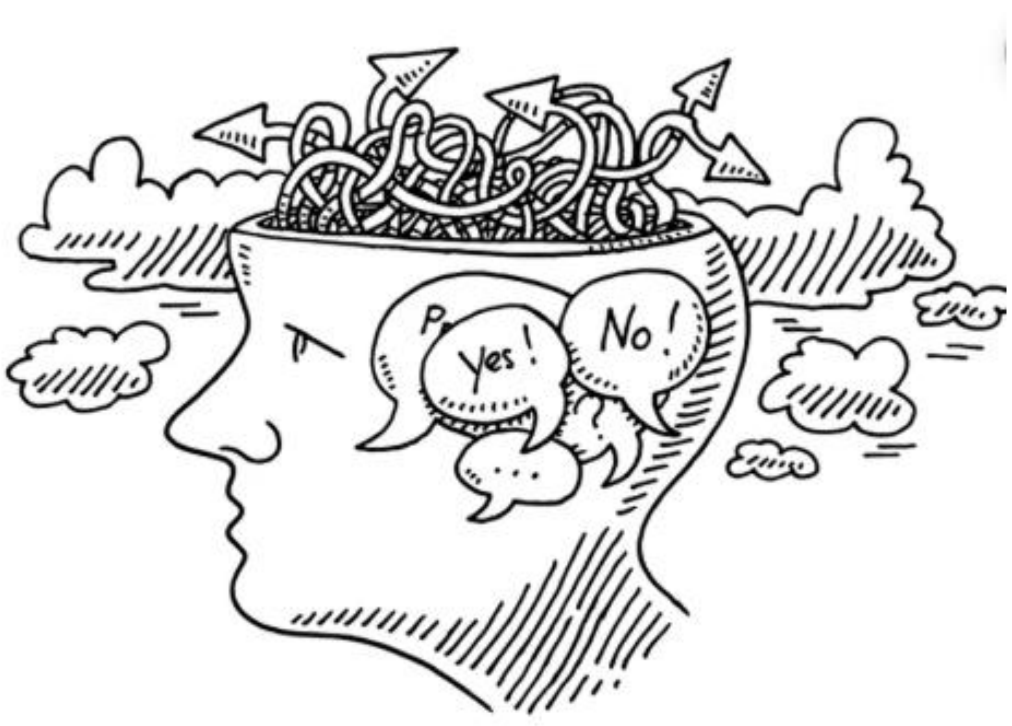
Source: Delcan.

Supply Chain Imperatives

- Time is money: reduce transit and dwell time, cargo processing, virtual warehouses, trucking advantage
- Scale economies: Bigger ships and hub systems, warehouse/distribution centers, rail long-haul high-volume advantage
  - Drewry: 40% of ships arrive 1 or more days late for berthing windows
- Benchmarking and Standardization
- Wal-Mart (still) sets the standard
- Customer service still important
- Agile SC to respond to changes

https://www.marineinsight.com/know-more/10-worlds-biggest-container-ships-2017/

Strongest forces driving decisions in logistics



- Costs
- Service
- Cost and Service
- Declining/Changing Demand
- Process Simplification
- Technology
- Sustainability
- Flexibility

Transportation Choice Decision Factors: New Trends and Influences

- Re-mix: Move from category to velocity-based distribution
- DSD: Direct store deliveries (DVDs, some apparel, etc.)
- Requires more ship, more capital and more fuel to run all water service: 5 ships to WCNA vs. 8 via Panama Canal
- 1 day of work stoppage in LA/LB = I week of delay
- Shipping companies to take more control of land-side services (partnerships with RRs as an example)
- Relationship between feeder service and transshipment ports, need bigger feeder ships as well

Trends on shipping cost

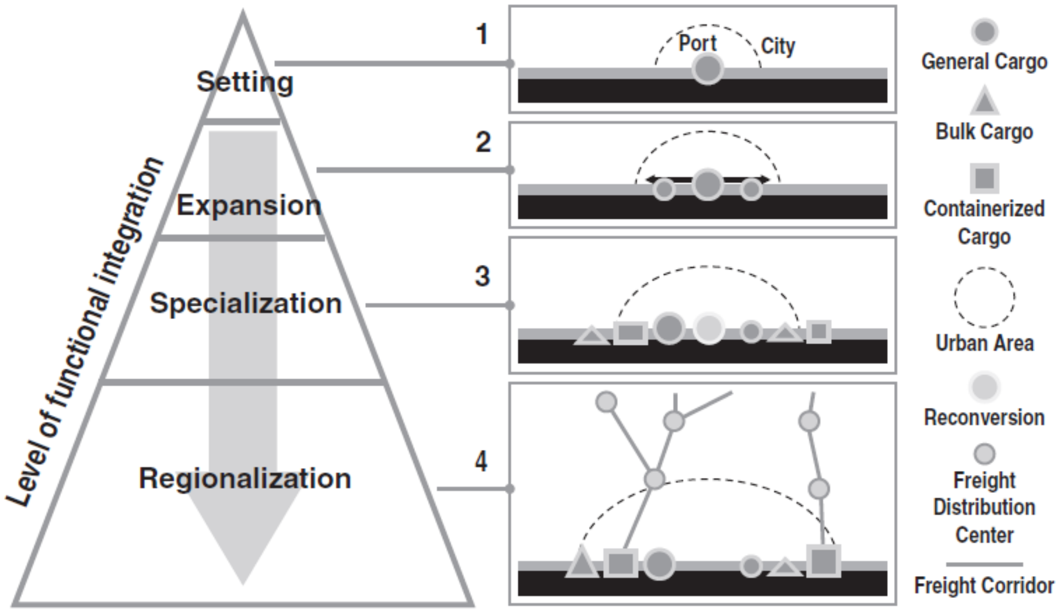
Inflation and Shipping Costs (Air and Sea)

NOTE: The figure uses a monthly average Freight Chain Index, an Import Price Index, and an Inbound Air Freight Price Index.

SOURCE: Freightos and FRED®, Federal Reserve Bank of St. Louis.

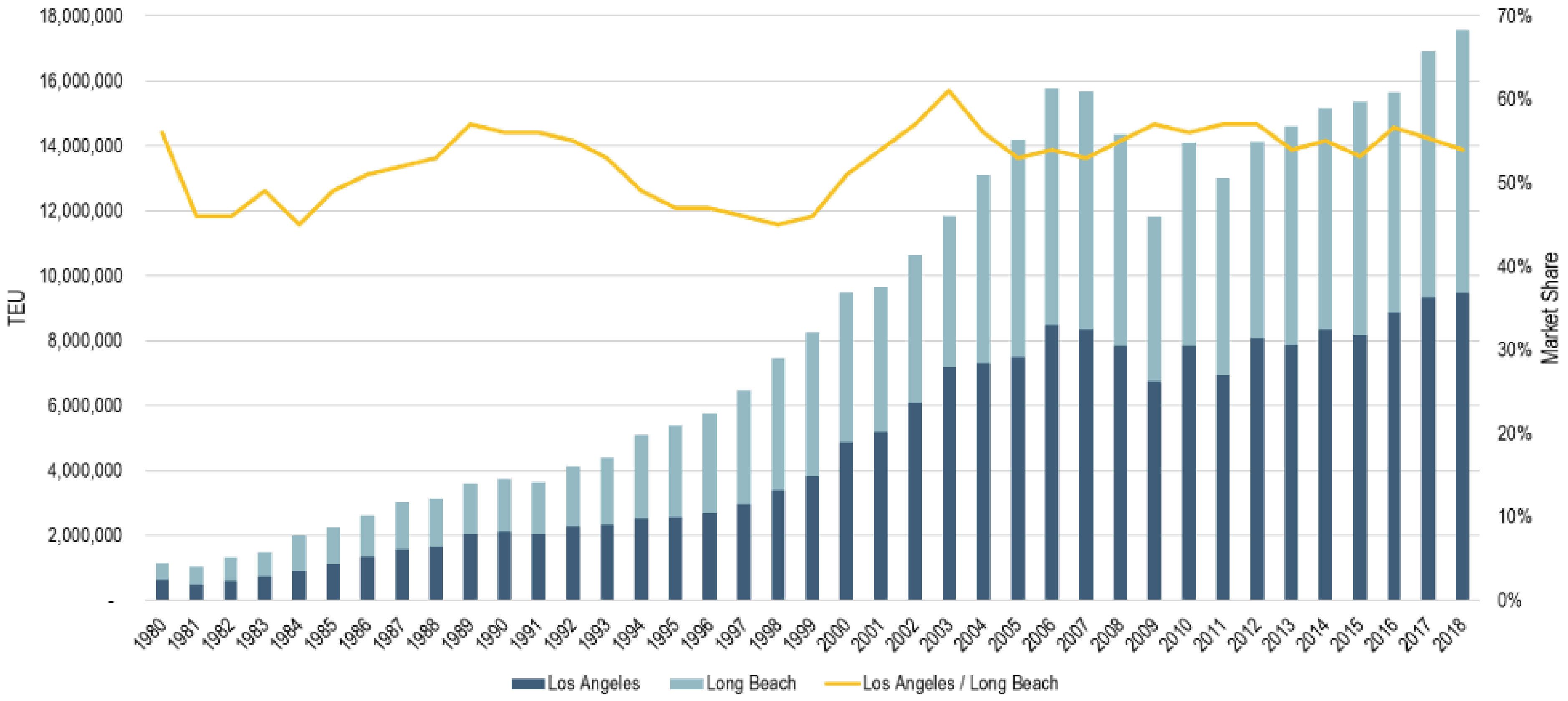
Ports have become regionalized hubs

- Ports have a new functional role in value chains
- “Regionalization” of port network
  - Seaports and their inland terminals highly integrated
  - New patterns of freight distribution
  - Port hierarchy
- Changes in spatial configurations
  - Seaport function goes beyond the port beyond traditional perimeter
  - Inland distribution key success (exports/imports)



Theo E. Notteboom & Jean-Paul Rodrigue (2005) Port regionalization: towards a new phase in port development, Maritime Policy & Management, 32:3, 297-313, DOI: 10.1080/03088830500139885

Post Recession Volumes: Ports



- They're back!
- LA/LB ports combined account for ~~32%~~ 40% of total container traffic in US

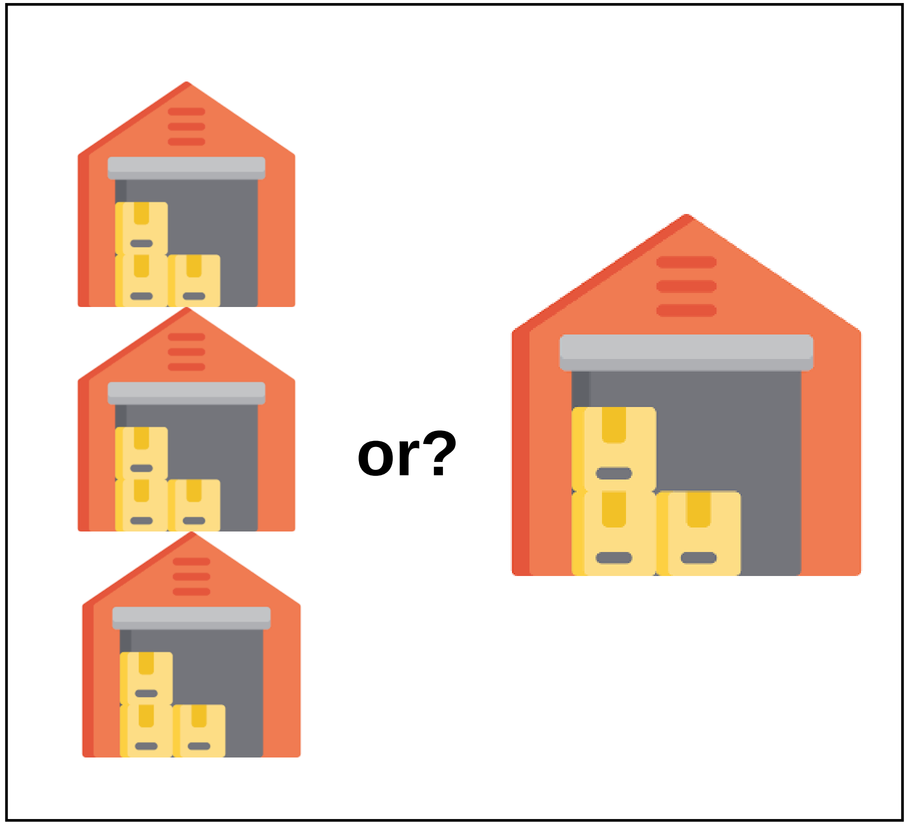
https://transportgeography.org/?page_id=8958

Trends: Warehousing

- Warehousing moving closer to inland ports/Intermodal Terminals
  - Drayage costs, Railroad Service
- Increasing **flexibility** in supply chains
  - Diversified Port Strategies – increase activity for East Coast ports
  - Continually changing sources of supply
- Distribution Network Adjustments
  - New network rationalization
  - Deconsolidation centers as additions to network
- Development of **big box DCs**
  - DCs of 400,00 square feet or more account for 36.8% of all new warehouse construction in US since 2000.
- Growth of **direct-to-consumer sales** has forced major retailers to consolidate online and store-based fulfillment operations under one roof
- Increased use of **tech** like layer picking for simultaneous building of cases for different customers

What are the most recent changes in the logistics network?

- Downsizing the Network
- Direct Shipping
- Increased Use of 3PLs
- New DC
- Nearshoring



What is the most recent change in support systems?

ERP (forecasting, procurement)

WMS (location, picking, shipping)

TMS (dispatching, yard, tracking)

→ VISIBILITY

Trends in SCM Information Systems

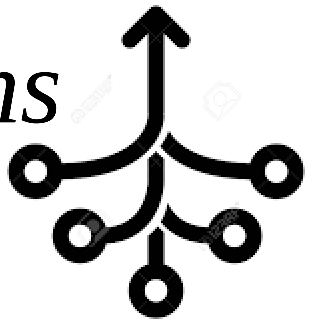
Example: Warehouse Management System

Five Levers for Effective Supply Chains

Mode mix: Identifying the correct combination of transportation modes (road, rail, ocean, and air) for freight movements can increase the overall cost effectiveness of shipping activities.

Source: CSCMP's Supply Chain Quarterly 2/2011

Five Levers for Effective Supply Chains

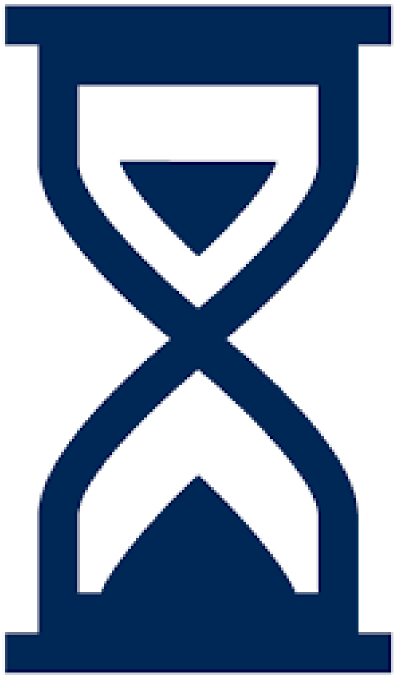


<u>Consolidation</u>: The second tool to consider, consolidation, has gained considerable interest as more companies utilize regional supply chains in order to increase flexibility. This can mean establishing operations in suitable locations to reduce the average distance needed to service regional operations, and at the same time consolidating and centralizing some processes (such as manufacturing and distribution) in favorable countries.

Source: CSCMP's Supply Chain Quarterly 2/2011

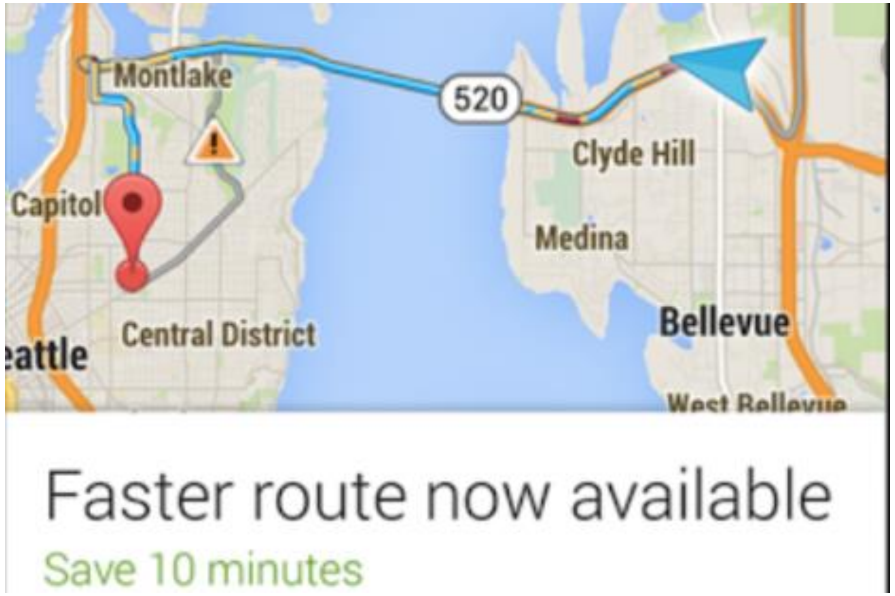
Five Levers for Effective Supply Chains

Postponement: Increased use of postponement strategies can reduce volatility in inventory and shipment volume by delaying certain processes and completing them at later points in the supply chain.



Source: CSCMP's Supply Chain Quarterly 2/2011

Five Levers for Effective Supply Chains



Rerouting: Changing the route of a particular supply chain leg can reduce transportation and inventory costs while increasing speed to market. The benefits of this relatively simple change can be substantial.

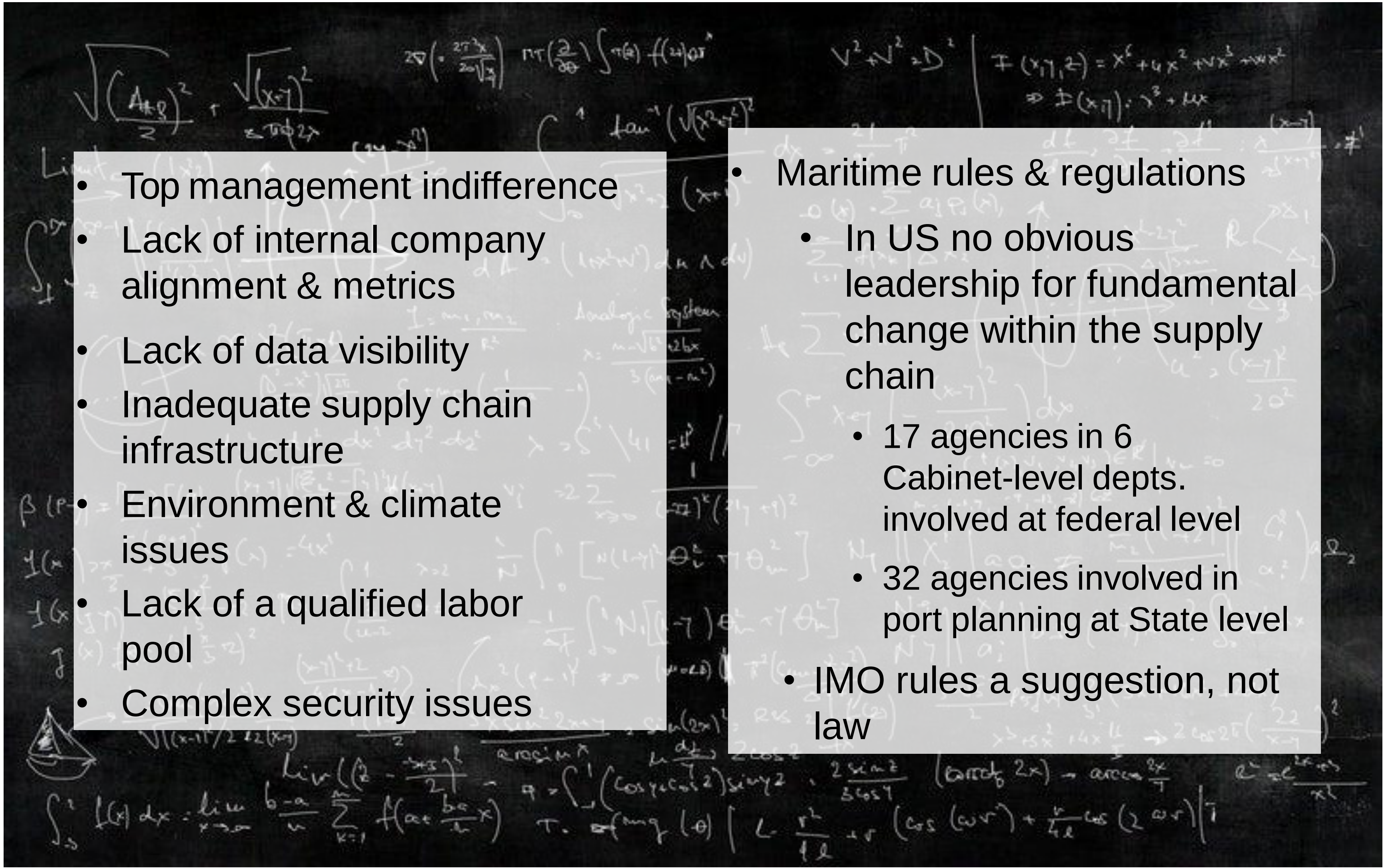
Source: CSCMP's Supply Chain Quarterly 2/2011

Five Levers for Effective Supply Chains

<u>Rightshoring</u>: Involves taking total landed cost into consideration in order to determine the optimal location of distribution centers and plants for serving a particular market. Not only can rightshoring help companies reduce costs in certain cases, but it can also reduce supply chain complexity.

Source: CSCMP's Supply Chain Quarterly 2/2011

Challenges to change



- Top management indifference
- Lack of internal company alignment & metrics
- Lack of data visibility
- Inadequate supply chain infrastructure
- Environment & climate issues
- Lack of a qualified labor pool
- Complex security issues

- Maritime rules & regulations
  - In US no obvious leadership for fundamental change within the supply chain
    - 17 agencies in 6 Cabinet-level depts. involved at federal level
    - 32 agencies involved in port planning at State level
  - IMO rules a suggestion, not law

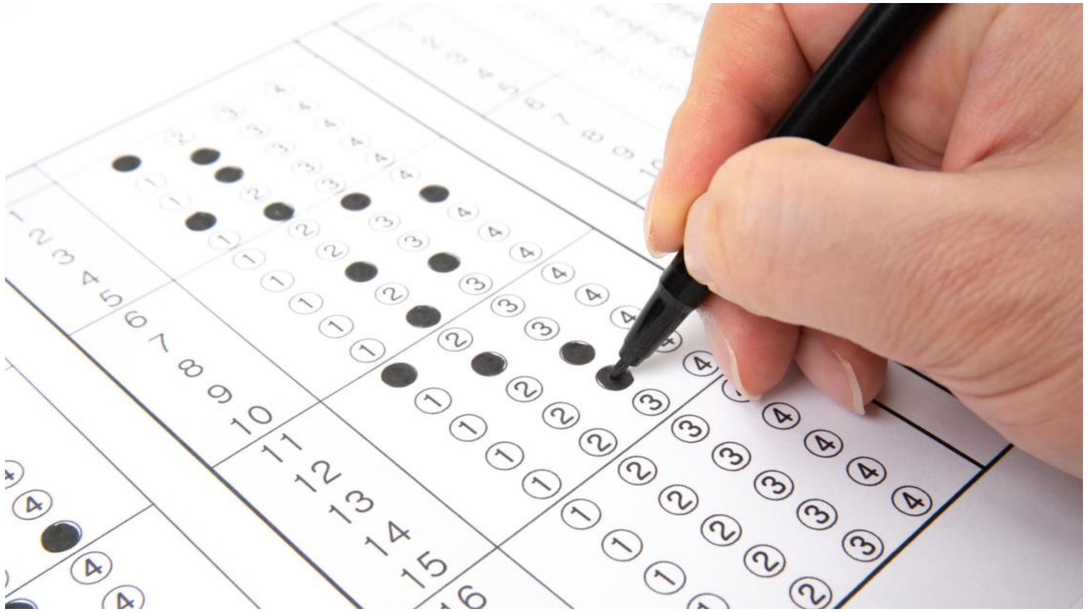
Assignment

- Case 4 prerecorded presentation due before next class
  - Remember that presentation should be BRIEF (5-6 minutes)
  - Everyone participates some way, shape, or form
  - Q&A will follow

Office hours! Last one 5/9, Tuesday from 1-2pm (or by appointment!)

Final Exam

- Starts at 8pm after presentations & quick break
- 1.5 hours + 15 minutes to post
- 100 points
- Review: slides, summary of learning objectives, homework and quiz answers



Exam is worth 100 points, 3 sections		
Section 1: T/F, multiple choice	10 Q at 2 pts/piece	similar to quizzes, based on concepts, but some might need a calculator
Section 2: Essay	1 question at 20 pts	the big picture, integration of several concepts (based on lecture/videos)
Section 3: Problems using Excel templates	3 questions at 20 pts/piece	LP
		FC + accuracy
		Agg planning or inventory management (pick 1 from 3 questions)

Final Exam

Topic	Module/chapter	Types of questions
SC overview, drivers, & metrics	Module 1/ Chapter 1, 3	concepts
Forecasting, agg planning	Module 2/ Chapter 7, 8	- concepts - develop FCs using various methods (naïve, weighted avg, moving avg, expo smoothing, linear), when to use method, FC error/accuracy (MAD, MSE, MAPE) - level and chase plan comparison - linear programming (Solver) to solve mix and constraint problems (set up, solve, report); ID objective function, constraints, feasible solution, slack, surplus
Sourcing, sustainability	Module 3/ Chapter 15, 17	concepts
Inventory management, replenishment planning under certainty and uncertainty	Module 4/ Chapter 11, 12	- concepts - SS, EOQ (TC), EPQ, quantity discounts, ROP (usage/LT constant, varying usage, varying LT)
SCOR	Module 5	concepts
Network design	Module 6/ Chapter 4, 5, 6	concepts
Transportation, supply chain trends	Module 7/ Chapter 14	concepts, especially the Five Levers for driving supply chain efficiency

Final Exam Review