Supply Chain Management: An overview

EE 381/382

What forces are driving the rate of change

- Globalization
- Technology
- Organizational consolidation
- Empowered consumer
- Government policy and regulation

Globalization

- Led to a more competitively intense economic and geopolitical environment
- Companies seeking to rationalize their global networks ask such questions as the following:
  - Where in the world should we source our materials and/or services?
  - Where in the world should we manufacture or produce our products and/or services?
  - Where in the world should we market and sell our products and/or services?
  - Where in the world should we store and/or distribute our products?
  - What global transportation alternatives should we consider?

- Important issues or challenges for supply chains or the global economy
  - More volatility of supply and demand
  - Shorter product life cycles
  - The blurring of traditional organizational boundaries

Technology

- A major impact on supply chains as a facilitator of change as companies have transformed their processes
- Individuals and organizations are “connected” 24/7 and have access to information on the same basis via the internet
- Technology has allowed individuals and smaller organizations to connect to the world’s “knowledge pools” to create an unbelievable set of opportunities for collaboration in supply chains

Organizational consolidation

- The importance of the consolidation and power shift is that the large retailers are accorded special consolidation from consumer product companies
  - Customized distribution services – schedule deliveries, rainbow pallets, advance shipment notices, etc.
  - Allow retailers to operate more efficiently and often more effectively
- Value-added services- vendor-managed inventory (VMI)
- Gain mutual cost savings and improved customer service

The Empowered consumer

- Consumers are more enlightened, educated and empowered than before by the information that they have at their disposal from the internet and other sources
- Opportunity to compare prices, quality, and service
- They demand competitive prices, high quality, tailored/customized products, convenience, flexibility, and responsiveness
- These demand place increased challenges and pressure on the various supply chains for consumer products

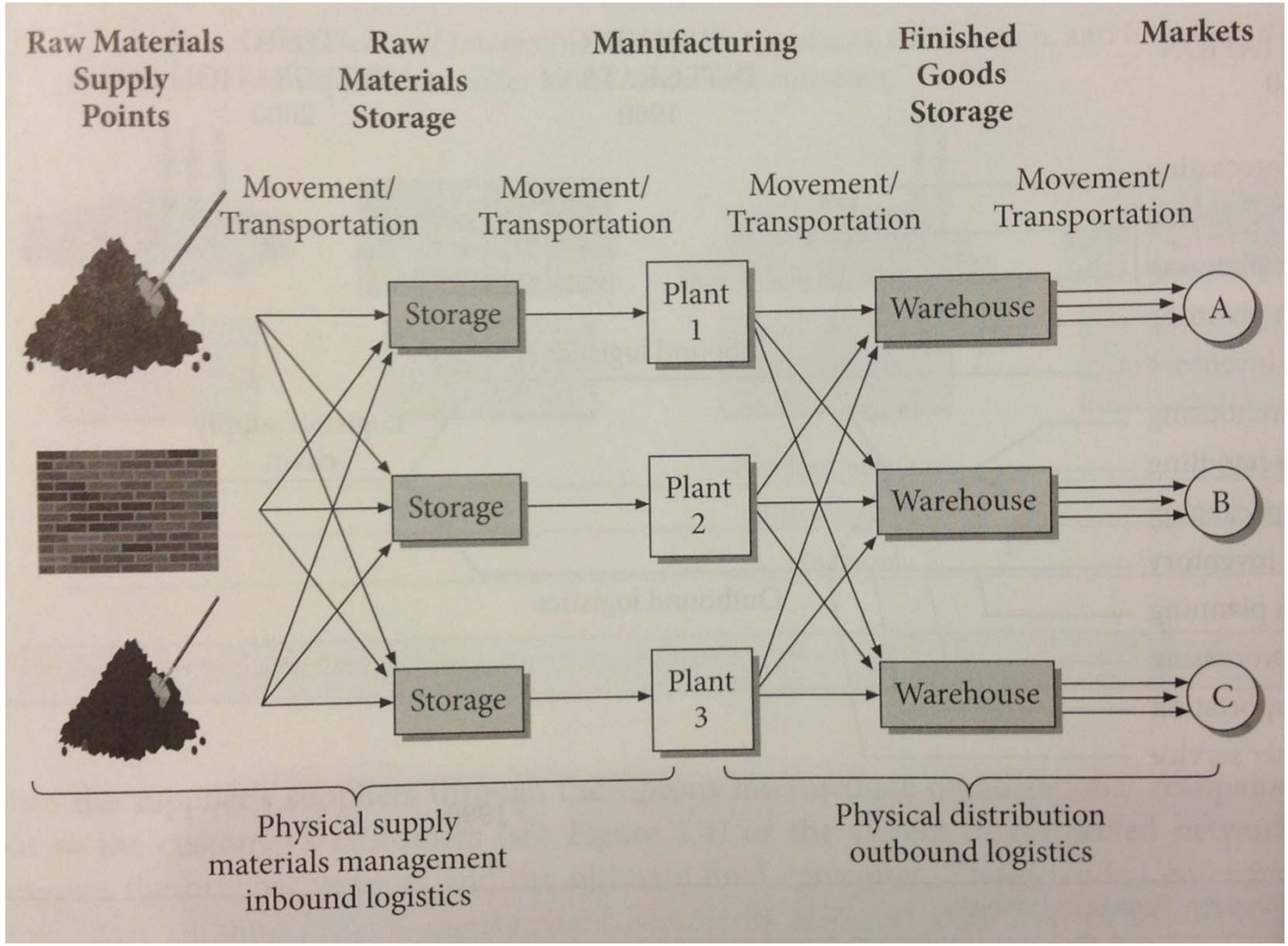
Government policy and regulation

- Policies, regulations, taxes – impact individual businesses and their supply chains
- Deregulated sectors include transportation, communications, and financial institutions
  - Example- U.S. transportation was deregulated at the federal level in terms of economic controls such as rates and areas of service
  - Net effect- possible for transportation services to be purchased and sold in a much more competitive environment- lower prices to users and better services

The supply chain concept

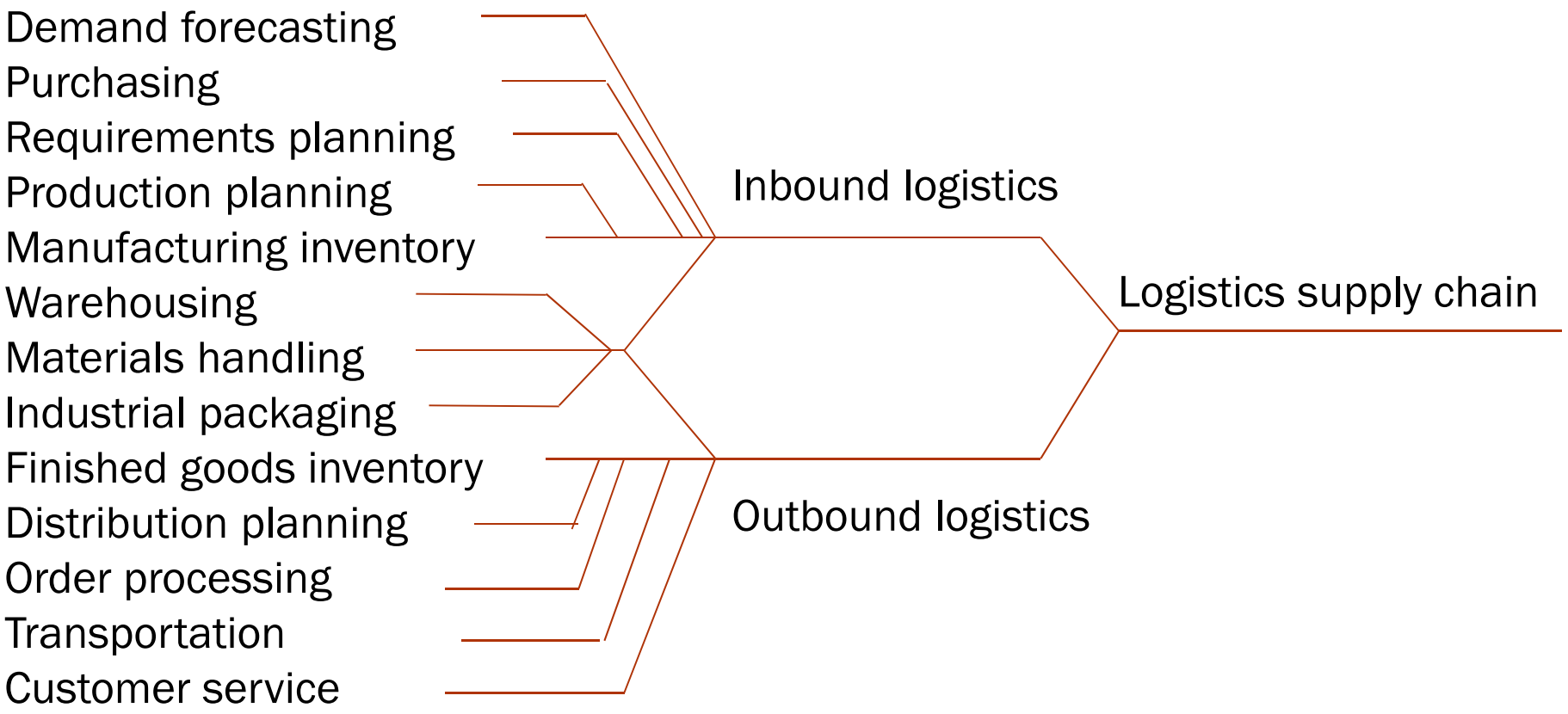
- The development of the physical distribution concept that focused on the outbound side of a firm's logistic system
- The focus of physical distribution was on total systems cost and analyzing tradeoff scenarios to arrive at the best or lowest system cost
- The system relationships among transportation, inventory requirements, warehousing, exterior packing, materials handlings, and some other activities or cost centers

A view of business logistics in a company

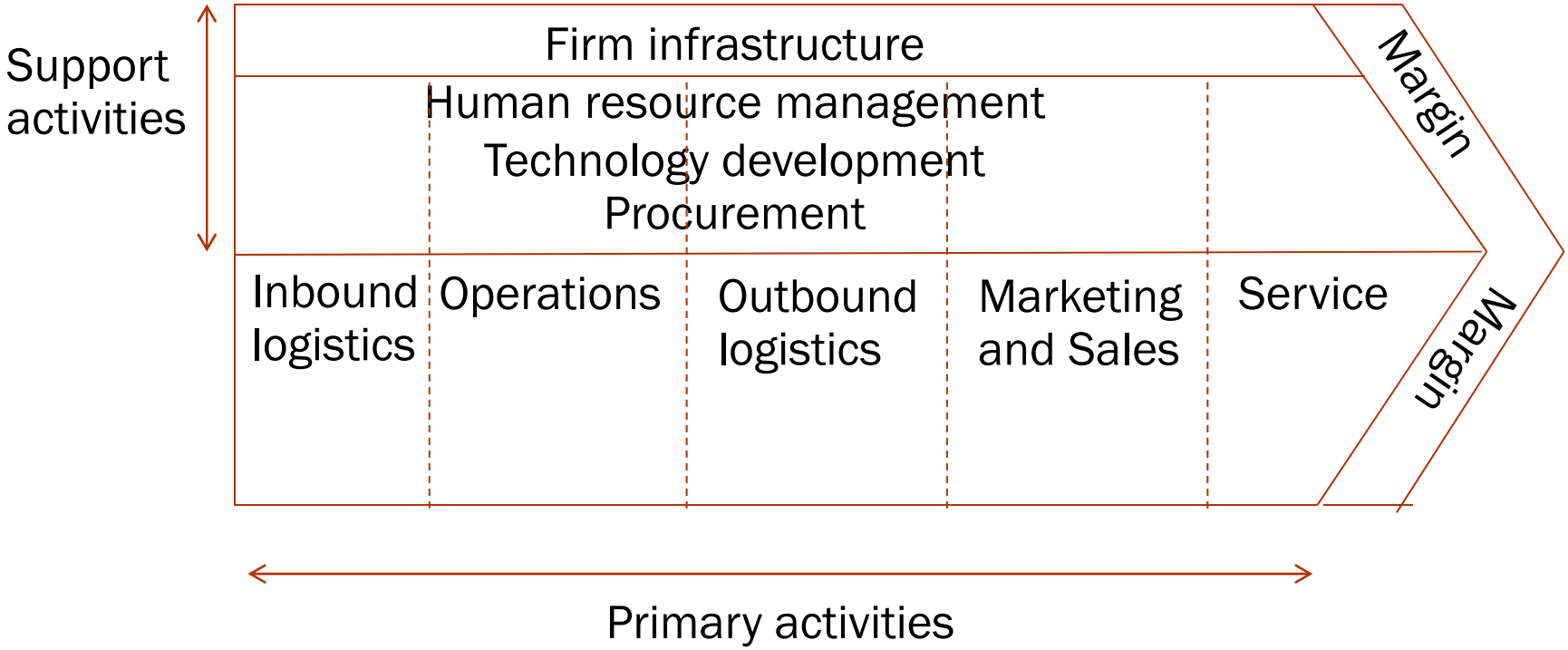


Integrated Logistics Management

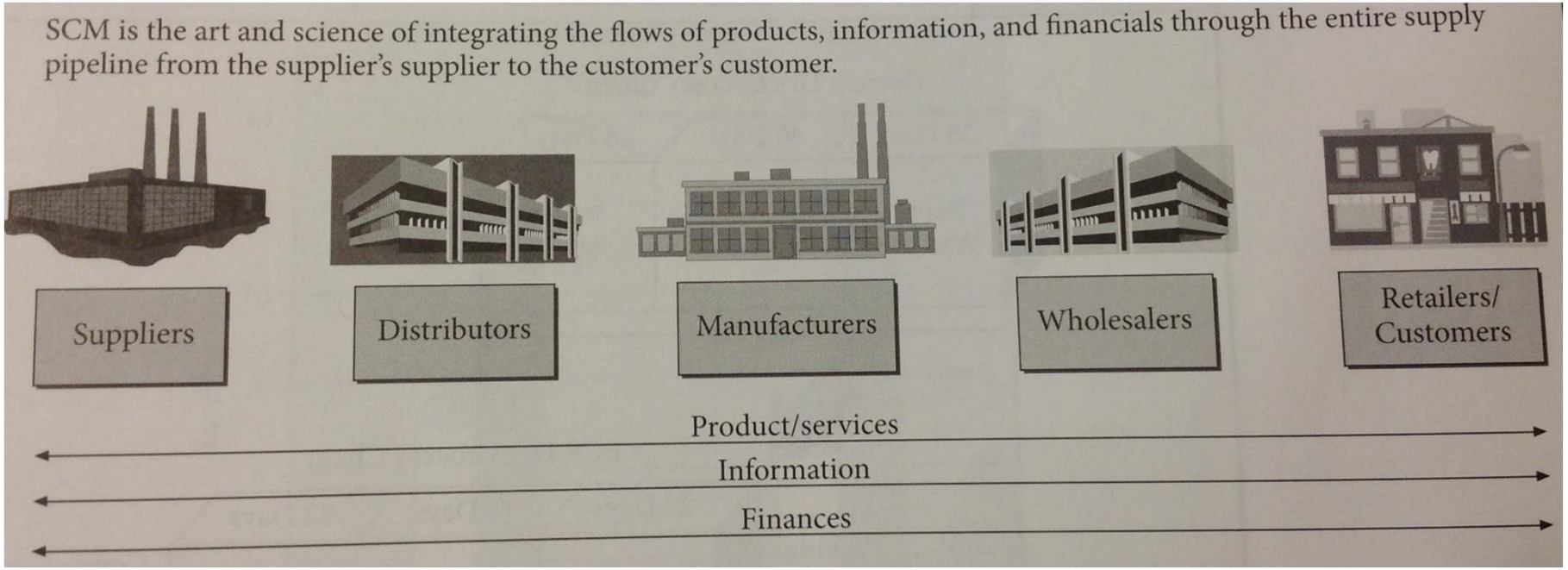
Fragmentation 1960 Evolving Integration 1980 Total Integration 2000



Generic Value Chain



Integrated supply chain



Integrated supply chain

Products and related services

- Customers expect their orders to be delivered in a timely, reliable, and damage-free manner and transportation is critical to this outcome
- Product flow is a two-way flow in today's environment because of the growing importance of reverse logistic systems for returning products that are unacceptable to the buyer
- The location, size, and layout of facilities are frequently different; and the transportation carriers need to be utilized differently

Information flow

- Flowing in the opposite direction of products- the market back to the wholesalers, manufacturers and vendors
- The information was primarily demand or sales data- were the trigger for replenishment and the basis for forecasting
- Real time basis- leads to less uncertainty and therefore less safety stock
  - Inventory can be eliminated from the supply chain by timely, accurate information about demand

Financials flow

- Cash
- A major impact of supply chain compression and faster order cycle times has been faster cash flow
- Customers receive order faster, they are billed sooner, and companies can collect sooner

Roles of logistics in supply chains

Supply Chain Management

- The art and science of integrating the flows of products, information, and financials through the entire supply pipeline from the supplier's supplier to the customer's customer

- The supply chain can be viewed as a series of integrated enterprises that must share information and coordinate physical execution to ensure a smooth, integrated flow of goods, services, information, and cash through the pipeline

What is Logistics?

- Logistics is the process of anticipating customer needs and wants; acquiring the capital, materials, people, technologies, and information necessary to meet those needs and wants; optimizing the goods or service-producing network to fulfill customer requests; and utilizing the network to fulfill customer requests in a timely manner

Value-Added Roles of Logistics

Five principal types of economic utility add value to a product or service (Form, Time, Place, Quantity, and Possession)

Production

- Form utility
  - The value added to goods through a manufacturing or assembly process

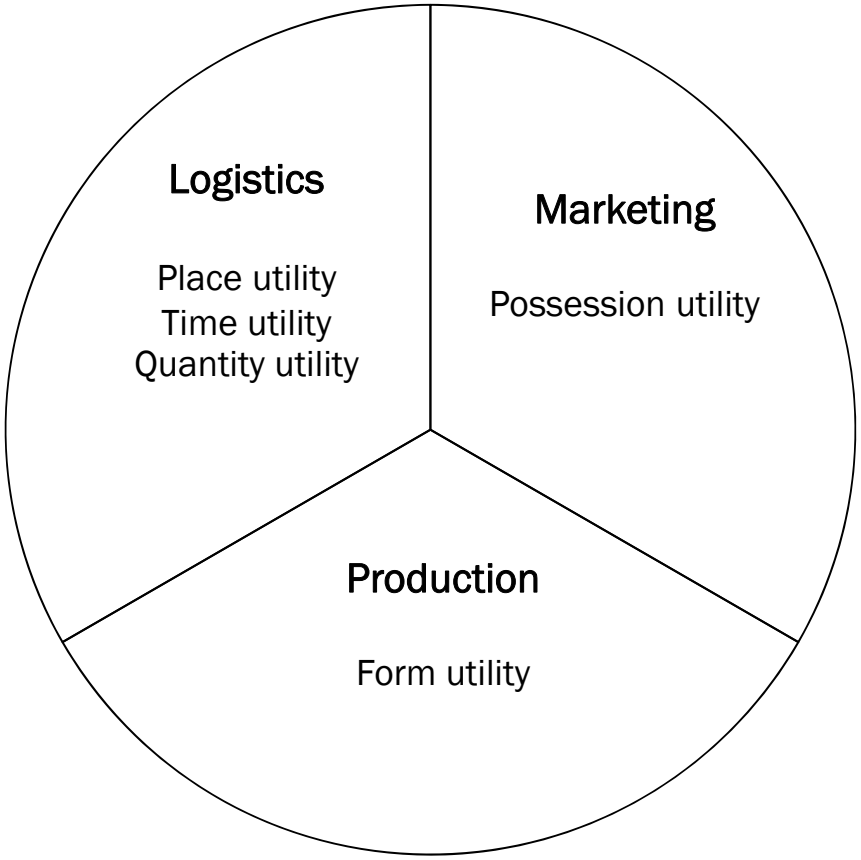
Logistics

- Place utility
  - Logistics provides place utility by moving goods from production surplus points to points where demand exists
- Time utility
  - The economic value added to a good or service by having it at a demand point at a specific time
  - Logistics creates time utility through proper inventory maintenance, the strategic location of goods and services, and transportation
- Quantity utility
  - Production forecasting, production scheduling, and inventory control

Marketing

- Possession utility
  - Promotion of products and services
  - The effort through direct and indirect contact with the customer, to increase the desire to process a good or to benefit from a service

Fundamental utility creation in the economy



Logistics Activities

- Transportation
- Warehousing and storage
- Industrial packaging
- Materials handling
- Inventory control
- Order fulfillment
- Demand forecasting
- Production planning/scheduling
- Procurement
- Customer service
- Facility location
- Return goods handling
- Parts and service support
- Salvage and scrap disposal

Transportation

- Largest variable logistics cost
- Physical movement or flow of goods and on the network that moves the product
- The logistic manager is responsible for selecting the mode or modes and carriers used in moving raw materials, components, and finished goods or for developing private transportation

Storage

- A tradeoff relationship with transportation
- Inventory management
- Warehousing
- Example
  - If organizations use a relatively slow mode of transportation, they usually have to hold higher inventory levels and thus have more warehousing space for inventory
  - An organization might consider using a faster mode of transportation to eliminate some of these warehouses and the inventory stored in them

Packaging

- Industrial packaging protects the product during transportation and storage

- Rail or Ocean transportation typically requires additional packing expenditures because of the greater possibility of damage in transit

Material handling

- Mechanical equipment used for short-distance movement and includes equipment such as forklift trucks, overhead cranes, automated storage, and retrieval systems
- Important in warehouse design and efficient warehouse operations
- Logistics manager are concerned with the movement of goods into a warehouse, the placement of goods in a warehouse, and the movement of goods from storage to order-picking areas and to dock areas for transportation out of the warehouse

Inventory control

- Assuring adequate inventory levels
  - Requires logistics to monitor current inventory levels and either place replenishment orders or schedule production to bring inventory levels up to a predetermined level
  - Example – a distribution center fills customer orders for shipment, current inventory levels are depleted
- Certifying inventory accuracy
  - Assure that the actual physical inventory levels match that shown in the information system, cycle counts are taken of selected items every period throughout the year

Order fulfillment

- Filling and shipping customer orders

- An important physical distribution factor is the time that elapses from when a customer places an order until the customer receives a satisfactory fulfillment of the order – **lead time**

- Example
  - Assume that the present order fulfillment process takes a total lead time of 8 days for order transmittal, order processing, order preparation, and order shipment
  - Order processing -4 days, Order preparation 2 days, Order shipment 2 days
  - The short delivery time require a premium mode of transportation

Forecasting

- Accurate forecasting of inventory requirements and materials and components is essential to inventory control, manufacturing efficiency, and customer satisfaction

Production Planning

- Once a forecast is developed and the current inventory on hand and usage rate are determined, production managers can calculate the number of units to manufacture to ensure adequate market coverage

Procurement

- Transport costs relate directly to the geographic location of raw materials and component parts purchased for an organization's manufacturing needs

- Transportation and inventory costs- the quantities purchased would also affect total logistics costs

- E.g. buying component parts from China for a manufacturing facility located in the United States might have a lead time of several weeks – this would have a direct impact on the inventory levels that would need to be held at the manufacturing facility to prevent a plant shutdown

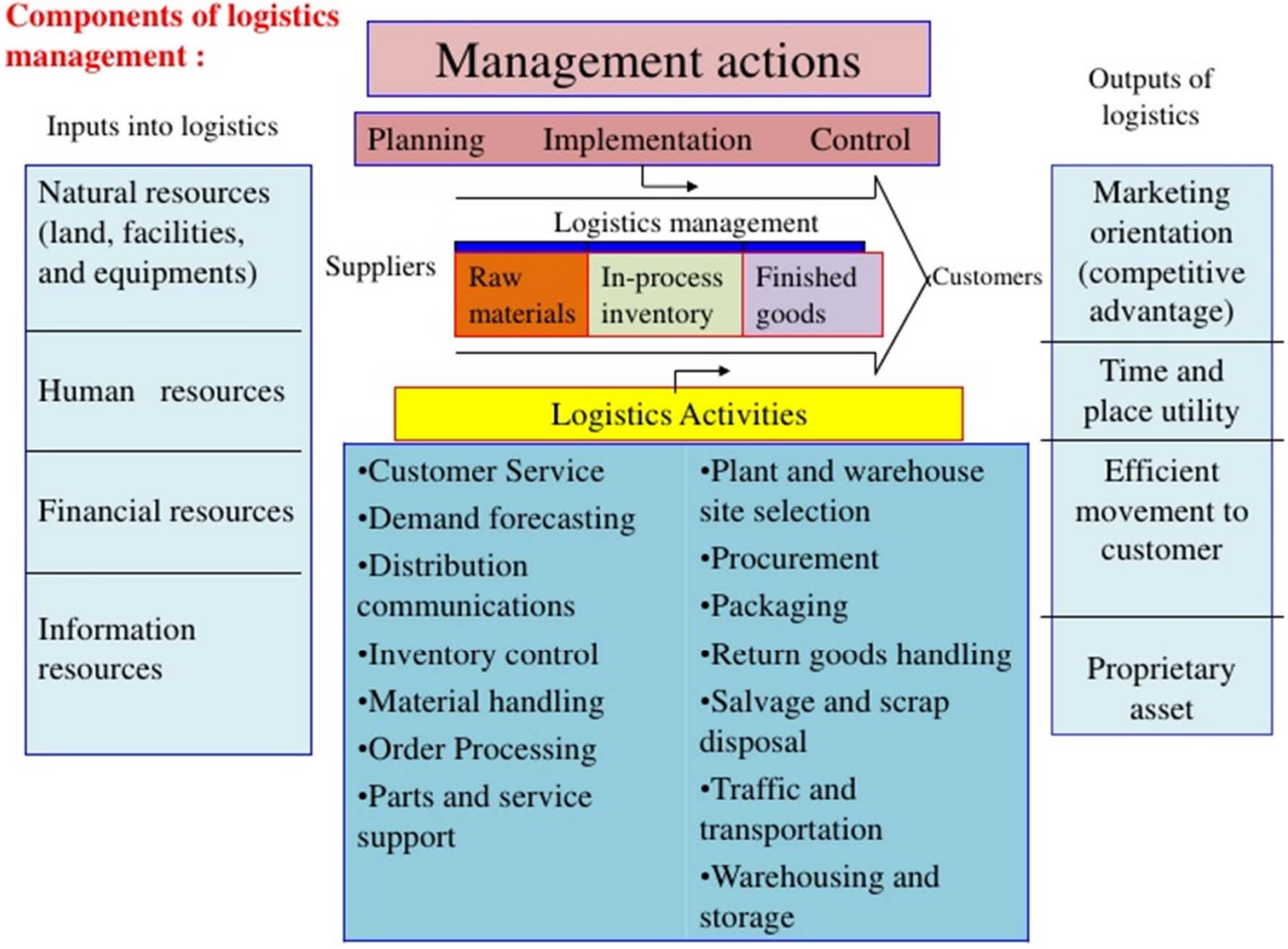
Customer service

- The process of interacting directly with the customer to influence or take the order
  - Logistics is concerned with being able to promise the customer, at the time the order is placed, when the order will be delivered
- The levels of service an organization offers to its customer
  - Order fill rates and on-time delivery rates
  - Decisions about inventories, transportation, and warehousing relate to customer service levels

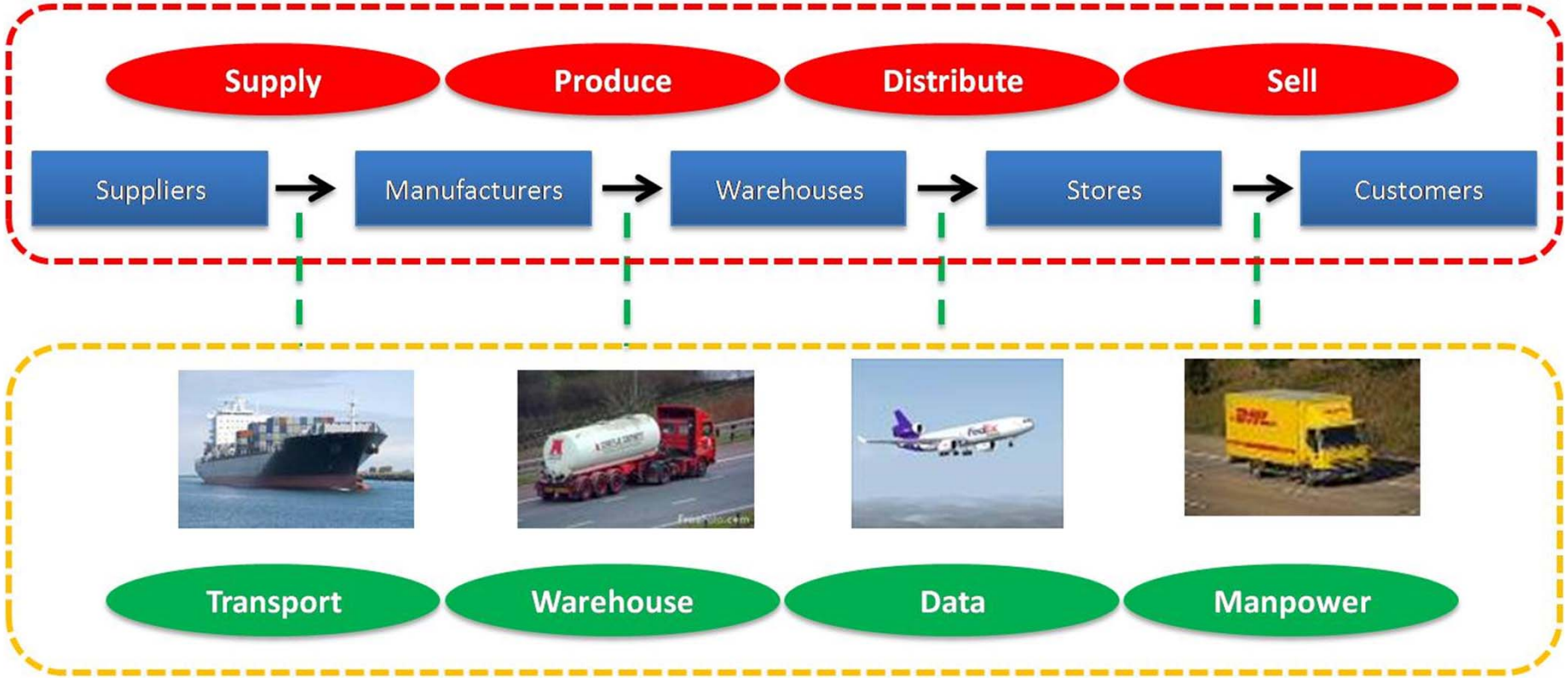
Facility location

- Plant and warehouse site location

Components of logistics management :



Example of Supply Chain Management vs Logistics Management



Logistics in the Economy: A macro perspective

- Absolute cost of logistics on a macro basis will increase with growth in the economy
- If more goods and services are produced, logistics costs will increase
- To determine the efficiency of the logistic system, total logistics costs need to be measured in relationship to GDP

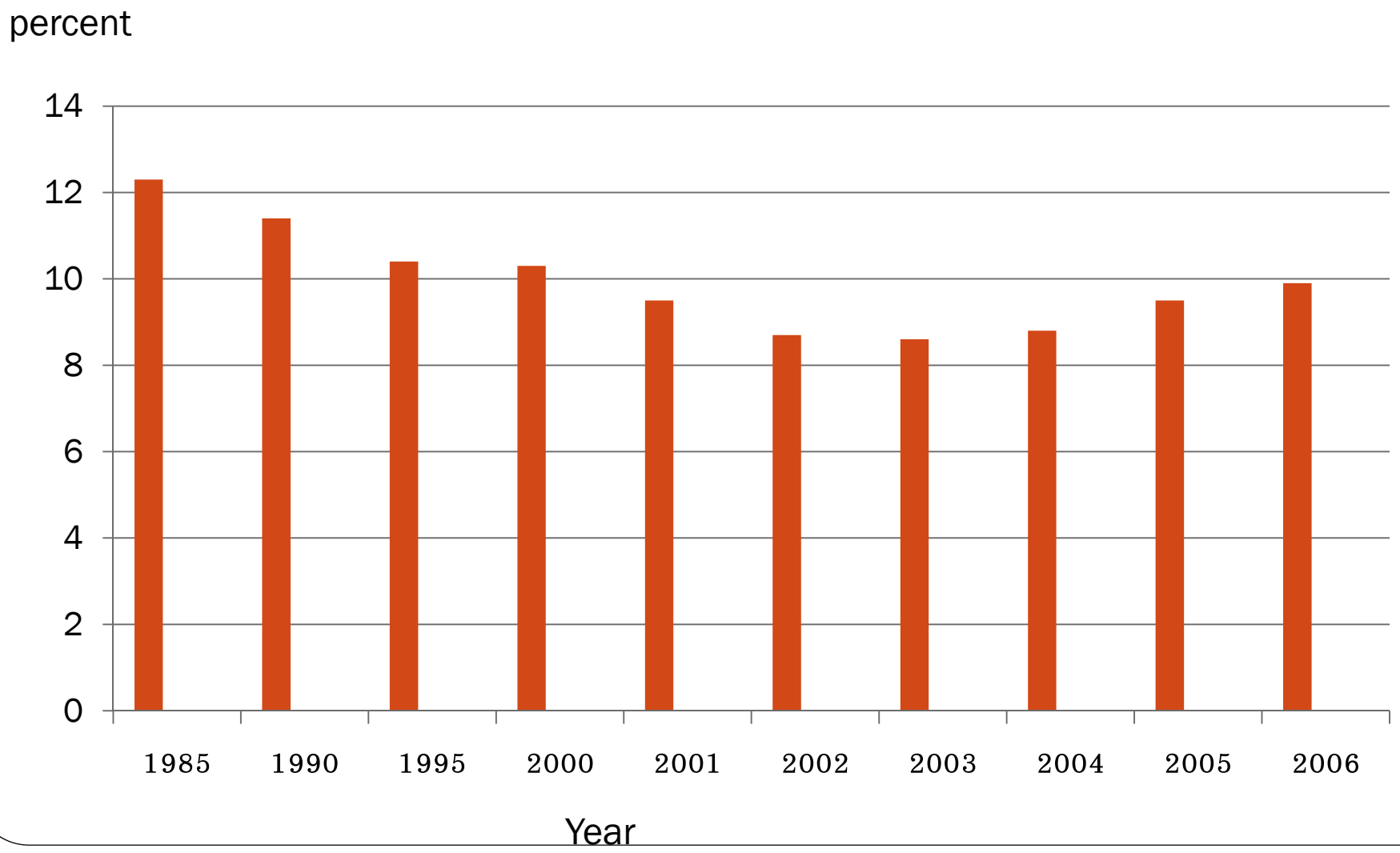
Logistics costs as a percentage of GDP

- The reduction in logistics cost as a percent of GDP has resulted from a significant improvement in the overall logistics systems of the organizations operating in the economy

- The reduction in relative cost allows organizations to be more competitive since it directly impacts the cost of producing goods

- The declining trend for logistics cost relative to GDP was
  - closely related to the deregulation of transportation, which permitted much more flexibility for carriers to adjust their freight rates and service in response to competition
  - Improved management of inventory levels – better technology available to managers to make more effective inventory decisions

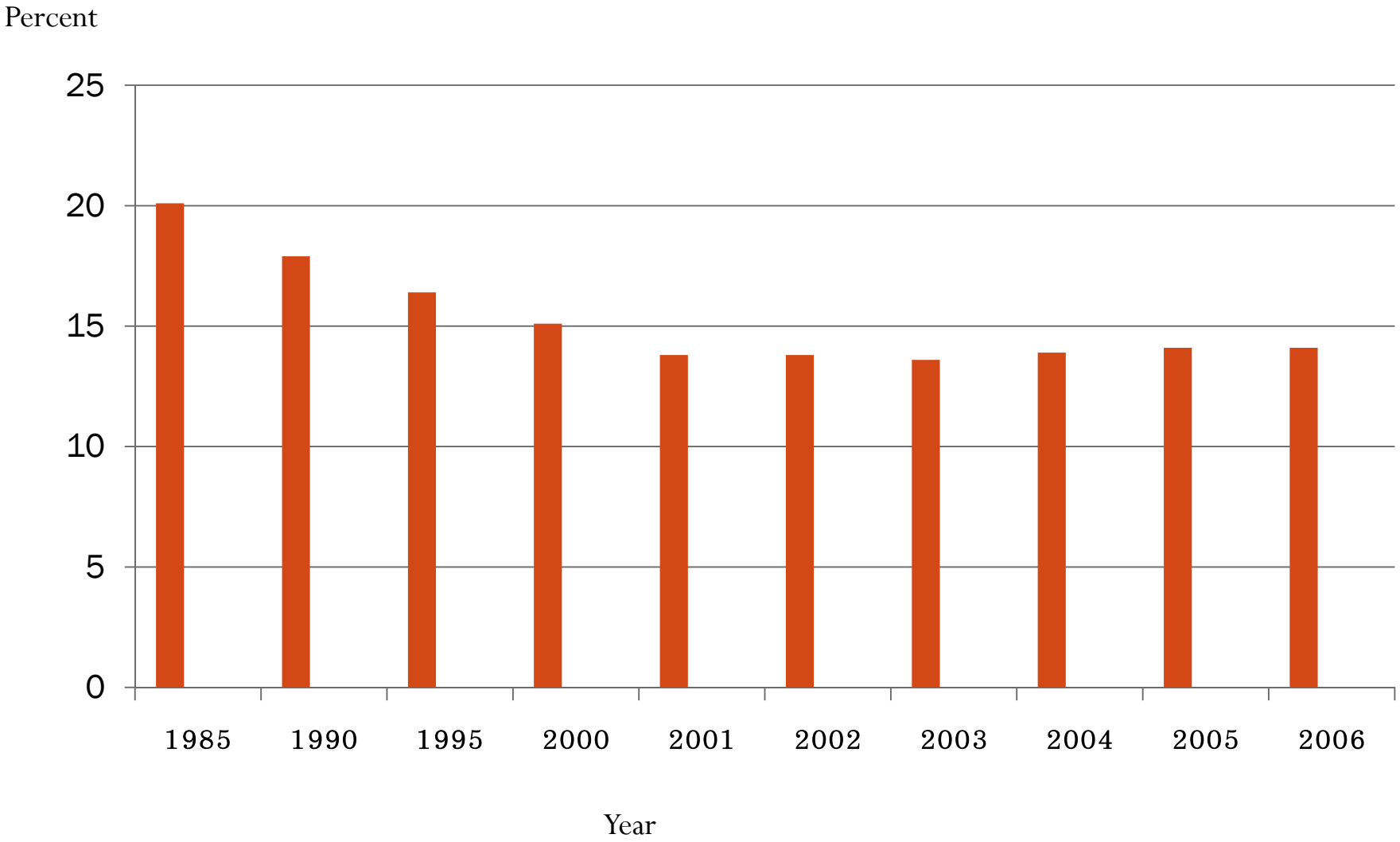
Logistics costs as a percentage of GDP



Macro Inventory as a Percentage of GDP

- This is a measure of efficiency and clearly indicates that organizations are improving in managing their inventory

Macro Inventory as a Percentage of GDP



Logistics in the Firm: The Micro Dimension

- Logistics interfaces with manufacturing/operations
- Logistics interfaces with marketing

Logistics interfaces with manufacturing/operations

- Length of production run
- Long run versus Short run production
- JIT approaches to inventory and scheduling
- Pull system – the product is pulled in response to demand
  - Lowers inventory levels- can lower total logistics costs
- Push system – the product is pushed in advance of demand
- A logistics manager is responsible for the inbound movement and storage of raw materials and components that will support production, logistics and manufacturing

Logistics interfaces with marketing

- Price
  - Adjust quantity prices to conform to shipment sizes appropriate for transportation
- Product
  - Size, shape, weight, packaging affect ability of the logistics system to move and store them
- Promotion
  - An organization making a promotional effort to stimulate sales should inform its logistics manager so that sufficient quantities of inventory will be available for distribution to the customer
- Place
  - Distribution channels decision

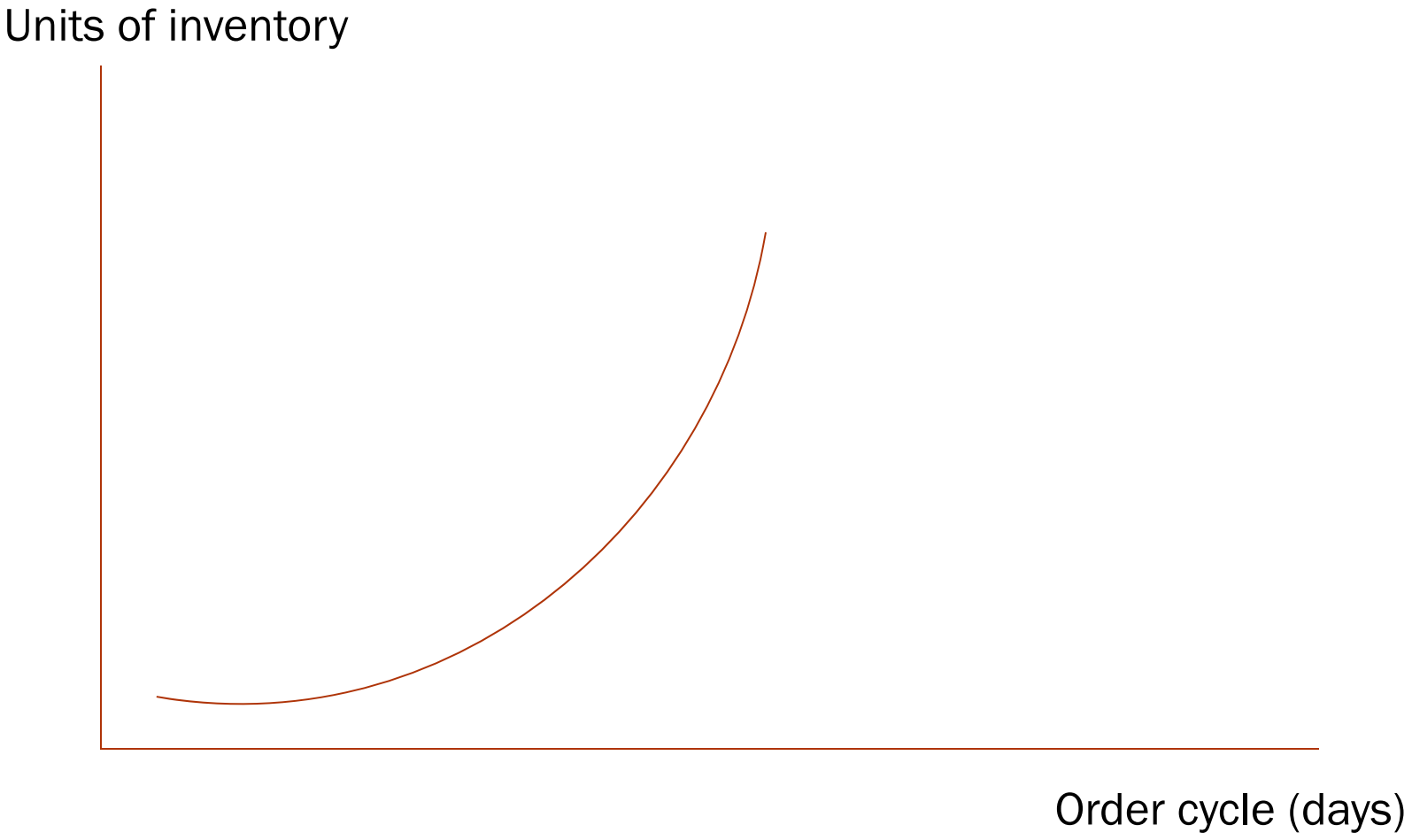
Logistics in the firm: factors affecting the cost and importance of logistics

- Competitive relationships
- Product relationships
- Spatial relationships

Competitive relationships

- Order cycle
  - The time elapses from when a customer places an order until the order is received
- Substitutability
  - Affects the importance of customer services
  - If a product is similar to other products, consumer might be willing to substitute a competitive product if a stockout occurs

The relationship between required inventory and order cycle length from a customer perspective

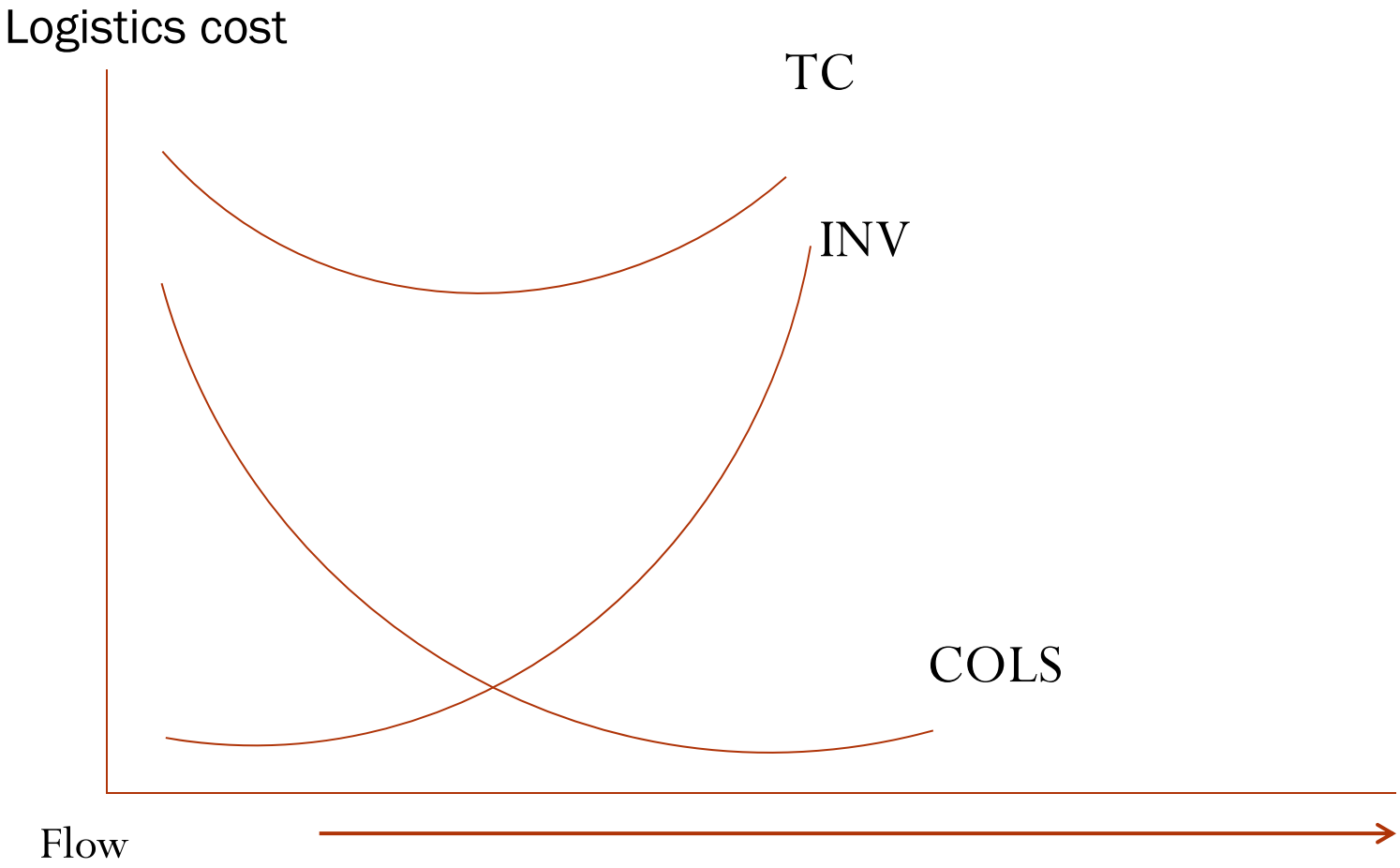


Inventory effect

- Organizations are usually willing to increase the inventory cost only until total costs start to increase

- Organizations are typically willing to spend increasing amount on inventory to decrease lost sales cost by larger amounts – that is, up to the point at which the marginal savings from reducing lost sales cost equal the marginal cost of carrying additional inventory

The general relationship of the cost of lost sales to inventory cost

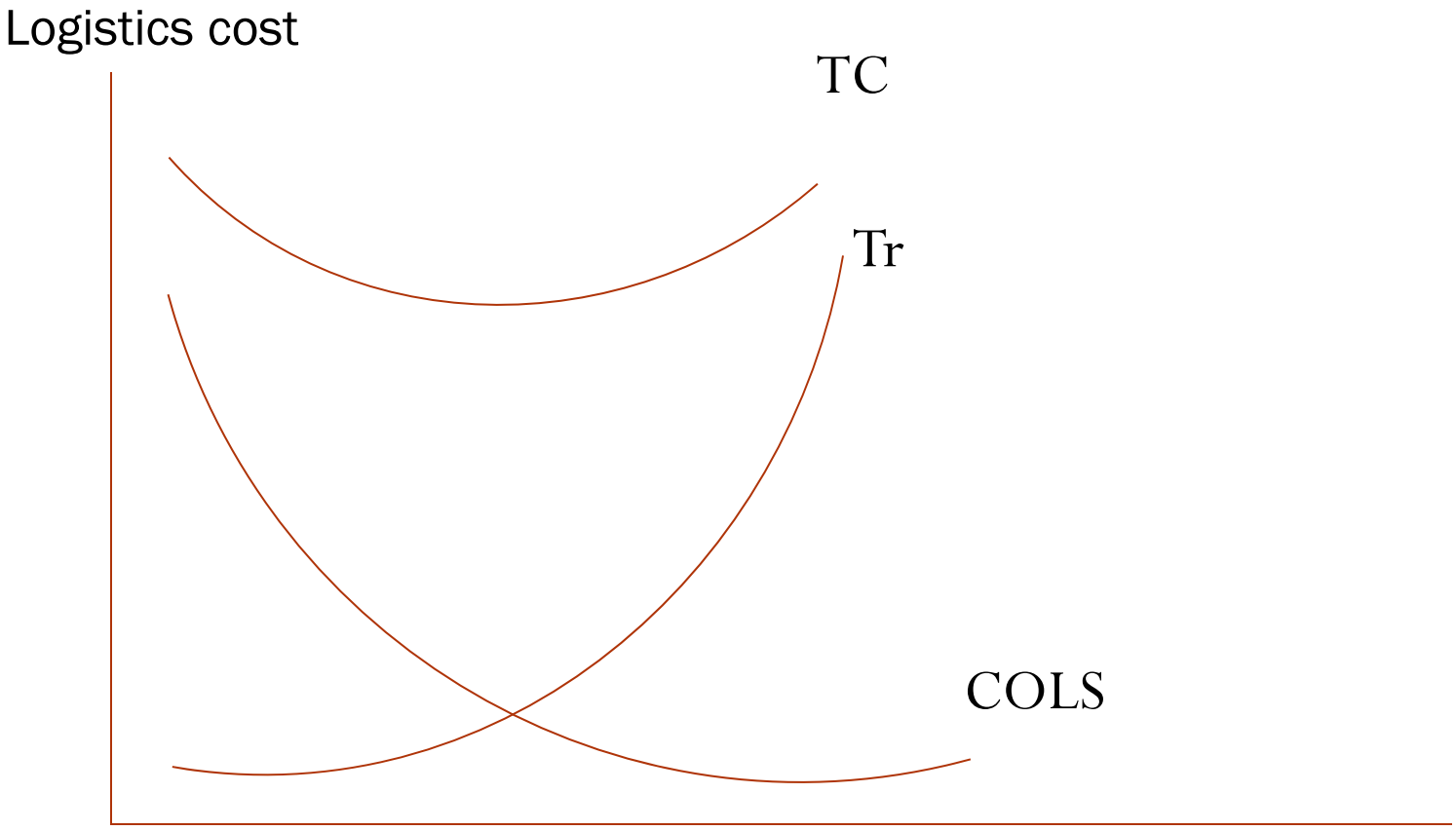


TC =Total cost
INV = Inventory cost
COLS = Cost of lost sales

Transport effect

- Organizations can usually trade off increased transportation costs against decreased lost sales costs
- The additional expenditure involves buying a better service – switching from water to rail, or rail to motor, or motor to air
- The higher transportation cost could also result from shipping more frequently in smaller quantities at higher transportation prices
- Organizations can reduce the cost of lost sales by spending more on transportation service to improve customer service
- Organizations willingly do this only up to the point where the marginal savings in lost sales cost equals the marginal increment associated with the increased transportation cost

The general relationship of the cost of lost sales to transportation cost



TC =Total cost
Tr = Transportation cost
COLS = Cost of lost sales

Product relationships

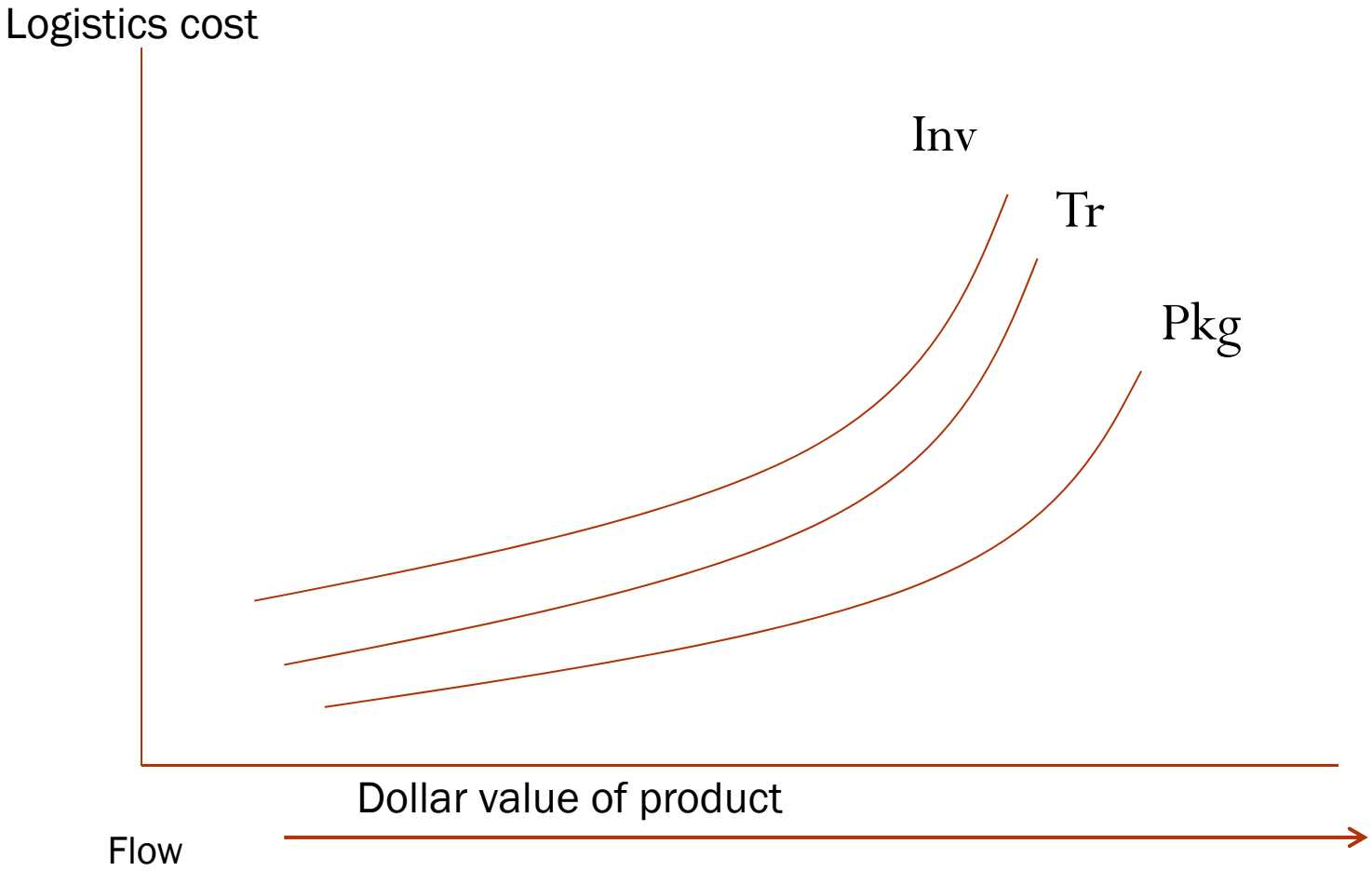
- Dollar Value
  - The product's dollar value typically affects warehousing costs, inventory costs, transportation costs, packaging costs, and even materials-handling costs
- Density
  - Refers to the weight/space ratio of the product
- Susceptibility to Damage
  - The greater the risk of damage to a product, the higher the transportation and warehousing cost
  - Because of a higher degree of risk and liability associated with more fragile goods, the higher are the prices charged by both transportation and warehousing providers
- Special Handling Requirements
  - Related to damage susceptibility but somewhat distinct, is special handling requirements for products

Density

- As density increases for a product, its transportation and warehousing costs tend to decrease
- When establishing their prices, transportation providers consider how much weight they can fit into their vehicles, since they quote their prices in dollars and cents per hundred pounds
- On high density items, these providers can afford to charge a lower price per hundred pounds because they can fit more weight into their vehicle

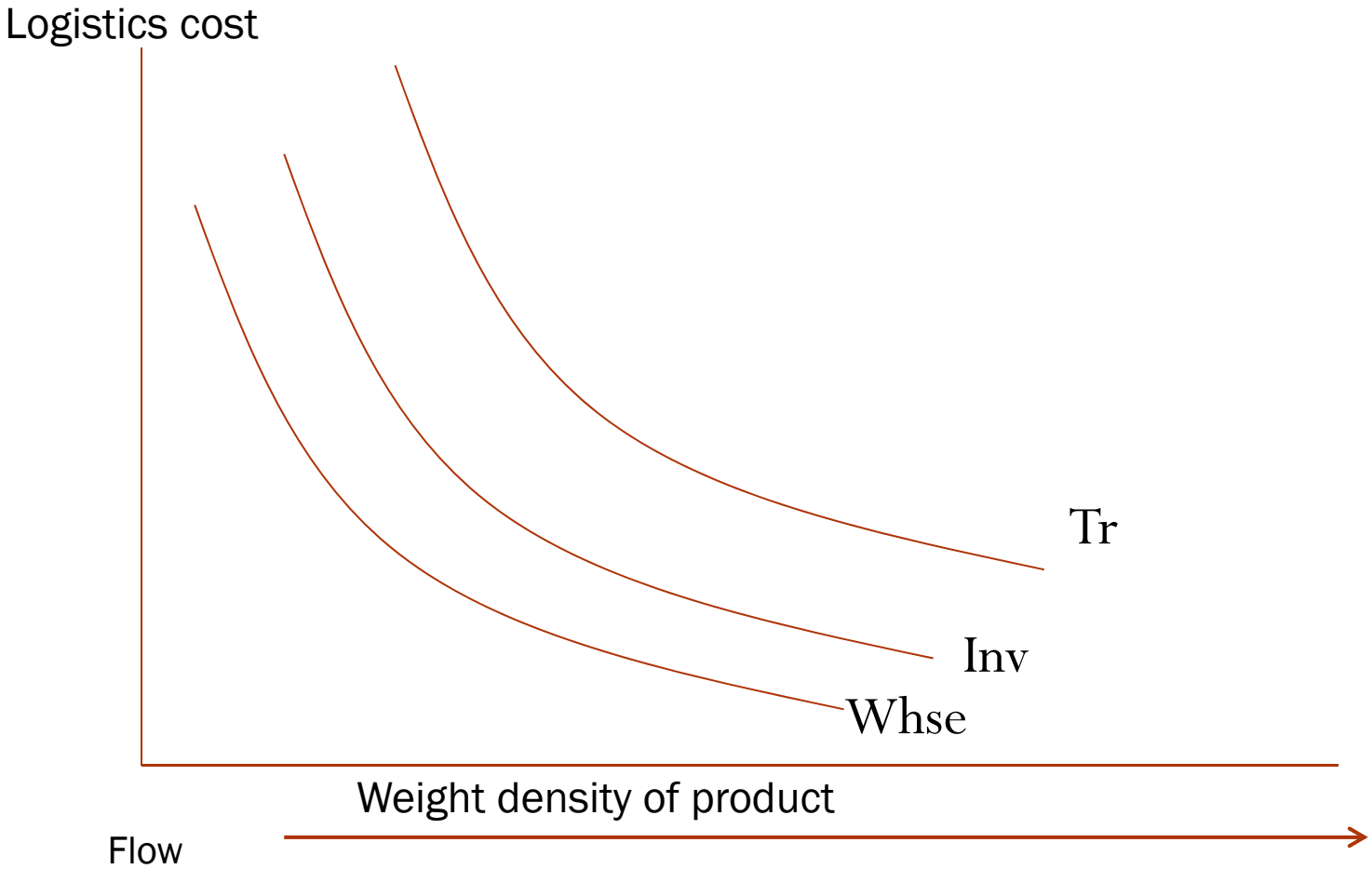
- For example, assume a motor carrier needs $5000 in revenue from the freight that fills a 53 foot trailer.
  - A lower density product might be able to fit 20,000 pounds into this trailer to fill it completely. The motor carrier would need to charge $25 per hundred pounds for this product
  - A high density product might be able to fill the trailer at 40,000 pounds. The resulting price per hundred pounds would be $12.50

The general relationship of product dollar value to various logistics costs



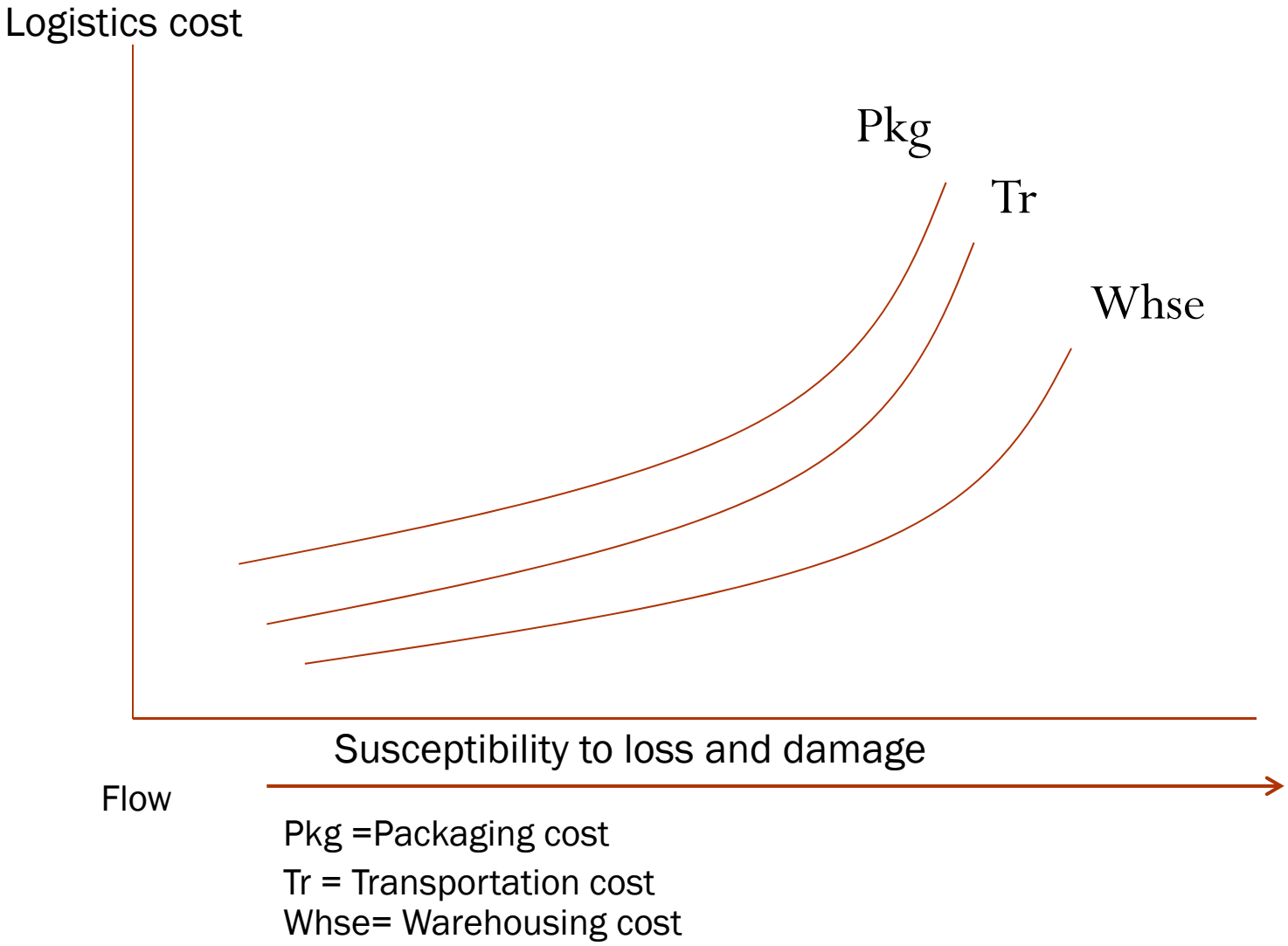
Inv =Inventory cost (including storage)
Tr = Transportation cost
Pkg= Packaging cost

The general relationship of product weight density to logistics costs



Tr = Transportation cost
Inv= Inventory cost (including storage)
Whse= Warehousing cost

General relationship of product susceptibility to loss and damage to logistics costs



Spatial relationships

Example

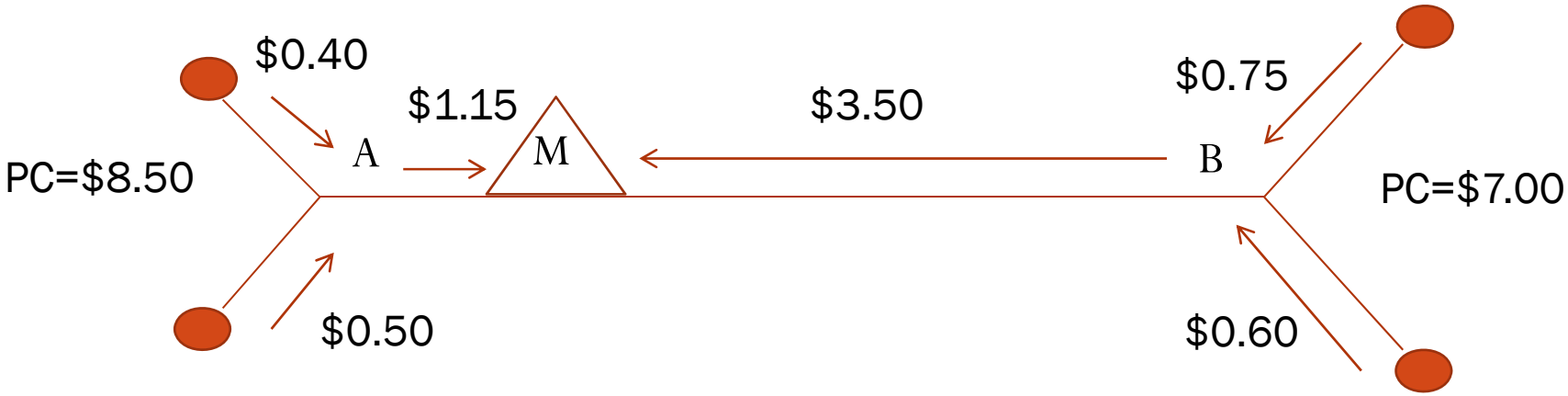
The firm located at point B has a $1.50 production cost advantage over Firm A

Firm B pays $1.35 for inbound raw materials and $3.50 for outbound movement to the market for a total of $4.85 in per unit transportation charges

Firm A pays $0.90 for inbound raw materials and $1.15 for outbound movement to the market for a total of $2.05 in per unit transportation charges

Firm A's $2.80 transportation cost advantage offsets the $1.50 production cost disadvantage

- The location of fixed points in the logistics system with respect to demand and supply points



Techniques of logistic system analysis

- Short-run/Static analysis
  - A specific point in time
  - Multiple short run analyses would be considered and then the system with the lowest overall cost would be selected, as long as it was consistent with constraints the organization imposed on the logistics area
- Long-run/Dynamic analysis

Example- Static analysis of C&B Chemical company (50,000 pounds of output)

- An organization is currently using an all-rail route from its plant and the associated plant warehouse to its customers
- At the plant warehouse, the chemicals are bagged and palletized and shipped by rail to the customer
- A proposed second system would use a market oriented warehouse
- The chemicals would be shipped from the plant to the market oriented warehouse and then packed and sent to the customer
- Instead of shipping all goods by rail, the organization would ship them by barge to the market warehouse, taking advantage of low, bulk transportation prices
- Then after bagging, the chemicals would move by rail from the warehouse to the customer

Plant logistics costs	System 1	System 2
Packaging	$500	$0
Storage and handling	150	50
Inventory carrying	50	25
Administrative	75	25
Fixed cost	**4,200**	**2,400**
Transport costs		
To market warehouse	0	150
To customer	800	100
Warehouse costs		
Packaging	0	500
Storage and handling	0	150
Inventory carrying	0	75
Administrative	0	75
Fixed cost	**0**	**$2,400**
Total cost	$5,775	$5,950

Long-run/Dynamic analysis

- System 1

$$Total\ cost = Fixed\ cost + \frac{Variable\ cost}{unit} \text{ x number of units}$$

$$y = \$4{,}200 + \$0.0315x$$

- System 2

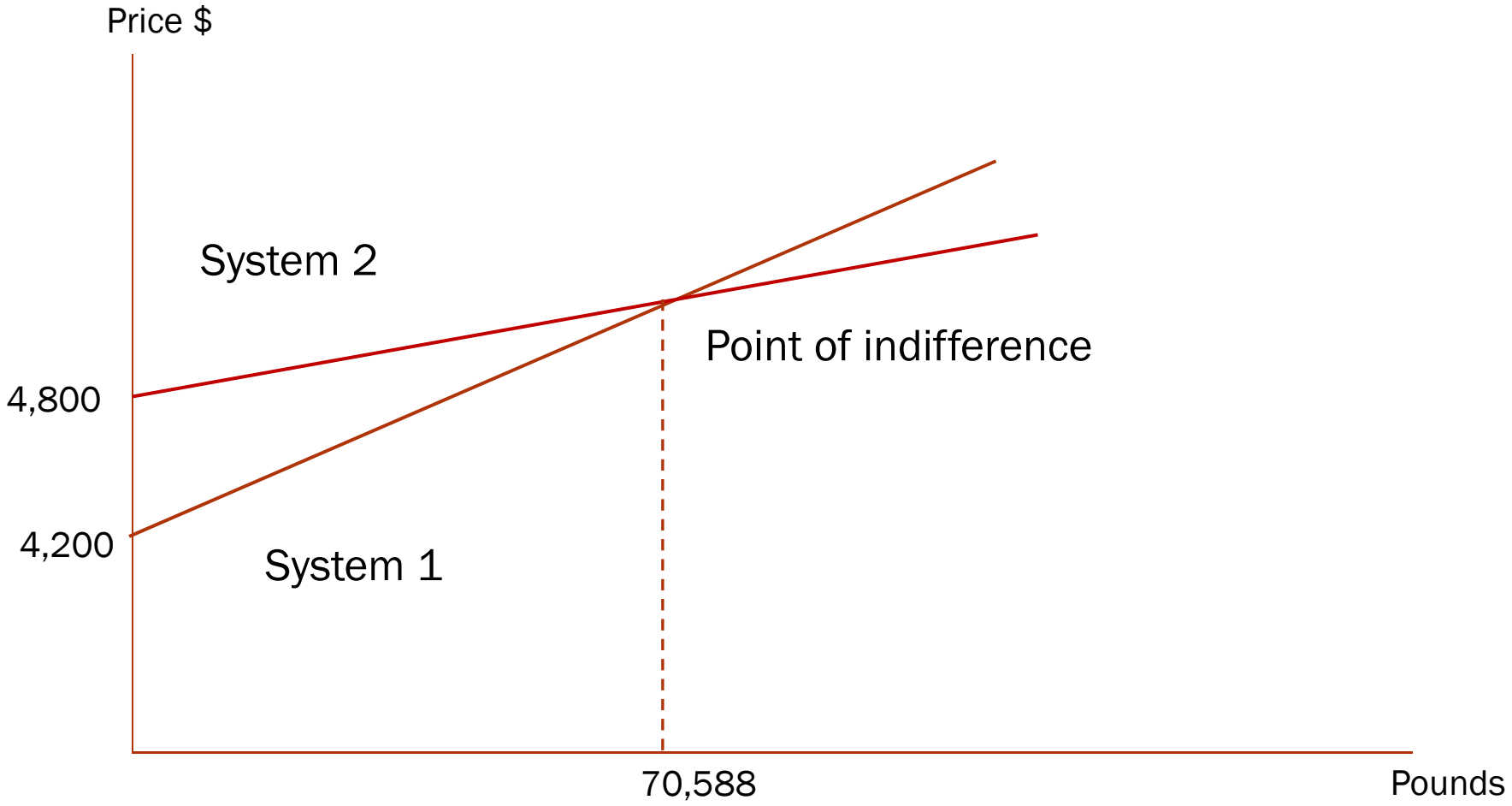
$$y = \$4800 + \$0.0230x$$

- Tradeoff point

$$x = 70{,}588\ \ pounds$$

	Total cost	Fixed cost	Total variable cost	Variable cost per pound
System 1	$5,775	$4,200	$1,575	$0.0315
System 2	$5,950	$4,800	$1,150	$0.0230

Dynamic analysis



Approaches to Analyzing Logistics System

- Materials management versus Physical Distribution
- Cost centers
- Nodes versus Links
- Logistics channels

Materials management versus Physical Distribution

- The Movement and storage of raw materials in an organization is different from the movement and storage of finished goods

- Balanced system
  - Balance flow of inbound and outbound sides of their logistics systems – they receive raw materials and components from suppliers in different locations and ship finished product to customers in various locations
- Heavy inbound
  - Heavy inbound flow and a very simple outbound flow- Boeing
- Heavy outbound
  - Heavy outbound flow - ExxonMobil
- Reverse system
  - Reverse flows on the outbound side of their logistics systems

Cost centers

Example- Analysis of Total logistics cost with a change to a higher cost mode of transport

Cost Centers	Rail	Motor
Transportation	$3.00	$4.30
Inventory	5.00	3.75
Packaging	3.50	3.20
Warehousing	1.50	0.75
Cost of lost sales	2.00	1.00
Total cost	$15.00*	$13.00*

*Costs per unit

Nodes versus links

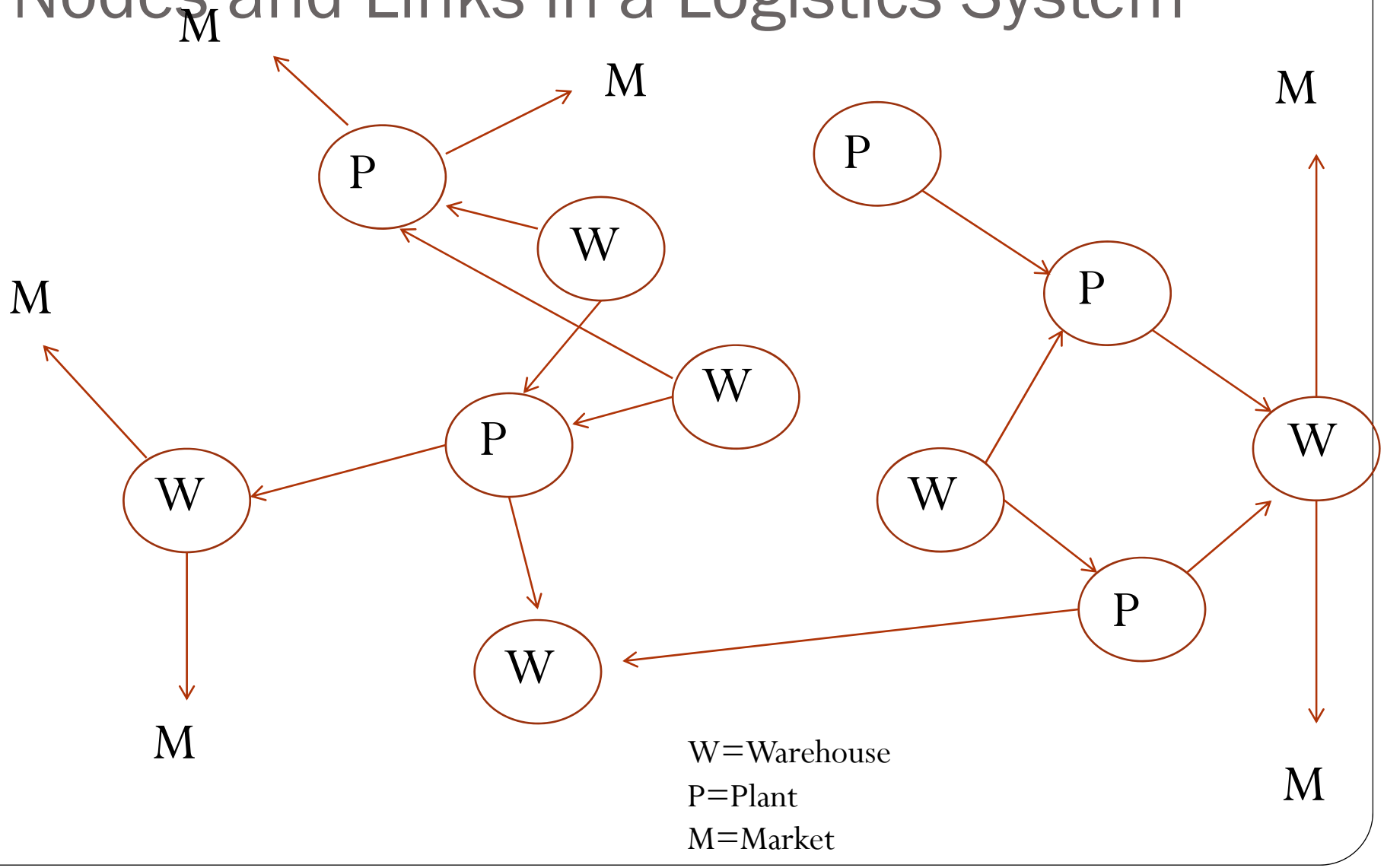
Nodes

- Fixed spatial points where goods stop for storage or processing
- Manufacturing / assembling facilities are warehouses

Links

- The transportation network and connect the nodes in the logistics system
- The network can be composed of individual modes of transportation (rail, motor, air, ocean, or pipeline)

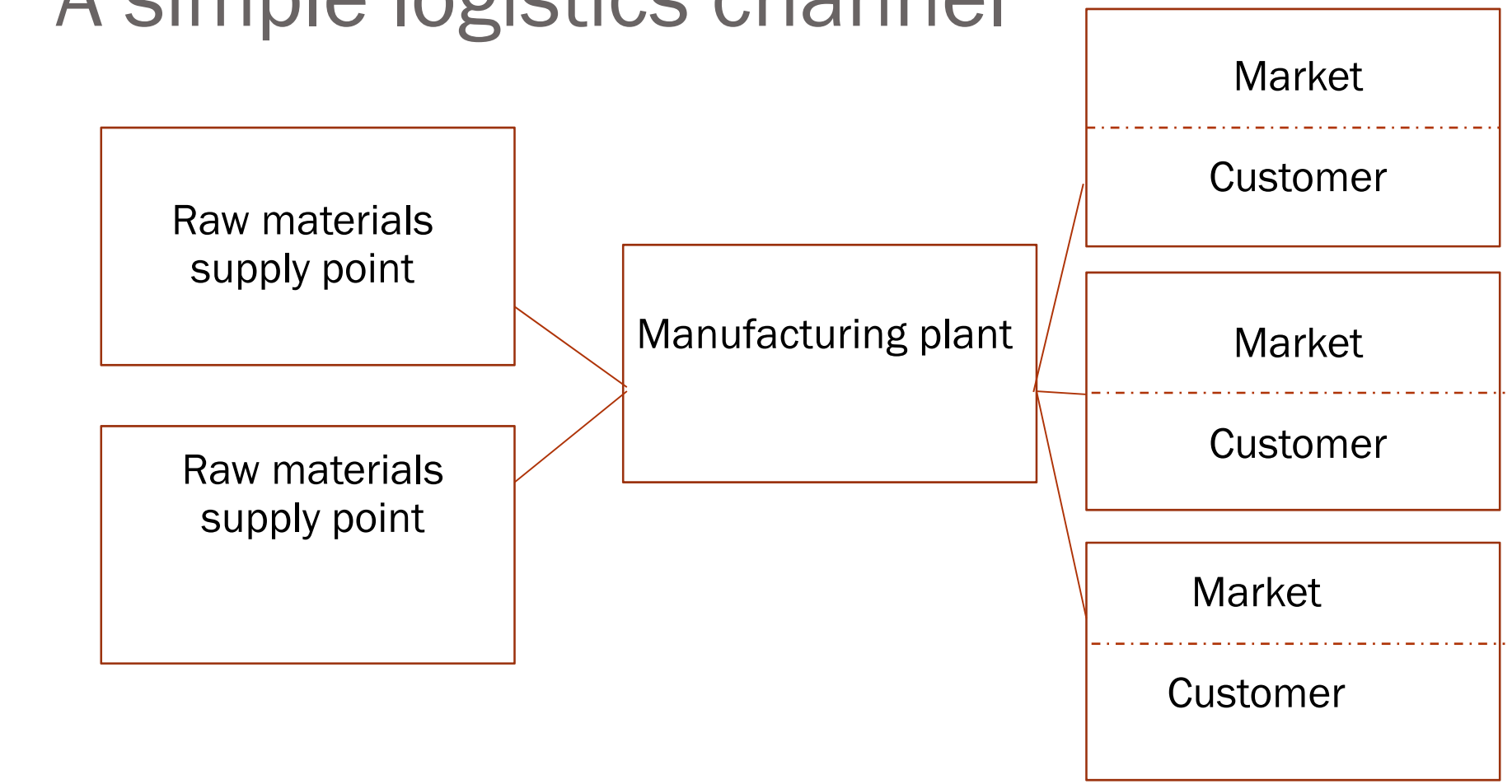
Nodes and Links in a Logistics System



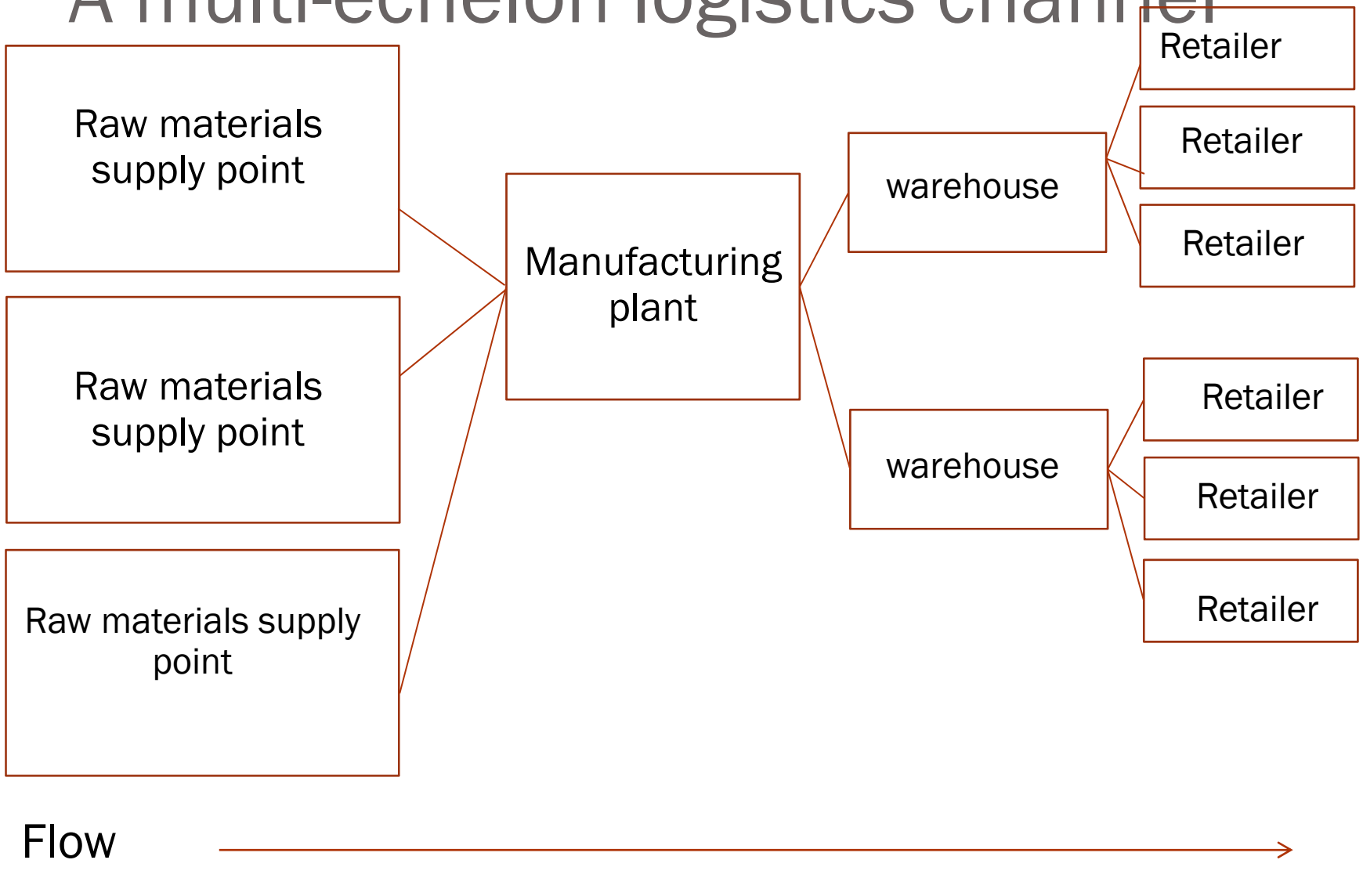
Logistics Channels

- The network of intermediaries engaged in transfer, storage, handling, communication, and other functions that contribute to the efficient flow of goods

A simple logistics channel



A multi-echelon logistics channel



References

- Coyle J.J., Langley C.J. Jr., Novack R.A., Gibson, B.J. (2013). Managing Supply Chains A Logistics Approach. 9th edition. South-Western, Cengage Learning.