IE 479
Distribution Logistics

Personal Information

- Instructor: Bahar Yetiş Kara
  - Office: EA-314
  - Tel: 3156
  - Email: bkara@bilkent.edu.tr
- Assistant: Egehan Uğraş
  - Office: EA-307
  - Email: egehan.ugras@bilkent.edu.tr

- Office hour: by appointment

Lecture Hours

- Mondays 9:30-10:20
- Wednesdays 13:30-15:20

Text Book

- Introduction to Logistics Systems Planning and Control,

G. Ghiani, G. Laporte, R. Musmanno,
Wiley, 2003, ISBN : 0-470-84917-7

- Lecture notes very crucial

Course Grading Policy- Tentative

- Midterm 25%
- Final 30%
- Article Presentation 10%
- Projects 25% (10 + 10 + 5)
- Class-participation 10 %
- No FZ policy

Teams of 2-3

- Article Presentation
  - Interfaces articles
- Project 1 & 2 (20%, 10% each)
  - Realistic problems
  - Will sort the reports based on the objective function values
  - Report format is also very important (Latex is highly suggested)
- Project 3 (5%)
  - A Class project!

2025 Fall Calendar

WEEK 1	September 15	Lecture-1
		Lecture-2
	September 17	**NO CLASS**
WEEK 2	September 22	Lecture-1
		Lecture-2
	September 24	Lecture-3
		Lecture-4
WEEK 3	September 29	Lecture-1
		Lecture-2
	October 1	Lecture-3
		Lecture-4
WEEK 4	October 6	Lecture-1
		Lecture-2
	October 8	Lecture-3
		Lecture-4
WEEK 5	October 13	Lecture-1
		Lecture-2
	October 15	Lecture-3
		Lecture-4
WEEK 6	October 20	Lecture-1
	October 22	Lecture-2
		Lecture-3
WEEK 7	October 27	**NO CLASS**
	October 27	
WEEK 8	November 3	**MIDTERM**
	November 5	Lecture-3
		Lecture-4
WEEK 9	November 10	Lecture-1
	November 12	Lecture-2
		Lecture-3
WEEK 10	November 17	Lecture-1
	November 19	Lecture-2
		Lecture-3
WEEK 11	November 24	Lecture-1
	November 26	Lecture-2
		Lecture-3
WEEK 12	December 1	Lecture-1
	December 3	Lecture-2
		Lecture-3
WEEK 13	December 8	Lecture-1
	December 10	Lecture-2
		Lecture-3
WEEK 14	December 15	Lecture-1
	December 17	Lecture-2
		Lecture-3
WEEK 15	December 22	**NO CLASS**
	December 24	**NO CLASS**

Course Webpage

https://courses.ie.bilkent.edu.tr/ie479/

IE 479 Distribution Logistics

2025-2026 Fall

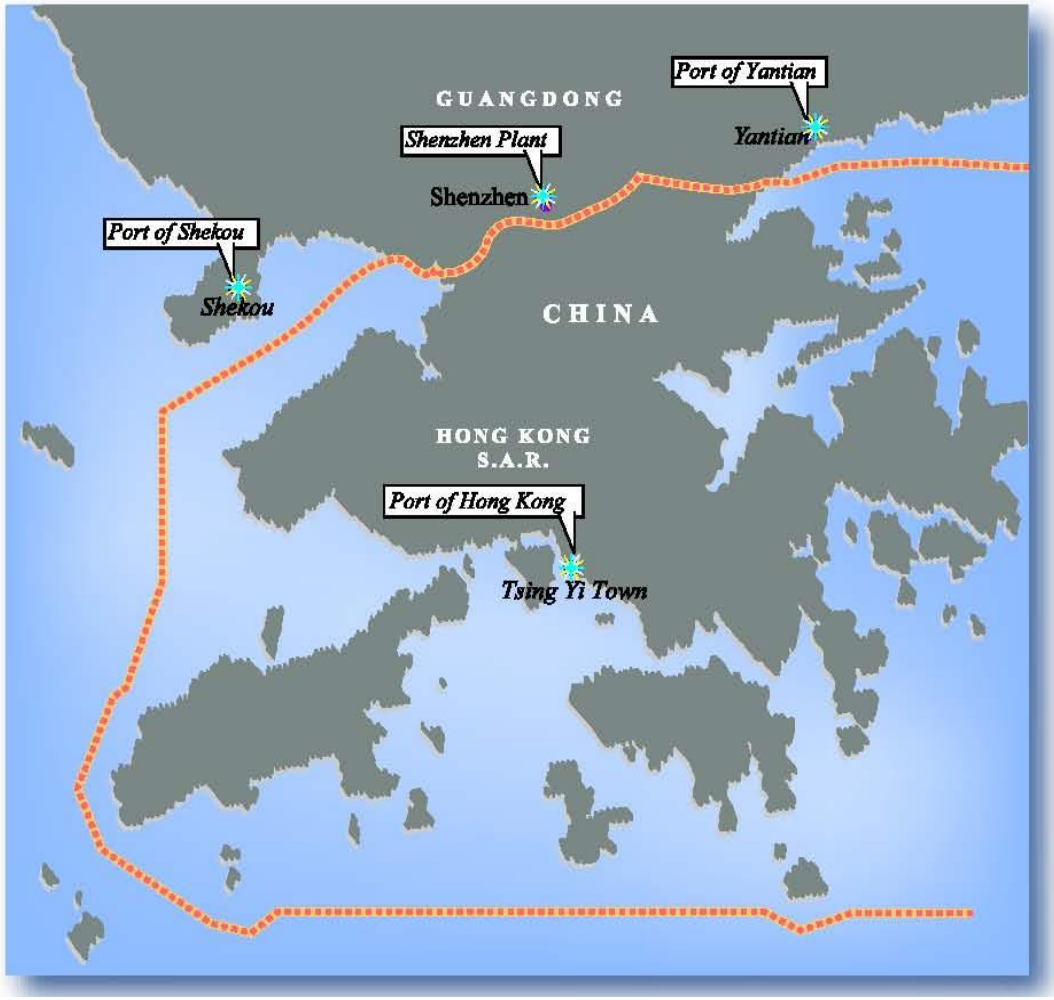
Questions on Rules of the Game

Why Logistics?

CASE study: Shoes From China

- As a manufacturer, how should I ship my shoes from Shenzen (China) to Kansas City (USA)
  - Shoes are manufactured, labeled, and packed at a plant
  - ~4.5M shoes shipped per year from this plant
  - 6000-6500 shoes shipped per container
  - Value of pair of shoes ~$35

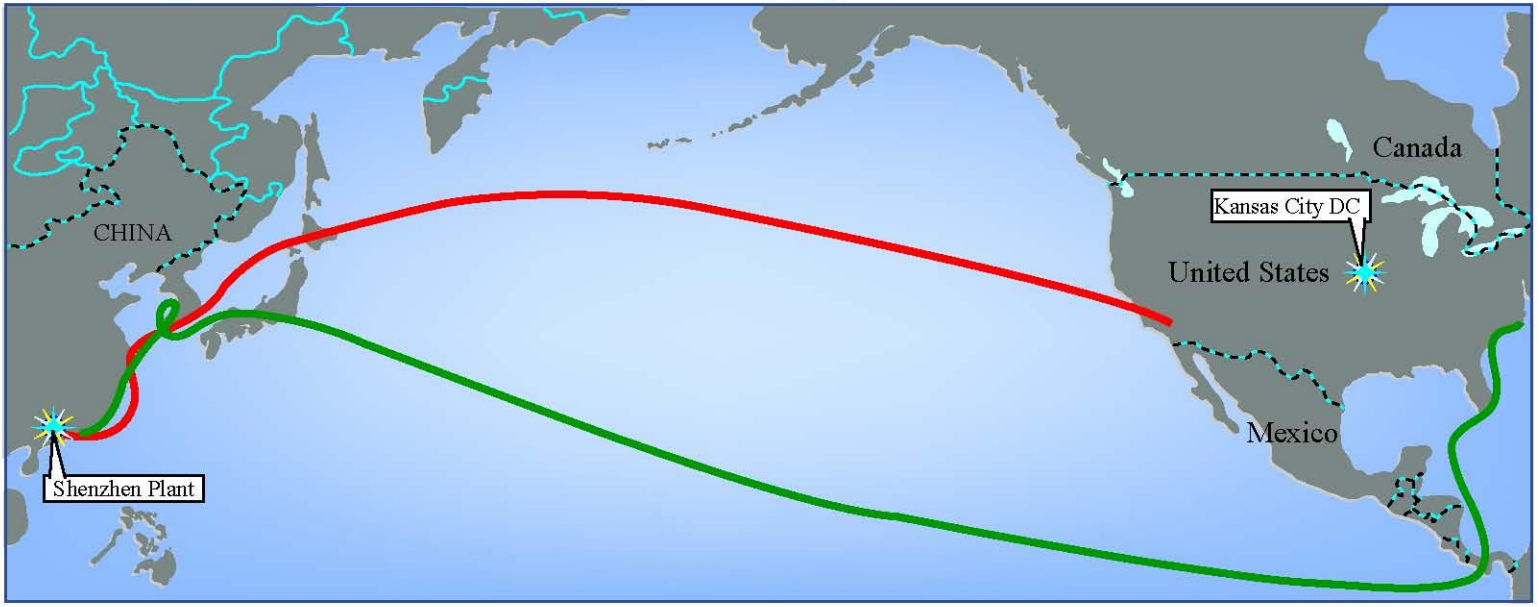
Inland Transport @ Origin



- 3 Port Options
  - Shekou
    - Truck
  - Yantian
    - Rail
    - Truck
  - Hong Kong
    - Rail
    - Truck
- In Hong Kong
  - 9 container terminals

Ocean Shipping Options

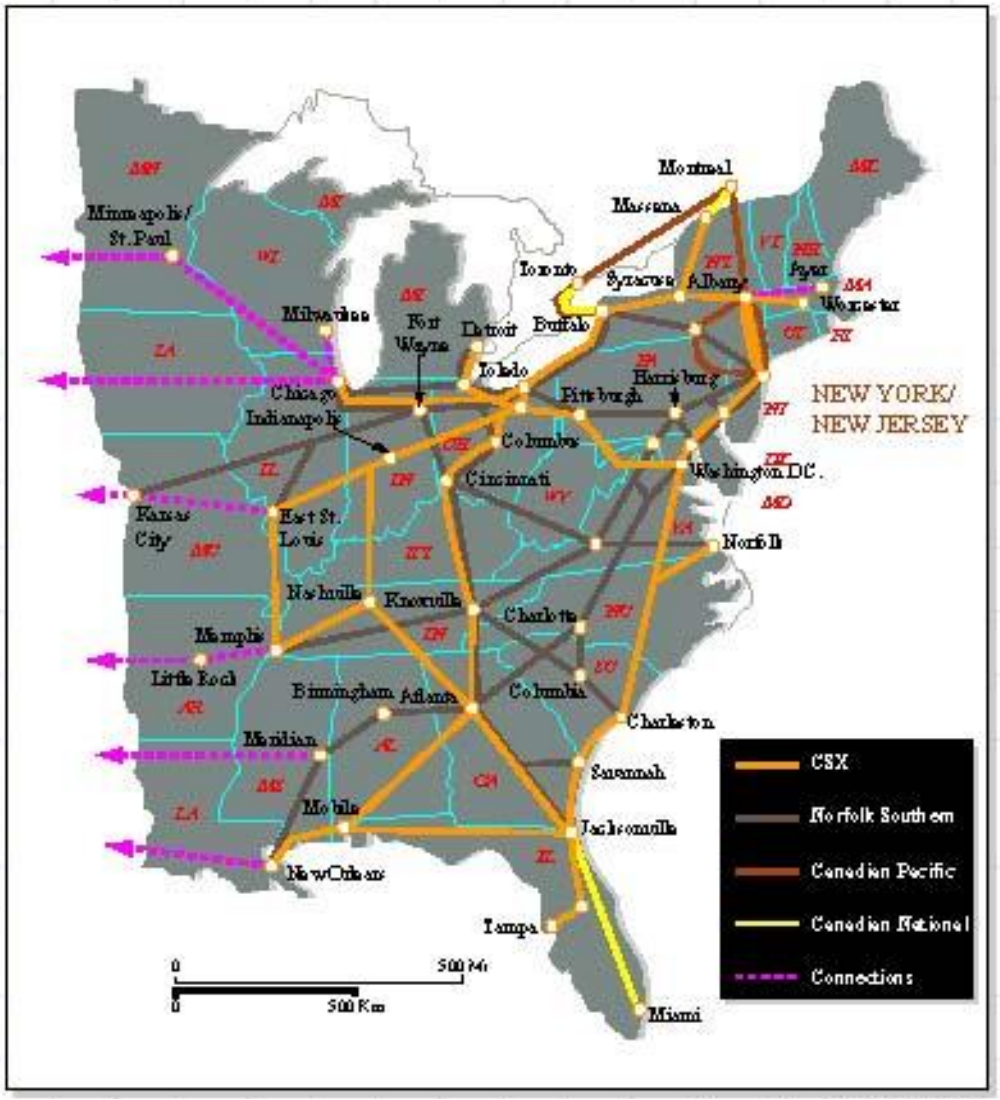
- 40 shipping lines visit these ports each w/ many options
- Examples:
  - APL – APX-Atlantic Pacific Express Service
    - Origins: Hong Kong (Sat) -> Kaohsiung, Pusan, Kobe, Tokyo
    - Stops: Miami (25 days), Savannah (27), Charleston (28), New York (30)
  - CSCL – American Asia Southloop
    - Origins: Yantian (Sat) -> Hong Kong, Pusan
    - Stops: Port of Los Angeles (16.5 days)



Inland Transportation in US

Port of New York / New Jersey

- Maher Terminal
  - Express Rail II NS RR
    - Double stack thru:
    - Harrisburg, Pittsburgh, Cleveland, Ft. Wayne, to Kansas City
  - CSX RR (5-10 days)
    - Double stack thru:
    - Philadelphia, Baltimore, Washington, Pittsburgh, Stark, Indianapolis, to Kansas City
  - Truckload (2.5 – 3 days)
    - NJ Turnpike to I-78W, I-81S, I-76/70 to Kansas City



Transport Options

- So how do I ship shoes from Shenzhen to Kansas City?
- What factors influence my decision?

Why Logistics?

Oracle Logistics

Know More. Do More. Spend Less.

Logistics Management At-a-Glance

Aberdeen Group "Forward-thinking manufacturers use logistics strategically to reduce safety stock levels and improve customer service – and hence profits – through better information. Bottom line, logistics is a new game, and the old rules simply do not apply."

- Research Analyst, Logistics Resource Mgmt Executive White Paper

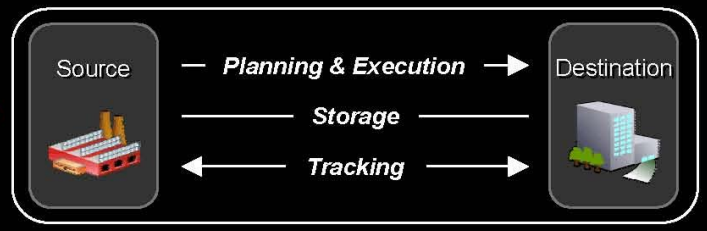
Business Pressures

Customer Expectations

- How do I improve the speed and visibility of shipments?
- How can I improve global order promise accuracy?

Variable Demand

- How do I account for higher volume from Internet selling?
- What adjustments do I make in planning for mass customization?



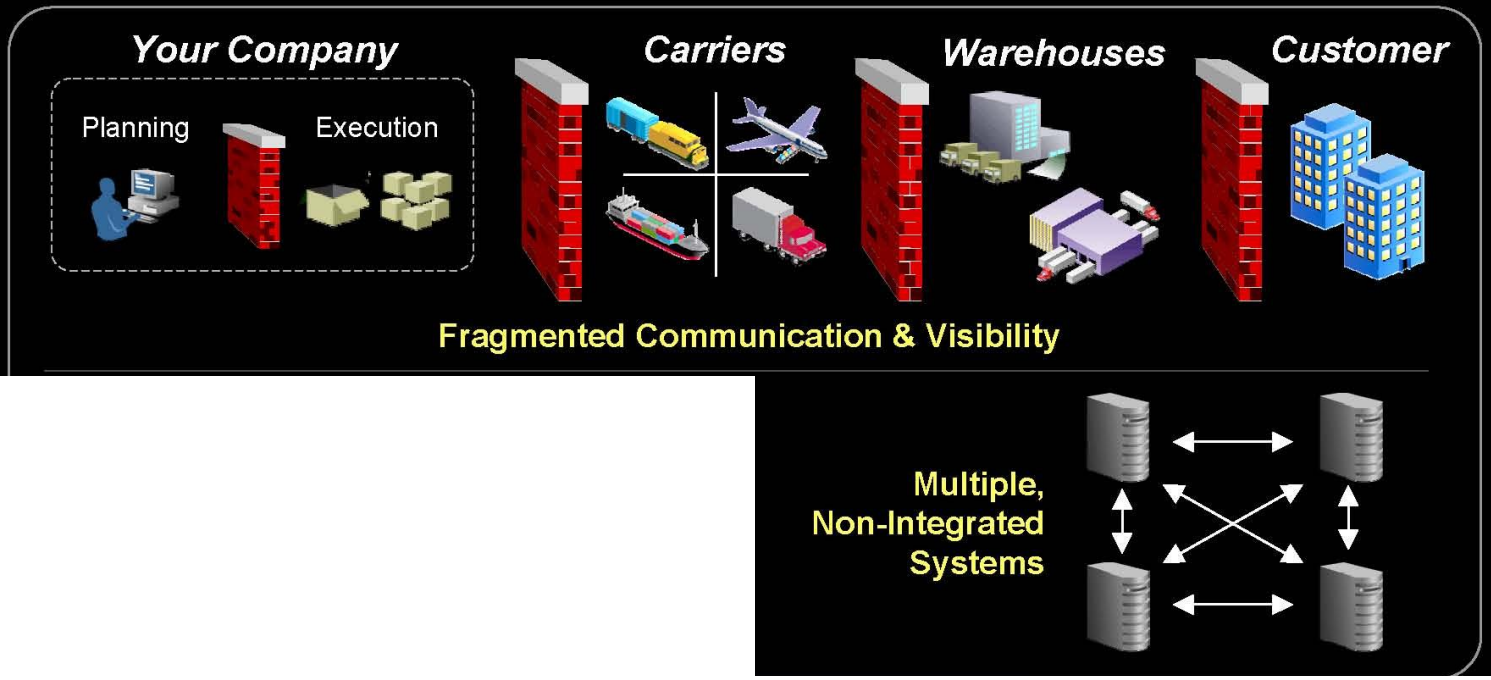
Increased Complexity

- How can I manage product proliferation?
- How do I balance global supply and demand to ensure on-time delivery?

Margin Pressure

- Where can I reduce costs to maintain competitive prices?
- How do I differentiate my logistics offerings?

Operational Challenges



A Need for Change

Leading Business Trends

- Fulfillment Processes Integrated with Partners
- Streamlined Material Flow (e.g. Cross-Docking)
- Mobile Solutions for Increased Visibility/Passive Tracking
- Consolidation & Outsourcing of Shipping Activities
- Reverse & Service Parts Logistics Management

Oracle Logistics Solution

Dimensional Considerations

Time

- Dynamic
- Tactical
- Operational
- Strategic

Place

- Facility
- Domestic
- Local Area
- International

Logistics Management

Mode

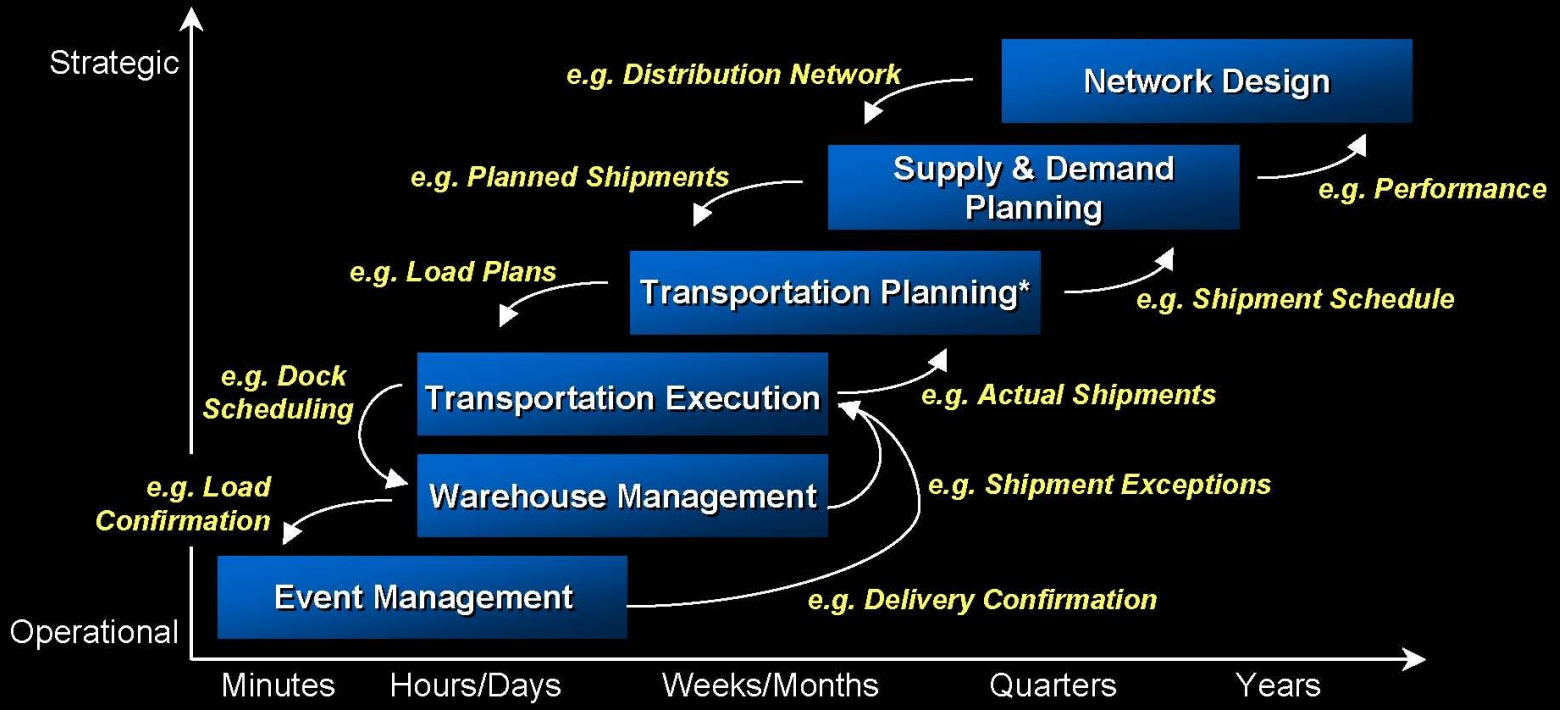
- Truck
- Air
- Rail
- Ocean

Flow

- Outbound
- Intra-Org
- Inbound
- Returns

Integrate Planning and Execution

Seamless Flow of Information



IE 479 Distribution Logistics

Aim of the Course

- Provide an understanding for logistics problems
- Using OR point of view
- Introduce models to analyze logistics problems
- Introduce quantitative models to analyze logistics problems
- Present solution techniques for selected models

Logistics

- Deals with the planning and control of :
  - Material flows
  - Related information

- Mission is to get
  - The right materials
  - To the right place
  - At the right time

  while optimizing a performance measure and satisfying constraints

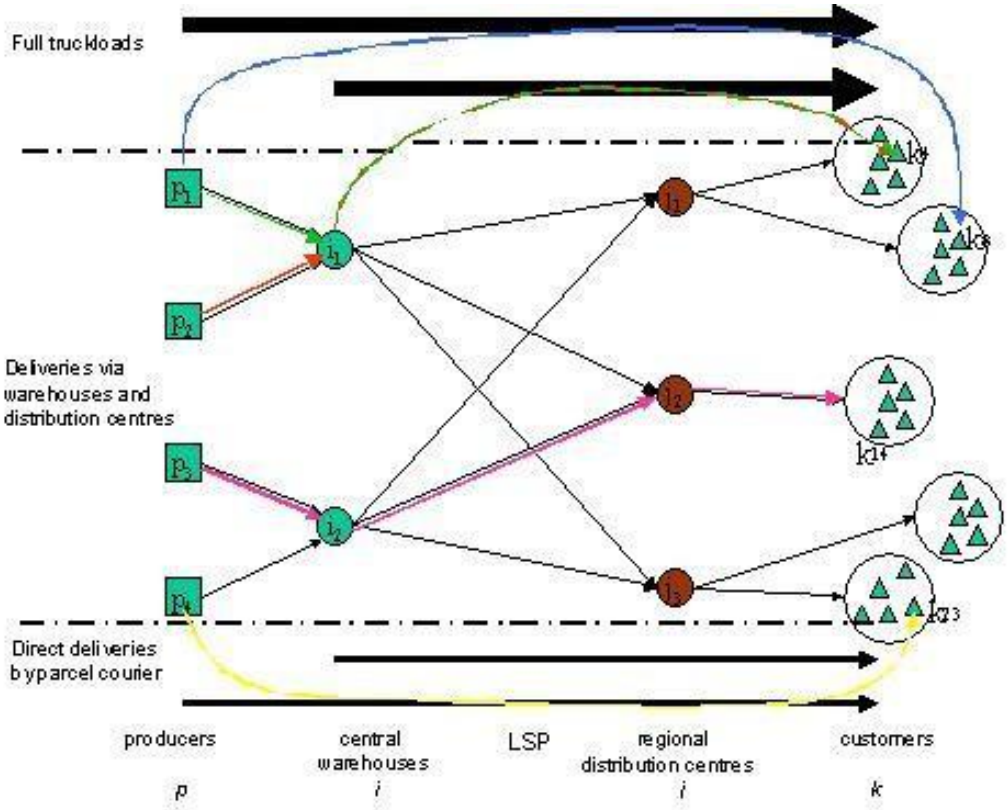
Logistics Decisions

- This course is focused on quantitative methods used for planning, organizing, and controlling of logistics systems.

Logistics systems

- Composed of facilities linked by transportation services
- Facilities include
  - Sites of manufacturing, storing, sorting, selling, consuming etc…
  - Warehouses, distribution centers (DCs), transportation terminals, dump sites, etc…

Logistics Systems (Supply Chains)



Logistic System Characteristics

- *Push* versus *Pull* Systems
  - make-to-order, make-to-stock, make-to-assembly
- Vertical integration vs. third-party logistics (3PL)
  - transaction based relationships, strategic alliances

Third Party Logistics(3PL)

- Use of an outside company
  - Perform all or part of a company's product distribution
- Three different levels:
  - Basic service providers
    - Physical distribution services (warehousing, transportation)
  - Value added service providers
    - Basic service + services such as specialized pick/pack, labeling
  - Logistics integrators
    - Full responsibility for managing key supply chain operations on a daily basis.

Outsourcing: Pros and Cons

- Pros:
  - Improve company focus
  - Access to new technology
  - Free-up resources
  - Reduce operation costs
- Cons:
  - Coordination costs
  - Loss of internal logistics management capability
  - Reduced contact with final customer

Logistic System Characteristics

- *Push* versus *Pull* Systems
  - make-to-order, make-to-stock, make-to-assembly
- Vertical integration vs. third-party logistics (3PL)
  - transaction based relationships, strategic alliances
- Retailer managed vs. vendor managed inventory
- Product and information flows

Logistics systems

- Can categorize in three main activities:
  - Order processing
    - Links information flow with product flows
  - Inventory management
    - Controls inventories that are waiting to be manufactured, assembled, sold or salvaged
  - Freight transportation
    - Allows production and consumption to be far apart

Order processing

- Links information flows with product flows
  - Customers request products (EDI, fax, telephone,…)
  - Availability of requested items is checked (PPS, SAP,…)
  - Required items are produced (if necessary) or retrieved from the warehouse
  - Items are shipped to customers
  - Customers are kept informed about order status

Inventory management

- Inventories are stocked
  - Raw materials
  - Semi-finished products and components
  - finished products (in warehouse or en-route)

- waiting to be manufactured, assembled, sold or salvaged

Inventory management

- Reasons for holding inventories
  - Demand seasonality
  - Improving customer service level
  - Price seasonality
  - Exploit economies of scale in freight transportation
  - Cope with demand and lead-time randomness
  - Cover inefficiencies in managing the logistics system

Inventory management

- A good inventory policy takes into account
  - the economic significance of stored products
  - transportation policies
  - production process characteristics
  - competitors' policies

Freight transportation

- allows production and consumption to be far apart
  - global availability of certain products
  - economic benefits from production at low wage countries
  - improved availability of perishable goods

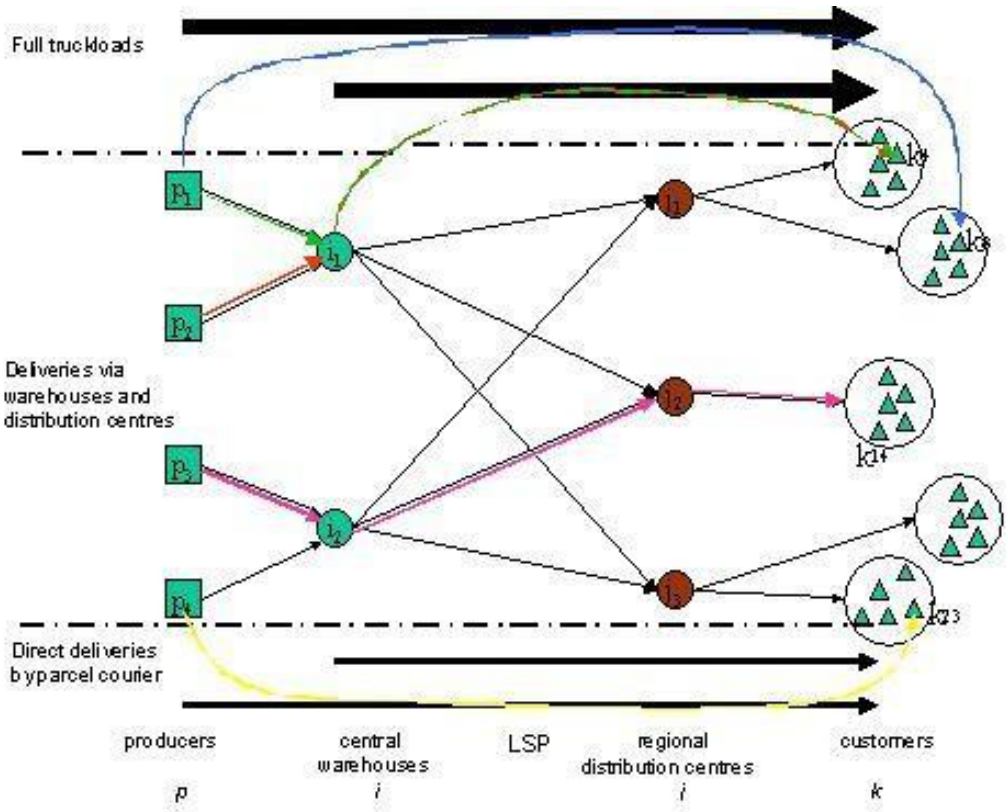
Freight Transportation

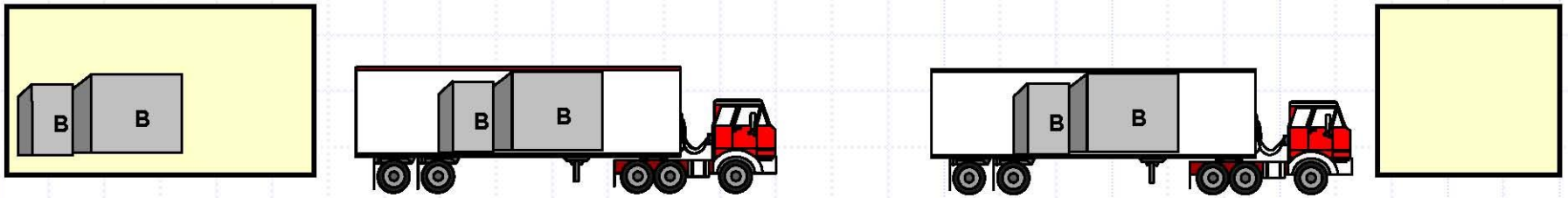
- Types:
  - Private transportation
    - (owned or leased vehicles)
  - Contract transportation
    - (dedicated carrier)
  - Common transportation
    - (general carrier)

Freight Transportation

- Main features:
  - Distribution channels:
    - warehouses, DCs, direct…
  - Freight consolidation:
    - Facility consolidation : (e.g. hubs) individual shipments are consolidated at hubs .
    - multi-stop: serving some customers together
    - Temporal: adjusting schedules to ship larger quantities
  - Modes of transportation

Distribution channels





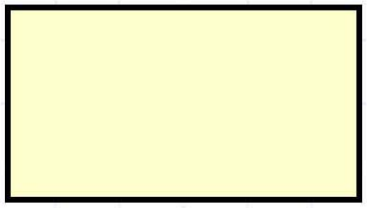
- Loading/Unloading
  - Key drivers:
    - Number of items
    - Time
    - Stowability (Packaging)
  - Not always symmetric

- Linehaul
  - Key drivers:
    - Distance
    - Balance / Backhaul

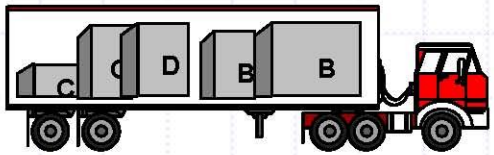
Freight consolidation

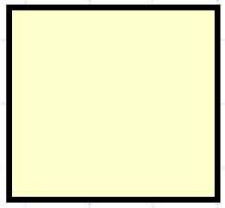
- *Facility consolidation*
  - e.g. UPS consolidates individual shipments at hubs for joint transportation between hubs
- *Multi-stop consolidation*
  - e.g. Fedex delivers individual shipments to their final destination on routes serving several customers
- *Temporal consolidation*
  - e.g. shipments schedules may be adjusted forward or backward to ship large quantities periodically

Multi-stop consolidation



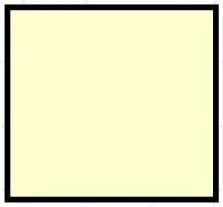
Plant A



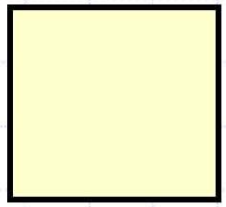


Customer B

- Vehicle Routing
  - Key drivers:
    - Number/Density of stops
    - Vehicle Capacity
    - Time
  - Origin or Destination
    - One to Many
    - Many to One

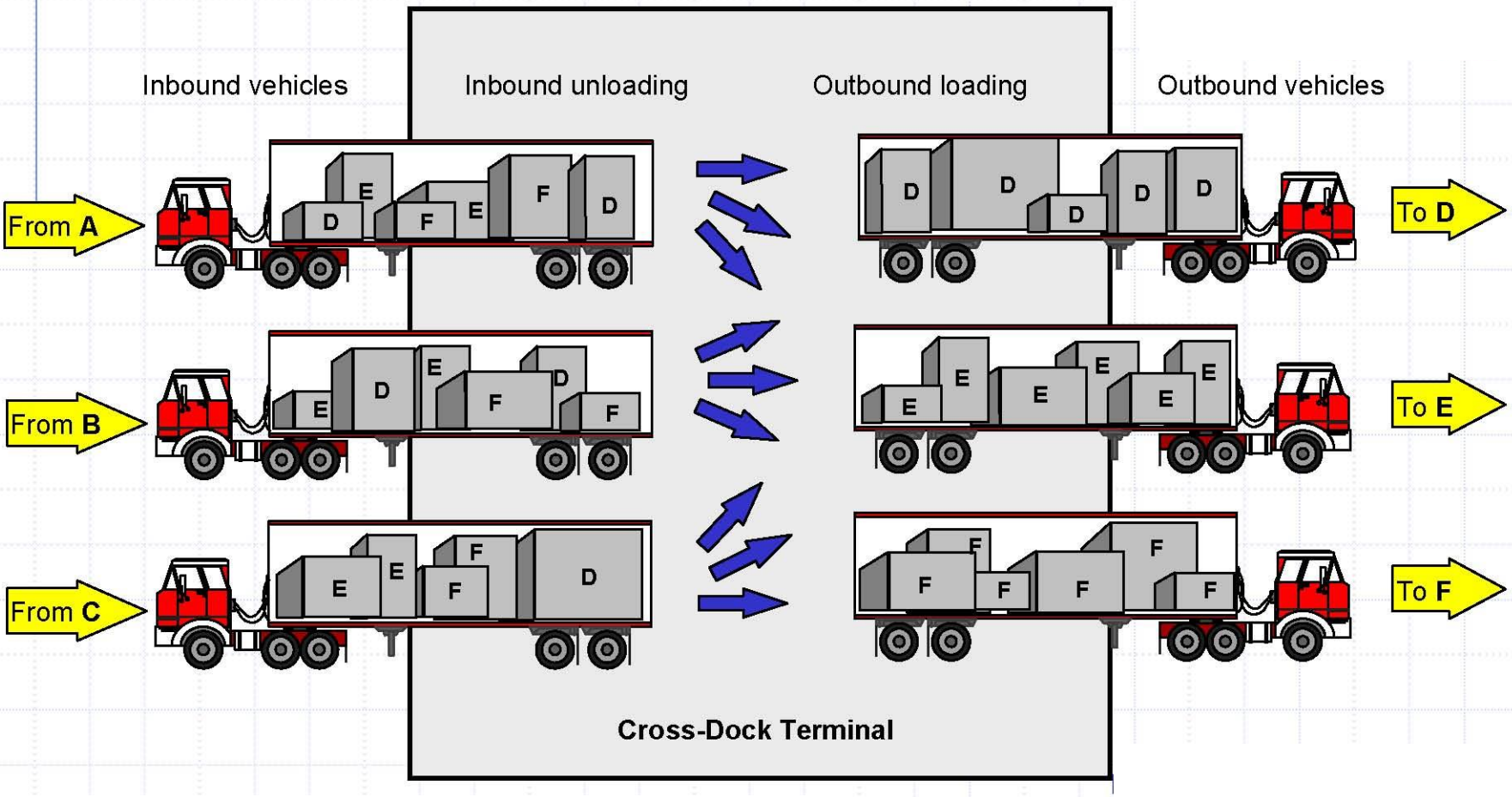


Customer D



Customer C

Facility consolidation



An Aside: Routing & Scheduling

- Problem:
  - How do I route vehicle(s) from one or many origins to one or many destinations at a minimum cost?
  - A HUGE literature and area of research
- Traveling Salesman Problem / Vehicle Routing Problem
  - One origin, many destinations, sequential stops
  - Stops may require delivery & pick up
  - Vehicles have different capacity (capacitated)
  - Stops have time windows
  - Driving rules restricting length of tour, time, number of stops

Freight Transportation

- Modes of transportation:
  - Air
  - Truck
  - Train
  - Ship
  - Pipeline

  - intermodal

Freight Transportation

- Mode Choice Decisions:
- Air:
  - Fastest, handling slows down the process
  - Long distance high value goods
- Truck
  - Truck load vs Less-Than-Truck load
- Rail
  - Inexpensive, relatively slow

Freight Transportation

- Mode Choice Decisions:
- Intermodal
  - Air-Truck
    Birdyback
  - Train-Truck
    Piggyback
  - Ship-Truck
    Fishyback

Mode Comparison Matrix

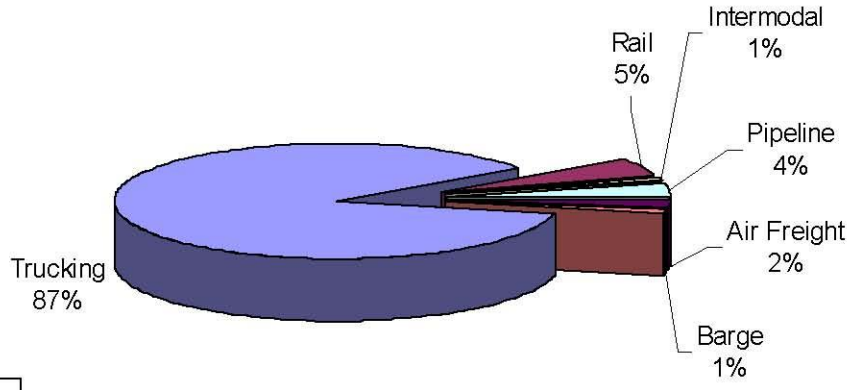
	Truck	Rail	Air	Water
Operational Cost	Moderate	Low	High	Low
Market Coverage	Pt to Pt	Terminal to Terminal	Terminal to Terminal	Terminal to Terminal
Degree of competition	Many	Few	Moderate	Few
Traffic Type	All Types	Low to Mod Value, Mod to High density	High value, Low density	Low value, High density
Length of haul	Short – Long	Medium – Long	Long	Med - Long
Capacity (tons)	10 – 25	50 – 12,000	5 – 12	1,000 – 6,000

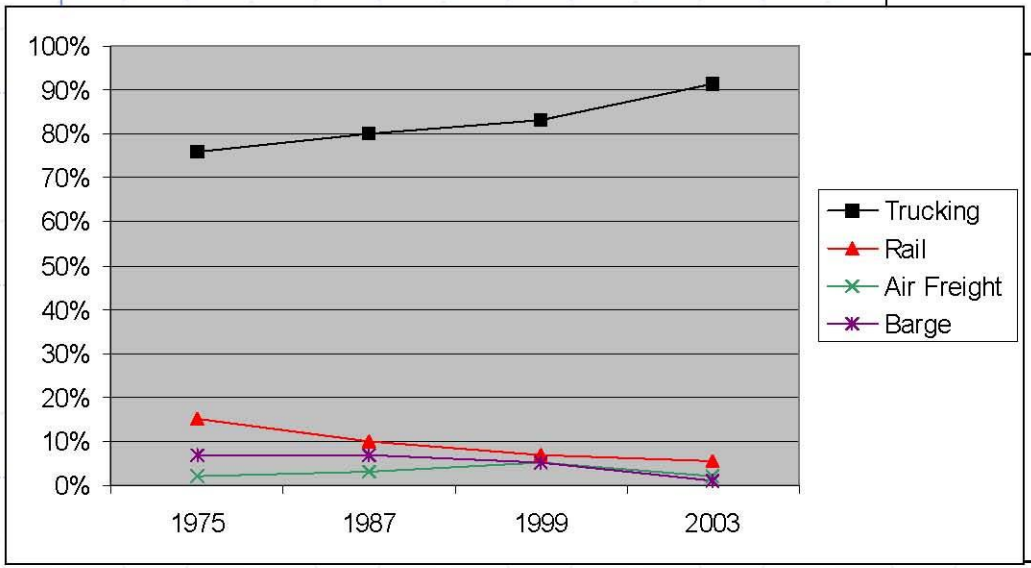
Mode Comparison Matrix

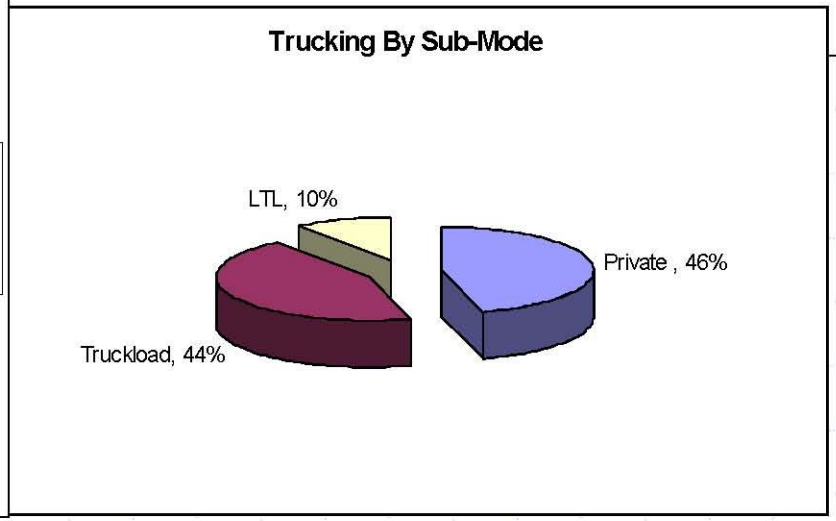
	Truck	Rail	Air	Water
Speed	Moderate	Slow	Fast	Slow
Availability	High	Moderate	Moderate	Low
Consistency (delivery time)	High	Moderate	Moderate	Low
Loss & Damage	Low	High	Low	Moderate
Flexibility	High	Low	Moderate	Low

Traditional Transport Modes (US)

Mode	2003 revenue ($B)	
Trucking	610	87%
Rail	36	5%
Intermodal	8	1%
Pipeline	27	4%
Air Freight	13	2%
Barge	8	1%
	702	100%







Logistics Managerial Issues

- Capital reduction vs. Operating cost reduction
- Service level improvement
- Cost vs. Level of service trade-off
- Sales vs. Level of service trade-off

Logistics Decisions

	Planning Horizon	Data	Decision maker	E.g.
Strategic	Up to several years	Very imprecise and incomplete	Top management	Facility location, layout
Tactical	Up to a year	Disaggregated data available	Middle management	Resource allocation, production and distribution planning
Operational	Days	Precise data available	Lower management	Order picking, vehicle dispatching

Back to book and Course Outline

- Book categorizes the logistics decisions in five main streams :
  - Forecasting
  - Designing logistics networks ch.3
  - Managing inventories
  - Warehouse management
  - Planning and controlling
    - long-haul ch.6
    - short-haul transportation ch.7

Tentative Course Outline

Topic	*Duration*
Introducing Logistics Systems	2 weeks
Introduction	
Logistics Managerial Issues	
Logistics Decisions	
3PL	
Reverse Logistics	
Designing the Logistics Network	3 weeks
Introduction	
Classification of Location Problems	
Single-Echelon Single Commodity Location Models	
Two-Echelon Multicommodity Location Models	

Tentative Course Outline

Topic	*Duration*
Planning and Managing Long-Haul Freight Transportation Introduction Classification of Transportation Problems Freight Traffic Assignment Problems Fixed Charge Network Design Models	3 weeks
Planning and Managing Short-Haul Freight Transportation Introduction Vehicle Routing Problems The Travelling Salesman Problems Integrated Location and Routing	2 weeks
Cases	2 weeks