



Distribution Logistics

IE 479

Personal Information

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Text Book

- Introduction to Logistics Systems Planning and Control, G. Ghiani, G. Laporte, R. Musmanno, Wiley, 2003, ISBN : 0-470-84917-7
- Lecture notes are **very** crucial

Course Grading Policy- Tentative

Midterm	25%
Final	30%
Article Presentation	10%
Projects (3)	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 very important (Latex is highly suggested)
- Project3 (5%)
 - A Class project!

2024 Fall Calendar

Week 1	September 17	Lecture 1
	September 17	Lecture 2
	September 19	Lecture 3
	September 19	Lecture 4

Week 2	September 24	Lecture 1
	September 24	Lecture 2
	September 26	Lecture 3
	September 26	Lecture 4

Week 3	October 1	Lecture 1
	October 1	Lecture 2
	October 3	NO CLASS
	October 3	NO CLASS

Week 4	October 8	Lecture 1
	October 8	Lecture 2
	October 10	Lecture 3
	October 10	Lecture 4

Week 5	October 15	Lecture 1
	October 15	Lecture 2
	October 17	Lecture 3
	October 17	Lecture 4

Week 6	October 22	MIDTERM
	October 22	
	October 24	
	October 24	

Week 7	October 29	NO CLASS
	October 29	NO CLASS
	October 31	Lecture 3
	October 31	Lecture 4

Week 8	November 5	Lecture 1
	November 5	Lecture 2
	November 7	Lecture 3

Week 9	November 12	Lecture 1
	November 12	Lecture 2
	November 14	Lecture 3

Week 10	November 19	Lecture 1
	November 19	Lecture 2
	November 21	NO CLASS

Week 11	November 26	Lecture 1
	November 26	Lecture 2
	November 28	Lecture 3

Week 12	December 3	Lecture 1
	December 3	Lecture 2
	December 5	Lecture 3

Week 13	December 10	Lecture 1
	December 10	Lecture 2
	December 12	Lecture 3

Week 14	December 17	Lecture 1
	December 17	Lecture 2
	December 19	Lecture 3

Course Webpage



Scan me!

- <https://courses.ie.bilkent.edu.tr/ie479/>



IE 479 Distribution Logistics

2024-2025 Fall

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Questions on Rules of the Game





Why Logistics?

CASE study: Shoes From China

- As a manufacturer, how should I ship my shoes from Shenzhen (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 (30k)
 - ◆ Truck
- Yantian (20k)
 - ◆ Rail
 - ◆ Truck
- Hong Kong (32k)
 - ◆ Rail
 - ◆ Truck
 - ◆ Barge

◆ In Hong Kong

- 9 container terminals

Figure by MIT OCW.

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)

■ **CSCCL – American Asia Southloop**

- ◆ Origins: Yantian (Sat) -> Hong Kong, Pusan
- ◆ Stops: Port of Los Angeles (16.5 days)



Figure by MIT OCW.

Inland Transportation in US



Figure by MIT OCW.

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

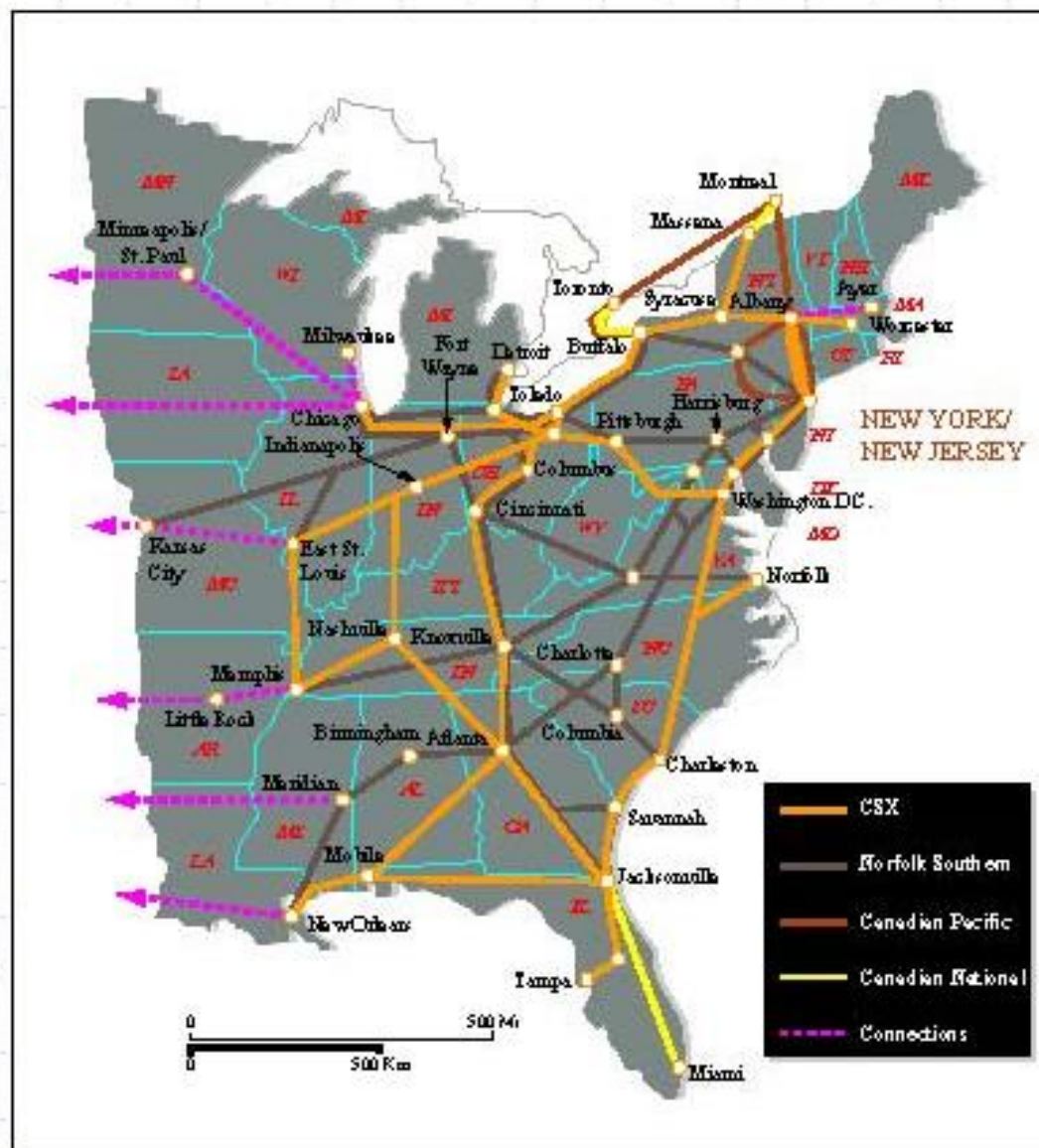


Figure by MIT OCW.

Transport Options

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

A background image showing a dense stack of multi-colored shipping containers in shades of red, blue, green, and yellow. The containers are stacked in a way that creates a strong sense of depth and perspective, with shadows cast between them. A semi-transparent white rectangular box is overlaid on the left side of the image, containing the text.

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

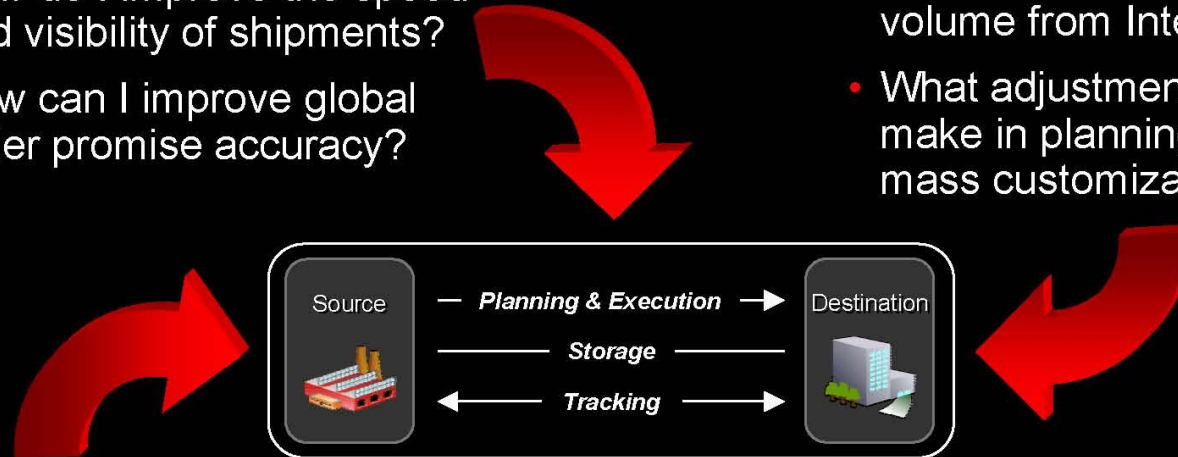
Business Pressures

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?



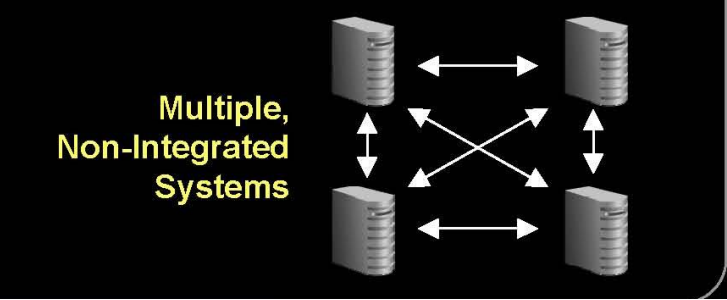
Increased Complexity

- 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



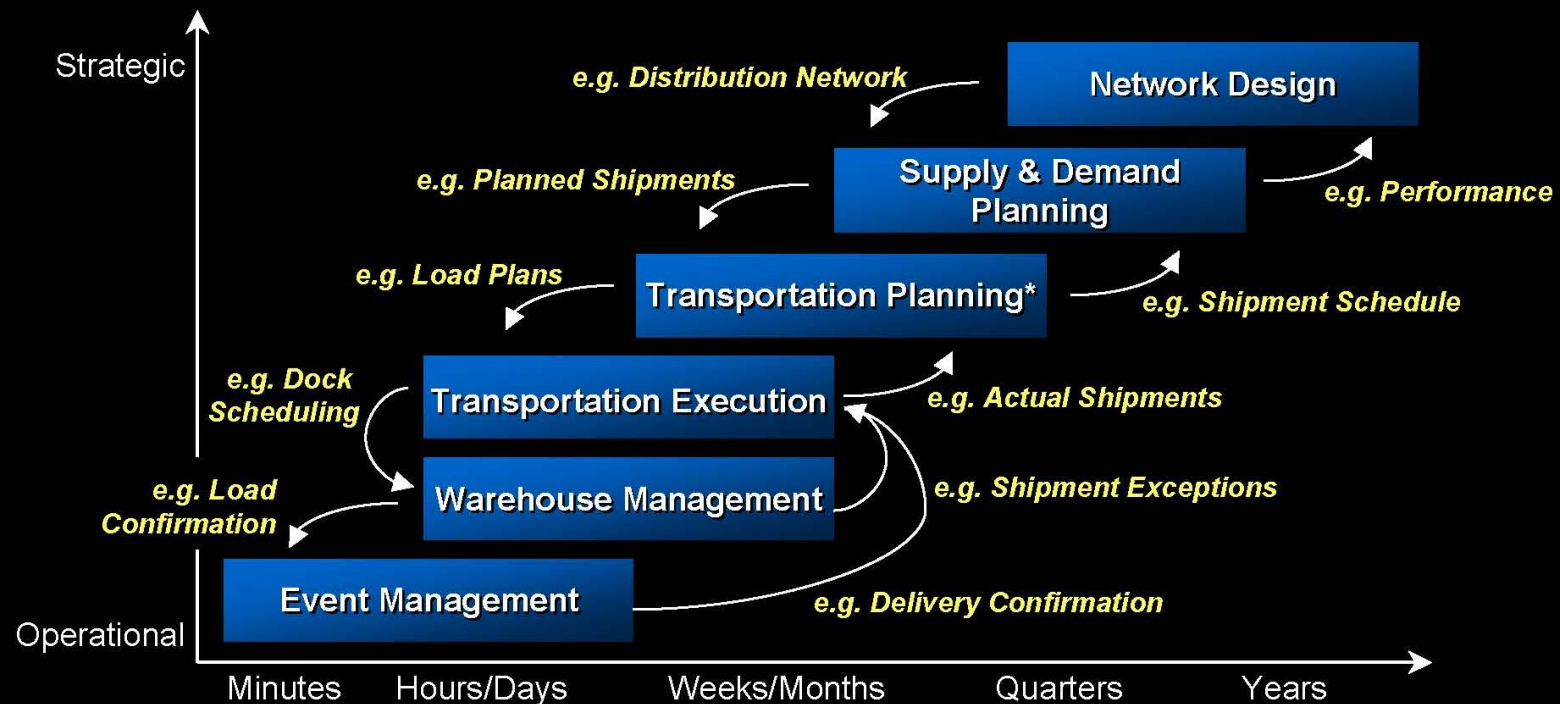
Flow

- Outbound
- Intra-Org
- Inbound
- Returns

ORACLE

Integrate Planning and Execution

Seamless Flow of Information





Distribution Logistics

IE 479

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

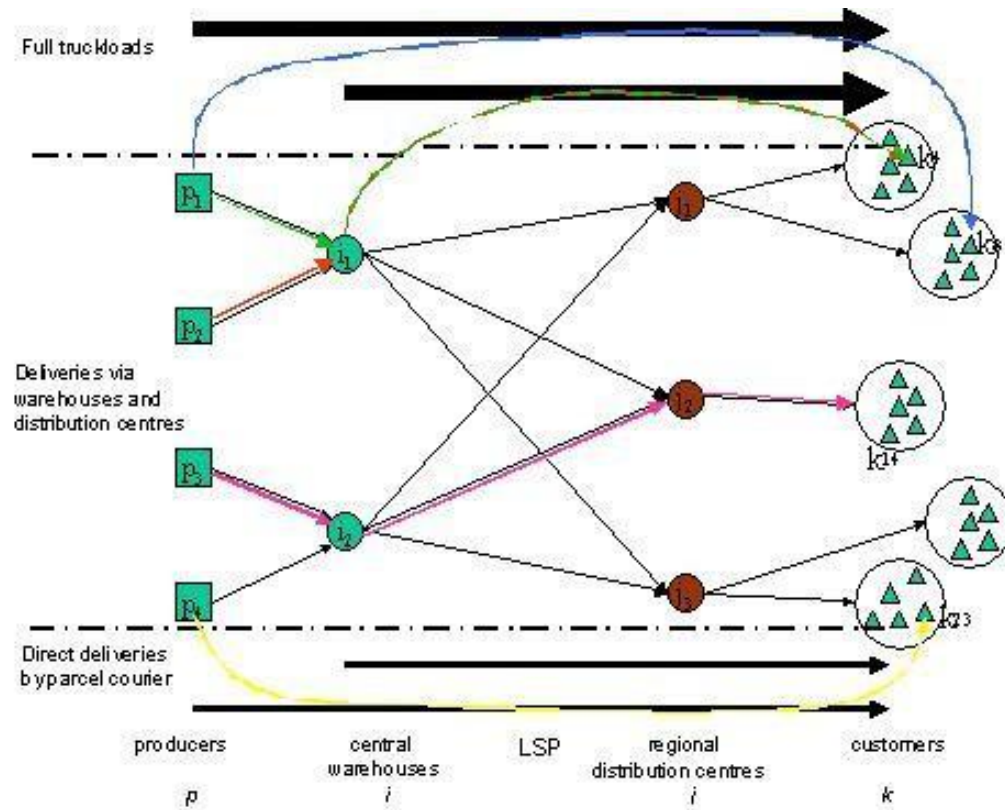
Logistics Decisions

- 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

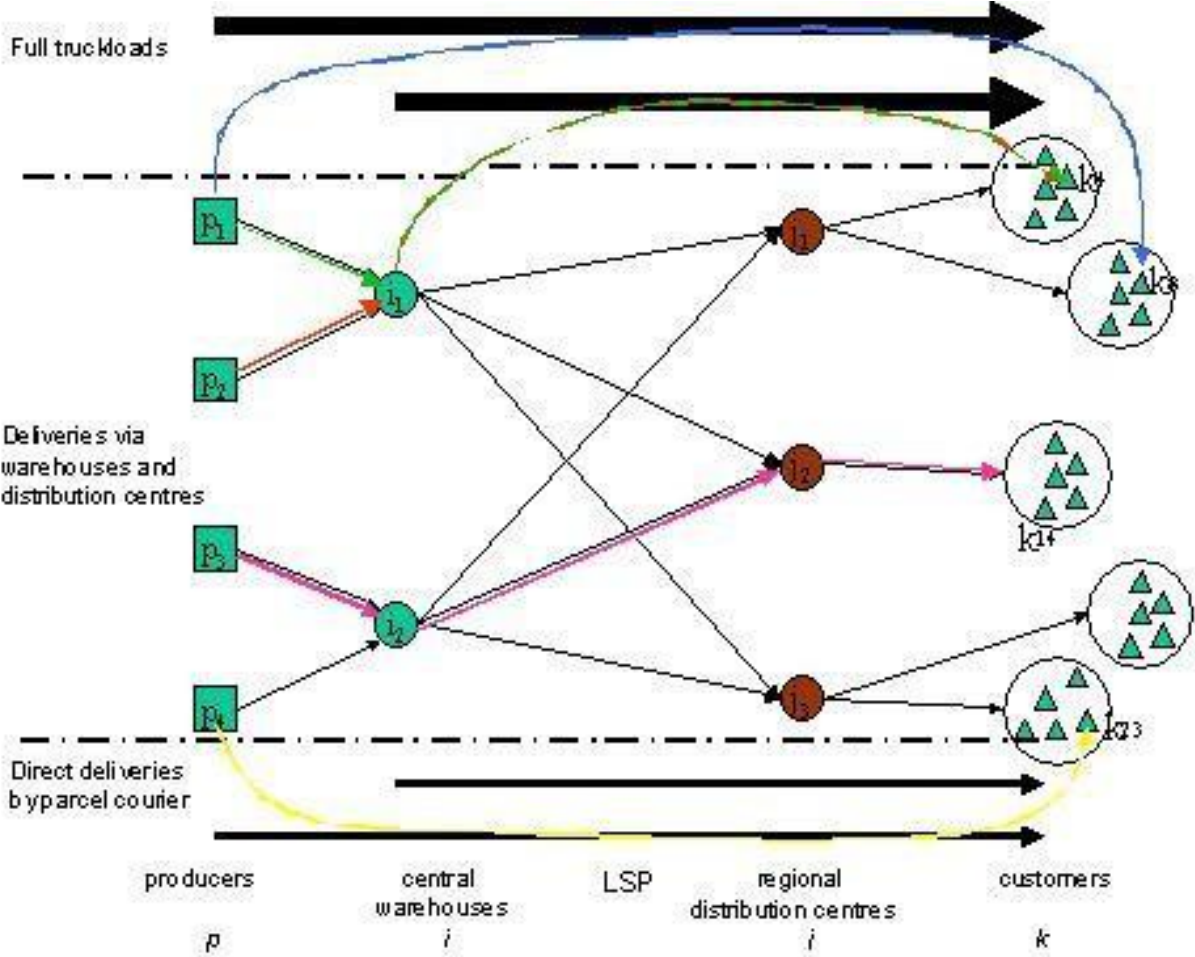
Freight Transportation

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

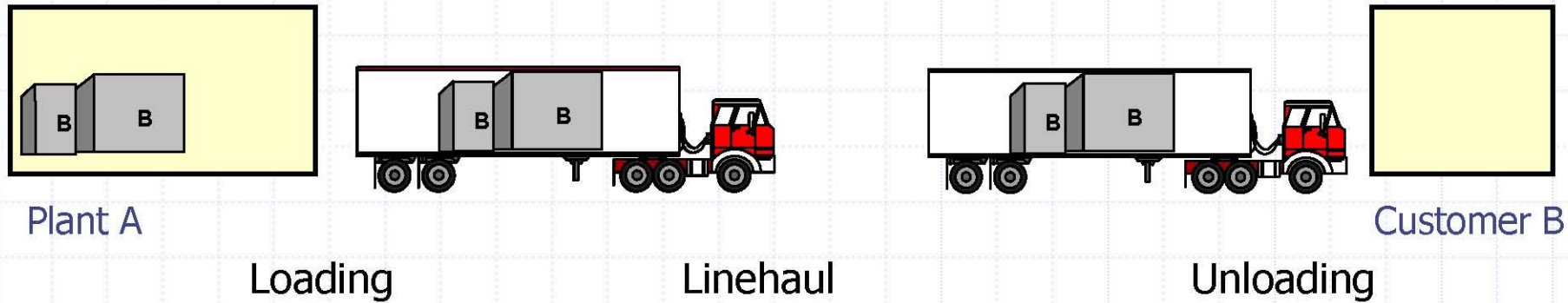
Freight Transportation

- 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



The Transportation Product



◆ Loading/Unloading

- Key drivers:
 - ◆ Number of items
 - ◆ Time
 - ◆ Stowability (Packaging)
- Not always symmetric

◆ Linehaul

- Key drivers:
 - ◆ Distance
 - ◆ Balance / Backhaul
- Impacted by network
 - ◆ Congestion
 - ◆ Connectivity

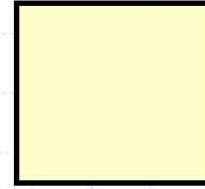
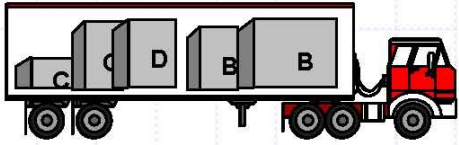
Freight consolidation

- *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

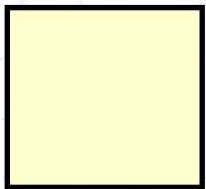
◆ Vehicle Routing

■ Key drivers:

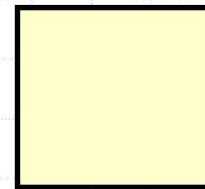
- ◆ Number/Density of stops
- ◆ Vehicle Capacity
- ◆ Time

■ Origin or Destination

- ◆ One to Many
- ◆ Many to One
- ◆ Interleaved

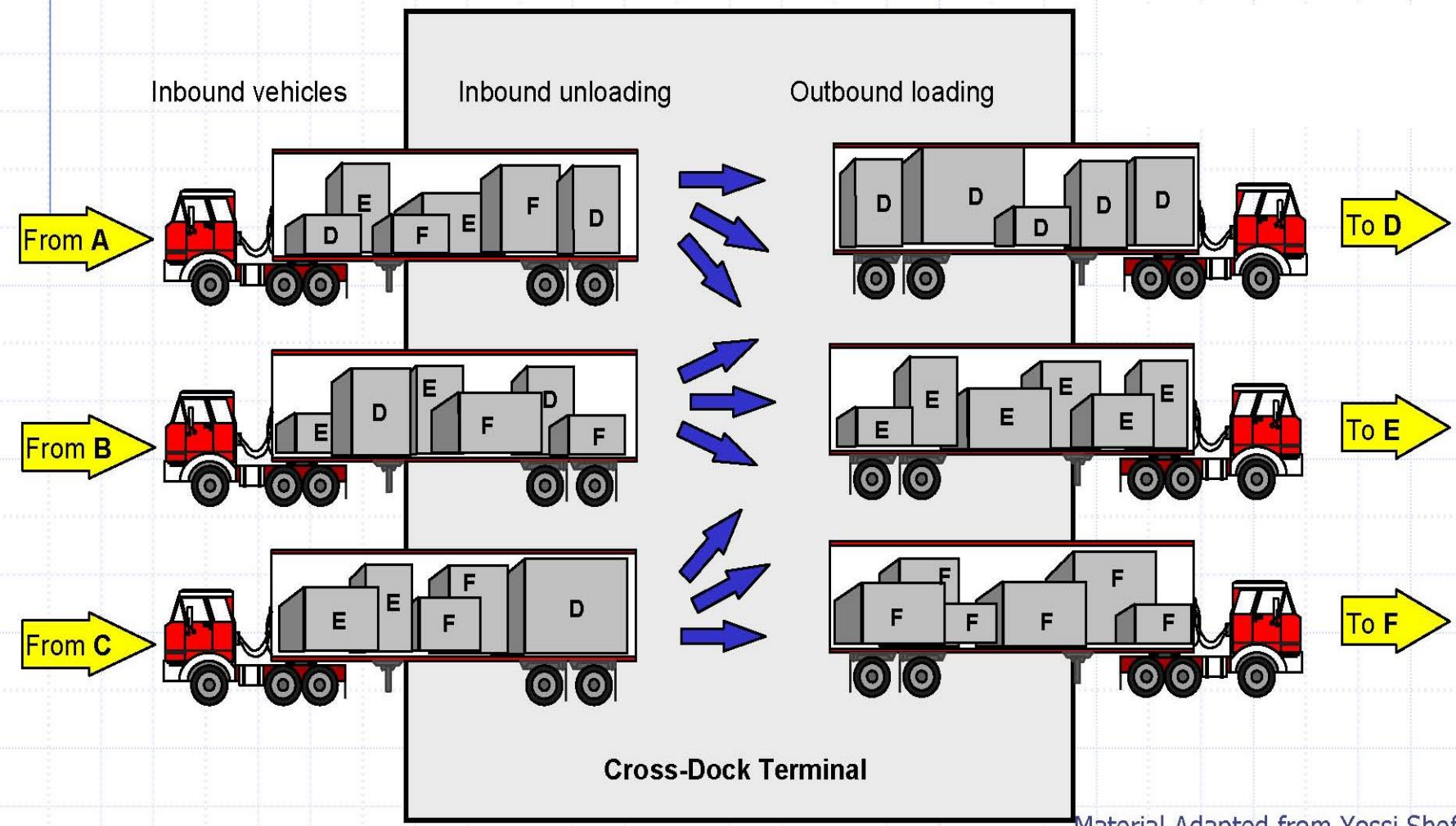


Customer D



Customer C

Facility consolidation



Material Adapted from Yossi Sheffi

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

◆ Discussed next lecture – Dr. Edgar Blanco

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

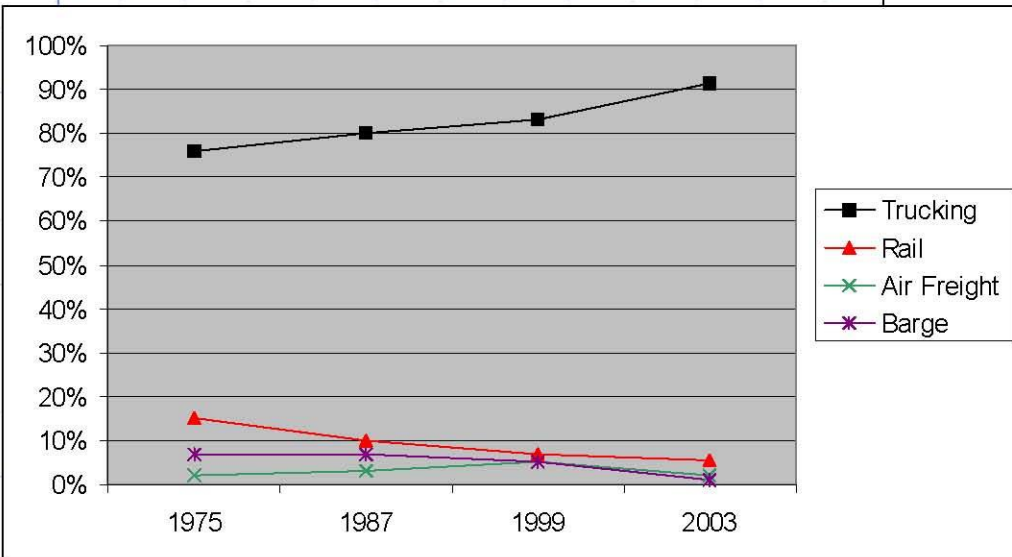
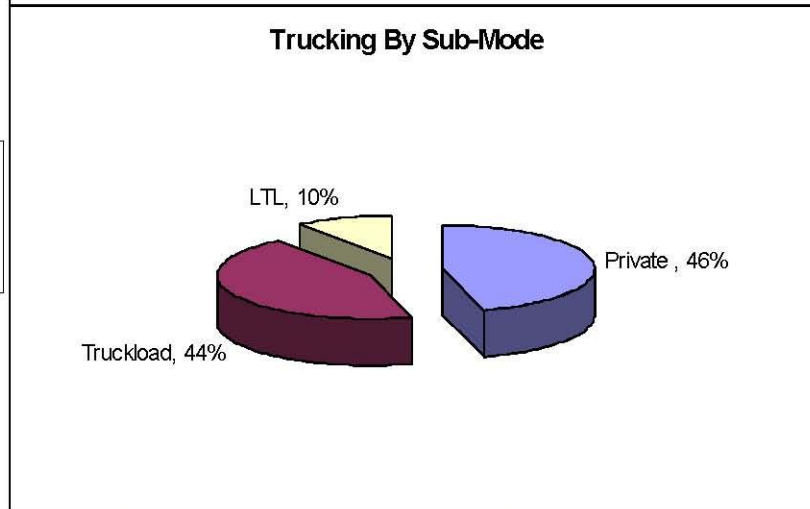
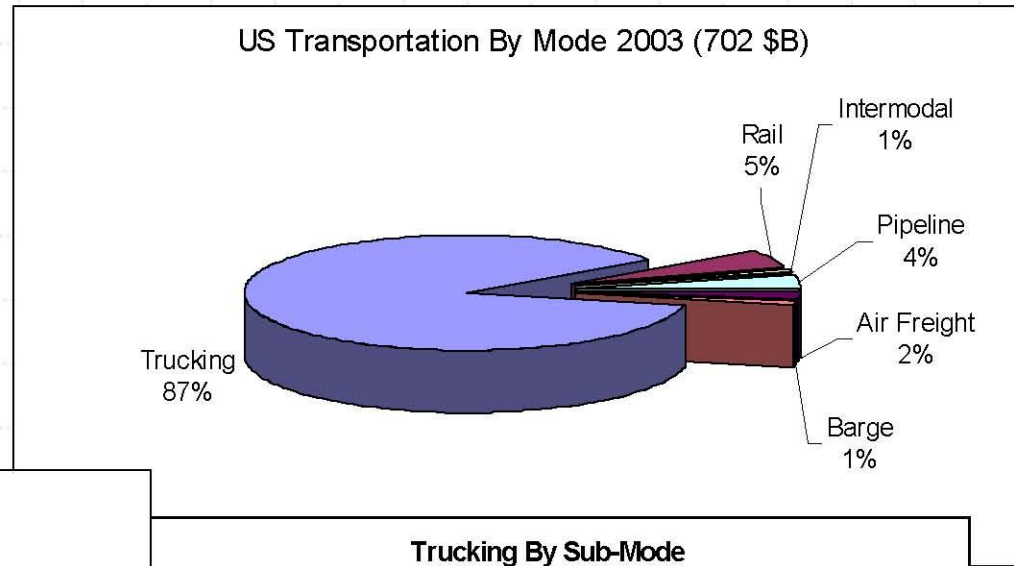
Mode Comparison Matrix

	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

	Truck	Rail	Air	Water	Pipeline
BTU/ Ton-Mile	2,800	670	42,000	680	490
Cents / Ton-Mile	7.50	1.40	21.90	0.30	0.27
Avg Length of Haul	300	500	1000	1000	300
Avg Speed (MPH)	40	20	400	10	5

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%



Note that these modes are all technology based – according to the type of power unit and guideways used.

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

<u>Topic</u>	<u>Duration</u>
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

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

Freight consolidation

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