

# ISM 125/225, LECTURE #18 (3/4/10)

## Agenda:

### 1. Transportation

- General considerations
- Transportation Network Options
- Transportation Network Design

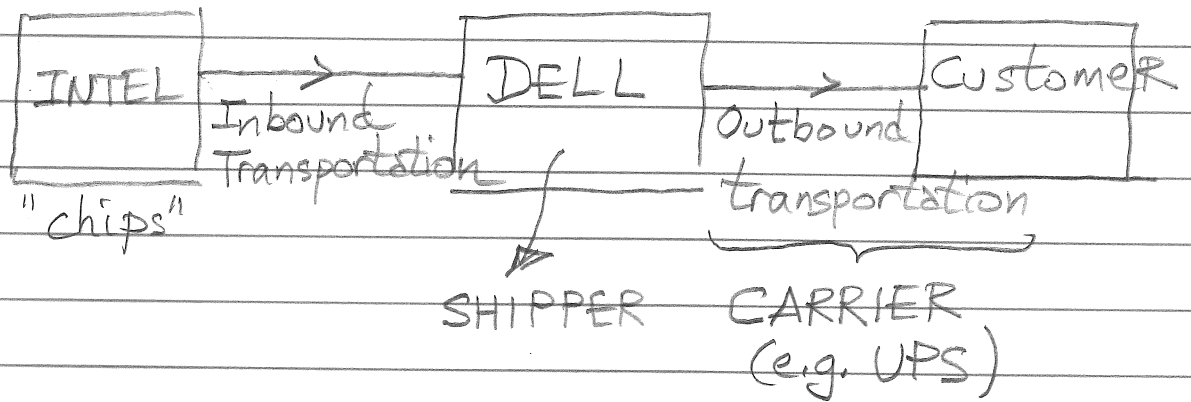
### 2. Safety Inventory : Aggregation

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## Comments

- HW #6 is due on Friday, by 4 PM, in the drop-box outside E2, Room 561
- HW #7 (covering the above two topics) is on the class website
- See Instructor for Project Review next week

# Transportation



"BUILD-TO-ORDER"

General Considerations in designing a transportation network

1. What is the function (purpose, role) of transportation [efficient? responsive]  
e.g. WALMART needs an efficient transportation system to lower overall costs

## 2. Decision Making

- The objective of the CARRIER (e.g. UPS) is to design the transportation network infrastructure (trucks, ships, routes, ...) (e.g. DELL)
- The objective of the shipper is to minimize the total transportation cost

### 3. Modes of transportation

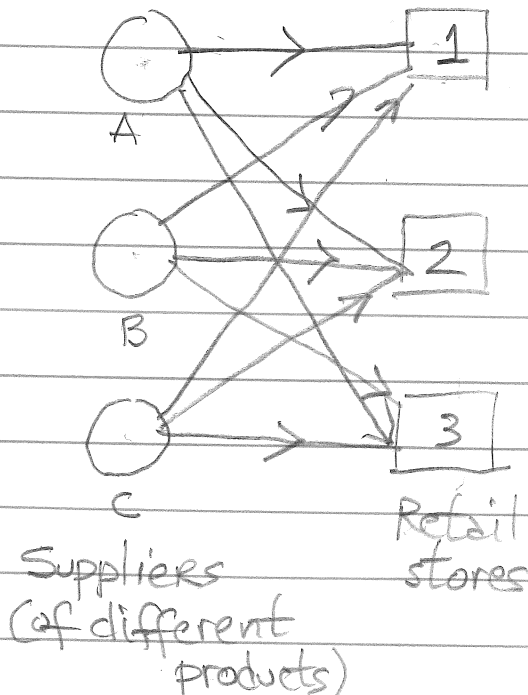
- Air, Ship (water), Rail, Truck, package (Fed Ex, UPS), .....

### 4. Transportation Network Design

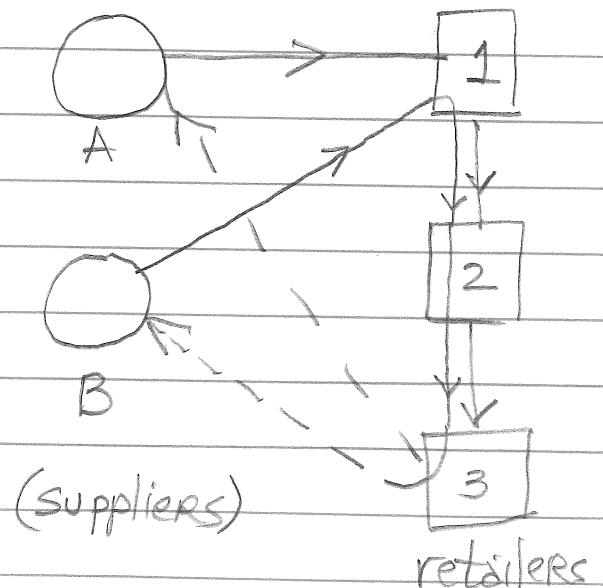
- modes (air, .....
- options (see below)
- aggregation: space, time, products.
- Routing

## 2. TRANSPORTATION NETWORK OPTIONS

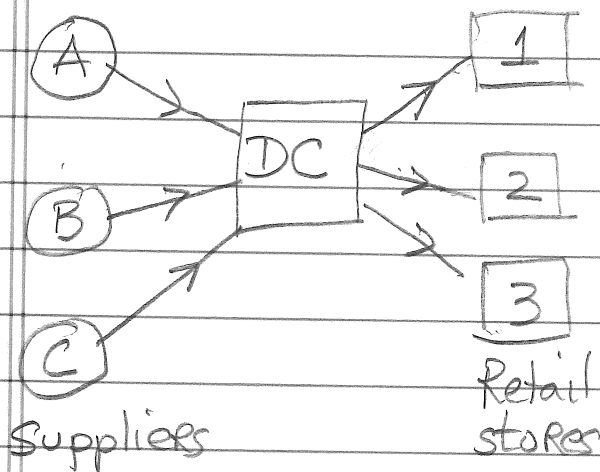
(i) Direct shipping Networks



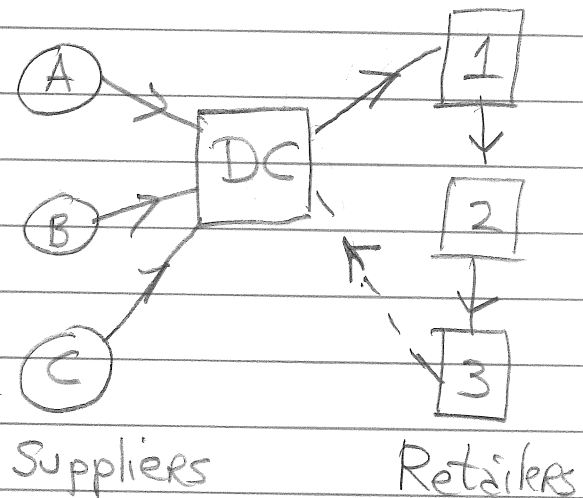
(ii) Direct shipping with Milk runs.



(iii) Shipping via  
a Central Distribution  
Center (DC)



(iv) Shipping using  
DC + milk  
runs



e.g. WALMART  
(cross-decking)

Please read Chapter on Transportation  
(Third Edition, Chapter 13)

→ See Table 13.2 (SCM, 3<sup>rd</sup> Edition)  
for the Pros & Cons of the  
above options



# TRANSPORTATION NETWORK DESIGN

Problem: Design the transportation network connecting suppliers to end-customers, with the objective of minimizing total cost.

Process (Five-Step):

Step 1: Q: Which mode of transportation should I choose?

A: Choose the mode of transportation (air, water, land) that minimizes total cost

Total cost  $\triangleq$  Transportation cost +  
(Inventory holding costs  
↳ (cycle + safety))

Create a table of options (see next page) → →

(1) Mode	(2) Lot size	(3) Transportation costs	(4) Cycle Inventory costs	(5) Safety Inventory costs	(6) In-transit Inventory costs	(7) Total Inventory costs	(8) Total cost (3)+(7)
Mode 1 (Air)							
Mode 2 (Truck)	Small Lot						
Mode 3 (Truck)	Medium Lot						
Mode 4 (Truck)	Large Lot						
...							

Pick the option that minimizes total cost (See the "Eastern Electric/Golden" example in Chapter 13 (Third Edition) of the text)

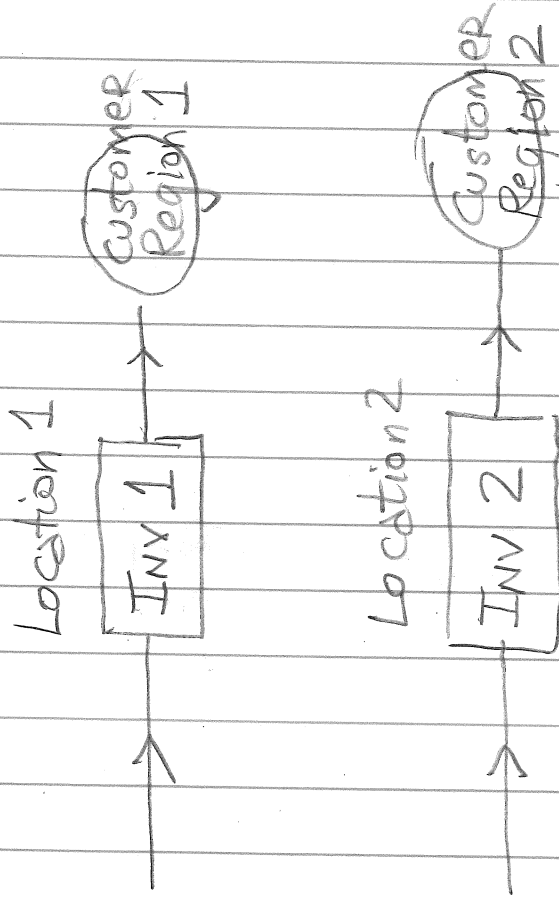
Comments

(A) Total Inventory cost = columns (4) + (5) + (6)

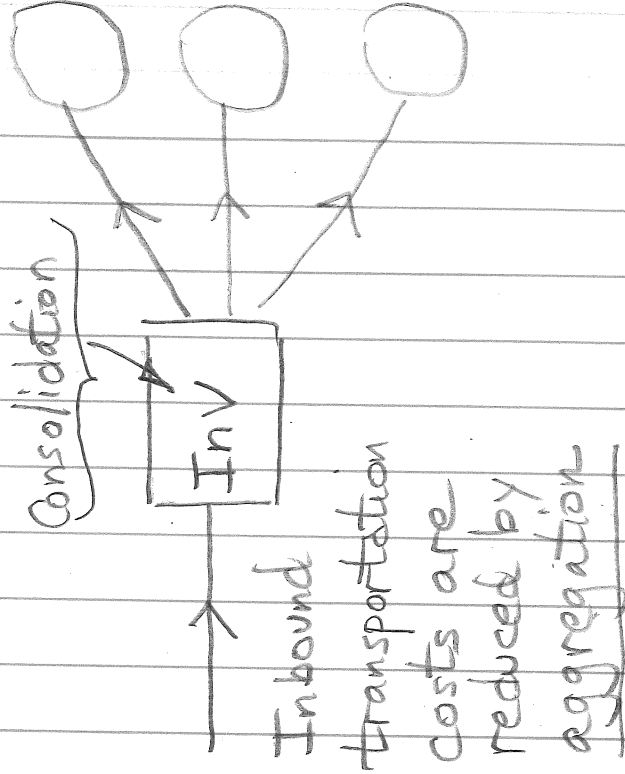
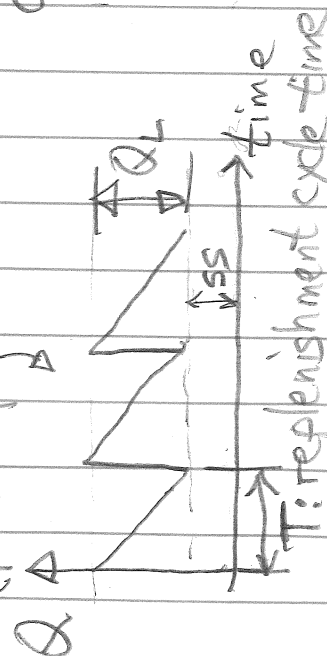
(B) Total Cost = columns (3) + (7) column 8

Step 2: Q: Should inventory be aggregated spatially?

A: Yes: explore options for spatial aggregation.



In-Bound transportation costs (for replenishment)  
 Outboard transportation costs: costs can be minimized if customers are responsible for pickup



Create a table of options

OPTIONS	SCENARIO 1	SCENARIO 2	SCENARIO 3	SCENARIO 4
Number of stocking locations $X$	$X = 50$ (say)	$X = 50$ (say)	$X = 1$ (complete aggregation)	?
Replenishment interval, $T$	4 weeks (say)	2 weeks (say)	1 week	
- Cycle Inventory cost	---	---	---	---
- Safety Inv. Cost	---	---	---	---
Annual Inv. Cost	---	---	---	---
Shipment Type	Replenishment	R	R	Customer Order
Shipment Size				
Shipment weight				
Annual Transportation cost				
Annual Total Cost = Annual Inv Cost + Annual Transportation Cost				

Select the scenario that minimizes the total annual cost

→ See "HIGH MED" example in the Transportation chapter of the text

STEP 3

Q: Should orders be aggregated in time (temporal)

Explore options for temporal aggregation

Aggregation in time will reduce transportation costs (i.e. improve efficiency), but will reduce responsiveness to customers (because of the delay in shipping items to the customers).

Create a table of options:

see next page for an example



Day	Demand (actual customer orders)	2-day response		3-day response		4-day response	
		Quantity shipped	Cost	Quantity shipped	Cost	Qty. shipped	Cost
1	X (# of orders)	X	\$ C <sub>1</sub>	0	0	0	0
2	Y	Y	\$ C <sub>2</sub>	(X+Y)	\$ C <sub>1</sub>	0	0
3	Z	Z	\$ C <sub>3</sub>	0	0	(X+Y+Z)	\$ C <sub>1</sub>
4	W	W	\$ C <sub>4</sub>	(Z+W)	\$ C <sub>2</sub>	0	0
5	V	V	\$ C <sub>5</sub>	0	0	0	0
6	U	U	\$ C <sub>6</sub>	(V+U)	\$ C <sub>3</sub>	(W+V+U)	\$ C <sub>2</sub>
TOTAL COST			\$ (C <sub>1</sub> +C <sub>2</sub> +C <sub>3</sub> +C <sub>4</sub> +C <sub>5</sub> +C <sub>6</sub> )		\$ (C <sub>1</sub> +C <sub>2</sub> +C <sub>3</sub> )		\$ (C <sub>1</sub> +C <sub>2</sub> )

STEP 4 : Explore Tailored  
Transportation

- by Customer Density  
and Distance
- by Product Demand &  
Value

See Section 13.6 &  
Tables 13.9 & 13.10

STEP 5 : Plan the routing &  
scheduling of deliveries  
(operational decisions) based  
- savings matrix method  
- generalized assignment  
method  
(SCM, Second Edition)  
section 14.7).