Problem 01
Which Transport

• Basic Modes of Transportation
• Types of Air and Ocean Carriers and its Characteristics
• Transportation Mode Selection
Basic Modes of Transportation

• There are 5 basic modes of transportation
  a) Rail
  b) Motor
  c) Water
  d) Pipeline
  e) Air
Mode of Transport — Rail

• Rail is a long haul, large volume system
  ▪ High fixed costs; own rights-of-way.

• Capable of carrying a wide variety of products
  ▪ E.g. Raw materials such as coal, lumber or low-valued manufactured products such as paper and wood products

• Reliability and safety are improving and are generally good.

• Accessibility can be a problem.

• Transit times are spotty and generally long
Mode of Transport — Motor Carriers

- Low cost of entry
  - Consists of for-hire and private carriers
- Characterized by low fixed costs and high variable costs.
- Do not own their rights-of-way.
- Limited operating authority regarding service areas, routes, rates and products carried.
- High accessibility; can offer door-to-door, speed and convenience
- Transit times faster than rail or water.
- Reliability can be affected greatly by weather.
- Relatively high cost compared to rail and water
  - More labor intensive
  - Trade-off is faster service
Mode of Transport — **Water Carriers**

- Relatively low cost mode; do not own rights-of-way; easy entry and exit.
- Typically a long distance mover of low value, bulk-type mineral, agricultural and forest products.
- Low rates but long transit times.
- Low accessibility.
- Vessels can operate according to a fixed schedule, called liner vessels, or only when it is chartered (or hired) from the ship operator, thus called tramp vessels.
Types of Water Carriers

- **Container Ships**
  - Specifically designed to carry 20 or 40 foot long containers
  - Containerization speed up the process of loading and unloading, minimizing idle time
  - measured according to number of 20 foot equivalent unit (TEUs)

- **Tankers**
  - Specially designed for liquid cargoes, e.g. crude oil and refined petroleum
  - Fitted with pumps and pipes to load and discharge liquid cargo
Types of Water Carriers

• **RO-RO (Roll on-Roll off)**
  - Basically a large ferry that facilitates the loading and unloading process by using drive on/off ramps
  - Designed to carry automobiles and heavy trucks as primary cargo

• **LASH (Lighter Aboard Ship)**
  - Designed to carry lighters (barges), where they are lifted by crane over the stern (rear) of the vessel
Types of Water Carriers

• **Bulk carriers**
  - Large compartments for carrying loads of ore, grain or coal
  - Entire ship is used for the same type of cargo

• **LNG/ LPG carriers**
  - Specially constructed to carry liquefied natural gas and liquefied petroleum gas in special pressurized tanks
Mode of Transport — **Pipeline**

- Limited range of services and capabilities, thus not suitable for general transportation
- Accessibility is very low
- Cost structure is highly fixed with low variable costs.
- Own rights-of-way much like the railroads.
- High dependability due to few interruptions to cause transit time variability
- High capacity and products are able to move 24/7
Mode of Transport — Air Carriers

- Constitutes the newest and the least used method of transporting cargo
- All air carriers can carry air freight but air freighters haul freight only
- Cost structure is highly variable; do not own rights-of-way
- Transit times are fastest but rates are also highest
  - Well-suited to carrying valuable, fragile and perishable cargoes
- Air-service dependability can be rated as good under normal operating conditions, and has a distinct advantage in terms of loss and damage
Types of Air Carriers

- All-Cargo Airline (Freighters)
  - Provide point-to-point service for air freight forwarders, either as common carriers or under guaranteed-space agreements
    - E.g. Polar Air Cargo, SIA Cargo, Lufthansa Cargo
  - Some others, like Atlas Air and Air Transport International, primarily operate aircraft on a contract basis for other airlines
Types of Air Carriers

• Integrated carriers (Express Carriers)
  ✓ Operate door to door freight transportation networks that include own cargo aircraft, delivery vehicles, sorting hubs, and advance info systems to provide international delivery service
  E.g. FedEx, UPS, DHL

• Combination Carrier
  ✓ Carries passengers and cargo
  ✓ Primarily offers point-to-point services on wholesale basis
  ✓ Relying on Freight Forwarders for pickups, delivery, sales to shippers and customer service
# Transportation Desirability Criteria

<table>
<thead>
<tr>
<th>Mode</th>
<th>Cost</th>
<th>Speed</th>
<th>Reliability</th>
<th>Capability</th>
<th>Accessibility</th>
<th>Security</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Road</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Water</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Air</td>
<td>1</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Pipeline</td>
<td>5</td>
<td>--</td>
<td>--</td>
<td>1</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

1 = Least desirable  5 = Most desirable

Besides freight rate, other determinants are also important in the selection of transportation mode.

### FIGURE 9-3 Importance Ranking of Carrier Selection Determinants

<table>
<thead>
<tr>
<th>Determinant</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transit time reliability or consistency</td>
<td>1</td>
</tr>
<tr>
<td>Door-to-door transportation rates or costs</td>
<td>2</td>
</tr>
<tr>
<td>Total door-to-door transit time</td>
<td>3</td>
</tr>
<tr>
<td>Willingness of carrier to negotiate rate changes</td>
<td>4</td>
</tr>
<tr>
<td>Financial stability of the carrier</td>
<td>5</td>
</tr>
<tr>
<td>Equipment availability</td>
<td>6</td>
</tr>
<tr>
<td>Frequency of service</td>
<td>7</td>
</tr>
<tr>
<td>Pickup and delivery service</td>
<td>8</td>
</tr>
<tr>
<td>Freight loss and damage</td>
<td>9</td>
</tr>
<tr>
<td>Shipment expediting</td>
<td>10</td>
</tr>
<tr>
<td>Quality of operating personnel</td>
<td>11</td>
</tr>
<tr>
<td>Shipment tracing</td>
<td>12</td>
</tr>
<tr>
<td>Willingness of carrier to negotiate service changes</td>
<td>13</td>
</tr>
<tr>
<td>Scheduling flexibility</td>
<td>14</td>
</tr>
<tr>
<td>Line-haul services</td>
<td>15</td>
</tr>
<tr>
<td>Claims processing</td>
<td>16</td>
</tr>
<tr>
<td>Quality of carrier salesmanship</td>
<td>17</td>
</tr>
<tr>
<td>Special equipment</td>
<td>18</td>
</tr>
</tbody>
</table>

Basic Cost Trade-Offs

Steps:

• Find the transportation costs for each mode with in-transit inventory
• Find the In-transit inventory costs for each mode
• Sum both of the above to find the total cost
• Select the lowest total cost transport mode
Basic Cost Trade-Offs

- The longer the door-to-door transit time, the higher the inventory cost in transit.
- Annual cost of carrying this in-transit inventory is \( I \times C \times D \times T / 365 \)
  - \( I \): Inventory Carrying cost of 1 unit
  - \( C \): Value of one unit
  - \( D \): Annual Demand
  - \( T \): Time in Transit
Competitive Considerations

• Selection of transport mode may be used to create a competitive service advantage

• To Customer, a better transport service means lower inventory levels maintained and operating schedules met with greater certainty

• To Supplier, profits can be higher from the increase business, even from a more expensive transportation mode
Problem Statement

Method 1 - Basic Cost Trade-Offs

<table>
<thead>
<tr>
<th>Mode</th>
<th>Rail</th>
<th>Sea</th>
<th>Truck</th>
<th>Air</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transportation Costs per kg ($R)</td>
<td>0.15</td>
<td>0.10</td>
<td>0.20</td>
<td>1.50</td>
</tr>
<tr>
<td>Door-to-Door Transit Time in days (T)</td>
<td>4</td>
<td>7</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

\[
\text{Transportation Costs} (\$) = R \times D
\]

<table>
<thead>
<tr>
<th>Calculation</th>
<th>Rail</th>
<th>Sea</th>
<th>Truck</th>
<th>Air</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transportation Costs ($R) = R x D</td>
<td>75,000</td>
<td>50,000</td>
<td>100,000</td>
<td>750,000</td>
</tr>
<tr>
<td>In-Transit Inventory Costs = ICDT/365</td>
<td>2,055</td>
<td>3,596</td>
<td>1,541</td>
<td>514</td>
</tr>
<tr>
<td><strong>Total Costs</strong></td>
<td>77,055</td>
<td>53,596</td>
<td>101,541</td>
<td>750,514</td>
</tr>
</tbody>
</table>

- Sea transport offers the **lowest total cost** even though air transport offers the lowest In-Transit Inventory cost.
Method 2 – Competitive Considerations

Sample Calculation (Sea Mode):
Volume Sold for Sea Transport Mode (per month) = 50,000/2
= 25,000 kg

Gross Profit on each kg = $2.50 x 30%
= $0.75

Total Gross Profit (per month) = $0.75 x 25,000 kg
= $18,750

Transport Cost (per month) = Transport Rate x Volume in kg
= $0.10 x 25,000
= $2,500

Total Net Profit (per month) = $18,750 - $2,500
= $16,250
Problem Statement

Method 2 – Competitive Considerations

<table>
<thead>
<tr>
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<th>Truck</th>
<th>Air</th>
</tr>
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<tbody>
<tr>
<td>Transportation Rate per kg ($R)</td>
<td>0.15</td>
<td>0.10</td>
<td>0.20</td>
<td>1.50</td>
</tr>
<tr>
<td>Lead Time in days (T)</td>
<td>4</td>
<td>7</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

**Calculation**

<table>
<thead>
<tr>
<th>If NT chooses…</th>
<th>Rail</th>
<th>Sea</th>
<th>Truck</th>
<th>Air</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume sold in kg</td>
<td>25,750</td>
<td>25,000</td>
<td>26,000</td>
<td>26,500</td>
</tr>
<tr>
<td>Gross Profit</td>
<td>19,313</td>
<td>18,750</td>
<td>19,500</td>
<td>19,875</td>
</tr>
<tr>
<td>Transport Cost</td>
<td>3,863</td>
<td>2,500</td>
<td>5,200</td>
<td>39,750</td>
</tr>
<tr>
<td><strong>Net Profit</strong></td>
<td>15,450</td>
<td><strong>16,250</strong></td>
<td>14,300</td>
<td>(19,875)</td>
</tr>
</tbody>
</table>

Note: We assume that transport cost to be the only cost used in the computation of net profit

- Even though **sea freight** offers the lowest gross profit, it has the **highest overall net profit**
Problem Statement

• Based on **Basic Cost Trade-Offs and Competitive Considerations**, **sea freight** is selected as the best transportation mode.

• In reality, other considerations like Characteristics in Transportation Service Selection & Transportation Desirability may also be taken, when more information is available.
Learning Outcome

• Basic Modes of Transportation
• Types of Carriers and their Characteristics
• Transportation Mode Selection