

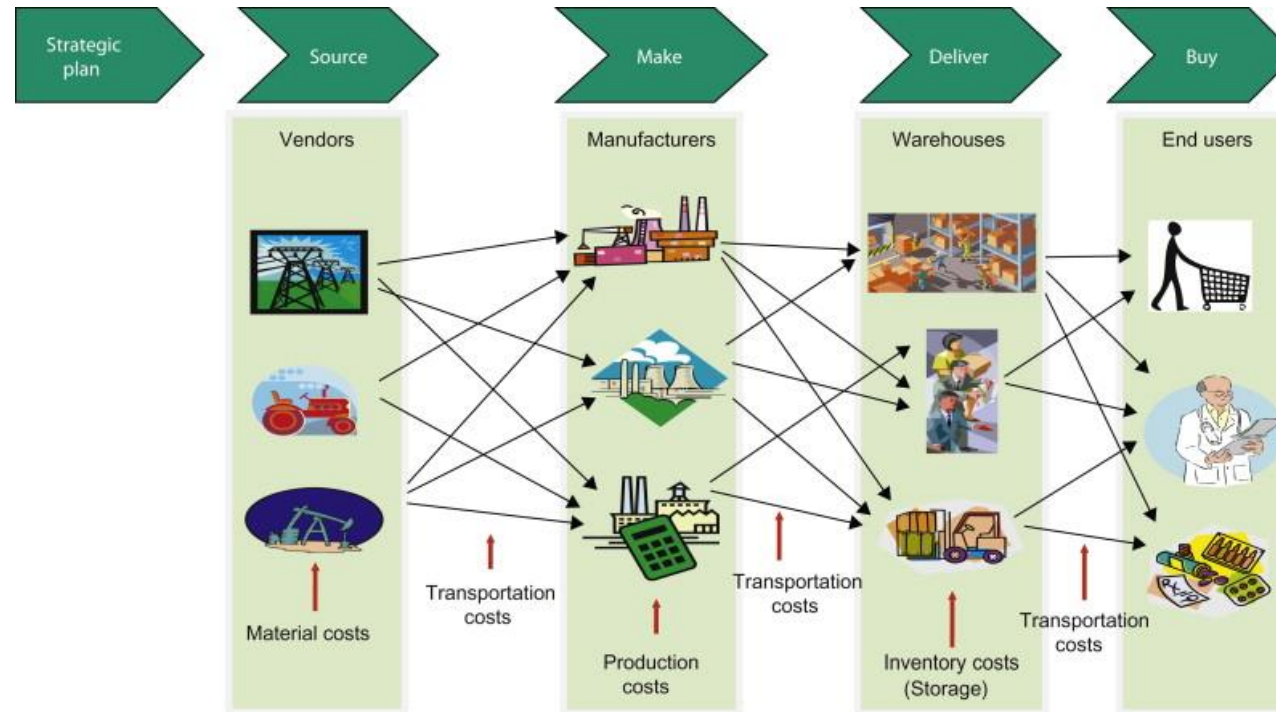
# Logistics Optimization

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# Logistics Planning and Optimization



- Logistics planning is the process of integrating and utilizing suppliers, manufacturers, warehouses, and retailers so that products are produced and delivered at the right quantities and at the right time while minimizing costs and satisfying customer requirements .
- Implementation of Logistics system has crucial impacts on a company's financial performance.

The six major cost components that form the overall logistics costs are:

(1) raw material costs, (2) costs of raw material transportation from vendors to manufacturing plants, (3) production costs at manufacturing plants, (4) transportation costs from plants to warehouses, (5) inventory or storage costs at warehouses, and (6) transportation costs from warehouses to end users.

# Typical Logistics Problems

- **Transport1** - Transportation Model: Determine how many products to ship from each factory to each warehouse, to minimize shipping cost while meeting warehouse demands and not exceeding factory supplies
- **Transport2** - Multi-Level Transportation Model: Determine how many products to ship from each factory to each warehouse and each customer, to minimize total shipping cost while meeting demands and not exceeding warehouse capacities and factory supplies
- **Transport3** - Multi-Level, Multi-Commodity Transportation Model: Determine how many products of several different types to ship from each factory to each warehouse and each customer, to minimize total shipping cost while meeting demands and not exceeding capacities and supplies
- **Knapsack** - Partial Loading - Decide which sizes or types of products to load into a vehicle, given its size limits, to best meet demand or to minimize wasted space
- **Facility** - Facility Location: Determine which (if any) plants to close to minimize total costs, which include fixed operating costs and shipping costs from plants to warehouses
- **Prod+Tran** - Production / Transportation Model: Determine how many products to produce in each factory and ship to warehouses and customers, to minimize overall costs while meeting demands and not exceeding warehouse capacities and factory supplies

# Sigle-Stage-Multi-Commodity Transportation Problem

Shipment Cost/Unit From Factories To Customers

Factories	Products	Customer-1	Customer-2	Customer-3	Customer-4	Customer-5	Customer-6	Customer-7	Customer-8	Customer-9	Customer-10
Factory-1	Prod-1	2	2.5	3	1.5	2	4	3	1.25	3.75	5
	Prod-2	4.5	3.5	1.25	2	2.5	1.25	2	4	2	2.5
	Prod-3	1.5	2	1.25	3	3.5	5	5.5	2	1	1.25
factory-2	Prod-1	4	1.5	5	1.25	1.5	1	3	4	2.5	4
	Prod-2	1.25	3	1.5	1.5	4	2	1	1.5	2	1.5
	Prod-3	2.5	1.75	2	3	3.5	2.5	1.75	3	4	2.25

Customers Demand in Units

Products	Customer-1	Customer-2	Customer-3	Customer-4	Customer-5	Customer-6	Customer-7	Customer-8	Customer-9	Customer-10
Prod-1	500	1000	1500	2000	2500	3000	3500	4000	4500	5000
Prod-2	5000	4500	4000	3500	3000	2500	2000	1500	1000	500
Prod-3	1000	4000	1000	4000	1000	4000	1000	4000	1000	4000

Factories Capacity in Units

Factories	Products	Capacity
Factory-1	Prod-1	15000
	Prod-2	16000
	Prod-3	17000
factory-2	Prod-1	17000
	Prod-2	16000
	Prod-3	15000

Problems:

- One needs to minimize shipment cost to deliver 3 products from 2 factories to 10 customers.
- With given customer demand in each product and factory capacities.

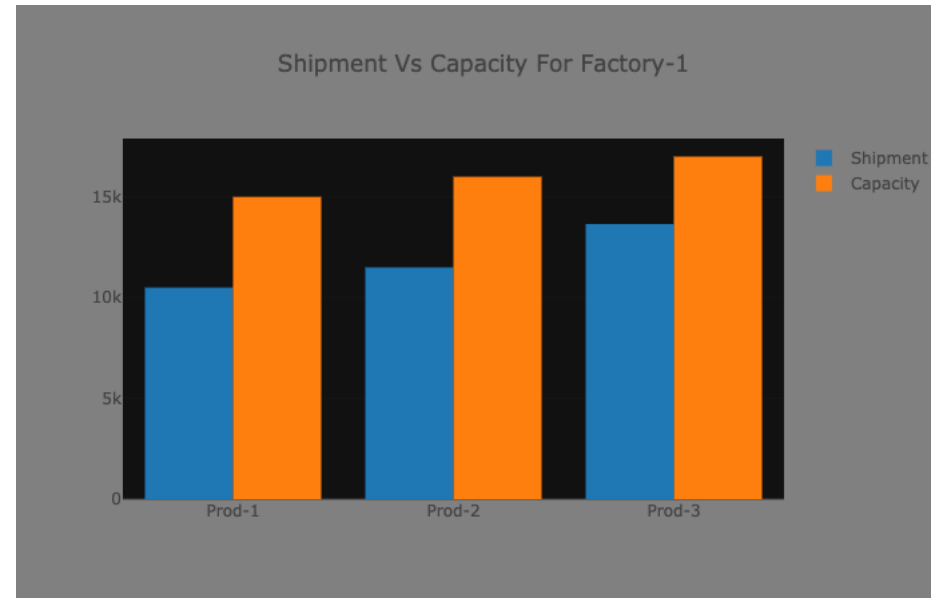
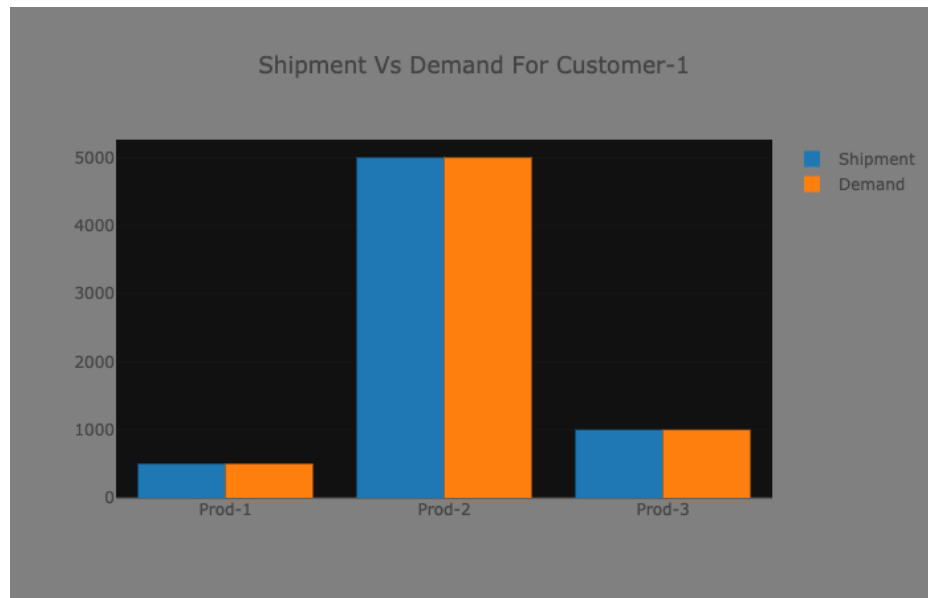
# Sigle-Stage-Multi-Commodity Transportation Solution

The Total Optimum Shipment Cost

162375.0

Shipment From Factories To Customers

		Customer-1	Customer-2	Customer-3	Customer-4	Customer-5	Customer-6	Customer-7	Customer-8	Customer-9
<b>Factories</b>	<b>Products</b>									
Factory-1	Prod-1	500	0	1500	1000	0	0	3500	4000	0
	Prod-2	0	371	4000	629	3000	2500	0	0	1000
	Prod-3	1000	0	1000	2146	506	0	0	4000	1000
factory-2	Prod-1	0	1000	0	1000	2500	3000	0	0	4500
	Prod-2	5000	4129	0	2871	0	0	2000	1500	0
	Prod-3	0	4000	0	1854	494	4000	1000	0	0



# Facility Choosing Decision Transportation Problem

- We have to shutdown or choose some facilities in cases where the production capacity is much higher than the demand.
- Here we have to consider the total cost (Fixed operation cost + Production cost + Transportation cost) and do optimization to decide which facilities have to be chosen or shutdown , while not exceeding the supply available from each chosen facilities and meeting the demand of each destination.
- Input of the model are Number of facilities(Sources), Number of warehouses(Destinations), Commodity list of each facilities, Shipment cost per unit of commodities from each facility to each warehouses, Fixed operation cost of each facilities, Production cost per unit of commodities at each facilities, Production capacity of commodities at each facility and Demand of commodities at each warehouse.

Facilities	Products	Warehouse-1	Warehouse-2	Warehouse-3	Warehouse-4
Facility-1	Prod-1	4	2.5	1.2	2.2
	Prod-2	3.5	2	0.7	1.7
Facility-2	Prod-1	2	2.6	1.8	2.6
	Prod-2	1.5	2.1	1.3	2.1
Facility-3	Prod-1	3	3.4	2.6	3.1
	Prod-2	2.5	2.9	2.1	2.6
Facility-4	Prod-1	2.5	3	4.1	3.7
	Prod-2	2	2.5	3.6	3.2
Facility-5	Prod-1	4.5	4	3	3.2
	Prod-2	4	3.5	2.5	2.7

Facilities	Products	Production Cost
Facility-1	Prod-1	6
	Prod-2	5.5
Facility-2	Prod-1	5.75
	Prod-2	5
Facility-3	Prod-1	7
	Prod-2	4.5
Facility-4	Prod-1	6
	Prod-2	6.75
Facility-5	Prod-1	5
	Prod-2	4

Products	Fixed Operation Cost
Facility-1	25000
Facility-2	25000
Facility-3	25000
Facility-4	25000
Facility-5	25000

# Facility Choosing Decision Transportation Solution

Optimum Solution For All Possible Combinations

Table Description

	Facility-1	Facility-2	Facility-3	Facility-4	Facility-5	Trans/Prod	Fix:Oper:	Total Cost
<input checked="" type="radio"/>	1	1	0	1	1	1117600	75000	1192600
<input type="radio"/>	1	1	0	0	1	1117600	75000	1192600
<input type="radio"/>	1	1	1	1	1	1115800	100000	1215800
<input type="radio"/>	1	1	1	0	1	1115800	100000	1215800
<input type="radio"/>	1	1	1	0	0	1149900	75000	1224900
<input type="radio"/>	1	1	1	1	0	1135800	100000	1235800
<input type="radio"/>	0	1	1	1	1	1141100	100000	1241100
<input type="radio"/>	1	0	1	1	1	1145600	100000	1245600
<input type="radio"/>	1	0	1	0	1	1170900	75000	1245900
<input type="radio"/>	1	0	0	1	1	1185100	75000	1260100
<input type="radio"/>	1	1	0	1	0	1189150	75000	1264150
<input type="radio"/>	1	0	1	1	0	1216400	75000	1291400
<input type="radio"/>	0	0	1	1	1	1230250	75000	1305250

- After analyzing all possible Combinations, most optimal solution might be closing Facility 3 or 3 &4
- Our tools allow inspecting all these solutions in details.

# Facility Choosing Decision Transportation Solution

## Shipment From Factories To Customers

		Warehouse-1	Warehouse-2	Warehouse-3	Warehouse-4
Facilities	Products				
Facility-1	Prod-1	0	3000	14000	8000
	Prod-2	0	16000	19000	0
Facility-2	Prod-1	15000	15000	0	0
	Prod-2	20000	5000	0	0
Facility-4	Prod-1	0	0	0	0
	Prod-2	0	0	0	0
Facility-5	Prod-1	0	0	0	12000
	Prod-2	0	2000	0	25000

- After analyzing all possible combinations, most optimal solution might be closing Facility 3 or 3 & 4
- Our tools allow inspecting all these solutions in details.

## Shipment Vs Demand

		Warehouse-1	Warehouse-2	Warehouse-3	Warehouse-4
	Products				
Shipment	Prod-1	15000	18000	14000	20000
	Prod-2	20000	23000	19000	25000
Demand	Prod-1	15000	18000	14000	20000
	Prod-2	20000	23000	19000	25000
Slack	Prod-1	0	0	0	0
	Prod-2	0	0	0	0

The Chosen Facilities Are	Facility-1, Facility-2, Facility-5
The Total Prod/Trans Cost	1117600.0
The Total Operation Cost	75000.0
The Total Cost	1192600.0





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