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TABLE 4
Forecast Demand by
Region

North East	Midwest	South	Northwest	Southwest
30%	20%	30%	5%	15%

TABLE 5
Transportation Cost
per Truckload

Plants to SW	New Jersey	Kentucky	California		
New Jersey	\$ 100	\$ 600	\$2000		
California	\$2,000	\$1,700	\$2000		
SW-DC	North East	Midwest	South	Northwest	Southwest
New Jersey	\$ 100	\$ 800	\$1,000	\$5,000	\$5,500
Kentucky	\$ 700	\$ 200	\$1,500	\$3,000	\$3,500
California	\$5,000	\$3750	\$3,250	\$ 600	\$ 300

(DCs). Each plant ships its production to the staging warehouses which, in turn, ship to the five regional distribution centers. Any staging warehouse can ship to any distribution center. The forecasted demand by region is provided in Table 4.

Transportation lanes from the plant to staging warehouses and from staging warehouses to the regional distribution centers will consist of full truck loads. A full truck contains of 100 cubic meters. Johnson Skin Care products typically weigh-out a truck before cubing out a truck. The products will only fill 70 percent of a truck's cubic capacity before it weighs out. Bob spent considerable time researching transportation cost data and developed Table 5 regarding transportation cost.

The distribution centers will deliver to stores throughout the United States. Bob felt that he could omit that cost for the moment as he pondered what the total cost of distribution. There are several alternative networks, particularly related to the assignment of staging warehouses to distribution centers. To complete his analysis, he assumed that the overall inventory turnover rate would be five per year. He also knew that Johnson Skin Care historically had an inventory carrying cost of 18 percent based on average inventory for the year.

Questions

1. Develop a flow diagram depicting all of the possible supply chain flows,
2. What supply chain network would you recommend to Bob Bassett based on the current four echelon structure (plant → SW → DC → Store)?
3. If you could modify the current supply chain strategy, what would you change and why?

CASE 13

DOW Greenhouse Gas Emission Scenario Study¹

Don Weintritt Jr., Amarendra Kumar Martin Fernandes, and Pooja Anand

An increasing number of studies in the area of environmental research indicate that the earth's environment is at risk due to human activities. The research specifically points

¹The authors would like to thank The Dow Chemical Company for preparing the case and granting permission to include this case in the textbook.

towards the increase in greenhouse gas emissions in the post-industrial revolution era and calls for a pressing need for the human society to establish a symbiotic relationship with the environment. With growing concern in the global community, it is anticipated that stringent environmental standards will be incorporated into the Federal Regulations in the next five to ten years.

DOW believes that it is a major stakeholder in any changes that come about from the efforts to redress the global climate issues; therefore it aims to contribute to slowing, stopping and reversing the growth of its Green House Gas (GHG) footprint as part of its commitment to the planet. In alignment with its 2015 sustainability goals, DOW wants to study its supply chain from an environmental perspective.

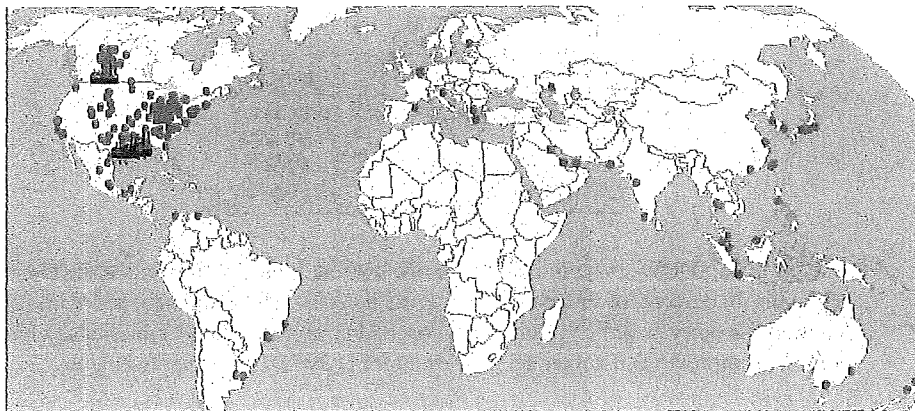
The company wants to reevaluate its current supply chain for certain products, one of which is Gas Treated (GT) Amine. Sixteen raw materials are required for this product, two of which are supplied by DOW's raw material suppliers, and the rest are acquired internally from other DOW plants. These supplier plant locations cannot be changed based on other constraints. There is one manufacturing plant in Plaquemine, Louisiana, that manufactures a particular grade of this product. This grade can be blended with raw materials supplied by external suppliers, in different proportions, to produce a total of 28 finished products. Different customers require various grades of this product. There are two blending plants, one of which is in Pearland, TX. This site also has a drumming facility attached to it where the blended product is packed in drums to ship out to customers. The product can also be shipped via bulk from this facility. Another blending site is in Calgary, AB, that supplies a group of customers in that vicinity in a bulk mode of transportation.

There are three terminal locations:

Terminal1	Houston	TX
Terminal2	Texas City	TX
Packaging Site	Deer Park	TX

Houston and Texas are bulk terminals but the one in Deer Park is a packaging facility. Bulk mode of transportation includes tank truck, bulk vessel, Intermodal (IM) ISO, and rail tank car, while packed mode includes drums put in containers loaded on to a rail, ship, truck or as air freight.

Raw material suppliers can supply to blending facilities only in tank trucks. Production, blending, and drumming facilities are connected through the rail. Bulk terminals can receive the products by rail and tank truck and ship out to the customers in tank truck within North America (USA, Canada, and Mexico). Overseas customers are served in both bulk (mode of transportation used—IM ISO and vessel) and packed/drummed mode

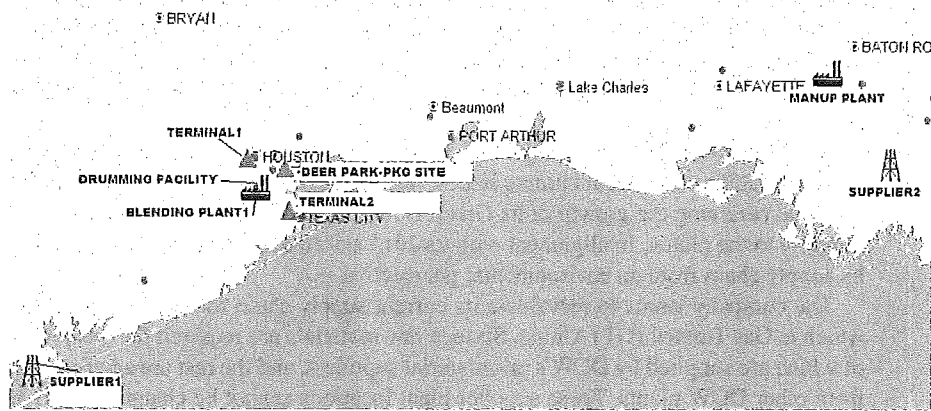


Global Customer Base

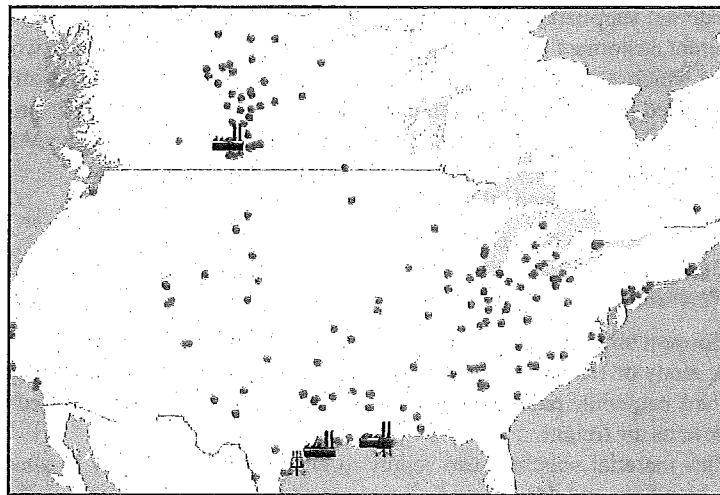
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A Close Look at the Facilities



North America Supply Chain Network



(mode of transportation—IM 20 FT). Customers within North America which need product in drums are served by FTL (Full Truck Load). Here is a schematic to show the complete operation:

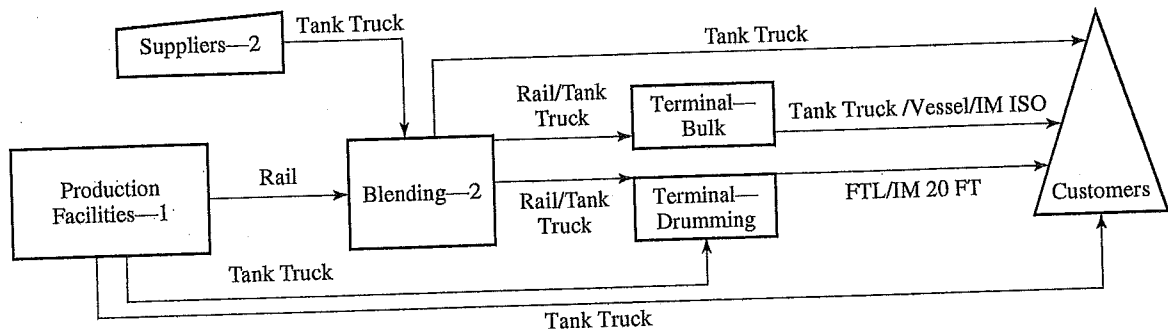
The relative cost of transportation is currently:

MOT	Unit Cost
FTL/Tank Truck	\$ 0.29/lb
Rail	\$ 0.12/lb
Vessel	\$ 0.09/lb
IM ISO/ IM 20 ft	\$ 0.24/lb

Optimizing DOW's supply chain network both at strategic and tactical levels is key to achieving 30 percent lower cost to serve goals by 2010. The challenge, however, is balancing multiple objectives, i.e., minimizing cost and minimizing GHG emissions, while maintaining or improving customer service levels for DOW's global supply chains.

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Amine Production, Blending, and Shipping Operation

We will meet agreed-upon service standards and translate strategic product plans into improved tactical and operational planning and execution to meet demand. Finally, we will design/redesign low cost-to-serve, effective, and flexible supply chains for emerging geographies. As a responsible corporate citizen, Dow continues to work towards reducing green house gas (GHG) emissions by aligning its strategies and incorporating measures from product conceptualization to final consumption.

CO₂ emission estimates associated with various modes of transportation are given below:

MOT	CO ₂ Emission Estimates (in grams/tonkm)		
	Low	Med	High
Air	1,000	1,400	1,800
Bulk vessel/barge	10	40	60
Container vessel	40	70	100
Rail	30	50	70
Truck/IM	70	90	110

Source: Dutch.

Based on the table above, we have determined the current CO₂ emitted in transportation for each mode of transportation (MOT) used by DOW's global transportation network:

Mode of Transportation	% of Weight Shipped	% of CO ₂ Emissions
Truck/IM	39.05%	20.21%
Bulk Vessel/Barge	28.55%	25.96%
Container Vessel	6.49%	33.83%
Rail	25.89%	17.77%
Air	0.03%	2.23%

DOW would like you to evaluate its supply chain to answer the following questions.

Questions

1. What sort of framework should a company like DOW follow to start on a green initiative and what are the associated challenges?

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2. What technologies and solutions can DOW use to minimize fuel consumption and GHG emissions in its supply chain? What challenges could DOW face while applying these technologies and solutions?
3. What types of relationships will DOW need to build with its customers and suppliers in order to achieve a greener supply chain?
4. How can a company like DOW benefit from an initiative like emissions trading?
5. What changes in mind-sets are required to institutionalize greening of the supply chain?