An example of supply chain design

Oilseed processing – biodiesel applications (example, Jatropha, which was considered as a fuel alternative in the period 2000-2008 and interest perhaps declined after 2009). The growing areas are arid regions and the production cost is ignored in this exercise.

Processing alternatives – there are different alternatives for extracting oil from seeds (called T1, T2 and T3 below) which result in oil and seedcake. The present plan is to use the seedcake for further extraction of oil and then blend with other fuels. Any alternate use of seedcake is ignored below.

Each step has cost structure – fixed cost (volume independent cost per month) and variable cost (per unit processed in a month).

If each unit is in operation independently, it will price its capacity and try to process what it can. There could be multiple supply chains in operation.

In contrast, a supply chain driver (in this case, the blending plant) can try to design the entire network so as to minimize costs. This was attempted by a company some years ago.

Some data regarding the decision

Technologies T1, T2 and T3 are for extracting oil and the by-product seedcake. Each has a capacity (max processing per month). These can be set up in any of the growing areas G1-G8 below.

Tech	Capacity (T/month)	Fixed cost (rs/month)	Processing cost (rs/T)	Crude-oil o/p (kg/T)	Seed cake o/p (kg/T)	Oil content in seed cake (%)
T1 (FullPress)	6000	875000	500	250	750	7.5
T2 (SemiPress)	6000	500000	380	150	850	12.5
T3	12000	625000	320	166	834	16

Seed cake can be further processed in an extraction plant – which results in yield corresponding to the oil content in the seed cake. One such plant (E2 below) is available near the refinery, if needed and one other location is possible (E1 below). An extraction plant is possible to operate at three levels:

Tech	Capacity (T/month)	Fixed cost (Rs/month)	Processing cost (Rs)
Low	9000	625000	445
Medium	30000	1500000	415
High	150000	6000000	400

The transport costs (Rs/Ton) to various locations are as in the table below. The potential yield in each growing area G1 – G8 is 1500 T per month.

	G1	G2	G3	G4	G5	G6	G7	G8	E1	E2/plant
G1	0	200	450	450	200	400	150	250	300	600
G2	200	0	300	300	300	150	300	300	150	600
G3	450	300	0	50	300	100	450	200	200	700
G4	450	300	50	0	200	200	400	150	180	500
G5	200	300	300	200	0	400	200	100	300	500
G6	400	150	100	200	400	0	450	350	200	900
G7	150	300	450	400	200	450	0	300	400	800
G8	250	300	200	150	100	350	300	0	300	600

The cost per ton of transport from E1 to E2/plant is 600.

The task is to decide where to set up plants of technologies T1, T2 and T3 and where to set up extraction plants (and at what level) and where the output of each region should go to (to keep things simple, assume that all yield from one region will go to one location for alternative T1, T2 or T3. It is not required to set up plants of all types.

Notes

Production costs are ignored in this exercise. They can be estimated independently and then it can be decided whether the entire activity of blending is worth it.

This assignment was based on a task taken up some years ago which took up some weeks of work to collect the data, model it, compute a few alternatives and present to the company.

For fixed costs, what is given is approximately 30% of the installation cost, taken as an annualized contribution to the costs. This needs to be worked out in each such instance.

It may help to start with a schematic view of the supply chain.