FACILITIES PLANNING

Rashtriya Chemical Fertilizers (RCF) is considering the rationalization of the distribution of urea in Karnataka. Urea has to be moved from the factory in Mumbai to five potential Rake Point Warehouses (RPWs) at Gulbarga, Hospet, Raichur, Bellary and Bangalore and then on to the Feeder Point Warehouses (FPWs) where it is required. The demand for urea in a particular season at the nine FPWs is given in the Table 1. The capacity at Mumbai is adequate to satisfy the total demand. The cost (in Rs/ton) of distribution from Mumbai to the five RPWs is given in Table 3 and the cost of distribution from each RPW to each FPW is given in Table 2.

Note: Usually the rail mode is used for distance above 300 km and the road movement is used for distance less than 300 km. Hence the costs between Mumbai and the RPWs are railway costs and the costs between RPWs and FPWs are road fares.

The location of the FPWs is fixed, while the location of the RPWs are possible ones that the management is considering for the primary warehouses.

Management wants to minimize the total cost of distribution from the factory to RPWs and then on to the FPWs but at the same time have only a few RPWs in order to have better control.

1) Provide the management with a trade off between the number of RPWs and minimum total distribution costs.
2) If the fixed costs of opening a warehouse are not the same, then provide management with a model to help the decision. How might fixed cost be estimated / calculated?
3) The management would also like to keep a percentage of the demand to provide for fluctuations (from forecast) of demand at the FPWs. Develop the logic to allow management to decide the additional stocking quantities. Show how this quantity will decrease as the number of warehouses decreases.
4) The transport link between the following pairs of locations is not established and has a cost associated with them: Gulbarga – Belgaum, Bellary - Raichur and Hospet - Hassan. The company may not want to incur this cost at this time and would like to do so only if some immediate benefits flow. Before contracting with transporters, the company would like to know what sort of cost saving would accrue.
5) Demand is placed once a month to the FPWs around the 25th of every month. In the peak season (March to September), they are placed once in 15 days. They are placed at the RPWs after a gap of 3-4 days and to the factory after another 2-3 days. The lead times for supply are typically one week from RPW to FPW and three weeks from factory to RPW. FPWs are in more direct touch with dealers and final demands and are apt to react vigorously to fluctuations. They place orders extrapolating both increases and decreases in demand for the month ahead as well i.e if there is a 10 above the forecasted value, the assumptions are that next month too, the demand will be that much more than the forecasted value. Find out

how long it takes for such a system to settle down (in terms of steady state pipeline inventories).

6) RCF is also considering direct supplies to some FPWs (bypassing the RPWs). They were warned that this would lead to much larger management of pipeline stocks. Therefore, RCF would also like to estimate the impact of its location policy on pipeline stocks. Given the typical lead times, make assumptions about the fixed and variable part of lead times (fixed part is the order processing loading of the rakes, etc. and the variable part depends on the distance and location), estimate the pipeline inventories in your facility location solution.

Table 1: Forecasted requirements at marketing districts in M tonnes

Marketing Dist.	Jan	Feb	Mar	Apr	May	Jun	July	Aug
Gulbarga	32	26	24	35	57	69	75	52
Belgaum	18	13	15	20	32	38	50	31
Bangalore	35	33	23	35	41	46	54	32
Mysore	18	17	18	20	23	27	32	19
Dharwar	12	13	8	11	15	20	26	16
Raichur	13	16	23	26	31	48	53	34
Bellary	10	10	4	7	10	16	14	10
Hassan	12	11	4	8	11	17	23	12
Chitradurg	8	7	2	4	9	15	15	9

Table 2: Cost Matrix (Rs/ ton)

	Bangalore	Hospet	Raichur	Gulbarga	Bellary
Bangalore	Nil	156	185	386	157
Raichur	113	103	Nil	156	108
Gulbarga	133	139	124	Nil	156
Bellary	102	42	105	204	Nil
Hubli	130	83	145	176	108
Belgaum	139	120	162	180	138
Mysore	83	161	227	283	182
Hassan	102	139	201	270	191
Chitradurg	115	Not known	Not known		

Table 3: Cost Matrix (Rs/ton)

Mumbai to	
Bangalore	320
Hospet	250
Raichur	203
Gulbarga	145
Bellary	230