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SHOT COMMUNICATION: SUPPLY CHAIN DESIGN WIH FIXED CHARGE AND DEDICATED FACILITIES

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ABSTRACT

In this article we design a supply chain with fixed charge and dedicated facilities. The data is collected from a pump manufacturing industry. A mathematical model is created and the model is optimized using LINGO package. The result is discussed with the management and readied for implementation.

Index terms—supply chain, fixed charge, dedicated facilities,mathematical model, LINGO.

I. INTRODUCTION

The quantity and variations of the manufactured goods have increased greatly in the last three decades. Today, manufacturing companies should have the ability to produce large variations of products in smaller quantities and lots so that the customer requirement can be met. Manufacturing companies have been using several methods to help them optimize their expenses and increase their profits to achieve customer satisfaction. Customer requirements and method of buying have changed. The customer who was once satisfied with black car when he wanted to buy the car. The customer was not aware of the variety when he wanted to buy. He simply wanted a model of the car. It was true that at that time the manufacturing companies were not equipped to handle variety. Once the manufacturing requirements were met in large quantities the customer wanted variety. This was necessary because when the customer wanted to buy again he did not want the same model. When this happened the manufacturing, companies changed from producing one type of model to producing varieties. The manufacturing companies themselves changed from product based manufacturing to process based manufacturing. The layouts and other production needs changed to meet this need.

II. LITERATURE REVIEW

Radovan and Jozef (2015) have optimized the postal transportation network. Farhad (2016) had worked on using different types of vehicles for transportation. Susan and Mark (1998) have reviewed the strategic nature of facility location problems. Lee and Elsayed (2007) have addressed the problem of leased storage of warehouse. Linda and Turnquist (1998) have created a model which includes inventory cost within a fixed charge facility location model. Luohao et al., (2016) have studied a reliable facility location problem. Song et al., (2013) have created two optimization models for “not in my backyard” phenomenon. A. Christy and Kousalya (2017) have studied about indoor positioning system. Deepa and Dhivya (2017) have studied about the partial replacement of cement in concrete. Subhakala et al., (2017) have studied about the design of smart village.

III. THE PROBLM

There are eight demand points and three potential locations for factories. In general. we may have n demand points and m potential locations. There is a fixed cost fi of locating a facility in site i. There is a demand dj in point j and there is a transportation cost of Cij. The objective of the function is to meet all demand from a single facility.

$$\text{Min} \sum_{i=1}^{m} fiYi + \sum_{i=1}^{m} \sum_{j=1}^{n} \text{dj Cij Xij}$$

$$\sum_{i=1}^{m} \text{Yi} = \text{p}$$

$$\sum_{j=1}^{n} \text{djXij} \leq \text{KiYi}$$

$$\sum_{i=1}^{m} \text{Xij} = 1$$

$$\text{Yi, Xij} = 0,1$$

The capacities of the three locations are 1000000, 800000 and 1250000. The demand at the eight demand points are 200000 for first four points and 250000 for the remaining points. The unit transportation costs are given in the Table 1. The fixed costs of potential locations of facilities is given in Table 2.

Table 1: Unit transportation costs

	D1	D2	D3	D4	D5	D6	D7	D8
L1	4	5	5	4	4	4.2	3.3	5
L2	2.5	3.5	4.5	3	2.2	4	2.6	5
L3	2	4	5	2.5	2.6	3.8	2.9	5.5

Table 2: Fixed cost of locating facilities.

S.No	Location	Fixed Cost
1	Location 1	Rs 5000000
2	Location 2	Rs 4000000
3	Location 3	Rs 5500000

IV. LINGO Program

```
Model:
F1 = 5000000; F2 = 4000000; F3 =
5500000;
P =2;
K1 = 1000000; K2 = 800000; K3 =
1250000;
D1 = 200000; D2 = 200000; D3 =
200000; D4 = 200000; D5 = 250000; D6
= 250000; D7 = 250000; D8 = 250000;
C11 = 4; C12 = 5; C13 = 5; C14 = 4;
C15 = 4; C16 = 4.2; C17 = 3.3; C18 =
5;
C21 = 2.5; C22 = 3.5; C23 = 4.5; C24
= 3; C25 = 2.2; C26 = 4; C27 = 2.6;
C28 =5;
C31 = 2; C32 = 4; C33 = 5; C34 = 2.5;
C35 = 2.6; C36 = 3.8; C37 = 2.9; C38
= 5.5;

Min = F1*Y1 + F2*Y2 + F3*Y3 +
D1*C11*X11 + D2*C12*X12 + D3*C13*X13
+ D4*C14*X14 + D5*C15*X15 +
D6*C16*X16 + D7*C17*X17 + D8*C18*X18
                                   +
D1*C21*X21 + D2*C22*X22 + D3*C23*X23
+ D4*C24*X24 + D5*C25*X25 +
D6*C26*X26 + D7*C27*X27 + D8*C28*X28
                                   +
D1*C31*X31 + D2*C32*X32 + D3*C33*X33
+ D5*C34*X34 + D5*C35*X35 +
D6*C36*X36 + D7*C37*X37 + D8*C38*X38;

Y1 + Y2 + Y3 = P;
X11 + X12 + X13 <= K1*Y1;
X21 + X22 + X23 <= K2*Y2;
X31 + X32 + X33 <= K3*Y3;

X11 + X21 + X31 = 1;
X12 + X22 + X32 = 1;
X13 + X23 + X33 = 1;
X14 + X24 + X34 = 1;
X15 + X25 + X35 = 1;
X16 + X26 + X36 = 1;
X17 + X27 + X37 = 1;
X18 + X28 + X38 = 1;

@BIN(Y1); @BIN(Y2); @BIN(Y3);
@BIN(X11); @BIN(X12); @BIN(X13);
@BIN(X14); @BIN(X15); @BIN(X16);
@BIN(X17); @BIN(X18);
@BIN(X21); @BIN(X22); @BIN(X23);
@BIN(X24); @BIN(X25); @BIN(X26);
@BIN(X27); @BIN(X28);
@BIN(X31); @BIN(X32); @BIN(X33);
@BIN(X34); @BIN(X35); @BIN(X36);
@BIN(X37); @BIN(X38);
END
```

V. Result And Discussion

Plants Y1 and Y2 are opened.
Plant 1 to customer 8 goods are transported.

Plant 2 to customer 1, 2, 3, 4, 5, 7 goods are transported. Plant 3 to customer 6 goods are transported. The result is shown in Fig 1.

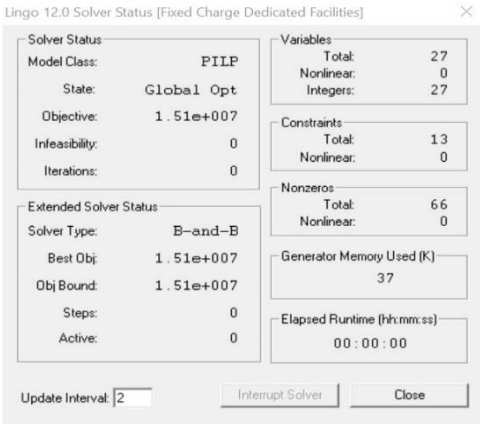

Fig 1: Result

VI. Conclusion

Thus, we have solved the problem for Fixed Charge with Dedicated facilities.

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