Warehouse Capacity Determination and Supplier Selection in Industrial Manufacturing

Sadik Çökelez

Abstract--- The warehouse capacity determination and supplier selection are important issues in industrial manufacturing. What should be the optimal warehouse capacities that would meet the customer demand at minimum cost? Which suppliers should be chosen? This study will develop a linear programming model capable of determining the optimal warehouse capacities and will also adress the supplier selection issue concurrently. The objective function of the optimization linear program will involve warehouse capacity costs and part of the objective function will involve supplier related inputs. The objective function of the optmization model will be followed by relevant constraints such as warehouse capacity constraints and supplier related constraints. Such an optimization model can be quickly expanded fully and it can easily be solved by a linear programming optimization software such LINDO(Linear Interactive Discrete Optimizer.)

Key words--- warehouse capacity, supplier selection, optimization,linear programming

I. Introduction

The optimization model in this paper aims at finding suitable industrial warehouse capacities with sections of warehouses devoted to different products and also. aims at choosing the appropriate suppliers for certain industrial manufacturing firms to minimize the total purchasing cost of the products. The model here determines the industrial warehouse capacities in a similar manner as done in a previous work[1]; however, with a different emphasis and orientation. In the model developed in this paper, the differentiation is made in regards to the industrial warehouse capacity in units at a certain industrial warehouse section that is reserved for storing a certain product.

II. The Optimization Model

The optimization model for the industrial warehouse capacities and supplier selection can be formulated as outlined below. First, the objective function of the model is explained. The objective function consists of two components:

1. The component or segment that involves the total cost of all the products bought from all the suppliers by the manufacturers for all the industrial warehouses
2. The component or segment that contains industrial warehouse capacity costs to store all the products.

The objective is to minize the sum of these two components. The objective function integrates purchasing costs and industrial warehouse storage capacity costs.
On the other hand, the constraints can be divided into 4 categories:;

<u>Constraint Set 1:</u>

The first constraint set states that the total shipment of product *i* from supplier *j* to all the industrial warehouses can't exceed the capacity of supplier *j* for that product.

<u>Constraint Set 2:</u>

The second constraint set shows that the capacity in units at industrial warehouse *k* that is reserved for storing product i must be equal to the total units of product i shipped from all the suppliers to industrial warehouse *k* .

<u>Constraint Set 3:</u>

The third constraint set shows that the total amount of product *i* shipped from industrial warehouse *k* to all demand centers must be equal to industrial warehouse capacity in units at industrial warehouse *k* that is reserved for storing product *i.*

<u>Constraint Set 4:</u>

The fourth and final constraint set shows that the total amount of product *i* shipped from all industrial warehouses to demand center *l* is equal to the demand of product *i* at demand center l.

The full optimization model that incorporates the objective function subject to the above mentioned constraints is shown below:

Prof. Dr. Sadık Çökelez works at Dept. of Econometrics,
I.I.B.F, Süleyman Demirel University, Isparta, Turkey

$$\text{Min} \sum_{i}\sum_{j}\sum_{k} c_{ijk}x_{ijk} - \sum_{i}\sum_{k} e_{ik}w_{ik}$$

st

$$\sum_{k} x_{ijk} \leq s_{ij} \qquad i = 1,2,...,m \quad j = 1,2,..., n \quad k = 1,2,..., p \qquad (1)$$

$$w_{ik} = \sum_{j} x_{ijk} \qquad i = 1,2,...,m \quad j = 1,2,..., n \quad k = 1,2,..., p \qquad (2)$$

$$w_{ik} = \sum_{l} w_{ikl} \qquad i = 1,2,...,m \quad k = 1,2,..., p \quad l = 1,2,..., r \qquad (3)$$

$$\sum_{k} w_{ikl} = d_{il} \qquad i = 1,2,...,m \quad k = 1,2,..., p \quad l = 1,2,..., r \qquad (4)$$

c_{ijk} = unit purchasing cost for product *i* offered by supplier *j* to be sent to indutrial warehouse *k*

x_{ijk} = amount of product *i* in units bought from supplier *j* to be sent to industrial warehouse *k*

e_{ik} = storage capacity cost per unit capacity of product *i* at industrial warehouse *k*

w_{ik} =storage capacity in units at the section of industrial warehouse *k* reserved for storing product *i*

x_{ikl} = amount of product *i* in units sent from industrial warehouse *k* to demand center *l*

s_{ij} = capacity in units of product *i* provided by supplier *j*

w_{ikl} =amount of product *i* in units sent from industrial warehouse *k* to demand center *l*

d_{il} = demand in units on product *i* at demand center *l*

III. Conclusion

Determining suitable warehouse capacities has huge ecenomical impact in daily production and distribution activities. Choosing appropriate suppliers has also significant importance in industrial manufacturing. This paper addresses these two important issues in an integrated and efficeint way and is expected to provide potential benefits to certain industrial manufacturing firms in terms of cost reduction.

References

[1] S Cokelez & J Burns, Distribution Systems-Warehouse Location and Capacity, *Omega, The International Journal of Management Science,*, Vol. 17, No. 1, pp. 45-51.