Distribution Selection for Pump Manufacturing Companies

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Abstract - *A supply chain is a system of organizations, people, activities, information, and resources involved in moving a product or service from supplier to customer. Supply chain activities involve the transformation of natural resources, raw materials, and components into a finished product that is delivered to the end customer. In sophisticated supply chain systems, used products may re-enter the supply chain at any point where residual value is recyclable. Supply chains link value chains. A Supply Chain Network (SCN) is an evolution of the basic supply chain. Due to rapid technological advancement, organisations with a basic supply chain can develop this chain into a more complex structure involving a higher level of interdependence and connectivity between more organisations, this constitutes a supply chain network.Businesses are often part of a larger network of organisations, a supply chain network can be used to highlight interactions between organisations; they can also be used to show the flow of information and materials across organisations. Supply chain networks are now more global than ever and are typically structured with five key areas: external suppliers, production centres, distribution centres (DCs), demand zones, and transportation assets. In this paper we solve a numerical problem using LINGO software.*

Key Words: **Supply chain, Network, Suppliers, Production centre, Distribution centre.**

1. INTRODUCTION

A manager decides on the location and capacity allocation for each facility. Besides locating the facilities a manager also decides how markets are allocated to facilities. This allocation must account for customer service constraints in terms of response time. The demand allocation decision can be altered on a regular basis as costs change and markets evolve. When designing the network, both location and allocation decisions are made jointly. Successful supply chain management requires many decisions relating to the flow of information, product, and funds. These decisions fall into three phases, depending on the frequency of each decision and the period over which a decision phase has an impact. The design, planning, and operation of a supply chain have a strong impact on overall profitability and success. A typical SCN design problem sets the configuration of the network and the missions of its locations. Some facilities may be opened, others closed, while others can be transformed using different capacity options. Each selected facility is assigned one or several production, assembly and/or distribution activities depending on the capacity options available at each location. The mission of each facility must also be specified in terms of product mix and facilities/customers to supply. Key raw-material suppliers must be selected. For each product-market, a marketing policy setting service and inventory levels, as well as maximum and minimum sales levels, must also be selected. The objective is typically to maximize net profits over a given planning horizon. Typical costs include fixed location/configuration costs, fixed vendor and market policy selection costs, as well as some variable production, handling, storage, inventory and transportation costs.

2. LITERATURE REVIEW

Anand Jayakumar A and Krishnaraj C [1] have created a mathematical revenue model for multiple customer segments. Anand Jayakumar A et al [2] have optimized a p median problem using python. Anand Jayakumar A et al [3] have optimized a fixed charge problem using python. Anand Jayakumar A and Krishnaraj C [4] have created a mathematical model for pricing and revenue management of perishable assets. Anand Jayakumar A and Krishnaraj C [5] have suggested on implementation of quality circle. Anand Jayakumar A et al [6] have suggested a mixed strategy for aggreage planning. Anand Jayakumar A et al [7] have created a mathematical model for aggregate planning. Anand Jayakumar A et al [8] have created a mathematical model for supply chain network design. Anand Jayakumar A et al [9] have created a mathematical model for aggregate planning for a pump manufacturing company. Anand Jayakumar A et al [10] have improved productivity in a stitching section. Anand Jayakumar A et al [11] have created another model for aggregate planning. Anand Jayakumar A et al [12] have reviewed on the mathematical models for supply chain network design. Anand Jayakumar A et al [13] have created a chase strategy for aggregate production planning. Anand Jayakumar A and Krishnaraj C [14] have created a mathematical model for supply chain network optimization using gravity location method. Krishnaraj C et al [15] have solved a supply chain network optimization model. Anand Jayakumar A et al [16] have presented a supply chain location allocation problem in multiple stages and dedicated supply. Anand Jayakumar A et al [17] have presented a facility layout problem.

3. WHAT IS LINGO?

LINGO is a simple tool for utilizing the power of linear and nonlinear optimization to formulate large problems concisely, solve them, and analyze the solution. Optimization helps you find the answer that yields the best result; attains the highest profit, output, or happiness; or achieves the lowest cost, waste, or discomfort. Often these problems involve making the most efficient use of your resources—including money, time, machinery, staff, inventory, and more. Optimization problems are often classified as linear or nonlinear, depending on whether the relationships in the problem are linear with respect to the variables.

LINGO includes a set of built-in solvers to tackle a wide variety of problems. Unlike many modeling packages, all of the LINGO solvers are directly linked to the modeling environment. This seamless integration allows LINGO to pass the problem to the appropriate solver directly in memory rather than through more sluggish intermediate files. This direct link also minimizes compatibility problems between the modeling language component and the solver components.

Local search solvers are generally designed to search only until they have identified a local optimum. If the model is non-convex, other local optima may exist that yield significantly better solutions. Rather than stopping after the first local optimum is found, the Global solver will search until the global optimum is confirmed. The Global solver converts the original non-convex, nonlinear problem into several convex, linear subproblems. Then, it uses the branch-and-bound technique to exhaustively search over these subproblems for the global solution. The Nonlinear and Global license options are required to utilize the global optimization capabilities.

4. THE MODELING FRAMEWORK

In this section, the provided mathematical formulation by Sunil Chopra, Peter Meindl and D V Kalra (9) for logistics network design problems is considered. Our presented model for deterministic SCND problems is largely inspired from this work.

The demand allocation problem can be solved using a demand allocation model. The model requires the following inputs:

n = number of factory locations

m = number of markets or demand points

D_j= annual demand from market j

K_i = capacity of factory i

C_{ij} = cost of producing and shipping one unit from factory i to market j (cost includes production, inventory and transportation)

x_{ij}= quantity shipped from factory i to market j

The goal is to allocate the demand from different markets to the various plants to minimize the total cost of facilities, transportation and inventory.

The problem is formulated as the following linear program:

$$Min \sum_{i=1}^{n} \sum_{j=1}^{m} C_{ij} x_{ij} \qquad (1)$$

Subject to

$$\sum_{i=1}^{n} x_{ij} = D_j \quad for \ j=1,\dots,m \quad (2)$$

$$\sum_{j=1}^{m} x_{ij} \le K_i \quad for \ i=1,\dots,n \quad (3)$$

5. DATA COLLECTION

The data was collected from four different companies in Coimbatore district of Tamil Nadu, India.

- Best Engineers Pumps (India) Pvt Ltd
- Alpha Pump Industry (India) Pvt Ltd
- Asthra Pumps (India) Pvt Ltd
- Sigma Pump Industry (India) Pvt Ltd

6. RESULT AND DISCUSSION

For Best Engineers Pumps (India) Pvt Ltd

- From Tamil Nadu we have to supplt to Andhra Pradesh
- From Andhra Pradesh we have to supply to Tamil Nadu
- From Telengana we have to supply to Telengana
- From Karnataka we have to supply to Telengana and Karnataka
- From Uttar Pradesh we have to supply to Uttar Pradesh and Orissa
- From Orissa we have to supply to Orissa and Kerala
- From Madhya Pradesh we have to supply to Madhya Pradesh

For Alpha Pump Industry (India) Pvt Ltd

- From Kerala we have to supply to Kerala
- From Karnataka we have to supply to Karnataka
- From Tamil Nadu we have to supply to Tamil Nadu

For Asthra Pumps (India) Pvt Ltd

- From Karnataka we have to supply to Karnataka
- From Tamil Nadu we have to supply to Tamil Nadu

- From Andhra Pradesh we have to supply to Andhra Pradesh

  For Sigma Pump Industry (India) Pvt Ltd

- From Kerala we have to supply to Tamil Nadu and Kerala
- From Gujarat we have to supply to Gujarat

7. CONCLUSION

We have found the most demanded regions for their products than other dealers regions for all the four companies based on distribution selection for pump manufacturing companies using LINGO 12.0 software

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