MIT SCALE RESEARCH REPORT

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Consolidation of Distribution Centers: An Analysis of Cost Parameters
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Executive Summary

"A penny saved is worth more than a penny earned"

Consolidation of distribution centers can enable companies to reduce the overall cost of holding and distribution. The business of distribution is a balance between the availability of inventory in adequate quantity at the right place, and the cost of doing or not doing so.

The level of inventory required consists of the cycle stock- the actual demand and the safety stock – additional stock required to be maintained as a safeguard against the demand uncertainties during the lead time. A larger inventory in a larger number of warehouses can improve the availability of the product. However, there are costs attached to maintaining large inventories, more so at different locations. The total cost is a function of a large number of parameters such as lead time, transport costs, order policy & quantity and so forth, which are inter-related. Numerous other considerations such as cost of capital, taxation, labor policies, service level and nature of the products also have a material bearing on this issue

Scope of Study: This thesis examines the various parameters of consolidation of distribution centers, theoretically and by simulation of a "two echelon distribution system" with two distribution centers and four retailers, carried out in two parts- before and after consolidation, with a (Q, R) order policy at the retail level and one-for-one ordering policy at the Distribution Center level where one unit is equal to Q.

Consolidation of distribution centers can reduce costs: Theoretically, consolidation of distribution centers (DCs) can result in lower overall costs. But even theoretically, the advantages due to consolidation are limited by the nature of the product, market conditions, uncertainties in demand, and lead times. A thorough research of the literature- academic, business and anecdotal reveals that this subject is not amenable to a rigorous quantitative treatment.

However, a large number of scholarly papers have been written on the subject, revealing important and useful constructs such as the following:

- **"Risk Pooling" effect:** The safety stock required to provide a given level of service reduces by the square root of the number of warehouses pooled together.

- **Correlation of demands:** Inventory centralization and aggregate safety stock are a function of the correlation of demands between stocking locations. This phenomenon is termed as the "Portfolio Effect".
- **Lead times**: Consolidations may produce either increases or decreases in inventory depending upon the particular lead time parameters.
- **Cost of transportation:** The network design should include inventory cost simultaneously with transportation and fixed warehouse cost in the optimization process.
- **Other considerations:** Impact of practical and strategic business considerations that are critical for decision

Consolidation advantages: A large number of reputed companies have consolidated their distribution centers to gain a variety of advantages. Still, it is not possible to announce a clear verdict for or against consolidation. In general, consolidation of two or more warehouses into one may reduce the cost of holding inventory due to "risk pooling" of demand but increase the transportation cost. It works well if the demands at different points are negatively correlated. It is also helpful for high value, low weight products such as computer chips, high fashion garments, and so on, as it reduces the cost of holding. Consolidation also frees some assets and may reduce the capital cost. It usually presents an opportunity for upgrading technology and for improving systems in a firm.

Strategic concerns against excessive consolidation: There is no doubt that consolidation provides adequate benefits and incentives to merit a serious examination periodically. However, common prudence warns that it is dangerous to keep all the eggs in one basket, i.e. the entire inventory in one location could be a strategic risk due to a very real danger of disruption of the total chain in case of a natural or man-made disaster. Nevertheless like all other business decisions, there is an acceptable level of risk that has to be taken in order to take advantage of consolidation. As communication and transport infrastructure is becoming more reliable, several firms have successfully consolidated their distribution to fewer warehouses, some even to the extent of keeping only one warehouse for the entire world!

Conclusion: Consolidation is a strategic decision. Quantitative techniques and simulation can at best provide some guidelines for the decision makers who would be confronted with a number of financial, operational (and sometimes emotional issues as well). Simulation of the two echelon distribution system with a continuous review order has demonstrated the savings in holding cost. For this system, the optimum saving in inventory carrying cost due to consolidation are about 37.5%. The consolidated system also results in greater cost saving when compared to non-consolidated systems for expensive inventory and the inventory with large variability in demand. The variability of the lead times shows no conclusive result on the total cost.

Further refinement of the simulation is possible by linking transportation costs to the quantity carried and by accounting for uncertainty in leadtimes.