Supply Chain Management at Rannila Steel OY

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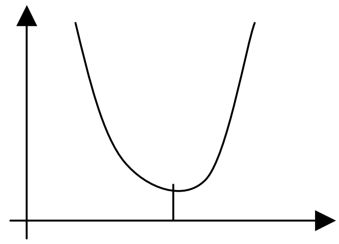
INTRODUCTION

With the globalization and consolidation in businesses, the competition is getting fierce and the firms have been actively seeking ways to gain comparative advantages over competition, these advantages being on either cost or quality. Accordingly, for commodity products like steel, which is the product of our company at hand, cost turns out to be the major component of "needed to win" criteria.



There are three major supply cost drivers; material cost, cost of ordering, and cost of holding inventory. This study tries to answer the question of how much a steel manufacturer should order from its n-suppliers each time it places an order to minimize its total cost of supply.

METHODOLOGY

Present study assumes that demand for the output of the manufacturer is constant and the supply from the suppliers is exponentially distributed. Another assumption is that whenever an order is placed, it is allocated among all the available suppliers. The final deliverable of this study is an EOQ model for this case.

Rannila Steel Oy procures all its steel from its mother company Rautaruukki. Accordingly, we received supply data of Rannila for 25 years time horizon. In our experiment, we intended to use 3 suppliers. Therefore, second and third suppliers are fictitious ones. The supply data belonging to these suppliers has been determined by multiplication of the data belonging to supplies from Rautaruukki by some constants, so that:

Supply from Supplier 2 = 1.30 x Supply from Supplier 1 (for each month)
Supply from Supplier 3 = 1.45 x Supply from Supplier 1 (for each month)

Interestingly, it was discovered that the supply data of Rannila Steel OY closely fits to exponential distribution. Therefore, exponential distribution diagrams are drawn for μ values of $1.00 < \mu < 1.50$ (for each 0.01 increment). The best fit has been observed with $\mu = 1.12$. Accordingly, the formulation for the EOQ model was based on exponentially distributed supply data with $\mu = 1.12$.

The total supply cost formula has been given as:

$$\text{Total Cost} = TC = \frac{Kn + cE\left|Yq1 + Yq2 + \ldots + Yqn\right| + hE\left|\left(Yq1 + Yq2 + \ldots + Yqn\right)^2\right| / \left(2D\right)}{E\left|Yq1 + Yq2 + \ldots + Yqn\right| / D}$$

$$Yqi = \min\{qi, Ai\}$$

where:

Kn = Joint order cost (cost of giving an order to all of the n available suppliers, n = 3 in our case) (€/order)
c = Unit material cost (€/ton)
h = Unit inventory holding cost (€/year/ton)
qi = Order quantity for the ith supplier (quantity ordered by purchaser, purchaser is Rannila in our case) (tons)
Ai = Independent random capacities of suppliers having an exponential distribution function Fi and density fi

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Yqi = Actual amount received from each supplier (minimum of the capacity of the supplier and the order quantity) (tons)
D = Total yearly demand (tons/year)

The optimization solution of this total cost formula for 3 non-identical suppliers having exponential distributions of supply is;

$$\frac{2}{\mu^2}(\mu_1 q_1 + e^{-\mu_1 q_1} - 1) +$$

$$\sum_{i=2}^{n}\frac{2}{\mu_1\mu_i}(\mu_1 q_1 + (1-e^{-\mu_1 q_1})W(-e^{-1-\mu_i f(q_1)})) + 2\sum_{i=2}^{n-1}\sum_{j=i+1}^{n}\frac{1}{\mu_i}\frac{1}{\mu_j}(1+W(-e^{-1-\mu_i f(q_1)}))(1+W(-e^{-1-\mu_j f(q_1)}))$$

$$= \frac{2K_n D}{h}$$

and

$$q_k = f(q_1) + \frac{1}{\mu_k}\left[1 + W(-e^{-(1+\mu_k f(q_1))})\right] \quad \text{for k = 1, 2, 3, ..., n.}$$

RESULTS

When the concerning values are entered, our code computes q_1, q_2 and q_3 values such that;

q_1 = 1,210 t / order

q_2 = 1,763 t / order

q_3 = 2,085 t / order

Consequently, the total inventory and holding cost with our EOQ policy turns out to be 185,334 €. This cost is calculated to be 213,300 € with Rannila's current policy. Accordingly, the new EOQ model leads to a significant cost saving, totaling 13% of the inventory and ordering cost.

CONCLUSION

Even the giant industrial firms might have wrong inventory and material ordering policies. EOQ concept provides a robust methodology for these manufacturing firms to optimise their inventory and ordering expenses.

There are certain points to be considered when formulating an EOQ model for a firm. In addition, there are certain assumptions. Most of the EOQ models, as does ours, assume some of the factors to be constant (such as demand, material price per unit). In reality, none of these factors is constant in most cases. Demand for a good fluctuates as a consequence of many factors and unit raw material price declines due to volume discounts, as the amount ordered per unit period of time increases. In our model, we also assumed the yields of the suppliers to be independent from each other and built our model on this assumption. However, it can confidently be defended that supply yields of raw material suppliers (steel suppliers in our case) are highly dependent on each other in many unusual cases, i.e. when the economy booms or when there is a shortage in the world steel supply.

Given all these constraints and limitations of the model, EOQ concept still provides a sound basis for cost optimisation for manufacturing firms. For instance, a constraint that was released in our case study was not to consider the supply yields of suppliers constant. Consequently, we were able to come up with a better solution for the firm, which led to a 13% saving on inventory and ordering costs. When the deteriorating profitability levels in most of the industries are taken into account, this is quite a substantial saving. Therefore, it can be recommended for most industrial firms to challenge their ordering policies and try to discover better policies that would lead to comparative advantages over their competitors.

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