Inventory management models report sample

Business, Company

Introduction

Inventories are the raw materials which the company has stored for use in production. Inventory management refers to the policies and inventory models that the company uses to conduct its operations. There are different kinds of inventory management models which are dependent on the nature and types of inventory that the company holds.

There are certain factors that have to be considered when considering the optimum inventory model. There is the ordering cost which is the price the company pays to the supplier for placing an order. It is assumed that the ordering cost has a variable and a fixed cost element. The fixed cots element is known as the set up cost. There are product costs and the holding costs.

Every company desires to control the holding cost which is the costs of storing the inventories. The holding cost includes the opportunity cost of holding the asset in storage instead of selling it, storage, insurance and other costs associated with storage. Even though the company wants to minimise the holding costs, it is also concerned that it does not incur shortage costs. When a customer contacts the company to place an order, he may either not return or wait for the product to arrive. The company may lose sales or be forced to do back orders.

Deterministic Model

There are certain assumptions that are incorporated in a deterministic model. In the first scenario, let us assume that the items are taken from the

store at an even rate a, and the lots are fixed at size Q and the lead time is known to be zero or constant (Anderson, et all, 2011, pp. 465).

This is a model where there are no shortages allowed, the inventory level is not allowed to go below 0. The requested inventory is delivered immediately since the lead time is zero so the inventory quantity shoots from 0 to Q every time an order is placed.

There are perpetual inventory systems where the reorder quantity is fixed at the EOQ level and whenever the inventory reaches the reorder level, more inventories is ordered. There is the simple EOQ model where there are certain variables, D is the demand for the period, S is the set-up cost, h is the inventory holding costs and Q is the lot size. T is the time between consecutive production runs.

Cost/unit time = setup cost + product cost + holding cost

The ordering cost = K + cQ. The average inventory held by the company is given by (Q+0)/2 = Q/2. The holding cost for the inventory is Hq/2. The cycle time of the inventory is Q/a therefore the holding costs per cycle will be Hq^2/2a

The total costs per cycle in this inventory model will be: K + cQ + hQ^2/2a. The total cost per unit time will therefore be T = Ak/Q + ac+ hQ/2. The company therefore has to find the optimal quantity that minimises the total cost per unit time which is given by: Q* = √2Ak/h.

The corresponding cycle time to the economic order quantity will be given by: T* = Q*/a=√ (2K/ah)

At the optimum level for this model, the holding cost is equal to the set up cost. The optimal policy is not dependent on the unit product cost. The optimal lot size increases with the increasing set up cost and flow rate and decreases with the holding costs.

Let us take a company that produces 24, 000 speakers in each production and 8, 000 speakers are sold every month. The product cycle length of the company will be 24, 000/8, 000 which is 3 months. The optimum order quantity of this organization will be Q* = √2aK/h. =√2(8, 000)(12, 000)/0. 30 = 25, 298.

The cycle time will be T* = Q*/a =√ (2K/ah) = 25, 298/8, 000 which is 3. 2 months.
The company should perform at the optimum position where it produces 25, 298 speakers at each production run. These speakers should be produced once in three months.

EOQ Models with planned Shortages

In every organization, the managers want to avoid those situations where there are stock outs. The inventory has been depleted and the unhappy customers have to be turned away or advised to come later. The basic EOQ model does not allow shortages causing the managers to avoid shortages as much as possible.

There are deterministic orders where the company is allowed to have shortages. The company will have to conduct back orders. The inventory level is allowed to go below the zero level (Mahapatra, 2010, pp. 363). p will

be the shortest cost per unit while S will be the inventory level just before the management orders a batch of quantity Q from the suppliers. The maximum back order level will therefore be Q-S. This presents the shortage in the inventory before the company orders for the quantity Q. In this model, the production or ordering cost per cycle will be given by: K + Cq

In every production cycle, the inventory level at a given time will be given by S/a. The average inventory level will be given by S+0/2 = S/2. The corresponding holding cost for this inventory is given by Hs/2. The holding cost per cycle in this model will be given by Hs/2(S/2) = Hs2/2a.

The shortest cost per cycle is given by p(Q-S)/2*Q-S/a= p(Q-S)2/2a. The total cost per cycle in this model will be given by T = K + cQ + ac +hS^2/2a +p(Q - S)2/2a. The total costs per unit time will be calculated by the following formulae: Cost/time = Setup cost + Product cost + Holding cost + Backorder cost T = aK/Q + ac +hS^2/2Q +p(Q - S)2/2Q.

When the above formulas are solved, the company is able to determine the optimum shortage, time cycle and the order quantity as follows: T* = Q*/A = √2K/ah√p+h/p Q* = √2aK/h√p+h/p S* = √2aK/h√p/p+h. The maximum shortage therefore that the company should have will be Q*-S* = √2aK/p√h/p+h. Taking the company that produces 24, 000 speakers in each production and 8, 000 speakers are sold every month. The product cycle length of the company will be 24, 000/8, 000 which is 3 months. The optimum order quantity of this organization will be S* = √2 (8, 000)(12, 000)/0. 3√1. 1/1. 1+0. 3 = 22, 424. Q*= √2(8, 000)(12, 000)/0. 3√1. 1+0. 3/1. 1 = 28, 540.

The optimum time cycle will be given by: T* = 28, 540/8, 000 = 3. 6 months

The production facilities of the company should be used after every 3. 6 months to produce 28, 540 speakers. The shortage that the company is allowed to have is 28, 540 – 22, 424 which gives rise to an optimum shortage of 6, 116 speakers.

EOQ Models with quantity Discount: There is the deterministic inventory model where the company gets quantity discounts. In the other models, the cost per unit was constant however

now this assumption has changed. The cost per unit of the product is dependent on the quantity of the items in the batch (Waters, 2003, pp. 99). The company has an incentive to place an order for larger batches so as to reduce the costs per unit of the inventories. There are no shortages allowed in this EOQ model (Hillier, 2010, pp. 947)

A television company buys every speaker for $11 if it purchases less than 10, 000 speakers. In the event it purchases between 10, 000 and 80, 000 speakers, the company will purchase each speaker at $10. The speaker's price goes even lower when the company purchases over 80, 000 speakers since it will only pay $9. 5. The company will need to get the optimum policy that it should adopt so that the company minimizes its costs and maximizes its profits. The total costs per unit for this model will be given by

Tj = Ak/Q + acj + Hq/2 where j= 1, 2, 3 At each pint in time, the optimal order quantity is arrived at by using the economic order quantity formulae. Advantages of EOQ models although the demands of the EOQ system are

rather demanding and not realistic, the model has been found to be robust in most situations. The EOQ model gives optimal results where the different variables have been estimated well.

It is important however for the company to question whether this is the optimum inventory system that should be used.

Disadvantages

The EOQ model is a very simple model that managers prefer as the formulae are well known however the model has certain limitations. First of all the assumptions in the model are not realistic. The demand of the product cannot be forecasted accurately. The order cost is also assumed to be the same regardless of the quantity that the companies purchase which is very questionable. Companies therefore choose to either use the marginal or the average cost as the ordering cost as these values are more appropriate.

The interest rate is also a forecasted item and the forecasted value may not be the correct value. What about the product cost? What value should the company work with? It can either use the replacement cost, actual cost or the average cost? There are those companies that use the replacement cost while others disagree and use the average cost. The model also assumes that the average inventory held is half of the maximum amount. In other words the model assumes that the demand is constant and continuous. If the company faces a non-uniform, the EOQ model will give very poor results (Bicheno & Elliot, 1997, p. 181)

Schostatic Models

There are models where the company cannot operate under the deterministic inventory models. The company is operating under situations of uncertainty. There is no perfect information available when it comes to the different variables under inventory management. In the first model let us consider a firm that is operating under uncertainty when it comes to the demand of its product. However, the company knows the probability distribution of the demand variable.

The assumptions of this model are several. First of all each order application by the company is for a single product. The inventory level of the company is always being assessed or reviewed so the current value is known.

There is a variable or fixed lead time between the time the company places an order and the company receives the goods. The company is allowed to have shortages. There is a shortage cost incurred by the company. When the customers place orders and there is no stock the company is able to place back orders.

This inventory model is similar to the EOQ model with planned shortages however the main difference is that in the schostatic model the demand for the inventory is uncertain. Another difference between the two models is that the uncertainty model will have to add more inventories to the safety stock in order to provide for some cushioning effects due to the uncertain demand. The order quantity will be the same as the order quantity as the EOQ model with planned shortages which is: $Q = \sqrt{2Ak/h} + \sqrt{p+h/p}$

On choosing which will be the re-order quantity, the management of the company will have to choose the service level the company will commit itself to when it comes to their customers. There are alternative measures of the service levels. The company can decide to use the average number of stuck outs in a year, the probability that a stock out will happen and the average delay in filling the orders. If the management chooses not the probability of not experiencing a stock out between the time an order quantity is placed and the order quantity is received. If the demand distribution is normal then R = a +L(b -a), P(D < R) = L.

The mean of the normal distribution will be E(D) = a+b/2, the safety stock of the company operating under this inventory model should be Safety stock = R -E(D) + a + L(b -a) -a +b/2_ = (L-1/2)(b-a).

This is the amount of stock that the company should have in its store just before the company places an order and the order is received by the company.

Considering the speakers example where a company produces 24, 000 speakers in each production and 8, 000 speakers are sold every month. The product cycle length of the company will be 24, 000/8, 000 which is 3 months. Under the EOQ model with planned shortages, the shortage cost had been calculated to be $1. 1. The company however at this point in time has been facing great variation in its demand for speakers from the customers. 8, 000 cannot be used to give the company the optimum quantity that minimises the costs and maximises the profits.

Assuming there is a lead time of one month between the time the company places an order and the goods are delivered to the company and the demand for the speakers is a variable D that has a mean of 8, 000 and a normal distribution of 2, 000 the economic order quantity will be: Q = √2Ak/h + √p +h/p = √2(8, 000)(12, 000)/0. 3√1. 1+0. 3/1. 1 = 28, 540.

The company has come up with a policy that the safety stock that a company has should assist the company to avoid a stock out 95% of the time. The model for the EOQ with planned shortages had a certain level of safety stock to cater for the planned shortages, the difference i this model is that the company now wants a certain level of safety stock that will be able to cater for the variable demand that is it experiencing.

The chosen service level is 0. 95 from the mathematical tables it has the value of 1. 645.

The re-order point of the company will therefore be given by: R = a +L (b -a) = 8, 000 + 1. 645(2, 000) = 11, 290. The safety stock that the company should be having is 11, 290 -8, 000 = 3, 290.

Single Period Stochastic Inventory Models

A company should also consider stochastic models for goods that are perishable or obsolete. These goods should be treated differently from the stable goods which can be stored for a long time before being sold to the customers. The perishable goods cannot be stored for a long time so the company should have a single period system (Delurgio and Kwak, 1980, pp. 160) A good example of a periodic or perishable product is a newspaper. At

the end of the day, the product cannot be sold to someone else. The good is only sold at the beginning of each day.

The management of the company is faced with ensuring that the company operates at the tradeoff of the potential cost of over ordering and under ordering. Other perishable goods are flowers, food in a restaurant, Christmas trees, seasonal greeting cards and seasonal clothing. There are companies which are using this inventory model such as the American Airlines which wants to avoid having incidences of overbooking.

Taking the example of a bicycle distributor who has made a purchase of bicycles to distribute to the people during the Christmas season, he has to be careful and find the optimal order quantity in order to avoid overstocking and under stocking both of which will be expensive for the company. The businessman knows that if he is left with any stock after the Christmas season he will have to sell the bicycles at a throw away price of $10 which is known as the salvage value. The purchase cost is $20 and the company will sell the bicycles at $45 making a profit of $25.

The holding costs of the bicycles which will be unsold at Christmas is estimated to be $1. The holding costs will therefore be $10-$1 which is $9 after considering the salvage value. The profit of the bicycle businessman will be the value of the bicycles sold both the at the normal and the salvage value less the holding costs. The businessman will have to get the new optimal quantity re-order level.

Reflective Statement

I would advise the company to use the stochastic models. If the company's demand and lead times are volatile, then the company should use other inventory models that incorporate uncertainty and probability in its formulas. Using the EOQ model will not be advisable where the demand cannot be forecasted or estimated reliably.

There are also certain advantages in using the stochastic models in that the holding costs are eliminated. The company can operate without holding any inventory in that shortages are allowed. There are times when an inventory model that allows shortages is justified from a manager's point of view where the customers are willing to accept to wait for a while to receive their order. If the holding costs are higher than the shortage costs then lowering the inventory levels so as to allow the shortages is justified.

The company should adopt either the single period model or the variable demand model. This is especially for those situations where the company works in a service industry like airlines or goods that are seasonal.

References

Anderson, D. et al (2011). Introduction to Management Science: Quantitative Approaches to Decision Making. Mason: South Western Cengage Learning.

Bicheno, J. and Elliot, B. (1997). Operations management: an active learning approach.

Oxford: Blackwell Publishers.

Delurgio, S. and Kwak, N.(1980). Quantitative Models for Business Decisions.

USA:

Duxbury Press.

Hillier, F. (2010). Introductions to Operations Research. 9th Edition, United States:

McGraw Hill.

Mahapatra, B. (2010). Operations Management: A quantitative approach. New Delhi:

PHI learning Private Limited

Waters. D. (2003). Inventory Control and Management. England: John Wiley & Sons.