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ECONOMIC ORDER QUANTITY (EOQ) – A TOOL FOR INVENTORY MANAGEMENT IN A SUPPLY CHAIN (A CASE STUDY)

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ABSTRACT
The Economic Order Quantity (EOQ) is the number of units that a organization should add to inventory with each Order to minimize the total Costs of inventory such as holding Costs, Order Costs, and inventory Cost. In inventory management, economic Order quantity (EOQ) is the Order quantity that minimizes the Order Quantity, Ordering Cost, Number of Orders, Total Annual Cost, Carrying Cost, Order Size and Average Inventory. Simplicity and precautionary modeling assumptions usually go together, and the EOQ model is not an exception. The purpose of this model is to decide order quantity and reorder point. This research goes throughout the process of analyze the company's current forecasting model and recommends an inventory control model. Order Quantity and Reorder Point was recommended to reduce product inventory. In this work a case study has been done for optimal inventory control, applied to B Brown Medical India Pvt. Ltd. Researcher analyzes a single product inventory in which cyclic review of inventory control, where separate unsystematic demand may be satisfied. A numerical study is provided to add insight into the results.

Keywords: Supply chain management; Inventory control; Economic order Quantity

INTRODUCTION

Supply Chain Management practices as a set of actions undertaken in a group to support effective and accurate management system. Therefore, one can conclude that mechanism of SCM practices includes supply and material management issues, information technology, operations, customer service and information sharing. Components such as inventory management, technology, cost, competitiveness and external regulations need to be managing efficiently to attain the business goals of each supply chain members. This also leads to value formation to end customers. Organizations are regularly parts of supply chains that link the process steps such as acquiring raw materials, manufacturing, assemblage and delivery to end customer. Whether a company succeeds in being possible and creating good results does not only depend on its internal performance, but also on the presentation of its collaborating partners. Being able to produce business associations with suppliers, customers and other strategic partners is seen to be based on trust, and long time assurance then becomes a vital competitive parameter. Increased vertical incorporation requires increased coordination of wealth and activities, which in turn results in greater complication in management and control. Increasingly, supply chain management is being expected as the management of key business processes across the system of organizations that include the supply chain. While many have recognizable benefits of a process approach to managing the business and the supply chain, most are unclear about what processes are to be consider, what sub-processes and activities are controlled in each process, and how the processes interrelate with each other and with the traditional purposeful silos.

Supply chain management constitutes the series of interdependent upstream, manufacturing and downstream processes targeted at transforming raw materials into products to meet customer demand. A supply chain is

an inter-linked set of relationships connecting customer to supplier, perhaps through a number of intermediate stages such as manufacturing, warehousing and distribution. The supply chain consists of suppliers, manufacturing centers, warehouses, distribution centers, and retail outlets, as well as raw materials, work-in-process inventory, and finished products that flow between the facilities. Supply chain management is a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses, and stores, so that product can be produced and distributed in the right quantities, to the right locations, and at the right time, in order to minimize system wide costs while satisfying service level requirements. Supply chain management revolves around efficient integration of suppliers, manufacturers, warehouses, and stores. It encompasses the firm's activities at many levels, from the strategic level through the tactical to the operational level.

In inventory management, economic Order quantity (EOQ) is the Order quantity that minimizes the Order Quantity, Ordering Cost, Number of Orders, Total Annual Cost, Carrying Cost, Order Size and Average Inventory. Simplicity and precautionary modeling assumptions usually go together, and the EOQ model is not an exception. The purpose of this model is to decide order quantity and reorder point. This research goes throughout the process of analyze the company's current forecasting model and recommends an inventory control model. Order Quantity and Reorder Point was recommended to reduce product inventory. In this work a case study has been done for optimal inventory control, applied to B Brown Medical India Pvt. Ltd. Researcher analyzes a single product inventory in which cyclic review of inventory control, where separate unsystematic demand may be satisfied. A numerical study is provided to add insight into the results.

LITERATURE SURVEY

As competition shifts from a company orientation to a supply chain orientation, SCM is touted as a policy of choice for unbeaten competitors (Quinn, 1997; Rich and Hines, 1997). For example, in the automotive industry, competition is among Honda, Ford, Toyota, etc. and the supply chains that facilitate each of them to deliver finished product to the final customer. The expansion, design, production, marketing, and delivery of new cars is a team effort that begins with extracting raw materials from the earth, continues through design, fabrication, and assembly, and ends with fit and finish in the dealer's show room. Questions stay about how supply chains meaning and how deeply supply chain concepts are embedded in manufacturing organizations. Researchers investigated the factors needed to plan and construct effective supply chains (Childerhouse et al., 2002; Cooper and Ellram, 1993) and also illustrated the strategies for improving the efficiency of supply chain such as benchmarking strategy, postponement strategy, redefining inventory and third party logistics. Ragatz et al. (1996) defined five individuality that help managers to collect the full benefits of the SCM approach. These engross achievable implementation phases, senior level involvement, collaboration, business process and organizational design, and effective presentation measures. He completed that these five steps help in the effective implementation of a SCM scheme. Ragatz et al. (1996) examined issues related to lean and agile supply chains as they examined the addition of suppliers with product development. According to this author, organizations are integrating their suppliers by linking them in product design and in some cases making them accountable for the design of components and systems that reduce product development time. A lean supply chain (LSC) employs incessant improvement efforts that focus on eliminating waste or non-value steps along the chain.

Current research on supply chain management covers conceptual problems and managerial themes frameworks for plan implementation (Harland, 1996), social features of supply chain management, coordinated management of the supply chain (Thomas and Griffin, 1996), the application of inter-organizational information systems in supply chain, design and analysis of supply chain models (Beamon, 1998), etc. It has been understood that individual investigation of various processes of the supply chain is not

enough. Rather, the design and analysis of the supply chain as a whole is critical to attain efficient supply chain management. In other words, active supply chain design and integration is the key to reducing costs. Research in the design category involves contributions from different disciplines. Design of the supply chain determines its structure, i.e., it focuses on the location of decision spots and the aims of the design (Arntzen et al., 1995). Design of the chain should be able to integrate the various elements of the chain and should strive for the optimization of the chain rather than the objects or group of objects. Information sharing and its control play a vital role in integration of the different elements of the chain and need highly coordinated efforts of both engineers and man- agers. Design requirements to focus primarily on the objectives and not just the development of tools used in decision making. This paper primarily deals with the design/selection of an appropriate supply chain arrangement to achieve optimal performance, which is measured using a standard set of metrics.

In the article, "Optimizing Economic Order Quantity," issued by Dave Piasecki in 2001, focused on the Economic Order Quantity. A Piasecki indication that in today's leading technology, many companies are not taking advantage of the fundamental inventory models. There are various software packages in aiding companies with inventory control, but if the data entered are inaccurate, it may lead to poor results.

The Economic Order Quantity (EOQ) formula has been used in both engineering and business disciplines. Engineers study the EOQ formula in engineering economics and industrial engineering courses. On the other hand, business restraints study the EOQ in both operational and financial courses. In both disciplines, EOQ formulas have practical and exact applications in showing concepts of cost tradeoffs; as well as specific application in inventory (Roach 2005).

METHODOLOGY ADOPTED

The economic Order quantity model consider the exchange between Ordering Cost and storage Cost in choosing the quantity to use for restores item inventories. This model can also be defined as the Cost Minimizing Order quantity. Economic Order Quantity (EOQ) is defined as the optimal quantity of Orders that minimizes total variable Costs required to Order and hold inventory.

This model is known as Economic Order quantity model because it recognized the most profitable size of Order to place. This model is one of the oldest classical production scheduling models.

Most of the data was provided by the company to calculate the economic Order quantity for single product. In the data gathered, an EOQ model has been used to minimize inventory and find the optimal Order quantity while minimizing total Cost associated with single product.

Additional data was collected for research method to calculate the Economic Order Quantity, Ordering Cost, Number of Orders, Total Annual Cost, Carrying Cost, Order Size and Average Inventory per year for single product. The additional data collected was the number of Orders placed per year, Economic Order Quantity, Ordering Cost, Total Annual Cost, Carrying Cost, Order Size and Average Inventory per year. With this data, the Economic Order Quantity, Ordering Cost, Number of Orders, Total Annual Cost, Carrying Cost, Order Size, Average Inventory per year was determined in Order to compare the Cost estimates from their current method and the research method.

This model is the easiest way for calculating Inventory. Economic Order quantity may be calculated as:

- $EOQ = \sqrt{2AO_c/C_o}$ (1)

- $C_o = O_c * N$ (2)
- $N = A/EOQ$ (3)
- $T_c = C_c + C_o$ (4)
- $C_c = S * I_A$ (5)
- $S = A/N$ (6)
- $I_A = S/2$ (7)

Equation (1),(2),(3),(4),(5),(6),(7) have been implemented for calculating the Economic Order Quantity, Ordering Cost, Number of Orders, Total Annual Cost, Carrying Cost, Order Size, Average Inventory respectively where:

A = Total units required

I_{max} = Max inventory

Q_t = In-transit Inventory

Q_b = Surplus inventory

EOQ = Economic Order Quantity

T_c = Total Annual Cost

C_c = Carrying Cost

C_o = Ordering Cost

O_c = Cost per Order

S = Order Size

N= Number of Orders for the year

I_A = Average Inventory

- **OBSERVATION AND CALCULATION (2014)**

The firm requires below given units of material for inventory. The following are the details of their operation during 2014.

TABLE 1.1 DATA FOR THE YEAR 2014

ITEMS	
Billets/Blooms Qty (mt)	28,889
Ordering Cost per Order	Rs. 2,000
Carrying Cost	10%
Purchase price per unit	400

- **CALCULATION OF EOQ**

Total units required (A) =28889

Cost per Order (O_c) = Rs.2000

Carrying Cost per unit (C_c) = 10%

(i.e.) 10% of Rs.400 =Rs.40

- **EOQ** $= \sqrt{2AO_c/C_c}$

$=\sqrt{2*28889*2000/40}$

=Rs.1699.6

- **Number of orders for the year = a/eoq**

=2889/1699.67

=16.99~17Order

- **Total Annual Cost = Carrying Cost + Ordering Cost**

=1445000+ 34000

=Rs.1479000

- **Carrying Cost = Order Size * Average Inventory**
- **Order Size = A/No of Orders**

=28889/17

=1699.67

- **Average Inventory = Order Size/2**

=1700/2

=Rs.850

- **Carrying Cost** = 1700*S850

= Rs.1445000

- **Ordering Cost = Cost per Order * No of Orders**

=2000*17

=Rs.34000

- **OBSERVATION AND CALCULATION (2015)**

The firm requires below given units of material for inventory. The following are the details of their operation during 2015.

TABLE 1.2 DATA FOR THE YEAR 2015

ITEMS	
Billets/Blooms Qty (Mt)	1,23,596
Ordering Cost per Order	2,200
Carrying Cost	10%
Purchase price per unit	Rs 420

- **CALCULATION OF EOQ**

Total units required (A) =123596mt

The Ordering Cost per Order (O_c) = Rs.2200

Carrying Cost per unit (C_c) = 10%

(i.e.) 10% of Rs.2000 =Rs.42

- **EOQ = $\sqrt{2AO_c/C_c}$**

= 2*123596*2200/42

= Rs.3598.354

- **Number of Orders for the year = A/EOQ**

= 123596/3598.354

=34.79~35Orders

- **Total Annual Cost = carrying Cost + Ordering Cost**

= 6245669+ 77000

= Rs.6322669

- **Carrying Cost = Order size Average Inventory**
- **Order size = A/No of Orders**

= 123596/35

= 3531.31

- **Average Inventory = Order Size/2**

= 3531.1/2

= Rs.1768.655

- **Carrying Cost =** 3531.31*1768.655

  = Rs.6245669

- **Ordering Cost = Cost per Order no of Orders**

  = 2200 *35

  = Rs.77000

RESULTS AND DISCUSSION

The reason of EOQ models is to decide how much to Order and when to Order. This research goes throughout the process of examine the company's current Inventory model and suggest an inventory control model. A case study for inventory control has been done on B Brown Medical India Pvt. Ltd. The company offers Surgery, Intensive Care, Plexux Anesthesia, and Acute and Chronic Dialysis Equipment, including Syringe, Infusion Pumps, and FM Systems; Nerve Stimulators; and Dialysis Machines.

Comparison of collected data and the data received from the opted model has been shown in Table 1.3.

Table 1.3 Comparison of company data and research data at different years.

Data Year	2015		2014	
	Company data	Research data	Company data	Research data
EOQ (Rs.)	3805.4	3598.4	1885	1699
Ordering Cost (Rs.)	78000	77000	35580	34000
Number of Order	39	35	20	17
Total Annual Cost (Rs.)	7344567	6322669	1600k	1479k
Carrying Cost (Rs.)	7552467	6245669	1666k	1445k
Order Size	3700	3531	1850	1700
Average Inventory (Rs.)	1800	1769	1200	850

Results indicate that the Inventory Cost for the year 2015 upto 5.75% and reduction upto 10.71% for the year 2014. The Ordering Cost has been reduced upto 1.29% and 4.64% for 2015, 2014 respectively. Similarly, it has been found that the Number of Order for the year 2015 has been reduced upto 11.42% and for the year 2014 has been reduced upto 17.64%. The Total Annual Cost has also been decreased upto 16.16% for the year 2015 and upto 8.18% for the year 2014. The Carrying Cost for the year 2015 has been reduced upto 20.92% and for the year 2014 has been reduced upto 15.29%. The Order Size has been reduced upto 4.78%

for the year 2015 and 8.82% for the year 2014. The Average Inventory for the year 2015 has been reduced upto 1.75% and for the year 2014 has been reduced upto 41.17%.

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