

## **Inventory Management**

(Relevant to PBE Paper II – Management Accounting and Finance)

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In Paper II, students are expected to have comprehensive knowledge in applying various techniques of managing working capital. Inventory management is one of the critical pillars in working capital management. Students are therefore required to demonstrate knowledge of the economic order quantity (EOQ) model and just-in-time (JIT) systems to assist a company to manage its inventory costs properly.

This article starts by explaining why inventory management is important to a company with a brief analysis of different elements of inventory costs. This is then followed by a discussion on how the EOQ model and JIT systems help in establishing an effective inventory management policy.

### **The importance of inventory management**

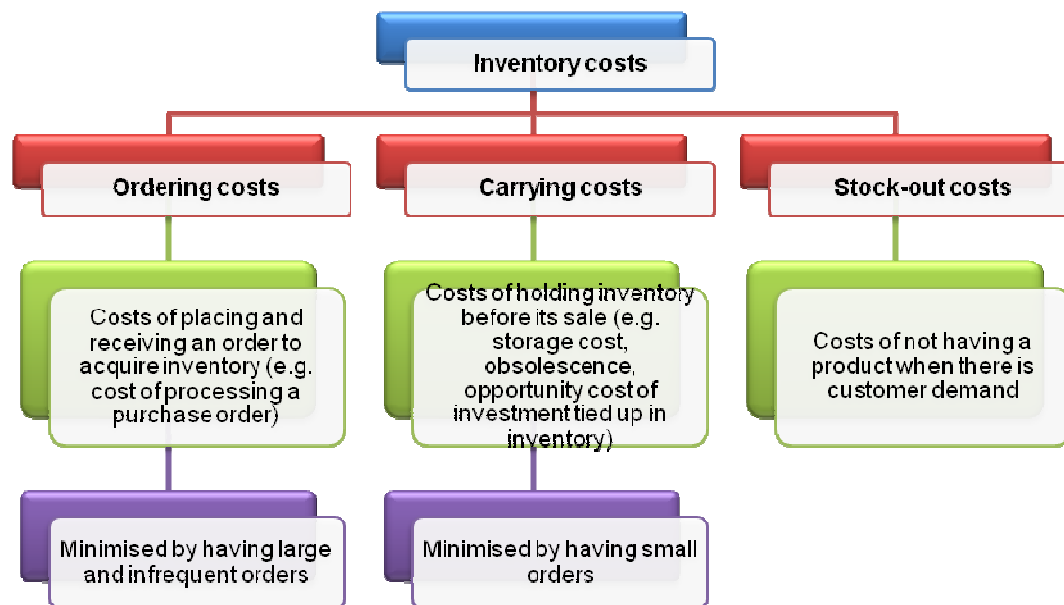
Most companies (except service companies) invest in inventories. This can be evidenced by the substantial inventory balance under current assets in the statement of financial position of most companies, particularly retailers. Such investment, to a certain extent, is essential as companies need to face uncertainty in customer demand so as to avoid losing sales. Further, companies may enjoy quantity discounts if they purchase in bulk from suppliers. Having sufficient inventory on hand may therefore facilitate operations.

This investment however does have its cost. On one hand, companies need to incur storage costs for the excessive amounts of inventory. On the other hand, companies bear the risk of inventory obsolescence if the inventories are perishable goods (e.g. food) or fashionable products (e.g. mobile phones and clothes). Most importantly, investment in inventory ties up money which may be used elsewhere to generate higher return.

The objective of inventory management is to deal with the above dilemma. Companies should set the optimal level of inventories so as to enjoy the advantages of investing in inventories and at the same time minimize their costs.

### **Inventory costs**

Inventory costs can be divided into different categories based on the cost nature:



Ordering costs and carrying costs are linked to each other. How to balance these two costs to minimize total inventory costs is the essence of inventory management, which in turn highlights the significance of the EOQ model.

### EOQ model

The EOQ model aims at **balancing ordering costs** and **carrying costs** in order to minimize total inventory costs. This model basically helps company to answer the following two questions relating to inventories:

- (1) What should the optimal quantity of an inventory order (i.e. the quantity of inventory per order) be?
- (2) When should the order be placed (i.e. the re-order point)?

This model has been simplified by assuming the following:

- (1) Only ordering costs and carrying costs are considered.
- (2) The same quantity is ordered each time at the re-order point. Inventory is sold off at a constant rate. Once the inventory is exhausted, it is returned to its optimal quantity level of inventory.
- (3) Demand, ordering costs, carrying costs and the lead time (i.e. the time between placing an order and receiving the order) are known with certainty.
- (4) Purchasing cost per unit is constant. The purchase price is the same no matter what the order size is.

Before proceeding to answer the above questions, students first need to fully understand how total inventory costs can be derived by adding up total ordering and carrying costs:

$$\text{Total ordering costs} = \text{Number of orders placed in a year} \times \text{Ordering cost per order}$$

$$= \frac{\text{Demand in a year (D)}}{\text{Size of each order (Q)}} \times \text{Ordering cost per order (P)}$$

Total carrying costs = Average inventory quantity x Carrying cost per unit

$$= \frac{\text{Size of each order (Q)}}{2} \times \text{Carrying cost per unit (C)}$$

$\text{Total inventory costs} = \frac{D}{Q} \times P + \frac{Q}{2} \times C$
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By calculus, the total inventory costs will be minimized with the optimal size of each order (EOQ) as follows:

$\text{EOQ} = \sqrt{\frac{2DP}{C}}$
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Example:

Sweets Ltd. operates as a candy shop. The average annual demand for candies is 50,000 boxes. The ordering costs are \$100 per order and the carrying cost is \$0.40 per box. Currently, Sweets Ltd. orders 5% of annual demand per order. Sweets Ltd. is considering adopting the EOQ model to save inventory costs.

Currently, 2,500 boxes are ordered each time (50,000 x 5%). The number of orders placed in a year is 20 (50,000 ÷ 2,500). Total ordering cost is \$2,000 (\$100 per order x 20 times). Total carrying cost is \$500 [(2,500 boxes ÷ 2) x \$0.4]. Total inventory cost is therefore \$2,500.

By adopting the EOQ model, the optimal boxes of candies for each order is calculated as follows:

$$\text{EOQ} = \sqrt{\frac{2 \times 50,000 \times 100}{0.4}} = \sqrt{25,000,000} = 5,000 \text{ boxes}$$

As 5,000 boxes will be ordered each time, the number of orders in a year will drop to 10. Total ordering cost will then be \$1,000.

The average number of boxes of candies in the shop is 2,500 (5,000 ÷ 2). Total carrying costs will then be \$1,000 (2,500 boxes x \$0.40 per box).

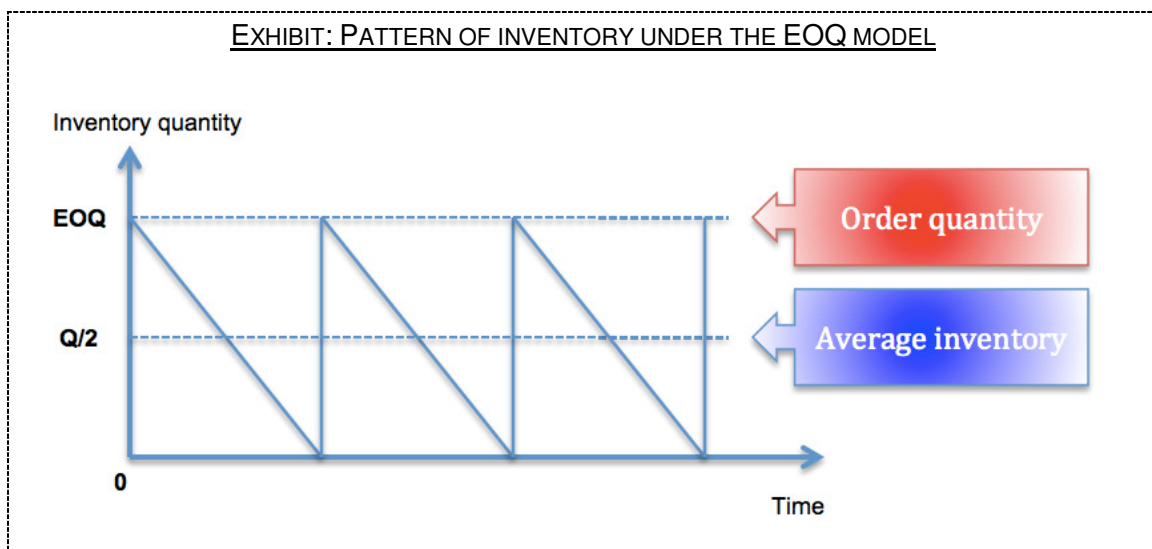
The total inventory cost will be \$2,000, with a saving of \$500 after the adoption of the EOQ model.

(Note 1: The demand ( $D$ ) used in the EOQ model represents annual demand. If the given demand is daily or weekly demand, remember to multiply by 365 (or other total operating days in a year) or 52 (or other total operating weeks in a year) to obtain the annual demand required in the EOQ model.)

(Note 2: Under this basic EOQ model, total inventory costs will be minimized at the point when total carrying costs equal total ordering costs. In this example, at its optimal level of quantity ordered, the total carrying costs and total ordering costs are both \$1,000.)

(Note 3: Students should try to visualize the relationship between costs (\$) and quantity of inventory ( $Q$ ) graphically. Carrying cost is directly proportional to quantity of inventory with a slope of  $(C/2)$ ; while ordering cost is inversely proportional to quantity of inventory.)

The following exhibit represents graphically the EOQ model. Students should try to visualize this exhibit with the above example.



The next question is when the order should be placed (i.e. at which quantity level of inventory on hand will *trigger* the new order). This is known as the re-order point. In determining the re-order point, the lead time has to be known with certainty. As mentioned earlier, lead time represents the time between the order being placed and the order being received. The **re-order point** should then be the **usage** (or product demanded) **during the lead time**.

Example:

Follow the example above. Assume Sweets Ltd. operates only 50 weeks in a year and it normally takes two weeks from ordering the boxes to receive the candies from the suppliers.

The weekly demand of candies is 1,000 boxes (50,000 boxes ÷ 50 weeks). The usage during the two-week lead time is then 2,000 boxes (1,000 boxes per week x 2 weeks).

This means Sweets Ltd. will order 5,000 boxes of candies (i.e. the optimal number of boxes of candies for each order from the EOQ model above) when inventory drops to 2,000 boxes (i.e. the re-order point triggering a new order).

### JIT systems

The philosophy of JIT is different from the EOQ model. Instead of balancing the two conflicting costs of ordering and holding inventories, the objective of JIT systems is to **minimize inventories** to an extent which is just needed by the company. This is mainly achieved by **continuous improvement** such as increasing efficiency and eliminating waste. Under JIT systems, a company normally will:

- (1) streamline operating methods to reduce defects and to avoid bottlenecks;
- (2) put greater emphasis on the quality of supplies;
- (3) work closely with suppliers to establish a good relationship with suppliers;
- (4) maintain flexibility in operations to respond to customer demands.

The above philosophy is able to bring the company to a so-called “lean operation” which has the following benefits:

- (1) **Financial** benefits: Minimizing inventory levels reduces carrying costs which at the same time frees up investment in working capital.
- (2) **Operational** benefits: Overall operating efficiency is continuously improved through better supply chain management (e.g. developing a long-term relationship with suppliers and conduct careful supplier evaluation) and better product quality (e.g. eliminating waste and reducing defects).

However, JIT has the following risks and limitations:

- (1) It places **heavy reliance on suppliers**. If suppliers are neither reliable nor willing to promptly react to customer demand through frequent deliveries, JIT systems will fail.
- (2) The JIT system is regarded as a “pull-demand” system. Inventories are pulled through the system by present customer demand. The system works well only when such **demand is predictable** with minimum fluctuations.
- (3) Companies adopting JIT systems are exposed to high business risks as a single mistake in the operating environment may easily lead to **work stoppages**.

## Conclusion

Inventory costs mainly comprise ordering and carrying costs. Effective inventory management should reduce total inventory costs. Companies may apply techniques like the EOQ model and JIT systems. The EOQ model tries to balance two conflicting costs (ordering and carrying costs) in order to determine the optimal quantity of inventory for each order placed and at which point should the order be placed. The JIT philosophy challenges the reasons for carrying inventories and urges companies to continuously improve their operations so as to minimize inventories.

In order to evaluate whether the company has an effective inventory management policy from the perspective of working capital management, one can calculate the inventory turnover (in times) or days of inventory (in days) so as to evaluate whether the inventory balance is sensible or not. These ratios are:

$$\text{Inventory turnover (in times)} = \frac{\text{Cost of goods sold}}{\text{Average inventory}}$$

$$\text{Days of inventory (in days)} = \frac{365}{\text{Inventory turnover}}$$