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C.15 Inventory Level

INVENTORY COSTS AND BENEFITS

Marketers do not ordinarily have control over inventory policy; it is more likely controlled by operations managers. However, marketers usually have a voice in determining finished goods inventory levels as one of the elements in a marketing logistics program because that decision influences service to customers.

Marketing Logistics as an Element in Service to Customers. **Marketing logistics** is a term used to refer to the storage and movement of finished goods from the producer to the customer. A company's marketing logistics system is made up of a number of elements, including **inventory level,** considered in this entry; **warehouse** location, considered in GLOSSARY entry C.41; and **transportation methods,** considered in GLOSSARY entry C.40. Each of these elements in the marketing logistics system has a cost and each provides service benefits to customers. Design of each of the system elements requires a tradeoff of costs with benefits.

Marketing logistics is one of several marketing mix elements that serves to provide service to customers. In addition to the three elements of inventory level, transportation, and warehousing that make up marketing logistics, service to customers is provided by other marketing mix variables.

- *Sales Force Size.* The greater the number of salespeople, the more often a customer will be called on and "serviced." **Sales force size** is considered in GLOSSARY entry C.35.
- *Distribution Intensity.* The greater the number of intermediaries handling the product, the greater the service and convenience offered to customers. **Distribution intensity** is considered in GLOSSARY entry C.12.
- *Channel Cooperation Programs.* When channel members are the customers, service is provided to them through channel cooperation programs. These include training programs, promotional support, and financial incentives. **Channel cooperation** is considered in GLOSSARY entry C.6.
- *Customer Service Programs.* The service component of a product includes such elements as user training, installation, and repair services. **Customer service** is considered in GLOSSARY entry C.9.

Hutchinson suggests that a total customer service "package" should be designed, much as a product is designed.[1] The process begins by surveying customers to determine their service needs and requirements, determining the cost of each service offering, and determining the level of competitive service of-

[1] William M. Hutchinson, Jr., and John F. Stolle, "How to Manage Customer Service," *Harvard Business Review* (November–December 1968), pp. 85–96.

ferings.[2] With this information, the marketer then designs the firm's service package by using combinations of services that best and most economically meet customer service requirements.

Functions of Inventory. The topic of this entry is inventory level. It should be clear from the above that inventory level is only one of several elements by which service is provided to customers. Moreover, inventory does more than provide service to customers. It is also an important consideration in manufacturing. In order to set an inventory level policy, it is well to understand the range of functions provided by inventory.[3]

- *Geographic Separation.* Inventory permits geographically separate manufacturing units to specialize in production of a component of the finished product. Inventory provides the bridge between the specialized manufacturing unit and the assembly of the finished product. Inventory also provides the bridge between manufacturing units and geographically dispersed distribution units such as warehouses or wholesalers.

- *Manufacturing Economies.* Often an economic lot size should be manufactured or distributed in order to realize scale economies. The costs of interruption of the production operation and setup to produce a different product would be excessive if each product were produced only for immediate need. Instead, product is produced or distributed in economic lots and held in inventory until sale. Inventory serves as a buffer between production and sales.

- *Balancing Supply and Demand.* Inventory can be used to balance production and sales when one of the two is seasonal. Canning of vegetables, for example, must be done when the ripe vegetables are available, but consumption takes place year-round. Inventory here serves to balance supply and demand. The same purpose is served when production is even during the year, but purchase is seasonal, as might be the case with air conditioners.

- *Safety Stock.* Of greatest interest to marketers is the role that inventory plays in assuring that product is available to customers when they order it and that orders can be promptly filled. This is the customer service function of inventory. Inventory held to assure desired levels of customer service is termed **safety stock.**

Inventory Costs. While inventory provides benefits to the marketer and others, it also has an offsetting cost. Making inventory decisions requires balancing the benefits against the costs. There are three classes of inventory cost.

- *Inventory Maintenance Costs.* Both direct and indirect costs are associated with maintaining inventory. Direct costs include storage space charges, insurance, taxes, record keeping, and personnel costs. In many cases, the largest cost of maintaining inventory is the cost of the working capital required to finance the inventory. The cost is commonly calculated by applying the firm's borrowing rate or its target return on investment to the amount of working capital employed. Inventory maintenance costs vary directly with the level of inventory. Firms with long product lines or firms whose product lines have proliferated will have higher inventory costs than firms with simpler product lines.[4]

  Another kind of inventory maintenance cost, and one that can be significant, is the risk of obsolescence. Inventory can become obsolete in several ways. A new product produced for inventory in anticipation of strong introductory demand becomes obsolete if the demand does not materialize. Mature products in inventory can be made obsolete by the introduction of a competitively superior new product. Changes in **environmental variables** can also make products in inventory obsolete (see GLOSSARY entry A.4). Finding a harmful ingredient, a dangerous side effect, or violation of a packaging regulation could make an in-

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[2]See also Robert E. Sabath, "How Much Service Do Customers Want?" *Business Horizons* (April 1978), pp. 26–32.

[3]Suggested by Donald J. Bowersox, *Logistical Management,* 2d ed. (New York: Macmillan Publishing Co., 1978), pp. 149–52.

[4]On this point, see Roy D. Shapiro, "Get Leverage from Logistics," *Harvard Business Review* (May–June 1984), pp. 119–26, and John F. Magee, "The Logistics of Distribution," *Harvard Business Review* (July–August 1960), pp. 89–101.

ventory worthless. Inventory risk can result in total loss of the inventory value, but estimating its probability is difficult. Some inventory risks are insurable and, in that way, cost can be estimated, but many are not.

- *Inventory Ordering Costs.* Ordering costs are incurred each time an order is placed for materials that are to go into inventory. For raw materials ordered by a manufacturer or for finished goods ordered by a wholesaler or retailer, the ordering costs include the clerical time and expense in processing the order, the cost of receiving the materials ordered, and the cost of materials inspection. The order cost for a firm to produce finished goods for its own inventory is the cost to halt the production line and set up to run the desired product. Associated with this are some processing and overhead charges as well. Ordering costs vary not with size of inventory, but with the number of orders placed.

- *Cost of Being Out of Stock.* The third class of inventory cost is the cost incurred when the firm is out of stock and cannot fill customer orders. Out of stock occurs when inventory replenishment does not occur before inventory is depleted. The result is that delivery of product is delayed or orders are canceled. Customers interpret an out-of-stock condition as poor customer service. The result may not only be loss of the current sale, but retaliation by the customer by withholding future sales.

Setting an Inventory Level Policy. Shapiro suggests that a firm's marketing logistics system, which would include inventory level determination, should be designed to enhance the firm's competitive advantage. He suggests asking the question, "What must our logistics system do particularly well?"[5] This suggests that the marketing logistics strategy, like any other **marketing mix** decision, should look for guidance to the **positioning** of the product or product line. The positioning specifies the target market customers who are to be satisfied and defines the competitive advantage to be presented to customers. The marketing logistics system strategy, in turn, suggests what the inventory level policy should attempt to accomplish to support the positioning.

Shapiro suggests three potential marketing logistics strategies, each of which helps to define an inventory policy.[6]

- *Customer Service.* One logistics strategy is to excel in customer service, making that attribute the competitive advantage of the product or product line. Carrying out this strategy requires a high level of safety stock, perhaps dispersed in the channel, to assure rapid and reliable delivery. Inventory costs would be high.

- *Low Cost.* For firms that wish to position themselves as the low-priced producer, a marketing logistics system designed to reduce distribution cost would be appropriate. This suggests a minimum inventory level to provide acceptable, but not perfect, delivery service. Inventory costs would be low.

- *Innovative.* For firms that wish to position themselves as suppliers of new products and creators of new markets, a logistics system that supports innovation is required. Such a system must be prepared to promptly handle small, erratic orders as customers try new products. Inventory policy for the innovative firm represents a compromise between the high safety stocks needed to be responsive to irregular customer demands and the need for low safety stocks to minimize the danger of obsolescence.

MAKING INVENTORY LEVEL DECISIONS

Inventory level policy must decide upon three inventory level dimensions: the economic order quantity, the reorder point, and the level of safety stock. These dimensions are interrelated and take direction from the marketing logistics strategy.

Determining the Economic Order Quantity. The **economic order quantity** (EOQ) policy defines the quantity to be ordered for inventory in any one order. EOQ balances inventory maintenance cost against inventory ordering cost, defining an amount to order that will minimize the sum of these two costs.

Understanding the determination of EOQ requires understanding of the behav-

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[5]Shapiro, "Get Leverage," p. 120.
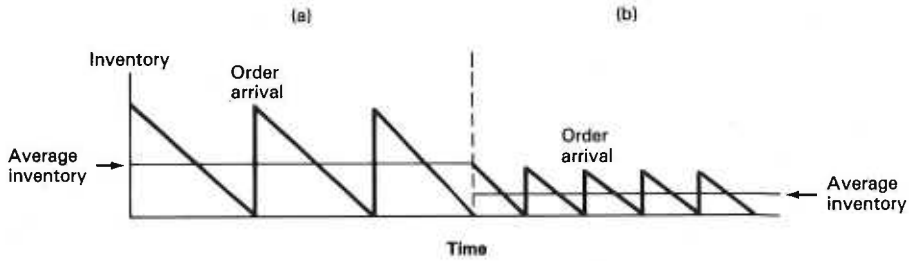
[6]Ibid., pp. 119–26.

FIGURE C.15–1

The Inventory Replenishment Cycle

ior of the two cost components as the amount ordered changes. Inventory maintenance costs increase as order size increases. The reason for this can be seen in the sawtooth-like diagram in Figure C.15–1a and b. In Figure C.15–1a, large amounts of inventory are ordered at infrequent intervals. The average inventory, which is one-half the amount ordered, is high and as a consequence, inventory maintenance costs would be high. In Figure C15–1b, by contrast, smaller amounts are ordered more frequently and the average inventory is lower. As a result, inventory maintenance costs are lower. In Figure C.15–2, inventory maintenance costs per unit are shown increasing with the size of order.

Inventory ordering cost per unit decreases with the size of the inventory order. The cost per order tends to be mostly fixed. As a result, a large order costs about as much to process as a small one, but the ordering cost per unit for a large order is less. In Figure C.15–2, ordering costs per unit are shown decreasing with order size.

The EOQ can be determined graphically from Figure C.15–2. Total inventory cost per unit has been plotted as the sum of maintenance and ordering costs. The order size giving the lowest total cost is at the intersection of the maintenance and ordering cost curves. This is the EOQ.

Economic order quantity can also be calculated mathematically using the following formula:

$$EOQ = \sqrt{\frac{2\,A\,S}{I}}$$

where: A = ordering cost per unit
S = annual unit sales volume
I = maintenance cost per unit

In practice, the apparent simplicity of EOQ determination is complicated by a number of factors.[7] The EOQ calculation as-
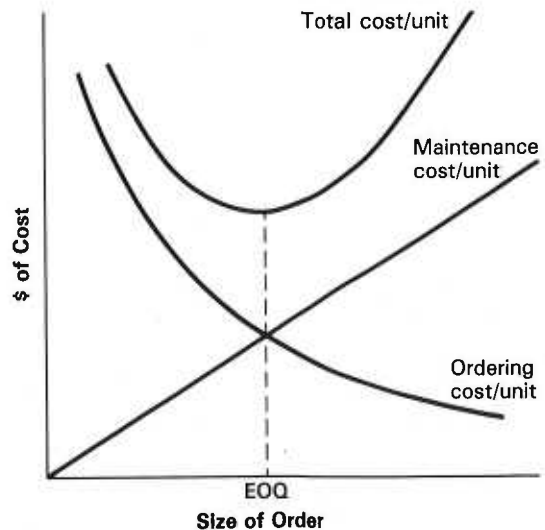

FIGURE C.15–2

Economic Order Quantity

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[7]These complications are discussed in Bowersox, *Logistical Management,* pp. 161–64.

sumes that transportation costs per unit are constant and can therefore be ignored. In practice, discounts on transportation charges may be earned for larger, heavier orders, thus lowering the cost per unit of larger orders. A similar problem occurs when the seller offers discounts for quantity purchases. Other complications occur when the inventory is not purchased, but is produced by the firm to form finished goods inventory.

Determining the Reorder Point. The second inventory policy needed is to define when an inventory reorder should be placed. The **inventory reorder point** defines the level of stock at which a new order should be placed. The inventory reorder point is determined by the safety stock minimum level, the rate at which inventory is projected to be used or sold, and the time required to order and receive new stock. Thus the inventory reorder point is the level of safety stock plus the daily usage rate times the number of days required to replenish the stock.

The frequency of reordering will, of course, be dependent upon the EOQ decision. The smaller the EOQ, the more frequently stocks will reach the reorder point and restocking be necessary.

Determining the Level of Safety Stock. The third inventory level policy, and the one of greatest concern to marketers, is the one settting the level of safety stock. A firm maintains safety stock in order to minimize the danger of being out of stock and unable to meet customer orders. The higher the level of service the firm wishes to offer, the higher the level of safety stocks must be.

Level of service is usually defined in terms of the percentage of orders that the firm wishes to be able to fill from inventory. If, for example, a firm sets a 96 percent service level, it would mean that the safety stock would have to be large enough to fill 96 percent of all orders received between the time of reorder and the receipt of inventory replenishment. To determine what that safety stock should be requires an analysis of sales to determine the distribution of sales for the replenishment period. Typically, sales for the replenishment period would be normally distributed. This permits computation of the standard deviation and, in turn, calculation of the probability that a given level of sales will occur during a replenishment period. The level of safety stock needed to provide a defined percentage in-stock service can then be defined. If, for example, the distribution of sales indicates that 96 percent of the time sales during a replenishment period will be ten units or less, the firm can provide a 96 percent service level by setting the safety stock at ten units. The firm can expect to be out of stock 4 percent of the time.

Determining the service level desired takes direction from the marketing logistics strategy. Beyond this, however, it can be evaluated in terms of its contribution to cost or profit. Service level and safety stocks represent a tradeoff between two costs.[8] As safety stocks are increased, inventory maintenance costs increase. However, as safety stock increases, the sales lost through stock-outs decrease.

The nature of inventory maintenance costs was described earlier and need not be repeated here. It should be noted, however, that inventory maintenance costs will usually increase at an increasing rate as service levels are raised. In other words, because of the distribution of sales during the replenishment period, increasing service levels from 96 percent to 97 percent will normally require substantially more than a 1 percent increase in safety stocks.

Out-of-stock costs vary inversely with the level of safety stock. There are several costs associated with being out of stock and unable to fill an order. The first cost is that the customer may buy the product from another vendor, so that the sale is lost. A second cost is that the buyer in the future may not return, but continue to buy the product from the other supplier. A third potential cost is

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[8]This discussion is based on Harvey N. Shycon and Christopher R. Sprague, "Put a Price Tag on Your Customer Service Levels," *Harvard Business Review* (July–August 1975), pp. 71–78.

that the buyer may also shift purchases of other products to new suppliers. Another potential outcome is that inability to fill orders will result in loss of distribution or, at least, lessened cooperation from channel members.[9]

Although there are practical difficulties in doing so, estimation of the costs of being out of stock permits comparison of out-of-stock costs with the maintenance cost of increased levels of safety stock. Through this comparison, the cost benefits of changing service levels can be evaluated.

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[9]Ibid.

SUGGESTIONS FOR FURTHER READING

HESKETT, JAMES L. "Logistics—Essential to Strategy." *Harvard Business Review* (November–December 1977), pp. 85–96.

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