REPORT TO THE CONGRESS

Proper Use Of The Economic Order Quantity Principle Can Lead To More Savings

B-133396

Department of Defense
Department of Transportation
General Services Administration
Veterans Administration

BY THE COMPTROLLER GENERAL OF THE UNITED STATES

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-133396

To the President of the Senate and the
Speaker of the House of Representatives

We are reporting on the use of the economic order quantity principle by selected civil agencies and the Department of Defense.

We made our review pursuant to the Budget and Accounting Act, 1921 (31 U.S.C. 53), and the Accounting and Auditing Act of 1950 (31 U.S.C. 67).

We are sending copies of this report to the Director, Office of Management and Budget; the Secretary of Transportation; the Administrator of General Services; the Administrator of Veterans Affairs; and the Secretary of Defense.

Elmer B. Staats
Comptroller General
of the United States

COMPTROLLER GENERAL'S REPORT TO THE CONGRESS

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D I G E S T

WHY THE SURVEY WAS MADE

The economic order quantity (EOQ) principle is a mathematical device for determining the purchase quantity that will result in the lowest total costs for ordering and holding inventory to meet expected supply requirements.

Some time ago GAO concluded that the military services could save a great deal if they improved their implementation of the EOQ mathematical system (B-133396, June 30, 1969).

The present report follows up on the military services' improvements in the use of EOQ. In addition, GAO examined current policies, procedures, and methods of procurement by the military services and civil agencies to get an indication of the use of the EOQ principle Government-wide.

FINDINGS AND CONCLUSIONS

The Government is not saving as much as it could in operating costs and reduced inventory investments, because the organizations surveyed are not applying the EOQ principle properly or fully.

In one or more of these organizations:

--The EOQ principle was not used.

--Cost factors used to compute EOQ were not current.

--An inadequate number of factors were used to accurately reflect costs.

--Price discount information for quantity purchases was generally not obtained or used.

--Constraints were placed on EOQ computations; therefore true EOQs were not determined.

--The EOQ principle was generally not applied to reparable items.

RECOMMENDATIONS

So the Government can more fully realize the savings from properly using the EOQ principle:

1. The Secretary of Transportation should require the Federal Aviation Administration to expand the Aeronautical Center's EOQ tables, update and revise ordering-cost factors, and request bids on alternate purchase quantities. (See p. 13.)

2. The Administrator of General Services should require the Federal Supply Service to be more

selective in applying EOQ modifications and to test the market for price discount information on items to be purchased. (See p. 17.)

3. The Administrator of Veterans Affairs should require the Marketing Center to implement a system using the EOQ principle. (See p. 19.)

4. The Secretary of Defense should

--instruct the military services and the Defense Supply Agency to review and update cost factors and develop additional factors as needed,

--test the feasibility of removing EOQ restrictions,

--monitor the progress of this action, and

--revise the Department of Defense's (DOD's) instructions to include additional items in the EOQ principle and to require procuring activities to obtain and use quantity price discount information. (See p. 27.)

AGENCY ACTIONS AND UNRESOLVED ISSUES

The Department of Transportation agreed that the Federal Aviation Administration would phase out its modified EOQ plan in favor of a basic EOQ plan, develop and use cost factors, and obtain quantity price break information. (See p. 13.)

The General Services Administration (GSA) said that it had discontinued one of the modifications to the EOQ formula and that the use of modifications was justified under certain circumstances.

GSA will conduct a limited test to determine whether dollar savings are possible for volume discounts. GAO recognizes that some modifications to EOQ formulas are justified but believes the Federal Supply Service should be more selective in applying these modifications. (See p. 17.)

The Veterans Administration (VA) does not agree that its Marketing Center should implement a system using EOQ. GAO questions the validity of VA's reasons for not using EOQ and believes that the provisions of the Federal Property Management Regulation pertaining to the applicability of EOQ apply to VA. (See p. 19.)

The Department of Defense said that its existing instructions should be complied with, quantity discount information should be maintained and used, and the EOQ principle should apply to reparable items.

DOD did not fully agree with our proposals that restrictions on EOQ should removed. GAO believes that minimum restrictions on EOQ are preventing substantial savings and is recommending that a pilot program be initiated to test the feasibility of removing these restrictions. (See p. 28.)

MATTERS FOR CONSIDERATION BY THE CONGRESS

This report discloses that, because civil agency and DOD application of the EOQ principle is weak, the Government is not saving as much as it could.

Contents

ABBREVIATIONS

AVSCOM	U.S. Army Aviation Systems Command
DOD	Department of Defense
EOQ	economic order quantity
EPQ	economic purchase quantity
ESO	Electronics Supply Office
FAA	Federal Aviation Administration
FSS	Federal Supply Service
GAO	General Accounting Office
GSA	General Services Administration
OCAMA	Oklahoma City Air Materiel Area
VA	Veterans Administration

CHAPTER 1

INTRODUCTION

The economic order quantity (EOQ) principle is a mathematical device for arriving at the purchase quantity that will result in the lowest total costs for ordering and holding inventory to meet expected supply requirements. The principle's two main elements are the value of requirements and the cost factors. The cost factors are based on the cost for each replenishment order and for each additional dollar's worth of stock.

The cost to order a group of items is obtained by dividing the total costs for ordering those items over a period (usually 1 year) by the number of times the items were ordered during that period. The cost to hold stock for a group of items is obtained by dividing the total costs for holding those items over a period (usually 1 year) by the value of the average inventory (operating and safety stock) held during that period.

Although the EOQ principle assumes a fixed purchase price for each item, suppliers sometimes offer price discounts for large-quantity purchases. Since the minimum quantity which must be ordered to receive the discount may differ considerably from EOQ, which is determined on the basis of no discount, EOQ based on the discount must be determined. The quantity so determined is the economic purchase quantity (EPQ).

In a prior report (B-133396, June 20, 1969) we concluded that the military services could save a great deal by improving their implementation of the EOQ principle.

SCOPE OF REVIEW

We surveyed the military services' use of the EOQ principle to follow up on their improvements since our prior report and to become familiar with their current policies, procedures, and methods for using the principle. We obtained similar information from selected civil agencies to get an indication of the use of the principle Government-wide. We made our survey at the following organizations.

Department of Transportation
Federal Aviation Administration (FAA) Aeronautical
Center
Oklahoma City, Oklahoma

General Services Administration (GSA)
Federal Supply Service (FSS), region 6
Kansas City, Missouri

Veterans Administration (VA) Marketing Center
Hines, Illinois

Army Aviation Systems Command (AVSCOM)
St. Louis, Missouri

Navy Electronics Supply Office (ESO)
Great Lakes, Illinois

Air Force Oklahoma City Air Materiel Area (OCAMA)
Oklahoma City, Oklahoma

CHAPTER 2

SUMMARY OF OBSERVATIONS

The organizations surveyed differed widely in their use of the EOQ principle, and one did not even use the principle. If the organizations do not use or properly apply the principle, the Government will not realize the savings in operating costs and reduced inventory investments that the concept is designed to achieve.

CRITERIA FOR USING EOQ PRINCIPLE

The Federal Property Management Regulation, subpart 101-27.102, requires all executive agencies except the Department of Defense (DOD) to replenish inventories of stock items having recurring demands, except items held at points of final use, in accordance with the EOQ principle. DOD Instruction 4140.39, dated July 17, 1970, requires the military departments and the Defense Supply Agency to minimize the total variable costs for ordering and holding inventory at inventory control and their stock points.

THEORY OF EOQ

The theory of EOQ contemplates that inventory items in stock at any given time may be at any one of three different quantity levels.

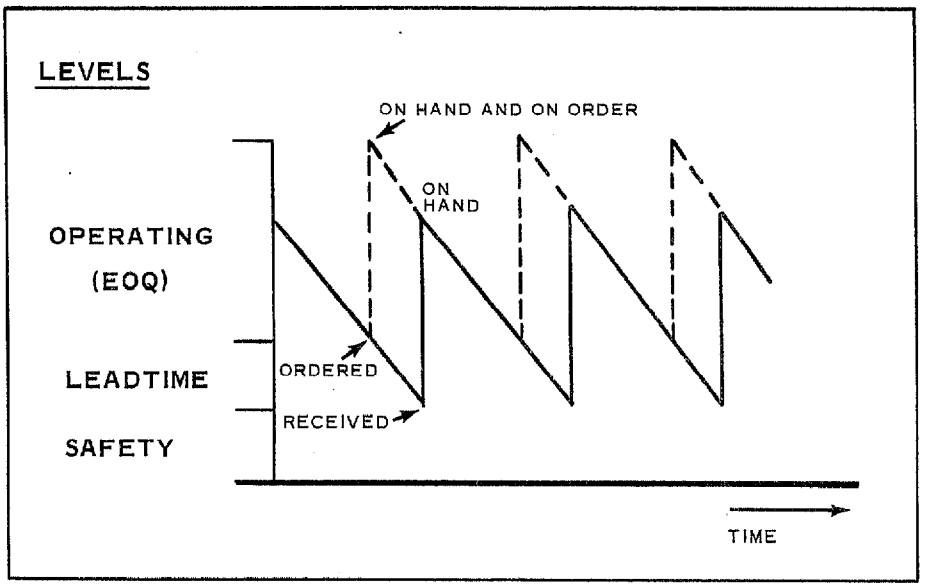
1. Safety level, which is the level below which stocks are in danger of becoming fully depleted at current levels of demand.

2. Leadtime level, which is the safety level plus the additional stocks required to satisfy current demand before replacement stocks will be received in response to an order.

3. Operating or EOQ level, which is the amount of stockage maintained above the safety and leadtime levels.

The EOQ principle applies only to the operating level; i.e., it determines the quantity to order when operating-level stocks are to be replenished. However, if leadtime and safety stock levels are below those required when replenishment is ordered, the quantity ordered must be increased.

The following chart shows how the EOQ principle would operate in relation to each of the different quantity levels, under ideal conditions.



REPLENISHMENT CYCLE AND INVENTORY LEVELS

Stocks (represented by the solid line in the chart) are drawn down to the order leadtime level. At that point, an order for replenishment stocks is placed. While the order is being processed, filled, and delivered (dotted line in the chart), the on-hand stocks continue to be drawn down to the safety level. At the safety level, the ordered stocks are received, inventories are replenished, and the cycle repeats itself.

The EOQ principle is based on balancing the costs of ordering and holding stock as much as possible to obtain the minimum total of these costs. Once EOQ is identified, the purchase of any other quantity will increase costs, except when an organization obtains a price discount on large-quantity purchases. Buying less than EOQ will decrease the cost of holding inventory, but the increased ordering costs will more than offset the decrease. Buying more than EOQ will decrease ordering costs, but the increased holding costs of the large inventory will more than offset the decrease.

Using the EOQ principle can achieve savings principally because of differences in the dollar value of requirements. Ordering larger quantities of low-dollar-value items less

frequently reduces the total number of orders, and ordering smaller quantities of high-dollar-value items reduces the total inventory investment.

NEED TO UPDATE ORDERING- AND HOLDING-COST FACTORS

Holding costs of inventories consist of the charges for investing capital, losses due to obsolescence, and storage costs. The holding costs used in applying the EOQ principle are a percentage (usually determined by experience) of average inventory values and are referred to as holding-cost factors. Ordering-cost factors used in applying the principle are stated in dollars and represent the administrative costs of placing and processing the order for and receipt of the replenishment stock.

DOD organizations, such as the U.S. Army Aviation Systems Command, which apply the EOQ principle are referred to as inventory control points. In the civil agencies no such term is applied to the inventory control organizations.

Holding-Cost Factor (Percent of Average Inventory Value)

	Civil			DOD		
Costs	FAA	GSA	VA (note a)	AVSCOM	ESO	OCAMA
Investment	6.1	10	-	4	10	10
Storage	3.9	1 to 6	-	1	1	1
Obsolescence	8.1	2	-	12	10	28
Other	4.8	10	-	-	-	-
Total	22.9	23 to 28	-	17	21	39

Ordering-Cost Factor

	Civil			DOD		
Contracts	FAA (note b)	GSA	VA (note a)	AVSCOM	ESO	OCAMA
Under $2,500	$28.24	$18 to $81	-	$145	$ 66	$127
Call-type	-	-	-	[c]20	[c]56	[c]281
Over $2,500	28.24	-	-	700	140	379

[a]Va Marketing Center had not developed factors.

[b]FAA Aeronautical Center used $15.46 for all procurements from GSA and the Defense Supply Agency.

[c]Factors have been developed but are not being used.

FAA and GSA require annual reviews of the factors to make sure they are current.

DOD Instruction 4140.39 provides that the military services update ordering costs at least every 2 years and when general schedule civilian wages change. However, the military organizations we reviewed had not done so and therefore were using factors which were outdated or not representative of the actual costs incurred.

HOLDING-COST FACTOR NOT COMPUTED AS REQUIRED

DOD Instruction 4140.39 prescribes a 10-percent investment factor and a 1-percent storage cost factor because storage costs are minimal. Rates of obsolescence differ for the various inventory items. Therefore, obsolescence is the only factor that should significantly vary the holding cost.

The DOD instruction provides that, as a minimum, each inventory control point will compute an obsolescence factor for the items it manages by dividing the value of annual disposal by the value of on-hand and on-order inventory. The computed cost must be reviewed annually, and a list of past computations must be kept for establishing a smoothed rate. The organizations surveyed have not always complied with the instruction. For example, neither ESO nor OCAMA has annually reviewed its obsolescence factor.

According to the instruction, establishing different obsolescence costs for various commodity groupings is authorized when warranted by the nature of the materiel, particularly materiel subject to rapid technological change or deterioration. We found no evidence that the services made such a breakdown of obsolescence costs. Because of the large differences in the types of items managed by the services, using the same obsolescence rate for all items managed at a location does not seem reasonable. For example, items for an active weapon system should have a much lower obsolescence rate than those for a system being phased out.

We believe the services should take advantage of their authority to use more than one holding-cost factor and should annually review those factors to insure that each one is reasonable.

NEED FOR MORE ORDERING-COST FACTORS

In computing ordering-cost factors no distinction is made as to whether the procurement source is another Government agency or a commercial supplier. We believe this may result in inaccurate ordering-cost factors since it conceals different degrees of administrative effort involved in purchasing from the two types of sources. If the source is a commercial supplier, the factors should also consider whether the purchase is under small-purchase procedures, an open-end contract, or a more formal advertised or negotiated contract. As indicated in the schedule on page 5, FAA uses two ordering-cost factors and GSA uses many. Although instructions require the military services to use at least three factors (for call-type contracts, contracts under $2,500, and contracts over $2,500), they use factors only for the latter two.

We believe the number of ordering-cost factors is inadequate, except at GSA, to reflect accurate costs for the various sources and types of procurement. For example, before July 1, 1972, ESO used separate ordering costs for negotiated and advertised contracts over $2,500; the difference between the two costs was 31 percent. Assuming the 31-percent difference is valid for ESO's mix of contracts in fiscal year 1972, we believe the ordering costs should be $135 for negotiated and $177 for advertised contracts. Using these costs, rather than $140, would make a large difference in EOQ, particularly for advertised procurements.

NEED FOR MORE PRICE DISCOUNT INFORMATION

Three of the organizations surveyed had no procedures for obtaining quantity price discount information from suppliers. ESO had procedures but was not taking advantage of all discounts because of fund shortages. GSA was obtaining discount data but only for small local purchases. GSA officials said they did not request discounts on negotiated and advertised contracts because they believed the additional work would not be warranted.

We tested 168 items at 4 locations and found that suppliers had offered discounts on 109 items. For 56 of these, the discounts were not economical, and for 53 the discounts could have saved about $122,695 annually.

Although we recognize that restrictions may preclude using EPQ for all items, it should at least be used when the return for additional investment and the cost savings are great.

CONSTRAINTS ON EOQ

Cost reductions from using the EOQ principle were limited by constraints on minimum and maximum purchase quantities.

GSA's inventory system computes EOQ for a minimum 2 weeks' supply, but we were told that purchases at region 6 were usually not for less than 1 month's supply because it would be unrealistic to expect deliveries more frequently. At the other organizations, however, replenishment purchases were restricted to a minimum of 3 months' supply, even though smaller quantities were called for by the EOQ principle. Because this constraint applied to high-value annual demand items, the average inventories and the combined ordering and holding costs were not reduced. For example, we estimated that, by decreasing the minimum from 3 months to 1 month, OCAMA could save about $1.2 million annually.

Maximum purchase quantities were 3 years' supply at FAA and 5 years' supply at AVSCOM and ESO but only 1 year's supply at OCAMA. This caused OCAMA to buy low-value items too frequently, which increased annual costs. In many cases the prices paid for 1 year's supply of low-demand items were less than the costs to order. Annual costs could have been reduced substantially by changing the maximum to 3 years' supply. (See p. 22.)

We recognize that it may not be possible to realize all the potential savings by buying unrestricted EOQ since it may not always be feasible to buy unrestricted minimum EOQ or minimum purchase quantities. However, the actual EOQ should be determined and the quantity purchased should be the most economical quantity after considering price and ordering and holding costs and such other factors as the time minimums.

NARROW APPLICATION OF EOQ PRINCIPLE

The EOQ principle is used to replenish stocks of items having recurring demands. The organizations surveyed, except ESO, applied the principle only to expendable items; i.e., those discarded after use rather than repaired. Most of the civil agencies did not apply the principle to reparable items because they did not manage such items or needed quantities which were too small for EOQ purchases.

Stocks of reparable items diminish as they are issued to replace like items which have become unserviceable. These stocks are generally replaced by repairing the unserviceables. During the repair process, however, some items are condemned because they are uneconomical to repair. Because of condemnations during repair, other losses, and increased usage requiring more items, additional stocks eventually need to be bought. We believe these replenishment stocks should be bought in EOQs rather than in quantities expected to be needed for a given period; i.e., 6 months, 1 year, or 3 years. Because of the large inventory investments in reparable items, especially in the military services, using the EOQ principle would reduce these investments.

ESO purchases reparable items under EOQ, and it seems reasonable that other military installations could do so also. We randomly tested purchase requisitions OCAMA had issued for reparable items during the last 6 months of calendar year 1972. We estimated that OCAMA could have saved at least $1.1 million annually by procuring these items under EOQ. (See p. 26.)

CONCLUSIONS

Decisions on quantities to buy were frequently made for reasons other than economy. Therefore, the Government did not receive the full benefits of using the EOQ principle. To achieve the savings available through EOQ, the organizations surveyed should:

--Apply the principle to the maximum number of items.

--Determine the number of cost factors needed to accurately reflect costs to order and hold material.

--Periodically review and revise these factors to maintain their accuracy.

--Obtain information on and use price discounts.

--Remove the constraints on using EOQ so that actual EOQ is determined.

It may not always be possible or prudent to buy EOQ or EPQ for such reasons as fund shortages, lack of warehouse space, procurement leadtimes, or workload of procurement personnel. However, EOQ should be determined using current, complete, and accurate data on annual requirements and ordering and holding costs. On the basis of an accurately computed EOQ and quantity price discount information, procurement personnel can readily determine the most economical quantity to buy. Decisions to buy other than this quantity can then be made and justified on an informal basis.

CHAPTER 3

CIVIL AGENCIES

FAA AERONAUTICAL CENTER

The Center's material inventory for maintaining FAA facilities and aircraft was valued at $64.2 million as of September 30, 1972. The inventory comprises expendable and reparable items valued at $24 million and $40.2 million, respectively.

The Center uses the EOQ principle, with certain limitations, to determine purchase quantities for about 70,000 expendable items which it acquires from commercial suppliers and for about 18,000 expendable items which it acquires from the Defense Supply Agency. The Center also determines whether price discounts for larger quantities are available for the commercial items bought under annual contracts.

For approximately 10,000 reparable items, the Center establishes inventory levels and buys replenishment quantities to replace those that become uneconomical to repair. Center officials said these items do not lend themselves to EOQ purchases because they do not have to be replenished very often and because replenishing them requires long lead-times and tooling and setup times. Our limited test supports this position.

Need to improve EOQ determinations

The Center's EOQ tables are too restrictive because they provide for 3 months' supply as the minimum purchase quantity and 6 months' supply as the next purchase quantity for items with high-value annual demands. The EOQ table for commercial items provides for acquiring

--3 months' supply if the demand exceeds $1,776 worth a year and

--6 months' supply if the demand is from $592 to $1,776 worth a year.

These categories include 1,956 items with annual demands ranging to about $942,000 worth. These items comprise

only 3 percent of the Center's commercial items but account for most of the commercial item inventory value. Acquiring these items for 3 and 6 months' supply results in high inventory investments, which increases the combined ordering and holding costs.

By revising the tables to provide for EOQ orders from a minimum of 1 month's supply for the highest demand commercial items to 6 months' supply for higher demand items, average inventories could be reduced by about $439,300. The annual holding cost would be decreased by about $100,600 and the ordering cost would be increased by about $15,000, or a net decrease of about $85,600. (See p. 14.)

The Center may not be able to realize all these savings because buying smaller quantities can result in higher prices or transportation costs for some items. If so, the quantities bought should be based on price and combined ordering and holding costs.

Using the revised tables could increase the number of commercial orders by about 530 a year, which would increase ordering costs by about $15,000. However, if the Center buys larger quantities to obtain discounts, the increase in the number of orders may be significantly lower.

Need to review cost factors

Accurate cost factors are a prerequisite to achieving the economies inherent in the EOQ principle. The Center uses one ordering-cost factor for commercial items regardless of the type or dollar value of the procurement. In computing this factor, the Center divided the total procurement division costs by the total line items processed, which included buys of stock replenishment, reparable, and direct shipped items and processing actions relating to commercial repair.

Center officials agreed that they should consider only the ordering costs for stock replenishment items and that, as a minimum, they should use different ordering costs for stock replenishments under $2,500 and those over $2,500.

Need to determine the availability of discounts

The Center does not determine whether discounts are available if it buys larger quantities of commercial items unless it buys the items under annual contracts. At our request the Center solicited bids for alternate quantities of 75 items. It received pricing data on 42 of these items by the cutoff date. For 33 items the suppliers offered discounts for larger quantities, and the discounts for 19 of the 33 were sufficient to offset the additional holding costs.

After this test Center officials agreed to obtain bids on alternate quantities of expendable items above $2,500 in annual demand and to determine the feasibility of annual contracts for items having more than two annual procurements. Because expendable items account for most of the commercial item inventory value, obtaining lower prices on them can result in savings.

Recommendations

We recommend that FAA

--expand the Center's EOQ tables so that the size of its orders are more nearly EOQ,

--update and revise the ordering-cost factors so that more than one factor is used, and

--request bids on alternate quantities to determine whether buying larger quantities than EOQ can reduce costs.

Agency comments and our evaluation

In a letter dated January 28, 1974 (see app. I), the Department of Transportation said that FAA would, to the extent permitted, phase out the current modified EOQ plan in favor of the basic EOQ plan. In addition, FAA would develop and use cost factors more closely aligned with the specific type and value of procurement transactions and would place greater emphasis on obtaining data on available quantity price discounts to determine EPQ. These

actions, when implemented, can significantly reduce the Center's inventory investment and its ordering and holding costs.

Comparison Of Average Inventory

And Ordering And Holding Costs

Using Alternate EOQ Tables

Number of commercial items	FAA table			Revised table			Potential reductions	
	Buy months	Average inventory (note a)	Ordering and holding costs	Buy months	Average inventory (note a)	Ordering and holding costs	Average inventory	Ordering and holding costs
897	6	$ 196,800	$ 95,700	6	$196,800	$ 95,700	$ -	$ -
361	6	134,100	51,100	5	111,600	50,000	22,500	1,100
298	3	88,200	53,900	4	117,600	52,200	-29,400	1,700
178	3	85,600	39,700	3	85,600	39,700	-	-
69	3	51,000	19,500	2-1/2	42,500	19,100	8,500	400
63	3	74,600	24,200	2	49,700	22,100	24,900	2,100
54	3	119,900	33,500	1-1/2	59,900	25,900	60,000	7,600
36	3	529,200	125,300	1	176,400	52,600	352,800	72,700
1,956		$1,279,100	$442,900		$840,100	$357,300	$439,300	$85,600

[a] Figures represent operating stock levels and do not include safety and leadtime stock levels which are also on hand.

FSS REGION 6, GSA

Region 6 has an inventory of about 23,000 active items. As of September 30, 1972, the inventory was valued at about $20.9 million, which is about 13.6 percent of the total FSS inventory. Each year the region buys about $38 million worth of these supplies, $14 million of which it buys under definite-quantity local contracts and $24 million under indefinite-quantity (term) contracts.

FSS's computer system is designed to determine EOQs by using an average price per unit for recent purchases. FSS used 6 holding-cost factors ranging from 23 to 28 percent and as many as 64 ordering-cost factors ranging from $18 to $81. These factors are generally reviewed annually and updated as necessary. The computed EOQ, however, is reduced by 50 percent to reduce inventory investment. The region does not obtain information on price discounts for larger quantities, except for purchases under $2,500.

Uneconomical modifications to EOQ

FSS officials said the Office of Management and Budget had instructed them to reduce total supply inventories by $15 million during fiscal year 1973 and another $25 million during fiscal year 1974, mainly by eliminating items which are uneconomical to store.

FSS has also reduced inventory levels by reducing EOQs. Early in 1969 FSS increased the holding-cost factor by 10 percent. Later it began reducing the computed EOQ, and since January 1973 it has reduced all computed EOQs by 50 percent. Although these modifications have reduced inventory levels, they have increased region 6's costs and reduced the region's service to customer agencies.

To estimate the effect of the reductions, we randomly selected 235 purchases from about 30,000 purchases made from August 1971 through November 1972. The computed EOQ for all the items was reduced because of the 10-percent increase in the holding-cost factor. Our sample included 138 items for which the computed EOQ was further reduced by 20 percent and 5 items for which the EOQ was reduced by 50 percent.

Because the region's item managers were not able to place the 235 orders on time, reserve stocks had to be used and

quantities purchased were increased accordingly. As a result, ordering frequency was not significantly increased. However, the region's inability to fill requisitions without back orders increased from 11 percent in fiscal year 1967 to 17 percent in fiscal year 1972. On the basis of our random sample, the 50-percent reduction in computed EOQ since January 1973 will increase the average order frequency from 2.48 to 3.76 orders a year, an increase of about 50 percent. Assuming no change in employees' efficiency and no further deterioration in customer service, this change could be expected to increase combined ordering and holding costs at least $262,000 a year. Because the region has a personnel ceiling, however, the most likely effect is a further deterioration in customer service. Such deterioration could cause disruptions in customers' operations, higher priced purchases, or stockpiling by customers.

Need to obtain information on availability of lower prices

Region 6 did not obtain information on the availability of quantity price discounts except for small, local purchases. Region officials said they had not obtained such information for larger purchases because:

1. Procurement personnel were reluctant to obtain data on quantities which only supply control personnel had authority to order.

2. Quantity discounts had little effect on larger purchases.

3. A supplier bidding lowest on one quantity but not on the others caused administrative problems.

At our request, region officials agreed that for a trial period they would request discount information on larger, definite-quantity purchases. At the close of our survey the region had received responses to 86 solicitations. Quantity discounts were available for 37 items. The estimated annual savings of $25,900 for 17 of these items represented an 18- to 156-percent return on the additional investment required. Discounts for the remaining 20 items were not economical. By taking advantage of the discounts on five items, the region saved $20,461 on the purchase price.

We recognize that there must be some constraints on increasing purchase quantities to obtain lower prices. These constraints can be expressed in such terms as months of supply and minimum rates of return on additional investment. Such constraints can be easily incorporated in a short computer program so that determining optimum purchase quantities will not be burdensome.

Recommendations

We recommend that the Administrator of General Services work with FSS to:

--Revise the policies so that modifications to EOQ are applied more selectively rather than across the board.

--Instruct the regions to periodically test the marketplace and obtain discount information on items to be purchased to determine the most economical quantity to buy.

Agency comments and our evaluation

In a letter dated January 22, 1974 (see app. II), GSA advised us that it had discontinued using the EOQ multiplier (reduction of computed EOQ by 50 percent). However, GSA feels that under certain circumstances the use of a variable percentage in the holding cost factor is justified. It is a common practice in industry to use it to increase or decrease inventory in response to management objectives.

GSA also feels that it has had little opportunity in the past to adjust EOQ for volume discounts because of the volume of procurements made against term contracts or other open-end contracts awarded annually. Supply orders are placed against these contracts periodically during the year. Nevertheless, it will run a limited test during calendar year 1974 to determine whether dollar savings are possible.

There are instances when modifications to the EOQ formula are appropriate as an expedient to meet management objectives. However, care must be exercised in determining and applying these modifications to insure that their effect is what is desired. The modifications applied by FSS met the objective of reducing inventory levels, but they should not have been applied to all items.

GSA's decision to test the potential for achieving volume discount savings on term contracts is consistent with our recommendations.

VA MARKETING CENTER

One function of the Marketing Center is to purchase and manage stock to be held at the three VA depots primarily for distribution to VA stations. During fiscal year 1972, the Center managed approximately 2,500 depot stock items with an average inventory value of about $23 million and purchased about $76 million worth of such items.

The Center does not use the EOQ principle; it purchases stock on the basis of a selected number of months of demand. We believe using the EOQ principle could significantly reduce inventories and ordering and holding costs.

Potential for savings by using the principle

We selected for review 30 items with annual demands ranging from under $5,000 to over $500,000. We developed ordering and holding costs for the various Center purchasing methods and stock storage locations. By applying these cost factors to the 30 items, we found a potential reduction in average inventory of about $511,000 and an annual net savings in ordering and holding costs of about $53,500. Because we did not select these items statistically, we could not estimate the total potential for savings.

We recognize that all items managed by the Center may not be susceptible to the strict EOQ principle due to price breaks, transportation costs, shelf lives, seasonal purchases, and other limitations. However, as provided in the Federal Property Management Regulations, modified EOQs should be developed to minimize net ordering and holding costs.

Center officials acknowledged that (1) by modifying their current system, EOQs could be computed and printed on existing stock reports and (2) the EOQ principle could be applied to some of the subsistence items.

Recommendation

We recommend that the Administrator of Veterans Affairs work with the Marketing Center to implement a system using the EOQ principle.

Agency comments and our evaluation

In its letter dated February 6, 1974 (see app. III), VA said that it did not agree that its wholesale system should use the EOQ principle. VA did say that:

--It had made a study of the EOQ more than 15 years ago and had adopted it for all VA field activities.

--At that time, and on several occasions since, it had studied the adoption of EOQ in its central purchasing activity and had decided that it would not be desirable or profitable.

--Its stock replenishment operation must accommodate certain factors, such as seasonal pack items, shelf-life items, fund availability, warehouse space, procurement leadtime, and indefinite requirements by serving other Government agencies.

VA therefore concluded that using the EOQ principle for inventory management at the wholesale centralized level was questionable.

The factors VA cited in opposition to using EOQ are not peculiar to VA. Except for seasonal pack items, each of these factors applies to all other activities included in our survey and in most instances to a much greater degree.

The centralized wholesale procurement level is the point at which savings are attainable by using the principle because it is at this point that procurement costs are incurred for total system requirements. VA's application of the principle at field locations, but not at the wholesale level, is inconsistent. Officials at the Center could not provide us with any studies made on EOQ, and, when we made further inquiry at VA headquarters, we were told that no studies had been made recently.

The Federal Property Management Regulation is also very specific that the principle shall be used by all executive agencies except DOD. VA officials told us that they had not requested exemption from the provisions of the regulation. It is apparent therefore that VA officials should either comply with the regulations or request the necessary exemption.

CHAPTER 4

DEPARTMENT OF DEFENSE

Our survey at AVSCOM, ESO, and OCAMA indicates that the military services can save a great deal by improving their application of the EOQ principle. These savings are not being attained now because the services:

--Limit the quantities that may be purchased.

--Use inaccurate and insufficient ordering- and holding-cost factors.

--Exclude from EOQ computations certain items which could benefit from their use.

--Do not obtain enough information on quantity price discounts.

LIMITATIONS ON QUANTITIES PURCHASED

DOD Instruction 4140.39 states that the services should normally use a minimum purchase quantity of 3 months' supply and a maximum of 3 years' supply. Deviations from these limits are permitted if particular commodity characteristics (shelf life, seasonal buys, etc.) or industry procurement practices (quantity discounts, economics, etc.) dictate otherwise.

ESO uses a minimum of 3 months and a maximum of 5 years. AVSCOM, at the beginning of our review, was using a minimum of 6 months and a maximum of 5 years. OCAMA was using a minimum of 3 months and a maximum of 1 year, depending on the dollar value of annual demands.

During our survey, the Air Force Logistics Command issued guidelines which provide that, when the annual demand is less than $640 worth, 1 year's supply will be bought. When the demand is worth $640 to $9,500, EOQ will be bought, and when the demand exceeds $9,500 worth, a 3 months' supply will be bought regardless of whether EOQ is greater or smaller.

To show the effect of these restrictions at OCAMA, we obtained a computer list of EOQ items by unit cost and annual

demand. The table below shows the ordering and holding costs with and without restrictions.

Restrictions	Number of items	Ordering and holding cost With restrictions	Ordering and holding cost Without restrictions	Difference (savings using EOQ)
3 months	891	$ 5,681,827.89	$ 4,461,675.66	$1,220,152.23
3 months (note a)	2,061	4,827,922.89	4,566,063.37	261,859.52
EOQ	19,326	9,298,609.55	9,298,609.55	-
1 year	52,892	8,036,746.62	5,354,791.05	2,681,955.57
Total	75,170	$27,845,106.95	$23,681,139.63	$4,163,967.32

[a]EOQ would be 3 to 5 months' supply, but at the time of our survey, OCAMA was procuring 3 months' supply.

Ordering costs would be reduced primarily because OCAMA would make about 29,000 less buys each year by using EOQ.

Restrictions	Number of buys each year With restrictions	Number of buys each year Without restrictions	Difference
3 months	3,564	5,495	-1,931
3 months	8,244	6,048	2,196
EOQ	35,188	35,188	-
1 year	52,892	24,130	28,762
Total	99,888	70,861	29,027

We believe the military services should determine the actual EOQ and should purchase the most economical quantity after considering price and ordering and holding costs.

INACCURATE AND INSUFFICIENT COST FACTORS

The accuracy of the services' cost factors is questionable; therefore, the services may not be computing the best purchase quantities.

Holding costs

As previously stated, the holding-cost factor is made up of investment, obsolescence, and storage costs. In

accordance with DOD Instruction 4140.39, AVSCOM, ESO, and OCAMA used a 1-percent storage cost factor. Both ESO and OCAMA used the prescribed 10-percent investment rate. AVSCOM, however, has used a 4-percent investment rate since 1962. AVSCOM officials told us that they were planning to adjust the rate.

According to DOD instructions, the obsolescence rate was to be determined by dividing the value of annual disposals by the value of on-hand and on-order inventory and was to be reviewed annually.

OCAMA used a 28-percent obsolescence rate which was based on an average of the Logistics Command's items in five air materiel areas rather than on the items it manages. This rate was reduced to 21 percent during our review. We did not review the accuracy of AVSCOM's 12-percent obsolescence rate.

ESO has used a 10-percent rate since 1964 but has not reviewed it annually. This rate was based on the minimum allowed under the Navy uniform automated data processing system. We determined that, for the last 5 fiscal years, ESO's actual obsolescence rate ranged from 3.9 to 24.9 percent. The following table shows the obsolescence rates for the various categories of materiel managed by ESO. The significantly higher rates since 1970 are due to a massive disposal program.

Materiel category	Fiscal year				
	1968	1969	1970	1971	1972
1N	2.5	3.9	28.0	18.3	21.6
2N	2.5	2.9	10.4	8.0	16.4
4N	4.6	8.6	30.8	42.2	31.0
8N	7.1	1.1	6.8	32.9	40.0
2G	-	3.5	2.9	12.1	19.4
4G	-	-	6.4	6.8	21.5
Yearly average	3.9	6.3	24.9	24.9	23.8

The total rates for each category, as well as the variations by categories in any given year, indicate that more than one holding-cost factor should be determined and reviewed annually as required.

Ordering costs

In revising their ordering-cost factors, each of the inventory control points had departed from DOD instructions.

--ESO's factors, developed early in 1971, were not updated for civilian pay increases in 1972 and 1973.

--OCAMA's factors were updated in May 1970 and May 1973--a 3-year period rather than the 2 years required. In addition, the May 1970 update was not implemented until January 1972, so factors developed in 1966 were used until then.

--AVSCOM planned to begin using revised factors in June 1973. These factors were developed from another Army inventory control point's costs for October 1968 through March 1969. The factors therefore do not necessarily represent AVSCOM costs, nor do they include the 33-percent civilian pay increase from July 1969 to January 1973. The effect of not including this pay increase is shown below.

	AVSCOM-revised factor (note a)	GAO-computed factors (including pay increases)	Percent understated
Call-type contract	$ 90	$114	21
Contracts under $2,500	125	163	23
Contracts between $2,500 and $10,000	450	553	19
Contracts between $10,000 and $25,000	745	916	19

[a] Because these factors were to be implemented after our survey, they are different from those on page 5.

DOD instructions provide for using three ordering costs, but as shown in the table on page 5, only two were being used. Although each inventory control point had developed a cost for call-type contracts in accordance with the instructions, none were using the cost. ESO did not use this cost because it was not provided for in its computer program.

After discussing this with ESO officials, they said they would revise the computer program to include the cost.

ESO used separate costs for advertised and negotiated contracts before July 1972 and now uses a single cost of $140. The difference between the two costs previously used was 31 percent. Assuming the 31-percent difference is valid for ESO's mix of contracts in fiscal year 1972, ordering costs should be $135 for negotiated and $177 for advertised contracts over $2,500. Using these costs rather than $140 would make a large difference in EOQ, particularly for advertised procurements. On the basis of our survey at ESO, we believe the services should be using separate ordering costs for advertised and negotiated contracts over $2,500 because negotiations generally take more effort in obtaining, reviewing, and using cost and pricing information.

We did not check the accuracy of ordering-cost factors at any location. But by comparing costs for high-value contracts as shown on page 5, we believe AVSCOM's costs are out of line. We believe some of this difference is due to a lack of uniformity by the services' application of Defense Contract Administration services and Defense Contract Audit Agency costs for contract administration and preaward surveys.

The following schedule shows the effect of the services' wide range of ordering- and holding-cost factors. We used the actual order and holding costs as shown on page 5, using ESO factors as a base. In the illustration we assumed that the test item had an annual demand worth $40,000 and was purchased under contracts exceeding $2,500.

	ESO	AVSCOM	OCAMA
Using actual factors (see p. 5):			
Number of buys	5.48	2.21	4.54
Value of EOQ procurement	$7,300	$18,140	$ 8,820
Using actual ordering costs and ESO holding cost of 21 percent:			
Number of buys	2.45	5.48	3.33
Value of EOQ procurement	$7,300	$16,320	$12,020
Using ESO ordering cost of $140 and actual holding costs:			
Number of buys	5.48	4.93	7.46
Value of EOQ procurement	$7,300	$ 8,120	$ 5,360

Appendix V shows a similar schedule for contracts under $2,500 and an assumed annual demand worth $7,744.

EXCLUSION OF ITEMS FROM EOQ COMPUTATIONS

As stated on page 9, ESO was the only organization in our survey which purchased reparable items under the EOQ principle. At June 30, 1972, it used the principle for $325 million, or 88 percent, of its total inventory of $368 million. ESO plans to apply the principle to all the items it manages.

OCAMA applies the EOQ principle to about 142,000 expendable items which accounted for over half of its annual procurements in fiscal year 1972. We randomly selected 91 OCAMA purchase requisitions issued for reparable items during the last 6 months of fiscal year 1972 to determine the difference in procurement quantities by using EOQ. We dropped 22 items from our sample because they were one-time buys and could not be considered under EOQ. For the remaining 69 items, the quantity procured exceeded EOQ on 62 items and was less than EOQ on 7 items. The value of procurements in excess of EOQ was about $589,000, and the value of those less than EOQ was about $23,000, or a net excess of about $566,000. We estimate that OCAMA could have saved $1.1 million to $3.5 million annually by procuring EOQ.

We believe that AVSCOM, which applies the principle to small-value (annual demands worth up to $5,000) expendable items, could also save substantially by applying the principle to reparable items and to higher annual demand value items.

QUANTITY PRICE DISCOUNTS

The computed EOQ may not be the most economic quantity to buy if a discount can be obtained for quantity purchases. However, the military organizations, except ESO, generally did not request or receive discount information.

ESO has an appropriate formula for evaluating bids to determine the most favorable combination of price and quantity based on ordering and holding costs and anticipated use rates.

Although ESO usually obtained discount information, it did not adjust purchase quantities to take advantage of the discounts because of fund shortages. From a random sample of 34 items, we found that for valid reasons discount

information was not requested or received for 10 items. For the remaining 24 items, ESO adjusted the purchase quantity of only 1 item to take advantage of a discount. By adjusting the quantity on this item, ESO reduced the unit price by 31 percent and saved over $28,000 annually. For seven other items we determined that ESO could have saved about $54,000 annually by buying alternate discount quantities.

At our request, OCAMA requested prices for alternate quantities on 50 EOQ and 50 reparable items in January 1973. At the close of our fieldwork, OCAMA had received information on only 12 EOQ and 4 reparable items. Discounts for alternate quantities were offered on 11 of the 12 EOQ items, 7 of which would have resulted in savings. Discounts were available for all four reparable items and would have been economical for two of the four. We believe agencies should have procedures for periodically testing the marketplace for quantity price discounts and should purchase the most economical quantities after considering these discounts.

CONCLUSIONS

The military services are not achieving the savings possible by properly applying the EOQ principle. Although we cannot be certain that the conditions we found are typical of all inventory control points--except in the Air Force where all air materiel areas use the same factors and guidelines--we believe they are widespread. Considering the potential for savings and the number and dollar value of EOQ-type procurements at all inventory control points, including those of the Defense Supply Agency, the proper and expanded use of EOQ could save a large amount.

RECOMMENDATIONS

We recommend that the Secretary of Defense instruct the military services and the Defense Supply Agency to comply with the provisions of DOD Instruction 4140.39 by

--reviewing and updating cost factors and

--developing additional factors to more accurately reflect ordering and holding costs.

DOD should monitor the progress in attaining compliance.

We also recommend that the Secretary

--require that a pilot program be initiated to test the feasibility of removing the minimum restriction and

--revise the instruction to include additional items, particularly reparables, in the EOQ principle and to require procuring activities to obtain and use quantity price discount information.

AGENCY COMMENTS AND OUR EVALUATION

In its letter dated February 5, 1974 (see app. IV), DOD agreed that

--it should update ordering and holding costs;

--it would consider a means of refining holding costs; i.e., separate holding costs for each Air Force inventory control point and other means;

--it would require procuring activities to maintain and use quantity discount information on a more uniform and formal basis; and

--it should apply the EOQ principle to reparable items.

DOD, however, did not agree that it should use additional cost factors. DOD stated that full implementation of the current instruction providing for the use of three ordering costs and consideration of Defense Contract Audit Agency costs on an exception basis for high-dollar procurements would provide adequate sensitivity for EOQ results. Cost updates will significantly improve the situation pointed out in this report. We believe there would be additional improvement if DOD would consider one additional factor so that separate ordering costs would be used for

--procurements under $2,500,
--procurements between $2,500 and $100,000,
--negotiated procurements above $100,000, and
--call-type contracts.

DOD did not agree that restrictions on EOQ should be removed and said that lack of sophistication in the formula caused EOQ to be understated for high-dollar/demand items. To compensate for these shortcomings, DOD constrained the

minimum EOQ to 3 months to avoid uneconomic repetitive procurements of high-dollar/demand items. Similarly, it developed the 3-year maximum constraint to recognize that economic, technological, and political events influence requirements and could impact on future needs.

We agree that the 3-year maximum restriction on EOQ should be retained. However, we feel that efforts should be made to insure its use by all the services. With respect to removing the 3 months' minimum restriction, we believe DOD needs to reevaluate its position. Relatively few items are involved, and a test should be made to ascertain whether or not significant savings can be realized on these high-demand items.

OFFICE OF THE SECRETARY OF TRANSPORTATION
WASHINGTON, D.C. 20590

ASSISTANT SECRETARY
FOR ADMINISTRATION

January 28, 1974

Mr. Richard W. Kelley, Associate Director
Resources and Economic Development Division
U. S. General Accounting Office
Washington, D. C. 20590

Dear Mr. Kelley:

This is in response to your letter of November 8, 1973, transmitting copies of a General Accounting Office (GAO) draft report on the use of the economic order quantity (EOQ) principle at various Government agencies. As you will recall, you asked for comments on certain recommendations concerning the application of the EOQ principle by the Federal Aviation Administration's (FAA) Aeronautical Center, Oklahoma City.

From your review at the FAA's Aeronautical Center you have concluded that the Center could realize substantial savings by improvements in application of the EOQ principle. Accordingly, you recommend that the Center: (1) Expand its EOQ table so that the size of its orders are more nearly EOQ; (2) update and revise its ordering-cost factors so that more than one factor is used; and (3) request bids on alternate quantities to be bought to determine whether savings can be achieved by buying larger quantities than the EOQ.

We agree with your recommendations and to the extent permitted within the constraints imposed by the supply support demands of the FAA national airway facilities and aircraft fleet and by other staffing and fund limitations, the FAA will phase out the modified EOQ plan currently in use in favor of the basic EOQ. In addition, FAA will: (1) Develop and utilize cost factors more closely aligned with specific type and value of procurement transactions; and (2) place increased emphasis on obtaining data on the availability of alternate quantity price discounts for item quantities larger than EOQ to determine the economic purchase quantity.

We appreciate the opportunity to comment on this matter.

Sincerely,

William S. Heffelfinger

APPENDIX II

UNITED STATES OF AMERICA
GENERAL SERVICES ADMINISTRATION
WASHINGTON, DC 20405

JAN 22 1974

Honorable Elmer B. Staats
Comptroller General of the United States
General Accounting Office
Washington, D.C. 20548

Dear Mr. Staats:

We appreciate having been given the opportunity to review the draft report to the Congress on use of the Economic Order Quantity (EOQ) Principle, 947013-74-LCD-411 (MM-69). Our reply will be confined to the two recommendations contained on page 23, chapter 3.

The draft report recommends first that we require the Federal Supply Service to "revise the policies to require that actual EOQ be computed without modifications." On pages 20 and 21, the report singles out the practice of (1) increasing the holding cost factor by 10 percent, and (2) the application of an EOQ multiplier which reduced all computed EOQ's by 50 percent.

Comment: The application of an EOQ multiplier was discontinued in October 1973 after having served the purpose of lowering inventory investment values to meet budgetary objectives. While we do not plan to use the EOQ multiplier in the future, there are circumstances, we believe, which justify modification of the EOQ either upward or downward. These include shortage of investment funds, limitations of storage space, anticipated vendor material shortages, and prospective demand increases. In consonance with this, it is common practice in industry to use a management variable percentage in the holding cost factor of the EOQ formula. In this way, inventory can be increased or decreased in response to the objectives of management.

Modification of the holding cost factor to incorporate management policy is prescribed in a number of textbooks on modern inventory management. To quote Robert Goodell Brown, a noted authority in the field: "The major part of the cost of carrying inventory, however, is more subjective: management's policy about the economic use of capital funds for inventory . . . ." (Management Decisions for Production Operations, p. 28, the Dryden Press Inc., Hinsdale, Ill., 1971). Brown goes on to say, ". . . there is considerable operating latitude to choose values which suit some other factors not considered in the (EOQ) model." We believe that rigid constraints imposed by a fixed formula do not, under some circumstances, serve the best interests of the Government.

The report recommends, secondly, that we "require FSS to instruct regions to obtain discount information on all items to determine the most economical quantity to buy." Predominantly, the policies employed by the Federal Supply Service have not, in the past, afforded great opportunity for modification of the EOQ in response to volume discounts. Up to 85 percent of our requirements were purchased against term contracts and other open-end established sources which covered annual requirements. The current trend toward more definite quantity procurement would have caused us to reexamine the potential for economic procurement quantity buying even without the GAO report. The GAO findings here are somewhat distorted because the audit was conducted in Kansas City, where there are thousands of key depot items which are not covered by established contract and require definite quantity purchasing.

We plan to run a limited test during calendar year 1974 to determine whether dollar savings are possible. As the draft observed, all costs, not just vendor costs, must be assessed to see whether implementation of the recommendation can be justified.

The complimentary comments paid to the Federal Supply Service in the body of the report are gratifying.

Sincerely,

Dwight Ink

Dwight A. Ink
Acting Administrator

VETERANS ADMINISTRATION
OFFICE OF THE ADMINISTRATOR OF VETERANS AFFAIRS
WASHINGTON, D.C. 20420

FEBRUARY 6 1974

Mr. Frank M. Mikus
Assistant Director
Manpower and Welfare Division
U. S. General Accounting Office
Room 137, Lafayette Building
Washington, D. C. 20420

Dear Mr. Mikus:

We appreciate the opportunity to review and comment on your draft report relating to the use of the economic order quantity principle. While we strongly favor the use of this method where it is practical, we do not agree with your recommendation that the system be implemented at our Marketing Center.

More than 15 years ago we studied the economic order quantity principle and adopted it for use in all of our field activities. We believe this agency pioneered its use within the Government, in any event, our implementation of the system predated the Federal Procurement Regulation that prescribed its use. At that time, and on several occasions since, we have studied the probable impact of using the system in our central purchasing activity. We have determined that it would not be desirable or profitable for the reasons mentioned in your draft report as well as for other reasons.

We are convinced that our system of procurement, replenishment and stockage, based on past usage criteria, is far superior. Through our present system we have achieved the lowest operating cost for activities of this kind in the Federal Government.

Mr. Frank M. Mikus
Assistant Director
Manpower and Welfare Division
U. S. General Accounting Office

Our stock replenishment operation must accommodate factors such as seasonal pack items, shelf life, fund availability, warehouse space, procurement lead times and transportation increments. With current market conditions where availability of some supplies is uncertain, we must purchase some items when they are available. Our inventory control, based on monetary limitation in our supply fund, has been effective for our wholesale level operation. An additional factor is that we serve a number of other Government agency customers; this makes our requirements highly indefinite. There are also "family groups" or categories of items which must be reviewed and a single purchase made to reduce procurement workload and consolidate deliveries. Replenishments in our system are triggered by levels established for each item at each depot and/or storage point. This type of operation lends itself more appropriately to the commodity management orientation which has proved the most economical and responsive system.

We believe your report, as well as the factors we have discussed in this letter, raises a question as to whether or not economic order quantity is a valid principle for management of inventories at the wholesale centralized distribution level. Your report points out that "it may not always be possible or prudent to buy EOQ or EPQ." Also, your report reflects that the other Government agencies included in your review have experienced some problems in applying EOQ to their wholesale operations.

There appears to have been misunderstanding between the Marketing Center officials and the study group. In the report, it is stated that Center officials agreed with the report and they would consider establishing a procedure to calculate and use the EOQ principle. The minutes of the GAO team's exit interview show that the

Mr. Frank M. Mikus
Assistant Director
Manpower and Welfare Division
U. S. General Accounting Office

recommendations would be reviewed but did not express agreement. Therefore, we suggest that the language that indicates agreement of the Marketing Center personnel with the recommendations be appropriately revised.

Sincerely,

[illegible]istrator - in the absence of

DONALD E. JOHNSON
Administrator

ASSISTANT SECRETARY OF DEFENSE
WASHINGTON, D.C. 20301

FEB 5 1974

SR
INSTALLATIONS AND LOGISTICS

Mr. Werner Grosshans
Associate Director
Logistics & Communications Division
General Accounting Office
Washington, D. C. 20548

Dear Mr. Grosshans:

This is in response to your letter of November 23, 1973, to the Secretary of Defense which forwarded copies of your Draft Report on Use of the Economic Order Quantity Principle (Code 957013) (OSD Case #3736).

It is agreed that a review and update of ordering and holding cost factors in accordance with DoD Instruction 4140.39, "Procurement Cycles and Safety Levels of Supply for Secondary Items" should be accomplished.

With respect to the recommendation to develop additional cost factors, it is believed that when full implementation of the current Instruction is achieved, the use of three ordering costs, in addition to the consideration of Defense Contract Audit Agency costs on an exceptional basis for high dollar procurements, will provide adequate sensitivity to the Economic Order Quantity (EOQ) results. Additional categories of ordering costs would not guarantee lower total costs unless requirements could become static in the manner assumed in the EOQ formula--an unlikely situation for inventories within the DoD. The use of separate holding costs for each Air Force Inventory Control Point (ICP) is being explored. This and other means of refining the holding costs will be pursued and evaluated.

The problem of dynamic requirements also relates to the DoD restrictions on EOQ computations. The EOQ formula is based upon an assumption that requirements are consistent, uniform, and without variation, while the demand patterns observed at ICPs are extremely random. Simulation studies have shown that the EOQ quantity would be larger, if the EOQ formula were adjusted to account for the randomness of demand. An acceptable technique, however, to modify the EOQ formula for application to large scale computer systems has not been developed. The EOQ is further understated for high-dollar/demand items as a result of using an average cost-to-hold, which includes the obsolescence for slow moving as well as fast moving items.

Also the manufacturer's set-up costs are not normally known and, thus, are not included in the cost-to-order. Were it feasible to do so, use of these costs would increase the EOQ quantity. Therefore, it seems only prudent to recognize the lack of sophistication in the basic EOQ formula and our cost data by compensating in a manner dictated by judgment and common sense; i.e., constrain the minimum EOQ to three months in order to avoid uneconomic repetitive procurements of high-dollar/demand items. The three-year maximum placed on EOQ procurements has been developed to recognize that, unlike the assumption inherent in the EOQ formula, requirements are influenced by economic, technological and political events which may have a significant impact on future needs. Recognizing these imperfections in the mathematics behind the EOQ principle, the recommendation to remove restrictions on EOQ computations cannot be accepted.

Although it is agreed that the EOQ principle should apply to reparable items, this does present a problem in relation to the Air Force requirements system in the process of being implemented as a part of their Advanced Logistics System (ALS). The ALS requirements system for reparables is based on a marginal analysis technique with the objective of maximizing support within a given dollar constraint. An analysis and review will have to be made of this system in order to determine the feasibility of applying the EOQ principle in conjunction with the marginal analysis technique already programmed.

Procuring activities will be required to maintain and use quantity discount information on a more uniform and formal basis, recognizing, however, that the quantity related to the lowest unit price will not necessarily be the EOQ.

The opportunity to comment on this report in draft form is appreciated.

Sincerely,

Hugh E. Witt

Hugh E. Witt
Principal Deputy Assistant Secretary of Defense
(Installations and Logistics)

NUMBER OF BUYS EACH YEAR AND

VALUE OF EACH PROCUREMENT QUANTITY

USING ORDERING COSTS FOR CONTRACTS

UNDER $2,500 AND DEMAND WORTH $7,744

	ESO	AVSCOM	OCAMA
Using actual factors (see p. 5):			
Number of buys	3.51	2.13	3.45
Value of EOQ procurement	$2,209	$3,634	$2,244
Using actual ordering costs and a holding cost of 21 percent:			
Number of buys	3.51	2.37	2.53
Value of EOQ procurement	$2,209	$3,274	$3,062
Using an ordering cost of $66 and actual holding costs:			
Number of buys	3.15	3.51	4.78
Value of EOQ procurement	$2,209	$2,455	$1,619

APPENDIX VI

PRINCIPAL OFFICIALS

RESPONSIBLE FOR ADMINISTERING ACTIVITIES

DISCUSSED IN THIS REPORT

	Tenure of office	
	From	To
DEPARTMENT OF DEFENSE		
SECRETARY OF DEFENSE:		
James R. Schlesinger	June 1973	Present
William P. Clements, Jr. (acting)	Apr. 1973	June 1973
Elliot L. Richardson	Jan. 1973	Apr. 1973
Melvin R. Laird	Jan. 1969	Jan. 1973
DEPUTY SECRETARY OF DEFENSE:		
William P. Clements, Jr.	Feb. 1973	Present
Kenneth Rush	Feb. 1972	Jan. 1973
David Packard	Jan. 1969	Dec. 1971
ASSISTANT SECRETARY OF DEFENSE (INSTALLATIONS AND LOGISTICS):		
Arthur T. Mendolia	Apr. 1973	Present
Hugh McCullough (acting)	Jan. 1973	Apr. 1973
Barry J. Shillito	Feb. 1969	Jan. 1973
DEPARTMENT OF THE ARMY		
SECRETARY OF THE ARMY:		
Howard Calloway	May 1973	Present
Robert F. Froehlke	July 1971	May 1973
Stanley R. Resor	July 1965	June 1971
UNDER SECRETARY OF THE ARMY:		
Herman R. Staudt	Oct. 1973	Present
Vacant	June 1973	Oct. 1973
Kenneth E. BeLieu	Aug. 1971	June 1973
Thaddeus R. Beal	Mar. 1969	July 1971

	Tenure of office	
	From	To
DEPARTMENT OF THE ARMY (continued)		
ASSISTANT SECRETARY OF THE ARMY:		
Eugene E. Berg	Nov. 1973	Present
Vincent P. Huggard (acting)	Apr. 1973	Nov. 1973
Dudley C. Mecum	Oct. 1971	Apr. 1973
J. Ronald Fox	June 1969	Sept. 1971
DEPARTMENT OF THE NAVY		
SECRETARY OF THE NAVY:		
John W. Warner (acting)	May 1972	Present
John H. Chafee	Jan. 1969	Apr. 1972
UNDER SECRETARY OF THE NAVY:		
Frank Sanders (acting)	May 1972	Present
John W. Warner	Feb. 1969	Apr. 1972
ASSISTANT SECRETARY OF THE NAVY (INSTALLATIONS AND LOGISTICS):		
Jack L. Bowers	June 1973	Present
Charles L. Ill	July 1971	May 1973
Frank Sanders	Feb. 1969	June 1971
DEPARTMENT OF THE AIR FORCE		
SECRETARY OF THE AIR FORCE:		
John L. McLucas	July 1973	Present
Dr. Robert C. Seamans, Jr.	Feb. 1969	May 1973
UNDER SECRETARY OF THE AIR FORCE (INSTALLATIONS AND LOGISTICS):		
Richard J. Keegan (acting)	Aug. 1973	Present
Lewis E. Turner (acting)	Oct. 1972	Aug. 1973
Philip N. Whittaker	May 1969	Sept. 1972
DEPARTMENT OF TRANSPORTATION		
SECRETARY OF TRANSPORTATION:		
Claude S. Brinegar	Feb. 1973	Present
John A. Volpe	Jan. 1969	Feb. 1973

APPENDIX VI

	Tenure of office	
	From	To
FEDERAL AVIATION ADMINISTRATION		
ADMINISTRATOR:		
Alexander P. Butterfield	Mar. 1973	Present
John H. Shaffer	Mar. 1969	Mar. 1973
GENERAL SERVICES ADMINISTRATION		
ADMINISTRATOR OF GENERAL SERVICES:		
Arthur F. Sampson (note a)	June 1972	Present
Rod Kreger (acting)	Jan. 1972	June 1972
Robert L. Kunging	Mar. 1969	Jan. 1972
FEDERAL SUPPLY SERVICE		
COMMISSIONER:		
Milton S. Meeker	Jan. 1972	Present
Lewis W. Spangler (acting)	Apr. 1971	Jan. 1972
H. A. Oberspeller	Mar. 1970	Apr. 1971
Lewis E. Spangler (acting)	Dec. 1969	Mar. 1970
Arthur F. Sampson	June 1969	Dec. 1969
VETERANS ADMINISTATION		
ADMINISTRATOR OF VETERANS AFFAIRS:		
Donald E. Johnson	June 1969	Present

[a]Acting Administrator until June 1973.

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