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REPORT TO THE CONGRESS

Savings Attainable Through Improved Application Of The Economic Order Principle In The Procurement Of Military Supplies B-133396

Department of Defense

BY THE COMPTROLLER GENERAL OF THE UNITED STATES

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JUNE 30, 1969

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

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

This is our report on the savings attainable through improved application of the economic order principle in the procurement of military supplies in the Department of Defense. Our review was made 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).

Copies of this report are being sent to the Director, Bureau of the Budget; the Secretary of Defense; and the Secretaries of the Army, Navy, and Air Force.

Comptroller General
of the United States

COMPTROLLER GENERAL'S
***REPORT TO THE** CONGRESS*

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Department of Defense B-133396

D I G E S T

WHY THE REVIEW WAS MADE

A General Accounting Office (GAO) survey in 1967 indicated that the military services were not always using the most economical practices when procuring consumable aeronautical repair parts. Consequently, the GAO scheduled a more comprehensive review of the matter.

This report covers GAO's findings concerning the method used to hold to a minimum the costs of ordering and storing consumable repair parts. This method is called the economic order quantity (EOQ) principle, defined below.

***FINDINGS AND** CONCLUSIONS*

Applicable Department of Defense (DOD) instructions for the use of the EOQ principle are sound but are in need of revision with respect to what types of items should be covered and when cost factors should be revised.

Improved implementation of the EOQ principle by the military services could result in significant savings to the Government because the services have not yet fully realized the intended benefits of EOQ purchasing techniques.

The EOQ is that quantity of an item that should be bought if the costs to order the item and the costs to hold the item in inventory are to be held to a minimum. If procurements are made at frequent intervals, holding costs are reduced since smaller quantities are stored. However, if procurement actions increase, the cost to order increases.

GAO's review showed that current and accurate cost data were not available or were not being used by the military services in computing requirements for EOQ items. GAO computed the EOQ requirements for each of the military services on the basis of the latest available cost data, to illustrate the effect that different cost factors could have on EOQ inventories.

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JUNE 30, 1969

The latest available data was not, in all cases, current and accurate. However, GAO believes that the data was sufficiently accurate to illustrate the savings that would be attainable by all three military services if the cost factors were updated and used in computing EOQ requirements.

According to GAO estimates:

--The Air Force, by initiating a one-time additional investment of $50 million in inventory, could reduce its annual operating costs by between $12 and $17 million.

--The Navy could reduce its investment in inventories by almost $4 million and reduce annual operating costs by approximately $500,000.

--The Army could reduce annual operating costs by nearly $400,000 and reduce inventory investments by some $200,000.

RECOWNDATIONS OR SUGGESTIONS

GAO proposed that the Secretary of Defense establish firm guidelines for determining what types of repair parts should be considered as EOQ-type items.

GAO proposed also that the Secretary direct the military services to perform cost studies to determine the current cost to order and hold the various classes of materiel. The purpose would be to update the EOQ formulas currently in use.

AGENCY ACTIONS AND UNRESOLVED ISSUES

The Acting Assistant Secretary of Defense (Installations and Logistics) advised

--that the current instructions concerning the EOQ principle are being revised and that the revised instructions should be available by mid-year 1969;

--that the new instructions will "provide firm criteria relating to deviations from the EOQ concept"; and

--that "in regard to the use of inaccurate cost factors, we concur that these factors need to be revised and updated periodically ***."

MATTERS FOR CONSIDERATION BY THE CONGRESS

GAO is issuing this report to the Congress because of its expressed interest in achieving economies in Defense procurement practices.

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ABBREVIATIONS

ASO	Aviation Supply Office
AVSCOM	Army Aviation Systems Command
DOD	Department of Defense
EOQ	economic order quantity
GAO	General Accounting Office
NICP	national inventory control point

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INTRODUCTION

The Department of Defense has 22 national inventory control points (NICPs). In general, each NICP has been assigned the responsibility for managing certain groups of materiel and commodities.

Our review encompassed the services' methodologies for determining their needs or requirements for replacement repair parts--secondary items--for aircraft, which we believed to be representative of most classes of repair parts. We did not make a complete review of the supply functions of each of the military services.

Repair parts, in general, fall into two principal categories: (1) consumable or nonrepairable parts and (2) repairable parts. As a consequence, the methods used to determine requirements vary greatly between the two categories of repair parts.

As a result of the use of computer equipment, the military departments have been able to apply advanced mathematical concepts to the determination of requirements for a large number of items. One of the techniques now utilized is the economic order quantity method which, if properly implemented, results in reducing variable purchasing and holding costs to a minimum.

NEED TO PROPERLY IMPLEMENT THE ECONOMIC ORDER QUANTITY PRINCIPLE IN THE DEPARTMENT OF DEFENSE

Proper implementation of the EOQ principle by procuring activities of the military services could result in significant savings to the Government. The services, however, have not realized the maximum benefits of EOQ purchasing techniques because of (1) use of inaccurate and outdated cost factors in the computations of quantities to be purchased or (2) arbitrary limitations imposed on quantities to be procured.

The EOQ is that quantity of an item that should be procured if the total variable operating costs, i.e., costs to order and the costs to hold, are to be held to a minimum. If procurements are made at frequent intervals, holding costs are reduced since smaller quantities are stored. However, as the number of procurement actions increase, the cost to order increases. Various applications of the EOQ principle are included, in the form of bar graphs as exhibits to this report.

On June 24, 1958, the military services were directed by DOD Instruction 4140.11 to implement the EOQ principle for all consumable items. The instruction stated that:

> "It is the policy of the Department of Defense that operating levels and replenishment cycles for each repetitive demand, consumable item, will be adjusted to that point where total variable costs of operation are minimized." (Underscoring supplied)

Also, DOD Instruction 4140.11 sets forth the elements that should be considered in determining the cost to order and the cost to hold. In general, all costs incurred up to the time that the materiel is received from the supplier and is warehoused are to be considered as ordering costs. For example, contract administration would be included in such costs. The costs to hold include such elements as

interest on average investment in inventory and handling and storage costs.

Achievement of the economies inherent in the EOQ method of procurement depends upon the (1) utilization of accurate cost factors and (2) application of the principle to the greatest extent practicable. We found, however, that the three military departments were all utilizing costs to hold and costs to procure that were outdated and inaccurate. Furthermore, arbitrary restrictions had limited the application of the **EOQ** principle both as to the quantities procured and the items covered.

If the latest available cost data were accurate and current, each of the services could achieve substantial savings in operating and/or inventory investment costs in the future. On the basis of the latest cost data available, we estimate, €or example, that the Air Force could reduce its annual operating costs by between $12 million and $17 million; the Navy could reduce its investment in inventories by almost *$4* million and could reduce operating costs by about *$492,000* annually; and the Army could reduce operating costs by about *$390,000* annually and at the same time reduce its investment in inventory by about $220,000.

As pointed out elsewhere in this report, there is reason to believe that the cost data available at the time of our review was not current or accurate. Thus, we do not believe that the computations based upon this data should be considered as absolute or finite. We believe, however, that the data was sufficiently accurate to illustrate the effect that different cost factors could have on **EOQ** inventories.

We recognize that full implementation of the **EOQ** concept could require additional investment in inventories, especially in the Air Force. We recognize also that, because of the Vietnam conflict, resources may not be available to fully fund **EOQ** requirements at one time. We believe, however, that accurate cost data and **EOQ** computations should be available *so* that management could (1) be aware of the potential savings and **(2)** make informed decisions regarding the level of funding that can be applied each year.

Further details of our findings follow:

AIR FORCE

The cost factors used by the Air Force in its application of the EOQ principle are neither current nor accurate. Furthermore, the formula is applied without restriction to only about 50 percent of the items managed under the EOQ system, and separate cost factors are not used for groups of items subject to significantly differing ordering or holding costs. As a result the Air Force is not achieving the maximum benefits that would be available through proper implementation of the EOQ principle.

Inaccurate cost factors

The Air Force uses only one formula in determining the quantity to be procured for all EOQ items. This formula is based upon a cost to order of $37.50 and a cost to hold of 7-1/2 percent of the average inventory value, both of which costs had been arbitrarily determined rather than based upon a study of costs. These factors were adopted in 1961 and apparently had been predetermined in order to arrive at an EOQ quantity valued at $1,000 when the value of the average annual demands--customers' orders--was $1,000. The Air Force was still using the factors of $37.50 and 7-1/2 percent at April 30, 1969.

The most recent study of the cost to order EOQ items within the Air Force was that reported by the Air Force Logistics Command in a September 1966 report entitled, "The Impact of Procurement Upon EOQ Requirements." According to this report the cost to order an EOQ item was $213 for procurements under $2,500 and $350 for procurements over $2,500. That report indicated that the $37.50 cost to order currently being used by the Air Force in the EOQ formula was significantly understated.

The latest information on the cost to hold inventories was contained in a July 1959 Air Force report entitled, "Scientific Inventory Management in the United States Air Force." According to this report, the annual holding costs were 13 percent of the average inventory value, broken down as follows:

	Percent
Interest on investment	4%
Obsolescence	7
Deterioration, loss and damage, and direct physical storage costs	2
Total	13%

We have no basis to believe that the cost to hold, expressed as a percentage of average inventory value, has changed significantly since 1959, except for interest costs. We estimate that interest costs have increased approximately 2 percent and that the current cost to hold is, therefore, about 15 percent. This is predicated on the fact that the average interest rate paid by the U.S. Treasury on borrowed funds has increased by about 2 percent since 1959.

In addition to the fact that the cost factors being utilized are not accurate, it is our opinion that the entire range of items in the Air Force EOQ inventory cannot be properly represented by only one cost-to-order factor and one cost-to-hold factor. The type of procurement action--competitive, negotiated, follow-on award, etc.--and the nature of the items stored, have a significant bearing on the cost factors. Since there are a number of different procurement actions utilized and because of widely differing characteristics of the items procured, it does not appear to be logical to attempt to utilize one set of average factors for all items.

Even though these estimates of ordering and holding costs (ordering costs of $213 and $350 and holding costs of 15 percent) may not be representative of all the EOQ items, we believe that they are much more accurate than the cost factors presently incorporated by the Air Force in its EOQ formula and are sufficiently accurate for illustration purposes.

Potential savings through the use of updated cost factors

Since the cost factors used by the Air Force in determining requirements for EOQ items were arbitrarily established and appear to be highly inaccurate, we have estimated the effect of the use of these factors upon total ordering and holding costs. Using summary data for all Air Force EOQ items, we projected the total annual cost that would result from the use of the current EOQ formula and compared that with the costs that would be incurred by the use of the most recent cost data available in the EOQ formula. On the basis of this comparison, we estimated that the Air Force could realize minimum and maximum annual savings of $7 and $12 million, respectively, in total ordering and holding costs.

For example, the EOQ level for an item having annual demands of $1,225 would be $612 on the basis of the existing Air Force EOQ formula, but would be $1,865 on the basis of the most recent cost factors. Use of the updated cost factors would lengthen the interval between orders and thereby reduce annual ordering costs from $426 to $140. This would result in an increase in the average inventory value of the item and thereby increase annual holding costs from $46 to $140. The net effect would be a saving in total annual ordering and holding costs of $192, determined as follows:

On the basis of	Holding costs	Ordering costs	Total annual costs
Formula in use	$ 46	$426	$472
Most recent cost factors	140	140	280
Savings	$-94	$286	$192

Potential savings through reduction of minimum order quantity restriction

During the first 9 months of fiscal year 1968, the Air Force restricted its application of the EOQ formula

to a maximum level of 60 months of stock and a minimum level of 6 months of stock. Because of these restrictions, the current EOQ formula is applied to only about 50 percent of the consumable repair parts in the Air Force.

The unrestricted application of the EOQ principle will result in the lowest total annual ordering and holding costs. When restrictions such as a 60-month and a 6-month level of stock are applied, additional variable operating costs are incurred. However, because of such factors as limited sources of supply and of manufacturing know-how, lack of competition for small-quantity orders, lack of available storage space, excess obsolescence, etc., the unrestricted application of the EOQ formula to consumable items having very low or very high annual requirements may not be practical in all instances.

We recognize, therefore, that upper and lower limits (restrictions) to the quantity of stocks to be procured may be necessary or desirable. The selection of these upper and lower limits is extremely critical to the total costs of ordering and holding stock to meet expected supply requirements. We are of the opinion that the established limits should be based upon studies of such factors as available investment funds, storage space, and the ability to process orders, and should result in the application of the EOQ principle to the maximum extent practicable. It was apparent from our discussions with Air Force personnel, however, that the limits currently used by the Air Force had been determined rather arbitrarily.

We stated earlier in this report that we estimated that the Air Force could realize annual savings of from $7 million to $12 million if updated cost factors were used in the EOQ formula. We estimate also that additional annual savings of about $5 million could be realized if the lower limit was changed from a 6-month to a 3-month supply of stock.

For example, the EOQ level for an item having annual demands valued at $149,069 would be $74,534 (a 6-month supply) on the basis of the existing Air Force restrictions, but would be $37,267 if the minimum restriction were lowered to 3 months. The 3-month lower limit would result in a reduction in the average inventory value--from $37,267 to $18,634--which would reduce annual holding costs from $5,590 to $2,795. However, since the number of orders would be increased from two orders a year to four orders a year, annual ordering costs would be increased from $700 to $1,400. The net effect would be a saving in total annual ordering and holding costs of $2,095, determined as follows:

EOQ formula	Holding costs	Ordering costs	Total annual costs
6-month restriction	$5,590	$ 700	$6,290
3-month restriction	2,795	1,400	4,195
Savings	$2,795	$ −700	$2,095

Effect upon investment in inventory

We recognize that, if the Air Force were to utilize the more current cost factors in determining operating levels for EOQ items, the average inventory value of many items would be increased. However, if the lower limit were reduced from 6 months to 3 months, the average inventory value of some items would be decreased. Our computations, consisting of determining the net increases or decreases for the entire range of Air Force EOQ items, indicate that the net amount of this one-time additional investment in inventory would be about $50 million, most of which would be required during the first year. It should be recognized, however, that, as noted on pages 8 and 9, estimated savings in total ordering and holding costs of from $12 to $17 million annually would be achieved. We are of the opinion that, if the Air Force were unable to fund the additional investment during 1 year, the increased procurements could

be made over a period of several years, as the availability of funds allow.

NAVY

The Navy's Aviation Supply Office (ASO) was using cost factors in its EOQ computations that were not based on actual cost data. As a result, requirements determinations and procurements were being made that did not reflect the most economical order quantities. On the basis of information obtained during our review, we estimate that the use of more current cost data, if accurate, could reduce the Navy's investment in consumable aeronautical repair part inventories by about $3.9 million. We estimate also that this inventory reduction would result in a reduction in operating costs of about $492,000 annually. Details follow:

Low-cost, low-usage consumables--ASO was using an amount of $36 as the cost to order in its EOQ formula for its low-cost, low-usage consumable items. Our review showed that this amount had been estimated by ASO and had not been based on any study or review of actual costs.

After our discussions with ASO personnel concerning the validity of the $36 cost to order amount, they initiated a study of all the cost factors utilized in the EOQ computations. This study was completed in March 1968 and indicated that the Navy's cost to order a low-cost, low-usage consumable item was about $14. The use of $14 rather than $36 as the cost to order would significantly reduce procurement quantities, as illustrated by the following example:

> A December 1967 requirement study for a ring seal, valued at $4.84, indicated an EOQ procurement of 236 units. In March 1968 ASO awarded a contract for the 236 units. If the $14 instead of the $36 cost to order had been used in computing the EOQ, the quantity purchased would have been only 160 units.

Using the demand data obtained from ASO for fiscal year 1967 and using the latest available cost data for various categories of inventory, we estimate that the investment for low-cost, low-usage consumables could be reduced by about $6.8 million if the current cost to order were used in the EOQ formula.

We estimate that, since the rate of procurement would increase because smaller quantities would be obtained, the reduction in inventory investment would result in an increase in the annual costs to order by about $425,000. However, the annual costs to hold would decrease by about $683,000 because of the decrease in inventory levels. We, therefore, estimate that, a net annual savings of about $258,000 could be realized by using current cost to order in the EOQ formula for low-cost, low-usage consumable items.

Medium/high-cost-usage consumables--The ASO cost study completed in March 1968 shows that the cost to procure a medium/high-cost-usage item is about $14 if bought under the automated program, about $40 if bought under an open-end contract, and about $74 if more complex procurement methods are used. The study shows also that a minimum cost to hold of 15 percent of the average inventory value should be used for medium/high-cost-usage items. The study shows further that the cost to order and cost to hold figures used in ASO's EOQ formula for medium/high-cost-usage items need to be revised since they are not based on current cost information.

We estimate that the use, in the EOQ formulas for medium/high-cost-usage items, of the cost-to-order and cost-to-hold data derived from ASO's latest study would increase the investment in the inventory of these items up to a maximum of $2.9 million.

We estimate also that the increase in inventory investment would decrease the annual costs to order by about $565,000 since the number of procurements would decrease because of larger buy quantities. However, the annual cost-to-hold inventory would increase by

about $331,000 a year because of the increase in inventory levels. We, therefore, estimate that, a net annual cost savings of about *$234,000* could be realized if the cost information used in the EOQ formula for medium/high-cost-usage items were updated on the basis of results of the ASO's 1968 cost study.

To summarize, the Navy, by using the latest available cost data in its EOQ formula, could reduce its investment in consumable aeronautical repair parts by $3.9 million and at the same time reduce operating costs by *$492,000* annually *($258,000* for low-cost, low-usage items and *$234,000* for other items).

ARMY

We found that the Army Aviation Systems Command (AVSCOM) could reduce operating costs by about $390,000 annually if cost-to-order and cost-to-hold factors developed by the Army in 1963 were applied by AVSCOM in its **EOQ** formula. On the basis of the results of our review, we estimate that AVSCOM could also reduce its investments in low-dollar-value items by some $220,000 if it were to use in its **EOQ** formula the most recent cost figures available.

AVSCOM classifies its consumable items as low-, medium-, and high-dollar-value items on the basis of the value of the annual demands (number of units requisitioned by customers). At present, these classifications are as follows:

Value of annual demands	Classification	Approximate number of items
Up to $ 7,500	Low dollar value	49,300
$ 7,500 to $25,000	Medium dollar value	3,560[a]
$25,000 and up	High dollar value	1,290[a]

[a]All the above items are nonrepairable; however, AVSCOM does not treat the medium- and high-dollar-value items as being subject to the EOQ principle.

In 1962 AVSCOM made a study which indicated that the cost to order was $61.90, regardless of the unit cost of the item or the dollar value of the procurement. Another study, made in 1963, indicated varying costs to order, based on the value of the procurement, as follows:

Value of procurement	Cost factors
Up to $ 2,500	$ 53.66
$ 2,500 to $25,000	133.94
$25,000 and up	192.26

Despite the fact that the 1963 study indicated differing costs to order, AVSCOM has been using a factor of

$61.90. We could not determine the reasons why **AVSCOM** had not utilized the more current data.

In **1962 AVSCOM** made a study of the costs involved in holding specific types of items and found that the cost to hold nonrepairable aeronautical items was 23.87 percent of the average inventory. **AVSCOM** officials, however, decided to use a 17-percent cost-to-hold factor. We were unable to obtain a reason for that decision.

Potential savings in costs and inventory investment

A potential exists for reducing costs by about $390,000 annually and at the same time reducing the inventory investments by about **$220,000.** This potential saving in costs and inventory investment represents the difference between the results of using **AVSCOM's** present EOQ formula and using an EOQ formula which incorporates the latest available cost data.

Also, we found that the present **AVSCOM** requirements system for low-dollar-value items was not based on EOQ calculations, but was adopted by **AVSCOM** in January 1968 because of instructions from higher headquarters to reduce investment in inventories. It was anticipated by **AVSCOM** that the new levels adopted would eventually cause a 40-percent reduction in inventories. Our evaluation of the impact of the change made in January 1968 indicates that about a 40-percent reduction in inventory investment will occur because of the revised instructions. However, we calculate that somewhat more than a 40-percent reduction would be realized if **AVSCOM** were to adopt the more recent and refined cost to order factors of $53.66 to $192.26, Use of the refined data would also, of course, result in substantial savings in operating costs.

CONCLUSIONS

The basic purpose for adopting the EOQ principle is to reduce the variable ordering and holding costs to a minimum. The military services have not achieved this objective because they have not effectively implemented the DOD

guidelines for determining order and holding costs. Consequently, the services do not know the extent to which they are incurring excessive ordering or holding costs.

In our opinion DOD Instruction 4140.11 is a sound document setting forth basic guidelines for implementing the EOQ principle. We found, however, that the instruction does not provide specific guidance as to what items should be covered by the EOQ principle or when cost factors should be revised. We believe, therefore, that the instruction should be revised in order to establish firm criteria for determining (1) what types of items should be considered as EOQ-type items, and (2) when revised cost factors should be prepared.

In summary, we believe that, in order for the military services to properly implement the EOQ formula, they must periodically redetermine, by item groupings, accurate ordering and holding costs; evaluate the revised EOQ formula for the purpose of establishing the most realistic, as well as economical, restrictions or limitations on its application; and establish a firm policy for updating cost data when costs have changed materially.

We recognize that full application of the EOQ concept may require some additional investment in inventories. We recognize also that, because of possible fund limitations, it may not be feasible to make the additional investment immediately. We are of the opinion, however, that the long-range benefits of the EOQ concept are substantial and that management has information available to enable comparison of the potential savings with the required additional investment. Unless accurate cost data are utilized and unless requirements are computed under the EOQ concept for the greatest possible range of items, management cannot make the most advantageous funding decisions.

AGENCY COMMENTS AND *OUR* EVALUATION

On January 7, 1969, our findings were reported to the Secretary of Defense with proposals that (1) firm criteria be established for determining what types of items should be considered as EOQ items and (2) the military services be

directed to perform cost studies to update cost factors in the EOQ formula.

By letter dated March 14, 1969, the Acting Assistant Secretary of Defense (Installations and Logistics) commented on our draft report. (See app. I). The Assistant Secretary stated that DOD generally concurred with our findings and proposals. He advised us that, on the basis of a study initiated in August 1968, revisions were being made to DOD Instruction 4140.11 firming up the criteria for those items applicable to and exempt from the EOQ concept.

He also concurred that the cost factors used in the EOQ formula--cost to order/cost to hold--needed to be reviewed and updated periodically and that it was not logical to use one cost-to-order factor for all items. We believe that, if properly implemented, the actions being taken by DOD should correct the basic deficiencies that we found during our review. We will, however, follow up on this matter at an appropriate time, to determine whether the required improvements have been achieved.

The Acting Assistant Secretary stated that "it is not feasible to make finite estimates of savings, such as indicated in the [GAO] draft report." We did not intend to imply that our computations of savings were finite. In this report we have made appropriate changes designed to clarify this matter.

SCOPE OF REVIEW

GAO has reviewed the methods used by the military services in implementing the EOQ principle for consumable aeronautical repair parts.

The primary objective of our review was to analyze, compare, and evaluate the methods used by the three military services in implementing the EOQ principle, in order to determine if they were procuring materiel in an economical manner. To accomplish this objective, we discussed methodologies with responsible officials of the military services and DOD; reviewed pertinent directives, instructions, and regulations; and made detailed examinations into randomly selected EOQ computations.

Our review was made at the following NICPs, which manage about 860,000 consumable items, as follows:

	Number of items managed
U.S. Army Aviation Systems Command St. Louis, Missouri	54,000
Navy Aviation Supply Office Philadelphia, Pennsylvania	360,000
Ogden Air Materiel Area Ogden, Utah	80,000
San Antonio Air Materiel Area San Antonio, Texas	171,000
Warner Robins Air Materiel Area Warner Robins, Georgia	195,000
Total	860,000

EXHIBITS

EXHIBIT A

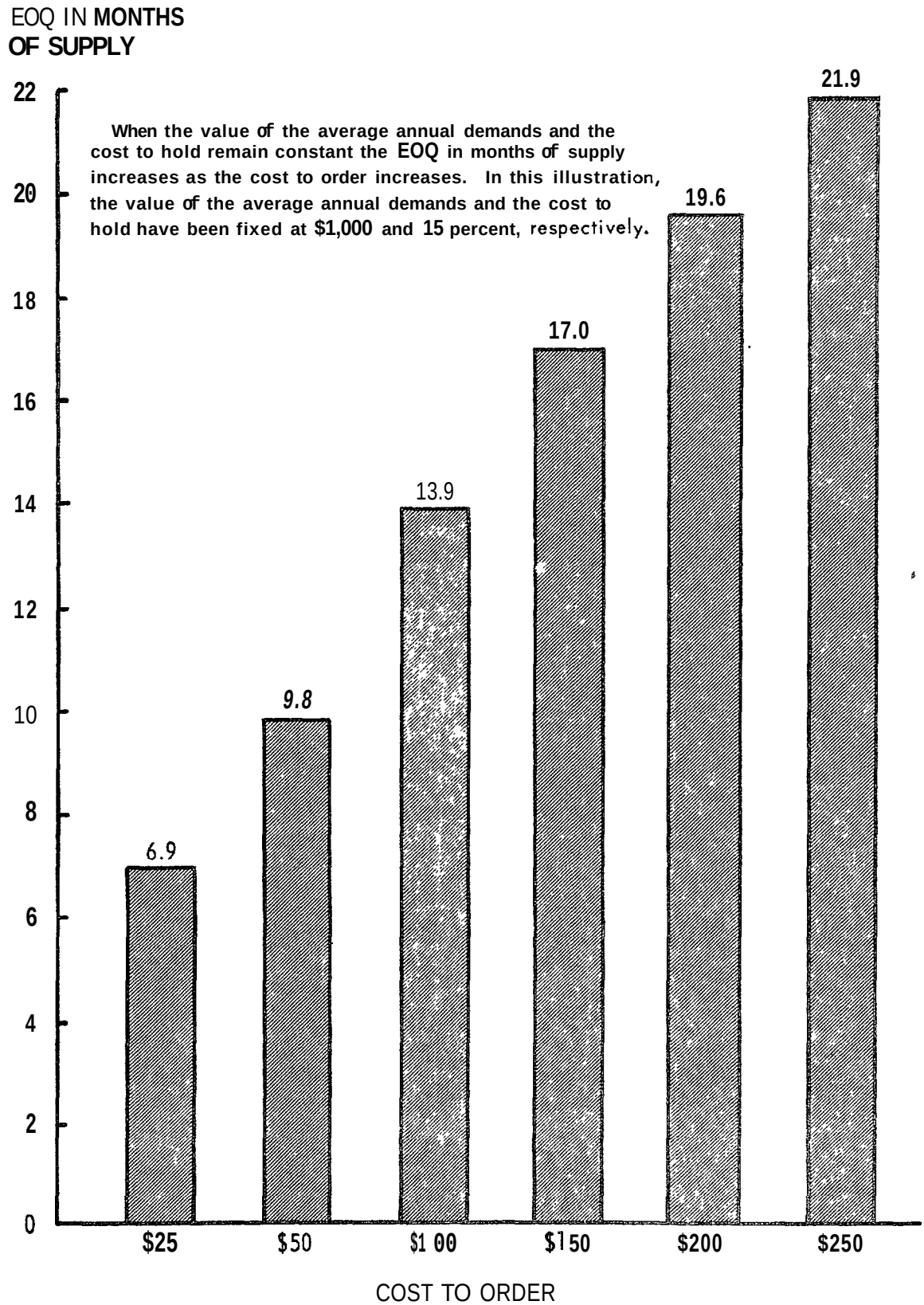

EOQ IN MONTHS OF SUPPLY
When the value of the average annual demands and the cost to hold remain constant the EOQ in months of supply increases as the cost to order increases. In this illustration, the value of the average annual demands and the cost to hold have been fixed at $1,000 and 15 percent, respectively.
22
20
18
16
14
12
10
8
6
4
2
0
6.9
9.8
13.9
17.0
19.6
21.9
$25
$50
$1 00
$150
$200
$250
COST TO ORDER

EXHIBIT B

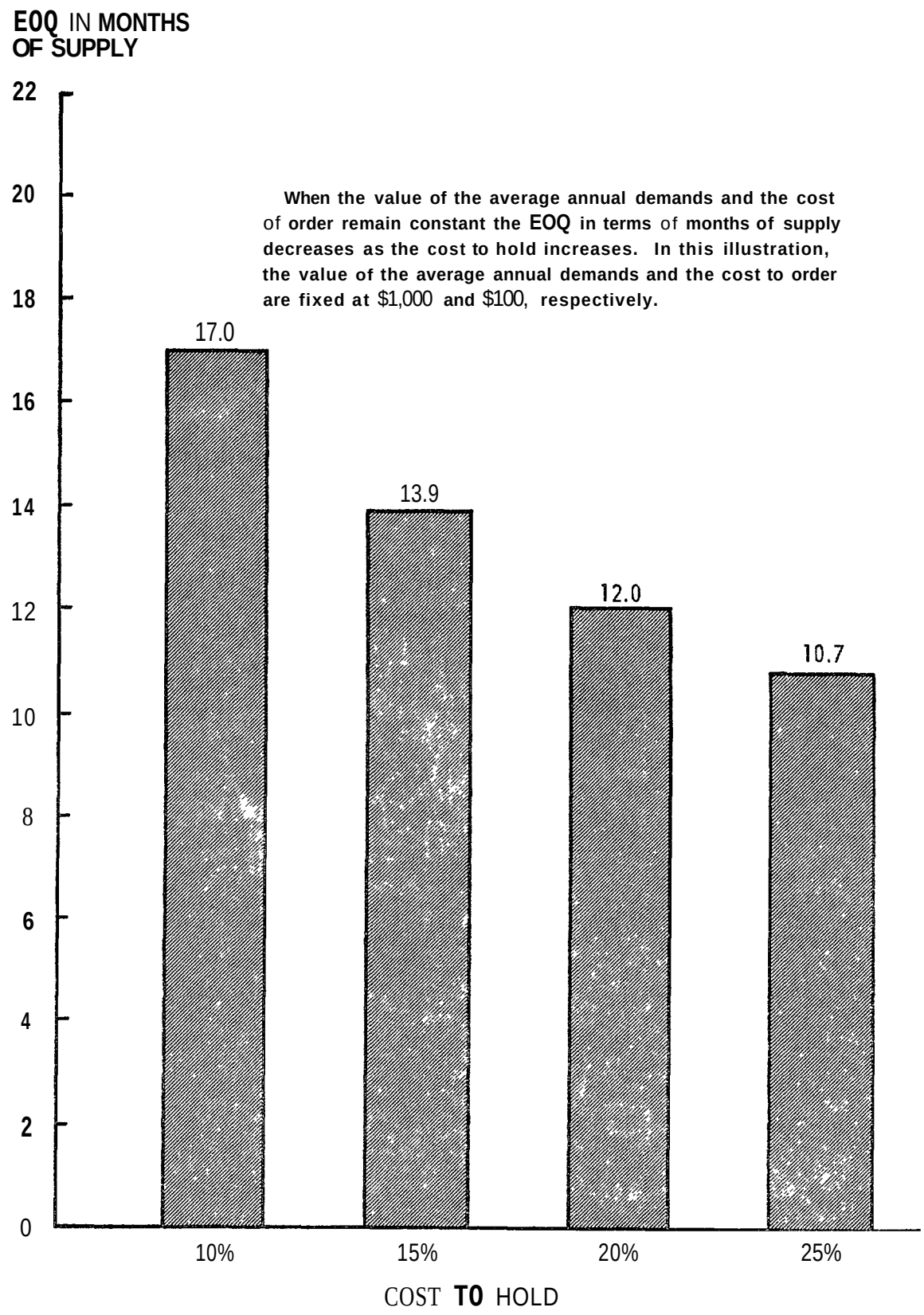

EOQ IN MONTHS OF SUPPLY
22
20
18
16
14
12
10
8
6
4
2
0
When the value of the average annual demands and the cost of order remain constant the EOQ in terms of months of supply decreases as the cost to hold increases. In this illustration, the value of the average annual demands and the cost to order are fixed at $1,000 and $100, respectively.
17.0
13.9
12.0
10.7
10%
15%
20%
25%
COST TO HOLD

EXHIBIT C

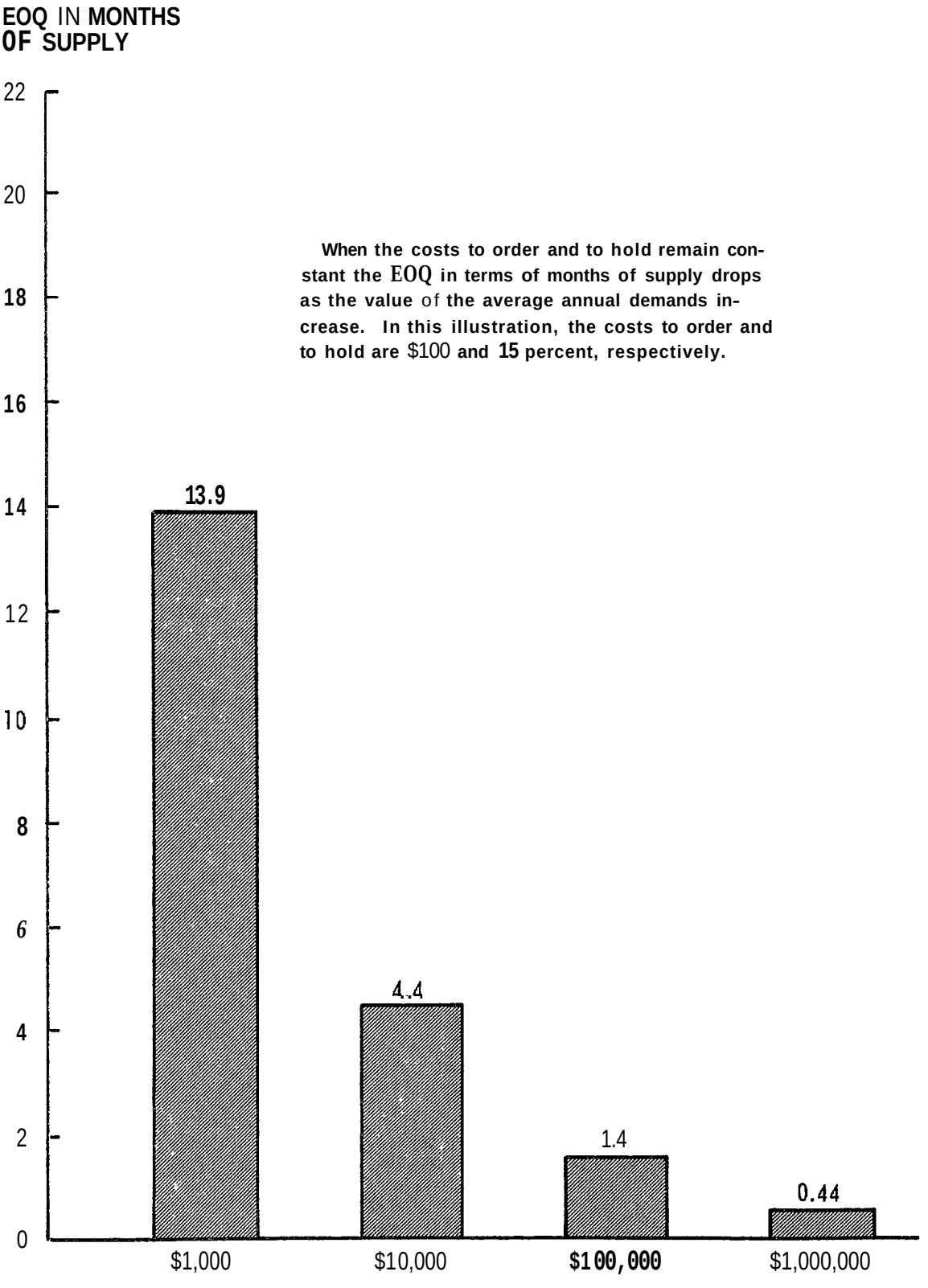
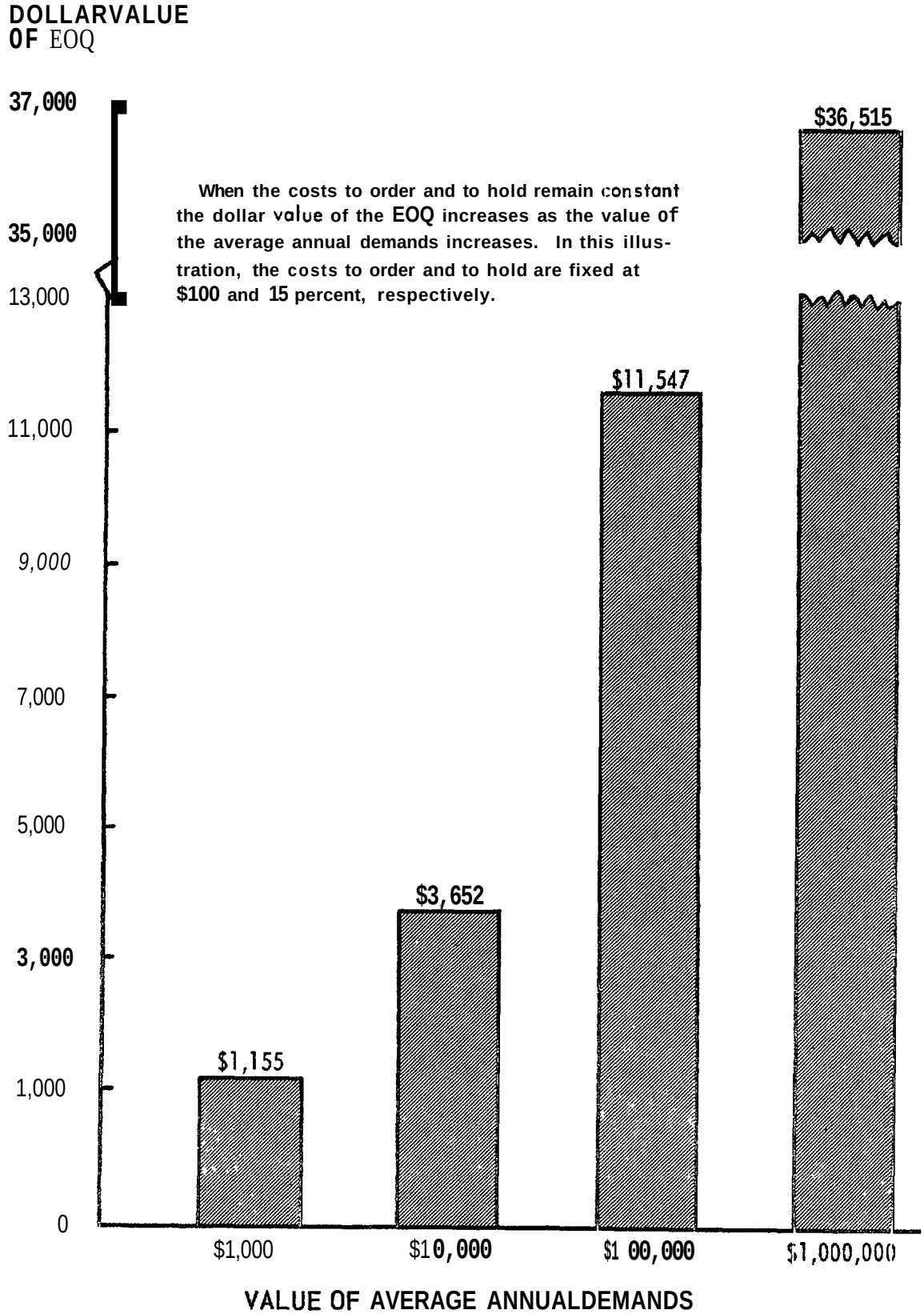

EOQ IN MONTHS OF SUPPLY
22
20
18
16
14
12
10
8
6
4
2
0
When the costs to order and to hold remain constant the EOQ in terms of months of supply drops as the value of the average annual demands increase. In this illustration, the costs to order and to hold are $100 and 15 percent, respectively.
13.9
4.4
1.4
0.44
$1,000
$10,000
$100,000
$1,000,000
VALUE OF AVERAGE ANNUALDEMANDS

EXHIBIT D


DOLLARVALUE OF EOQ
37,000
35,000
13,000
11,000
9,000
7,000
5,000
3,000
1,000
0
When the costs to order and to hold remain constant the dollar value of the EOQ increases as the value of the average annual demands increases. In this illustration, the costs to order and to hold are fixed at $100 and 15 percent, respectively.
$1,155
$3,652
$11,547
$36,515
$1,000
$10,000
$100,000
$1,000,000
VALUE OF AVERAGE ANNUALDEMANDS

APPENDIXES

ASSISTANT SECRETARY OF DEFENSE
WASHINGTON, D.C. 20301

14 MAR 1969

SR
INSTALLATIONS AND LOGISTICS

Mr. C. M. Bailey
Director, Defense Division
General Accounting Office
Washington, D. C. 20548

Dear Mr. Bailey:

This is in reply to Mr. Fasick's letter of January 7, 1969, which forwarded for review and comment a draft report on the need for more economical procurement practices in the Department of Defense (OSD Case #2877).

The draft report indicates that proper implementation of the Economic Order Quantity (EOQ) principle by the Department of Defense (DoD) procuring activities could result in significant savings to the Government. Specifically cited are (1) the use of inaccurate cost factors; i.e., cost-to-order and cost-to-carry, and (2) arbitrary limitations imposed on quantities to be procured. It is recognized in the draft report that correction of these deficiencies would likely require a substantial additional investment in inventories. The draft report recommends that DODI 4140.11, "Peacetime Operating and Safety Levels of Supply," dated June 24, 1358, be reviewed in order to establish firm criteria for determining what types of items should be considered applicable. The draft report also recommends that the Office of the Secretary of Defense provide the Services with the advice and assistance needed to aid them in implementing the EOQ principle and updating the EOQ formulas based on current cost data.

DODI 4140.11 contains the basic EOQ formula that has been used by the American manufacturing industry since 1904. In August of 1968, a review of DODI 4140.11 was begun in collaboration with the Services. We found that, although the basic formula is sound, there are some revisions that should be made to account for differences between a manufacturing concern and Defense Inventory Control Points (ICPs), and we plan to have a draft revision prepared by midyear 1969. In those areas covered in the draft report, our findings are somewhat parallel. There are, however, additional factors bearing on a DoD EOQ; and, since these factors also affect the validity of the procurement action, we would like to comment on them in conjunction with those items indicated in the draft report:

a. The revised Instruction will apply to all secondary investment and expense type items and provide firm criteria relating to deviations from the EOQ concept.

b. In regard to the use of inaccurate cost factors, we concur that these factors need to be reviewed and updated periodically and that it is not logical to use one cost-to-order factor for all items.

c. As to the use of upper limits, this condition is necessitated by two considerations. For example, a basic prerequisite relating to usage rates to be used in the EOQ formula is that they be reasonably constant. As you know, we have many items that do not meet this condition, which is assumed to have been met in the derivation of the EOQ formula. Therefore, we have established upper limits to take into consideration (1) the ever-present possibility of dramatic reductions in demands upon the ICPs, and (2) the limitation of financial resources available for the procurement of spare parts.

d. The six-month lower limit established by the Air Force was basically a reaction to industry criticism of frequent ordering. Although more specific criteria for application of lower limits will be applied in the revised Instruction, the Air Force policy is not entirely without foundation, as indicated by the following description of a change we find necessary to the basic EOQ formula.

The EOQ formula in based upon the assumption that all orders are received in one increment and that, therefore, the average inventory to which the cost-to-carry factor is applied is always one-half the order quantity. Many of our items managed at the ICP level are delivered in monthly increments and, thus, the inventory factor should be much less than the fixed one-half. In the revised Instruction, provisions will be made for the use of variable inventory factors. This will result in a larger computed EOQ on high dollar demand items and, thus, lessen the need for a lower limit on the EOQ. Even after this improvement to the EOQ formula, lower limits of one to three months will probably be maintained for the practical reason that it is unlikely we could obtain the increases in staffing that would be necessary to process additional procurements that would generate without the lower limits.

Although not specifically mentioned in the draft report, you may have noted the large disparity in the cost-to-order figures developed by each Military Department. Since all DoD procurement activities are governed by the Armed Services Procurement Regulation (ASPR), these costs should be similar for any particular type contract, and our current planning calls for the development of standard DoD cost-to-order figures for five basic types of contracts, By updating the cost factors, some savings will be achieved; however, because of the disparity *among* the Military Departments in current cost figures, the current lack of relatively sound cost data, which we are now developing, and the inadequacies in the basic EOQ formula, it is not feasible to make finite estimates of savings, such as indicated in the draft report.

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

Sincerely,

GLENN V. GIBSON
Acting Assistant Secretary of Defense
(Installations and Logistics)

PRINCIPAL OFFICIALS OF THE DEPARTMENT OF DEFENSE AND THE DEPARTMENTS OF THE ARMY, NAVY, AND AIR FORCE RESPONSIBLE FOR ADMINISTRATION OF ACTIVITIES DISCUSSED IN THIS REPORT

	Tenure of office	
	From	To
DEPARTMENT OF DEFENSE		
SECRETARY OF DEFENSE:		
Melvin R. Laird	Jan. 1969	Present
Clark M. Clifford	Mar. 1968	Jan. 1969
Robert S. McNamara	Jan. 1961	Feb. 1968
DEPUTY SECRETARY OF DEFENSE:		
David Packard	Jan. 1969	Present
Paul H. Nitze	July 1967	Jan. 1969
Cyrus R. Vance	Jan. 1964	June 1967
Roswell L. Gilpatric	Jan. 1961	Jan. 1964
ASSISTANT SECRETARY OF DEFENSE (INSTALLATIONS AND LOGISTICS):		
Barry J. Shillito	Jan. 1969	Present
Thomas D. Morris	Sept. 1967	Dec. 1968
Paul R. Ignatius	Dec. 1964	Aug. 1967
Thomas D. Morris	Jan. 1961	Dec. 1964
DEPARTMENT OF THE ARMY		
SECRETARY OF THE ARMY:		
Stanley R. Resor	July 1965	Present
Stephen Ailes	Jan. 1964	July 1965
Cyrus R. Vance	July 1962	Jan. 1964

PRINCIPAL OFFICIALS OF

THE DEPARTMENT OF DEFENSE

AND THE DEPARTMENTS OF THE ARMY, NAVY, AND AIR FORCE

RESPONSIBLE FOR ADMINISTRATION OF ACTIVITIES

DISCUSSED IN THIS REPORT (continued)

	Tenure of office			
	From		To	
DEPARTMENT OF THE ARMY (continued)				
UNDER SECRETARY OF THE ARMY:				
Thaddeus R. Beal	Mar.	1969	Present	
David E. McGiffert	July	1965	Feb.	1969
Stanley R. Resor	Mar.	1965	July	1965
Vacant	Dec.	1964	Mar.	1965
Paul R. Ignatius	Mar.	1964	Dec.	1964
ASSISTANT SECRETARY OF THE ARMY (INSTALLATIONS AND LOGISTICS):				
Vacant	Mar.	1969	Present	
Dr. Robert A. Brooks	Oct.	1965	Feb.	1969
Daniel M. Luevano	July	1964	Oct.	1965
A. Tyler Port (Acting)	Mar.	1964	June	1964
Paul R. Ignatius	May	1961	Feb.	1964
DEPARTMENT OF THE NAVY				
SECRETARY OF THE NAVY:				
John H. Chafee	Jan.	1969	Present	
Paul R. Ignatius	Sept.	1967	Jan.	1969
Charles F. Baird (Acting)	Aug.	1967	Sept.	1967
Robert H. B. Baldwin (Acting)	July	1967	Aug.	1967
Paul H. Nitze	Nov.	1963	June	1967
UNDER SECRETARY OF THE NAVY:				
John W. Warner	Feb.	1969	Present	
Charles F. Baird	Aug.	1967	Jan.	1969

PRINCIPAL OFFICIALS OF

THE DEPARTMENT OF DEFENSE

AND THE DEPARTMENTS OF THE ARMY, NAVY, AND AIR FORCE

RESPONSIBLE FOR ADMINISTRATION OF ACTIVITIES

DISCUSSED IN THIS REPORT (continued)

	Tenure of office			
	From		To	
DEPARTMENT OF THE NAVY (continued)				
UNDER SECRETARY OF THE NAVY (continued):				
Robert H. B. Baldwin	July	1965	July	1967
Kenneth E. BeLieu	Feb.	1965	July	1965
Paul B. Fay, Jr.	Feb.	1961	Jan.	1965
ASSISTANT SECRETARY OF THE NAVY (INSTALLATIONS AND LOGISTICS):				
Frank Sanders	Feb.	1969	Present	
Barry J. Shillito	Apr.	1968	Jan.	1969
Vacant	Feb.	1968	Apr.	1968
Graeme C. Bannerman	Feb.	1965	Feb.	1968
Kenneth E. BeLieu	Feb.	1961	Feb.	1965
DEPARTMENT OF THE AIR FORCE				
SECRETARY OF THE AIR FORCE:				
Dr. Robert C. Seamans, Jr.	Jan.	1969	Present	
Dr. Harold Brown	Oct.	1965	Jan.	1969
Eugene M. Zuckert	Jan.	1961	Sept.	1965
UNDER SECRETARY OF THE AIR FORCE:				
John L. McLucas	Mar.	1969	Present	
Townsend Hoopes	Oct.	1967	Feb.	1969
Norman S. Paul	Oct.	1965	Oct.	1967
Dr. Brockway McMillan	June	1963	Sept.	1965

PRINCIPAL OFFICIALS OF

THE DEPARTMENT OF DEFENSE

AND THE DEPARTMENTS OF THE ARMY, NAVY, AND AIR FORCE

RESPONSIBLE FOR ADMINISTRATION OF ACTIVITIES

DISCUSSED IN THIS REPORT (continued)

	Tenure of office	
	From	To
DEPARTMENT OF THE AIR FORCE (continued)		
ASSISTANT SECRETARY OF THE AIR FORCE (INSTALLATIONS AND LOGISTICS):		
Vacant	Jan. 1969	Present
Robert H. Charles	Nov. 1963	Jan. 1969

U.S. GAO, Wash., D.C.