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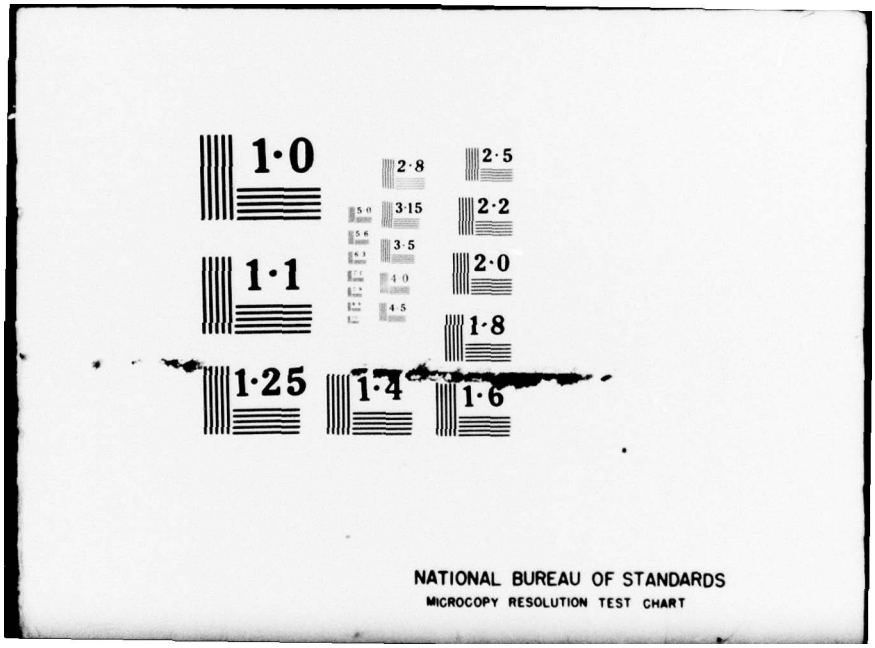
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ECONOMIC PROCUREMENT CUTBACK RULE

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BY

(10) W. KARL KRUSE

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US ARMY LOGISTICS MANAGEMENT CENTER
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A simple rule is developed to identify when a procurement cutback may be economical. The rule is meant to control the printing of a cutback recommendation on a supply control study. Further analysis is needed to determine if in fact a cutback is most economical. The value of the rule is that it is able to eliminate a great deal of possible cutback situations from further consideration.

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Economic Cutback Rule

Problem

The supply levels, reorder point (R), and reorder quantity (Q) as they are computed within CCSS vary from one computation to the next. Typically computations are a month apart. Variations are caused by changes to any of the input parameters, some of which, notably demand rate, behave randomly, and some of which change due to management decision, e.g. procurement costs and shortage cost. Other variations are inherent in the model. Some of the variation in levels may be significant. A particularly disturbing consequence is a recommendation to cutback a procurement which was originally recommended only a month or two earlier. CCSS presently allows for two parameters relating to the dollar value on contract which determine when a recommendation to cutback is to be made. There is one parameter for amounts on contract, and another for amounts requested but not yet on contract. If assets are above the newly computed RO and if the dollar value of the buy exceeds the appropriate parameter, a cutback recommendation is printed and sent to the item manager. Each MRC may set the parameters as they see fit. However, these are not set with any attempt to assess the economical considerations of cancelling a procurement. Moreover, since the MRC's have tended to set these conservatively, there have been too many unnecessary cutback recommendations.

Simple Cutback Rule

We are concerned here with developing an economic rule to determine when to recommend a cutback. The rule is not to be used to make the decision to cutback; it only identifies those cases where it appears profitable to pursue the cutback decision. The actual decision to cutback is dependent on the penalty costs for cutting back which are not known until negotiations with the contractor. A model for cutback decisions has been developed.*

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*Alan Kaplan, "Economic Retention Limits," Final Report, DARCOM Inventory Research Office, June 1969.

This rule is a simplified version of Kaplan's. It compares the approximate additional costs incurred if the assets above the RO are retained on order, versus the additional costs if they are cancelled. The number of months of assets above the RO which may be economically retained on contract is produced by the rule. Because recommended values for cancellation costs are kept small, the rule safely eliminates from further consideration those cases when no cutback should be made. However, when the rule does permit the cutback decision to be printed on the supply control study, it may not, in fact, be economical to do so.

Definitions

M = amount on contract above RO

Q = EOQ quantity

UP = unit price

AYD = average yearly demand

H = holding cost rate (cost/$/year)

T = delay in PLT caused by cutting back - measured in years. This occurs for procurements not yet on contract when some of the procurement processes must begin anew if the quantity is reduced.

λ = shortage cost factor (cost/requisition short/year)

S = average requisition size

CC = cost of cutting back

U = steady state unavailability, i.e. prob no stock is on hand

Formula

There are three elements to the formula:

(1) The additional cost of holding the M assets above RO.

(2) The additional backorders caused by the delay in PLT if a cutback is made. Used only when the amount is not yet on contract.

(3) The administrative and penalty cost of cutting back.

Additional Holding Cost

Consider each of the M assets above the RO. The i^{th} asset, i = 1,2,..M, is above the RO until i items are demanded. On the average it takes i/AYD years to experience i demands. So total expected holding cost of the M assets while they are above the RO is

$$(1) \qquad (UP)(H)\sum_{i=1}^{M}(i/AYD) = \frac{(M)(M+1)(UP)(H)}{(2)(AYD)}$$

Additional Backorder Cost for Amounts Not Yet on Contract

If part of an order which is not yet on contract is cut, then a new procurement action must begin. Consequently, the lead time is lengthened for those items retained on order. For simplicity we ignore the effect of the difference in the amount on order and look only at the difference in backorders when an order of size Q arrives a time τ later than originally selected. Some backorders originate somewhere in the original lead time and must wait the additional τ. The expected number of these is U Q, so the expected additional backorder cost of these is $(\frac{\lambda}{S})(U)(Q)(\tau)$. The other additional backorder cost is due to those backorders which originate in the additional τ units of the lead time. These backorders would not have occurred had the lead time not been lengthened. We approximate these by $(U)(\tau)(AYD)$, where U is meant to be the probability that there is no stock on hand at the end of the lead time. If Q is large U is a good approximation to this probability, although, in general, U understates the actual probability. On the average these additional backorders last $\tau/2$ units, so the expected additional backorder cost of these is $\frac{\lambda}{S}\ (U)(\tau^2)(AYD)/2$.

Total additional backorder cost then is

$$(2) \qquad (\frac{\lambda}{S})(U)[(Q)(\tau) + (\tau^2)(AYD)/2]$$

We set $U = \min\left[\frac{(UP)(H)}{\lambda/S}, .5\right]$

The first term is the unavailability that would be expected if there were no constraints on the safety level in the CCSS VSL/EOQ model. However, since the safety level is not permitted to be less than zero, we constrain U to be no more than .5.

Cost of Cutting Back

Naturally, the actual cost of cutting back is peculiar to each cutback action. Typically, this cost is composed of the additional administrative costs due to item manager review and procurement procedures, as well as the penalty cost levied by the contractor for cancellations. Since the intent is to identify, with virtual certainty, a large subset of those cases when cutback is economical, the penalty and administrative costs estimates are meant to be minimum amounts. Consequently, the rule may permit a cutback recommendation where in fact it would not be most economical. There is to be one cutback cost for amounts on contract, and one for amounts requested but not yet on contract. These are to be set by the MRC's, although $500 and $100 respectively were recommended.

Use of the Rule

We seek the largest value of M such that the additional holding cost does not exceed the additional backorder cost plus the cost of cutback. That is we solve for M in

$$(3) \qquad \frac{(M^2)(UP)(H)}{(2)(AYD)} = CC + \left(\frac{\lambda}{S}\right)(U)[(Q)(\tau) + (\tau^2)(AYD)/2]$$

Note that the term (M)(M+1) in equation (1) has been replaced for simplicity by M^2 in (3). Dividing both sides by AYD, and rearranging some terms

$$(4) \qquad \left(\frac{M}{AYD}\right)^2 = \frac{2}{(UP)(H)} \left[\frac{CC}{AYD} + \left(\frac{\lambda}{S}\right)(U)\left[\frac{(Q)(\tau)}{AYD} + \tau^2/2\right]\right]$$

M/AYD is the number of years of supply above the RO which is economically retainable and need not be recommended for cutback. The following table shows examples of the cutback rule computation.

EXAMPLE OF CUTBACK RULE

The following table gives the number of months of supply above the RO which can economically be retained on contract for two values of CC - $100 and $500. ADV and AYF are annual dollar value and average yearly frequency of demand respectively. The number in the upper left corner corresponds to CC = 100, while the lower right number corresponds to CC = 500.

MAXIMUM MONTHS TO RETAIN ON CONTRACT

ADV \ AYF	1	10	100
$500	17.5 34	17.5 34	17.5 34
5000	5.5 11	7 11	7 11
50000	2 3.5	2.5 3.5	4 3.5
500000	1 1	1 1	2 1

λ = 500

τ = 1.5 months (used only with CC = $100)

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