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EOQ ITEM MISSION IMPACT ANALYSIS

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ABSTRACT

We developed a new Item Mission Impact Coding Scheme and compared its performance to the scheme documented in the Air Force Logistics Management Center's "EOQ Item Essentiality" report. The new technique outperforms the previous technique. The new technique is based on Stockage Priority Codes and updated by Urgency Justification Codes from issue requests. Increasing the depth of stock for higher mission-impact coded items reduces MICAP incidents by 1.65% and increases fill rates by 2.5% for consumables.

EXECUTIVE SUMMARY

The **Retail Inventory Management and Stockage Policy (RIMSTOP) Study** and DODI 4140.45 recommends using item essentiality to determine inventory policy. The AFLMC was tasked to develop an item mission-impact coding scheme that is compatible with DoD guidance.

The objective of our analysis was to develop an item mission-impact coding technique and to determine the operational, stockage and cost impact of applying mission-impact codes to existing retail level inventory policy. We developed a new technique which uses the Stockage Priority Code (SPC) and is updated with the Urgency Justification Code (UJC) from an issue request. The resulting mission-impact codes comply with the DOD standards set by Military Standard 1552A. We identified five retail level uses for mission-impact coding. The uses are to:

a. Determine what items to buy with limited investment funds,

b. Determine the range of stock,

c. Increase the depth of stock,

d. Interface with wholesale essentiality coding programs like the Defense Logistics Agency Weapon System Support Program (WSSP), and

e. Identify items to use with capability assessment and aircraft availability models.

We showed, by increasing the safety level for high mission-impact items, we can reduce grounding incidents by 1.65% and increase the fill rate by 2.5% for consumable items. We recommended our coding scheme be submitted for DOD approval and be implemented for both consumable and reparable items.

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CHAPTER 1

THE PROBLEM

PROBLEM STATEMENT

The **Retail Inventory Management and Stockage Policy (RIMSTOP) Study** [2] recommended essentiality codes be used to determine retail level inventory policy. Although the current Standard Base Supply System uses an implied essentiality code in its range model, there is no retail level system to code mission impact for Economic Order Quantity (EOQ) items.

BACKGROUND

The RIMSTOP study and DODI 4140.45 recommends using item essentiality to determine inventory policy. The Air Force Logistics Management Center (AFLMC) was tasked to develop a retail level essentiality coding scheme, which we documented in a report entitled "EOQ Item Essentiality" [3]. The AFLMC report was distributed to all major air commands (MAJCOMs) and was briefed at the first Air Force Stockage Advisory Board. As a result of the MAJCOM reviews of the report and briefing, the AFLMC was tasked to examine other coding techniques and to determine the operational and cost impact of applying these codes to set retail level inventory policy. This report satisfies those taskings.

The purpose of this report is to develop a coding scheme to identify the mission impact of items and analyze the use of mission-impact codes to set inventory policy. We believe "**mission impact**" is a better term to use than essentiality to describe the coding scheme and the applications that we propose in this report.

This study seeks to satisfy the following objectives.

a. Develop and analyze mission-impact coding techniques for retail level EOQ items.

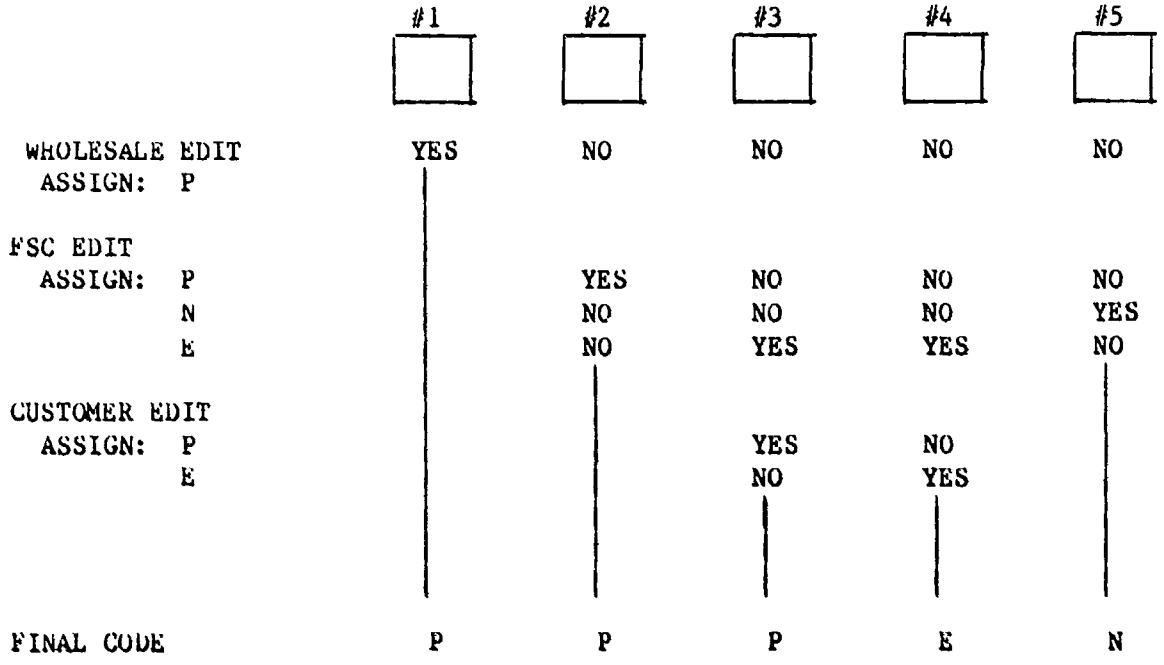
b. Determine the operational, stockage and cost impact of applying mission-impact codes to the existing retail level inventory models.

In the remainder of this chapter, we summarize our previous EOQ item essentiality coding technique and list five potential uses for a mission-impact coding technique.

Previous EOQ Item Essentiality Coding Technique

Figure 1-1 summarizes the essentiality coding technique recommended in the original EOQ Item Essentiality Report [3]. The coding technique used a three-tiered edit process: a wholesale edit, a Federal Supply Class (FSC) edit, and a customer edit.

FIVE SAMPLE ASSETS



NOTE: Only asset #4 would be subject to further edits based on subsequent demands. It would remain so until a "P" is assigned.

P = Primary Essential N = Non-essential E = Neither

FIGURE 1-1

Essentiality Coding Edits

An item was coded P, essential, if the item was coded essential in either the Air Force Logistics Command (AFLC) or Defense Logistics Agency essentiality coding system as in the case of Asset 1. Once an item was coded P, it was no longer edited. In the case of Assets 2 through 5, the item was not coded essential by either AFLC or DLA, so they pass to the Federal Supply Class (FSC) edit. Certain FSCs are considered essential, hence with Asset 2 the item was coded P and there were no more edits. Some FSCs are definitely not weapon system essential, and are therefore assigned Code N as was the case with Asset 5. Some FSCs may or may not be weapon system essential. These items are assigned Code E as is the case with 3 and 4, and undergo the third edit, a customer edit. If the customer is in direct support of sortie generation and orders an E-coded item, Code P is assigned, (Asset 3) otherwise the item remains coded E (Asset 4). In the next chapter we analyze this technique and compare its performance to another coding technique.

Five Potential Uses for a Mission Impact Coding Technique

Prior to beginning our analysis, we explain five potential uses for a retail level mission impact.

a. Retail level inventory managers can use mission-impact codes to determine what items to buy with limited investment funds. Given the requirement exceeds available funds, the items that ground weapon systems should be bought before items that do not ground weapon systems. Items that impair weapon systems, but do not ground them, should be bought before indirect support items, and so on. Thus, mission-impact codes can be used to determine the buy sequence. However, for System Support Division and Reparable items determining the buy sequence applies to the wholesale level not the retail level. The Air Force retail General Support Division items apply to base level and the stock fund usually has sufficient funds to meet customer requirements.

b. The second use of mission-impact codes is to determine what items to stock (i.e., the range of stock). The current SBSS range model determines which items to stock based on economic criteria, as directed by DODI 4140.45. The SBSS range model includes an "**essentiality code**" in its cost formulation, but its value is set to 1 for all items. However, high mission-impact items should be stocked sooner since the penalty cost of backordering an item that grounds a weapon system is certainly more than the penalty cost of backordering an administrative item. The same rationale applies to when to stop stocking, or the retention criteria. The AFLMC has shown in our excess retention studies that mission impact should affect retention policy.

c. Mission-impact codes can also be used to determine how much to stock (i.e., the depth of stock). High mission-impact items should have more stock. Currently, the SBSS treats all items the same. Current policy uses a C factor to determine the percent of time stock is available during a reorder cycle. Table 1-1 displays the C factors and the theoreteral percent availability (assuming a normal distribution of leadtime demand).

PERCENT AVAILABILITY
DURING A REORDER CYCLE

C FACTOR	PERCENT AVAILABILITY
1	84%
2	97%
3	99%

TABLE 1-1

The C factor is multiplied by the safety level to obtain the availability rates in Table 1-1. Thus the C factor can be used to adjust the depth of stock for high mission-impact items.

d. The next use of a retail mission-impact code is to interface with the wholesale coding scheme. Currently, wholesale essentiality coding is a time-consuming, mostly manual process involving use of technical orders and vendor supplied data to determine the importance of an item to a weapon system. The Defense Logistics Agency has MAJCOMs review their essentiality codes to make adjustments, corrections, and recommendations. In fact, the Strategic Air Command just completed a review of the Defense Logistics Agency essentiality coding for the Air Force. SAC's efforts are documented in [4] and required considerable amount of manhours to accomplish. If a retail coding scheme was developed, it could automatically feed the wholesale system via AUTODIN interface.

e. The final potential application for EOQ mission-impact coding is for use in capability assessment and aircraft availability models. There was a recent change in policy to include EOQ items in the War Readiness Spares Kit (WRSK), and there is a DOD objective to size requirements in terms of end-item availability. An assumption in many of the capability assessment and aircraft availability models is that the lack of a part grounds a weapon system. Certainly the lack of some EOQ items ground a weapon system, but others do not. Being able to identify the grounding parts would improve the performance of the capability assessment and aircraft availability models.

Thus, there are many applications for retail mission-impact coding of EOQ items. According to DODI 4140.39, whatever system the Air Force develops must be approved by DOD prior to implementation. In accordance with Military Standard 1552A, the mission impact system must be able to differentiate between the following groups of items.

ESSENTIALITY CODING

CATEGORY	DEFINITION	MILSTD CODE
Operationally Essential	Lack of the item prevents the weapon system (aircraft, communications equipment, vehicle, aerospace ground equipment, etc.) from being fully mission capable.	1
Direct Weapon System Support	Lack of the item does not ground a weapon system but results in an activities inability to perform its combat on combat support mission.	7
Indirect Weapon System Support	Lack of an item impairs assigned combat or supply mission accomplishment.	3
Other Support	Those items not in any of the categories above.	3

TABLE 1-2

CHAPTER 2

ANALYSIS

OVERVIEW: We documented our analysis in four sections. In the first section we analyzed the **item characteristics** using the previous AFLMC coding scheme [3]. We then developed an **alternative coding technique**. In the third section we compared the **performance of a mission-impact coding technique**. In the final section we discussed **implementation issues**.

ITEM CHARACTERISTICS

Our first step was to review the characteristics of the items coded P, N, and E in [3] which represents grounding, non-grounding, and undetermined, respectively. Note that "**essentiality**" codes apply to all EOQ items in support of all MICAP reportable weapon systems, these include aerospace ground equipment, vehicles, communication, and electronics equipment. Thus grounding refers to all weapon systems, not just aircraft. Table 2-1 provides the averages for several demand and stockage factors by "**essentiality**" code and represents the wholesale and Federal Supply Class (FSC) edits.

AVERAGES FOR DEMAND AND STOCKAGE FACTORS BY ESSENTIALITY CODE
(RANDOLPH AFB)

FACTOR	P (WHOLESALE)	P (FSC)	E	N (FSC)	OVERALL
Daily Demand Rate	.26	.08	.39	.65	.39
Price	$6.35	$170.00	$27.55	$22.83	$39.40
Total Demands	5.9	5.3	4.4	6.6	4.8
Demand Level	38	8	44	42	40
Stockage Priority Code	3.7	3.2	3.7	4.0	3.7
Number of Items	71	214	1738	303	2326

TABLE 2-1

If you exclude the items coded P due to the FSC edit, there is little to distinguish between the item characteristics of the wholesale P-coded items and the E-coded items. In fact the E-coded items had the same average stockage priority code (SPC) as the wholesale P-coded items. The stockage priority code is assigned based on the priority of the customer request. Table 2-2 explains the assignment of stockage priority codes.

STOCKAGE PRIORITY CODE

CODE	URGENCY JUSTIFICATION CODE	DEFINITION
1	MICAP reportable condition or awaiting parts "AR"	Grounding
2	A requirement or awaiting parts "BR"	Nongrounding but prevents mission accomplishment
3	B requirement	Mission Impairment
4	C	Routine
5	Other	

TABLE 2-2

Note the Stockage Priority Code (SPC) closely follows the DOD and Military Standard guidance for mission essentiality coding (refer to Table 1-2). The Stockage Priority Code is assigned based on the customer's Urgency Justification Code (UJC) on any issue request that results in a backorder. Thus, **A HIGH SPC SIGNIFIES SOME PROBLEM EXISTS IN THE STOCKAGE FOR THAT ITEM**, especially when an SPC is upgraded after a demand level has been established. **EVEN THOUGH THE PROBLEM IS HIGHLIGHTED FOR DEMAND LEVELED ITEMS**, we take no action - **WE DO NOT INCREASE THE STOCK TO PREVENT FUTURE BACKORDERS.** Once an SPC 1 through 3 is assigned it is downgraded, by one, if there has been no demand in 90 days. Stockage Priority Code 4 is downgraded to 5 if there has been no demand in 180 days. Thus stockage priority codes are transient.

We analyze the stockage priority codes for the essentiality coding scheme for items from Randolph AFB in Table 2-3.

STOCKAGE PRIORITY CODES

(Randolph AFB)

Percent of Items

SPC	P (Wholesale)	P (FSC)	E	N (FSC)	Overall
1	8.5	16.4	8.3	.3	8.0
2	8.5	18.2	13.1	7.6	12.7
3	14.1	15.4	11.8	2.6	11.0
4	40.8	30.8	38.7	72.3	42.4
5	28.2	19.2	28.1	17.2	25.9

TABLE 2-3

Again, there is very little difference between wholesale coded P items and E-coded items. Also note some N-coded items caused a grounding incident (.3%) and some prevented mission accomplishment (7.6%). Since we evaluate an essentiality coding technique using stockage priority codes, the obvious question to ask is:

IF STOCKAGE PRIORITY CODES MEET THE GUIDELINES SET BY THE DEPARTMENT OF DEFENSE, WHY NOT USE STOCKAGE PRIORITY CODES TO IDENTIFY MISSION IMPACT?

ALTERNATIVE CODING TECHNIQUE

In this section we examine the use of existing SBSS stockage priority codes as a mission impact coding technique. The Strategic Air Command (SAC) supply staff was tasked at the Air Force Stockage Advisory Board to review and validate the Defense Logistics Agency Weapon System Support Program (WSSP) essentiality codes for the Air Force. SAC documented their analysis in [4]. SAC's technique was to initially assign essentiality codes using stockage priority codes.

However, there were two problems with using SPCs - their transient nature and their assignment as a result of a backorder. Since Stockage Priority Codes are transient, SAC also had to review NICAP data to identify essential items whose SPC had been subsequently downgraded. To illustrate, suppose a grounding incident occurred on Day 1 and an SPC of 1 was assigned to an item. There were no demands for that item in the next 90 days so the item's SPC was downgraded to 2. If SAC conducted their analysis on Day 91, the item would not be coded as grounding using the SPC existent on Day 91. Therefore, SAC had to look at historical NICAP data.

The point is that the Stockage Priority Code provides a good starting point for mission-impact coding, but some additional steps are needed. Our technique is to initially assign a mission-impact code based on the current Stockage Priority Code. Then as transactions occur against this stock number, the mission-impact code is checked and, if appropriate, upgraded--it is never downgraded as long as the weapon system the item supports is still active. That is, as long as the weapon system is being supported at that base or is not modified so the EOQ item is no longer needed, the mission-impact code is not downgraded. **The mission-impact code will be upgraded based on the urgency justification code for any subsequent issue (or MSI) for that item whether it is backordered or not!** A War Readiness Spares Kit (WRSK) withdrawal will also upgrade the mission-impact code to 1. We illustrate with two examples.

Example 1: Suppose an item currently has a Stockage Priority Code of 3. An issue request is received with a UJC of A and the item is issued. The mission-impact code will be upgraded to 2, even though the SPC stays at 3. If a subsequent issue request is received with a UJC of A and the item is pulled from the WRSK, the mission impact code is upgraded to a 1.

Example 2: Suppose an item is requested with UJC "BR" and the item does not currently have an item record. The item is backordered, an SPC of 2 and a mission-impact code of 2 is assigned.

This technique accounts for the two problems of using SPCs for essentiality coding. These are the transient nature of SPCs and SPCs are only changed because of a backorder. To determine how well this technique works and how it can be applied, we measured the technique's performance using the System to Analyze and Simulate Base Supply (SASBS) model.

PERFORMANCE OF A MISSION IMPACT CODING TECHNIQUE

We compared the performance of the technique described in the previous section using stockage priority codes from the current SBSS system with the revised safety level found in [1]. We increased the depth of stock for high mission-impact items by increasing the C factor. We assigned C factors as shown in Table 2-4.

C FACTOR ASSIGNMENT

Mission Impact Code	C FACTOR	
	CONUS	Overseas
1	2	3
2	1.5	2.5
3 to 5	1	2

TABLE 2-4

In Tables 2-5 and 2-6, we show the results for Randolph and Upper Heyford Air Force Bases.

SIMULATION RESULTS

(Randolph)

Performance Factor	Baseline	Mission Impact Code 1:C=2 2:C=1.5 3-5:C=1
UNIT FILL RATE	92.0	92.2
$ INVENTORY	$227K	$241K
REDUCTION IN BACKORDERS		
Priority Group 1	-	5.1 %
Priority Group 2	-	1.5 %
Priority Group 3	-	3.7 %

TABLE 2-5

SIMULATION RESULTS

(Upper Heyford)

Performance Factor	Baseline	Mission Impact Code 1:C=3 2:C=2.5 3-5:C=2
UNIT FILL RATE	86.6	87.3
$ INVENTORY	$298K	$303K
REDUCTION IN BACKORDERS		
Priority Group 1	-	1.6 %
Priority Group 2	-	.3 %
Priority Group 3	-	.7 %

TABLE 2-6

Using Randolph and Upper Heyford data, increasing the depth of stock for high mission-impact items reduced the number of backorder occurrences. In Appendix A, we present the results for England, Minot, and Kunsan Air Force Bases. For the one year simulation run, the number of Priority Group 1 and 2 backorders was also reduced at these bases. In addition the fill rate was increased, meaning more stock would have been on-hand and used for high mission-impact items.

Note that increasing the depth of stock for high mission-impact items also decreases the number of Priority Group 3 backorders. In fact, at Minot, England, and Kunsan (see Appendix A), there was a larger percentage reduction in Priority Group 3 backorders than in the two higher priority groups. As we show in AFLMC's report, "**Inventory Policy for High Backorder Items**," many low-priced, high-demand, bench stock items will generate a high mission-impact code. Failure to have a bench stock item on hand will ground weapon systems. Thus, many of the requests for these high mission-impact items are routine bench stock issues. Hence, an increase in the depth of stock for these items reduces the number of Priority Group 3 backorders. When we compared the mission-impact method to the previous AFLMC essentiality coding technique, the mission-impact method was always better - the fill rate and the number of Priority Group 1 and 2 backorders reduced were always higher.

USING AN SPC- AND UJC-BASED MISSION-IMPACT CODING SCHEME WILL REDUCE MICAPs AND INCREASE THE UNIT FILL RATE FOR ESSENTIAL ITEMS.

The codes can also be used to automatically update wholesale essentiality coding techniques.

IMPLEMENTATION ISSUES

In this section, we discuss three implementation issues; the relationship between mission-impact codes and the LMC project entitled, "**Inventory Policy for High Backorder Items**;" DOD approval of the Air Force mission impact coding technique; and the stock fund impact.

In our "**Inventory Policy for High Backorder Items**" study, we recommended adding a lot size to the reorder point for items with a daily demand rate greater than or equal to one and had a Stockage Priority Code of 1. In that study, we recommended the mission-impact coding scheme be implemented concurrently, so the code could be used instead of the SPC. Thus the lot size would be added to items with a daily demand rate of 1 or greater and a mission-impact code of 1. We recommend the C factor be increased for all mission-impact Code 1 items. This would include mission-impact Code 1 items with a daily demand rate of 1 or greater. Thus the C factor increase is over and above the lot size increase. Also the C factor is a multiple of the safety level only, the lot size should not be multiplied by the C factor.

In accordance with DOD Instruction 4140.39, any Air Force mission-impact coding scheme must be approved by the DOD. Since DOD approval is required, **WE RECOMMEND OUR MISSION IMPACT CODE TECHNIQUE BE APPLIED TO BOTH CONSUMABLE AND REPARABLE ITEMS.** We recommended the Air Force implement this technique for field-level reparable items as part of the new retention policy. Although we do not have any current application for mission impact codes for depot reparable items, we foresee a need in Initial Spares Support Listing updates and capability assessment modeling.

The final implementation issue is to determine the stock fund impact of applying mission-impact codes. We document our analysis in Appendix B. We estimate the stock fund impact to be $8.2 million for System Support Division and $14.8 million for General Support Division.

CHAPTER 3

CONCLUSIONS/RECOMMENDATIONS

CONCLUSIONS

a. The Air Force needs mission-impact codes to increase the depth of stock for high mission-impact items, to provide an automated interface with wholesale essentiality coding, and to identify high mission-impact items for weapon system support and capability assessment.

b. A Stockage Priority Code- and Urgency Justification Code-driven mission-impact coding technique meets the essentiality definition set by DOD policy.

c. Increasing the depth of stock for high mission-impact items will increase the Air Force stockage effectiveness by 2.5% and decrease grounding incidents by 1.65%.

d. Using Stockage Priority Codes and Urgency Justification Codes to establish mission-impact code outperforms the previously proposed AFLMC essentiality coding technique.

e. Mission-impact codes can and should be applied to both consumable and reparable items.

RECOMMENDATIONS

a. Obtain DOD approval of the proposed coding technique in accordance with DODI 4140.45 and 4140.39. **(OPR: HQ USAF/LEY)**

b. Upon DOD approval, make the modification to the current system to assign mission-impact codes to both consumable and reparable items. **(OPR: AF/LEYS; OCR: DSDO/LGS)**

c. Modify the current system to increase the depth of stock by increasing the C factor for high mission-impact consumable items. **(OPR: AF/LEYS; OCR: DSDO/LGS)**

d. Develop an automated system to provide a wholesale essentiality code interface system. **(OPR: AF/LEY; OCR: AFLC/MMM, DSDO/LG, HQ DLA/OPW)**

APPENDIX A

PERFORMANCE OF A MISSION IMPACT CODING TECHNIQUE

SIMULATION RESULTS

(Minot)

Performance Factor	Baseline	Mission Impact Code 1:C=2 2:C=1.5 3-5:C=1
UNIT FILL RATE	84.4	84.8
$ INVENTORY	169.4	171.5
REDUCTION IN BACKORDERS		
Priority Group 1	-	.1 %
Priority Group 2	-	.2 %
Priority Group 3	-	4.4 %

TABLE A-1

SIMULATION RESULTS

(England)

Performance Factor	Baseline	Mission Impact Code 1:C=2 2:C=1.5 3-5:C=1
UNIT FILL RATE	80.7	81.5
$ INVENTORY	82.2K	90.4K
REDUCTION IN BACKORDERS		
Priority Group 1	-	0 %
Priority Group 2	-	2.5 %
Priority Group 3	-	4.0 %

TABLE A-2

SIMULATION RESULTS

(Kunsan)

Performance Factor	Baseline	Mission Impact Code 1:C=3 2:C=2.5 3-5:C=2
UNIT FILL RATE	83.3	94.0
$ INVENTORY	227.8K	231.3K
REDUCTION IN BACKORDERS		
Priority Group 1	-	.9 %
Priority Group 2	-	0 %
Priority Group 3	-	8.0 %

TABLE A-3

APPENDIX B

STOCK FUND IMPACT

APPENDIX B

STOCK FUND IMPACT

In this appendix we compute the stock fund impact of increasing the depth of stock for high mission-impact EOQ items. We add .5 to the current C factor for items with mission-impact Code 2 and we add 1 to the current C factor for items with mission-impact Code 1. This causes an increase to the safety level quantity. The overall increase to the safety level for General Support Division (GSD) item is 12% and for System Support Division (SSD) items the increase is 20%.

The next step is to multiply this present increase to the Air Force safety level quantity total from the consolidated AF M-20, Stock Fund Listings. However the current figures do not include the results of the revised safety level implementation. Therefore, we use the estimates provided in [1]. The projected GSD safety level dollar value in [1] was $123.2 million and the SSD total was $41.2 million. Therefore the cost impact for increasing the depth of stock for high mission impact EOQ items is:

Systems Support	General Support
$ 41.2 Million	$ 123.2 Million
X .20	X .12
$ 8.2 Million	14.8 Million

Thus, the total cost is $23 million. We recommended the stock fund impact be recomputed after implementation of the revised safety level. However, the above estimates are reasonable for planning purposes.

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