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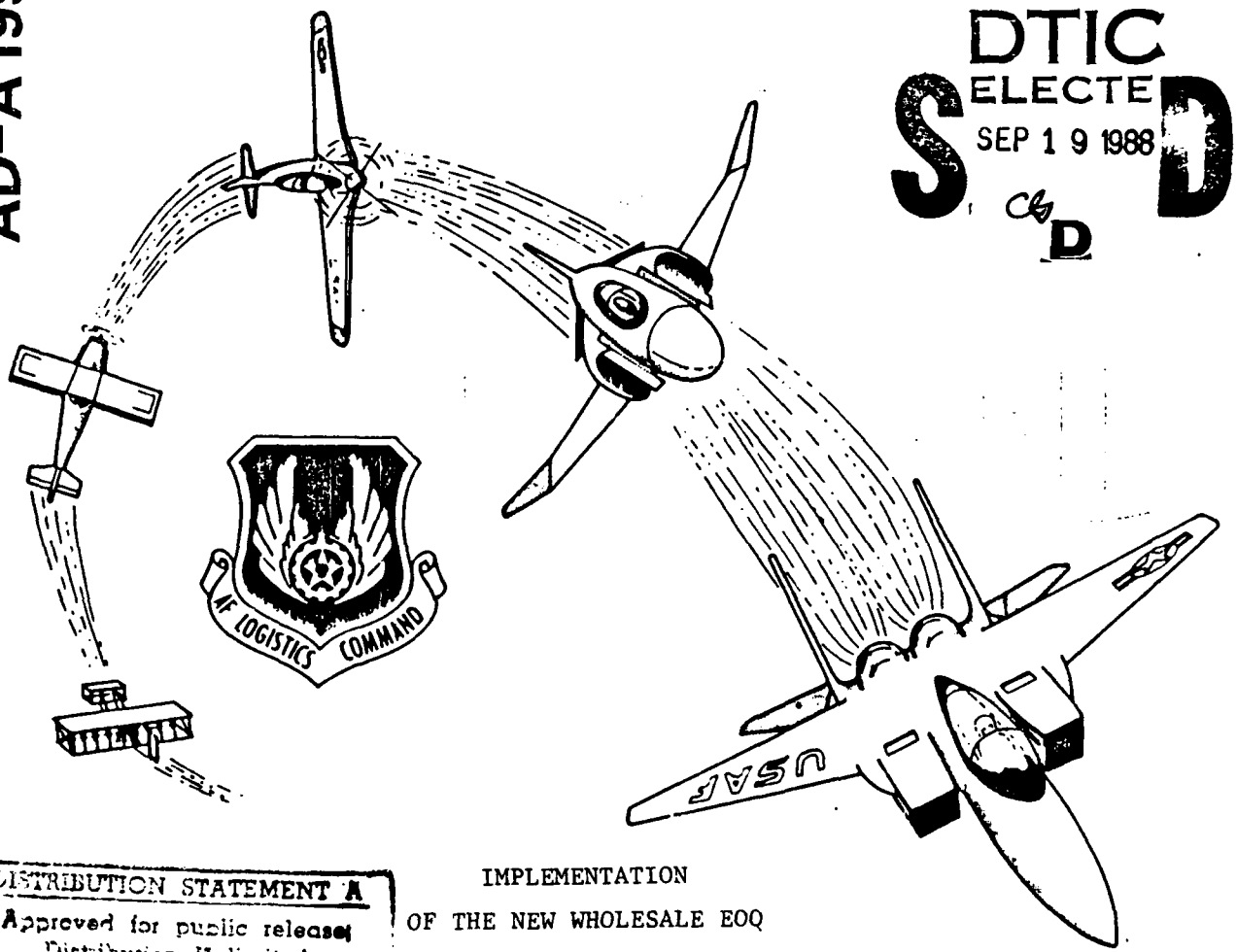
AIR FORCE LOGISTICS COMMAND

MATERIEL ANALYSIS



IMPLEMENTATION OF THE NEW WHOLESALE EOQ SAFETY LEVEL FORMULA

MR MARK GAETANO

HQ AFLC/MMMAA

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IMPLEMENTATION

OF THE NEW WHOLESALE EOQ

SAFETY LEVEL FORMULA

PROJECT MANAGER: Mr Mark Gaetano, HQ AFLC/MMMAA, AUTOVON 787-5270

BACKGROUND: In an earlier study, Wholesale EOQ Safety Level [Gaetano], we analyzed the Air Force's System Support Division (SSD) consumable item wholesale safety level algorithm. As a result of our analysis, we recommended changes to the safety level that would increase unit fill rates by four percent at the same requirements cost as today. While working implementation issues, we "fined-tuned" the model to better support the high cost, high essentiality items and still achieve the four percent gain in unit fill rate. The high cost, high essentiality items can significantly impact mission support and therefore warrant safety level support. The safety level is designed to minimize back orders based on variable costs. Because the unit cost of consumable items varies from one cent to over a million dollars, the model increases the safety levels for inexpensive items, **since they provide a greater reduction in back orders per dollar spent.**

PROBLEM STATEMENT: Develop a method to increase the safety level for the more expensive, high essentiality items, **without significantly decreasing the gain in the unit fill rate.**

ANALYSIS:

To examine the support provided by the new safety level, we divided the items into different cost groups as displayed in Table 1.

UNIT COST GROUPINGS

GROUP	COST RANGE
1	0 - 10
2	10 - 50
3	50 - 100
4	100 - 200
5	200 - 500
6	500 - 1000
7	1000 - 2500
8	2500 - up

Table 1

Within each cost group, we divided the items by essentiality group. We then computed the days safety level for each essentiality group within each cost group. Table 2 shows a comparison of the current system to the new safety level using actual data from Oklahoma Air Logistics Center. Appendix A contains the results from the other four Air Logistic Centers.

COMPARISON OF DAYS SAFETY LEVEL
OF CURRENT SYSTEM TO THE NEW SAFETY
(OC-ALC)

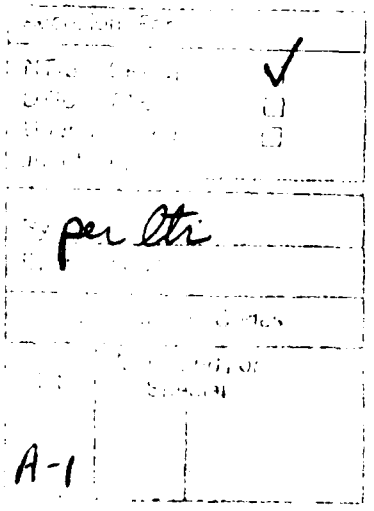
UNIT COST	ESSENTIALITY GROUP	NUMBER OF ITEMS	CURRENT SYSTEM AVG DAYS	NEW SL AVG DAYS
0 - 10	1	9199	331	379
	2	1458	144	330
	3	203	30	255
10 - 50	1	9978	251	348
	2	1655	21	267
	3	240	1	23
50 - 100	1	5017	187	262
	2	878	2	97
	3	115	0	0
100 - 200	1	4743	145	134
	2	756	0	19
	3	93	0	0
200 - 500	1	4877	105	31
	2	696	8	0
	3	115	0	0
500 - 1000	1	2301	61	0
	2	350	0	0
	3	58	0	0
1000 - 2500	1	1565	21	0
	2	210	0	0
	3	38	0	0
2500 - UP	1	695	5	0
	2	86	0	0
	3	26	0	0

Table 2

As you can see, our proposed safety level provides much better support for the inexpensive items, but provides less safety level support to the more expensive items. From a strictly marginal analysis perspective this makes sense; we can reduce more units back ordered per dollar by stocking more cheap items. However, high essentiality expensive items can significantly impact mission support and therefore warrant some safety level. Most of the consumable items considered expensive in the "EOQ arena" are considered cheap in the "recoverable arena" and would receive relatively larger safety levels

if considered a recoverable item. So, we decided to set **safety level floors** for each essentiality group within each cost group. The floors would be some multiple of the standard deviation of demand rather than some arbitrary days of supply. The standard deviation of demand is a measure of the variability of demand, so the more variable (spread out) demand is the more safety level (in terms of days of supply) it will receive. The floors can be changed for different essentiality groups and different cost groups based on the available funds.

Table 3 shows a comparison of the EOQ items managed by the current system and the new safety level with a floor for Oklahoma City Air Logistics Center. Appendix A contains the results for the other four Air Logistic Centers. We used a floor of 15 percent of the standard deviation of demand. We used 15 percent because it provided support for the more expensive items without significantly decreasing the support for the inexpensive items.



COMPARISON OF DAYS SAFETY LEVEL OF CURRENT SYSTEM TO THE NEW SAFETY LEVEL WITH FLOORS (OC-ALC)

UNIT COST ($)	ESSENTIALITY GROUP	NUMBER OF ITEMS	CURRENT SYSTEM AVG DAYS	NEW SL w/ FLOOR AVG DAYS
0 - 10	1	9199	331	375
	2	1458	144	323
	3	203	30	217
0 - 50	1	9978	251	317
	2	1655	21	214
	3	240	1	7
50 - 100	1	5017	187	187
	2	878	2	38
	3	115	0	0
100 - 200	1	4743	145	77
	2	756	0	3
	3	93	0	0
200 - 500	1	4877	105	43
	2	696	0	0
	3	115	0	0
500 - 1000	1	2301	61	44
	2	350	0	0
	3	58	0	0
1000 - 2500	1	1565	21	42
	2	210	0	0
	3	38	0	0
2500 - UP	1	695	5	0
	2	86	0	0
	3	26	0	0

Table 3

By using floors, we "force" the model into providing a safety level for high essentiality, high cost items. Note we only used a floor for the items with high essentiality and a unit cost of less than $2,500.

Table 3 highlights some of the weaknesses of the current system; it is "tricked" to spend money on very expensive items because it uses the square root of unit cost. It thinks a $10,000 item cost $100. Therefore, expensive items get a safety level larger than its demand would warrant. These few expensive items were using safety level dollars that would better be spent on the vast majority of less expensive items. Note for 85 percent of items at Oklahoma City, the new safety level formula computes a safety level equal to or greater than the current system. At the AFLC level, 92 percent of the items receive a safety level greater than or equal to the current system. Clearly, the new system is a better way to spend available dollars.

To analyze the stockage impact of using a safety level floor, we ran the Multi-Echelon Simulation Model [Rinks]. We used actual historical consumable data and ran the model for a simulated 50 years. The results show less than a 1 percent decrease in unit fill rates by using the new safety level formula with a floor.

IMPLEMENTATION: We tested the new formula with the safety level floors using the current EOQ requirements production system. We analyzed the "turbulence" the new safety level will have on the requirements systems. For example, we determined how many more buy notices would generate with the new safety level. Table 4 displays the results at the AFLC level. Appendix B displays the turbulence for each Air Logistic Center.

TURBULENCE
(AFLC)

ACTION	CURRENT SYSTEM	NEW SAFETY LEVEL WITH FLOOR	DIFFERENCE
BUY	5,244	7,694	2,450
TERM	2,365	2,512	147

Table 4

Our new safety level with floors will not create undue turbulence on the system; it will not generate a mass surge of buys nor generate termination notices. As a result of the new safety level formula and the floor, stock will increase on low cost, high demand items which will increase fill rates. Safety levels for expensive items will increase for the high essentiality items and stay about the same for the lower essentiality items. The new formula applies limited safety level dollars to the right items.

The safety level floors can also be changed by the D062 OPR as he/she sees necessary. The old safety level formula could only be adjusted in the implied shortage factor. There was no way to spend safety levels dollars on a particular group of items. The new safety level provides more management control on the safety level dollars. As funding situations change, the floors can be adjusted to provide maximum support given the available dollars.

CONCLUSIONS:

1. Our initially proposed safety level change resulted in little or no safety stock for expensive consumable items.

2. Highly essential, expensive items warrant safety stock.

3. Adding a safety level floor as a multiple of the standard deviation of demand for high essentiality items increases support for these items without significantly reducing the support for all items.

4. The new safety level with a floor provides safety stock equal to or greater than the current system for 92 percent of the items.

5. Implementing the new safety level with a floor will increase unit fill rates by almost 4 percent at the same requirements cost as today's safety level.

6. The new safety level with a floor has been approved and will be implemented in July 1988.

ACTION:

1. Continue with the plans to implement the new safety level including a floor for high cost, high essentiality items. (OPR: HQ AFLC/MMM)

APPENDIX A

DAYS SAFETY LEVEL COMPARISON

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DAYS SAFETY LEVEL COMPARISON

In this appendix, we show the comparison of the current system safety level algorithm versus the new safety level formula and the new safety level formula with a floor. We used a floor of 15 percent of the standard deviation of demand for items with a unit cost of less than $2,500 and a Mission Item Essentiality code of less than 12 for each Air Logistic Center.

COMPARISON OF DAYS SAFETY LEVEL OF CURRENT SYSTEM TO THE NEW SAFETY AND THE NEW SAFETY LEVEL WITH A FLOOR (OO-ALC)

UNIT COST	ESSENTIALITY GROUP	NUMBER OF ITEMS	CURRENT SYSTEM	NEW SL	NEW SL w/ FLOOR
0 - 10	1	5729	326	351	350
	2	1206	265	337	337
	3	360	138	304	303
10 - 50	1	5728	319	369	368
	2	1245	193	357	355
	3	414	14	172	164
50 - 100	1	2724	310	370	367
	2	618	117	351	343
	3	269	0	6	4
100 - 200	1	2701	298	349	342
	2	608	64	267	253
	3	324	0	2	2
200 - 500	1	2595	270	253	240
	2	559	29	125	110
	3	370	0	0	0
500 - 1000	1	1235	233	108	98
	2	350	6	10	7
	3	228	0	0	0
1000 - 2500	1	827	177	8	26
	2	343	0	0	0
	3	109	0	0	0
2500 - UP	1	470	75	0	0
	2	167	0	0	0
	3	57	0	0	0

Table A-1

COMPARISON OF DAYS SAFETY LEVEL OF CURRENT SYSTEM TO THE NEW SAFETY AND THE NEW SAFETY LEVEL WITH A FLOOR (SA-ALC)

UNIT COST	ESSENTIALITY GROUP	NUMBER OF ITEMS	CURRENT SYSTEM	NEW SL	NEW SL w/ FLOOR
0 - 10	1	9618	316	371	370
	2	3523	216	358	356
	3	1733	55	293	283
10 - 50	1	8646	220	354	345
	2	3344	35	298	282
	3	1612	1	45	33
50 - 100	1	4477	148	286	262
	2	1642	8	147	114
	3	763	0	0	0
100 - 200	1	4028	100	166	139
	2	1525	3	46	31
	3	681	0	0	0
200 - 500	1	4444	79	54	52
	2	1596	1	5	2
	3	732	0	0	0
500 - 1000	1	2211	37	2	28
	2	841	0	0	0
	3	329	0	0	0
1000 - 2500	1	1393	19	0	27
	2	680	0	0	0
	3	170	0	0	0
2500 - UP	1	668	10	0	0
	2	335	0	0	0
	3	76	0	0	0

Table A-2

COMPARISON OF DAYS SAFETY LEVEL OF CURRENT SYSTEM TO THE NEW SAFETY AND THE NEW SAFETY LEVEL WITH A FLOOR (SM-ALC)

UNIT COST	ESSENTIALITY GROUP	NUMBER OF ITEMS	CURRENT SYSTEM	NEW SL	NEW SL w/ FLOOR
0 - 10	1	1903	317	338	338
	2	1569	254	330	329
	3	366	85	311	310
10 - 50	1	2519	304	365	364
	2	2024	131	336	334
	3	442	21	249	241
50 - 100	1	1471	274	373	370
	2	1184	52	311	304
	3	161	0	24	20
100 - 200	1	1573	253	361	355
	2	1224	23	230	218
	3	198	0	3	3
200 - 500	1	1877	216	268	254
	2	1615	8	108	95
	3	203	0	0	0
500 - 1000	1	1023	181	114	100
	2	953	1	15	11
	3	132	0	0	0
1000 - 2500	1	815	153	16	27
	2	567	0	0	0
	3	84	0	0	0
2500 - UP	1	382	77	0	0
	2	179	0	0	0
	3	64	0	0	0

Table A-3

COMPARISON OF DAYS SAFETY LEVEL OF CURRENT SYSTEM TO THE NEW SAFETY AND THE NEW SAFETY LEVEL WITH A FLOOR (WR-ALC)

UNIT COST	ESSENTIALITY GROUP	NUMBER OF ITEMS	CURRENT SYSTEM	NEW SL	NEW SL w/ FLOOR
0 - 10	1	5567	318	347	347
	2	1993	281	351	351
	3	1759	97	325	324
10 - 50	1	7047	313	378	377
	2	2577	173	372	370
	3	1995	5	197	186
50 - 100	1	4039	306	417	413
	2	1470	77	357	349
	3	1154	0	20	16
100 - 200	1	3386	258	388	380
	2	1269	52	293	278
	3	862	1	3	2
200 - 500	1	3521	213	289	274
	2	1392	23	147	130
	3	980	0	0	0
500 - 1000	1	1918	176	138	122
	2	735	7	26	18
	3	499	0	0	0
1000 - 2500	1	1379	150	28	48
	2	505	1	0	0
	3	301	0	0	0
2500 - UP	1	757	90	0	0
	2	265	0	0	0
	3	154	0	0	0

Table A-4

APPENDIX B

SYSTEM IMPACT

APPENDIX B

SYSTEM IMPACT

In this appendix, we show the expected "turbulence" of implementing the new safety level formula. The new safety level will change the reorder level of many items and therefore might cause buy notices or termination notices to generate. This appendix shows, by Air Logistic Center, the number of expected notices, both buy and termination, to generate due to the new safety level.

TURBULENCE

ALC	ACTION	CURRENT SYSTEM	NEW SAFETY LEVEL WITH FLOOR	DIFFERENCE
OC	BUY	873	1117	+ 244
	TERM	445	562	+ 117
OO	BUY	846	1048	+ 202
	TERM	268	317	+ 49
SA	BUY	1578	2367	+ 789
	TERM	663	669	+ 6
SM	BUY	463	891	+ 428
	TERM	245	224	- 21
WR	BUY	1484	2211	+ 727
	TERM	744	740	- 4

* Repeat buy notices are included in these figures.

Table B-1

REFERENCES

1. Gaetano, Mark A. and Blazer, Lt Col Douglas J., "Wholesale EOQ Safety Level," HQ AFLC/MMMA, April 1988

2. Rirks, D.B., "Mech: A Simscript Simulation Program of a Multi-Echelon EOQ System for Consumables," User/Programmer Guide, Air Force Logistics Management Center, Gunter AFS, Alabama, September 18, 1986.