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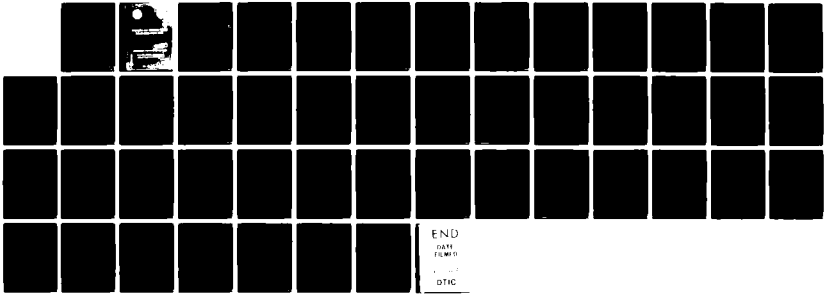

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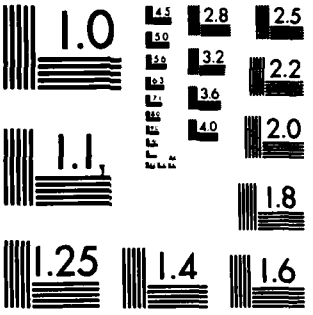

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Submarines and Submarine Tenders Demand-Based Policy Study

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ABSTRACT

This study evaluates alternative Selected Item Management (SIM)/Demand-Based Item (DBI) criteria for submarines and submarine tenders using a computer simulation and historical demand data. The alternatives are evaluated in terms of: (1) gross requisition effectiveness; (2) dollar investment in on-hand plus due-in stock; (3) workload (the number of resupply orders); and (4) volatility of the SIM/DBI stock battery. Volatility refers to the size of the SIM/DBI battery and to the rate of adds/deletes to the stock battery. The objective of this study was to evaluate various SIM/DBI qualifying and retention criteria based on supply effectiveness, investment, workload, and volatility for submarines and submarine tenders.

The study shows that the current COMSUBLANT and COMSUBPAC SIM/DBI criteria, two demands in six months to qualify and two demands in 12 months to retain for automated ships, and two demands in six months to qualify and one demand in six months to retain for nonautomated ships achieve comparable effectiveness and investment. Results of the study also identify several other SIM/DBI criteria that also show no decrease in effectiveness with respect to the above two policies but their retention criteria may lead to a constantly expanding SIM/DBI battery size which would also significantly increase investment. Of the two current policies, however, the one with the longer retention review period showed reduced shipboard workload in terms of less battery volatility. Therefore, it is recommended that the SIM/DBI criteria of two hits in six months to qualify and two hits in 12 months to remain be adopted for both submarines and submarine tenders.

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EXECUTIVE SUMMARY

1. Background. Selected Item Management (SIM) is an inventory control technique which, on nonautomated ships, focuses management attention on the small percentage of items experiencing the majority of on-board demands for material. There is a similar technique on automated ships to identify the faster moving items and to compute stock levels based on historical demand. These items are called Demand-Based Items (DBIs).

The criteria two demand requisitions in six months to qualify as SIM/DBI and one demand in six months to remain SIM/DBI (called "benchmark" for this study) is commonly used on submarines, which are nonautomated. Submarine tenders which are automated currently use the criteria two demand requisitions in six months to qualify as SIM/DBI and two demand requisitions in 12 months to remain SIM/DBI. The Navy has opted to implement this criteria for submarine tenders; however, the General Accounting Office (GAO) recommends that the Navy implement the SIM/DBI criteria two months with demand in six months to qualify and two months with demand in 12 months to remain.

2. Objective. The objective of this study is to evaluate various SIM/DBI qualifying and retention criteria in terms of supply effectiveness, investment, workload, and volatility for submarines and submarine tenders.

3. Approach. A computer simulation model, using historical demand data from three types of ships representing both Fleets was used in the study. The test ships consisted of two SSNs, two ASs, and an AS(FBM). The variations in the supply environment and inventory rules used by each ship type were adhered to in the computer simulation. The simulation was run using various SIM/DBI qualification/retention rules. The effects of these various policies were measured in terms of: (1) gross requisition effectiveness, (2) dollar value investment in terms of on-hand plus due-in stock, (3) number of resupply orders, and (4) size and volatility of the SIM/DBI stock record battery.

Two different techniques of looking at an item's demand history were considered for SIM/DBI qualification and retention. The frequency of demand technique is the one currently in use. Under this technique, each separate occurrence of a demand was counted towards meeting the stated criteria. The months of demand method was the second technique. In using this technique, one or more demands placed within the same month were only counted once towards meeting the stated criteria.

4. Findings. In evaluating the alternative policies to determine the best criteria, it is assumed that the best criteria should reduce dollar investment and/or volatility with no decrease in effectiveness. Based upon that assumption, the following policies were comparable in gross requisition effectiveness to the benchmark (2/6-1/6 (Freq)):

Policy	Criteria
1	2/6-2/12 (Freq)
2	2/12-1/12 (Freq)
3	2/12-1/12 (Mos.)
5	2/6-1/12 (Freq)

All of these policies have investment statistics approximately equal to the benchmark except for Policy 2 which shows a 3% to 7% increase in cost. The three policies (2, 3, and 5) which employ the most lenient retention criteria show the potential for growth in the SIM/DBI battery size. This could pose significant problems with respect to the management of the battery size and an attendant increase in investment over time.

The fourth policy, the policy currently used for submarine tenders, demonstrates a reduced volatility from the benchmark, thus implying an actual decrease in shipboard workload. Therefore, based upon the above

considerations, it is recommended that the policy of two hits in six months to qualify and two hits in 12 months for retention be adopted as the SIM/DBI criteria for submarines and submarine tenders.

I. INTRODUCTION

Selected Item Management (SIM) is an inventory control technique which, on nonautomated ships, focuses management attention on the small percentage of items experiencing the majority of on-board demands. Inventory management of items designated as SIM requires close and continuing attention with quarterly stock status review and stock replenishment based on historical demand. Inventory management of non-SIM items requires attention only upon receipt and issue of material, with stock replenishment on a one-for-one basis. There is a similar technique on automated ships to identify the faster moving items and to compute stock levels based on historical demand. These items are called Demand-Based Items (DBIs).

The current criteria for nonautomated ships specified by reference (1) (Appendix A) require two demand requisitions in six months to qualify for SIM and one demand requisition in six months to remain a SIM item. The current technique for automated ships specified in reference (2) (Appendix A) for classifying items as DBI are essentially the same, but the number of qualifying demands and the time period are variable parameters regulated by the Type Commanders. Commander, Submarine Forces, Atlantic (COMSUBLANT) and Commander, Submarine Forces, Pacific (COMSUBPAC) currently use the criteria two demand requisitions in six months to qualify as a DBI and two demand requisitions in 12 months to remain DBI for automated ships.

As a result of a SIM/DBI simulation study in 1976, reference (3) (Appendix A), General Accounting Office (GAO) recommended that the Navy implement the criteria two months with demand in six months to qualify and two months with demand in 12 months to remain for SIM/DBI items. The Navy has opted to implement the criteria two demand requisitions in six months to qualify and two demand requisitions in 12 months to remain for SIM/DBI items for submarine

tenders. Commander, Naval Supply Systems Command (COMNAVSUPSYSCOM), by reference (4) (Appendix A), requested that Navy Fleet Material Support Office (FMSO) evaluate current SIM/DBI qualifying and retention criteria and various alternatives, including GAO's and the Navy's recommendations in terms of supply effectiveness, investment, workload, and volatility for both submarines and submarine tenders.

A computer simulation model described in Section II was used in this study. Evaluations were made for the following five ships: (1) USS SIMON LAKE - AS 33; (2) USS FULTON - AS 11; (3) USS DIXON - AS 37; (4) USS LAPON - SSN 661; and (5) USS DRUM - SSN 677. A full two year simulation was run for the tenders and the SSN 661. Only a one and three-fourths year simulation was run for the SSN 677 since the last quarter of data for the SSN 677 contained data voids.

Historical demand data for the SSNs were extracted from the Navy Maintenance and Material Management (3M) data bank. The demand data for the SSN 661 were for the period March 1980 to February 1982, while the data for the SSN 677 were for the period March 1980 to November 1981. Coordinated Shipboard Allowance List (COSAL) tapes for the SSNs provided allowance quantities for the items carried on these ships. The COSAL quantities were based on the Navy Ships Parts Control Center (SPCC) Ship's History File data as of 1 April 1982. The Master Record File (MRF) was the data source for the simulation of the tenders. The tender's MRF contains all necessary data, including allowance quantities, unit price, and demand data, for processing the three automated submarine tenders, AS(FBM) 33, AS 11, and AS 37, through a full two year simulation. The period of demand data was March 1980 to February 1982 for the AS(FBM) 33 and May 1980 to April 1982 for the AS 11 and AS 37.

The simulation was run using various SIM/DBI qualification and retention rules. For example, the rule considered the benchmark in this study and the current policy for nonautomated ships two demands in six months for items to become SIM/DBI and one demand in the following six month interval to remain SIM/DBI. Twelve additional rules were also tested. These 12 policies are shown below.

Policy	Criteria
Benchmark	2/6-1/6 (Freq)
1 (Navy Proposal)	2/6-2/12 (Freq)
2	2/12-1/12 (Freq)
3	2/12-1/12 (Mos.)
4	2/6-1/6 (Mos.)
5	2/6-1/12 (Freq)
6	3/6;2/6-1/6 (Freq)
7 (GAO Proposal)	2/6-2/12 (Mos.)
8	2/6-1/12 (Mos.)
9	4/12-4/12 (Freq)
10	4/12-2/12 (Freq)
11	4/12-4/12 (Mos.)
12	4/12-2/12 (Mos.)

All of the policies that were tested have the same qualifying and retention criteria for allowance items (i.e., items with a positive allowance quantity) and nonallowance items except for Policy 6. Policy 6 had different qualifying criteria for allowance items than for nonallowance items but the same retention criteria for both allowance and nonallowance items. For example, if an allowance item had three demands in six months, then that item qualifed as a SIM/DBI item. Likewise, if a nonallowance item had two demands in six months, that item also qualified as a SIM/DBI item. The retention criteria for both allowance and nonallowance items under Policy 6 was one demand in six months to remain SIM/DBI.

The impact on the ships using a given policy was measured in terms of the following statistics:

- Gross Requisition Effectiveness. This statistic is computed by dividing the number of requisitions totally satisfied plus the number of partially satisfied requisitions during the last year of the simulation by the number of requisitions placed during the same year of the simulation. This computation conforms to the way the Fleets currently compute gross requisition effectiveness.
- Dollar Value of On-Hand Plus Due-In Stock. This figure represents investment or the dollar value of the sum of on-hand and on-order stock at the end of the simulation for all items that experienced any dema during the two year simulation period.
- Frequency of Orders. The number of resupply orders placed during th last year of the simulation is summed for all items. This statistic provides some measurement of the ordering and receipt workload.
- Number of SIM/DBI Items, Additions and Deletions. The size of the SIM/DBI battery is the number of items in the SIM/DBI category at the end of the two year period. The number of SIM/DBI additions is the number of non-SIM/DBI items qualifying as SIM/DBI over the last year. The number of SIM/DBI deletions is the number of SIM/DBI items returning to a non-SIM/DBI state during the last year of the simulation. These statistics measure the item volatility of the SIM/DBI battery.

II. TECHNICAL APPROACH

A. SIMULATION MODEL. The various SIM/DBI criteria were evaluated by using a computer simulation that models shipboard supply operations. Variations in supply procedures used on each ship were incorporated in the simulator. The following description is a summary of the major events of the simulator.

- Event: Demand. This event occurs whenever a requisition is placed against the ship's inventory. The two essential data elements necessary for processing are the date of the requisition within the simulation and the demand quantity. During this event, material, if available, is issued and effectiveness statistics are gathered.
- Event: Inventory Review. At the beginning of the simulation, each item is designated as non-SIM/DBI. During this event an item's past demand history is reviewed to determine the SIM/DBI status. If the item is currently non-SIM/DBI, a check is made to determine if the item meets the specified SIM/DBI qualification rule. Similarly, if the item is currently SIM/DBI, its demand record is compared with the specified SIM/DBI retention rule. This event takes place every 30 days on the automated tenders. On the nonautomated submarines, a non-SIM item is reviewed after every demand, while a SIM item is reviewed every 90 days.

After determining the item's SIM/DBI status, inventory levels are computed in accordance with the appropriate instructions. Specifically, the levels for the manual ships are computed as follows: (1) for a non-SIM item, the Requisitioning Objective (RO) equals the allowance quantity and the Reorder Point (RP) is one unit less than the RO; (2) for a SIM item, the RO and RP depend upon whether the item is Fleet Issue Load List (FILL)/non-FILL or consumable/repair part. For FILL - repair parts items, the RO equals 4.0 x

Average Monthly Demand (AMD) and the RP equals 3.0 x AMD; for FILL - consumable items the RO equals 2.5 x AMD and the RP equals 1.5 x AMD; for non-FILL - repair part items the RO equals 6.0 x AMD and the RP equals 5.0 x AMD; and for non-FILL - consumable items the RO equals 4.5 x AMD and the RP equals 3.5 x AMD. These figures were derived from the tables in reference (1) (Appendix A).

The levels for the mechanized ships are computed as follows: (1) for a non-DBI item, the RO equals the allowance quantity and the RP equals .65 x RO; (2) for a DBI item, levels are derived using the current SUADPS rules. Those rules have the following parameter settings: The operating level multiplier factor is 7.5 for attack tenders and 9.0 for Fleet Ballistic Missile (FBM) tenders; the maximum months of the operating level equals 7.5 months, the minimum months of the operating level equals 1.5 months for attack tenders and 2.75 months for FBM tenders (the maximum and minimum months figures are the constraints placed on the operating level); the order and shipping time factor equals 1.0 months; the safety level factor equals 2.0 months and the safety level is constrained to be at least as large as allowance quantity. These parameter values are within the range of values used by both Fleets.

- Event: Review of Assets. This event occurs once a day at most. For nonautomated ships, it takes place after the events "Demand" or "Inventory Review". For automated ships, this event occurs every 10 days. This event reviews the status of an item's assets based on the inventory levels computed during the event "Inventory Review". Whenever the assets are less than or equal to the reorder point, a resupply order is placed for that item.
- Event: Receipt. This event occurs upon the arrival of a resupply order placed in "Review of Assets". The receipt time is fixed at 30 days for a FILL item and 90 days for a non-FILL item.

B. ALTERNATIVE SIM/DBI TECHNIQUES. Two different techniques of reviewing an item's demand history were considered in defining alternative SIM/DBI criteria. The following describes each of the techniques:

- Frequency of Demand Technique. This is the technique currently in use. Each separate occurrence of demand is counted towards the item's demand frequency. The demand frequency of an item in a specified time period is used to determine if a non-SIM/DBI item meets the qualification criteria or if a SIM/DBI item meets the retention criteria.
- Months of Demand Technique. In using this technique, one or more demands that are placed within the same month are only counted once. For example, if an item experiences two separate demands during Month 1, one demand in Month 2, and no demands in Months 3 through 6, the item would then have only two months of demand in a six month period. The two demands placed in Month 1 are only counted as one "month".

III. RESULTS

Thirteen different SIM/DBI qualification and retention policies were evaluated for SSN 661, SSN 677, AS(FBM) 33, AS 11, and AS 37. The policy of two demands in six months to qualify and one demand in six months to remain which is the stated policy for nonautomated ships in reference (1) (Appendix A) was considered to be the benchmark against which all other policies would be compared. Each of the ships went through a two year simulation except SSN 677 which went through one and three-fourths year simulation. The first year's data was used to initialize the quantities and the statistics were gathered

over the second year's data. For SSN 677, the simulator was initialized using the first nine months of data and statistics were gathered during the last year of the simulation.

Due to the different operating procedures of the ships, each ship was analyzed separately. Navy Stock Account (NSA) items were evaluated for all ships. Depot Level Repairable (DLR) items were only evaluated for the FBM submarine tender. However, DLR items on a FBM tender which have one of the following cognizance symbols (cogs) 2P, 4P, 6A, 6H, 6N, 6P, 8P, 2X, 6X, or 8X and a unit price greater than $500 or items with cogs 0A, 8A, 2Z, 2F, or 2S do not go through the level setting process since changes to their authorized allowance are not permitted. DLR items on the SSNs and attack tenders have fixed allowances and do not go through the level setting process. The various policies that were evaluated had no effect on these DLR items. Therefore, the results of the DLR item SIM/DBI simulation for these ships are only presented in Appendix B.

Only items with experienced demand during the simulation were considered in this study and are shown in TABLE I. TABLE II displays statistics for those items having no demand during the two year period and thus were not considered in the simulation.

TABLE I

Items Considered In Simulation*

	Number of Items with Demand		Allowance Dollar Value	
	NSA	DLR	NSA	DLR
SSN 661	2,289	242	$ 80,446	$ 243,194
SSN 677	2,149	157	84,020	452,278
AS(FBM)33	30,810	3,322	5,311,268	20,265,005
AS 11	21,024	805	1,330,487	1,587,009
AS 37	21,022	656	2,724,432	1,634,703

TABLE II

Items with No Demand*

	Number of Items With No Demand		Allowance Dollar Value	
	NSA	DLR	NSA	DLR
SSN 661	5,591	838	$ 489,416	$1,545,473
SSN 677	6,104	1,001	547,518	2,029,849
AS(FBM)33	10,322	231	781,494	363,316
AS 11	9,695	344	634,392	578,451
AS 37	13,905	677	1,441,764	2,426,920

*Although TABLEs I and II display statistics for DLR items, only DLRs for the AS(FBM)33 were evaluated in the study.

A comparison of the benchmark's statistics with the corresponding values of the 12 alternatives in the areas of effectiveness, investment, workload, and volatility are presented in TABLEs III through VIII. The various policies are labeled to indicate frequency of demand technique (Freq) or months of demand technique (Mos.). The actual output figures from the simulation appear on the benchmark policy line. The benchmark policy is two demands in six months to qualify and one demand in six months to remain. The effectiveness numbers for the 12 alternatives is the difference between each policy's actual percent figure and the benchmark's percent figure. The investment and workload numbers for the 12 alternatives represent the percent change from the benchmark to the given policy. The figures in the volatility measures columns of the SIM/DBI battery are the actual numbers for the benchmark and the 12 alternatives.

The 12 alternatives are ranked in descending order according to their gross requisition effectiveness numbers and within effectiveness the alternatives are ranked in ascending order according to their on-hand plus due-in dollar value. This was done for each of the five ships. For ease of reference across all ships, each criteria was assigned a policy number. For example, the policy 2/6-2/12 (Freq) was assigned number 1. The assigned policy numbers referred to the same SIM/DBI criteria across all ships regardless of the criteria's ranking on a particular ship.

Appendix B shows the dollar value of long supply and excess along with gross units effectiveness and gross requisition effectiveness (partials counted as two requisitions, one completely satisfied and one not satisfied) statistics for the five test ships.

A. RESULTS OF NSA ITEMS ON THE SSNs. The results of the simulation for SSN 661 are presented in TABLE III, while the results of the simulation for SSN 677 are presented in TABLE IV. Although the simulation period for SSN 677 was shortened from two years to one and three-fourths years due to data voids in the last quarter of the second year, the relative comparisons of the second year's performance are considered valid because the simulation statistics are based on the last full year of demand data.

The top line of each table highlights the benchmark statistics in effectiveness, investment, number of resupply orders, and the size and volatility of the SIM/DBI battery.

For both SSNs, Policy 2 increases gross requisition effectiveness by one percentage point while Policies 9, 10, 11, and 12 reduces effectiveness by two percentage points. Gross requisition effectiveness for the other seven policies is the same as the effectiveness for the benchmark. Policies 4, 6, 7, and 8 show 3% to 12% reduction from the benchmark on-hand plus due-in dollar value, while Policies 9, 10, 11, and 12 show a 31-42% reduction in dollar value for both SSNs. Policy 1, the Navy's proposal, shows the dollar value of on-hand plus due-in stock did not change from the benchmark. For SSN 661, Policy 5 shows no change in the dollar value of on-hand plus due-in, while Policies 2 and 3 show a 1% to 6% increase. For SSN 677, Policies 2 and 5 show a 1% to 6% increase in the on-hand plus due-in dollar value. For both SSNs Policy 2 increases the number of resupply orders by 1% to 4%. Policies 1 and 5 also increase workload on SSN 661. In all other cases, the total number of resupply orders decreases from the benchmark. The size of the SIM/DBI battery decreases for Policies 4, 6, 9, 10, 11, and 12 for both SSNs. The number of additions to and deletions from the SIM/DBI battery decreases for all policies, except Policy 2 which shows an increase only to the number of additions to the battery.

TABLE III

SIM Criteria Analysis - SSN 661
NSA Items

Criteria	Policy	Gross Reqn Eff. Partials Included	OH+DI	Resupply Orders	# SIM Items	# Adds	# Deletes
2/6-1/6 (Freq)	Benchmark (Current Policy)	53%	$160,018	1,458	298	393	269
2/12-1/12 (Freq)	2	+1	+6%	+4%	608	419	128
2/6-1/6 (Mos.)	4	0	-6%	-6%	236	305	210
2/6-2/12 (Mos.)	(GAO Proposal) 7	0	-6%	-4%	339	290	161
2/6-1/12 (Mos.)	8	0	-6%	-5%	420	282	72
3/6;2/6-1/6 (Freq)	6	0	-3%	-4%	201	259	152
2/6-2/12 (Freq)	(Navy Proposal) 1	0	0%	+2%	438	365	205
2/6-1/12 (Freq)	5	0	0%	+2%	518	357	117
2/12-1/12 (Mos.)	3	0	+1%	-1%	526	357	86
4/12-4/12 (Mos.)	11	-2	-42%	-19%	55	100	75
4/12-2/12 (Mos.)	12	-2	-42%	-20%	98	78	10
4/12-2/12 (Freq)	10	-2	-37%	-18%	149	116	21
4/12-4/12 (Freq)	9	-2	-37%	-17%	108	137	93

TABLE IV

SIM Criteria Analysis - SSN 677
NSA Items

Criteria	Policy	Gross Reqn Eff. Partials Included	OH+DI	Resupply Orders	# SIM Items	# Adds	# Deletes
2/6-1/6 (Freq)	Benchmark (Current Policy)	54%	$134,626	1,221	226	306	408
2/12-1/12 (Freq)	2	+1	+6%	+1%	561	348	197
2/6-1/6 (Mos.)	4	0	-12%	-7%	185	240	301
2/6-2/12 (Mos.)	(GAO Proposal) 7	0	-12%	-8%	283	231	204
2/6-1/12 (Mos.)	8	0	-12%	-9%	360	229	125
2/12-1/12 (Mos.)	3	0	-5%	-6%	442	300	137
3/6;2/6-1/6 (Freq)	6	0	-4%	-4%	155	217	265
2/6-2/12 (Freq)	(Navy Proposal) 1	0	0%	-1%	369	295	272
2/6-1/12 (Freq)	5	0	+1%	-1%	453	293	186
4/12-2/12 (Mos.)	12	-2	-33%	-23%	106	87	26
4/12-4/12 (Mos.)	11	-2	-33%	-23%	49	99	95
4/12-2/12 (Freq)	10	-2	-31%	-20%	143	104	39
4/12-4/12 (Freq)	9	-2	-31%	-19%	89	116	105

B. RESULTS OF NSA ITEMS ON THE ASs - ATTACK TENDERS. TABLEs V and VI display the findings on the NSA items for the AS 11 and AS 37, respectively. The actual numbers for the benchmark appear on the top line of each table.

Policies 1, 2, 3, and 5 show supply effectiveness did not change from the benchmark for both tenders. The other eight alternatives decreased effectiveness by one to five percentage points. Both tables show Policies 1, 2, 3, and 5 increased dollar investment in stock from 1% to 7% over the benchmark's value. The other policies reduced investment from 2% to 23% with Policies 9, 10, 11, and 12 showing the largest reduction in the dollar value of on-hand plus due-in stock. For AS 11, the number of resupply orders increased for Policies 1, 2, and 5. The other policies show a reduction in workload except for Policy 8 which shows no change from the benchmark. For AS 37, Policies 2, 3, 4, and 6 increased workload while Policies 7 and 11 show no change. For the other six policies, the total number of resupply orders decreases.

For both ships, the size of the SIM/DBI battery decreases for Policies 4, 6, 9, 10, 11, and 12. All other policies have a larger SIM/DBI battery. All of the policies lower the number of additions to and deletions from the SIM/DBI battery.

TABLE V

DBI Criteria Analysis - AS 11
NSA Items

Criteria	Policy	Gross Reqn Eff. Partials Included	OH+DI	Resupply Orders	# DBI Items	# Adds	# Deletes
2/6-1/6 (Freq)	Benchmark	74%	$2,974,393	16,287	5,562	4,604	4,261
2/6-2/12 (Freq)	(Navy Proposal & Current Policy)1	0	+1%	+2%	7,094	3,789	2,710
2/6-1/12 (Freq)	5	0	+2%	+3%	8,108	3,550	1,448
2/12-1/12 (Mos.)	3	0	+3%	-6%	8,671	4,002	1,247
2/12-1/12 (Freq)	2	0	+7%	+9%	9,089	4,266	1,547
3/6;2/6-1/6 (Freq)	6	-1	-6%	-2%	4,740	3,636	3,195
2/6-1/6 (Mos.)	4	-1	-5%	-3%	5,158	4,055	3,764
2/6-2/12 (Mos.)	(GAO Proposal) 7	-1	-4%	-1%	6,450	3,422	2,418
2/6-1/12 (Mos.)	8	-1	-3%	0%	7,521	3,191	1,161
4/12-4/12 (Freq)	9	-4	-19%	-17%	3,725	2,469	2,324
4/12-2/12 (Freq)	10	-4	-18%	-17%	4,306	1,761	635
4/12-4/12 (Mos.)	11	-5	-23%	-19%	2,158	2,289	2,172
4/12-2/12 (Mos.)	12	-5	-23%	-18%	3,748	1,557	420

TABLE VI

DBI Criteria Analysis - AS 37
NSA Items

Criteria	Policy	Gross Reqn Eff. Partials Included	OH+DI	Resupply Orders	# DBI Items	# Adds	# Deletes
2/6-1/6 (Freq)	Benchmark	80%	$3,987,679	20,183	5,479	5,047	4,414
2/6-2/12 (Freq)	(Navy Proposal & Current Policy)1	0	+1%	-1%	6,594	4,069	4,090
2/12-1/12 (Mos.)	3	0	+1%	+1%	7,628	3,807	2,159
2/6-1/12 (Freq)	5	0	+1%	-1%	7,431	3,544	2,728
2/12-1/12 (Freq)	2	0	+3%	+1%	8,112	4,043	2,853
3/6;2/6-1/6 (Freq)	6	-1	-6%	+2%	4,154	3,489	2,966
2/6-1/6 (Mos.)	4	-1	-3%	+1%	5,098	4,437	3,719
2/6-2/12 (Mos.)	(GAO Proposal) 7	-1	-2%	0%	5,851	3,661	3,358
2/6-1/12 (Mos.)	8	-1	-2%	-1%	6,728	3,163	1,983
4/12-4/12 (Freq)	9	-2	-17%	-4%	2,907	2,503	2,540
4/12-2/12 (Freq)	10	-2	-17%	-4%	3,533	1,716	1,127
4/12-4/12 (Mos.)	11	-3	-20%	0%	2,219	2,117	1,952
4/12-2/12 (Mos.)	12	-3	-20%	-1%	2,827	1,382	609

C. RESULTS OF THE EVALUATION OF ITEMS ON AS(FBM) 33. The submarine tender AS(FBM) 33 has a larger number of items with demand than any other test ship. This is reflected in the higher inventory, workload and SIM/DBI battery values.

1. NSA Items. TABLE VII shows the results of the comparison between alternative SIM/DBI qualifying and retention criteria and the benchmark criterion for NSA items on AS(FBM) 33. For Policies 9, 10, 11, and 12, gross requisition effectiveness is reduced by one or more percentage points from the benchmark while all others are the same as the benchmark. Increases in the dollar value of on-hand plus due-in stock range from 1% to 4% for Policies 1, 2, 3, and 5. All other policies reduce inventory investment by at least 3%.

Policies 1, 2, 3, 5, and 8 increase the number of resupply orders by 1% to 6% from the benchmark's value. Policy 7 maintains the same workload as the benchmark while in all other cases the total number of resupply orders decrease. The number of SIM/DBI items for Policies 1, 2, 3, 5, and 8 ranges from 9,725 to 12,535, an increase of 745 to 3,555 items over the benchmark's 8,980 items. All other policies show a decrease in SIM/DBI battery size. All policies show that the number of additions and deletions to the SIM/DBI battery decrease.

2. DLR Items. The results of the comparison between alternative SIM/DBI criteria and the benchmark criterion for DLR items for AS(FBM) 33 are shown in TABLE VIII. Gross requisition effectiveness for Policies 1, 2, 3, and 5 is the same as the benchmark. All other policies show effectiveness decreases one to two percentage points from the benchmark. The on-hand plus due-in dollar value increases for Policies 2, 3, and 5, while Policies 6, 9, 10, 11, and 12 show a reduction in investment value. The other policies show no investment dollar difference from the benchmark.

TABLE VII

DBI Criteria Analysis - AS(FBM) 33
NSA Items

Criteria	Policy	Gross Reqn Eff. Partials Included	OH+DI	Resupply Orders	# DBI Items	# Adds	# Deletes
2/6-1/6 (Freq)	Benchmark	84%	$8,518,016	25,334	8,980	5,914	6,241
3/6;2/6-1/6 (Freq)	6	0	-6%	-3%	6,211	3,870	3,889
2/6-1/6 (Mos.)	4	0	-4%	-2%	7,332	5,089	5,463
2/6-2/12 (Mos.)	(GAO Proposal) 7	0	-3%	0%	8,736	4,257	4,407
2/6-1/12 (Mos.)	8	0	-3%	+1%	10,445	3,860	2,301
2/6-2/12 (Freq)	(Navy Proposal & Current Policy)1	0	+1%	+2%	9,725	4,783	5,111
2/12-1/12 (Mos.)	3	0	+1%	+5%	11,934	4,755	2,664
2/6-1/12 (Freq)	5	0	+1%	+3%	11,359	4,313	3,007
2/12-1/12 (Freq)	2	0	+4%	+6%	12,535	5,052	3,298
4/12-4/12 (Freq)	9	-1	-13%	-9%	4,863	3,339	3,850
4/12-2/12 (Freq)	10	-1	-13%	-8%	6,527	2,282	1,429
4/12-4/12 (Mos.)	11	-2	-19%	-10%	3,962	2,998	3,471
4/12-2/12 (Mos.)	12	-2	-18%	-9%	5,353	1,890	972

TABLE VIII

DBI Criteria Analysis - AS(FBM) 33
DLR Items

Criteria	Policy	Gross Reqn Eff. Partials Included	OH+DI	Resupply Orders	# DBI Items	# Adds	# Deletes
2/6-1/6 (Freq)	Benchmark	76%	$20,502,867	2,287	323	335	396
2/6-2/12 (Freq)	(Navy Proposal & Current Policy)1	0	0%	+2%	450	275	327
2/6-1/12 (Freq)	5	0	+1%	+4%	556	260	206
2/12-1/12 (Mos.)	3	0	+1%	+6%	624	315	201
2/12-1/12 (Freq)	2	0	+1%	+7%	654	326	242
4/12-4/12 (Freq)	9	-1	-2%	-6%	166	156	193
4/12-2/12 (Freq)	10	-1	-2%	-5%	249	116	70
3/6;2/6-1/6 (Freq)	6	-1	-2%	-3%	215	174	176
2/6-1/6 (Mos.)	4	-1	0%	-1%	296	292	342
2/6-2/12 (Mos.)	(GAO Proposal) 7	-1	0%	+1%	393	252	289
2/6-1/12 (Mos.)	8	-1	0%	+2%	511	240	159
4/12-4/12 (Mos.)	11	-2	-3%	-8%	115	134	170
4/12-2/12 (Mos.)	12	-2	-3%	-6%	187	88	52

The total number of resupply orders for Policies 1, 2, 3, 5, 7, and 8 ranges from a 1% to 7% increase over the benchmark figure, while the other policies show a decrease of 1% to 8%. The size of the SIM/DBI battery is smaller than the benchmark for Policies 4, 6, 9, 10, 11, and 12. All other policies show an increase in the size of the battery. All of the policies show a decrease in the number of additions to and deletions from the SIM/DBI stock battery.

IV. SUMMARY AND CONCLUSIONS

In evaluating the alternative policies to determine the best criteria, it is assumed that the best criteria should reduce dollar investment and volatility with no decrease in effectiveness.

Policies 4, 7, and 8 are based on the months of demand technique. This technique would require Shipboard Uniform Automated Data Processing System (SUADPS) programming changes on automated ships and may increase the manual workload on nonautomated ships until the advent of automation via SNAP II. Policy 6 has separate SIM/DBI qualification criteria for allowance and nonallownace items and thus may also pose implementation problems on manual ships until automation is introduced.

All of the policies that were evaluated are summarized in TABLE IX. Of the policies evaluated, Policies 9, 10, 11, and 12 cause the greatest reduction in gross requisition effectiveness. As a result of this large decrease in effectiveness, those policies are not considered for implementation.

For policies 4, 6, 7, and 8, gross requisition effectiveness ranged from zero to one percent below the benchmark. While a one percentage point decrease may not be statistically significant, the fact that this range was demonstrated over a variety of ships indicates a relative effectiveness decrease vis-a-vis all of the policies examined. Therefore, these policies were judged as permitting a degradation to effectiveness and not further considered.

The remaining policies (1, 2, 3, and 5) all bracket or slightly exceed the benchmark gross requisition effectiveness figures. These policies compare favorably or show slight investment increases with respect to the benchmark except for Policy 2 which shows a three to seven percent increase in investment.

TABLE IX

SIM/DBI Summary Chart Across All Ships (NSA Items Only)

Criteria	Policy	Gross Reqn. Eff.	OH + DI (Cost)	Volatility
2/6-1/6 (Freq)	Benchmark	With the exception of the SSNs, highest effectiveness	Generally has highest investment	SIM/DBI battery average; # adds & deletes generally the highest.
2/6-2/12 (Freq)	1 (Navy Proposal)	Same as benchmark	0-1% increase from benchmark	# of SIM/DBI items always higher than benchmark; # of adds & deletes lower than benchmark.
2/12-1/12 (Freq)	2	0-1% increase from benchmark.	3-7% increase from benchmark	# of SIM/DBI items always higher than benchmark; # of adds higher for SSNs but lower than benchmark for ASs and # of deletes always lower than benchmark.
2/12-1/12 (Mos.)	3	Same as benchmark	1-3% increase from benchmark; except for SSN 677 - 5% decrease	# of SIM/DBI items always higher than benchmark; # of adds & deletes always lower than benchmark.
2/6-1/6 (Mos.)	4	0-1% decrease from benchmark	3-12% decrease from benchmark	# of SIM/DBI items always lower than benchmark; # of adds & deletes lower than benchmark.
2/6-1/12 (Freq)	5	Same as benchmark	0-2% increase from benchmark	# of SIM/DBI items always higher than benchmark; # adds & deletes lower than benchmark.
3/6 2/6-1/6 (Freq)	6	0-1% decrease from benchmark	3-6% decrease from benchmark	# of SIM/DBI items always lower than benchmark; # adds & deletes lower than benchmark.
2/6-2/12 (Mos.)	7 (GAO Proposal)	0-1% decrease from benchmark	2-12% decrease from benchmark	# of SIM/DBI items higher than benchmark, except for AS(FBM)33; # adds & deletes lower than benchmark.
2/6-1/12 (Mos.)	8	0-1% decrease from benchmark	2-12% decrease from benchmark	# SIM/DBI items always higher than benchmark; # adds & deletes always lower than benchmark.
4/12-4/12 (Freq)	9	2-4% decrease from benchmark	13-37% decrease from benchmark	# SIM/DBI items significantly lower than benchmark; # adds & deletes significantly lower than benchmark.
4/12-2/12 (Freq)	10	1-4% decrease from benchmark	13-37% decrease from benchmark	# SIM/DBI items significantly lower than benchmark; # adds & deletes significantly lower than benchmark.
4/12-4/12 (Mos.)	11	2-5% decrease from benchmark	19-42% decrease from benchmark	# SIM/DBI items significantly lower than benchmark; # adds & deletes significantly lower than benchmark.
4/12-2/12 (Mos.)	12	2-5% decrease from benchmark	18-42% decrease from benchmark	# SIM/DBI items significantly lower than benchmark; # adds & deletes significantly lower than benchmark.

Workload or volatility is the other key consideration and is addressed in TABLE X where SIM/DBI battery adds are shown as a fraction of deletes by policy for each ship in the study. The three policies (2, 3, and 5) which employ the most lenient retention criteria of one in 12 (either frequency or months technique) show the potential for growth in the SIM/DBI battery size as reflected by the higher battery growth ratios (BGR) for these policies in comparison to the benchmark and Policy 1. This could pose significant problems with respect to the battery size management over time. The other workload factor is the number of add and delete actions per policy. TABLE X shows this statistic for Policy 1 as a fraction of the benchmark policy. In all cases, the actual workload associated with maintaining the SIM/DBI battery is less for Policy 1 than the benchmark even though the core battery itself is slightly larger.

Therefore, based upon the above decision criteria and evaluation, it is recommended that the SIM/DBI criteria for submarines and submarine tenders be two hits in six months to qualify and two hits in 12 months to remain.

TABLE X
SIM/DBI Volatility and Workload Statistics

Ship/Policy	Battery Growth Ratio (BGR) (Note 1)					Workload Ratio (Note 2)
	Benchmark	1	2	3	5	
SSN 661	1.461	1.780	3.273	4.151	3.051	.861
SSN 677	.750	1.084	1.766	2.190	1.575	.794
AS 11	1.080	1.398	2.758	3.209	2.452	.733
AS 37	1.143	.995	1.417	1.763	1.299	.862
AS(FBM) 33	.948	.936	1.532	1.785	1.434	.814

NOTE 1: $BGR_i = \frac{ADDS_i}{DELETES_i}$ for Policy i

NOTE 2: Workload Ratio = $\frac{\text{Policy 1 (ADDS + DELETES)}}{\text{Benchmark (ADDS + DELETES)}}$

APPENDIX A: REFERENCES

1. NAVSUP PUB 485 (Afloat Supply Procedures)

2. NAVSUP PUB 522 (SUADPS-207 Support Procedures)

3. FMSO Operations Analysis Department Study Report 124 (SIM/DBI Analysis for Submarines and Submarine Tenders" of 30 March 1976

4. COMNAVSUPSYSCOM ltr 04A6/LJB of 28 Sep 1981

APPENDIX B: ADDITIONAL STATISTICS

This appendix shows additional statistics that were produced as a result of a two year simulation using various SIM/DBI qualification and retention criteria for five test ships; SSN 661, SSN 677, AS 11, AS 37, and AS(FBM) 33. These statistics are presented in TABLEs BI-BVII.

TABLE B-I

SIM Criteria Analysis - SSN 661
NSA Items

Criteria	Policy	Gross Reqn Eff.		Unit Eff.	Long Supply + Excess
		Partials Split	Partials Sat.	Gross	
2/6-1/6 (Freq)	Benchmark (Current Policy)	46%	53%	28%	$33,705
2/12-1/12 (Freq)	2	0	+1	0	-49%
2/6-1/6 (Mos.)	4	0	0	-1	-16%
2/6-2/12 (Mos.)	7 (GAO Proposal)	-1	0	-1	-50%
2/6-1/12 (Mos.)	8	-1	0	-1	-66%
3/6;2/6-1/6 (Freq)	6	0	0	-1	-11%
2/6-2/12 (Freq)	1 (Navy Proposal)	0	0	-1	-41%
2/6-1/12 (Freq)	5	0	0	-1	-59%
2/12-1/12 (Mos.)	3	0	0	-1	-56%
4/12-4/12 (Mos.)	11	-2	-2	-4	-89%
4/12-2/12 (Mos.)	12	-2	-2	-4	-94%
4/12-2/12 (Freq)	10	-2	-2	-3	-92%
4/12-4/12 (Freq)	9	-2	-2	-3	-72%

TABLE B-II

SIM Criteria Analysis - SSN 677
NSA Items

Criteria	Policy	Gross Reqn Eff.		Unit Eff.	Long Supply + Excess
		Partials Split	Partials Sat.	Gross	
2/6-1/6 (Freq)	Benchmark (Current Policy)	48%	54%	17%	$39,924
2/12-1/12 (Freq)	2	0	+1	0	-57%
2/6-1/6 (Mos.)	4	-1	0	0	-35%
2/6-2/12 (Mos.)	7 (GAO Proposal)	-1	0	0	-59%
2/6-1/12 (Mos.)	8	-1	0	0	-77%
2/12-1/12 (Mos.)	3	-1	0	0	-76%
3/6;2/6-1/6 (Freq)	6	0	0	0	-13%
2/6-2/12 (Freq)	1 (Navy Proposal)	0	0	0	-38%
2/6-1/12 (Freq)	5	0	0	0	-57%
4/12-2/12 (Mos.)	12	-2	-2	-1	-99%
4/12-4/12 (Mos.)	11	-2	-2	-1	-88%
4/12-2/12 (Freq)	10	-2	-2	0	-99%
4/12-4/12 (Freq)	9	-2	-2	0	-92%

TABLE B-III

DBI Criteria Analysis - AS 11
NSA Items

Criteria	Policy	Gross Reqn Eff.		Unit Eff.	Long Supply + Excess
		Partials Split	Partials Sat.	Gross	
2/6-1/6 (Freq)	Benchmark	69%	74%	68%	$463,186
2/6-2/12 (Freq)	1 (Navy Proposal & Current Policy)	0	0	0	-50%
2/6-1/12 (Freq)	5	0	0	0	-70%
2/12-1/12 (Mos.)	3	+1	0	0	-75%
2/12-1/12 (Freq)	2	+1	0	+1	-69%
3/6;2/6-1/6 (Freq)	6	-1	-1	-1	-18%
2/6-1/6 (Mos.)	4	0	-1	-1	-15%
2/6-2/12 (Mos.)	7 (GAO Proposal)	0	-1	-1	-53%
2/6-1/12 (Mos.)	8	0	-1	-1	-76%
4/12-4/12 (Freq)	9	-3	-4	-3	-42%
4/12-2/12 (Freq)	10	-3	-4	-3	-83%
4/12-4/12 (Mos.)	11	-5	-5	-4	-46%
4/12-2/12 (Mos.)	12	-5	-5	-4	-88%

TABLE B-IV

DBI Criteria Analysis - AS 37
NSA Items

Criteria	Policy	Gross Reqn Eff.		Unit Eff.	Long Supply + Excess
		Partials Split	Partials Sat.	Gross	
2/6-1/6 (Freq)	Benchmark	75%	80%	59%	$423,180
2/6-2/12 (Freq)	1 (Navy Proposal & Current Policy)	+1	0	0	-21%
2/12-1/12 (Mos.)	3	+1	0	0	-45%
2/6-1/12 (Freq)	5	+1	0	0	-39%
2/12-1/12 (Freq)	2	+1	0	0	-38%
3/6;2/6-1/6 (Freq)	6	0	-1	-1	-26%
2/6-1/6 (Mos.)	4	0	-1	-1	-15%
2/6-2/12 (Mos.)	7 (GAO Proposal)	0	-1	-1	-28%
2/6-1/12 (Mos.)	8	0	-1	-1	-48%
4/12-4/12 (Freq)	9	-2	-2	-2	-64%
4/12-2/12 (Freq)	10	-2	-2	-2	-74%
4/12-4/12 (Mos.)	11	-4	-3	-3	-73%
4/12-2/12 (Mos.)	12	-3	-3	-3	-84%

TABLE B-V

DBI Criteria Analysis - AS(FBM) 33
NSA Items

Criteria	Policy	Gross Reqn Eff.		Unit Eff.	Long Supply + Excess
		Partials Split	Partials Sat.	Gross	
2/6-1/6 (Freq)	Benchmark	81%	84%	72%	$1,019,727
3/6;2/6-1/6 (Freq)	6	-1	0	0	-20%
2/6-1/6 (Mos.)	4	-1	0	0	-21%
2/6-2/12 (Mos.)	7 (GAO Proposal)	0	0	0	-37%
2/6-1/12 (Mos.)	8	0	0	0	-65%
2/6-2/12 (Freq)	1 (Navy Proposal & Current Policy)	0	0	0	-30%
2/12-1/12 (Mos.)	3	0	0	+1	-61%
2/6-1/12 (Freq)	5	0	0	0	-51%
2/12-1/12 (Freq)	2	0	0	+1	-48%
4/12-4/12 (Freq)	9	-2	-1	-1	-34%
4/12-2/12 (Freq)	10	-2	-1	-1	-72%
4/12-4/12 (Mos.)	11	-2	-2	-3	-57%
4/12-2/12 (Mos.)	12	-2	-2	-3	-82%

TABLE B-VI

DBI Criteria Analysis - AS(FBM) 33
DLR Items

Criteria	Policy	Gross Reqn Eff.		Unit Eff.	Long Supply + Excess
		Partials Split	Partials Sat.	Gross	
2/6-1/6 (Freq)	Benchmark	74%	76%	47%	$521,846
2/6-2/12 (Freq)	1 (Navy Proposal & Current Policy)	0	0	0	-50%
2/6-1/12 (Freq)	5	0	0	0	-71%
2/12-1/12 (Mos.)	3	0	0	+1	-71%
2/12-1/12 (Freq)	2	0	0	+1	-70%
4/12-4/12 (Freq)	9	-1	-1	0	-51%
4/12-2/12 (Freq)	10	-1	-1	0	-88%
3/6;2/6-1/6 (Freq)	6	-1	-1	0	-51%
2/6-1/6 (Mos.)	4	-1	-1	0	-11%
2/6-2/12 (Mos.)	7 (GAO Proposal)	-1	-1	0	-52%
2/6-1/12 (Mos.)	8	-1	-1	0	-75%
4/12-4/12 (Mos.)	11	-2	-2	0	-51%
4/12-2/12 (Mos.)	12	-2	-2	0	-89%

TABLE B-VII

SIM/DBI Criteria Analysis - DLR Items

	Gross Reqn Eff.		Unit Eff.		
	Partials Split	Partials Sat.	Gross	OH+DI	Resupply Orders
AS 11	33%	34%	17%	$1,536,256	377
AS 37	42%	44%	27%	1,634,703	352
SSN 661	23%	24%	12%	243,194	35
SSN 677	34%	35%	31%	452,278	33

The following performance measures were used to evaluate the various SIM/DBI criteria:

- Gross Requisition Effectiveness. This statistic is computed using two different methods. The first effectiveness statistic (partials split) is computed by dividing the number of requisitions satisfied during the last year of the simulation by the number of requisitions placed during the same year of the simulation. This method counts partially satisfied requisitions as two separate requisitions, one completely satisfied and one not satisfied. The second effectiveness statistic (partials satisfied) is computed by dividing the number of requisitions satisfied and the number of partially satisfied requisitions during the last year of the simulation by the number of requisitions placed during the same year of the simulation.
- Gross Units Effectiveness. This statistic results from dividing the number of units satisfied during the second year of the simulation by the number of units required for the same year.
- Dollar Value of On-Hand Plus Due-In Stock. This figure represents the dollar vlaue of the sum of on-hand and on-order stock at the end of the simulation for all items that experience any demand during the last year of the simulation.
- Dollar Value of Long Supply and Excess. This statistic is the dollar value of the items that are considered to be in long supply or excess stock at the end of the second year of the simulation. Long supply stock is defined as inventory that is on-hand, above the allowance quantity, and not required nor supported by current demand. Long supply is applicable only to items with a nonzero allowance quantity that qualified as SIM/DBI at some time during the simulation and that by the end of the simulation had reverted back to a non-SIM/DBI state.

The dollar value is computed by multiplying the difference between the on-hand stock and the allowance quantity by the end item unit price for the applicable items. Excesses are applicable only to items with a zero allowance quantity that qualified as SIM/DBI at some time during the simulation, and thus become authorized range adds, but by the end of the simulation had reverted back to a non-SIM/DBI state. The dollar value of excess stock is then computed the same as the value of on-hand stock for the applicable items.

- Frequency of Orders. The number of resupply orders placed during the last year of the simulation is summed for all items. This statistic provides some measurement of the buy and receipt workload.
- Number of SIM/DBI Items, Additions, and Deletions. The size of the SIM/DBI battery is the number of items in the SIM/DBI category at the end of the two year simulation period. The number of SIM/DBI additions is the number of non-SIM/DBI items qualifying as SIM/DBI over the last year of the simulation. The number of SIM/DBI deletions is the number of SIM/DBI items returning to a non-SIM/DBI state during the last year of the simulation. These statistics represent the item volatility of the SIM/DBI battery.

It should be noted that the comparative statistics on the dollar value of long supply and excess should be interpreted very carefully since these values do not always represent true inventory reductions. For example, in order to build up an excess or long supply, two conditions must exist: (1) the item must experience sufficient demand to qualify for computation of SIM/DBI levels and (2) the item demand must later decrease to the point that the item is no longer considered a SIM/DBI item. Use of a stricter qualification criteria will eliminate SIM/DBI levels for borderline demand items that would later revert to excess/long supply. A stricter qualification criteria

represents a true reduction in inventory investment. Furthermore, the value of excesses and long supply may also be reduced by a more liberal retention criteria since an excess/long supply condition cannot exist until an item reverts to a non-SIM/DBI state. Due to the fact that excess/long supply values do not always represent true inventory reductions, these values were considered in a secondary role, with primary emphasis on total inventory investment.

The tables in this appendix show results from various alternative SIM/DBI criteria. Two different techniques of reviewing an item's demand history were considered in defining alternative SIM/DBI criteria and are described below.

- Frequency of Demand Technique. Each separate demand is counted towards the item's demand frequency. The demand frequency of an item in a specified time period is used to determine if a non-SIM/DBI item meets the qualification criteria or if a SIM/DBI item meets the retention criteria.
- Months of Demand Technique. In this technique, one or more demands that are placed within the same month are only counted once. For example, if an item experiences three separate demands during Month 1, one demand in Month 2, and no demands in Months 3 through 6, the item would then have two months of demand in the six month period. The three demands placed in Month 1 are only counted towards one month.

TABLEs BI-BV display the results for the various SIM/DBI qualification and retention rules for NSA items on the SSNs and ASs. The different policies are labeled to indicate Freq (frequency of demand technique) or Mos. (Months of demand technique). The policy taken from reference (1) (Appendix A) of two demands in six months to qualify and one demand in six months to remain a part of the SIM/DBI stock record battery is considered to be the benchmark. TABLEs BI-BVI compare the 12 alternative policies to the benchmark. The actual

figures from the simulation output appear on the benchmark line in those tables. The effectiveness numbers for the alternatives are the actual percent figure minus the benchmark's percent figure. The investment and workload numbers for the alternative policies represent the percent change from the benchmark to the given policy.

The results of applying alternative criteria on DLR items on the FBM submarine tender are presented in TABLE B-VI. Items on an FBM tender which have one of the following cogs: 2P, 4P, 6A, 6H, 6N, 6P, 8P, 2X, 6X, or 8X and a unit price greater than $500, or items with cogs 0A, 8A, 2Z, 2F, or 2S do not go through the level setting process since changes to their authorized allowance are not permitted. Therefore, the various policies that were evaluated had no effect on these DLR items.

TABLE B-VII displays the results of alternative criteria on DLR items on the SSNs and attack tenders. DLR items on these types of ships have a fixed allowance and therefore do not go through the level setting process. The different SIM/DBI criteria that were evaluated had no effect on these DLR items.

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13. ABSTRACT

This study evaluates alternative Selected Item Management (SIM)/Demand-Based Item (DBI) criteria for submarines and submarine tenders using a computer simulation and historical demand data. The alternatives are evaluated in terms of: (1) gross requisition effectiveness, (2) dollar investment in on-hand plus due-in stock, (3) workload (the number of resupply orders), and (4) volatility of the SIM/DBI stock battery. Volatility refers to the size of the SIM/DBI battery and to the rate of adds/deletes to the stock battery. The objective of this study was to evaluate various SIM/DBI qualifying and retention criteria based on supply effectiveness, investment, workload, and volatility for submarines and submarine tenders.

The study shows that the current COMSUBLANT and COMSUBPAC SIM/DBI criteria, two demands in six months to qualify and two demands in 12 months to retain for automated ships, and two demands in six months to qualify and one demand in six months to retain for nonautomated ships achieve comparable effectiveness and investment. Results of the study also identify several other SIM/DBI criteria that also show no decrease in effectiveness with respect to the above two policies but their retention criteria may lead to a constantly expanding SIM/DBI battery size which would also significantly increase investment. Of the two current policies, however, the one with the longer retention review period showed reduced shipboard workload in terms of less battery volatility. Therefore, it is recommended that the SIM/DBI criteria of two hits in six months to qualify and two hits in 12 months ro remain be adopted for both submarines and submarine tenders.

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