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A template for the selection and array of inventory as an aid in the development of evacuation plans

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NAVAL POSTGRADUATE SCHOOL
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A TEMPLATE FOR THE SELECTION AND ARRAY OF INVENTORY
AS AN
AID IN THE DEVELOPMENT OF EVACUATION PLANS

by

James Lawrence Dietz

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A Template for the Selection and Array of Inventory as an Aid in the Development of Evacuation Plans

by

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Submitted in partial fulfillment of the
requirements for the degree of

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from the

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ABSTRACT

A program is developed using the FOCUS interactive query language to aid in the selection of aviation-related inventory to be withdrawn from a forward-deployed stock point in the event of an evacuation. The program allows the input of critical parameters, and produces a scorecard which can be used to analyze withdrawal alternatives. Several possible selection objectives and measures of effectiveness are discussed.

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I. INTRODUCTION

A. THE PROBLEM

Navy logisticians commanding forward deployed stock points may have need to make choices among individual line items of inventory if forced to evacuate without having time to relocate the entire range and depth of carried stock. Decisions must be based on some global criterion which may not be visible to the logistician on scene. In addition, the choice of items to be evacuated must be such that the primary support mission of the stock point is degraded as little as possible; or to state the obverse, so that the mix of weapons required by the operational commander receives high levels of support albeit at the expense of "lower priority systems". An overseas stock point may carry in excess of 350,000 line items of inventory, with individual component counts numbering into the millions. Its inventory consists of old items, new items, fast movers and "insurance" material. Portions of the inventory are classified. There are many inexpensive items--fifteen percent of the items tie up fifty percent of the dollars invested--and a $5,000 item can cause a mission-degrading failure as surely as a $500,000 item .

The operational commander must be able to communicate his contingency support requirement as unambiguously as possible to the logistician, and the logistician must have a system in place which can respond quickly to support the desired mix of weapons, or lacking guidance from the operational commander, make reasonable, generalized choices among competing items within time, workload, and transportation constraints.

Dynamic programming solutions to this type of problem have been published since the early 1950's, and computational and logical enhancements to the process have been occurring on a regular basis. Mathematicians and statisticians stand ready to solve problems precisely like those faced by the forward deployed logistician in the scenario considered in this work. There is, in fact, a distinct genus of problems and solutions known as cargo loading, or the "knapsack problem", which translate directly. The knapsack problem, stated mathematically is:

$$\max_{(x_i)} \sum_{i=1}^{N} x_i v_i$$

$$\text{subject to} \quad \sum_{i=1}^{N} x_i w_i \leq W \text{ (all } w_i \text{ are positive integers)}$$

$$\text{and} \quad \sum_{i=1}^{N} x_i u_i \leq U \text{ (all } u_i \text{ are positive integers).}$$

$$x_i = 0 \text{ or } 1 \qquad (i = 1, \ldots, N).$$

For the stock point evacuation scenario, each item of inventory i is characterized by a positive integer weight w_i, a positive integer volume u_i, and a value v_i, and there are constraints on both available weight (W) and available volume (U). The total number of components in the inventory (N) must each be considered, subtracting from available lift as each item is added during the problem's solution.[1]

To solve this problem, one must know the capacity of the vessels assigned to transport (evacuate) the cargo, along with the physical dimensions and value measure for each candidate item. The difficulty in execution for the military planner lies in the fact that no criterion for the quantitative measure of an item's value has yet been defined with the requisite precision to facilitate the ranking of items in the wholesale system. With that

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[1]Stuart E. Dreyfus and Averill M. Law, The Art and Theory of Dynamic Programming (New York : Academic Press, 1977), p. 117.

impediment in mind, the task becomes one of offering some reasonable alternative method with which to execute a withdrawal given the inability to rank individual items.

B. THESIS OBJECTIVE

The Naval Supply Depot (NSD), Subic Bay, R.P. is sponsoring this research with the ultimate goal of developing a methodology to value its spare parts inventory . The first step is to develop a model which can be evaluated for its ability to operate over a wide range of input conditions, and suitability as a parts evacuation aid. Commanding Officers at NSD Subic Bay have examined withdrawal scenarios locally for some time. This thesis is the first to result from the research done at Subic Bay and has evolved into an cooperative effort integrating the resources of the stock point and the wholesale inventory control point (ICP) in the person of the Aviation Supply Office, Philadelphia. The thesis objective is to bring to bear the resources available at the ICP in order to provide a toolkit from which operational commanders and forward deployed logisticians can devise effective withdrawal plans.

C. APPROACH

The approach taken in the research has been to visit NSD Subic Bay and interview top management in order to determine the needs of the logistician-on-scene. A ten-day exploratory trip to Subic Bay provided the researcher with knowledge of the geographic supply support which the stock point provided and valuable insight into the problems faced by the command in attempts to value its inventory in the preparation of a contingency plan. As a consequence of that visit, the ICP was approached for assistance in testing a general model for use in prioritizing items of inventory. At the Aviation Supply Office, data processing time was made available for the researcher to do interactive programming using NSD Subic Bay "live data" to test the logic of the proposed heuristic.

D. SCOPE

Detailed study was concentrated on the aviation portion of NSD Subic Bay's inventory. The assignment of types of material to eight logical categories found in the test of the thesis model was made by the researcher. The scenario which governs the operation of the model was developed for testing purposes only.

This study is properly considered as a small component of a large and complex withdrawal environment. The boundaries set for this research assume that the operational commander has by some means arrived at the point where he may consider the evacuation of spare parts. No assertion is made concerning the relative importance of spare parts when compared with other physical property that may be co-located at the advance base, such as ordnance, or test equipment at a repair facility. The system described in the study is independent of transportation constraints, although it may be used as a predictive device to ascertain the quantity of spare parts that could be saved, given the availability of certain amounts of lift. It makes no assumption as to the probable availability of labor. It assumes the ability to orchestrate an orderly removal.

E. PREVIEW

Chapter II reviews the concept of value as it relates to spare parts inventories and the situational aspect of value assignment in the model. It discusses the objectives and measures of effectiveness available to the analyst for use in valuing an inventory. Chapter III previews the operation of the model. Chapters II and III are designed to provide the background, definitions, and context that will make the model's decision rules understandable and a useful tool for further research. Chapter IV presents information about the functioning of the model using NSD Subic Bay live data.

Chapter V presents a summary of the research effort and recommendations for further research.

II. VALUE ASSIGNMENT METHODOLOGY

A. INTRODUCTION

Given the powerful array of tools in the mathematician's arsenal with which to attack the evacuation problem, the central question in this thesis revolves around the selection of an appropriate criterion with which to value the forward-deployed inventory. What should be the aim of an inventory relocation from an advanced base? Clearly, the items selected for salvation on the basis of minimizing the loss of investment dollars would be different from a those saved based on maximizing the number of items which could be transported out of harm's way. Yet either objective seems to be a plausible choice, because each is easily quantifiable. "...We should save 40% of our inventory", or "we should preserve 65% of our investment dollars..." are objectives which are proposed early in any discussion of the problem.

Value may be viewed as inherent in a particular item of inventory, in which case its utility may be measured independently of any temporal aspect; or situational, in which case its worth can be measured only within the framework of the spare part's contribution to the effort for which it may be required. The Navy's inventory model for determining economic order quantity treats value as a continuing or inherent aspect of each item of inventory by including in its levels of inventory computation a factor representing essentiality. Having set the stage, it resolves the issue of making value measurements by setting the essentiality factor equal to "1" for each and every item.[2] An attempt to approximate the value of

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[2]U.S., Department of the Navy, Naval Supply Systems Command, Inventory Management: A Basic Guide to Requirements Determination in the Navy, NAVSUP P-553, p. 3-32.

individual items situationally has been through the process of military essentiality coding, which for ships' parts is a measure of the frequency with which an item is required to correct a mission-degrading casualty (CASREP), but on the aviation side of the house is a more subjective and thus less useful computation involving conferences and negotiation to arrive at mission essentiality codes.

This study approaches the question of value or utility with the view that operational or employment factors are the primary contributors to the worth of an item. Any valuing of inventory in the development of a relocation sequence to be used under the pressures of forced withdrawal must be adaptable to the operational commander's support requirements at that particular time and place. If the primary concern is amphibious operations, parts which support those operations must receive greater priority than they would receive under some other scenario, such as the prosecution of an undersea threat or bombing missions over enemy territory. Value must be defined in terms of usefulness to the ultimate possessor. If, after relocation, the logistician has many parts to support the operation of high technology systems but the operator requires other material, the wrong choices have been made in preserving the inventory.

Operational support, important though it may be, is not the only dimension which must be considered in the approach to this problem. Take the case of the high technology part. It is not in the national interest to allow technology transfer to occur. This would surely happen should an enemy get access to any high-tech parts left behind, so we must somehow attempt to include a value for possession of high technology into our formula for taking parts with us. The same holds true for items of our inventory which are classified.

Further, the inventory of the forward deployed site must not be considered in isolation. Some items, qualifying as "valuable" parts by virtue of the situational definition to which we subscribe, would not be the most logical parts to save first; given security, technology, or other constraints. Decision-makers must be afforded the opportunity to include material or classes of material based on experience and their perception of contemporary politics.

The operational commander has other important sources of material located aboard his Aircraft Carrier Battle Groups, and wholesale supply system posture must enter into the preservation equation. Under some conditions, the optimal mix to be preserved may be more closely related to wholesale supply system posture and the Navy's ability to support readiness in a global sense than to the needs of the theater commander. So it must be determined which "ultimate user" is to be supported in the effort.

There are many approaches to the problem, and probably many solutions which may be regarded as effective or efficient in guiding the evacuation of a spare parts inventory. Whereas the dynamic programming approach discussed in the introduction is devised to provide the optimal solution, it is not practicable in this case because of the incommensurability of competing objectives.

The problem is one of allocating resources to satisfy a wide range of competing requirements. Commanders must make the decisions, faced with uncertainty. The task at hand is to reduce uncertainty by describing the competing objectives, and laying out alternatives for the decision maker to consider. What follows is a discussion of a decision support system designed to array alternatives based on allocation decisions.

B. THE INVENTORY SELECTION MODEL

There are several objectives which must be considered in a policy decision of this type, each with a unique election criterion. One objective may be to save as many parts as possible. Another may be to select parts so that the maximum amount of dollars invested may be preserved. A third may be to maximize the effectiveness of the global supply system; or one closely related, to minimize the impact on "business-as-usual" for the deployed inventory. Operators may desire that the selection process be predicated upon some ranking of weapon systems to be supported by the repositioned inventory.

The consequences of pursuing any of these objectives must be understood in order to make a rational decision. Further, each objective must be measured in the light of its contribution to the overarching goal.

> The primary mission of the Department of the Navy is to protect the United States, as directed by the President or the Secretary of Defense, by the effective prosecution of war at sea including, with its Marine Corps component, the seizure or defense of advanced naval bases; to support, as required, the forces of all military departments of the United States; and maintain the freedom of the seas.[3]

C. COMPETING OBJECTIVES

1. Objective I: Maximize amount of inventory saved

a. Definitions Required

"Amount of inventory" here refers to the physical quantity of line items of spare parts saved. It could alternatively be stated in terms of numbers of individual pieces; or a volume measurement, such as measurement tons.

b. Measure of Effectiveness

Measures of Effectiveness for an operation of this type could be easily computed and readily explained to the American public in terms of the ratio of inventory saved to inventory on hand prior to evacuation. There is a danger in the use of a ratio as a measure of effectiveness, as the decision maker may lose sight of the absolute magnitude of the numbers comprising the ratio.

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[3]The United States Government Manual (Washington, D.C.: Office of the Federal Register, National Archives and Records Administration, 1986), p. 211.

c. Contribution to Overall Goal

Pursuit of this objective yields no direct operational support effect. It would discriminate against large or hard-to-pack items. The inventory saved is likely to consist of many minor parts of little use, whereas the parts left behind may be very expensive, operationally significant, and of great propaganda value to the enemy. This goal makes sense only in the context of a scenario which affords the necessary resources to evacuate an inventory in its entirety. Even then, to evacuate everything, including obsolete or otherwise unusable portions of the inventory, does not seem to make effective use of resources. This objective has little to do with valuing an inventory and is not explicit in the model.

2. Objective II: Preserve the Maximum Value of Taxpayers' Investment

a. Definitions Required

"Value of taxpayers' investment" is defined as the replacement cost of the inventory at the stock point subject to the relocation effort. It represents the summation of unit prices over all items held in inventory.

b. Measure of Effectiveness

The measure of effectiveness for an objective of this type would be the dollar value of material saved. While being both simply calculated and easily explained, the preservation of dollars invested may not accurately represent opportunity costs. For example; a hard-to-get, inexpensive item which is needed to repair a front-line weapon system but is left behind may represent a much higher opportunity cost than a high-priced item, also needed in the repair of a front-line system, which has many substitutes or is readily available.

c. Contribution to Overall Goal

This objective is attractive in that practically all decisions made on Capitol Hill have costs measured in dollars, and the Pentagon is often criticized for its stewardship of the public purse. The contribution of this objective to the overall goal may be directly correlated to the political situation. In time of war, when effectiveness of the operating force is ascendent, policy-makers may be less concerned with dollars than in times of peace, when the efficient use of available resources is more highly prized.

A selection criterion based upon large price tags is likely to get most high-technology parts, and many complex systems, but would have no direct operational support dimension and is likely to leave behind classified, or important yet inexpensive material which could compromise national security.

This objective is expressed within the model. Its influence may be varied through the selection of operating parameters.

3. Objective III: Maximize the Effectiveness of the Global Supply System

a. Definitions Required

"Effectiveness" is defined as the ability of the supply system to provide appropriate material to its clients upon demand.

"Global Supply System" refers to the existence and management of a level of inventory which is controlled at the national level, known as the wholesale level of inventory. It is related to, yet distinct from the level of inventories held at the forward-deployed sites.[4]

[4]Inventory Management, NAVSUP P-553, p. 1-3.

b. Measure of Effectiveness

The measure of effectiveness traditionally applied to the supply system is Supply Material Availability (SMA), calculated by dividing the number of requisitions filled by the number of requisitions received. The computation is done on a line-item basis, and can be aggregated to the system level.

A more operationally oriented, but indirect measure of effectiveness for the supply system is supply response time. It is an important contributor to Operational Availability (A_o), which is the probability that a system will operate satisfactorily when called upon in an actual support environment. It would be beyond the scope of this study, however, to reduce this measure so that it becomes useful to the valuation of individual items.[5]

The supply system is similar to any spare parts business in that it depends on sales of its shelf stock to generate revenues to procure more stock, and continue in operation. This relocation objective, therefore, may be alternatively stated as the minimization of reductions to the financial position of the Navy Stock Fund. The measure of effectiveness then used would become the value of annual demand for those items of inventory saved.[6]

A final method of measuring this objective could be to look at the inventory in terms of "long supply". Items in long supply are held in excess to projected requirements and represent a source of stock which we might not want to evacuate.

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[5]Supply support is a component of mean logistics delay time, which contributes to the time a system is unavailable for use. For a complete discussion of the Navy's availability computation, see NAVMATINST 3000.2, Operational Availability of Weapon Systems and Equipments; Definitions and Policy.

[6]Value of Annual Demand (VAD) is computed by multiplying the unit price of an item by the demand for that item over a twelve-month period.

The model uses the concepts of value of annual demand and long supply as surrogate criteria for measuring the effectiveness of the supply system.

c. Contribution to Overall Goal

The decision to save items with high values of annual demand, attractive from a financial standpoint, carries with it some negative effects. It has no direct relationship to the provision of support to an operational commander, in that a globally generated value of annual demand statistic may not be representative of the local inventory's usage. Items left behind may be strategically significant insurance items, or highly reliable items which do not fail often enough to qualify for retention. In this last case, we could conceivably leave behind our most reliable technology. Our "dead stock" may also include important items that have been procured to support new systems which have yet to generate significant sales.

4. Objective IV: Maximize the Ability to Continue Normal Operations of the Deployed Site

a. Definitions Required

"Normal Operations" is defined as the requisitioning pattern experienced by the deployed stock point during the time prior to evacuation.

b. Measure of Effectiveness

Effectiveness in achieving this objective could be measured and expressed as a ratio comparing, across a universe defined by the material originally located at the site, the number of requisitions satisfied with the number of requisitions received.

c. Contribution to Overall Goal

Selection based on this objective would include items which have been frequently ordered by local forces, but it is a backward-looking goal which assumes that the mix and utilization of forces does not change from previous levels in the new operating environment. Pursuit of this objective is not attempted within the proposed model.

5. Objective V: Preserve Items Which Are Not Otherwise Readily Available

a. *Definitions Required*

None.

b. *Measure of Effectiveness*

This objective could be measured by a ratio comparing the number on hand for each item at the deployed site with the total quantity available in the wholesale supply system for that particular item. A threshold statistic could be established, and success might be measured in terms of the percentage of items exceeding the threshold evacuated.

c. *Contribution to Overall Goal*

This objective seems to capture some sense of the true scarcity or value of an item. For example, if the majority of the supply system's stock of an asset were situated at the forward-deployed site it seems reasonable to save that item. By selecting items which relate to unique operations supported by the inventory, it would bear directly on needs of the operational commander. It could, on the other hand, select for relocation items which support systems that are no longer in operation anywhere and should have been scrapped or otherwise disposed of at some earlier time

Pursuit of this objective may also have produce reductions in the supply system's procurement requirements for hard-to-get material. It is an important feature in the operation of the model.

6. Objective VI: Save All Material Associated With Designated Systems

a. *Definitions Required*

None.

b. Measure of Effectiveness

The measure of effectiveness for this objective would be the number of items saved which relate to a designated system. This measure could be computed for individual systems or summed over all designated systems.

c. Contribution to Overall Goal

Under this system, the decision-maker would provide a list of systems for which supply support is to be maximized. The inventory for the first system would be saved, then the second, and so on down the list until the available lift resources have been used up. This method has intuitive appeal, in that it appears to have achieved a direct correlation between what the operational commander needs with what is actually saved. It makes sense for the commander to tell us what his top priority items are so that they can be saved first.

As the logistician proceeds further into the list this method becomes less sound. Are minor parts for system five more important than major components for system six? Should all resources be allocated among the first five systems and none on the remainder? It becomes clear when examining this alternative that the central problem is resource allocation, not simply the ranking of individual line items of inventory.

One important effect of planning with this objective in mind, however, is the development of lists of systems, or classes of parts which may be excluded from the allocation decision. Used in this way, the ranking methodology finds constructive expression at the extremes of the decision, where it can contribute realistic constraints to the analysis. The objective is used for this purpose within the model.

7. Objective VII: Preserve Classified and Developmental Material

a. Definitions Required

"Classified material" represents that stock which is held secret by the United States for security reasons. It is identified by any one of seven physical security codes in the records of the Navy's inventory control system.

"Developmental material," also known as interim support material, represents items placed at stock points in support of new weapons systems which have not yet had the complete suite of logistics elements installed by the Navy. These items generally represent the latest technology and exist in very small numbers. They are identified within the Navy's inventory system by a unique management code.

b. Measure of Effectiveness

The measure of effectiveness required for the withdrawal of this group of material is binary. It has either been saved or not saved. In this respect it resembles a goal more than an objective.

c. Contribution to Overall Objective

This is an objective which is in the interest of national security and must be met. It is treated as a constraint in the analysis. The first efforts of a military evacuation should be expended in safeguarding that which is secret or developmental.

D. SYNTHESIS, TRADE-OFFS AND ALLOCATION

Every objective discussed above carries with it both contributory and antagonistic characteristics. The selection of items to be saved is achieved through a series of trade-offs among objectives in order to increase the probability that the correct mix of inventory has been preserved. The role of the decision maker is to apply his expert judgement in selecting features from each objective in the proper proportion to maximize the value of the inventory to be preserved. The role of the model is to array selection alternatives based upon the decision maker's alliance of criteria.

The decision maker must specify the resources he will make available to the project in terms of lift capacity and man-days allowed to complete the project. Holding these costs fixed will facilitate the decision-making process later by permitting the gains achieved by pursuing each objective to be measured against the same investment in time, money, men, and materials. Summary statistics derived from the application of the heuristic can be useful in the determination of whether the preserved inventory meets the final objectives of the planner; and the records of individual items selected can be applied to the tasks of producing picking tickets, shipping documents, and scheduling the work to be done during any actual relocation effort.

III. THE INVENTORY SELECTION TEMPLATE

The ability to distill hundreds of distinct categories of material into intuitively recognizable weapon system identities is crucial to the development of an inventory relocation decision support system. A program developed by James Lomanno at the Aviation Supply Office, Philadelphia, to collate individual spare part performance data and present it by aircraft type has been adapted as the basis for the assignment of parts to specific weapon systems. Each item was entered into a table which assigned it to a unique system or category. Where one part showed multiple applications, it was related to the system having the highest priority assignment.[7]

A. GENERAL FUNCTION

The inventory selection model is a framework of questions programmed in FOCUS, an interactive query language available at the Navy's Inventory Control Points. Direct access to inventory and other system files makes work with up-to-date information possible. The analyst may gain access to all required data on a real-time basis.

A series of decision rules is employed to select material based on the objectives defined above. The first step in the process is to define the universe of items to be considered by the model. This is done by segregating the items belonging to the activity

[7]The applications of spare and repair parts managed by the Aviation Supply Office are identified by special material identification codes embedded within individual stock records. The EA-6B Prowler has eight distinct codes; the F/A-18 Hornet, four; and so on. Additionally, the identities of individual item management desks and special management programs are coded within the stock record. Mr. Lomanno's table provides the flexibility to select based on aircraft, type of material, special interest program, or other specified category without having detailed knowledge of supply system coding.

whose inventory is to be stratified from the rest of the items managed by the wholesale supply system.

After the candidates for stratification have been identified, any constraints imposed by the policy maker are applied. The remaining material is grouped into logical processing categories as requested by the decision maker, and subjected to a battery of tests designed to screen items based on the following criteria; uniqueness or scarcity, contribution to the repair of weapon systems, and volume of use within the supply system.

B. OPERATION OF THE MODEL

1. Logical processing groups

A logical processing group is a user defined category which becomes the basis for stratification of an inventory in order to support the execution of the operational support model. It is a grouping of similar systems or classes of material according to any criterion set by the user. The only constraint for assignment is that one system may not exist simultaneously in more than one logical group. The use of these groups allows managers not familiar with the computer program to easily define the arguments which will be used to array the inventory and assist in making large order-of-magnitude decisions about which types of material are to be preserved.

2. Opportunity Cost

The opportunity cost of an inventory relocation decision may be represented as the value associated with the use of the material left behind. If the operational commander is unable to execute his mission because of degraded equipment, which could have been repaired using the inventory left behind, the opportunity cost is very high. Indeed, if the logic is pursued to its ultimate state, the opportunity cost becomes the value of freedom lost due to defeat in battle. The aim of the inventory selection model is to balance the various objectives in order to minimize the opportunity cost associated with that segment of the stock point's inventory left behind. Within the model, surrogates for opportunity cost are interpreted in light of an item's contribution to the performance of maintenance on specified systems; the item's scarcity; or business volume within the supply system.

C. DECISION RULES

The model performs some tests during its operation which must be understood before a review of its application to a specific data set is undertaken. Where applicable, a default parameter has been set to work in a generalized case. The analyst may tailor the parameters to coincide with the choices made by the decision maker in any application of the model to actual circumstances.

1. Test For Uniqueness (U-TEST)

U-TEST is designed to identify those items of inventory unique (or nearly so) to the affected stock point. The test figure is computed by dividing an estimate of the on-hand quantity for each asset at the stock point by the wholesale system asset quantity. The ratio which will qualify an item for evacuation is a parameter which should be reviewed prior to executing the program. Default values for this test are set at 0.50 for consumables and launching accessories, or 0.33 for repairables and Naval Air Systems Command-managed end items.

2. Long-Supply Test

The long-supply test is designed to identify items which have low opportunity costs by virtue of their overabundance within the supply system. The test is achieved by matching a candidate item with the wholesale supply system file identifying items in long supply.

3. Value of Annual Demand Test

The value of annual demand test attempts to approximate the opportunity cost of an item over all its applications throughout the supply system. By combining price and volume data, it arrays for the decision maker items which comprise a significant portion of the Navy's spares input to the maintenance of weapon systems. Default settings for the value of annual demand test are observed value of annual demand ≥ $1Million for consumables, or observed value of annual demand ≥ $100,000 for repairables and other items.

IV. TESTING WITH NSD SUBIC BAY DATA

A. SCOPE OF ANALYSIS

Analysis was limited to the aviation portion of NSD Subic Bay's inventory to facilitate development of the model. Parameters of the model were selected such that material targeted for withdrawal would provide maximum benefit to the wholesale supply system, which could be expected to fill the gap in support until a new geographic support site could be established.

A hypothetical case was selected where the decision maker desired that all classified and interim support material be saved, that material associated with aircraft whose fleet introduction is not yet complete be given preference over items which support mature programs, and that visibility of major weapon systems be maintained throughout the selection process. Further, material with extremely high replacement prices was to be identified. Three days were allotted for the withdrawal. It was assumed that the stock point would be capable of processing 1,500 line items each day.[8]

1. Constraints

All classified and interim support material must be evacuated.

2. Logical Processing Groups

(1) Aircraft in Process of Fleet Introduction.
(2) Carrier-based Aircraft
(3) Electronic Warfare Aircraft
(4) Helicopters and Fleet Support Aircraft
(5) Anti-submarine Warfare Aircraft
(6) Armament and Launch Accessories

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[8]Discussions with planners at NSD Subic Bay indicate that normal daily throughput, including both receipts and issues, is approximately 2,500 line items per day. The figure was reduced for the evacuation study to compensate for the loss of civilian workforce.

(7) Support Equipment and Special Tools
(8) Obsolescent Aircraft

B. TEST PROCEDURE

Appendixes A through D contain information specific to the test of the model using NSD Subic Bay data. Appendix A displays the logical processing group assignments for the test of the model. Appendix B is a listing of files and data sources used in the execution of the model. Appendix C includes the parameters and test statistics used to tailor the model to the test case. Appendix D contains the source code for the FOCUS program.

Four tests were applied to each item of inventory in selecting candidates for withdrawal; two based on scarcity, one based on usage, and one based on historical cost. The qualification based on historical cost was applied as a result of the scenario chosen for the test. The other three qualifications are included in the structure of the model. Test parameters were developed after discussion with supply system managers at the Aviation Supply Office. An item was qualified for selection if it passed any one of the four tests.

C. TEST RESULTS[9]

The model recommended 4,600 line items for relocation, out of a population of 45,000 items within NSD Subic Bay's AVCAL.[10] Table 1 displays summary statistics by line item within logical group. All groups experienced an increase in proportion of items selected above their proportion to the overall population except group eight (obsolescent

---

[9]The outcomes presented in the thesis demonstrate the selection heuristic's ability to operate successfully using actual files and equipment at the Inventory Control Point. While the results may become a starting point for discussion to arrive at appropriate selection objectives, processing groups and test parameters, they may not represent optimal choices for evacuation.

[10]Aviation Consolidated Allowance List.

aircraft), which was excluded in its entirety; and group one (new aircraft), which includes a much larger number of minor repair parts than other groups because of recent changes to the method of supply support provisioning. Table 1 may be viewed as a report card for the performance of the model based on the objective to maximize or minimize support of designated systems.

TABLE 1

PROPORTION OF LINE ITEMS SELECTED[11]

CATEGORY	LINE ITEMS ALLOWED	PROPORTION OF TOTAL	LINE ITEMS SELECTED	PROPORTION SELECTED	CHANGE IN PROPORTION
1*	17,513	.3849	1,501	.3244	-16%
2	9,313	.2046	1,387	.2998	+47%
3	425	.0093	53	.0115	+24%
4	2,956	.0650	383	.0828	+27%
5	3,038	.0667	524	.1132	+70%
6	4,489	.0987	508	.1098	+11%
7	2,566	.0564	271	.0586	+04%
8	5,208	.1145	896**	.1622**	+41%**
TOTALS	45,503	1.0000	4,627	1.0000	------

* Category one material was exempted from the long supply test as future outfittings are expected to increase the need for those items.

** Not included in computation. Included for comparison only.

Table 2 further reveals the implications of the relocation decision guided by the test scenario stated above. It shows that given three days, NSD Subic Bay could likely save 12.5% of its items, representing 35.7% of the inventory's replacement cost and 40% of the stock point's annual business.

When the program is run using constraints based on the operational commander's preferences, a "scorecard" constructed similarly to Tables 1 and 2 may be produced, displaying outcomes for each measure of effectiveness. The decision maker would then

---

[11]Objective VI, save material associated with designated systems.

make his choice based on a realistic estimate of effectiveness measures explicitly stated. This scorecard approach is recommended by Quade for public sector decisions, where many aspects of a problem must be considered. It presents a disaggregated means of comparing impacts over several alternatives so that a decision maker may view competing alternatives in terms of their strengths and weaknesses according to several incommensurable measures of effectiveness.[12]

TABLE 2

SUMMARY PERFORMANCE DATA

MOE*	TOTAL	SELECTED	PERCENTAGE
REPLACEMENT COST OF INVENTORY[13]	$571.17 MILLION	$203.82 MILLION	35.7%
NUMBER OF LINE ITEMS[14]	45,000	4,600	10.2%
NUMBER OF ITEMS [15]	506,000	63,000	12.5%
VALUE OF ANNUAL DEMAND[16]	$6.52 BILLION	$2.61 BILLION	40.0%
UNIQUE LINE ITEMS SELECTED[17]	45,000	1,900	4.2%
CLASSIFIED AND INTERIM SUPPORT MATERIAL[18]	--------	-------------	100.0%

* Measure of Effectiveness

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[12]E.S. Quade, Analysis for Public Decisions, 2d. ed. (New York: North-Holland, 1982), pp 217-221.

[13]Objective II, maximize the dollar value of inventory saved.

[14]Objective I, maximize the number of items saved.

[15]Objective I.

[16]Objctive III, maximize effectiveness of the global supply system.

[17]Objective V, preserve items which are not otherwise readily available.

[18]Objective VII, preserve classified and developmental material.

V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

A. SUMMARY AND CONCLUSIONS

The objective of this thesis has been to develop a model which can display inventory relocation alternatives based on the preferences of the operational commander. The model uses the resources available at an Inventory Control Point (ICP) to build a table of outcomes which may assist the forward-deployed logistician in the preparation of contingency withdrawal plans.

Chapter II has presented the objectives, rationales, and measures of effectiveness which may be applied to the problem of inventory evacuation. Chapter III has discussed the general functioning of the model. Chapter IV has summarized the operation of the model using live data.

The model has successfully integrated data from several sources in the preparation of a scorecard to be evaluated by the decision maker, and has recommended a group of withdrawal candidates which embrace the parameters set in the test scenario. It operates with minimal guidance from the planner, while at the same time allowing the planner to vary selection parameters with relative ease. It can be a useful aid in the consideration of decision outcomes, and is ready for implementation.

B. IMPLEMENTATION

Further programming is required to move from the planning process to the execution of the contingency plan. Once the planner has approved the choice of inventory to be relocated, data from the model should be used in the preparation of redistribution orders from the Inventory Control Point to the Stock Point so that relocation could be carried out under existing supply system rules and procedures. This step is critical because the only substantial alternative to provide the lost services immediately following an evacuation will be to rely on the wholesale system. Evacuating the parts, although of primary importance, is only the first step. The value of the parts lies in their use. Visibility and control of the actual relocation within the wholesale supply system is crucial to the minimization of the time during which the parts which have been deemed critical are unavailable for use.

C. AREAS FOR FURTHER RESEARCH

There is a need for continuing research to discover an objective and measure of effectiveness which consolidate the several which the model attempts to balance. Further analysis of recommendations made by the model over many scenarios may reveal relationships between objectives that will permit a more precise approximation of inventory value and the construction of an item relocation scorecard.

A similar study of the relocation selection process should be undertaken for non-aviation segments of inventory at the forward-deployed stock point, so that decision makers may gain access to a more complete suite of alternatives concisely displayed.

Finally, research which examines the relationships among all activities at an overseas base should be attempted with the view toward integrating all functions in the development of an overall withdrawal contingency plan.

APPENDIX A: LOGICAL PROCESSING GROUPS DEVELOPED FOR THE SUBIC BAY TEST

(1) AIRCRAFT IN PROCESS OF FLEET INTRODUCTION.

- F/A 18
- AV-8B
- SH-60

(2) CARRIER-BASED AIRCRAFT

- A-6
- EA-6B
- E-2C
- F-14
- H-53*

*H-53 included because of mine warfare capability.

(3) ELECTRONIC WARFARE AIRCRAFT

- ELECTRONIC EQUIPMENT
- EP-3
- TACAMO

(4) HELICOPTERS AND FLEET SUPPORT AIRCRAFT

- C-2
- H-1
- H-2
- H-3
- H-46

(5) ANTI-SUBMARINE WARFARE AIRCRAFT

- P-3
- S-3

(6) ARMAMENT AND LAUNCH ACCESSORIES

•ARMAMENT
•COMMON AVIONICS
•LAUNCH AND RECOVERY **
•RADIOS

**Material managed by the Branch Aviation Supply Office.

(7) SUPPORT EQUIPMENT AND SPECIAL TOOLS

•AUXILIARY POWER UNITS
•METEOROLOGICAL EQUIPMENT
•PHOTOGRAPHIC EQUIPMENT
•SAFETY AND SURVIVAL EQUIPMENT
•SUPPORT EQUIPMENT:
AAM-60
CAT III-D
GENERAL SUPPORT EQUIPMENT
•SPECIAL-USE TOOLS

(8) OTHER AIRCRAFT

•AV-8A
•A-3
•A-4
•A-7
•C-130
•C-131
•C-135
•DRONES
•F-4
•F-5
•F-8
•GENERAL AIRCRAFT
•H-34
•H-50
•OTHER
•OV-10
•P-2
•S-2
•TRAINING DEVICES
•T-2
•T-34
•T-39

APPENDIX B: SOURCES OF DATA

(1) AVIATION SUPPLY OFFICE MASTER DATA FILE

The ASO Master Data File, which is updated quarterly, is the source of the following data:

- QUARTERLY DEMAND
- UNIT PRICE
- UNITS READY FOR ISSUE
- UNITS NOT READY FOR ISSUE
- PHYSICAL SECURITY CODES.

(2) AVIATION SUPPLY OFFICE DOCUMENT STATUS FILE

The ASO Document Status File, which is updated weekly, is the source of the following data:

- NUMBER OF BACKORDERED REQUISITIONS
- NUMBER OF REQUISITIONS HELD FOR ITEM MANAGER REVIEW.

(3) AVIATION SUPPLY OFFICE PLANNED PROGRAM REQUIREMENTS FILE

The ASO Planned Program Requirements File, updated as changes occur to site allowances, is the source of the following data:

- ITEMS LOCATED AT THE EVACUATION SITE (RANGE AND DEPTH)
- SPECIAL MATERIAL IDENTIFICATION CODE
- COGNIZANCE SYMBOL

(4) AVIATION SUPPLY OFFICE (UN)VALIDATED STRATIFICATION FILE

The ASO Stratification File is produced semi-annually in support of the budget process. Depending upon the time of the data request with respect to the annual budget cycle, data in this file may either be validated or in process of review. This file is the source of the following data:

•LONG SUPPLY DATA.

APPENDIX C: TEST STATISTICS AND PARAMETERS

(1) TEST STATISTICS

Test for Uniqueness (U-TEST)

U-TEST is the ratio of an approximation of the quantity on hand at the evacuation site with an estimate of the wholesale system quantity. It is derived in the following manner:

On Hand = Allowance quantity - (backorders + documents held for review).

Wholesale system = (Ready for Issue + Not Ready for Issue) +1*.

(2) PARAMETERS

U-TEST: 0.50 or greater for consumables and launch and recovery material
0.33 or greater for repairables and all other material.

VAD: $1,000,000 or greater for consumables and launch and recovery material
$ 100,000 or greater for repairables and all other material.

UNIT PRICE: $25,000 for consumables and launch and recovery material
$15,000 for repairables and all other material

*One is added to the estimated wholesale quantity to prevent the U-Test computation from having a denominator equal to zero.

APPENDIX D: FOCUS SOURCE CODE

```
EDIT ---- JXXXXXX.PPU00.PTFOC648.FOCEXEC(JEWELS) - 01.45 ----- COLUMNS 001 072
COMMAND ===>                                                  SCROLL ===> PAGE
****** ***************************** TOP OF DATA ******************************
000100 ************************************************************************
000200 **                                                                    **
000300 **                            FAMILY JEWELS                           **
000400 **                                                                    **
000500 **       JIM DIETZ                               JIM LOMANNO          **
000600 **           X2199                                   X6558            **
000700 **                                                                    **
000800 **                                                                    **
000900 **                                                                    **
001000 **                                 JIM MOCKUS X5818                   **
001100 **                                 KENT JONES X3528                   **
001200 **                                                                    **
001300 ************************************************************************
001400 ************************************************************************
001500 **                                                                    **
001600 **  LINES 19 THRU 25 OPEN FILES                                       **
001700 **                                                                    **
001800 ************************************************************************
001900 EX OFFLINE
002000 EX EXPAND
002100 EX PPRFILE

EDIT ---- JXXXXXX.PPU00.PTFOC648.FOCEXEC(JEWELS) - 01.45 ----- COLUMNS 001 072
COMMAND ===>                                                  SCROLL ===> PAGE
002200 EX IBMBX1
002300 EX DSFBB1
002400 EX DSFBD1
002500 EX UNVSTRAT
002600 ************************************************************************
002700 **                                                                    **
002800 **   LINES 31 THRU 53 ARE DEFINE STATEMENTS                           **
002900 **                                                                    **
003000 ************************************************************************
003100 EX JEWELSZ
003200 EX JEWELSSM
003300 EX JEWELSWP
003400 EX JEWELSWX
003500 EX JEWELSX
003600 EX JEWELSS
003700 EX BBDOC
003800 EX BDDOC
003900 DEFINE FILE PPR ADD
004000 TQTY/I10 = EDIT(QTY);
004100 END
004200 DEFINE FILE BX1 ADD
004300 DMD1/I10 = EDIT(QTRDMD);
```

```
EDIT ---- JXXXXXX.PPU00.PTFOC648.FOCEXEC(JEWELS) - 01.45 ----- COLUMNS 001 072
COMMAND ===>                                                  SCROLL ===> PAGE
004400 SPRICE/D10.2 = EDIT(STDPRICE);
004500 PRICE/D10.2 = SPRICE * .01;
004600 VAD/D14.2 = PRICE * DMD1 * .04;
004700 RFI1/I10 = EDIT(RFI);
004800 NRFI1/I10 = EDIT(NRFI);
004900 ASSETS/I10 = RFI1 + NRFI1 + 1;
005000 END
005100 DEFINE FILE UNX6 ADD
005200 LS/I8 = UDICI + UWD572;
005300 END
005400 *****************************************************************
005500 **                                                             **
005600 ** LINES 59 THRU 80 -- IDENTIFICATION OF RESTRICTED/CLASSIFIED ITEMS  **
005700 **                                                             **
005800 *****************************************************************
005900 MATCH FILE PPR
006000 BY NIIN
006100 IF UIC EQ 00651
006200 WRITE QTY ACFT TQTY
006300 RUN
006400 FILE BX1
006500 BY NIIN

EDIT ---- JXXXXXX.PPU00.PTFOC648.FOCEXEC(JEWELS) - 01.45 ----- COLUMNS 001 072
COMMAND ===>                                                  SCROLL ===> PAGE
006600 IF PSC EQ A OR B OR C OR D OR H OR S OR 7
006700 PRINT PSC PRICE
006800 AFTER MATCH HOLD AS AAA OLD-AND-NEW
006900 END
007000 DEFINE FILE AAA ADD
007100 EXVALUE/D15.2 = TQTY * PRICE;
007200 END
007300 TABLE FILE AAA
007400 PRINT NIIN QTY EXVALUE PRICE PSC BY ACFT
007500 COLUMN-TOTAL
007600 HEADING CENTER
007700 " "
007800 "CLASSIFIED/RESTRICTED ITEMS"
007900 " "
008000 END
008100 *****************************************************************
008200 **                                                             **
008300 ** LINES 86 THRU 109 -IDENTIFICATION OF O COG ITEMS            **
008400 **                                                             **
008500 *****************************************************************
008600 MATCH FILE PPR
008700 BY NIIN
```

```
EDIT ---- JXXXXXX.PPU00.PTFOC648.FOCEXEC(JEWELS) - 01.45 ----- COLUMNS 001 072
COMMAND ===>                                                  SCROLL ===> PAGE
008800 IF UIC EQ 00651
008900 IF COG EQ 0$
009000 PRINT TQTY ACFT WEAPONCAT
009100 RUN
009200 FILE BX1
009300 BY NIIN
009400 IF COG EQ 0$
009500 IF PSC NE A OR B OR C OR D OR S OR H OR 7
009600 WRITE PRICE
009700 AFTER MATCH HOLD AS BBB OLD-AND-NEW
009800 END
009900 DEFINE FILE BBB ADD
010000 EXVALUE/D15.2 = TQTY * PRICE;
010100 END
010200 TABLE FILE BBB
010300 PRINT NIIN TQTY PRICE EXVALUE BY ACFT
010400 COLUMN-TOTAL
010500 HEADING CENTER
010600 " "
010700 "OCOG ITEMS BY ACFT"
010800 " "
010900 END

EDIT ---- JXXXXXX.PPU00.PTFOC648.FOCEXEC(JEWELS) - 01.45 ----- COLUMNS 001 072
COMMAND ===>                                                  SCROLL ===> PAGE
011000 ***********************************************************************
011100 **                                                                   **
011200 ** LINES 116 THRU 137 ESTABLISH SUBIC BAY BACKORDER FILE             **
011300 **      . WITH DEFINE STATEMENTS --KNOWN AS 'BOFILE'                 **
011400 **                                                                   **
011500 ***********************************************************************
011600 MATCH FILE DSFBB
011700 BY DOCNR
011800 IF RIC EQ 00651
011900 PRINT NIIN QTY
012000 RUN
012100 FILE DSFBD
012200 BY DOCNR
012300 IF RIC EQ 00651
012400 PRINT NIIN QTY
012500 AFTER MATCH HOLD AS BACK OLD-OR-NEW
012600 END
012700 DEFINE FILE BACK CLEAR
012800 NIIN/A9 = IF E02 LT 'AAAAAAAAA' THEN E04 ELSE E02;
012900 QTY/A8 = IF E03 LT 'AAAAAAAA' THEN E05 ELSE E03;
013000 END
013100 DEFINE FILE BACK ADD
```

```
EDIT ---- JXXXXXX.FPU00.PTFOC648.FOCEXEC(JEWELS) - 01.45 ----- COLUMNS 001 072
COMMAND ===>                                                   SCROLL ===> PAGE
013200 BO/I10 = EDIT(QTY);
013300 END
013400 TABLE FILE BACK
013500 SUM BO BY NIIN
013600 ON TABLE HOLD AS BOFILE
013700 END
013800 *****************************************************************
013900 **                                                              **
014000 **  LINES 145 THRU 156 MATCH BOFILE AND SUBIC UNIQUE PPR FILE 'PPR1'  **
014100 **                ESTABLISHES AVCAL AND BACKORDER FILE FOR      **
014200 **                SPECIFIC AIRCRAFT CATEROGY KNON AS  'BO1'     **
014300 **                                                              **
014400 *****************************************************************
014500 MATCH FILE PPR
014600 BY NIIN
014700 IF UIC EQ 00651
014800 IF WEAPONCAT EQ &WEAPONCAT
014900 IF COG NE O$
015000 WRITE ACFT QTY COG SMIC WEAPONCAT TQTY
015100 RUN
015200 FILE BOFILE
015300 BY NIIN

EDIT ---- JXXXXXX.FPU00.PTFOC648.FOCEXEC(JEWELS) - 01.45 ----- COLUMNS 001 072
COMMAND ===>                                                   SCROLL ===> PAGE
015400 PRINT BO
015500 AFTER MATCH HOLD AS BO1 OLD
015600 END
015700 *****************************************************************
015800 **                                                              **
015900 ** LINES 162 THRU 173 PULLS ADDITIONAL DATA FOR BO1 FROM THE MDF **
016000 **                                                              **
016100 *****************************************************************
016200 MATCH FILE BX1
016300 BY NIIN
016400 IF WEAPONCAT EQ &WEAPONCAT
016500 IF COG NE O$
016600 IF PSC NE A OR B OR C OR D OR S OR H OR 7
016700 PRINT S12 PRICE VAD ASSETS
016800 RUN
016900 FILE BO1
017000 BY NIIN
017100 WRITE ACFT TQTY BO COG SMIC WEAPONCAT
017200 AFTER MATCH HOLD AS CAT1 NEW
017300 END
017400 *****************************************************************
017500 **                                                              **
```

```
EDIT ---- JXXXXXX.PPU00.PTFOC648.FOCEXEC(JEWELS) - 01.45 ----- COLUMNS 001 072
COMMAND ===>                                                  SCROLL ===> PAGE
017600 ** LINES 179 THRU 182 ESTABLISH U-TEST                                **
017700 **                                                                    **
017800 ***********************************************************************
017900 DEFINE FILE CAT1 ADD
018000 ASSET/I10 = TQTY - BO;
018100 PCT/D5.2 = ASSET/ASSETS;
018200 END
018300 ***********************************************************************
018400 **                                                                    **
018500 ** LINES 188 THRU 198 ARE LONG SUPPLY TEST--NOT USED FOR CAT 1 ACFT   **
018600 **                                                                    **
018700 ***********************************************************************
018800 MATCH FILE CAT1
018900 BY NIIN
019000 PRINT PRICE VAD COG ASSET PCT WEAPONCAT TQTY
019100 RUN
019200 FILE UNX6
019300 BY UNIIN AS 'NIIN'
019400 IF WEAPONCAT NE 1
019500 IF LS GT 0
019600 AFTER MATCH HOLD AS CAT2 OLD-NOT-NEW
019700 END

EDIT ---- JXXXXXX.PPU00.PTFOC648.FOCEXEC(JEWELS) - 01.45 ----- COLUMNS 001 072
COMMAND ===>                                                  SCROLL ===> PAGE
019800 ***********************************************************************
019900 **                                                                    **
020000 ** LINES 205 THRU 227 ARE SORT STATEMENTS FOR 1R/5R ITEMS IN SPECIFIC**
020100 **                    AIRCRAFT CATEORGY/S                             **
020200 **                                                                    **
020300 ***********************************************************************
020400 MATCH FILE CAT2
020500 BY NIIN
020600 IF COG EQ 1R OR 5R
020700 IF VAD GE 1000000
020800 WRITE VAD PRICE PCT ASSET TQTY COG WEAPONCAT
020900 RUN
021000 FILE CAT2
021100 BY NIIN
021200 IF COG EQ 1R OR 5R
021300 IF VAD LT 1000000
021400 IF PRICE GE 25000
021500 WRITE VAD PRICE PCT ASSET TQTY COG WEAPONCAT
021600 AFTER MATCH HOLD OLD-OR-NEW
021700 RUN
021800 FILE CAT2
021900 BY NIIN
```

```
EDIT ---- JXXXXXX.PPU00.PTFOC648.FOCEXEC(JEWELS) - 01.45 ----- COLUMNS 001 072
COMMAND ===>                                                   SCROLL ===> PAGE
022000 IF COG EQ 1R OR 5R
022100 IF VAD LT 1000000
022200 IF PRICE LT 25000
022300 IF PCT GE .50
022400 WRITE VAD PRICE PCT ASSET TOTY COG WEAPONCAT
022500 AFTER MATCH HOLD AS XXX OLD-OR-NEW
022600 END
022700 ************************************************************************
022800 **                                                                    **
022900 **  LINES 233 TO 241 COMPRESS/ORGANIZE HOLD FILE 'XXX'                **
023000 **                                                                    **
023100 ************************************************************************
023200 DEFINE FILE XXX CLEAR
023300 VAD/D14.2 = E02 + E09 + E16;
023400 PRICE/D10.2 = E03 + E10 + E17;
023500 PCT/D5.2 = E04 + E11 + E18;
023600 ASSET/I10 = E05 + E12 + E19;
023700 TOTY/I10 = E06 + E13 + E20;
023800 COG/A2 = IF E07 LT 'AA' THEN E14 ELSE E21;
023900 WEAPONCAT/A1 = IF E08 LT 'A' THEN E15 ELSE E22;
024000 END
024100 ************************************************************************

EDIT ---- JXXXXXX.PPU00.PTFOC648.FOCEXEC(JEWELS) - 01.45 ----- COLUMNS 001 072
COMMAND ===>                                                   SCROLL ===> PAGE
024200 **                                                                    **
024300 ** LINES 247 TO 278 DUPLICATE ABOVE FOR ALL OTHER COG ITEMS           **
024400 **                                                                    **
024500 ************************************************************************
024600 MATCH FILE CAT2
024700 BY NIIN
024800 IF COG NE 1R OR 5R
024900 IF VAD GE 100000
025000 WRITE VAD PRICE PCT ASSET TOTY COG WEAPONCAT
025100 RUN
025200 FILE CAT2
025300 BY NIIN
025400 IF COG NE 1R OR 5R
025500 IF VAD LT 100000
025600 IF PRICE GE 15000
025700 WRITE VAD PRICE PCT ASSET TOTY COG WEAPONCAT
025800 AFTER MATCH HOLD OLD-OR-NEW
025900 RUN
026000 FILE CAT2
026100 BY NIIN
026200 IF VAD LT 100000
026300 IF PRICE LT 15000
```

```
EDIT ---- JXXXXXX.PPU00.PTFOC648.FOCEXEC(JEWELS) - 01.45 ----- COLUMNS 001 072
COMMAND ===>                                                   SCROLL ===> PAGE
026400 IF COG NE 1R OR 5R
026500 IF PCT GE .33
026600 WRITE VAD PRICE PCT ASSET TQTY COG WEAPONCAT
026700 AFTER MATCH HOLD AS YYY OLD-OR-NEW
026800 END
026900 DEFINE FILE YYY CLEAR
027000 VAD/D14.2 = E02 + E09 + E16;
027100 PRICE/D10.2 = E03 + E10 + E17;
027200 PCT/D5.2 = E04 + E11 + E18;
027300 ASSET/I10 = E05 + E12 + E19;
027400 TQTY/I10 = E06 + E13 + E20;
027500 COG/A2 = IF E07 LT 'AA' THEN E14 ELSE E21;
027600 WEAPONCAT/A1 = IF E08 LT 'A' THEN E15 ELSE E22;
027700 END
027800 ******************************************************************
027900 **                                                              **
028000 **  LINES 285 TO 318 MATCH XXX AND YYY FILES INTO FINAL LIST    **
028100 **                AND DEFINE QTY FIELD                          **
028200 **                                                              **
028300 ******************************************************************
028400 MATCH FILE XXX
028500 BY NIIN

EDIT ---- JXXXXXX.PPU00.PTFOC648.FOCEXEC(JEWELS) - 01.45 ----- COLUMNS 001 072
COMMAND ===>                                                   SCROLL ===> PAGE
028600 PRINT VAD PRICE PCT ASSET TQTY COG WEAPONCAT
028700 RUN
028800 FILE YYY
028900 BY NIIN
029000 PRINT VAD PRICE PCT ASSET TQTY COG WEAPONCAT
029100 AFTER MATCH HOLD AS FINAL OLD-OR-NEW
029200 END
029300 DEFINE FILE FINAL CLEAR
029400 VAD/D14.2 = E02 + E09;
029500 PRICE/D10.2 = E03 + E10;
029600 PCT/D5.2 = E04 + E11;
029700 ASSET/I10 = E05 + E12;
029800 TQTY/I10 = E06 + E13;
029900 COG/A2 = IF E07 LT 'AA' THEN E14 ELSE E14;
030000 WEAPONCAT/A1 = IF E08 LT 'A' THEN E15 ELSE E08;
030100 END
030200 DEFINE FILE FINAL ADD
030300 QTY/I10 = ASSET;
030400 EXVALUE/D15.2 = PRICE * QTY;
030500 AVVALUE/D15.2 = PRICE * TQTY;
030600 END
030700 MATCH FILE FINAL
```

```
EDIT ---- JXXXXXX.PPUOO.PTFOC648.FOCEXEC(JEWELS) - 01.45 ----- COLUMNS 001 072
COMMAND ===>                                                    SCROLL ===> PAGE
030800 BY NIIN
030900 PRINT VAD PRICE PCT ASSET TOTY QTY EXVALUE AVVALUE
031000 RUN
031100 FILE PPR
031200 BY NIIN
031300 IF UIC EQ 00651
031400 IF COG NE 0$
031500 IF WEAPONCAT EQ &WEAPONCAT
031600 PRINT COG WEAPONCAT ACFT
031700 AFTER MATCH HOLD OLD-AND-NEW
031800 END
031900 ***********************************************************************
032000 **                                                                   **
032100 **    LINES 324 TO 356 ARE PRINT STATEMENTS                          **
032200 **                                                                   **
032300 ***********************************************************************
032400 TABLE FILE HOLD
032500 IF QTY NE 0
032600 PRINT NIIN
032700       TQTY AS 'AVCAL'
032800       QTY AS 'ONHAND'
032900       EXVALUE AS 'EXTENDED VALUE'

EDIT ---- JXXXXXX.PPUOO.PTFOC648.FOCEXEC(JEWELS) - 01.45 ----- COLUMNS 001 072
COMMAND ===>                                                    SCROLL ===> PAGE
033000       PCT AS 'U-TEST'
033100       PRICE
033200       VAD
033300       COG
033400       BY WEAPONCAT AS 'CATEGORY'
033500       BY ACFT
033600 ON WEAPONCAT SUB-TOTAL
033700 ON WEAPONCAT PAGE-BREAK
033800 HEADING CENTER
033900 " "
034000 "BALANCE OF ITEMS BY WEAPON CAT"
034100 " "
034200 END
034300 TABLE FILE HOLD
034400 SUM EXVALUE COUNT NIIN NOPRINT BY COG
034500 COLUMN-TOTAL
034600 HEADING CENTER
034700 " "
034800 "SUMMARY TOTALS"
034900 " "
035000 RUN
035100 SUM AVVALUE COUNT NIIN NOPRINT BY COG
```

```
EDIT ---- JXXXXXX.PFU00.PTFOC648.FOCEXEC(JEWELS) - 01.46 ----- COLUMNS 001 072
COMMAND ===>                                                  SCROLL ===> PAGE
COLUMN-TOTAL
HEADING CENTER
" "
"SUMMARY TOTALS"
" "
RUN
IF EXVALUE LT 0
SUM EXVALUE COUNT NIIN NOPRINT BY COG
COLUMN-TOTAL
HEADING CENTER
" "
"ADJUSTMENT OF EXVALUE"
" "
END
EX SENDOFF
****** ***************************** BOTTOM OF DATA ******************************
```

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Thesis
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A template for the selection and array of inventory as an aid in the development of evacuation plans.