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ESSENTIALITY WEIGHTING MODELS FOR
WHOLESALE LEVEL INVENTORY MANAGEMENT

by

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Item essentiality is currently determined in the U.S. Navy using an integer valued Item Mission Essentiality Code (IMEC). Unfortunately, this ordinal coding scheme does not provide a means of determining how much more important an item with, say, an IMEC value of 4 is over an item with an IMEC value of 1. In addition, the Navy's wholesale level inventory models have no way of using these code values in determining spare and repair part inventory levels. An essentiality parameter E does exist in these models but the Navy has not developed a way to convert IMEC values into E values. This thesis proposes four models for providing this conversion. These models incorporate ideas obtained from interviews with inventory management personnel at the Navy's Inventory Control Points. Implementing one of these models in conjunction with the other recommendations presented in this thesis would result in stocking policies which better relate to the operational effectiveness for items stocked by the Navy's wholesale supply system.

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Essentiality Weighting Models for Wholesale Level Inventory Management

by

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ABSTRACT

Item essentiality is currently determined in the U. S. Navy using an integer valued Item Mission Essentiality Code (IMEC). Unfortunately, this ordinal coding scheme does not provide a means of determining how much more important an item with, say, an IMEC value of 4 is over an item with an IMEC value of 1. In addition, the Navy's wholesale level inventory models have no way of using these code values in determining spare and repair part inventory levels. An essentiality parameter E does exist in these models but the Navy has not developed a way to convert IMEC values into E values. This thesis proposes four models for providing this conversion. These models incorporate ideas obtained from interviews with inventory management personnel at the Navy's Inventory Control Points. Implementing one of these models in conjunction with the other recommendations presented in this thesis would result in stocking policies which better relate to the operational effectiveness for items stocked by the Navy's wholesale supply system.

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I. INTRODUCTION

A. BACKGROUND

Current stocking levels for items within the Navy's wholesale supply system are calculated by wholesale inventory models. These models, developed in the late 1960's/early 1970's, contain a factor for item essentiality that should reflect the importance of each item in relation to its subsequent system as a whole. Department of Defense (DOD) inventory policies require the use of these item essentialities in the determination of spare and repair part inventories at both the wholesale and retail levels. [Ref. 1:p. 2] In this manner, the stocking level of each item is (or should be) partly based on its essentiality to all systems of which the item is a part or component. The problem with this process is that, up to now, the essentiality factor in these Navy wholesale models is given a constant value for all items. The result is that the stockage models ignore essentiality.

Each item in the Navy's wholesale system does receive an essentiality measure known as an IMEC (Item Mission Essentiality Code). IMEC's range on a scale of 1 to 5 with 5 reflecting the highest essentiality. This IMEC is developed from the combination of two additional codes: the MEC (Military Essentiality Code); and the MCC (Mission

Criticality Code). MEC's denote the essentiality of a part to its applicable end item. [Ref. 2:p. 2-24] MEC's currently can have values of 1, 3, 5, and 7, with 1 and 5 having the highest essentiality. MCC's denote the criticality of an end item to the overall mission of the system. [Ref. 2:p. 2-24] MCC's range from 1 to 5, 5 being the most critical. All combined, these three codes form a basis for an item's essentiality. (Chapter II will discuss how these codes are assigned in detail.)

Unfortunately, none of the essentiality codes just mentioned actually reflect how much more essential one item is over another. For example, is an item with an IMEC of 5 twice as essential as an item with an IMEC of 4, or is it 20 times more essential? Since this question currently cannot be answered, the essentiality factor used in the Navy's wholesale inventory levels-setting models is basically ineffective. Instead, as mentioned above, the essentiality factor in the Navy's wholesale models is set at a constant value. Therefore, it does not adequately reflect essentiality in the calculation of stocking levels.

B. THESIS OBJECTIVE

This thesis proposes four models for essentiality weighting based on the three essentiality codes (MEC's, MCC's, and IMEC's) that can be used in the wholesale inventory models for determining stocking levels. These models evolve from evaluating the management emphasis placed on items with different essentiality codes at both the Ships Parts Control Center (SPCC) and the Aviation Supply Office (ASO), and by studying the current procedures for assigning the three essentiality codes. The implications of implementing any of the models would be a stocking policy which better relates to the operational effectiveness for items stocked by the Navy's wholesale supply system.

C. SCOPE OF THESIS

This thesis is limited to the study of the current procedures for assigning essentiality codes, and the evaluation of management practices, policies, and opinions with respect to essentiality codes at the Navy's Inventory Control Points. It does not attempt to determine if the assignment of the current essentiality codes is correct.

D. PREVIEW OF SUBSEQUENT CHAPTERS

Chapter II will first provide more insight into the use of the essentiality factor in the wholesale inventory models and why this factor is important. It will then describe the essentiality assignment process in detail for MEC's, MCC's, and IMEC's. Finally, Chapter II will address the current approach used at SPCC and ASO to weight stockage levels by essentiality.

Chapter III will present the four different essentiality weighting models that have been proposed by the author and by personnel interviewed at SPCC and ASO. It also discusses a proposed method for implementation of these models.

Chapter IV will provide conclusions on the use of essentiality codes/weights in the Navy's wholesale inventory models, and will summarize some of the problems expected to be encountered with their use. It will also provide recommendations for improvements in essentiality weighted inventory models and areas for further study.

The appendices provide copies of relevant DOD and Chief of Naval Operations (OPNAV) instructions as well as excerpts from tables used to compute various essentiality codes.

II. ESSENTIALITY ASSIGNMENT AND CURRENT MODEL

This chapter first provides a brief background and example of where and how the essentiality factor fits in the wholesale inventory models. It then discusses the essentiality assignment process for MEC's, MCC's, and IMEC's. Finally, this chapter presents the current approach used at SPCC and ASO to calculate essentiality weighted stockage levels.

A. THE ESSENTIALITY FACTOR IN THE INVENTORY MODELS

To provide an example of where the essentiality factor fits in the wholesale inventory models, consider the Navy's Uniform Inventory Control Point (UICP) Consumables Inventory Model. The objective of the consumable model is to determine how much stock to buy and when, which will minimize the total expected or average annual variable costs of ordering and holding inventory, subject to a constraint on time-weighted, essentiality-weighted requisitions short (backorders). Mathematically, this is equivalent to:

$$\text{Minimize } TVC = OC + HC + \beta RS$$

where: TVC = Total average annual variable costs.

OC = Average annual variable order costs.

HC = Average annual variable holding costs.

ßRS = Time-weighted, essentiality-weighted shortage (backorder) cost.

ß = Shortage cost. (Most all Naval Supply Systems Command (NAVSUP) publications use the Greek letter lambda (λ) as the symbol for shortage cost. In this case, the Greek letter beta (ß) is used because lambda was not available as a character in the software package used to type this thesis). [Ref. 2:p. 3-A-3 & 4, and Ref. 3]

The term ßRS is where the essentiality factor is applied. Through various mathematical assumptions and procedures, ßRS is expressed as the following:

$$ßRS = (ß\mathbf{E}/SQ) \int_R^{\infty} (x-R)[F(x+Q;L)-F(x;L)]dx$$

where: ßRS = Time-weighted, essentiality-weighted average annual shortage costs for an item.

ß = Time-weighted shortage cost for a backordered requisition for an item.

E = Essentiality factor for an item; currently assumed to be between 0.0 and 1.0.

S = Average number of units per requisition for an item.

Q = Economic reorder quantity for an item.

R = Reorder point for an item.

x = Number of units of the item demanded over procurement leadtime.

L = Procurement leadtime for an item.

F(x;L) = Probability distribution function for leadtime demand for an item. [Ref. 2:p. 3-A-4 & 5, and Ref. 3]

Taking the partial derivative of the TVC equation with respect to R, an expression for Risk, or the probability of a stockout during L, is obtained:

$$\text{Risk} = P(x>R^*) = (DIC)/(DIC+\beta FE)$$

where: $P(x>R^*)$ = Probability that leadtime demand for an item is greater than the optimal reorder point (R^*) for the item.

D = Average quarterly demand for an item.

I = Holding cost rate per year (constant = .23 for consumables).

C = Unit cost for an item.

F = Quarterly requisition frequency for an item. [Ref. 2:p. 3-A-7, and Ref. 3]

Currently, the essentiality factor (E) in these equations is a constant set equal to 0.5 for all SPCC managed items and 0.01 for all ASO managed items. Therefore, E is basically ignored. In order for E to be utilized as it was meant to be, each item should have an essentiality value that discriminates how much more or less important it is relative to other items.

B. ESSENTIALITY CODE ASSIGNMENT PROCESS

This section describes the details of the assignment of the three essentiality codes currently used in the Navy's inventory system: Military Essentiality Codes (MEC's); Mission Criticality Codes (MCC's); and Item Mission Essentiality Codes (IMEC's).

1. Military Essentiality Codes (MEC's)

The assignment of MEC's is basically the same for both SPCC and ASO. MEC's denote the essentiality of a part to its applicable end item. From Appendix A, a Naval Supply Systems Command (NAVSUP) letter with enclosures which formally defines each MEC and explains the MEC assignment procedures in detail:

> This code (MEC) indicates the degree to which unavailability of a replacement for an installed item when needed to perform corrective maintenance affects the ability of the end item (e.g., radar set, fire control system, electrical generator) to perform its primary function in the intended manner. The need to perform corrective maintenance is normally the result of failure of an item and so essentiality is commonly evaluated in the context of item failure, but it must be remembered that some parts may be needed for replacement owing to their use when replacing other failed parts (e.g., gaskets).

When MEC's were first developed, there were only three categories: MEC 1, 3, and 5. MEC 1 meant the item was essential to the end item. MEC 3 meant the item was not essential to the end item. MEC 5 meant the item was essential to the end item due to safety reasons. As time progressed, it became obvious that the vast majority of items (up to 99%) were being coded as a MEC 1. [Ref. 4:p. 3] Another problem was there was no standard in-depth methodology published or implemented to actually assign MEC's. Even one of the primary documents that was supposed to be used for MEC assignments, MIL-STD-1388-2A, DOD Requirements for a Logistic Support Analysis Record (LSAR) dated 20 July, 1984, was confusing and incomplete. It has only one small section (less than a page) on MEC assignments.

As a result, the NAVSUP letter presented in Appendix A was written. It is intended to amplify MIL-STD-1388-2A. This letter explains in detail the definitions of MEC's and the procedures for MEC assignment. As presented in MIL-STD-1388-2A, it also provides for one additional MEC of 7 that allowed for gradual deterioration of a part. MEC 7 provides an alternative to assigning an MEC of 1.

MEC's, according to Appendix A, are to be assigned in the provisioning process by the contractor and the appropriate Hardware Systems Command (HSC). The two major HSC's are the Naval Air Systems Command (NAVAIR) and the Naval Sea Systems Command (NAVSEA). The MEC assignment is based on the results of the Failure Modes, Effects, and Criticality Analysis (FMECA, MIL-STD-1629A). As Appendix A states:

Accordingly, this letter requests that the Navy Hardware Systems Commands invoke the requirement for assignment of MIL-STD-1388-2A Military Essentiality Codes (MEC's) of reference (b) in accordance with the guidance contained in enclosure (1). These MEC assignments should be included in the provisioning process for all systems acquisitions for which a contract has not already been awarded. Where a contract has already been awarded every effort should be made to modify the contract to require the more stringent enclosure (1) requirements.

For systems designed and produced prior to this procedure, MEC's were similarly assigned but the procedure was not as difficult due to only three MEC's being possible for assignment. The MEC's for these systems will remain at their currently assigned values as it would be to expensive to attempt to change them. [Ref. 5]

Although the process explained in Appendix A is the approved methodology for assigning MEC's, improvements continue to be made. Although not yet approved, additional MEC's have been defined and a flow chart developed to improve the assignment process. During the Readiness Based Sparing (RBS) Experiment for DDG-52 (USS JOHN BARRY, second ship of the new ARLEIGH BURKE class of DDG's), the Naval Sea (NAVSEA) Logistics Center in Mechanicsburg, PA, further defined each MEC as follows (see Appendix B, the actual Working Paper for the RBS Experiment for DDG-52):

MEC 1: Failure of this part will immediately render the end item inoperable.

MEC 3: Failure of this part will not render the end item inoperable since the function of this part is not associated with a primary mission.

MEC 5: Failure of this part will create an immediate potential for the person operating or maintaining the end item to risk injury or death.

MEC 7: Failure of this part occurs gradually and the degradation of performance is observable and measurable and when fully failed will render end item inoperable.

MEC 8: Failure of this part limits the capability of the end item, since redundancy permits the end item to continue to function but with reduced capability.

MEC 9: Failure of this part will not immediately affect the performance of the end item nor will failure immediately reduce the capability of the end item because of redundant design or alternatives.

The definitions of MEC's 1, 3, 5, and 7 are basically the same as in Appendix A but two additional MEC's, 8 and 9, have been added. The issue behind the addition of these two new MEC's was primarily redundancy at the item level. During the RBS Experiment for DDG-52, it was discovered that there really were two separate categories within MEC 3 and two separate categories within MEC 7. MEC 3 and MEC 7 both included the possibility of redundancy at the item level. Rather than make two subcategories within each of these MEC's (i.e., 3A and 3B, or 7A and 7B), it was decided to separate these categories into two new MEC's. As a result, MEC 8 was split out from the original MEC 7, and MEC 9 was split out from the original MEC 3. [Ref. 5]

The new order of MEC importance that includes the two new MEC's, in descending order, is:

MEC 5, MEC 1, MEC 8, MEC 7, MEC 9, MEC 3
[Appendix B]

Another outgrowth of the RBS Experiment on DDG-52 was the development of a flow chart to assist pro sioners and the HSC's in assigning these MEC's.

An in-depth explanation of these revised MEC's along with the flow chart is given in Appendix B. Since this is the most current explanation of MEC's, it forms the basis for the development of the essentiality weighting models to be presented in Chapter III.

There are two major problems in assigning MEC's. First, the provisioners that are assigning MEC's must have an intimate knowledge of the interactions of the parts and components of the system. Otherwise, the entire MEC assignment process will be faulty. Second, the minimum level of acceptable performance must be defined for each system. The provisioners need to know what is the fully functional state of the system. This must be used as a baseline for MEC assignment. [Ref. 5]

2. Mission Criticality Codes (MCC's)

MCC assignment is different for SPCC and ASO, therefore each method will be addressed separately. In addition, ASO has different definitions for its MCC's, which range from 1 to 5, vice 1 to 4 as with SPCC.

MCC's denote the criticality of a system, equipment, or component to the mission of the military unit in which the system, equipment, or component is installed. [Ref. 2:p. 2-46]

a. Ships Parts Control Center (SPCC) MCC Assignment

Appendix C contains enclosures (2) through (5) from Reference 1 which explain the current MCC assignment process in detail for each different equipment/system circumstance. MCC's for SPCC range from 1 to 4, 4 being the most critical. There are three basic procedures used to assign MCC's depending on where the system is in its life cycle.

The most common procedure utilizes data from the maintenance history of a system. This procedure assigns MCC's based on the Casualty Report (CASREP) history of systems. A CASREP is a report from an operational unit to higher authority informing them of an equipment related problem that prevents the unit from performing one or all of its missions. A C4 CASREP is the most severe, with C3, C2, and C1 CASREPs following in decreasing order of severity. (An example of a C4 CASREP on a ship would be loss of a main propulsion engine or steering gear while at sea.)

The MCC assignments made using this procedure are as follows:

MCC 4: The ratio of C3 and C4 CASREPs to C2 CASREPs is at least one to five, and the ratio of C4 to C3 CASREPs is at least one to three.

MCC 3: The ratio of C3 and C4 CASREPs to C2 CASREPs is at least one to five, but the ratio of C4 to C3 CASREPs is less than one to three.

MCC 2: The ratio of C3 and C4 CASREPs to C2 CASREPs is less than one to five.

MCC 1: No CASREP history. [Ref. 2:p. 2-47]

A second procedure utilizes a file called the Mission Criticality Code Matrix File (MCCMF). "This file, approved for development by NAVSEA in 20 November 1981, currently exists for the majority of active fleet ships and links Equipment Identification Code (EIC) to MCC to ship, ship type and/or class." [Appendix C] This file is basically a master historical MCC file that lists all known SPCC managed systems by EIC and their resulting MCC's by ship type. An example of this file is contained in Appendix D. To obtain the MCC of a critical part from the MCCMF, simply find the EIC or the EIC nomenclature for the system that the part belongs to and assign the largest MCC in the row of MCC's corresponding to that EIC. (The largest MCC in the row is selected since a part can have only one MCC and the most serious situation is the one that should be represented.) [Refs. 5 and 6]

A third procedure is to use a matrix chart to determine the MCC's. The matrix chart, developed by a Naval Material Command (NAVMAT) Working Group and approved by the Office of the Secretary of Defense in October, 1981, is based on the system's number of alternate and/or redundant systems, and the impact upon the overall mission if these alternatives fail. Table 1 presents this chart. [Ref. 1:encl. (1), p. 1]

TABLE 1: MATRIX FOR ASSIGNING MCC'S

Alternatives for Mission Accomplishment			Impact if All Alternatives Fail
Redundant systems/ equipments/ components available.	Alternatives (excluding redundancies) available.	Neither redundancies nor other alternatives available.	
3	4	4	Total loss of mobility (propulsion or life support).
2	3	4	Severe degradation of mobility or total loss of a primary mission.
1	2	3	Severe degradation of a primary mission.
1	1	2	Total loss or severe degradation of a secondary mission.
1	1	1	Minor mission impact.

[Ref. 1:encl. (1) p. 1]

When MCC's were first developed, every system in the Navy's inventory required their assignment. The CASREP ratios, based on historical CASREP data, were provided to facilitate MCC assignment for all of the Navy's systems that had been operating for over three or four years. Obviously, this method is dependent upon the accuracy of the CASREP reporting system. Also there is no time limit on measuring the CASREP ratios for MCC's. Therefore, MCC's assigned using this method are "life-cycle" MCC's (i.e., all maintenance history available is utilized). [Refs. 5 and 6]

For relatively newer systems or systems that are undergoing configuration changes, alterations, or equipment changes, the MCCMF procedure is used when possible. All systems that fit in these categories are screened against the MCCMF to determine if an MCC already exists that can be assigned. If so, this is the MCC that is assigned. For example, if an updated circuit board was installed in the AN/SLQ-32(V)3 countermeasures set (EIC N87K), from Appendix D, the new MCC for that circuit board would be 4, the largest MCC in that particular EIC's row.

For new construction and major conversion systems, neither the MCCMF nor the CASREP ratios can be utilized. Therefore, using contractor data, maintenance and repair analysis data, and reliability block diagram data (showing redundancy and alternative systems), the matrix chart shown in Table 1 is utilized to assign MCC's.

Basically, if an item is on a reliability block diagram, then it may be critical and can be an MCC 1, 2, 3, or 4. If it is not on a reliability block diagram, it is not critical and is limited to an MCC of 1 or 2. The ship's/unit's mission is then considered along with redundancy and alternatives (and the sufficiency of the redundancy and alternatives) and an MCC is selected from the MCC matrix chart. [Refs. 5 and 6]

One problem that became apparent during this study is that a final step in the MCC assignment process should be to verify the current MCC's assigned periodically using the historical CASREP data and their related ratios. To date, only about 50% of the items managed by SPCC have been verified. However, the NAVSEA Logistics Center in Mechanicsburg has one person totally dedicated to MCC verification and the process is continuing at SPCC. [Ref. 5]

b. Aviation Supply Office (ASO) MCC Assignment

The MCC assignment process at ASO is different from SPCC's process. The main reason for the difference is explained by the way that systems, specifically weapons systems, are defined. At SPCC a system could be defined as any major component of a larger system, with a large number of systems onboard a ship or unit. At ASO the system is basically defined as the aircraft itself, made up of many different components. This is a simplistic view of the differences between SPCC and ASO but it will suffice for this study.

MCC's were developed for ASO on contract by the Naval Air Development Center (NADC) in Warminster, Pennsylvania. MCC's for ASO range from 1 to 5 with 5 being the most critical. The approved definitions for these five MCC's are:

MCC	Definition
5	Not safely flyable/Not Mission Capable (NMC).
4	Severe degradation of mission capability.
3	Not capable of performing all assigned missions but can perform at least one mission.
2	Full Mission Capable (FMC).
1	Optimum Performance Capability (OPC).

[Ref. 2:p. 2-39]

There are basically two procedures for assigning MCC's at ASO. Both methods utilize these same definitions and explanations. The use of a particular method depends on where the aircraft is in its life cycle (the same philosophy as SPCC's different methods).

The first procedure is used to assign MCC's to established systems (systems that have been in service for a number of years) and have an established maintenance record. It utilizes the 3-M Maintenance Data Collection System (MDCS) and the VIDS/MAF (Visual Identification Display System/Maintenance Action Form, OPNAV 4790/60) to obtain Equipment Operation Capability (EOC) codes on failed equipment. [Ref. 7]

EOC codes indicate the impact of a failure/removal of a subsystem or part on the mission of the aircraft. The procedures for assigning EOC codes are contained in Reference 8, OPNAVINST 5442.4L, commonly called the MESM (Mission-Essential Subsystems Matrices). From OPNAVINST 5442.4L [Ref. 8:p. 2]:

> EOC codes relate a particular system/subsystem within a Type/Model/Series of equipment (aircraft) to a specific mission. EOC codes have three positions. The first position is an alpha character which describes mission capability. The last two positions are the first two numeric characters of the Work Unit Code (WUC) which identify the system/subsystem impairing mission capability. [Ref. 8:p. 2]

Basically, each system installed on an aircraft is given an EOC code that indicates its effect on the mission of the aircraft if that system fails. The MESM provides an EOC code for each piece of equipment on an aircraft. An example of how the MESM works to assign an EOC code is contained in Appendix E, an excerpt from the MESM for the F/A-18 Hornet aircraft. From Appendix E, if the radar liquid cooling system is inoperative, an EOC code (alpha character) of J is assigned.

The VIDS/MAF form, while primarily used as a maintenance action document, also relates NSN's (National Stock Numbers) or part numbers to EOC codes for the purposes of MCC assignment. Appendix F is a copy of a VIDS/MAF form. Block 19 contains the part number (or NSN) and blocks B16 and B27 contain the EOC code that is assigned by the MESM to the equipment as a result of its failure. This relates the part number to this EOC code. [Ref. 7 and 9]

Each part now has an EOC code assigned to it for that particular aircraft. However, since a part may be utilized on several different aircraft, it is possible for that one part to have several different EOC codes assigned to it. Therefore, it is necessary to condense these different codes into one overall EOC code for each part. This is done by utilizing a frequency distribution developed by NADC. This distribution assigns a relative weight to each EOC code assigned to a part, and then produces one general overall EOC code that is assigned to the one part number. [Ref. 7]

For example, from Appendix E the magnetic compass on the F/A-18A/B is assigned an EOC code of B. A component part in this magnetic compass would also have an EOC code of B. However, this ame part may be used in another magnetic compass on a different aircraft and be assigned an EOC code of C. The frequency distribution may weight the EOC code of B with .8 and the EOC code of C with .2 for that particular part. The resulting part's overall EOC code would then be B.

At this point, each part number has one particular EOC code assigned to it. The MCC can now be easily determined from the following chart contained in Reference 2:

EOC	Readiness Category	MCC Assigned
Z	Not Mission Capable(NMC)/Not Safely Flyable	5
J-L	Partial Mission Capable (severe)	4
C-H	Partial Mission Capable (PMC)	3
B	Full Mission Capable (FMC)	2
A	Optimum Performance Capability (OPC)	1

[Ref. 2:p. 2-40]

The second method used to assign MCC's, which has just recently been formalized by NADC, is for systems that are new and have no or at least very little maintenance data history available. This procedure utilizes engineering design data taken from Failure Modes, Effects, and Criticality Analysis (FMECA, MIL-STD-1629A), Logistic Support Analysis Record (LSAR, MIL-STD-1388-2A), and the Maintenance Plan Analysis (MPA) for Aircraft and Ground Equipment (MIL-STD-2080AS). [Ref. 7] This data is used to determine the rules for:

- Mission Phase Code (MPC): Identifies the mission phase/operational mode in which a failure occurs.
- Safety Hazard Severity Code (SHSC): Identifies worst potential consequences of item failure in four categories: catastrophic (SHSC=1), critical (SHSC=2), marginal (SHSC=3), and minor (SHSC=4).
- Failure Mode Criticality Number (C_m): Criticality number for a specific failure mode within an SHSC category and MPC.
- Item Criticality Number (C_r): Number of system failures of a specific type expected due to the

item's failure modes. It is the sum of the C_m values for each combination of SHSC and MPC for the item. [Ref. 7]

The MCC for a new system is a function of MPC, SHSC, C_m, C_r, the maintenance concept, maintainability, and comparative logistic delays. Without going into too much detail, MCC's are assigned based on the SHSC having the greatest C_r weighted by estimated downtimes (downtime being defined as the total time the system is not functioning due to a failure, including supply, logistics and administrative time delays). For example, if a system had three C_r's of 10, 20, and 30 failures each weighted by a downtime of 10 hours, then the C_r's weighted by downtimes for this system would be 100, 200, and 300 failure-hours. Then, if these three C_r's of 100, 200, and 300 failure-hours had corresponding SHSC values of 4, 3, and 2, respectively, then the greatest C_r weighted by downtimes is 300 failure-hours which corresponds to an SHSC value of 2. An SHSC value of 2 crosses to an MCC of 4 using the following chart:

SHSC	MCC
1	5
2	4
3	3
4	1

This chart was developed by NADC and purposely skips an MCC of 2 due to not enough differences between the definitions of SHSC's 3 and 4 to include another code. [Ref. 7]

One problem with the MCC assignments for ASO is that this assignment process was done only once in 1986-87 on contract by NADC. Current plans are to bring the assignment of aviation MCC's under the control of ASO's Uniform Inventory Control Point (UICP) program through resystemization [Ref. 10]. Briefly, resystemization is the Naval Supply Systems Command's current effort to upgrade the computer hardware and software systems used by the Inventory Control Points (ICP's). However, in the interim, there are no apparent plans to continue to assign MCC's or check MCC assignments, even though the process has been established and is required by the Logistic Support Analysis Record (LSAR, MIL-STD-1388-2A). The main reason for this is lack of funding. Because of this it is unsure what will happen to new system's MCC assignments during this resystemization development period. [Refs. 7 and 9] One possible solution would be to require the contractor to assign MCC's during the provisioning process just as MEC's are assigned. These preliminary MCC's would be based on preliminary support data such as FMECA and the LSAR. [Ref. 3]

3. Item Mission Essentiality Codes (IMEC's)

IMEC's are assigned from a combination of both MEC's and MCC's. This is true for both SPCC and ASO. IMEC's range from 1 to 4 (5 for ASO), 4 being the most essential (5 for ASO). The approved definitions for IMEC's are:

IMEC	SPCC Definition	ASO Definition
5	N/A	NMC/Not Safely Flyable.
4	Loss of a primary mission capability.	PMC/Loss of at least one primary mission.
3	Severe degradation of a primary mission capability.	PMC/Degradation of a primary missi .
2	Loss of a secondary mission capability.	FMC/Loss of a secondary mission.
1	Minor mission impact. [Ref. 2:p. 2-47]	OPC/Capable of all missions. [Ref. 7]

The ASO definitions are very similar to the MCC definitions. The reason for this will be discussed later.

The assignment process is very simple and, in fact, most all IMEC's are computer assigned. Table 2, taken from Appendix A, specifies the IMEC assignment for each combination of MEC and MCC:

TABLE 2: IMEC DERIVATION BASED ON MIL-STD-1388-2A MEC ASSIGNMENTS

MEC	MCC	IMEC
1	1	1
1	2	2
1	3	3
1	4	4
1	5	5
7	1	1
7	2	1
7	3	2
7	4 or 5	3
3	1,2,3,4, or 5	1
5	1,2,3,4, or 5	5

Although there are several documents, including Reference 2, that provide equivalent information in different formats, this table is the most current. The other tables are older and do not include the addition of MEC 7. One will also notice MEC's 8 and 9 are not included in Table 2. This is because MEC's 8 and 9 are too new and as yet have not been officially recognized.

An interesting aspect of Table 2 is that MEC's have very little influence on the assignment of the IMEC. Another fact which supports this is that, as previously mentioned for ASO, the definitions for MCC's and IMEC's are very similar. It is unclear why this is true. Apparently, the MEC assignment process is not trusted and is not regarded as accurate by many at the ICP's because most, if not all, of the MEC's come from the contractor and the Navy does not have much control over that part of the assignment process. In addition, the assignment of MEC's is not as clear-cut as the assignment of MCC's. MEC's are based on preliminary information provided in the provisioning process whereas the predominance of MCC assignments come from actual casualty/maintenance information (CASREP information for SPCC and VIDS/MAF EOC information for ASO).

One final note on IMEC's and MCC's is that both SPCC and ASO may assign MCC's and IMEC's of 0 to new items. This code basically means that an MCC or IMEC has not been assigned yet. This becomes a serious problem when, after 18 to 24 months of operational use, the inventory management of the item transitions to the wholesale replenishment model and safety levels are calculated. For an item with an MCC and IMEC of 0 in the wholesale replenishment model, the result is that no safety level is provided. This can cause excessive numbers of shortages and backorders of critically needed parts with resulting decreases in the operational effectiveness for new weapons systems. The extent of this problem can be seen at ASO, where apparently 30% of their items have MCC's and IMEC's of 0. Almost all of these items are new. [Ref. 9] Coupled with the fact that it usually takes a long time (in excess of two years in some cases) to assign accurate MCC's and IMEC's, and the lack of funding at ASO that prevents future MCC assignment, this is a serious problem that needs to be addressed. [Refs. 6 and 9]

As mentioned at the end of section 2b, one way to solve this problem would be to require the contractor to assign an initial MCC just as they are now required to assign an MEC. This would allow the item to be assigned an initial IMEC, and would also insure an initial safety level from the wholesale replenishment model. Two or three years later, this initial MCC could be validated using current CASREP or VIDS/MAF information and changed if necessary. [Ref. 3]

C. ACTUAL ICP ESSENTIALITY WEIGHTING PROCEDURE

The current approach for weighting inventory levels-setting by essentiality is explained in Appendices G, H, and I. Appendix G, with enclosures, contains the Naval Supply Systems Command's (NAVSUP) request for approval of the procedure from the Chief of Naval Operations (CNO). Appendix H is CNO's approval. Appendix I is SPCC's 1990 Program

Operations Memorandum (POM) Spare Parts Initiative budget submission which attempts to identify the additional funding required to implement SPCC's portion of the procedure.

This approach is based on relating IMEC's and System Material Availability (SMA). SMA is a customer service measure for the wholesale inventory system and is defined as the percent of requisitions which are satisfied on the first pass from stock on hand in the wholesale system [Ref. 2:p. 1-19]. The current overall Navy goal for SMA is 85% without regard to IMEC.

The approach takes this overall goal of 85% and increases it for higher IMEC items. As shown in Appendices G and I, the new goals are:

IMEC	SMA Goal
4 and 5	92%
3	90%
2	87%
1	85%

What this process basically does is increase the SMA goal as IMEC increases and, as a result, increase the level of safety stock.

One important advantage of this approach is that it is easy to understand and implement. As Appendix G states:

> Several alternative methods were evaluated. However, the alternative of varying SMA goals by IMEC category was selected based upon both the ease of understanding and the relative ease of computer program modifications necessary for implementation.

The one major problem with this approach is that a one-time buy will be needed to implement it. As Appendix H indicates, the procedure has been approved contingent upon funding available to buy the increases in inventory levels resulting from the increases in SMA. As Appendix I indicates, the additional funding required is over $200 million just for IMEC 3 and 4 items. Appendix H also states that funding will be provided when the lowest essentiality items achieve an SMA of 85%. What this means is that funding will be available when the Navy achieves this 85% goal for all IMEC 1 items. For all practical purposes, that is an impossibility in the near future. Thus, although this approach will remain approved, it is doubtful if it will ever be implemented. [Refs. 6 and 9]

To understand how these SMA goals would be achieved by the Navy's wholesale replenishment model, Section A at the beginning of this chapter needs to be reconsidered. There, Risk was defined as the probability of a stockout and is used to determine the reorder point and the safety stock. At optimality, Risk is expressed as:

$$\text{Risk} = (DIC)/(DIC+\beta FE),$$

where ß is the time-weighted shortage cost for the backordered item and E is the essentiality factor for the item, currently set as a constant (.5 for SPCC and .01 for ASO). All the other values (D, I, C, and F) are known constants for any given item. The only parameter that is virtually impossible to quantify is ß since it is impossible to determine the cost of not having a part during wartime.

Instead, ß is used as a "knob" for setting the item's reorder point so that the expected number of backordered requisitions does not exceed 15% annually.

Since 85% SMA is the goal, it is input into a program called CARES (Computation and Research Evaluation System). The CARES program was developed by the Navy Fleet Material Support Office (FMSO, Code 93) and it is run by SPCC, ASO, and FMSO to evaluate the impact of different parameters on the inventory levels-setting models. Five values of ß are also input into CARES. For each ß, the program calculates a reorder point and the expected number of backorder requisitions that would occur during a year. A "plot" of SMA as a function of ß is developed and from it the ß value for an 85% SMA is determined.

Although ß is used to adjust the reorder point to achieve the SMA goal, it really doesn't matter if ß was set constant and E was varied to attain the goal. A part that is more essential should have a higher E value and thus a higher reorder point. [Ref. 3]

In practice, SPCC sets the shortage cost parameter ß for a new item at a base value equal to the shortage cost of an IMEC 0 item within that particular cog for an initial period of time equal to a procurement leadtime (PCLT) plus six to eight months or until normal demand is experienced (i.e., PCLT plus a settling period). This period of time could be two to three years. At this point, the shortage costs (ß) are updated if needed through the CARES program. The last update of shortage costs for SPCC done for this reason was in 1983 and an update is currently in progress. Approximately two full PCLT's have passed since the 1983 update and this has given the demand and SMA values ample time to settle out. [Ref. 6]

Updates are also done if funding levels change. For example, if funding was only provided for a goal of 82% SMA, the shortage costs would have to be reduced. [Ref. 6]

For ASO, the shortage costs (ß) are reviewed twice per year. One other difference at ASO is that ß is set by weapon system (type of aircraft) and does not vary by item within that weapon system. [Ref. 9]

A final comment with regard to the current essentiality approach used by SPCC and ASO concerns how this process affects the inventory managers at SPCC and ASO. The inventory managers at both SPCC and ASO do not manage parts by IMEC's, MEC's, or MCC's. They do, however, manage parts by some form of essentiality and criticality, but it is based primarily on experience with the parts and intuition. In other words, they manage parts by problem areas (the "squeaky wheel gets the grease") rather that by formally assigned essentiality codes. [Ref. 11]

In SPCC's case, it is unclear why the codes are not used. Possible explanations could be that the codes may not be trusted or it is felt they are really not needed. However, the most likely explanation for not using the essentiality codes is because the inventory managers probably don't know how to use them. The inventory managers do have access to IMEC codes on their data base as they are part of the four-digit cog coding system. The four-digit cog is composed of the standard two-digit cog symbol, the IMEC, and an alpha character representing a category of requisition frequency. In fact, the reason for the development of the four-digit cog coding system was to assist the inventory managers in managing their systems by IMEC. But the problem remains that no one can tell the inventory manager how much more important an IMEC of 4 is over an IMEC of 3 or 2 or 1 and, therefore, the inventory manager cannot correctly use the IMEC as a management tool. As a result, IMEC's are not currently used explicitly in the inventory management of items, even though the present system allows for their use.

At ASO the inventory managers do not even have visibility of IMEC's, MEC's, and MCC's on their data base. This is because the four digit cogs at ASO are composed of the standard two-digit cog, and the two-digit SMIC (Special Material Identification Code) for each system. Since IMEC's are not a part of this four digit cog and SMIC's have no essentiality meaning associated with them, if an inventory manager at ASO wanted to manage an item by essentiality it would be difficult to do so. He or she would have to manually look up the codes for each part. [Ref. 9]

III. PROPOSED ESSENTIALITY WEIGHTED MODELS

This chapter presents four models that weight the essentiality of an item based on its MEC, MCC, and/or IMEC in order to establish a means of quantitatively determining how much more important one IMEC is over another. These weighted values can then be use as the essentiality parameter E in the Risk formula for the current ICP inventory models. The end results are that two of the models are linear, meaning that the relationship between the weighted values is a linear function of the IMEC's; and two are non-linear, meaning that the relationship between the weighted values is not a linear function of the IMEC's.

The first model will be called the basic linear model. It is developed using subjective values for MEC's and MCC's which are then combined to obtain values for each IMEC category. The second and third models are variations of the basic linear model weighted by requisition frequency and ship type, respectively. These models are based on suggestions for improvements on the basic linear model which were obtained during interviews with personnel at both SPCC and ASO. The second model (basic linear model weighted by requisition frequency) is non-linear and the third model (basic linear model weighted by ship type) is linear. The last model is a non-linear model proposed by personnel at ASO and is called the $IMEC^2$ model.

A. BASIC LINEAR MODEL

This basic linear model is based on the assignment of subjective values to the different levels of MEC's and MCC's using their respective definitions. The subjective values assigned are between 0.0 and 1.0 which is the assumed range of the essentiality parameter E in the inventory levels-setting formulas.

The first step in this model's development is to assign subjective values to MEC's. The following detailed definitions of MEC's are taken from Appendix B, the NAVSEA Logistics Center Working Paper that was created as part of the RBS Experiment for DDG-52. The subjective values were assigned by comparing the definition of each MEC with the definition of the next lower MEC and determining a relative decrease over the value of the higher MEC's subjective value based on this comparison. As an example, MEC 5 was assigned the highest subjective value of 1.0. Comparing the definition of MEC 5 with the definition of the next lower MEC, MEC 1, the difference is basically that MEC 5 is life-threatening and MEC 1 is loss of a major system. It was subjectively determined that loss of a major system was 15 per cent less essential than the loss of a life, therefore MEC 1 was assigned a subjective value of 0.85. The MEC's are listed below in descending order of importance and the subjective value assigned to each MEC follows its definition.

MEC 5: An MEC 5 will be assigned to an item which meets all of the following conditions:

- Its failure, when it is expected to be functioning, will subject a person operating or maintaining the end item to an immediate risk of death or injury.
- Any risk will not be dependent on the occurrence of some second event following the failure of the part being examined, but will be created solely by its failure.
- The failure must be immediately detectable making the availability of a spare critical to safe resumption of operations or maintenance.

Subjective value assigned: 1.0

MEC 1: An MEC 1 will be assigned when the most severe failure mode disables at least one of the end item's primary functions.

Subjective value assigned: 0.85

MEC 8: An MEC 8 will be assigned to an item which is associated with designed redundancy or alternatives. Ordinarily, the failure of the item would disable the end item in at least one of its primary functions, however, because of the redundant design, the end item is still capable of performing but at reduced capacity. The intent of the MEC 8 is to provide a recognition of the redundancy and to respect the design integrity. An additional condition is that the failure must be within normal maintenance capability.

Subjective value assigned: 0.5

MEC 7: An MEC 7 will be assigned to an item which meets all of the following conditions:

- The item is not associated with redundancy.
- Its primary failure modes are not sudden, but gradual in nature as deterioration or reduced functioning over time.
- Its deterioration or reduced performance is detectable as it is occurring, allowing for the ordering and receipt of a replacement part prior to the installed unit deteriorating to the point that its performance is no longer acceptable.

- The rate of deterioration is such that normal, direct turnover supply response times will allow a requisitioned part to be received prior to total failure.
- At its final, fully deteriorated state, it will disable the end item in at least one of its primary functions.

Subjective value assigned: 0.4

MEC 9: An MEC 9 is also associated with redundancy, however, the assignment of the MEC 9 will be based upon all of the following:
- The failure of the item will not immediately diminish any capability or performance applicable to a primary function of the end item.
- The failure is recognizable at the instant it occurs.
- The failure mode is independent and will not lead to a series of secondary failures.

Subjective value assigned: 0.133

MEC 3: An MEC 3 will be assigned to an item whose failure does not impair any primary function since the function of this part is not associated with any primary function. However, the failure will result in an unscheduled maintenance action.

Subjective value assigned: 0.05

In summary, the subjective value assignments for MEC's are:

MEC	Subjective Value
5	1.000
1	0.850
8	0.500
7	0.400
9	0.133
3	0.050

Next, MCC's are assigned subjective values. The MCC matrix chart shown as Table 1 in Chapter II, Section B.2.a, is the basis for assigning these subjective values. This matrix was taken from Reference 1, enclosure (1), page 1, and is one of the methods used to assign MCC's. The following subjective values for MCC's were assigned based on the definitions in the matrix:

MCC	Subjective Value
4 or 5	1.00
3	0.80
2	0.20
1	0.05

Now, essentiality values for each IMEC are calculated and assigned based on particular combinations of the subjective values for MEC's and MCC's. To obtain each IMEC essentiality value, the subjective values for the MEC's and MCC's related to that particular IMEC are multiplied together. The following chart provides the resulting relative weight for each current IMEC essentiality value. The basis for this chart is taken from the table listed in enclosure (2) of Appendix A.

MEC	MEC Subjective Value	MCC	MCC Subjective Value	Resulting IMEC	IMEC Subjective Value
1	0.85	1	0.05	1	.0425
1	0.85	2	0.20	2	.1700
1	0.85	3	0.80	3	.6800
1	0.85	4	1.00	4	.8500
1	0.85	5	1.00	5	.8500
7	0.40	1	0.05	1	.0200
7	0.40	2	0.20	1	.0800
7	0.40	3	0.80	2	.3200
7	0.40	4 or 5	1.00	3	.4000
3	0.05	1-5	MEC Override	1	.0500
5	1.00	1-5	MEC Override	5	1.0000

Although this chart does not currently include MEC's 8 and 9 because these two MEC's are relatively new, it could easily be adapted to accept them. Also, by "MEC Override" is meant that since the MCC can be assigned any of the values 1 through 5, the MEC is the "overriding" factor and hence the MCC subjective value does not matter. (It is equivalent to setting the MCC subjective value to 1.0.)

As mentioned previously in this thesis, MEC's currently have little influence on the assignment of IMEC's. However in this model, MEC's are treated with equal importance as MCC's; i.e., this model assumes that MEC's are accurate and assigned properly.

This chart is now condensed into ranges for each IMEC value based on the values in the last column above. The final IMEC essentiality weight or value is assumed to be the highest value in that particular IMEC's range. The following chart lists the resulting IMEC essentiality values derived from this process:

IMEC Weighting Chart

IMEC	IMEC Subjective Value Ranges	IMEC Essentiality Value
1	0.00 - 0.08	0.08
2	0.09 - 0.32	0.32
3	0.33 - 0.68	0.68
4 or 5	0.69 - 1.00	1.00

The IMEC essentiality values given in the above chart are now in a form which can be used as the essentiality parameter E in the current inventory levels-setting models.

Figure 1 on page 48 contains a plot of these IMEC values which shows an approximate linear behavior for this model. This function could be mathematically expressed as the equation $E=a(IMEC)+b$ where E is the essentiality factor in the Risk equation, a is the slope of the line, and b is the y-intercept of the line.

A point made during Reference 6 which would change this model slightly is that MEC's 5 and 1 are often considered equal as far as essentiality is concerned, rather that MEC 5 (risk of personnel injury) taking priority over MEC 1 (loss of a major system). However, since operating personnel are a vital element of a system it can also be argued that the value of a life in this model has been regarded as more essential than the loss of a major system. The rational of Reference 6 suggests that in a wartime scenario the loss of a major system could mean the loss of many lives. Therefore, these two MEC's should be considered equal. As far as the model is concerned, the difference would be in assigning a subjective value of 1.0 to MEC 1's vice a subjective value of 0.85. The IMEC range and final value would then change slightly.

Before considering the next model, it is appropriate to note that a very simple linear model could be constructed which would pass through the graph's origin and would result in an IMEC 2 being twice as important as an IMEC 1, an IMEC 3 being three times as important as an IMEC 1, and an IMEC 4 being four times as important as an IMEC 1. This, however, is not believed to be the case because in the examination of the development of IMEC's, MCC's, and MEC's, no one believes, for example, that an IMEC 4 is four times more important than an IMEC 1. [Ref. 3]

B. BASIC LINEAR MODEL WEIGHTED BY REQUISITION FREQUENCY

This model was proposed during Reference 6. The reasoning behind weighting IMEC essentiality values by requisition frequency lies with the fact that, in certain cases, several IMEC 2 items in a combined system sense can cause more downtime than one IMEC 4. In this respect, an estimate of number of requisitions (frequency) should be a factor in essentiality weights. [Ref. 6]

This model picks up where the basic linear model left off. The IMEC essentiality values from the basic linear model were:

IMEC	IMEC E Values
4 or 5	1.00
3	0.68
2	0.32
1	0.08

Taking these IMEC E values and weighting them by an average of one year sample of requisition frequencies from SPCC for the period June, 1987 to June, 1988, for 1H cogs results in the following [Ref. 6]:

IMEC	IMEC E Value	Reqn. Freq. for IMEC	New IMEC E Value	Normalized IMEC E Value
4 or 5	1.00	0.37	0.3700	1.0000
3	0.68	0.24	0.1632	0.4411
2	0.32	0.09	0.0288	0.0778
1	0.08	0.12	0.0096	0.0259
0	N/A	0.18	N/A	N/A

In this chart the IMEC = 0 has been added. As was noted in Chapter II, it is being used by the ICP's to indicate a new system for which no permanent IMEC has been assigned yet. Its inclusion is important since the percentage of requisitions that occur for items with an IMEC of 0 is substantial (18%).

Again, Figure 1 on page 48 shows a plot of these IMEC weights or essentiality values. That plot emphasizes the non-linearity of this model.

One initial problem that can be seen with this model is that it seems to weight the shortage cost part of the Risk formula with requisition frequencies twice. From Chapter II, Section A, the Risk formula was Risk=DIC/(DIC+ßFE). The ßFE term already contains a factor for requisition frequency, F. So the creation of an E value which includes requisition frequency could be double counting F. However, the intent of this model is to provide a relative weight for the essentiality factor E based on IMEC values weighted by requisition frequency rather than weighting the shortage cost factor by requisition frequencies twice. In this context, the requisition frequencies used to weight the IMEC values would be an average over a long period of time (two or three years) whereas the requisition frequency values used as F would be quarterly values. The reason for using an average of requisition frequencies for weighting the IMEC values is because the inventory models must remain constant, consistent, and valid for long periods of time to prevent an excessive amount of inventory churn (adds and deletes).

In comparing this model's tabled IMEC essentiality values with those of the basic linear model, this model shows large changes between IMEC 4's and 3's (from 1.000 down to 0.4411), and between IMEC 3's and 2's (from 0.4411 down to 0.0778) whereas the basic linear model is much less dramatic.

C. BASIC LINEAR MODEL WEIGHTED BY SHIP TYPE

This model was proposed during Reference 5. The reasoning behind this model is that the basic linear model assumes that the weight of an IMEC 4 on an aircraft carrier is the same weight as an IMEC 4 on a tug boat. Although this, in an extremely rare case, could possibly be true, as a general rule it is not. An IMEC 4 on an *aircraft carrier* should be weighted more than an IMEC 4 on a less critical ship. [Ref. 5]

Again, this model begins where the basic linear model left off. First, a subjective weighting scheme for ship type is devised. This weighting scheme was created by first assigning a weight of 1.00 to all ship types whose primary mission is directly combat related (Major Frontline Combatants). Next, a proportionately lower weight was selected for those ship types that directly support these combatants (First Line Support Ships). Lastly, proportionately lower weights were assigned to the Second Line Support Ships and All Others ship type categories.

Ship Type	Subjective Weight
Major Frontline Combatants (carriers, cruisers, destroyers frigates, submarines, frontline amphibious ships, etc.)	1.00
First Line Support Ships (Combat Logistics Force ships, LKA's, etc.)	0.80
Second Line Support Ships (tenders, repair and salvage ships)	0.50
All Other Ships	0.30

Taking the basic linear model's IMEC essentiality values and weighting each one by these ship type weights results in a new set of IMEC essentiality values for each ship type category. Table 3 on the following page lists these new IMEC essentiality values by ship type category. (Note that if an item is common to several different ship types, the highest IMEC essentiality value would be used as the item's IMEC weight. For items that are non-common, the single ship type category IMEC essentiality value is used.)

As with the previous two models and for purposes of comparison, the first two categories of IMEC essentiality values (those pertaining to the Major Frontline Combatants and the First Line Support Ships ship type categories) are plotted in Figure 1 on page 48. Of course, the plot for the Major Frontline Combatants ship type category is identical to that of the basic linear model. The plot of the second ship

TABLE 3: NEW IMEC ESSENTIALITY VALUES BY SHIP TYPE CATEGORY

		New IMEC Essentiality Values			
IMEC	Basic Linear Model IMEC E Value	Major Frontline Combatants (Subjective Weight = 1.00)	First Line Support Ships (Subjective Weight = 0.80)	Second Line Support Ships (Subjective Weight = 0.50)	All Other Ships (Subjective Weight = 0.30)
4 or 5	1.000	1.000	0.800	0.500	0.300
3	0.680	0.680	0.544	0.340	0.204
2	0.320	0.320	0.256	0.160	0.096
1	0.080	0.080	0.064	0.040	0.024

Note: For common items that extend across ship type categories, the highest IMEC essentiality value should be used. For non-common items, the individual ship type category IMEC essentiality value should be used.

type category shows a linear model with a lower slope than that of the Major Combatants.

The major problem with this model is it is somewhat complicated and would be cumbersome to implement. It increases the number of IMEC essentiality values used from four to 16.

The point was made in Appendix G that conceptual simplicity must be kept in mind. The ease of understanding and the ease of making computer program modifications are important factors to consider. In this case, these factors may tend to override the benefits gained in using this model.

Another problem with this model is that it is not designed to be used by ASO because it only considers ships. The next model, however, as with the first two models, is universal and can be used by both SPCC and ASO.

D. IMEC^2 MODEL

This model was proposed during Reference 9. Although it is a rather simple model, it is an interesting concept and one which should not be discounted. It starts with IMEC 1 as a baseline IMEC essentiality value and then says: an IMEC 2 is four times (2^2) as important as an IMEC 1; an IMEC 3 is nine times (3^2) as important as an IMEC 1; and IMEC's 4 and 5 are 16 times (4^2) as important as an IMEC 1. The following chart summarizes this model:

IMEC	$IMEC^2$	IMEC E Value
4 or 5	16	0.16
3	9	0.09
2	4	0.04
1	1	0.01

Note that in this model, IMEC's 4 and 5 are treated equally. The reason for this is that frequently IMEC's 4 and 5 are viewed as the same at ASO and, for simplicity, it was decided not to split out IMEC 5 and make it 25 times more important than an IMEC 4. [Ref. 9]

The baseline IMEC essentiality value in the above model was selected to be ASO's current value for E which is .01. Since E is assumed to be between 0 and 1, SPCC's value of .5 would not work. The baseline, in reality, doesn't really matter as long as IMEC's 4 and 5 do not exceed the assumed limit of 1.00 as their IMEC weight and that the shortage cost parameter, ß, is adjusted for the new baseline so that the product ßE remains unchanged.

Another variation of this model would be to set IMEC's 4 and 5 as the baseline at an IMEC essentiality value of 1.00 and vary IMEC's 1 through 3:

IMEC	$IMEC^2$	IMEC E Value
4 or 5	16	1.0000
3	9	0.5625
2	4	0.2500
1	1	0.0625

Again, for purposes of comparison, these IMEC essentiality values are plotted on Figure 1 on page 48. This second variation of the $IMEC^2$ model was chosen for comparison in Figure 1 because of the IMEC 4/5 weight being equal to 1.0 for the first two models plotted in Figure 1.

It is interesting to note that this model falls between the basic linear model and the non-linear, basic linear model weighted by requisition frequency.

The advantage of this model is its simplicity and ease of understanding, as it uses only IMEC values in its computation of essentiality values. It also would be quite flexible, being able to vary the scaling factor as needed.

E. MODEL IMPLEMENTATION

One universal problem constraining the implementation of any of these proposed models is the availability of funding. Just as with the current proposed changes to SMA's associated with IMEC values described in Chapter II, Section C, these models would require additional funding to implement.

One can very easily see the relative effect these models would have on increased inventory levels and increased funding requirements. Currently E is set constant at .5 for SPCC and .01 for ASO. Simply raising IMEC 4's and 5's to an E value of 1.00, which is a possibility in all of the models, would increase the ßFE term in the Risk equation by 100% for SPCC and by 10,000% for ASO. Even for IMEC 1's with a new E value of .08 as in the basic linear model, the ßFE term is increased 800% for ASO. For SPCC, there would be a decrease in the ßFE term of 84% as E goes from .5 to .08. However, the dollar value of decreases in inventory levels would probably not outweigh the dollar value of increases because much of the cost increases would be associated with high essential, high cost repairables and most of the cost decreases would be attributed to low essential, low cost consumables. [Ref. 9]

A recommended solution to this funding problem while initially implementing these models would be to let the essentiality factor E take on these new IMEC weights but keep the product ßE in the ßFE term constant at whatever its value is now. To do this, new shortage costs for ß would have to be computed. However, the end result would be no change in the Risk factor, the resulting inventory levels, or funding. A second step would be to change the ß values to meet new SMA goals and obtain an estimate of what the new costs might be. This could be done through the use of the CARES analyzer. After the initial implementation phase, the wholesale inventory models would at least have a method of utilizing the essentiality factor E in the proper manner. This would be a definite improvement over the current method of not utilizing E at all. [Ref. 3]

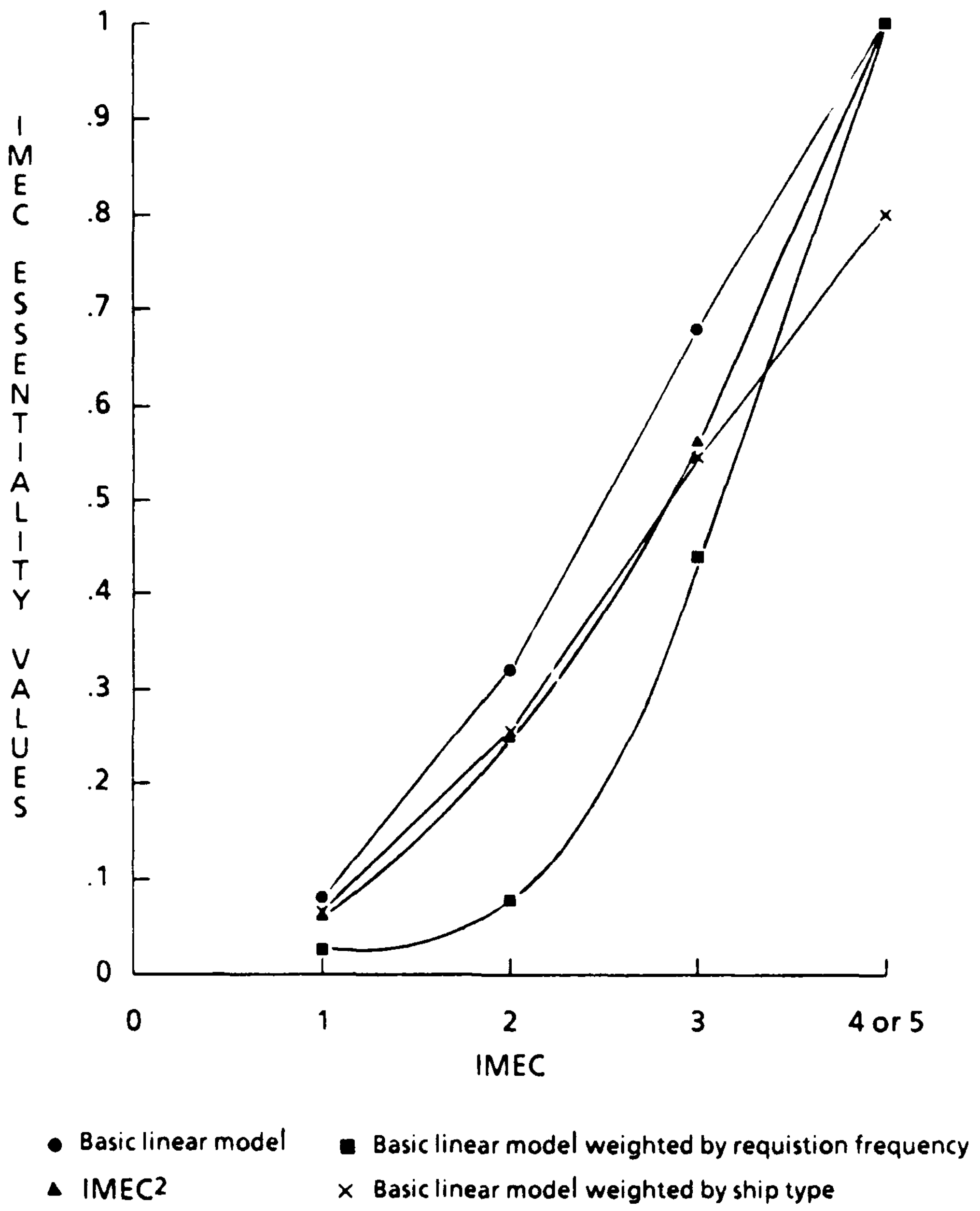


Figure 1: IMEC Essentiality Values for each Model

IV. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

A. SUMMARY

The primary objective of this thesis was to develop a linear model or relationship for essentiality weighting for items managed at the wholesale level based on the current essentiality coding system. The primary reason behind this objective was to be able to utilize the resulting essentiality weights in the current Navy wholesale inventory levels-setting models. The ultimate goal will hopefully be a better stocking policy with increased levels of operational effectiveness for those items which are highly essential.

Chapter II first reviewed the formulas currently used to establish essentiality weighted inventory levels (Risk formula, etc.). It then described the current essentiality coding system (MEC's, MCC's, and IMEC's). Finally, Chapter II presented the current method used by SPCC and ASO for indirectly adjusting inventory stockage levels with respect to essentiality (different IMEC's have different SMA goals).

Chapter III presented four essentiality weighting models. The first and third models (the basic model and the basic model weighted by ship type) were essentially linear models; that is, the relationship between the essentiality values and the IMEC values was linear. The second model (the basic model weighted by requisition frequency) was a non-linear model; that is, the relationship between the essentiality values and the IMEC values was non-linear. These three models were based on the assignment of subjective values for MEC's and MCC's, with IMEC subjective values being computed from a combination of the subjective values for MEC's and MCC's.

The fourth model, $IMEC^2$, was also a non-linear model. Its major advantage is being simple in its weighting computation and being easy to understand.

Finally, Chapter III presented a recommended method for implementing these models.

B. CONCLUSIONS

The current model approved for use by SPCC and ASO to indirectly weight inventory levels-setting by essentiality may be adequate. It is simple, easy to program, and will certainly meet the required SMA goals as set forth by higher authority. However, it does have its drawbacks. It does not use the E factor as it was designed to be used in the inventory models. Rather than using the inventory models as designed (i.e., working forwards through the inventory levels-setting models starting with an E value), an SMA goal is established and, working backwards by adjusting the ß, the levels are determined.

Throughout the interviews conducted at both SPCC and ASO, the basic linear model proposed in Chapter III was generally accepted as feasible, and was considered to be "as good a model as anyone else's." Almost all personnel interviewed said it is very difficult to say how much more important one IMEC is over another IMEC.

The two additional versions of the basic linear model are regarded as improvements. The first, and the one this author prefers, is the basic linear model weighted by requisition frequency. It appears to be a definite improvement over the basic linear model.

The second is the basic linear model weighted by ship type. Unfortunately, it would be complicated to implement and would have only limited applicability because it would only pertain to SPCC items. It would be of no use to ASO.

The $IMEC^2$ model is also a valid proposal and was suggested by ASO personnel. Its appeal is its simplicity. However, it may be too simple. Although the question of why the relationship between IMEC's is equal to the squared IMEC value can be posed, it may indeed apply to ASO managed items.

Probably the major obstacle to using these new models is that the current perceptions about the MEC, MCC, and IMEC codes by most personnel at SPCC and ASO is one of uneasiness. Are they currently assigned properly so that their values can be trusted? Some of the points that support this perception are:

- They feel that too much subjectivity is involved in the essentiality code assignment process. Although subjective decisions are certainly a part of the process, they by no means dominate the process. The codes are for the most part assigned based on valid quantifiable data.

- Until recently, procedures for assigning IMEC's, MEC's, and MCC's were not widely documented and, those that were, were somewhat vague and confusing. If one were to read the applicable portions of Reference 2 on the assignment procedures for the codes, one would find it is rather confusing and does not provide the reader with enough information about the assignment process. Fortunately, progress is being made in this area as a consequence of several major documents discussing essentiality codes having been written over the past two years. Reference 10 is one example.
- The assignment of MCC's and IMEC's of 0 for new systems creates safety level and shortage problems when the items transition to the wholesale replenishment model. A lengthy period of time is required to correct this situation and assign a proper MCC and IMEC to the items.
- No definite or permanent feedback loop has been established to conduct validation checks on the initial MEC, MCC, and IMEC assignments. Although progress is being made in this area as evidenced by

the Naval Sea Logistics Center's checking of MCC's for SPCC managed items and the resystemization efforts [Ref. 10], no formalized all-encompassing program seems to be outlined. The major reason is the lack of funds to conduct such a program. However, since these essentiality codes are not highly trusted and are also not used in the current inventory models or by the inventory managers, it is doubtful if funding will become available soon.

Until major changes in or attitudes toward essentiality coding and the concept of essentiality are made, or the current inventory models and goals are changed or replaced by better models (e.g., the Mean Supply Response Time model being developed at the Naval Postgraduate School), the current essentiality weighting model described in Chapter II, Section C, is the best available to accomplish and attain the required goals. Until inventory managers and everyone else involved in the process begins trusting and using IMEC's, MEC's, and MCC's, the models proposed in Chapter III probably won't be useful.

Lastly, funding will be a major problem for any essentiality weighted inventory models. Neither the current model nor the proposed models will probably be implemented until adequate funding becomes available to support them. Studies of the impact of the various essentiality models on the current inventory models should be conducted however before funding is sought.

C. RECOMMENDATIONS

The following recommendations are offered for overall improvement of the essentiality weighted coding systems:

1. Establish a feedback loop in the MEC, MCC, and IMEC assignment system so that these codes can be checked and verified. (Reference 10 and resystemization seems to be attempting to correct this problem.)
2. Do not allow 0 to be assigned as an initial MCC or IMEC. Utilize as much of the provisioning data as possible to make a reasonable estimate of what these values should be up front, letting the contractor assign the MCC if necessary, and adjust them later with CASREP/maintenance data. At the very least, assign the lowest code of 1 as the MCC and IMEC so that some initial safety stock is provided and revise the codes at a later date with CASREP/maintenance data.
3. Finally, and most important, an increased awareness of MEC's, MCC's, and IMEC's should be provided through better documentation, education, and management attention.

Initiating these changes will lay the groundwork for implementing better essentiality weighted inventory models. Once the improvements recommended above are initiated, an additional recommendation would be to implement one of the IMEC weighting models proposed in Chapter III. So as not to create a funding problem, implementation should be accomplished by using the IMEC essentiality values for the essentiality parameter E and revising the shortage costs ß so that the ßE term remains constant at its present value. Then CARES studies can be conducted to determine how essentiality redistributes the inventory levels. If it works well, funding may not be so difficult to obtain.

Finally, with regard to funding, one recommendation for further study would be to evaluate the affect of lowering the SMA goals for IMEC 1's and 2's below 85%, thereby possibly allowing for SMA goals of greater than 85% for IMEC 3's and 4's while keeping the funding constraint constant. What would happen to operational effectiveness in this case?

A second recommendation would be to evaluate the impact on funding levels if the basic linear model weighted by requisition frequency was implemented.

LIST OF REFERENCES

1. Department of the Navy, Naval Sea Systems Command (NAVSEA) Instruction 4441.11, Mission Criticality Codes (MCC's) for Shipboard Use, Washington, DC, serial 9052/2198, dated 16 February, 1985.

2. Department of the Navy, Naval Supply Systems Command, Naval Supply (NAVSUP) Publication 553, Inventory Management, Washington, DC.

3. Naval Postgraduate School, Monterey, CA, Course, Navy Supply Systems Overview, OA4910-3, course notes from Professor Alan McMasters. Academic Year 87-4 (Summer Quarter), July-September, 1988.

4. Department of the Navy, Navy Fleet Material Support Office (FMSO), Operations Analysis Department Report #154A, Item Essentiality Assignment, Mechanicsburg, PA, September, 1984.

5. Interview between Mr. Denny Straub, Naval Sea Logistics Center (NAVSEALOGCEN), Mechanicsburg, PA, and the author, 23 August, 1988.

6. Interview between Mr. John Boyarski, Navy Ships Parts Control Center (SPCC Code 04), Mechanicsburg, PA, and the author, 22 August, 1988.

7. Interview between Mr. John Perazza and Ms. Sandy Draham, Naval Air Development Center (NADC Code 7022), Warminster, PA, and the author, 25 August, 1988.

8. Department of the Navy, Chief of Naval Operations (OPNAV) Instruction 5442.4L, Aircraft and Training Devices Material Condition Definitions, Mission-Essential Subsystems Matrices (MESMS), and Mission Descriptions, Washington, DC, serial OP-515, dated 15 October, 1987.

9. Interview between Ms. Fran Ziegler, Aviation Supply Office (ASO Code SDB-4), Philadelphia, PA, and the author, 25 August, 1988.

10. Department of the Navy, Navy Fleet Material Support Office (FMSO), Uniform Inventory Control Program System Design Documentation: Essentiality Coding, Functional Description, FMSO Document Number FD-PD95, Mechanicsburg, PA, dated 31 August, 1987.

11. Interview between Mr. Bob Smith, Navy Ships Parts Control Center (SPCC Code 052), Mechanicsburg, PA, and the author, 22 August, 1988.

APPENDIX A
MEC ASSIGNMENT PROCEDURES

Commander, Naval Supply Systems Command letter, Implementation of MIL-STD-1388-2A Military Essentiality Code (MEC) Policy, 4423 Serial 031/KM/imec 6-13, dated 23 June, 1987 with enclosures, implementing the correct procedures to assign MEC's.

DEPARTMENT OF THE NAVY
NAVAL SUPPLY SYSTEMS COMMAND
WASHINGTON. D C 20376

TELEPHONE NUMBER
COMMERCIAL
AUTOVON
IN REPLY REFER TO

4423
031/KM/imec
6-13
23 JUN 1987

From: Commander, Naval Supply Systems Command
To: Commander, Naval Air Systems Command (AIR 412)
Commander, Naval Sea Systems Command (SEA CEL-MS)
Commander, Space and Naval Warfare Systems Command (Code 003)

Subj: IMPLEMENTATION OF MIL-STD-1388-2A MILITARY ESSENTIALITY CODE (MEC) POLICY

Ref: (a) CNO ltr Ser 412E/6U394562 of 12 Aug 86
(b) MIL-STD-1388-2A of 20 Jul 84
(c) MIL-STD-1629A of 24 Nov 80
(d) OASD (MRA&L) memo of 15 Oct 81
(e) CNO ltr Ser 412E/3U392481 of 8 Jul 83

Encl: (1) Guidance for Assignment of Part to Component MECs
(2) Item Mission Essentiality Code (IMEC) Derivation Based on MIL-STD-1388-2A MEC Assignments

1. Reference (a) issued Readiness Based Sparing (RBS) policy for new acquisition programs and requested that NAVSUP issue detailed procedures to promote uniform Navy-wide compliance with this policy. Accordingly, this letter requests that the Navy Hardware Systems Commands invoke the requirement for assignment of MIL-STD-1388-2A Military Essentiality Codes (MECs) of reference (b) in accordance with the guidance contained in enclosure (1). These MEC assignments should be included in the provisioning process for all systems acquisitions for which a contract has not already been awarded. Where a contract has already been awarded every effort should be made to modify the contract to require the more stringent enclosure (1) requirements. This letter also, via enclosure (2), provides the methodology that will be used for deriving Item Mission Essentiality Code (IMEC) based on MEC and Mission Criticality Code (MCC).

2. The new MEC assignment criteria were developed by the Naval Material Establishment Provisioning Policy Group which is comprised of representatives from the Naval Air Systems Command, the Naval Sea Systems Command, and the Naval Space and Warfare Systems Command and chaired by the Naval Supply Systems Command. In addition to providing guidance on assignment of MEC 5 to denote personnel safety items, enclosure (1) provides guidance on how to assign 3 variations of part to component essentiality vice the current 2 variation policy. These MECs will need to be assigned based on Failure Modes, Effects, and Criticality Analyses conducted in accordance with reference (c).

Subj: IMPLEMENTATION OF MIL-STD-1388-2A MILITARY ESSE[illegible]ALITY CODE (MEC) POLICY

3. Enclosure (1) is consistent with references (b), (d), and (e), and will permit the Navy to properly use readiness oriented models. In order to properly use readiness oriented models it is essential that accurate part to component MECs are assigned as well as realistic failure rates and unit prices. It is estimated that only about 40 percent of items currently coded as MEC 1 comply with the definition in reference (b). The remaining 60 percent, although not all MEC 3 items, must currently be assigned that MEC since none other exists. Implementation of enclosure (1) will enhance Navy attempts to improve readiness at least cost.

4. Request all SYSCOMs implement the MEC assignment criteria of enclosure (1) and require that Provisioning Technical Documentation (PTD) for all new acquisitions provide MECs in accordance with this guidance. The NAVSUP point of contact for this effort is Mr. Lenny Burdick (NAVSUP 0319), Commercial (202) 695-7121, Autovon 225-7121.

L. V. HANAGAN
Acting Deputy Commander
Fleet S[illegible] Logistics

Copy to:
CNO (OP 412)
ASO (WS)
SPCC (Codes 05, 041)
FMSO (Code 93)
NAVSEALOGCEN (Code 09)

GUIDANCE FOR ASSIGNMENT OF PART TO COMPONENT MECs

Military Essentiality Code (MEC). This code indicates the degree to which unavailability of a replacement for an installed item when needed to perform corrective maintenance affects the ability of the end item (e.g., radar set, fire control system, electrical generator) to perform its primary function in the intended manner. The need to perform corrective maintenance is normally the result of failure of an item and so essentiality is commonly evaluated in the context of item failure, but it must be remembered that some parts may be needed for replacement owing to their use when replacing other failed parts (e.g., gaskets).

I. CODE 1

A. MIL-STD-1388-2A Definition: Failure of this item will render the end item inoperable.

B. Guidance on Assignment of:

1. Failure of this item in its normal failure modes will result in total and catastrophic failure of the end item or a critical function of the end item.

or 2. This item is a part which normally is not considered to fail but is required to be installed, along with an item whose failure will result in total and catastrophic failure of the end item (e.g., gaskets, seals, etc.).

3. This item monitors a critical function and a malfunction will disenable an operators capability to recognize a catastrophic failure.

II. CODE 3

A. MIL-STD-1388-2A Definition: Failure of this part will not render the end item inoperable.

B. Guidance on Assignment of:

1. Failure of this item in its normal failure modes will result in at most minor degradation of the end item.

Enclosure (1)

III. CODE 5

A. MIL-STD-1388-2A Definition: Item does not qualify for assignment of Code 1, but is needed for personnel safety.

B. OP-41 Approved Definition: Item may or may not qualify for assignment of Code 1, but is needed for personnel safety.

C. Guidance on Assignment of:

1. Failure without immediate replacement or lack of this item will directly and immediately infringe on the safety of personnel operating or maintaining the equipment. This code should not be assigned to parts or assemblies which are installed in systems whose primary purpose is safety of ship/aircraft or personnel simply because of that system relationship unless the item separately meets the first part of this guidance.

2. If an item qualifies for MEC 5, it should be assigned MEC 5 regardless of what other MEC it also qualifies for.

IV. CODE 7

A. MIL-STD-1388-2A Definition: Item does not qualify for the assignment of Code 1 but is needed to prevent impairment or the temporary reduction of operational effectivenesss of the end item.

B. Guidance on Assignment of:

1. Failure of this item in any of its normal failure modes will not result in total and catastrophic failure of the end item but rather will result in only partial degradation of the end item allowing continued operation within acceptable performance ranges. Items should be classified as MEC 7 if their normal failure modes are gradual deterioration or wear and such gradual deterioration or wear is noticeable or detectable prior to its reaching maximum limits. Items should also be classified as MEC 7 if redundancy provides for continued operation after failure of one unit of an item but at reduced by acceptable capacity or capability. If redundancy provides for continued operation after failure of one unit of an item at normal capacity or capability, assignment of MEC 3 is appropriate.

2. This assignment applies to all built in test circuitry which is critical to the monitoring or fault isolation of the end item. The exception applies to those components which monitor critical functions in which a failure will hide a critical failure.

IMEC DERIVATION BASED ON MIL-STD-1388-2A MEC ASSIGNMENTS

MEC	MCC	IMEC
1	1	1
1	2	2
1	3	3
1	4	4
1	5	5
7	1	1
7	2	1
7	3	2
7	4 or 5	3
3	1, 2, 3, 4 or 5	1
5	1, 2, 3, 4 or 5	5

Enclosure (2)

APPENDIX B

WORKING PAPER ON MEC ASSIGNMENT

Naval Sea Logistics Center (NAVSEALOGCEN), Mechanicsburg, PA, Working Paper for the Readiness Based Sparing Experiment for DDG-52 on Military Essentiality Code (MEC) assignment, discussing the procedures for DDG-52 MEC assignment, including presenting two new MEC codes (8 and 9) and providing flow charts for MEC assignment.

Military Essentiality Codes (MEC) indicate the degree to which the failure of a part affects the ability of the end item to perform its intended purpose. The codes are defined as follows:

1 Failure of this part will immediately render the end item inoperable.

3 Failure of this part will not render the end item inoperable since the function of this part is not associated with a primary mission.

5 Failure of this part will create an immediate potential for the person operating or maintaining the end item to risk injury or death.

7 Failure of this part occurs gradually and the degradation of performance is observable and measurable and when fully failed will render end item inoperable.

8 Failure of this part limits the capability of the end item, since redundancy permits the end item to continue to function but with reduced capability.

9 Failure of this part will not immediately affect the performance of the end item nor will failure immediately reduce the capability of the end item because of a redundant design or alternatives.

General Guidance

The above definitions are subject to multiple interpretations. The following guidance is intended to reduce subjectivity and amplify the definitions with examples applicable to an automobile. The design includes many features which are intended to provide insurance that the user will enjoy a safe return without any delays due to major maintenance along the way.

The attached flow chart provides a systematic approach to the MEC assignment process. The approach is to begin at the highest level of indenture, the automobile, on the parts list which is provided and work down to determine the first level of indenture at which maintenance can be performed. The indenturing will be identified by LCN (LSA Control Number), RSN (Reference Symbol Number) or another recognized means of displaying an end item in hierarchical sequence. For the purpose of this task, the maintenance will be limited to that which was designed for the Organizational Level.

This can be identified by the third and fourth position of the SM&R (Source, Maintenance and Recoverability) Code. The list also includes the part number, CAGE (Commercial and Government Entity) Code and NSN (National Stock Number).

When an item coded for Organizational maintenance is identified, the drawing package, technical manual, data block tree or similar documentation may have to be consulted to ensure that fault detection, fault isolation and corrective action is within Organizational maintenance. If an FMEA has been done, it should be the first source to determine the mode of failure or modes of failure attributable to the item in its application. Each failure mode must be independently analyzed for the severity of impact on the end item associated with the failure. All other parts are assumed to be operational when the failure occurs. Secondary failures or failures which are induced by the failure of a related part should be considered as independent events. Severity should be assessed as follows:

Castrophic/Critical;	Immediate loss of at least one primary function or the result of an immediate potential hazard which can cause serious injury or death.
Marginal:	Reduced capability or degraded performance of at least one primary function.
Minor:	No loss of capability or performance, however, the failure will result in an unscheduled maintenance action.

Since each failure mode is identified and analyzed as an independent event, each part may fit more than one definition of severity. When this occurs, the MEC assignment will be made according to the most severe failure mode. The most severe failure mode must be reasonably probable. It will normally be a single point failure and not be caused by an unlikely chain of events.

Each level of indenture must be assessed independently. The importance of a part can be equal to, or less than, the relative importance of the next higher assembly. Additionally, whenever an item is assigned MEC 3 all lower identical parts are MEC 3. The order of MEC importance in descending order is as follows:

MEC 5, MEC 1, MEC 8, MEC 7, MEC 9, MEC 3

The following information is intended to amplify definitions and provide an example of each MEC code. Again the example end item is an automobile. Most end items will be defined by the related APL (Allowance Parts List).

MEC 5

An MEC 5 will be assigned to an item which meets all of the following conditions:

- o It's failure, when it is expected to be functioning, will subject a person operating or maintaining the end item to an immediate risk of death or injury.

o Any risk will not be dependent on the occurrence of some second event following the failure of the part being examined but will be created solely by its failure.

o The failure must be immediately detectable making the availability of a spare critical to safe resumption of operations or maintenance.

Example:

An example of an MEC 5 is the hood counterbalance spring. The automobile continues to function as intended with the broken spring. Note that MECs of 1, 7, 8, 9 or 3 do not apply. The assignment of an MEC 3 would have applied, but, the mechanic should not attempt to service the engine until the spring is replaced and maintenance can be performed safely under the hood.

The hazard lights on the automobile do not meet the criteria for an assignment of an MEC 5, even though their intended purpose is to reduce risk to the operator. The risk would only arise with the presence of some other condition in conjunction with the failure of the hazard lights.

MEC 1

An MEC 1 will be assigned when the most severe failure mode disables at least one of the end items primary functions .

Example:

An example of an MEC 1 is a tire. A tire can be punctured such that it experiences sudden and complete deflation. Most automobile tires and rims are of such a design that the automobile can't be used without all four tires. Also note that tires have multiple modes of failure. A tire's useful life can be 40 or 50 thousand miles. It wears gradually. Although the tire is designed to wear gradually, there is a reasonable chance of sudden puncture. Therefore, an assignment of an MEC 1 is appropriate.

MEC 8

An MEC 8 will be assigned to an item which is associated with designed redundancy or alternatives. Ordinarily, the failure of the item would disable the end item in at least one of it's primary functions, however, because of the redundant design, the end item is still capable of performing but at reduced capacity. The intent of the MEC 8 is to provide a recognition of the redundancy and to respect the design integrity. An additional condition is that the failure must be within normal maintenance capability.

Example:

An example of an MEC 8 is a failure of the overdrive gear in a standard transmission. Although the automobile can still continue to function the designed capability of the automobile is reduced as the lower gearing ratio limits the potential speed and will increase the stress on the engine at high speeds. Although a detectable failure has occurred, the automobile is still able to function, albeit at a reduced capability.

MEC 7

An MEC 7 will be assigned to an item which meets all of the following conditions:

- o The item is not associated with redundancy.
- o Its primary failure modes are not sudden, but gradual in nature as deterioration or reduced functioning over time.
- o It's deterioration or reduced performance is detectable as it is occurring, allowing for the ordering and receipt of a replacement part prior to the installed unit deteriorating to the point that its performance is no longer acceptable.
- o The rate of deterioration is such that normal, direct turnover supply response times will allow a requisitioned part to be received prior to total failure.
- o At it's final, fully deteriorated state, it will disable the end item in at least one of its primary functions.

Example:

An example of an MEC 7 is an oil seal on the crankshaft. Normal failure of the seal is gradual development of an oil leak past the seal, with evidence being an accumulation of an oil spot. The engine can continue to be operated in this condition, perhaps requiring more frequent replenishment of oil, but the replacement of the seal can be deferred.

MEC 9

An MEC 9 is also associated with redundancy. However, the assignment of the MEC 9 will be based upon all of the following:

- o The failure of the item will not immediately diminish any capability or performance applicable to a primary function of the end item.
- o The failure is recognizable at the instant it occurs.
- o The failure mode is independent and will not lead to a series of secondary failures.

Example:

An example of an MEC 9 is the failure of the low beam front headlight. The automobile still retains the use of two high beams as well as the other low beam. The headlight is properly assigned an MEC 9.

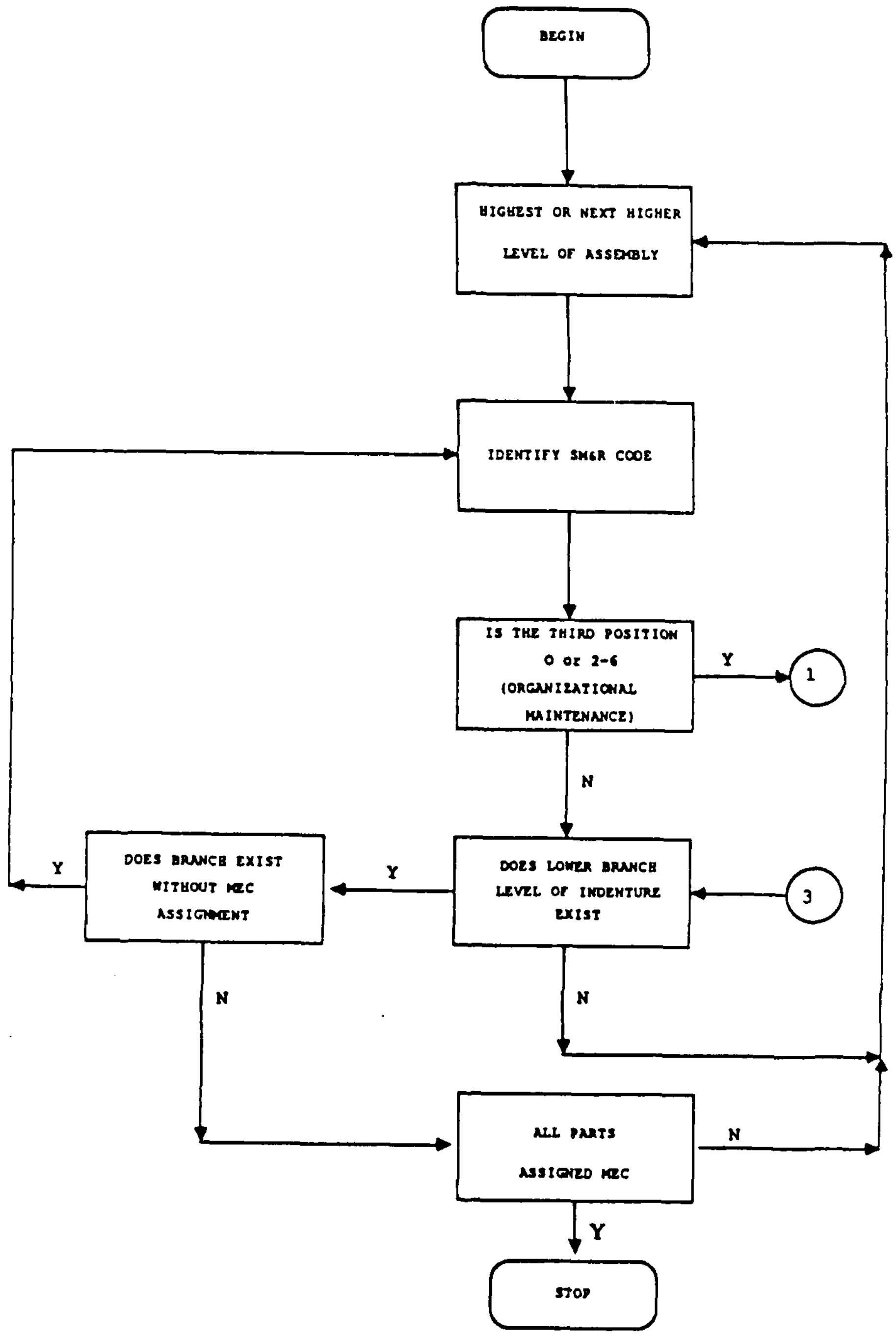
MEC 3

An MEC 3 will be assigned to an item whose failure does not impair any primary function since the function of this part is not associated with any primary function. However, the failure will result in an unscheduled maintenance action.

Example:

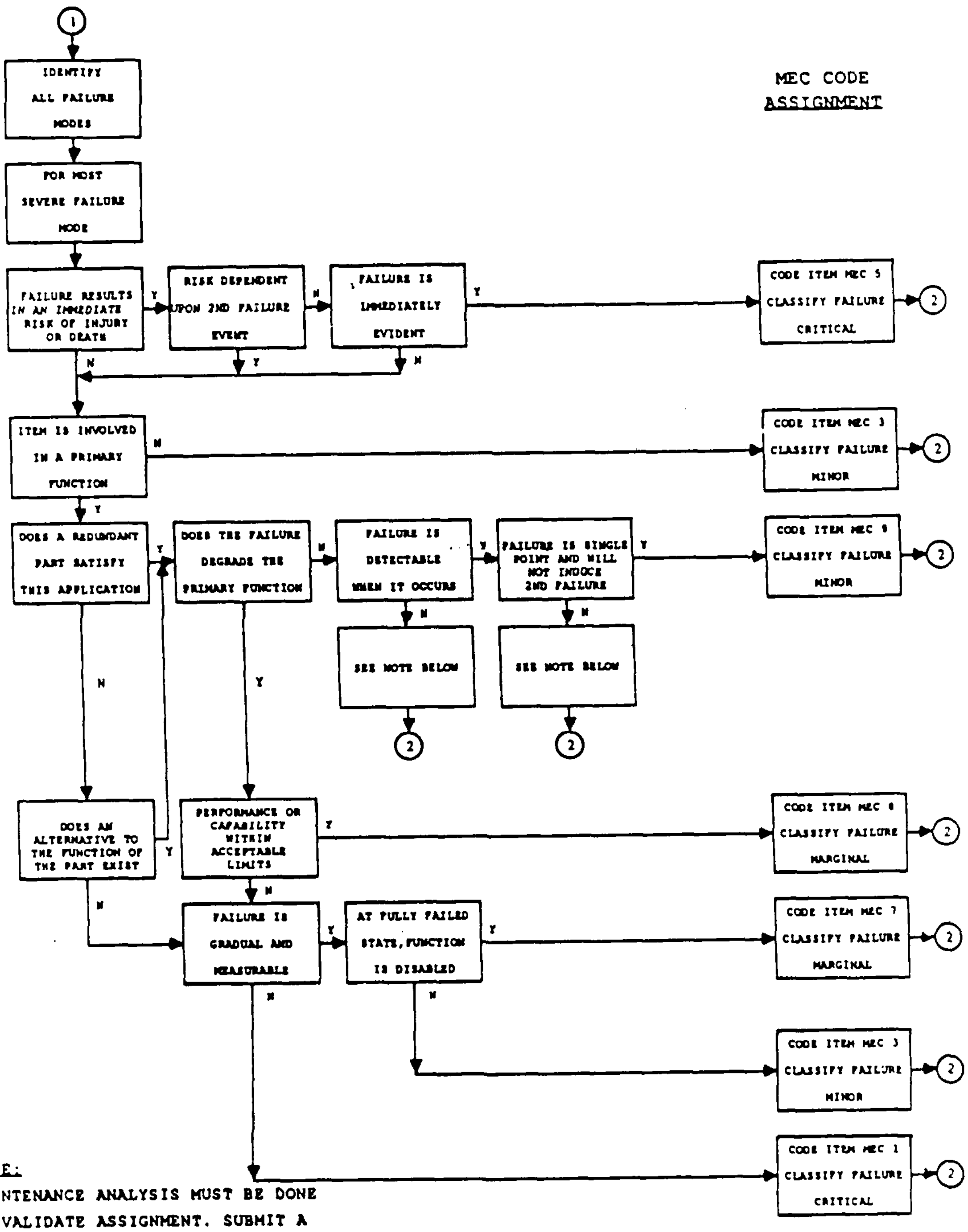
An example of a MEC 3 is the turn signal flasher which, when not working, does not impair any of the automobiles primary functions.

IDENTIFYING AND CLASSIFYING PART FOR MEC ASSIGNMENT



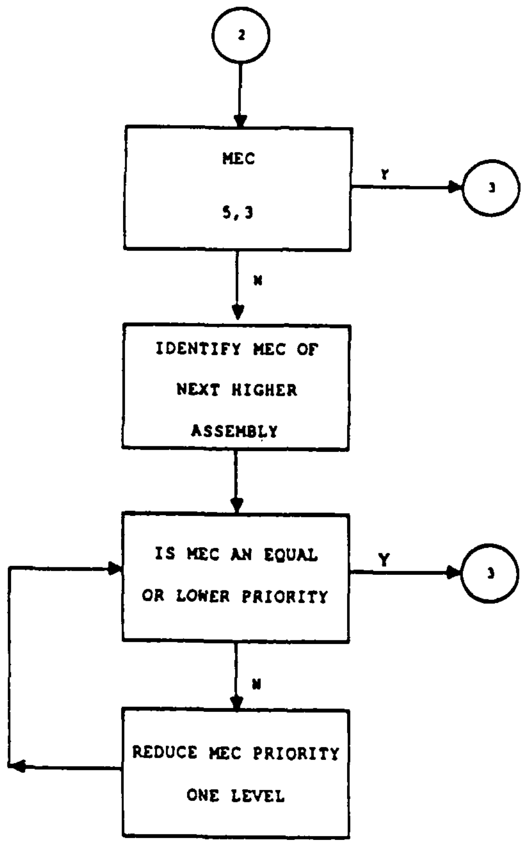
6

DETERMINATION OF MEC CODE



NOTE:
MAINTENANCE ANALYSIS MUST BE DONE TO VALIDATE ASSIGNMENT. SUBMIT A SEPARATE REPORT FOR EACH OCCURRENCE.

HIERARCHICAL MEC CONSISTENCY



APPENDIX C
MCC ASSIGNMENT PROCEDURES

Enclosures (2) through (5) of Reference 1, Naval Sea Systems Command (NAVSEA) Instruction 4441.11, Mission Criticality Codes (MCC's) for Shipboard Use, Serial 9052/2198, dated 16 February, 1985, describing the current procedures for determining MCC assignment.

MCC Assignment Procedures
(Active Fleet)

Step 1 - Establish a Mission Criticality Code Matrix File (MCCMF) of all MCCs assigned to active fleet or recent new construction ships as a result of CASREP analyses or other tasking. This file, approved for development by NAVSEA in 20 November 1981, currently exists for the majority of active fleet ships and links Equipment Identification Code (EIC) to MCC to ship, ship type and/or class. MCCs presently included in the MCCMF for active fleet ships were approved on a total ship basis by the cognizant NAVSEA Ship Acquisition Program Manager (SHAPM) or Ship Logistic Manager (SLM) using separate review procedures. Additional active fleet ships added to the MCCMF shall utilize similar review procedures until the new construction/major conversion procedures described in Enclosure (2) take effect. The MCCMF shall be used for both direct "on-line" retrieval of data and batch processing of information when required. (Note: For future new construction programs, the MCCMF shall link functional group code (FGC) to MCC to ship, ship type and/or class.)

Action: NAVSEALOGSUPENGACT Assist: SPCC

Step 2 - Upon receipt of a ship's Configuration Change Form (CCF) (OPNAV Form 4790/CK) from an active fleet ship which covers a configuration change or addition, ensure that the correct EIC and/or FGC (when authorized) has been included on the CCF prior to forwarding the change to the Ships Parts Control Center (SPCC).

Action: NAVSEACEN

Step 3 - Using the MCCMF, assign MCCs to each CCF prior to loading the configuration change into the Weapon Systems File (WSF).

Action: SPCC

Step 4 - If the MCC cannot be determined based on guidance contained in the MCCMF, assign an MCC of either "T" or "Z" to enable the data on the OPNAV Form 4790/CK to be introduced immediately into the WSF. A "T" (denoting temporary) shall be used to identify 4790/CK entries where the EIC (or FGC) is complete but no MCC policy guidance exists in the MCCMF for the system or equipment. A "Z" shall be used where the EIC (or FGC) submitted on the 4790/CK form is not sufficiently complete to permit the configuration change to be identified to an MCC in the MCCMF. Pass all MCC "Ts" to NAVSEALOGSUPENGACT for review and all MCC "Zs" to the NAVSEACENs for further EIC (or FGC) assignment and resubmittal.

Action: SPCC

Step 5 - Review MCC "Ts" passed in step 4 to determine if MCCs can be assigned based on information available at NAVSEALOGSUPENGACT but not yet included in the MCCMF. Pass all MCCs which cannot be assigned and are not the responsibility of NAVSEALOGSUPENGACT to the appropriate NAVSEA Life Cycle Manager for initial assignment of MCC.

Action: NAVSEALOGSUPENGACT

Step 6 - Assign MCCs to all temporary entries received in step 5, prepare cover letter to NAVSEALOGSUPENGACT, and forward to the cognizant Ship Logistic Manager (SLM) for final approval.

Action: NAVSEA Life Cycle Manager

Step 7 - Approve MCC assignment and release cover letter to NAVSEA-LOGSUPENGACT.

Action: SLM

Step 8 - Provide listings of all "T" and "Z" coded MCCs every six months to either NAVSEALOGSUPENGACT or NAVSEACENs, as appropriate, for review.

Action: SPCC

Step 9 - Review all "T" coded MCCs at no less than six months intervals to monitor timely MCC assignment by the appropriate NAVSEA SLM.

Action: NAVSEALOGSUPENGACT

Step 10 - Review all "Z" coded MCCs at no less than six month intervals to ensure that EIC (or FGC) voids have been filled.

Action: NAVSEACENs

Step 11 - Treat MCC "Ts" and "Zs" as MCC "1s" if they cannot be converted to proper MCCs at the time of Coordinated Shipboard Allowance List (COSAL) production. Retain the MCC "Ts" and

"Zs" on file until the correct MCC value has been assigned. This action will ensure that the equipments involved shall, as a minimum, receive support equivalent to that currently provided by the Fleet Logistic Support Improvement Program (FLSIP) COSAL computational model.

Action: SPCC

MCC Assignment Procedures
(New Construction, Major Conversion)

Steps 1 through 6 - Applicable to New Construction Only

Step 1 - Advise the Naval Sea Systems Command Logistic Support Engineering Activity (NAVSEALOGSUPENGACT) of any new ship type (including TOP Level Requirements as established by the Chief of Naval Operations (CNO) for which Mission Criticality Code (MCC) assignments are planned.

Action: Ship Acquisition Program Manager (SHAPM)

Step 2 - Provide the SHAPM and designated Ship Design Agent (SDA) for contract design with hard copy printouts of a prototypical list of MCCs that have previously been assigned to systems/equipments on similar ship types/classes based on Casualty Reporting (CASREP) data or other analyses conducted on recent new construction ships.

Action: NAVSEALOGSUPENGACT

Step 3 - Perform a Reliability, Maintainability and Availability (RM&A) analysis and assign Functional Group Codes (FGCs) and MCCs to systems and major equipments. FGCs will be assigned in accordance with the Class Standard Expanded Ship Work Breakdown Structure (ESWBS) Manual. Data provided in Step ˜ and other available resources (e.g. TIGER model simulations) may be used as guidance in the assignment of MCCs. Incorporate FGC and MCC assignments into Appendix A of the Class Standard Manual developed for the new construction program.

Action: Ship Design Agent responsible for contract design

Step 4 - After coordination of MCC assignments with the appropriate Participating Authority Requirements Managers (PARMs) and equipment Life Cycle Managers (LCMs) submit Appendix A of the Class Standard Manual to the CNO platform manager for MCC approval and subsequent incorporation into the applicable OPNAV "Plan for Use" Instruction.

Action: SHAPM

Step 5 - Use the approved Appendix A of the Ship Class Manual to assign MCCs to subordinate equipments associated with the parent system or equipment. Include MCC Assignments on the Functional Configuration Baseline Index authorized for development on new construction ships.

Action: Contractor (Shipbuilder)

Step 6 - Incorporate the approved Appendix A of the Ship Class Manual into the MCC Matrix File (MCCMF). This file, approved for development by NAVSEA in November 1981, shall, for new construction ships, link FGC to MCC to ship, ship type and/or class. (Note: If the Equipment Identification Code is designated as the approved functional identifier in selected new construction programs in lieu of the FGC, the MCCMF shall be based on an EIC to MCC linkage.) Based on approved NAVSEA policy, the MCCMF shall be used to assign MCCs to all Fitting-Out Management Information System (FOMIS) inputs subsequently received from the contractor (shipbuilder) prior to their inclusion into the Weapon Systems File (WSF). The MCCMF shall also be capable of providing direct "on-line" retrieval of data and/or batch processing of information where required.

Action: NAVSEALOGSUPENGACT Assist: SPCC

Steps 7 through 11 - Applicable to Major Conversion Only

Step 7 - Advise NAVSEALOGSUPENGACT of any major conversion program for which significant MCC revisions are planned.

Action: SHAPM

Step 8 - Provide the SHAPM with tape and hard copy printouts of the MCCMF previously established for the conversion ship based on CASREP or other data used to initially assign MCCs.

Action: NAVSEALOGSUPENGACT

Step 9 - Review the data provided in Step 8 and revise MCCs, as necessary, to conform to configuration and/or mission changes resulting from the conversion. Assign MCCs to all new systems and equipments not previously installed. Coordinate MCC assignments with Participating Authority Requirements Managers (PARMs) and Life Cycle Managers (LCMs) as required. Forward all revisions to NAVSEALOGSUPENGACT for update of the MCCMF.

Action: SHAPM

Step 10 - Update the MCCMF based on data provided by the SHAPM in Step 9.

Action: NAVSEALOGSUPENGACT Assist: SPCC

Step 11 - If the scope of the conversion requires a revision to the applicable OPNAV "Plan for Use" Instruction, submit a matrix of all new and changed MCCs to the CNO platform manager for incorporation into the new revision.

Action: SHAPM

Remaining steps applicable to both New Construction and Major Conversion Ships

Step 12 - Incorporate information on approved MCCs in all applicable Ship Project Directives (SPDs) issued to PARMs which involve essentiality coding. Maintain a record of approved MCCs for subsequent use by PARMs and LCMs in the development of Program Support Data Sheets (PSDs).

Action: SHAPM

Step 13 - Submit FOMIS inputs in accordance with the data element content and format as defined in the Fitting-Out Management Information System (FOMIS) Requirements Statement (FRS). Each FOMIS input shall include the Functional Group Code (FGC) and/or Equipment Identification Code (EIC) (when authorized). MCCs need not be included in FOMIS inputs for new construction and major conversion ships since they will be assigned by the MCCMF previously established or updated as described in Steps 6 or 10.

Action: Contractor (Shipbuilder)

Step 14 - Pass all FOMIS inputs through the MCCMF to identify the correct MCC to be loaded into the WSF.

Action: SPCC Assist: NAVSEALOGSUPENGACT

Step 15 - If the MCC cannot be determined based on the guidance contained in the MCCMF, assign an MCC of either "T" or "Z" to enable the FOMIS input to be introduced immediately into the WSF. A "T" (denoting temporary) shall be used to identify FOMIS entries where the FGC and/or EIC (where authorized) is complete but no MCC is included in the MCCMF for that particular system or equipment. A "Z" shall be used where the FGC and/or EIC is incomplete or missing and prevents identification to a valid MCC in the MCCMF. Pass all MCC "Ts" or "Zs" to NAVSEALOGSUPENGACT for review.

Action: SPCC

Step 16 - Review MCC "Ts" and "Zs" passed in Step 15 to determine if MCCs can be assigned based on information available at NAVSEALOGSUPENGACT but not yet included in the MCCMF. Pass all items for which MCCs cannot be assigned to the SHAPM for decision.

Action: NAVSEALOGSUPENGACT

Step 17 - Assign MCCs to all "T" and "Z" entries received in Step 16 and forward to NAVSEALOGSUPENGACT.

Action: SHAPM

Step 18 - Forward MCCs received in Step 17 to SPCC for inclusion in the MCCMF and WSF.

Action: NAVSEALOGSUPENGACT

Step 19 - Develop and submit to the appropriate NAVSEA coordinator, initial equipment program data in the form of PSD sheets as soon as the acquisition program is approved. PSD sheets shall include MCCs previously approved and provided by the SHAPM in Step 12. Submit changes to the basic PSDs as revisions occur.

Action: PARMs and LCMs

Step 20 - Screen all MCCs on PSDs received from acquisition managers against the MCCMF to ensure that the MCC conforms to previous guidance received. Submit all discrepancies to NAVSEALOGSUPENGACT for reconciliation.

Action: SPCC

Step 21 - Reconcile all MCC discrepancies received in Step 20 with the SHAPM and advise SPCC on a final decision in time to support budget submission - one month prior to SPCC on-site budget hearings.

Action: NAVSEALOGSUPENGACT

MCC Assignment Procedures
(Alterations)

Step 1 - Establish a Mission Criticality Code (MCC) Matrix File of all MCCs assigned to active fleet or recent new construction ships as a result of either CASREP analyses or other tasking. This file, approved for development by NAVSEA in November 1981, currently exists for the majority of active fleet ships and links Equipment Identification Code (EIC) to MCC to ship, ship type and/or class. The MCCMF shall be used for both direct "on-line" retrieval of data and batch processing of information when required. (Note: For future new construction programs, the MCCMF shall link Functional Group Code (FGC) to ship, ship type and/or class.

Action: NAVSEALOGSUPENGACT Assist: SPCC

Step 2 - Using the MCCMF, assign MCCs to each configuration input received prior to loading the configuration change into the Weapon Systems File (WSF). Summary Listing of Component Changes (SLCCs) submitted prior to Start of Overhaul (SOH) by the Naval Supervising Activity (NSA) shall be processed in accordance with current Integrated Logistics Overhaul (ILO) schedules and the MCCs incorporated into the SOH Coordinated Shipboard Allowance List (COSAL). Where two COSALs have been authorized (i.e., where the duration of the overhaul period warrants the publication of both an SOH COSAL and a Load COSAL), all SLCCs received prior to the Load COSAL cut-off shall be processed against the MCCMF and included in the Load COSAL. All such data shall be incorporated in the post overhaul COSAL Index published at End-of-Overhaul (EOH) plus 120 days.

Action: SPCC

Step 3 - If an MCC cannot be determined based on guidance contained in the MCCMF, assign an MCC of either "T" or "Z" to enable the data on the SLCC to be introduced immediately into the WSF. A "T" (denoting temporary) shall be used to identify SLCC entries where the EIC (or FGC) is complete but no MCC policy guidance exists in the MCCMF for the system or equipment. A "Z" shall be used where an incomplete or missing EIC (or FGC) prevents identification to an MCC in the MCCMF. Pass all MCC "Ts" and "Zs" to NAVSEALOGSUPENGACT for review.

Action: SPCC

Step 4 - Review MCC "Ts" and "Zs" to determine if MCCs can be assigned based on information available at NAVSEA-LOGSUPENGACT but not yet included in the MCCMF. Pass all items for which MCCs cannot be assigned and are not the the responsibility of NAVSEALOGSUPENGACT to the appropriate NAVSEA Life Cycle Manager for decision.

Action: NAVSEALOGSUPENGACT

Step 5 - Assign MCCs to all "T" and "Z" entries received in step 4, prepare cover letter to NAVSEALOGSUPENGACT, and forward to the cognizant Ship Logistic Manager (SLM) for final approval.

Action: NAVSEA LCM

Step 6 - Approve MCC assignment and release cover letter to NAVSEALOGSUPENGACT.

Action: SLM

Step 7 - Provide listings of all "T" and "Z" coded MCCs every six months to NAVSEALOGSUPENGACT.

Action: SPCC

Step 8 - Review all "T" and "Z" coded MCCs at no less than six month intervals to monitor timely assignments of permanent MCCs by the appropriate NAVSEA SLM.

Action: NAVSEALOGSUPENGACT

Step 9 - Treat MCC "Ts" and "Zs" as MCC "1s" if they have not been converted to permanent MCCs at the time of COSAL production. Retain the MCC "Ts" and "Zs" on file until the correct MCC value has been assigned. This action will ensure that the equipment involved shall, as a minimum, receive support equivalent to that currently provided by the Fleet Logistic Support Improvement Program (FLSIP) COSAL computational model.

Action: SPCC

Steps 10 and 11 are applicable to MCCs for equipments and components that could not be incorporated in either the SOH or Load COSAL.

Step 10 - To determine the correct repair part support required for equipments and components that could not be incorporated in either the SOH COSAL or the Load COSAL (where authorized), the following procedures shall be used locally to obtain an MCC:

a. Identify the MCCs assigned to other equipments and components installed in the same system. If all are identical, assign the same MCC. If MCCs vary within system, use the MCC that applies to equipments and components in that segment of the system in which the new equipment or component is to be installed.

b. If the new item is to be installed in a system that is not presently covered in the SOH COSAL, request NAVSEALOGSUPENGACT by letter to provide the correct MCC. Note: When real time capabilities are established for the MCCMF, direct interrogation can be accomplished by those activities having accessing hardware. In the interim, it is planned to provide users with hard copy printouts of the MCCMF which provide MCCs by EIC (or FGC) within ship/ship class.

Action: NSA

Step 11 - Furnish MCCs for all requests received within 10 days of receipt. If an MCC cannot be determined based on available guidance, assign an MCC of "T" or "Z" and advise the NSA to treat the equipment or component as a secondary mission item and procure conventional FLSIP support. Follow steps 5 through 8 for all "T" and "Z" coded MCC items and advise the NSA as soon as an MCC decision is available.

Action: NAVSEALOGSUPENGACT

MCC Assignment Procedures
(Individual Equipment Changes)

(Note: This enclosure applies to all recommendations to assign Mission Criticality Codes (MCCs) which differ from MCCs previously approved by Ship Acquisition Program Managers (SHAPMs) or Ship Logistic Managers (SLMs). Steps 1 through 8 apply to fleet recommendations; steps 9 through 16 apply to Participating Authority Requirements Managers (PARMs), Life Cycle Managers (LCM), In-Service Engineering Agents (ISEAs) or other authorized activity recommendations.)

Steps 1 through 8 - Applicable to Fleet Recommendations

Step 1 - Forward an Allowance Change Request (ACR) (NAVSUP 1220-2) prepared in accordance with NAVSEAINST 4441.2 for all proposed MCC changes which differ from approved MCCs. ACRs shall include full justification for the change and shall be forwarded to the appropriate TYCOM.

Action: Active Fleet Ships

Step 2 - Recommend approval or disapproval of all MCC ACRs received and coordinate with other TYCOMs as appropriate. Forward all ACR changes recommended for approval to the applicable processing control point (PCP) designated in NAVSEA Instruction 4441.2. (Note: For the majority of shipboard equipments, NAVSEALOGSUPENGACT is the applicable PCP. If the PCP is not NAVSEALOGSUPENGACT, the PCP shall be responsible for coordinating with NAVSEALOGSUPENGACT in the accomplishment of step 3.)

Action: TYCOM

Step 3 - Screen all ACRs against the MCC Matrix File (MCCMF) established for maintaining control of MCC assignments and determine if the change has not already been made as a result of previous approval action. If the MCC in the MCCMF has already been changed to conform with the ACR, advise the ship and TYCOM that the ACR is approved and to revise the COSAL accordingly. If the proposed change is at variance with the MCCMF, forward the change to the appropriate NAVSEA LCM for initial decision. Provide installed population data and the estimated cost to implement the MCC change under the Modified Fleet Logistic Support Improvement Program (MOD-FLSIP) computational rules.

Action: NAVSEALOGSUPENGACT

Step 4 - Assign initial MCCs to all ACRs provided in step 3 and forward the ACR to the appropriate SHAPM or SLM for final decision.

Action: LCM

Step 5 - Approve or disapprove MCC recommendations received in step 4. If an MCC change via ACR results in an extended dollar value increase of $25,000 or more, coordinate the change with NAVSEA 9054 to ensure funds are available to implement the change.

Action: SHAPM or SLM

Step 6 - Review all ACRs submitted by SHAPM or SLM. If funds are not available to implement a recommended MCC increase, advise the SHAPM or SLM as to what actions shall be taken to obtain the necessary funding and a best estimate of the earliest implementation date.

Action: SEA 9054

Step 7 - Forward all MCC ACR decisions to the submitting activity TYCOM, NAVSEALOGSUPENGACT, PCP (if different from NAVSEALOGSUPENGACT) and Ships Parts Control Center (SPCC) (approved ACRs only). MCC ACR decisions shall also be provided to the appropriate equipment manager. On disapproval of MCC ACRs, indicate the reason for disapproval. MCC ACR increases deferred for lack of funds shall include a best estimate of the earliest implementation date.

Action: SHAPM or SLM

Step 8 — Revise the MCCMF to reflect all approved MCC changes. MCC changes deferred for lack of funds shall not be introduced into the MCCMF until advised by the SHAPM or SLM.

Action: NAVSEALOGSUPENGACT

Step 9 - Revise all applicable files including the Weapon Systems File (WSF) to reflect all approved MCC changes. When an MCC increase causes a secondary mission equipment or component (e.g., MCC 1 or 2) to be redesignated as a primary mission equipment or component (e.g., MCC 3 or 4), provide a .10 MOD-FLSIP General Distribution Allowance Parts List (APL) to the ship(s) to enable the additional repair parts to be identified and requisitioned.

Action: SPCC

Steps 9 through 16 - Applicable to PARM, LCM, ISEA or Other Authorized Activity Recommendations

Step 10 - Submit a letter request or memorandum to the appropriate SHAPM or SLM for all proposed MCC changes which differ from currently approved MCCs. Full justification shall be provided for all recommended changes.

Action: PARM, LCM, ISEA or other authorized activity

Step 11 - Review all requests provided in step 10 and approve or disapprove, as appropriate. If the extended dollar value of the request for fleet ships is greater than $25,000, the SHAPM or SLM shall obtain the approval of SEA 9054 to ensure that funds are available to implement the change.

Action: SHAPM or SLM

Step 12 - Same as step 6.

Action: SEA 9054

Step 13 - Forward all approved MCC decisions to the submitting activity, NAVSEALOGSUPENGACT, PCP (if different from NAVSEALOGSUPENGACT) and SPCC. Return disapproved requests to the submitting activity and indicate the reason for disapproval. MCC increases deferred for lack of funds shall include a best estimate of earliest implementation date.

Action: SHAPM or SLM

Step 14 - If the disapproval by SHAPM/SLM is not concurred in, provide the SHAPM or SLM with additional justification (Note: All disputes in MCC assignments which cannot be resolved between the SHAPMs or SLMs and the submitting activity shall be forwarded to SEA 91 or 92 for final decision).

Action: PARM, LCM, ISEA or other authorized activity

Step 15 - Same as step 8.

Action: NAVSEALOGSUPENGACT

Step 16 - Same as step 9.

Action: SPCC

APPENDIX D

EXCERPT FROM THE MISSION CRITICALITY CODE MATRIX FILE (MCCMF)

Example of how the Mission Criticality Code Matrix File (MCCMF) is organized.

EIC NOMENCLATURE	EIC	LEAD EIC	AD	AE	AO	ARS	BB	CG 16	CG 26	CGN 36	CV CVN	CG 47	DDG 993	DD 963	DDG 2	FF	FFG 1	FFG 7	LCC	LHA	LKA	LPD	LPH	LST	MSC	SSN
AN/SLQ-17(XN-1), COUNTERMEASURES SET	NC07	NC16									3				1	2										
AN/SLQ-17, COUNTERMEASURES SET	NC16	NC16									3					2				1						
AN/SLQ-17A(V),COUNTERMEASURES SET	NC30	NC16									3					2										1
AN/SLQ-17A(V)1,COUNTERMEASURES SET	NC31	NC16									3					2										
AN/SLQ-19, RECEIVING SET, COUNTERMEASURE	N80M	N80M							1		3				3							2	2			
AN/SLQ-19A, COUNTERMEASURES SET	N85A	N85A									3				3							2	2			
AN/SLQ-20, COUNTERMEASURES SET	N85S	N85G						2	2		2		1		1	1	2									1
AN/SLQ-20A, COUNTERMEASURES SET	N85G	N85G			1			2	2	1	2	2			1		2									1
AN/SLQ-21(V)1, RECEIVING SET, COUNTERMEA	N85T	N85T							2																	
AN/SLQ-21(V)2, RECEIVING SET, COUNTERMEA	N85U	N85T							2																	
AN/SLQ-22(V), COUNTERMEASURES SET	NC11	NCOR							3		3											2	3			
AN/SLQ-22(V)1, COUNTERMEASURES SET	NCOG	NCOR							3		3											2	3			
AN/SLQ-22(V)2, COUNTERMEASURES SET	NCOH	NCOR							3		3											2	3			
AN/SLQ-22(V)3, COUNTERMEASURES SET	NCOJ	NCOR							3		3											2	3			
AN/SLQ-22(V)4, COUNTERMEASURES SET	NCOK	NCOR							3		3											2	3			
AN/SLQ-22A(V)1, COUNTERMEASURES SET	NCOL	NCOR							3		3											2	3			
AN/SLQ-22A(V)2, COUNTERMEASURES SET	NCOM	NCOR							3		3											2	3			
AN/SLQ-22A(V)3, COUNTERMEASURES SET	NCON	NCOR							3		3					1						2	3			
AN/SLQ-22A(V)4, COUNTERMEASURES SET	NCOP	NCOR							3		3											2	3			
AN/SLQ-22B(V)1, COUNTERMEASURES SET	NCOQ	NCOR							3		3					1						2	3			
AN/SLQ-22B(V)2, COUNTERMEASURES SET	NCOR	NCOR							3		3					1						2	3			
AN/SLQ-23(V), COUNTERMEASURES SET	NC13	NCOT								2			2							3			2			
AN/SLQ-23(V)1, CI UNTERMEASURES SET	NCOS	NCOT								2			2							3			2			
AN/SLQ 23(V)2, COUNTERMEASURES SET	NCOT	NCOT						1		2			2							3			2			
AN/SLQ-24(V), COUNTERMEASURES SET	NC14	NCOY															3						3			
AN/SLQ 24(V)1, COUNTERMEASURES SET	NCOU	NCOY															3						3			

EIC NOMENCLATURE	EIC	LEAD EIC	AD	AE	AO	ARS	BB	CG 16	CG 26	CGN 36	CV CVN	CG 47	DDG 993	DD 963	DDG 2	FF	FFG 1	FFG 7	LCC	LHA	LKA	LPD	LPH	LST	MSC	SSN
AN/SLQ-24(V)2, COUNTERMEASURES SET	NCOV	NCOY															3						3			
AN/SLQ-24A(V)1, COUNTERMEASURES SET	NCOW	NCOY															3						3			
AN/SLQ-24A(V)2, COUNTERMEASURES SET	NCOX	NCOX									1						3						3			
AN/SLQ-24B(V)1, COUNTERMEASURES SET	NCOY	NCOY														1	3						3			
AN/SLQ-25, TRANSMITTING SET, TORPEDO CM,	NB06	NB06		1	1		2	1	2	2	2	2	2	2	2	2	2	2	1	1		2	2			
AN/SLQ-26(V)(2), COUNTERMEASURES SET	N87D	N87D						2	3		3				3								2			
AN/SLQ-26(V)(4), COUNTERMEASURES SET	N87E	N87D						2	3		3				3								2			
AN/SLQ-26(V)(7), COUNTERMEASURES SET	N87F	N87D						2	3		3				3	1							2			
AN/SLQ-26(V), COUNTERMEASURES SET	N85B	N85B						2	3	1	3		1		3								2			
AN/SLQ-26(V)1,COUNTERMEASURES SET	N86V	N87D						2	3		3				3								2			
AN/SLQ-26(V)10,COUNTERMEASURES SET	N87B	N87D						2	3		3				3								2			
AN/SLQ-26(V)3,COUNTERMEASURES SET	N86W	N87D						2	3		3				3								2			
AN/SLQ-26(V)5,COUNTERMEASURES SET	N86X	N87D						2	3		3				3								2			
AN/SLQ-26(V)6,COUNTERMEASURES SET	N86Y	N87D						2	3		3				3								2			
AN/SLQ-26(V)8,COUNTERMEASURES SET	N86Z	N87D						2	3		3				3								2			
AN/SLQ-26(V)9,COUNTERMEASURES SET	N87A	N87D						2	3		3				3								2			
AN/SLQ-28(V), COUNTERMEASURES SET	N917	N917							2																	
AN/SLQ-28(V)1	N91B	N917							2						1											1
AN/SLQ-28(V)2	N91C	N917							2																	
AN/SLQ-31B(V)( ),COUNTERMEASURES SET	N878	N878																		1						
AN/SLQ-32( ),COUNTERMEASURES SET	N879	N879	1	2	2		3	4	3	3		1	3	3	3	2	3	3	4	4	2	2	3	1		
AN/SLQ-32(V)1 COUNTER-MEASURES SET	N87H	N879		2	2			4	3	3			3	3	3	2	3	3	4	4	2	2	3	1		
AN/SLQ-32(V)2 COUNTER-MEASURES SET	N87J	N879		2	2		3	4	3	3			3	3	3	2	3	3	4	4	2	2	3			
AN/SLQ-32(V COUNTER-MEASURES SET	N87K	N879		2	2		3	4	3	3		3	3	3	3	2	3	3	4	4	2	2	3			
AN/SLQ)17A(V)2 ECM SET	NC34	NC16									3					2										
AN/SLR-12(XN-1),RECEIVING SET,COUNTERMEA	N80Y	N80Y			2			3	3	2	2		2		2	2			2	2		2	2			

APPENDIX E

MESM EXCERPT

Excerpt from Reference 8, Chief of Naval Operations (OPNAV) Instruction 5442.4L, Aircraft and Training Devices Material Condition Definitions, Mission-Essential Subsystems Matrices (MESMS), and Mission Descriptions, Serial OP-515, dated 15 October, 1987, giving the procedures for assigning Equipment Operation Capability (EOC) codes.

F/A-18A/B
TYPE EQUIPMENT CODES: AMAA, AMAC

Do not assign an EOC code if all equipment is operational. The aircraft is OPC.

Assign alpha character (B) of the EOC code when the following system(s) are inoperative. The aircraft is FMC, M or S.

EXTERNAL POWER SYSTEM	
TAXI LIGHT	
CLOCK	
MAGNETIC COMPASS (AQU-3/A)	
AUTOMATIC DIRECTION FINDER SET	
VIDEO TAPE RECORDER	(NOTE 1)
STRIKE CAMERA SYSTEM	(NOTES 1,2)

Assign alpha character (C) of the EOC code when the following system(s) are inoperative preventing the escort/strike mission. The aircraft is not capable of independent detection and destruction of aircraft/missiles under all-weather conditions or providing protective escort for strike and support forces using all air-to-air weapons in a multi-threat ECM environment. The aircraft is PMC, M or S.

WEAPON SYSTEM CONTROL FUNCTION (HOTAS)	(NOTES 3,4)
MISSILE ILLUMINATION GROUP SPARROW	
SPARROW MISSILE EJECTOR LAUNCHER	
LAU-116	(NOTES 1,2)

Assign alpha character (D) of the EOC code when the following system(s) are inoperative preventing the strike mission. The aircraft is not capable of conducting interdiction or war-at-sea missions using all weapons and delivery modes compatible with aircraft regardless of terrain, weather or enemy defenses. The aircraft is PMC, M or S.

AMAC SYSTEM	(NOTE 1)

Assign alpha character (J) of the EOC code when the following system(s) are inoperative preventing the visual attack mission. The aircraft is not capable of conducting missions under VMC, using system deliveries of conventional ordnance, conducting anti-radiation missile strike support, close air support for friendly forces with forward air controller. The aircraft is PMC, M or S.

RADAR LIQUID COOLING SYSTEM
ANTI-G SUIT PRESSURE
EW THREAT DISPLAY

F/A-18A/B (cont)

HORIZONTAL INDICATOR	
RADAR SET (APG-65)	(NOTE 4)
ACM (AWG-25)(HARM)	(NOTE 5)
ARMAMENT CONTROL PROC SET	
SELECTIVE STORES JETTISON SYSTEM	
LASER SPOT TRACKER AND ADAPTER	(NOTES 1,2)
FLIR POD AND ADAPTER	(NOTES 1,2)
SIDEWINDER MISSILE SYSTEM	
SIDEWINDER LAUNCHERS (LAU-7A)	(NOTE 1)
WEAPON RELEASE RACKS (BRU-32/A)	(NOTE 1)
WING PYLONS (SUU-63)	(NOTE 1)
CENTERLINE PYLON (SUU-62)	(NOTE 1)
PALLETIZED GUN SYSTEM (M61A1)	(NOTE 2)
THREAT WARNING LIGHT DISPLAY GROUP	
RADAR WARNING RECEIVER (ALR-67)	(NOTE 1)
CHAFF COUNTERMEASURES SET (ALE-39)	(NOTE 1)
COUNTERMEASURES SET (ALQ-126)	(NOTE 1)

Assign alpha character (K) of the EOC code when the following system(s) are inoperative preventing the expanded mobility mission. The aircraft is not capable of safe movement on and off CV/SATs during day, night and inclement weather conditions, conducting independent navigation, using encrypted radio voice communications and IFF, or in-flight refueling (receive). The aircraft is PMC, M or S.

BOARDING LADDER DRAG BRACE	
CATAPULT SYSTEM	
WING FOLD	
AIR REFUELING PROBE FLOOD LIGHT	
AIR REFUEL PROBE	
APPROACH POWER COMPENSATOR SYSTEM	
ANGLE-OF-ATTACK SYSTEM AND INDEX LIGHTS	
RECEIVER TRANSMITTER PROCESSOR (RT-1379/ASW)	(NOTE 6)
SECURE IFF (KIT 1A)(MODE 4)	(NOTE 1)
SECURE VOICE (KY-58)	(NOTE 1)
ILS RECEIVER/DECODER (ARA-63)	(NOTE 6)
RADAR BEACON (APN-202)	(NOTE 6)
SECONDARY POWER SUPPLY (APU)	

Assign alpha character (L) of the EOC code when the following system(s) are inoperative preventing the IMC flight mission. The aircraft is not capable of day or night IMC field flight operations with necessary communications, IFF, navigation, flight and safety systems required by applicable NATOPS and FAA regulations. The aircraft is PMC, M or S.

INTERIOR LIGHTING

F/A-18A/B (cont)

EXTERIOR LIGHTING (POSITION AND FORMATION)	(NOTE 7)
WINDSHIELD ANTI-ICE AND RAIN REMOVAL	
WHEEL ANTI-SKID CONTROL SYSTEM	
ENGINE ANTI-ICE SYSTEM	
PITOT/ANGLE-OF-ATTACK PROBE HEATER SYSTEM	
UP FRONT CONTROL	
IFF TRANSPONDER (APX-100(V))	
TACTICAL NAVIGATION SET (ARN-118(V))	
ELECTRONIC ALTIMETER (APN-194(V))	
MISSION COMPUTERS (AYK-14)	(NOTE 8)

Assign alpha character (Z) of the EOC code when the following system(s)/condition(s) prevent the aircraft from being safely flyable. The aircraft is not capable of day, field flight operations under VMC with two-way radio communication and necessary aircraft and crew safety provisions. The aircraft is NMC, M or S.

AIRFRAME	
FUSELAGE COMPARTMENTS	
LANDING GEAR	
EMERGENCY/PARKING BRAKE	
FLIGHT CONTROLS	
ENGINES	
POWER PLANT INSTALLATION	
AIR CONDITIONING/PRESSURIZATION	
ELECTRICAL SYSTEMS	
LIGHTING SYSTEMS (ANTI-COLLISION LIGHT) (2 MINIMUM)	
HYDRAULIC/PNEUMATIC SYSTEM	
FUEL SYSTEM (FUSELAGE AND WINGS)	
OXYGEN SYSTEMS	
MISCELLANEOUS UTILITIES	
INSTRUMENTS/INSTRUMENT SYSTEM (WUC 51 SERIES)	(NOTE 9)
FLIGHT REFERENCE	(NOTE 10)
INTEGRATED GUIDANCE AND FLIGHT CONTROL	
MAINTENANCE SIGNAL DATA RECORDER SET	
UHF COMMUNICATION SYSTEMS	(NOTE 11)
ICS (F/A-18B)	
EMERGENCY RADIO	
CSC	
BOMBING NAVIGATION (INS)	
WEAPON CONTROL (HEAD-UP DISPLAY, MULTI-PURPOSE DISPLAY GROUP)	(NOTE 12)
WEAPON DELIVERY	(NOTE 2)
EMERGENCY EQUIPMENT	

F/A-18A/B (cont)

DECELERATION EQUIPMENT/DROGUE PARACHUTE
EXPLOSIVE DEVICES
EMI PROTECTION DEVICES (NOTE 13)
CONDITIONAL INSPECTION
ENGINE INSPECTION
SPECIAL INSPECTION
PHASE INSPECTION
CORROSION INSPECTION
TECHNICAL DIRECTIVE COMPLIANCE

NOTES:

1. WHEN THE EQUIPMENT IS INSTALLED, REPORT ON THE COMPLETE SYSTEM. IF THE EQUIPMENT IS NOT INSTALLED, REPORT ON THE WIRING AND PLUMBING ONLY.
2. EQUIPMENT INSTALLED OR BLANK-OFF AS REQUIRED FOR SAFELY FLYABLE AIRCRAFT.
3. ONLY REQUIRED FOR SPECIAL WEAPONS CAPABILITY.
4. ALL AIR-TO-AIR, ACM, AND AIR-TO-GROUND MODES.
5. REQUIRED WHEN CARRYING HARM WEAPONS.
6. DATA LINK/RADAR BEACON SET OR ILS REQUIRED FOR ADVERSE WEATHER CARRIER LANDINGS, BUT NOT BOTH. RADAR BEACON SET IS REQUIRED FOR FULLY AUTOMATIC CARRIER LANDINGS (MODE 1).
7. ONLY REQUIRED TO BE CODED (L) IF LESS THAN TWO (2) POSITION LIGHTS AND THREE (3) FORMATION LIGHTS ARE OPERABLE ON EACH SIDE OF AIRCRAFT.
8. BOTH REQUIRED FOR MISSIONS A, B, C, D, J AND K; NUMBER ONE MISSION COMPUTER REQUIRED FOR MISSION L.
9. INCLUDES: PRESSURE ALTIMETER (BOTH STANDBY AND RESET MODES), AIRSPEED INDICATOR, ATTITUDE REFERENCE INDICATOR, VERTICAL SPEED INDICATOR.
10. INCLUDES: AIR DATA COMPUTER EQUIPMENT, MAGNETIC AZIMUTH DETECTOR.
11. BOTH RADIO SETS REQUIRED FOR MISSIONS A, B, C AND D; ONLY ONE OF TWO RADIO SETS IS REQUIRED TO BE OPERATIONAL FOR MISSIONS J, K AND L.
12. HUD, LEFT AND RIGHT DDI, KI REQUIRED FOR MISSIONS A, B, C AND D. HUD AND LEFT DDI REQUIRED FOR MISSIONS J, K AND L.
13. ALL ELECTROMAGNETIC INTERFERENCE (EMI) PROTECTION DEVICES SHALL BE MAINTAINED WITHIN LIMITS SPECIFIED IN THE APPROPRIATE TECHNICAL MANUALS.

APPENDIX F

COPY OF VIDS/MAF

Copy of the Visual Identification Display System/Maintenance Action Form (VIDS/MAF), showing the placement of Equipment Operation Capability codes and part numbers (NSN's) on the form.

No. LPE 8403

COPY 1

5 PART FORM

USE BALL-POINT PEN PRESS HARD

ENTRIES REQUIRED SIGNATURE

NONE LOGS REC

☐ ☐ ☐

WORK CENTER REGISTER, CONTROL AND PROCESSING COPY

VIDS/MAF OPNAV 4790/60 (REV 2-82) S/N 0107-LF-047 9304

LOCAL USE

REFERENCE

ACCUMULATED WORK HOURS				
NAME/SHIFT	TOOL BOX	DATE	MAN HOURS	ELAPSED M/T

ACCUMULATED AWM HOURS			
DATE	TIME	REASON	HOURS

(H-Z) FAILED/REQUIRED MATERIAL

79 INDEX	08 F/P	09 AWP	10 A/T	11 MAL	14 MFGR	19 PART NUMBER	34 REF SYMBOL	41 QTY	PROJ	43 PRI	45 DATE ORD	49 REQ NO	53 DATE REC
	☐	☐											
	☐	☐											
	☐	☐											
	☐	☐											
	☐	☐											
	☐	☐											
	☐	☐											

FOLD

TECHNICAL DIRECTIVE IDENTIFICATION

A03 WORK UNIT CODE | A26 ACTION ORG | A32 TRANS | A34 ... | A35 ACT TAKEN | A36 MAL CODE | A39 ITEMS/P | A41 MAN HOURS | A45 ELAPSED M/T | FOD | TD CODE | F11 BASIC NO | F15 | F16 | F17 | F18

A46 TYPE EQUIP | A52 BU/SER NUMBER | A58 | A59 | A60 POSN | A62 FID | A65 SAFETY/EI SER | A69 METER | SE MFGR | F21 | F22 ... INVENTORY | F26

REPAIR CYCLE

	DATE	TIME	EOC
RECEIVED	B08	B12	B16
IN WORK	B19	B23	B27
COMPLETED	B30	B34	

AWAITING MAINTENANCE

B38 B39 HOURS | B43 B44 HOURS | B48 B49 HOURS

REMOVED/OLD ITEM

E08 MFGR | E13 SERIAL NUMBER

E23 PART NUMBER | E38 DATE REMOVED

E42 TIME/CYCLES | E47 TIME/CYCLES | E52 TIME/CYCLES

INSTALLED/NEW ITEM

G08 MFGR | G13 SERIAL NUMBER

G23 PART NUMBER

G38 TIME/CYCLES | G43 TIME/CYCLES | G48 TIME/CYCLES

MAINTENANCE/SUPPLY RECORD

JOB STATUS	DATE	TIME	EOC
B53	B54	B58	B62
B65	B66	B70	B74
C08	C09	C13	C17
C20	C21	C25	C29
C32	C33	C37	C41
C44	C45	C49	C53
C56	C57	C61	C65
D08	D09	D13	D17

DISCREPANCY

PILOT INITIATOR

CORRECTIVE ACTION

☐ ☐

CORRECTED BY | INSPECTED BY | SUPERVISOR | MAINT CONTROL

JOB CONTROL NUMBER

A08 ORG | A11 DAY | A14 SEQ | A17 SUP | A19 WORK CENTER

UP ☐ DOWN ☐ | MODEX | PRI | TURN IN DOCUMENT | SYSTEM/REASON | MCN

60

APPENDIX G

NAVSUP LETTER ON VARYING SMA BY IMEC

Commander, Naval Supply Systems Command letter, Item Essentiality Coding of Secondary Items, 4400 Serial 042E/KWL, dated 20 March, 1985 with enclosures, requesting approval from the Chief of Naval Operations (CNO) to implement an essentiality weighted inventory levels-setting model by varying System Material Availability (SMA) goals with respect to IMEC category.

DEPARTMENT OF THE NAVY
NAVAL SUPPLY SYSTEMS COMMAND
WASHINGTON, D C 20376

TELEPHONE NUMBER
COMMERCIAL
AUTOVON
IN REPLY REFER TO

4400
042E/KWL

20 MAR 1985

From: Commander, Naval Supply Systems Command
To: Chief of Naval Operations (OP-41)
Via: Chief of Material (Code 01FF)

Subj: ITEM ESSENTIALITY CODING OF SECONDARY ITEMS

Ref: (a) NAVMATINST 4423.8
(b) OPNAVINST 4441.12B

Encl: (1) OASD (MRA&L) Memorandum for the Assistant Secretary of the Navy (S&L) of 15 Oct 1981
(2) COMNAVSUPSYSCOM 042E of 22 Feb 1985
(3) Recommended Policy of Varying System Material Availability Goals by Essentiality Category

1. The purpose of this letter is to request permission to vary system material availability (SMA) goals by item essentiality category for fiscal year 1987 execution at SPCC and ASO. Enclosure (1) approved Navy's item mission essentiality code (IMEC) rules. To date, these codes have had limited applications (i.e., Modified Fleet Logistics Support Improvement Program (MODFLSIP) COSAL and, in accordance with reference (a), criteria for which to establish numeric stockage objectives at the wholesale level). Additionally, enclosure (1) requested that the Navy provide the Director, Supply Management Policy, OASD (MRA&L) with a detailed implementation milestone plan prior to initiation of implementation of actions.

2. It is the policy of this Command to use IMECs at all echelons of support. Based upon this policy, the following actions have been taken: (a) SPCC and ASO have completed the assignment of IMECs to their inventories, (b) analysis is currently underway evaluating the use of IMECs in both the range and depth decisions at the intermediate level, and a future POM initiative will address this issue, (c) the new AVCAL inventory model allows for IMECs in the safety level calculation, (d) a memorandum of agreement (enclosure (2)) has been signed by DLA and NAVSUP which provides for the transmission of IMECs, and (e) for Navy managed material, wholesale level POM initiatives have been submitted to establish higher SMA goals for the IMEC categories commencing in fiscal year 1987.

3. Enclosure (3) summarizes the results of the analysis evaluating the implementation of IMECs at the wholesale level. Several alternative methods were evaluated. However, the alternative of varying SMA goals by IMEC category was selected based upon both the ease of understanding and the relative ease of computer program modifications necessary for implementation. The analysis was conducted using the Computation and Research Evaluation System (CARES) analyzer for SPCC managed items. Since ASO has only recently completed the IMEC coding process, a detailed analysis similar to enclosure (3) has not been completed for ASO managed material. Results of the ASO analysis will be provided for information purposes at a later date. The SMA goals were chosen based upon the cost effectiveness projections of the CARES analyzer.

4400
042E/KWL
20 MAR 1985

Subj: ITEM ESSENTIALITY CODING OF SECONDARY ITEMS

4. Enclosure (3) displays a scenario of changing the mix of safety level toward the higher IMEC items, thereby improving readiness. The reference (b) SMA percent goal of 85 percent is maintained for the lowest essentiality category. However, SMA goals are enhanced for the items that are primary contributors toward readiness. It should be noted that this recommendation is consistent with both the NAVSUP/DLA policy of enclosure (2) and the guidance of the OASD Supply Management Policy Group (SMPG).

5. Sufficient funding has been requested to implement the above policy. Therefore it is recommended that this policy be approved for implementation at both ASO and SPCC as an initial effort toward improved sparing to readiness objectives at the wholesale level.

J. B. WHITTAKER
Assistant Commander
Inventory and Systems Integrity

Copy to:
CO, SPCC
CO, ASO
CO, FMSO
Superintendent NPGS (Codes 55RH, 54MG)

SR
MANPOWER
RESERVE AFFAIRS
AND LOGISTICS

ASSISTANT SECRETARY OF DEFENSE

WASHINGTON, D.C. 20301

OCT 15 1981

MEMORANDUM FOR THE ASSISTANT SECRETARY OF THE NAVY (S&L)

SUBJECT: Item Essentiality Coding of Secondary Items

This is in response to the memorandum from the Director, Materiel Division, DCNO(Logistics), dated 28 July, subject as above, which requested approval of the Navy's proposed item essentiality coding rules and the recommended changes to DoD Instruction 4140.42, "Determination of Initial Requirements for Secondary Item Spare and Repair Parts."

I want to commend you and your staff for taking the initiative to develop what appears to be a logical and viable essentiality coding system. As you are aware, the DoD Stockage Policy Analysis Report of August 1980 and recent reports published by the General Accounting Office have recommended that all DoD Components develop an essentiality coding system and that item essentiality become a major consideration in the management of secondary items. Your efforts to date are considered responsive to the recommendation contained in these Reports and provide a logical basis for necessary future actions.

As a result of our review, the Navy's proposed item essentiality coding rules are approved and authorization is granted for the Navy to proceed with plans to implement the essentiality function as provided for in DoD Instructions 4140.39, "Procurement Cycles and Safety Levels of Supply for Secondary Items," and 4140.45, "Standard Stockage Policy for Consumable Secondary Items at the Intermediate and Consumer Levels of Inventory." We are concerned, however, that the Navy's implementation of unique essentiality coding rules, together with similar actions by the other Services, may have a long-range detrimental impact on the capability of DoD activities to communicate essentiality information to assigned Integrated Materiel Managers. In this regard, it is requested that the Navy coordinate appropriate interface procedures applicable to Integrated Materiel Managers with this Office. Further, the Navy should provide the Director, Supply Management Policy, OASD(MRA&L) with a detailed implementation milestone plan prior to initiation of implementation actions.

While we understand the thrust of your initiative to revise DoD Instruction 4140.42, we do not agree with the necessity for making the requested changes. This Instruction currently recognizes essentiality in the initial spares

Enclosure (1)

computation and allows stockage of essential items even if they do not qualify for stockage through the use of the cost differential tables. Recent changes being staffed to both DoD Directive 4140.40, "Basic Objectives and Policies on Provisioning of End Items of Materiel," and DoD Instruction 4140.42 and the increased use of optimization models to spare to an operational availability will undoubtedly lead to the stocking of greater range and depth of essential items by the Navy.

R. D. Webster

R. D. Webster
Deputy Assistant Secretary of Defense
(Logistics and Materiel Management)

1000
042E

From: Commander, Naval Supply Systems Command
To: Commanding Officer, Navy Aviation Supply Office
Commanding Officer, Navy Ships Parts Control Center

22 FEB 1985

Subj: TRANSMISSION OF NAVY ESSENTIALITY CODES TO THE DEFENSE LOGISTICS AGENCY (DLA)

Encl: (1) Memorandum of Agreement Between the Defense Logistics Agency and the Naval Supply Systems Command

1. For the last several years, Navy and DLA have been negotiating both the method of transmitting Item Mission Essentiality Codes (IMECs) to DLA for Navy applicable items managed by DLA, and the DLA inventory management plan which would utilize the IMECs. With the completion of IMEC coding at both ASO and SPCC, the need for a final agreement became essential.

2. Enclosure (1) is an approved Memorandum of Agreement (MOA) between DLA and Navy resulting from recent negotiations. In summary, the MOA requires the transmittal of IMECs via the Weapons System Item Data Cards (WSI Cards). DLA will vary performance goals by IMEC category (i.e., the more essential items will have the higher System Material Availability (SMA) goals). The lowest performance goal will be ninety percent SMA.

3. It is requested that ASO and SPCC implement the procedures of enclosure (1) in coordination with DLA at the earliest feasible date, and that NAVSUP-034 be advised of this implementation schedule.

James E. Eckelberger
Deputy Commander
Inventory and Information
Systems Development

Copy to:
CO, FMSO
DLA-O
NOP-412E

BCC:
SUP-034

PREPARED BY: CDR LIPPERT/042E/x56865
DOCID: KWL14FEBTRANS

Enclosure (2)

11 FEB 1985

Memorandum of Agreement Between the Defense Logistics Agency and the Naval Supply Systems Command

BACKGROUND: The Navy's two Inventory Control Points, Navy Ships Parts Control Center (SPCC) and the Aviation Supply Office (ASO), are in the process of completing the assignment of essentiality codes to items for which they are the program support Inventory Control Point. The essentiality codes, referred to as IMECs (Item Mission Essentiality Codes), combine consideration of the importance of the equipment to the mission of the ship/aircraft with the importance of the item to the equipment. These codes range from one (least essential item) to four (most essential item), with IMEC five designated for safety items. This OSD approved methodology will allow Navy to manage its inventories to achieve improved Fleet readiness by varying performance goals by essentiality code, vice the use of the current fill rate goals applied across the entire inventory. To date, the essentiality codes have been used to increase range and depth of secondary items on shipboard allowances. Consistent with the above is the requirement to transmit the Navy essentiality codes to DLA for DLA managed items applicable to Navy weapon systems.

OBJECTIVE: Improve Fleet readiness by enhancing wholesale inventory levels for items that are the most essential to weapon sy tem operational availability.

METHOD OF OBTAINING OBJECTIVE: NAVSUP will transmit to DLA essentiality codes for all items in support of Navy weapon systems. Upon receipt of Navy essentiality codes, DLA will stratify Navy items into management levels to allow enhanced inventory levels for Navy's most essential items.

PROCEDURES: The following procedures apply:

a. ASO and SPCC will transmit Weapon System Item Data Cards (WSI Cards) to DLA for each Navy weapon system related item.

1. The WSI cards will contain the Navy IMEC codes (1,2,3,4, or 5).

2. The WSI cards will contain a weapon system code.

(a) ASO will submit the two position Weapon System Designator Code (WSDs).

(b) SPCC will submit a two position Local Routing Code (LRC), not to conflict with ASO's WSDs.

b. DLA will accept the Navy IMECs and incorporate them into the DLA inventory management system. The Navy IMEC will correspond to the following DLA management level:

Enclosure (1)

1. IMEC 4 and 5 corresponds to Management Level I
2. IMEC 3 corresponds to Management Level II
3. IMEC 1 and 2 corresponds to Management Level III
4. Non-weapon system designated items correspond to normal DLA support

c. Enclosure (1) portrays DLA's Inventory Management Plan.

d. Items returned/transferred back from DLA to Navy management will contain the assigned Navy IMEC.

TIMING: This Memorandum Of Agreement is effective upon signing by both DLA and NAVSUP. The actual transmittal of IMECs from Navy to DLA will commence 1 January 1985 at the Navy Ships Parts Control Center and 1 February 1985 at the Navy Aviation Supply Office.

for D. M. Babers
Lieutenant General, USA
Director, Defense
Logistic Agency

E. K. Walker, Jr.
Rear Admiral, SC, USN
Commander, Naval Supply
Systems Command

MANAGEMENT LEVELS	IMEC	INVENTORY LEVELS	STOCKAGE POLICY
I	4, 5	Highest Enhanced	Stock all items which qualify for stockage based upon either: A. *Past Actual Demands* B. Predictive Demands C. Military Service has indicated no anticipated demand but failure of item could cause system failure or impair intended mission.
II	3	Enhanced	
III	1, 2		

Enclosure (1)

Enclosure (2)

Recommended Policy System Material Availability Goals By Essentiality Category

1H COG

IMEC	Projected SMA	Projected Availability Delay **	Change Required Funds *
1	85	23	-$1.8
2	87	15	-$4.2
3	90	13	+$30
4 and 5	92	7	+$48
TOTAL	88	15	+$72

7H COG

1	85	49	-$25
2	87	43	-$5
3	90	29	+$33
4 and 5	92	21	+$41
TOTAL	88	32	+$44

7G COG

1	85	55	-$3
2	87	37	-$8
3	90	23	+$23
4 and 5	92	13	+$15
TOTAL	88	32	$27

* Change from current execution policy; dollars in millions.

** Response time statistics (availability delay) do not take into account transportation time, issue times, or receipt take up times.

ENCLOSURE (3)

APPENDIX H
CNO LETTER APPROVING VARYING SMA BY IMEC

Chief of Naval Operations letter, Item Essentiality Coding of Secondary Items, 4400 Serial 412E/5U394066, dated 3 June, 1985, approving the request from the Naval Supply Systems Command (NAVSUP) to implement an essentiality weighted inventory levels-setting model by varying System Material Availability (SMA) goals with respect to IMEC category.

DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
WASHINGTON, DC 20350-2000

IN REPLY REFER TO
4400
Ser 412E/5U394066
03 Jun 85

From: Chief of Naval Operations
To: Commander, Naval Supply Systems Command

Subj: ITEM ESSENTIALITY CODING OF SECONDARY ITEMS

Ref: (a) NAVSUP ltr 4400 042E/kwl of 20 Mar 85 (NOTAL)
(b) OPNAVINST 4441.12B

1. Reference (a) requested approval for flexibility to vary Supply Material Availability (SMA) goals by essentiality category at SPCC and ASO.

2. The policy of increased safety levels for weapons critical spare parts requested reference (a) is approved when funded. Funding is considered available when the lowest essentiality items are protected at levels that meet OPNAV availability goals specified in reference (b).

C. R. WEBB
By direction

Copy to:
CO, SPCC
CO, ASO
CO, FLEMATSUPPO
Superintendent NPGS (Codes 55RH, 54MG)

APPENDIX I

SPCC'S 1990 POM SUBMISSION

Abstract of SPCC's 1990 Program Operations Memorandum (POM) Spare Parts Initiative budget submission, attempting to identify the additional funding required to implement the current essentiality weighted levels-setting model (varying SMA goals by IMEC category).

POM 90 SPCC IMEC SPARE PARTS INITIATIVE

ABSTRACT

The Item Mission Essentiality Code (IMEC) program is the Navy's plan to relate the essentiality of parts to equipments and equipments to Fleet missions. By targeting increased material availability and reduced system response time for mission essential material, IMEC attempts to maximize the determinants in the Operational Availability equation. The program, as discussed herein, integrates the range, depth and repair requirement necessary to enhance support to both demand and nondemand based items. Since the inventory has been segmented into essentiality categories, significant flexibility exists in funding and executing the individual elements of the programs. Each initiative's range, depth and repair is costed out by essentiality level, benefits identified and execution plan described. Each initiative stands on its own merit and may be executed individually or as an integrated part of the total IMEC program.

4400
0412/JRB

NAVY SHIPS PARTS CONTROL CENTER
POM 90 SPCC IMEC SPARE PARTS INITIATIVE

Ref: (a) CNO ltr 4400 412G/5U394258 of 17 Jun 85
(b) OASD (MRA&L) Memorandum for the Assistant Secretary of the Navy (S&L) of Oct 81
(c) NAVSUP ltr 4400 042E/KWL of 20 Mar 85
(d) CNO ltr 4400 412E/5U394066 of 3 Jun 85

Encl: (1) IMEC Program Benefit Analysis
(2) IMEC Program Cost Analysis
(3) SPC IMEC 4 Weapon Systems and Equipments

1. Purpose. The purpose of this initiative is to identify funding necessary to implement the Navy's Item Mission Essentiality Coding (IMEC) program for material with high mission essentiality at SPCC. The funding requested is an inventory augmentation for wholesale system stock replenishment, to increase both the range and depth of material with potential primary mission impact. The initiative is forwarded pursuant to reference (a).

2. Background. The IMEC program is the Navy's plan to relate the essentiality of parts to the equipment in which they are installed, and in turn, the criticality of that equipment to the execution of Fleet primary/secondary missions. The product of this relationship is the IMEC. By stratifying the ICP inventory into IMEC categories, a method is provided whereby items with relatively higher essentiality can be designated for increased range and depth protection. This additional protection directly translates into increased material availability and reduced requisition response time for the Fleet key "readiness drivers." By targeting increased material availability and reduced system response time for mission essential material, IMEC attempts to maximize the logistic support determinants in the operational availability equation.

In 1981, OSD approved the Navy's item essentiality coding concept by reference (b). During the ensuring period (1981-1983), SPCC embarked on a major effort to complete IMEC coding for 1H, 7G and 7H Cog material. The inventory was stratified by essentiality and IMEC codes registered on the MDF on a line item basis. Alternative IMEC execution schemes were developed, analyzed and evaluated from 1982-1985 and a plan was agreed upon and forwarded by NAVSUP to OP-41 by reference (c) for approval. The plan significantly increases the SMA goals for high IMEC material (IMEC 4 92 percent and IMEC 3 90 percent) while concurrently dramatically reducing availability delay time. The plan further calls for maintaining the current support goal of 85 percent for nonmission essential material (IMEC 1) as directed by OPNAV. The plan was approved by reference (d) in June 1985 pending availability of required funding.

3. Benefits Analysis Summary. Enclosure (1) provides a detailed analysis of the benefits associated with the IMEC program. In summary, the benefits

include a significant increase in the supply availability goal for IMEC 3 & 4 (90 percent/92 percent) mission essential material, a dramatic decrease in availability delay and increased range protection for the Fleet for nondemand based essential material.

In summary, it is estimated that $98M will be required to fund and execute the IMEC 4 initiative over the five-year POM budget base with execution commencing in FY90. The IMEC 3 initiative will require $138M with execution beginning in FY91. Program sponsors should be aware that substantial flexibility exists in actual program execution and funding since the IMEC coding scheme allows SPCC to target specific program elements individually or "in total." This approach provides a vehicle to adjust the program support and direction to the future funding climate and readiness objectives.

In developing the cost projections individual weapons systems support requirements were aggregated at either the IMEC 4 or IMEC 3 level. Current UICP file structures do not provide downward visibility to individual weapon system level cost component. However, it is anticipated that such capability will exist through the advent of advanced data base management software in the time period of planned program execution; thus, allowing for the consideration of specific weapon system priority in executing the IMEC program. In recognition of the present limitations, enclosure (3) was developed to provide an overview of those primary mission (IMEC 4) weapon systems and equipments that will receive the initial enhanced support of the IMEC program in FY90.

4. Cost Analysis Overview. Enclosure (2) provides a detailed cost analysis for implementing IMEC at the wholesale level for items coded IMEC 3 and 4 (primary mission impact). Costs are identified for enhanced levels, required range increase and increased repair of DLRs. These costs are further broken out by IMEC category, funding year, one time costs and program maintenance costs.

5. Conclusion. For over fifteen years, SPCC has investigated methods to relate inventory support strategy to Fleet operational availability. We recognize the need to move from the classical demand based to a weapon system availability based inventory management scenario. We believe the plan presented here provides such a capability and warrants serious consideration and positive support at all levels. The capability exists today to make this major Navy program a working reality and we are "standing-by" to execute.

BENEFIT ANALYSIS

1. Increased Supply Material Availability for Critical Material:

IMEC	PROJECTED* SMA	CURRENT TARGET	SMA INC
4	92%	85%	7%
3	90%	85%	5%
2	87%	85%	2%
1	85%	85%	0%

*Note:

IMEC 4

Increasing supply material availability to 92 percent for IMEC 4 material should result in filling an additional 3,700 IMEC 4 requisitions per year or 18,500 over the five-year (FY90-94) budget base. Each of these requisitions are for material identified as essential to equipments whose failure could result in the loss of a primary mission capability within the Fleet.

IMEC 3

Likewise, by increasing supply material availability for IMEC 3 material to 90 percent should result in the filling of an additional 5,300 requisitions per year or 21,200 over the four-year readiness budget base. Each of these requisitions are for material identified as essential to equipments whose failure could result in the degradation of a primary mission capability within the Fleet.

2. Decreased Availability Delay* for "Readiness Drivers":

Projected Availability Delay* (Days)

	1H COG			7G COG			7H COG		
IMEC	Curr ADD	Proj ADD	% DECR	Curr ADD	Proj ADD	% DECR	Curr ADD	Proj ADD	% DECR
4	13	7	46%	64	13	79%	70	21	70%
3	16	13	18%	53	23	56%	77	29	62%

*NOTE: Response Time statistics (availability delay) do not take into account transportation time, issue times, or receipt take-up times. However, they do reflect a direct reduction in Mean Requisition Response Time (MRRT) associated with ICP delay for readiness related material requirements, i.e., material identified as potential C3/C4 CASREP.

3. Additional Range Protection for Mission Essential Material.

Stocking to readiness requirements, implies that item essentiality vice demand be the primary criteria for determining inventory range. At SPCC, all items which carry an IMEC 3 or 4 (potential C3/C4 CASREP) and which would not otherwise qualify for stockage based on demand are considered for readiness protection levels based on our Numeric Stockage Objective (NSO) program. This POM paper identifies a previously unfunded and unexecuted NSO readiness net requirement of $45M. Commencing in FY90 for IMEC 4 items and FY91 for IMEC 3 items, basic minimal (1 MRU) coverage is programmed for this essential material. By time phasing these range adds over the two fiscal years in priority sequence, all requirements can be procured with minimal disruption to the procurement pipeline. Historically, SPCC has been limited in both funding and inventory authority to procure NSO coverage only an items which have already experienced a CASREP/cannibalization. Our plan as presented here is proactive in that protection is provided to prevent the C3/C4 CASREPs for items where demand forecasting techniques have proven to be both ineffective and inappropriate.

4. Increased Repair of IMEC 3/4 DLRs.

The benefits of increased availability (paragraph 1) and decreased supply response time (paragraph 2) imply that repair output of DLRs must also increase to ensure sufficient RFI assets exist to support these new goals. A one-time increase in depot level repair dollar requirements of $15M is projected as an integral component to the levels (depth) enhancement initiative for IMEC 3/4 repairable assets.

5. Summary of Benefits:

We believe the IMEC program as described provides a well-organized and effective approach to increasing operational availability by increasing the availability and decreasing supply response time for mission essential material. To gain full benefits, the program integrates the range, depth and repair initiatives to provide a total approach for upgrading support to both demand and nondemand based items while balancing the procurement and repair decision process.

Since the inventory has been segmented into essentiality categories, significant flexibility exists in funding and executing the individual elements of the program. Each initiative's range, depth and repair is costed out by essentiality level, benefits identified and execution plan described. Each initiative stands on its own merit and may be executed individually or as an integrated part of the total IMEC program.

IMEC 3
COST ANALYSIS*

1. Readiness Levels (Depth) Requirements: (41,000 Line Items)

			FY			
COG	90	91	92	93	94	Total
1H	0	12	1.2	1.2	1.2	15.6
7G	0	16	1.6	1.6	1.6	20.8
7H	0	51	5.1	5.1	5.1	66.3
	0	79	7.9	7.9	7.9	$102.7M

2. Readiness Range-ADD (NSO) Requirements: (6,000 Line Items)

1H	0	5.8	.6	.6	.6	7.6
7G	0	2.4	.2	.2	.2	3.0
7H	0	10.2	1	1	1	13.2
	0	18.4	1.8	1.8	1.8	$23.8M

- NSO Reason Code "G" Potential C3 CASREP Applies

3. Readiness Levels Add'l Repair $ Reqmt's:

7G	0	2.0	.2	.2	.2	2.6
7H	0	7.0	.7	.7	.7	9.1
	0	9.0	.9	.9	.9	$11.7M

4. POM Summary IMEC 3 Readiness Support Reqm'ts:

			FY			
	90	91	92	93	94	Total
a. INV AUG						
1) DEPTH	0	79	7.9	7.9	7.9	102.7
2) RANGE	0	18.4	1.8	1.8	1.8	23.8
b. ADD Repair $:						
	0	9.0	.9	.9	.9	11.7
TOTAL	0	106.4	10.6	10.6	10.6	$138.2M

*Proposed plan for IMEC 3 identifies the specific and integrated costs of additional Depth, Range and Repair Budget requirements. Funding and execution of the IMEC 3 readiness initiative would occur in FY91 with maintenance costs (est at 10% of the FY91 base) for inventory/essentiality "churn" programmed in FY92-94. All requirements in net millions ($) as reflected in change from current execution policy after adjustment for asset application factors (DLA = 29%, 1H = 35%)

IMEC 4
COST ANALYSIS*

1. Readiness Levels (Depth) Requirements: (16,000 Line Items)

			FY			
COG	90	91	92	93	94	Total
1H	8	.8	.8	.8	.8	11.2
7G	6	.6	.6	.6	.6	8.4
7H	35	3.5	3.5	3.5	3.5	49
	49	4.9	4.9	4.9	4.9	$68.6M

2. Readiness Range-ADD (NSO) Requirements: (3,600 Line Items)

1H	5.4	.5	.5	.5	.5	7.4
7G	1.6	.2	.2	.2	.2	2.4
7H	8	.8	.8	.8	.8	11.2
	15	1.5	1.5	1.5	1.5	$21.M

- NSO Reason Code "G" Potential C4 CASREP Applies

3. Readiness Levels Add'l Repair $-Reqmt's:

7G	1	.1	.1	.1	.1	1.4
7H	5	.5	.5	.5	.5	7.0
	6	.6	.6	.6	.6	$8.4M

4. POM Summary IMEC 4 Readiness Support Reqm'ts:

			FY			
	90	91	92	93	94	Total
a. INV AUG						
1) DEPTH	49	4.9	4.9	4.9	4.9	68.6
2) RANGE	15	1.5	1.5	1.5	1.5	21.0
b. ADD Repair $:						
	6	.6	.6	.6	.6	8.4
TOTAL	70	7	7	7	7	$98M

*Proposed plan for IMEC 4 identifies the specific and integrated costs of additional Depth, Range and Repair Budget requirements. Funding and execution of the IMEC 4 readiness initiative would occur in FY90 with maintenance costs (est at 10% of the FY90 base) for inventory/essentiality "churn" programmed in FY90-94. All requirements in net millions ($) as reflected in change from current execution policy after adjustment for asset application factors (DLA = 29%, 1H = 35%)

SPCC IMEC "4" WEAPON SYSTEMS AND EQUIPMENTS

Air Supply Systems, Combustion
Air Supply Systems, Main Propulsion
Air Compressed Systems
Aircraft Launching Accessories
Alarm Safety & Warning Systems
AM-3007/URT Amplifier
AMMO Handling Equipment
AN/BQR2 Sonar Listening Set
AN/BQR1 Rec Set Sonar
AN/SLQ-32
AN/SPA-72
AN/SPS-10 Radar
AN/SPS-29 Radar
AN/SPS-40 Radar
AN/SPS-49 Radar
AN/SPS-5 Radar
AN/SPS-52 Radar
AN/SPS-6 Radar
AN/SQQ-23 Sonar
AN/SQR-14 Sonar
AN/SQR-15 Sonar
AN/SQS-23 Sonar
AN/SQS-4 Sonar
AN/SQS-42 Sonar
AN/SQS-44 Sonar
AN/SQS-56 Sonar
AN/UGC-20 TTY
AN/UGC-25 TTY
AN/URC-32 H. F. Transceiver
AN/URC-4 Radio Set
AN/USQ-36 Data Terminal Set
AN/UYK-7 Computer Set
AN/UYK-24 Data Processing Set
AN/WQC-2 Sonar Comm Set
AN/WQC-5 Sonar Comm Set
AN/WRR-2 Radio Rec Set
AN/WRR-3 VLF-MF Recvr
AN/WSC-3 Sattelite Transceiver
AN/WSN-2 Gyro Compass
AN/1018 URC Antenna
MK134 Stablization Computer
MK14 Gyro Compass
MK15 Phalanx C.I.W.S.
MK152 Digital Computer
MK16 Phalanx Weapon Group
MK162 Amplifier
MK17 Gyro Compass
MK18 Gyro Compass
MK19 Gyro Compass
MK23 Gyro Compass
MK24 Gyro Compass

AS-1735/SRC Antenna
AT-317/BRR Antenna System
AT-350/BRC Antenna
AT-948/U Colinear Array
Battery Group, Submarine
Bilge & Ballast Sys. Submarine
Bundle Tubes, Distilling Plant
Cirulating Group, Salt Water
Condenser Unit, Main
Condenser Unit, Auxilliary
Controls, Engine
Controls, Propulsion
Couplings, Propeller Shafts
Deareator Group
Distilling Plant
Ejection Unit, Main Air
Electric Power Dist Systems
Engine, Recip Main Propulsion
Exhaust System
Fuel Oil Filling System
Fuel Oil Service System
Gas Turbine Generator Set
Generator Sets 60 &/400 HZ
Gland Exhauster Group
Gun Mount, Systems DDG
Harpoon Weapon System
High Pressure Systems
Hull Structure
KY-537/U Coder
Lube Oil System
Main Condensate & Feed System
Main Reduction Gear
MK11 Fire Control Switch Board
MK198 GYro Compass
MK111 ASROC Fire Control
MK114 ASROC Fire Control
MK116 Shipboard Fire Control
MK118 Tartar Computer
MK12 Missile Launch SW Box
MK13 Steam Catapult
MK5/6 Fresnel Lens
MK6 Train Parallax Controller
MK60 XMTR Relay
MK61 Indicator Train
MK74 Guided Missile FCS
MK75 Range & Bear IND,
SDC, 76mm 62 Cal
Gun mount
MK78 Position Indicator
MK8 Gyro Compass
MP7 Hydrophone Assy

MK26 Firing, Gyro, Launching Panel
MK27 Syncro Amplifier
MK3 Signal Comparator
MK30 Computer Unit
MK31 ASW FCS Switchboard
MK32 Torpedo Tube, XMTR,
UB FCS & Switchboard
MK329 Weapon Control Panel
MK33 UB Fire Control Switchboard
MK330 Missile Setting Panel
MK331 Torpedo Setting Panel
MK332 Weapon Status Panel
MK333 Bridge Display Panel
MK338 Remote IND Unit Panel
MK339 Local Control Panel
MK34 21" BOW Submerged Torpedo Tube
MK34 UB Fire Control Switchboard
MK35 Radar Equipment
MK37 GFCS XMTR & AMP
MK337 Control Interface Panel
MK338 Gun Control Panel
MK38 ASROC ATTACK Console
MK4 Console, Timer
MK44 Relay XMTR
MK5 Target Designation System
MK53 ATTACK Console
MK56 FCS
MK59 Computer
Pumps:
- Main Circulating
- Main Condensate
- Main S.W.
- Emergency Feed
- Main Feed
- Main Fuel
- Main Lube Oil
- "FF" Marine Jet
Regulators, Line Voltage
SB/441 Radar Dist S.B.
Search & Track Radar "CG4"
Shell Plating
Ships Order & Indicating Systems
Shore Power FAC for "AD"
Sonar Liquid Cooling System "DDG"
SS-2 Radar Set "SS"
Starting Systems Helicopter "DD931"
Steam Generators, Super Chargers
Steering & Ships Control System
Submarine Steering & Diving System
20MM Gun Group "CG4"
Fleet Ballistic Missile Weapon System
AM-7114 Power Supply
Strategic Weapon Systems
TRIDENT/Poseidon MCC 4 Systems
Trident Standard Information Display Consoles
Nuclear Reactor Plant Material
Navigation Systems Electronic
OE-82 WSC-1 Antenna
"OUTBOARD"
Oxygen Gen Plant CV/CVN
Piping & ACC:
- Fuel Oil Service
- Main Lube Oil
- Main S.W. Cooling
- SS/SSN Piping
  & valve Group
- CV/CVN Nitrogen
- Turbo-Gen Sys
- Main Condensate
- SSN Main Stream
- BLR Blower System
- M.S. Valves & ACC
Plating Structural
Power Conversion System
PP-2031/SPS-29C
Propellers:
- CYCLODIAL
- Controllable pitch
- Fixed Pitch
Propulsion Shafting:
- DD963
- Main Stream
- FFG Gas Turbine
-SS/SSN
Switchboards:
- AC/DC Dist
- Emergency Power
- Motor Gen Control
- Ships Service 60 & 400 HZ
- Switchgear
Tanks:
- Main Condensate
- Main Structural
TR-208 SQS-23 Transducer
Transfer Group "MSC CLASS"
Transmission "MSC & PG CLASS"
TRIM & Drain System For:
- AD, FFG, SS, SSN
TSEC System For ARS
TT-187 System for ARS
TT-192 For CG-26
Tubes, Row H
Turbines:
- Cruising
- Main Propulsion
- Controls
Valves MNST BLR Blow System
Weapon Control Sub-system
"CG4"

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