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13. ABSTRACT

This study report is concerned with the collection and comparison of measures of effectiveness (MOE's) used in Navy studies and analyses. The results of examining 213 Navy studies of system effectiveness covering virtually all aspects of Naval warfare are presented. These results are presented in several different forms. First, a data base, utilizing two types of formats -- Study Review Summary or MOE Review, has been established to present in summary form the effectiveness profile of each study chosen for examination. This profile presents an outline of the military situation addressed, variables and qualitative factors considered, and the special assumptions and limitations in the MOE formulation and development. Second, a general summary of measures of effectiveness used in Naval warfare is presented, categorized by type of platform, system or subsystem of interest, as well as the warfare area of applicability.

The study volumes are as follows:

Vol. 1 - Summary
Vol. 2 - Study Review Summaries, Part I
Vol. 3 - Study Review Summaries, Part II
Vol. 4 - MOE Reviews

14. KEY WORDS	LINK A		LINK B		LINK C	
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Effectiveness						
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Missiles						
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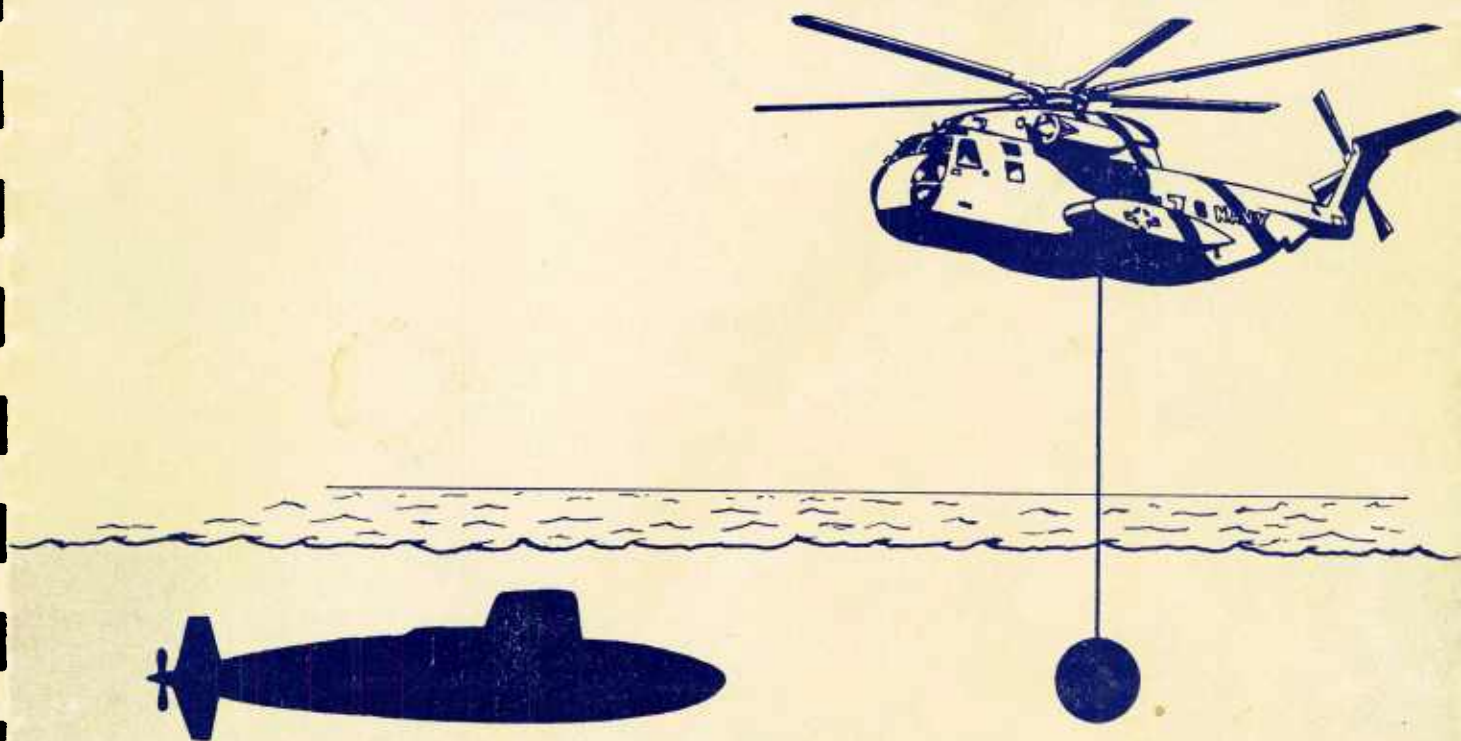
Operations Research						
Optimization						
Submarine						
Surface Ship						
Weapons						

A STUDY OF MEASURES OF EFFECTIVENESS USED IN NAVAL ANALYSIS STUDIES



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FINAL REPORT
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VOLUME 1
SUMMARY

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A STUDY OF MEASURES OF EFFECTIVENESS USED IN NAVAL ANALYSIS STUDIES

Volume 1
Summary

ONR Contract: N00014-71-C-0247
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31 October 1972

Prepared for

Office of Naval Research
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Prepared by

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SUMMARY

This study was conducted for the Naval Analysis Programs Office (Code 462) of the Office of Naval Research, and is concerned with the collection and comparison of measures of effectiveness (MOE's) used in Navy studies and analyses. The study results are intended primarily for the use of analysis staffs within the Department of the Navy.

In this final report are included the results of examining 213 Navy studies of system effectiveness covering virtually all aspects of Naval warfare. These results are presented in several different forms. First, a data base, utilizing two types of formats - Study Review Summary or MOE Review, has been established to present in summary form the effectiveness profile of each study chosen for examination. This profile presents an outline of the military situation addressed, variables and qualitative factors considered, and the special assumptions and limitations in the MOE formulation and development. Second, a general summary of measures of effectiveness used in Naval warfare is presented, categorized by type of platform, system or subsystem of interest, as well as the warfare area of applicability.

Of the studies examined, the ASW area accounts for 37%, the attack area accounts for 23% and the antiair warfare area accounts for 9% of the warfare areas considered. The remaining 31% consists of mining and mine countermeasures, surveillance, strategic systems, electronic warfare, amphibious assault, communications, command and control, navigation, special warfare, reconnaissance/intelligence, logistics and ship support. In terms of the General Operational Requirements areas, Strike Warfare accounts for 35%, Antisubmarine and Undersea Warfare accounts for 46%, Command Support accounts for 15% and Operational Support accounts for 4%.

Analysis was also conducted on the types of variables used in mathematical model formulation and development. Study results show that nearly 45% of all independent variables considered were associated with the

system(s) of interest to the study authors, only 19% of all independent variables relate to the threat or target, and slightly less than 3% of all independent variables relate to the physical environment.

Some general observations and conclusions that can be made on the basis of having examined 213 system effectiveness studies in Naval warfare are as follows:

(1) The criterion for success is seldom explicitly stated.

To explain what is meant by the term "success criterion" in this study, one must approach this from the recognition of the MOE as a quantification of how well the success criterion is met. Consequently, the success criterion could be the goal or objective of the mission or even a specific quantitative requirement that must be attained. For example, if the success criterion is destruction of target, then the MOE could be the probability of target kill, or for the success criterion of x yards localization accuracy, the MOE could be the probability of target localization within x yards. Unfortunately, the criterion for success in a given situation is generally never stated, but implied either through the choice of the MOE or through the specific details (such as airplane drops bombs on ground targets, submarine fires torpedo at merchant ship, etc.) of the warfare situation being analyzed.

(2) There exists more than one way of quantifying how well the criterion for success is met.

The message to be gleaned here is that, as one would no doubt expect, there is more than one choice of a MOE for a given success criterion. To illustrate this, Appendix D contains examples of success criteria observed in the preparation of the Study Review Summaries. For example, for the success criterion of target destruction, possible MOE's are the probability of target kill, the expected number of

targets killed and the number of targets killed per unit time. Furthermore, in some cases, as demonstrated in the preceding example, for the same success criterion we find both probabilistic and expected value types of MOE's. This is an interesting situation since probabilistic types of MOE's are more representative of a measure of confidence in system performance, whereas expected value types of MOE's are representative of a measure of relative system performance. The desired usage of a MOE for a given success criterion typically influences the choice of a MOE type.

(3) For each possible mission title (or name) there is more than one way of defining the mission.

The point being made here (as seen in the tables of Appendix D) is that a mission title without the supporting definition does not provide enough information about the situation to be analyzed, and, furthermore, does not provide enough insight into possible success criteria or even MOE's that are applicable. This is illustrated in Appendix D by the fact that for the same mission title there can be more than one definition, and for the same mission title there is more than one criterion for success.

(4) The rationale for MOE selection is not always presented.

Many study authors do not* say why they have chosen the MOE(s) presented in the study. This is probably due to several factors such as it was not considered necessary, or it is clear to those analysts working in that area what the meaningful MOE's are so why explain the choice. The mere

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* Rationale for selection was only provided for 84 out of 232, or 36.2%, MOE's considered in 139 Study Review Summaries. Counting all additional MOE's and those MOE's in MOE Reviews, this percentage drops to 21.4% (i.e., 200 out of 933).

fact that such rationale is not presented should not necessarily be regarded as bad, but it might be helpful to the readers of the study report(s) to know what the important considerations were that led to the choice of the MOE(s). This information provides insight into how the reader of the report would make such a choice.

(5) Physical environment aspects appear to be generally ignored or casually treated in effectiveness studies.

On the average (see Table 4), only about 3% of the independent variables used in MOE formulation and development relate to the physical environment. This is particularly true in the ASW areas where one would expect that factors such as sea state, water temperature, salinity, ocean depth, etc., would have significant influence on not only the study results but the model development. Sometimes it is difficult to tell when reading a report as to whether or not such factors have been accounted for when one chooses the value of a parameter such as detection probability. Specifically, sensor detection probability against a particular type of target is sometimes given as a number relating to the environmental situation being analyzed, whereas in other cases a sensor is characterized as one that has associated with it a given detection probability independent of weather and environment.

(6) It appears that there are cases where the variables selected for model formulation are not readily (if at all) measurable in the real world.

There does appear to be a significant gap between those analysts that build mathematical models and perform analyses and those individuals that collect and measure data, which presumably could be used to support and validate these models and analyses, in fleet exercises, tests and sea trials. In other words, one could raise the question as to whether or not

mathematical rigor is required when one cannot obtain realistic data. Of course, one reason for not addressing the question of data availability is that sensitivity analyses sometimes need to be performed to identify significant and influencing factors that should be measured. Furthermore, a particular variable may not be readily measurable but upper and lower bounds might be known thus enabling one to "bound" the model results.

(7) In general, the MOE's used are those that are readily obtained via model development.

The choice of a MOE appears to be dictated sometimes by how easy it is to formulate it and develop the underlying mathematical model. As a result, more suitable MOE's might be ignored simply because of the fact that it is either too difficult or one does not know how to perform the mathematical analyses required to generate values of these MOE's.

(8) Very seldom, when more than one MOE is identified, is a ranking of importance performed or combined measure developed and used.

It is not necessarily true that just because one uses more than one MOE in a study that he should rank them by importance or, for that matter, combine them in some way into a universal MOE. On the other hand, because of the subjectivity perhaps in doing this, in only a relatively few of the studies examined have the authors attempted to do this. This is an interesting observation because it suggests that study analysts and model developers in general tend to avoid doing this.

(9) Expected value type MOE's are most prevalent in force level studies, whereas probability type MOE's are most prevalent in subsystem level studies.

Statistical (basically expected value or average) type MOE's occur (see Table B) more often in force level studies (39%) and decrease in frequency in going from system level (21%) to

subsystem level (20%). Probabilistic type MOE's occur more often in subsystem level studies (43%) and decrease in frequency in going from system level (38%) to force level (26%) studies.

(10) On the average, over twice as many independent variables in the MOE formulation occur in the friendly force category than in the threat and target categories combined.

On the average (see Tables 4 and 5), 45% of the independent variables fall in the friendly force category and 19% in the combined threat and target categories, thus yielding a ratio of over 2 to 1. This provides an assessment of the emphasis placed by study authors on the force of interest to them in the opposing forces situation.

(11) As the study level increases, from subsystem to system to force level, the percentage of independent variables in the friendly force category decreases and the percentage of independent variables in the friendly force interaction with threat or target category increases.

The percentage (see Table 6) of independent variables in the friendly force category is highest for subsystem level (60%) studies and decreases in going from the system level (45%) to the force level (39%). In the case of the friendly force interactions with the threat and target, the percent distribution of independent variables is highest for force level (37%) studies and decreases in going from the system level (34%) to the subsystem level (18%).

(12) It is not easy to compare similar effectiveness studies.

A completed Study Review Summary format provides a profile of the study and could be used as the basis for performing a comparison of similar studies. Indeed, this is the case, but Ultrasystems has found that when viewed and compared in this way the study formats

usually do not agree beyond the first few entries, such as the Evaluation Level, Function, Mission and Definition in Section B.. If the Criterion For Success is not the same in the studies, then one cannot meaningfully proceed in the comparison; on the other hand, the fact that the success criteria do not agree does provide an item for comparison. Comparing Section C in the study formats does illustrate the level of detail used in the development of the respective mathematical models.

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I. INTRODUCTION

This report presents a summary of the effort performed under Contract #N00014-71-C-0247 as part of the Office of Naval Research MAFTEP* Program: "A Comparative Analysis of Objective Functions and Criteria of Performance Used in Navy Systems Analysis Studies." The period of performance was from 1 March 1971 through 31 October 1972.

This study is concerned with the collection and comparison of measures of effectiveness (MOE's) used in Navy studies and analyses, and its results are intended primarily for the use of analysis staffs within the Department of the Navy. In this final report are included the results of examining 213 Navy studies of system effectiveness covering virtually all aspects of Naval warfare. These results are presented in several different forms. One form consists of the basic data base used in this study which is presented in a format that provides visibility into how the effectiveness analysis was formulated and conducted in each study examined, the military situation addressed, variables and qualitative factors considered, and special assumptions and limitations regarding the utility of the analysis conducted. The other form consists of a general summary of measures of effectiveness that can be used in Naval warfare, categorized by type of platform, system or subsystem of interest, as well as area of applicability. The former is designed to present a sample of previously conducted effectiveness studies in Naval Warfare for ready reference by analysts desirous of gaining insight into what studies have been done previously, whereas the latter is designed to present a sample shopping list (based on the studies examined) of measures of effectiveness for analysts desirous of determining what are some of the possible measures of effectiveness that they could use in their analysis.

In the course of conducting this study, an extensive survey was conducted to determine the types and variety of measures of effectiveness used in Naval warfare. This survey effort consisted of a literature search, primarily through the Defense Documentation Center, but contacts were made to various Navy laboratories and agencies to identify additional, not readily available, studies.

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*Methods for Analysis of Fleet Tactical Effectiveness and Performance

Once the literature review was completed, the measures used were identified and categorized, as well as the success criteria utilized and, wherever mentioned, the rationale used in selection. A format was generated to record the pertinent effectiveness information contained in a study report and the collection of completed data forms for the 213 studies examined constitutes the data base. Examining information in this data base, it was possible to recognize a common approach to be used in studies for the selection of a measure of effectiveness and the methodology to be employed in its formulation.

An important consideration in the construction of measures of effectiveness is the hierarchy of variables considered, since this represents an outline of data requirements. The format, called the Study Review Summary, devised for use in the data base for studies with adequate supporting mathematical detail, provides insight into both the data requirements for MOE computation and the hierarchy of development regarding the model variables.

II. TECHNICAL APPROACH

To catalog and provide a summary of the types of measures of effectiveness used in Navy studies and analyses in such a way that it is possible to compare them and to identify the assumptions used to develop and evaluate them, necessitated a scheme that for each study gives consideration to: the physical environment; the threat and target characteristics, tactics and deployment; the mission scenario, or tactical situation, (its description and assumptions); and the measure(s) of effectiveness employed. The approach to developing such a scheme is illustrated by the Study Review Summary Flow in Figure 1.

The level of the study, such as Force, System or Subsystem, is first identified. The next step is to identify the type of warfare, which is referred to as the Function. The choice of candidates for the Function is made from the General Operational Requirements (GOR) Areas, given in Table 1. Frequently, the type of warfare or study activity is a combination of more than one entry from Table 1. The concept of "Function" provides a means for categorization of studies. Those functions representing studies reviewed are indicated by "X" in Table 1.

Once the Function has been selected, the Tactical Situation or Mission(s) under consideration is defined as used in the study. The former term is commonly used to describe those situations in which two or more forces or systems are competing in a situation, each with a different objective, and the study places emphasis on the joint interactions between these forces or systems. The term Mission is then used for those situations in which study emphasis is placed on one force or system and its success in meeting a specified objective or set of objectives.

Given the identification and definition of the Tactical Situation or Mission(s), the Criterion For Success of the force(s), system(s) or subsystem(s) involved is defined as either specifically stated or implied in the study. The measure(s) chosen to assess how well this Criterion For

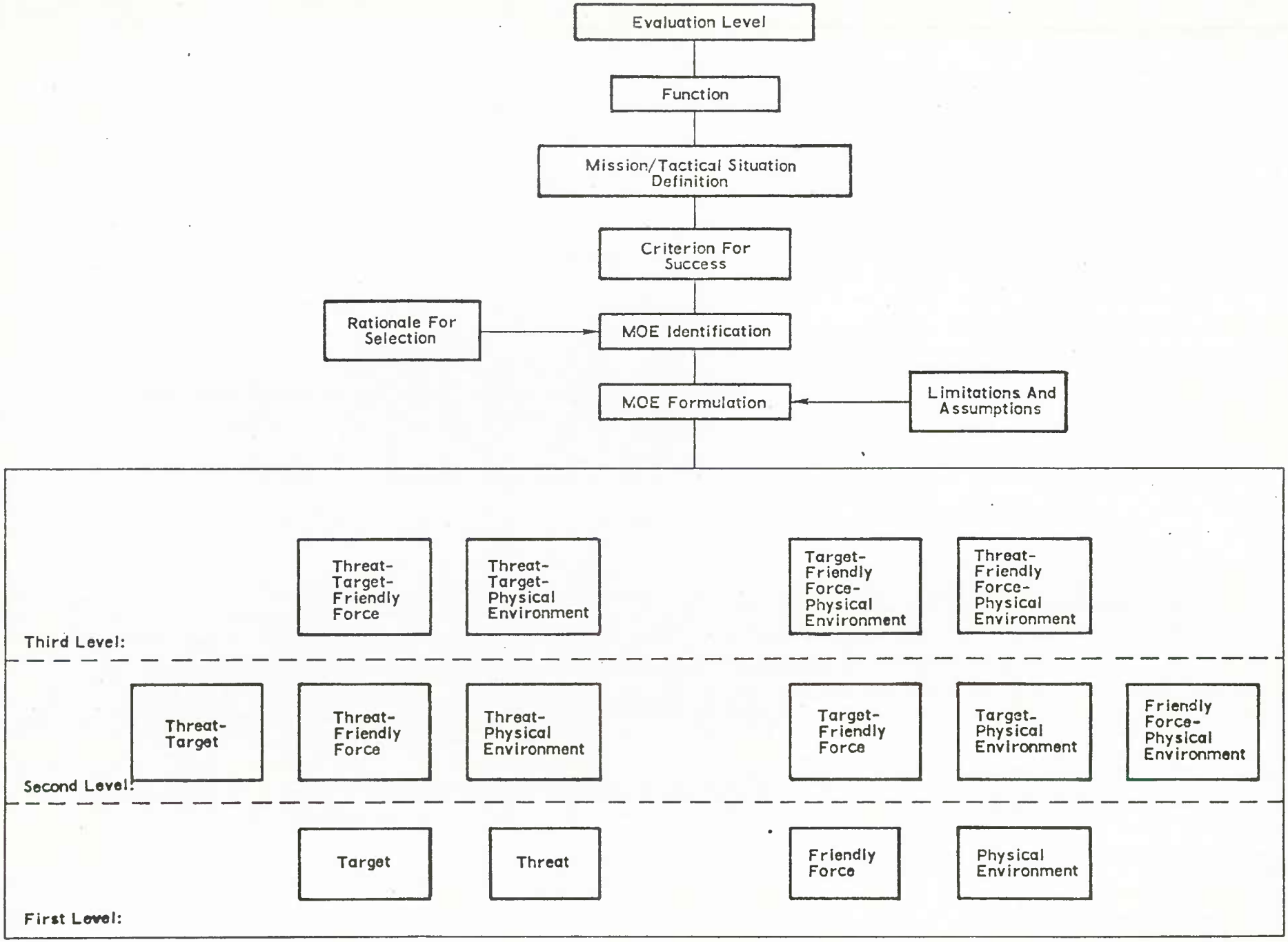


FIGURE 1 STUDY SUMMARY FLOW

TABLE 1 GENERAL OPERATIONAL REQUIREMENTS AREAS

FUNCTIONS	USED IN STUDIES REVIEWED
Strike Warfare	
Airborne Attack	X
Surface Attack	X
Submarine Attack	X
Amphibious Assault	X
Sea Based Strategic Systems	X
Airborne Antiair Warfare	X
Surface Antiair Warfare	X
Antisubmarine and Undersea Warfare	
Airborne ASW	X
Surface ASW	X
Submarine ASW	X
Undersea Surveillance	X
Mining	X
Mine Countermeasures	X
Command Support	
Command and Control	X
Naval Communications	X
Electronic Warfare	X
Navigation	X
Air Traffic Control	
Ocean Surveillance	X
Reconnaissance	X
Intelligence	X
Environmental Systems	X
Special Warfare	X
Operational Support	
Logistics	X
Ocean Science	
Personnel	
Astronautics	
Aviation Support	
Ship Support	X
Ordnance Support	
Weapons Effects Countermeasures	

Success is met is (are) then defined, together with the Rationale For Selection (if given), and its (their) functional form presented. For example, for a success criterion of target kill, a candidate MOE would be the probability of target kill and its rationale for selection would be that it measures the chances of meeting the success criterion. The functional form illustrates the number and type of parameters used to compute the MOE(s). These parameters can be sorted out to those that are peculiar to the physical environment, threat, target, friendly force or an interaction between any two or three of these. The distinction to be made between threat and target is based on the definition of the target as being an object which is both passive in its reaction to the encounter and does not possess any self-defense or attack capability, whereas the threat is either active in its reaction to the encounter and/or possesses a self-defense or attack capability. An example of the former would be a bridge, truck or building, whereas the latter would be represented by an intruding submarine, aircraft interceptor or SAM site. By sorting out the parameters in this way, visibility is acquired in terms of data requirements from fleet exercises and special tests or demonstrations in order to perform the MOE computations.

III. FORMATS FOR STUDY REVIEWS

In the review of Navy studies and analyses in system effectiveness, it was found that it was necessary to devise a format for collection and presentation of the pertinent information. Because of the fact that not all study reports examined included enough of the supporting parameter documentation and rationale for MOE formulation, two types of formats were designed--the Study Review Summary Format (see Appendix A, Table A-1) and the MOE Review Format (see Appendix A, Table A-2). The former was used when it was possible to identify all the pertinent study parameters, their relationships, and the resulting hierarchy in the MOE development and formulation. Consequently, the latter format was used when this was not the case and provides merely a means for presenting the MOE's used in the study and an identification of how they were used. The Study Review Summary Format consists of three sections: A, B, and C, whereas the MOE Review Format consists of the same Section A, but a modified Section B.

In Section A is presented a general description of the nature of the study including the agency performing the study, an identification of the report(s) prepared, the date of the study, the report author(s), classification, contract, an abstract and a set of key word descriptors. The descriptors are chosen in accordance with The Thesaurus of Engineering and Scientific Terms, prepared for the U.S. Department of Defense by the Office of Naval Research under Project LEX in joint cooperation with the Engineers Joint Council in 1967.

In section B are presented the Evaluation Level of the study, the applicable Function, the definition(s) of the Tactical Situation(s) or Mission(s) considered in the study, the Criterion For Success, the Measure(s) of Effectiveness selected, Rationale For Selection, and the corresponding functional form(s). In addition, any other MOE's used and identified as being important, but not necessarily of primary importance, are presented together with the MOE usage in the study and any special study assumptions. The latter provides information concerning the applicability of the MOE(s) and its (their) development to other similar situations, as well as the constraints and real-world utility of the study model. Also presented in

this section is an indication of the hierarchy of development in terms of the parameters used to formulate the MOE(s). The letter f is reserved for the MOE functional formulation, and the letters g, h, i,..., etc., in alphabetical order, are used to illustrate the functional dependence of parameters at successively lower levels.

In Section C are presented both the qualitative and quantitative factors of the MOE formulation. The latter represent the parameters considered in the study model development. These factors are sorted out according to physical environment, target, threat, friendly force and interactions between any two or three of these. Within the categories of target, threat and friendly force, the factors are related to the platforms involved, their armament, sensors, tactics and deployment. By further categorizing the factors in this way, the interactions are more readily identifiable, and it is then possible to show the interactions between the various platforms and their sensors or armament.

In the case of the MOE Review Format, the first two entries of its Section B coincide with those in Table A-1, however, the third entry consists of a listing of all situations addressed in the study for which MOE's were considered, together with their rationale for selection, the success criteria whose quantification of how well met is measured by the MOE's, and any limitations or assumptions governing the use of these MOE's.

A completed Study Review Summary can be regarded as a "profile" of the effectiveness study examined and can be used to provide an approximate assessment of the usefulness of the study made and its areas of applicability. Given completed Study Review Summaries for similar studies, one could make a comparison between them by comparing these "profiles". On the other hand, the MOE Reviews provide merely a listing of MOE's used in the study and their areas of applicability.

Of the 213 studies reports examined, 139 have been described using the Study Review Summary format and 74 by the MOE Review format. The completed formats are presented in the data base, comprising Volumes 2 and 3 for the Study Review Summaries and Volume 4 for the MOE Reviews.

The functions represented in the 213 study reports examined are given in their numerical ordering in Table 2. In particular, the number of times each function has arisen in the Study Review Summaries and MOE Reviews is given in Table 3, which shows that the ASW area accounts for 37% (110 out of 295) of the warfare areas considered in studies, the attack area accounts for 23% (68 out of 295), and the AAW area accounts for only 9% (27 out of 295). This means that, as an estimate, 69% of all effectiveness studies examined address one or more of the areas ASW, Attack or AAW.

In terms of the four categories in the General Operational Requirements Areas of Table 1, we see that Strike Warfare arose 35% (104 out of 295) of the time, Antisubmarine and Undersea Warfare arose 46% (140 out of 295) of the time, Command Support arose 15% (43 out of 295) of the time, and Operational Support arose 4% (8 out of 295) of the time.

IV. STUDY REPORT ACQUISITION PROCESS

A natural question to be asked regarding a study of this type concerns the identification and acquisition of study reports to be used. The initial source of study reports was derived from a Defense Documentation Center (DDC) bibliography search and then subsequent examination of DDC bi-monthly index tabs. In many cases the study reports received contained bibliography and reference lists that in themselves provided leads to other study reports. During visits to various Navy laboratories and agencies, additional technical reports and technical memoranda were identified and subsequently ordered.

Unfortunately, the process of report identification and acquisition is a time consuming one, especially when these reports are release controlled. The general approach to acquiring study reports to be reviewed and considered for inclusion in the data base is described in Figures 2 and 3 for the case of acquisition through the Defense Documentation Center and through the Navy Laboratories/Agencies, respectively. If reports are immediately available through DDC, then the average (calendar) time to acquire them is 20 days, whereas if any report is release controlled then an additional 30 days is required on the average to obtain approval of both the ONR sponsor and the report releasing agency. On the other hand, if a report is not available through DDC, then a request must be made to the originating agency. It takes approximately 20 days to ascertain that a report is not available through DDC and 30 days on the average to either receive the report from the originating agency or to receive notification that release is not approved. As a consequence, the time required to obtain a report once the request is initiated ranges from 20 to 70 days on the average. This can be a significant time delay when one is attempting to screen reports and establish a study data base of reasonable size for evaluation and analysis.

TABLE 2 STUDY REVIEW SUMMARIES AND MOE REVIEWS

	FUNCTIONS	STUDY REVIEW SUMMARIES	MOE REVIEWS	TOTAL
(1)	Airborne ASW	17	8	25
(2)	Airborne AAW	4	0	4
(3)	Airborne Attack	14	9	23
(4)	Environmental Systems	1	0	1
(5)	Mining	2	2	4
(6)	Mine Countermeasures	3	2	5
(7)	Ocean Surveillance	3	3	6
(8)	Submarine ASW	18	5	23
(9)	Submarine Attack	4	0	4
(10)	Surface ASW	15	5	20
(11)	Surface AAW	6	2	8
(12)	Surface Attack	6	3	9
(13)	Sea Based Strategic Systems	2	1	3
(14)	Electronic Warfare	3	2	5
(15)	Undersea Surveillance	3	2	5
(16)	Amphibious Assault	1	1	2
(17)	Naval Communications	0	4	4
(18)	Command and Control	0	1	1
(19)	Navigation	0	0	0
(20)	Reconnaissance/Intelligence	2	2	4
(21)	Logistics	1	0	1
(22)	Ship Support	0	0	0
(23)	Special Warfare	1	0	1
(1,8)	Airborne ASW and Submarine ASW	1	0	1
(1,10)	Airborne ASW and Surface ASW	4	2	6
(1,15)	Airborne ASW and Undersea Surveillance	1	0	1
(2,3)	Airborne AAW and Airborne Attack	1	1	2
(3,11)	Airborne Attack and Surface AAW	1	0	1
(3,12)	Airborne Attack and Surface Attack	1	1	2
(3,20)	Airborne Attack and Reconnaissance/ Intelligence	1	1	2
(5,6)	Mining and Mine Countermeasures	5	0	5

	FUNCTIONS	STUDY REVIEW SUMMARIES	MOE REVIEWS	TOTAL
(6,16)	Mine Countermeasures and Amphibious Assault	0	1	1
(6,19)	Mine Countermeasures and Navigation	1	0	1
(7,14)	Ocean Surveillance and Electronic Warfare	1	0	1
(8,10)	Submarine ASW and Surface ASW	2	0	2
(8,18)	Submarine ASW and Command and Control	0	1	1
(9,10)	Submarine Attack and Surface ASW	2	1	3
(9,12)	Submarine Attack and Surface Attack	0	1	1
(10,12)	Surface ASW and Surface Attack	1	1	2
(11,12)	Surface AAW and Surface Attack	2	1	3
(11,14)	Surface AAW and Electronic Warfare	1	0	1
(11,18)	Surface AAW and Command and Control	0	1	1
(12,16)	Surface Attack and Amphibious Assault	0	1	1
(14,17)	Electronic Warfare and Naval Communications	0	1	1
(21,22)	Logistics and Ship Support	1	1	2
(1,7,10)	Airborne ASW, Ocean Surveillance and Surface ASW	0	1	1
(1,8,9)	Airborne ASW, Submarine ASW and Submarine Attack	0	1	1
(2,3,11)	Airborne AAW, Airborne Attack and Surface AAW	0	1	1
(2,11,14)	Airborne AAW, Surface AAW and Electronic Warfare	1	0	1
(3,12,16)	Airborne Attack, Surface Attack and Amphibious Assault	1	0	1
(3,12,23)	Airborne Attack, Surface Attack and Special Warfare	1	0	1
(6,18,19)	Mine Countermeasures, Command and Control and Navigation	0	1	1
(8,9,10)	Submarine ASW, Submarine Attack and Surface ASW	1	0	1

	FUNCTIONS	STUDY REVIEW SUMMARIES	MOE REVIEWS	TOTAL
(1,2,10,11)	Airborne ASW, Airborne AAW, Surface ASW and Surface AAW	0	1	1
(1,8,9,13)	Airborne ASW, Submarine ASW, Submarine Attack and Sea Based Strategic Systems	1	0	1
(8,9,10,12)	Submarine ASW, Submarine Attack, Surface ASW and Surface Attack	1	0	1
(1,7,8,10,15)	Airborne ASW, Ocean Surveillance, Submarine ASW, Surface ASW and Undersea Surveillance	1	0	1
(1,5,8,9,10,21,22)	Airborne ASW, Mining, Submarine ASW, Submarine Attack, Surface ASW, Logistics and Ship Support	0	1	1
(2,3,14,17,18,20,21,23)	Airborne AAW, Airborne Attack, Electronic Warfare, Naval Communications, Command and Control, Reconnaissance/ Intelligence, Logistics and Special Warfare	0	1	1
	TOTAL	139 +	74 =	213

TABLE 3 FUNCTIONS REPRESENTED IN STUDY REVIEW SUMMARIES AND MOE REVIEWS

FUNCTIONS	NUMBER REVIEWED
Airborne ASW	39
Airborne AAW	10
Airborne Attack	34
Environmental Systems	1
Mining	10
Mine Countermeasures	13
Ocean Surveillance	9
Submarine ASW	32
Submarine Attack	13
Surface ASW	39
Surface AAW	17
Surface Attack	21
Sea Based Strategic Systems	4
Electronic Warfare	10
Undersea Surveillance	7
Amphibious Assault	5
Naval Communications	6
Command and Control	5
Navigation	2
Reconnaissance/Intelligence	7
Logistics	5
Ship Support	3
Special Warfare	3
Total	= 295

Figure 2 Study Report Acquisition Process Via Defense Documentation Center

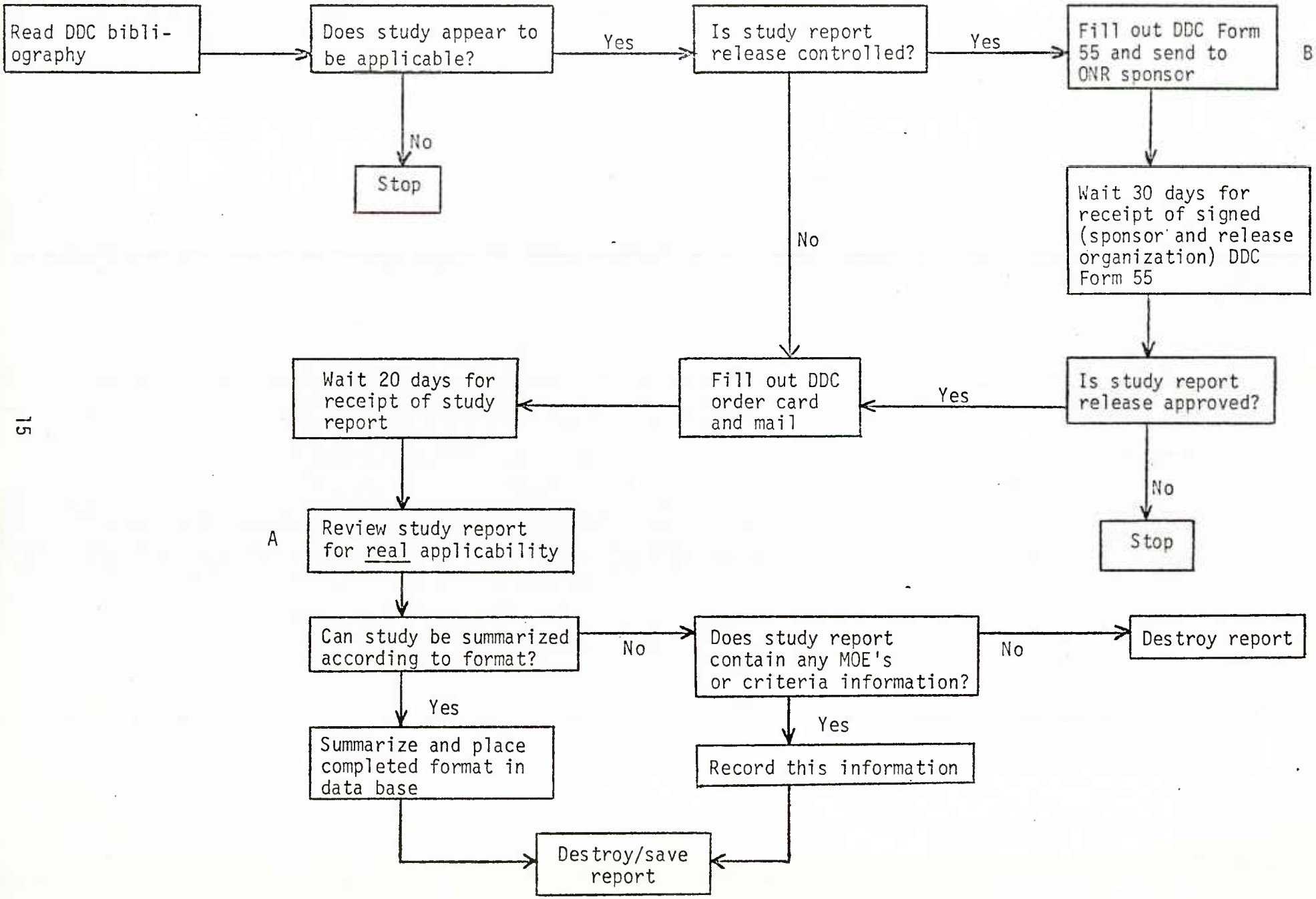
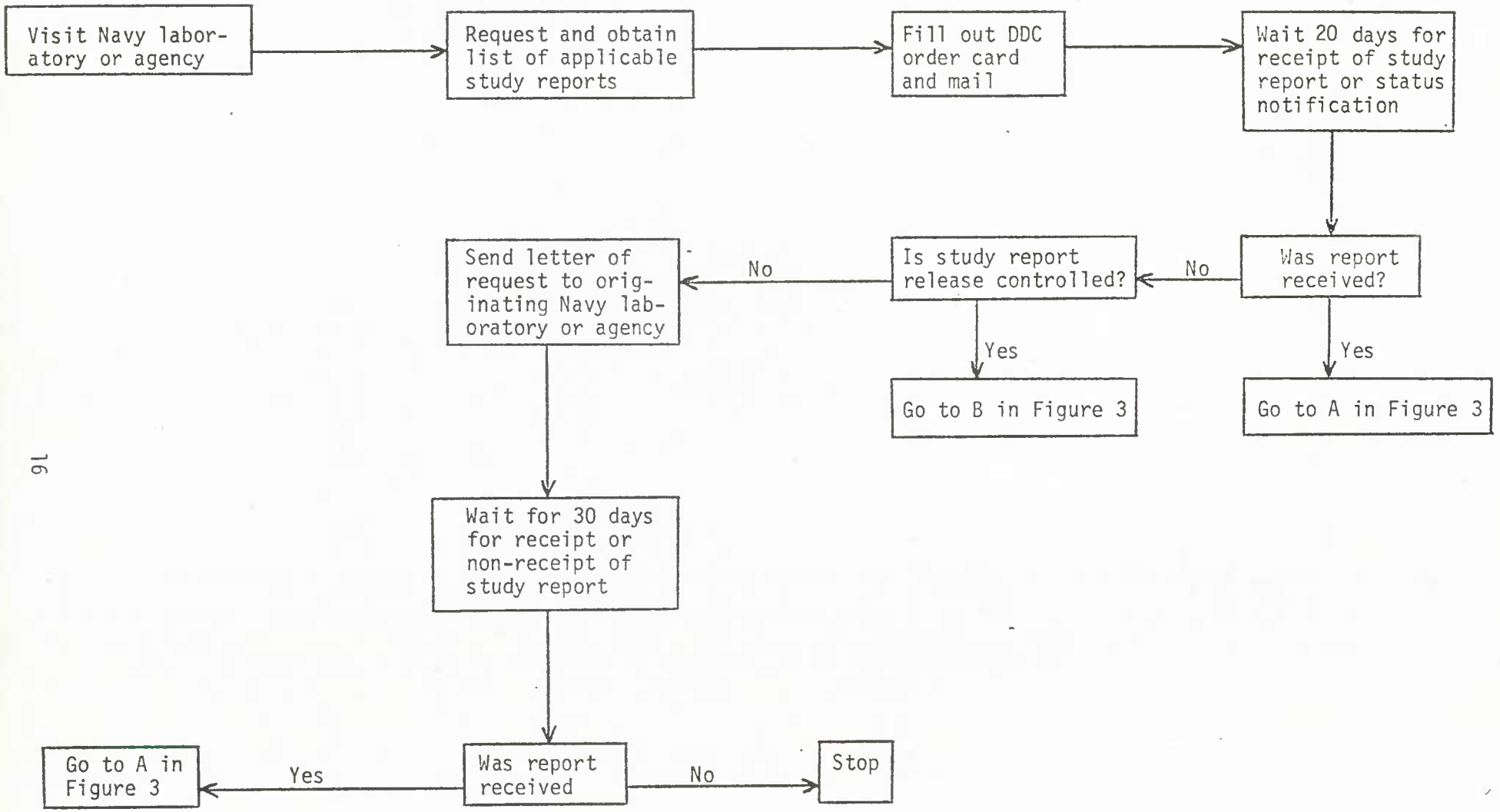


Figure 3 Study Report Acquisition Process Via Navy Laboratories/Agencies



V. ANALYSIS OF STUDY PARAMETERS

For each of the 139 Study Review Summaries, Section C was examined to determine the frequency distribution of parameters (or variables) by category such as physical environment and its interactions, threat or target, friendly force, and friendly force-threat and friendly force-target interactions. The sample points were chosen to be for each MOE, given by case, mission or tactical situation in the study, the vector of (lowest level) parameters used in the MOE formulation in each of these categories. For all such vectors representing a given function, the corresponding coordinates were summed and relative percentages computed. The percentages were then averaged over the total sample for each parameter category of interest with the results presented in Table 4. The entries in parentheses represent the sample size for each function. Because MOE's are sometimes applicable to more than one warfare area, the sum of the sample points for each of the AAW, ASW, Attack, Mining and Mine Countermeasures, and Surveillance subareas (such as Airborne, ASW, Submarine ASW and Surface ASW in the generic area ASW) will exceed the sample size in the generic area. The "All" grouping represents the result of combining all 139 Study Review Summaries.

Some interesting observations that can be made from Table 4 are as follows:

(1) Of all studies considered and analyzed via the Study Review Summary format, nearly 45% of all independent variables used in the formulation of MOE's are peculiar to the category called Friendly Force-the side of interest to the study author(s). This percentage ranges from a low of 31% in Submarine Attack to a high of 76% in Reconnaissance/Intelligence. These percentages reveal the emphasis that study authors place on the variables they wish to consider in their models relative to the force side of interest to them. This is particularly significant when compared to the fact that the percentage of independent variables peculiar to the threat or target is on the average only 19% and has a range of 6% to 31%.

(2) On the average, only slightly less than 3% of all independent

TABLE 4 PER CENT* DISTRIBUTION OF PARAMETERS BY TYPE AND BY FUNCTION

FUNCTION	PHYSICAL ENVIRONMENT AND INTERACTIONS	THREAT/ TARGET	FRIENDLY FORCE	FRIENDLY FORCE-THREAT/TARGET INTERACTIONS
AAW(39)**	.2	17.7	37.5	44.5
Airborne(19)	.3	6.1	38.4	55.2
Surface(24)	.1	25.3	37.5	37.1
ASW(129)	2.6	20.9	41.8	34.7
Airborne(42)	3.2	13.9	59.3	23.6
Submarine(45)	3.1	21.6	33.5	41.7
Surface(54)	1.6	23.7	35.7	39.0
Attack(87)	2.7	21.2	39.6	36.5
Airborne(48)	3.1	20.2	39.4	37.3
Submarine(16)	5.2	17.6	31.3	46.0
Surface(42)	.5	26.5	41.8	31.2
Electronic Warfare(11)	.3	18.0	44.8	36.9
Mining and Mine Countermeasures(22)	3.4	22.2	53.4	21.0
Mining(14)	2.8	30.5	48.7	18.0
Mine Countermeasures(18)	4.2	14.6	59.5	21.8
Reconnaissance/Intelligence(9)	.5	14.5	76.0	9.0
Surveillance(11)	11.5	21.1	39.4	28.1
Ocean(7)	8.8	25.4	37.2	28.5
Undersea(5)	12.9	20.7	34.5	31.9
All(294)	2.9	19.3	44.6	33.3

* Entries across a row do not necessairly sum to 100.00 because of round-off errors.

** Number of MOE formulations

variables used in MOE formulations relate to the physical environment or its interactions with the other categories. The observed percentage, with the exception of Surveillance, ranges from .1% to 5%. In particular, in the ASW area, only 2.6 variables out of every 100 (independent) variables in an MOE formulation relate to the physical environment-a rather startling result. Mining and Mine Countermeasures are areas in which the observed percentages are essentially at least as large or larger than the overall average. The reason for this appears to be that in the mine warfare areas consideration is given to physical environment parameters such as the size and dimensions of the area being mined and/or swept. In contrast to the other categories, Ocean and Undersea Surveillance yield a percentage 3-4 times higher than the overall average. This can be readily explained by noting that in Ocean Surveillance the primary system employed is a satellite and its effectiveness is determined by such physical environment parameters as the frequency of clear or cloudy weather as well as the size and dimensions of the ocean area observed. In Undersea Surveillance, the system generally of interest is of the sonar or hydrophone type whose performance is affected by the physical environment parameters propagation loss and ambient noise. These are all important parameters in the ASW area but, relative to the number of other variables considered, they represent a small percentage.

(3) Interaction variables (or parameters) are those that are peculiar to two or more categories, as indicated by the second and third hierarchy levels of Figure 1. These kinds of variables arise in several ways such as the output of another model of complex interactions between opposing forces, or as representative of an interaction situation which is either very difficult to describe mathematically or about which little is known in order to describe it. On the average, these types of variables are used 33% of the time with a range of 9% to 55%, the latter being in the area of AAW.

The reason for the highest percentage being in the AAW category is that this area includes the analysis of end-game situations involving encounters such as missile-target or aircraft-aircraft; consequently, interaction variables arise rather naturally. In the AAW, ASW, Attack, Electronic Warfare and Surveillance areas, we observe that the Friendly Force interactions with the Threat and/or Target exceed, percentage-wise, the percentage of variables associated solely with either Threat or Target. This reflects the lack of knowledge that exists many times concerning the threat and target and the resulting tendency to use interaction variables to bridge this gap. A specific example can be found in analyzing aircraft survival in passing thru an area defended by surface-to-air missile batteries. In the absence of information concerning SAM firing doctrines, inter-battery coordination and performance envelopes, etc., it is sometimes easier to use as a variable the probability of aircraft survival against a SAM battery complex, which represents an interaction between the Friendly Force and Threat categories.

(4) In considering both the Friendly Force and Friendly Force Threat/Target Interaction categories, if we sum the corresponding percentages we observe that, on the average, for all studies considered nearly 78% of the independent variables in the MOE formulations dealt with either the Friendly Force category or its interaction with the Threat and/or Target categories. For AAW this average is 82%, for ASW it is 76.5%, for Attack it is 76.1%, for Electronic Warfare it is 81.7%, for Mining and Mine Countermeasures it is 74.4%, for Reconnaissance/Intelligence it is 85%, and for Surveillance it is 67.5%. The actual range when examining the functions separately is from 66% to 94%, with Ocean Surveillance the lowest and Airborne AAW the highest. These percentages provide quantitative insight into the importance that Friendly Force considerations have in effectiveness analyses.

Using the results of Table 4, to measure the relative frequency or, in some sense, the importance study authors place in the selection of one category

of independent variables versus another category, the percentage of occurrence numbers were ratioed to obtain quantities called "importance ratios". In effect, by forming the ratio of the percentage for one category to the percentage for a second category, one obtains an average estimate of the number of independent variables associated with the first category relative to the number of independent variables associated with the second category. Specifically, this was done for friendly force variables relative to threat and target variables and for friendly force variables relative to friendly force interactions with the threat and/or target. The resulting ratios can be regarded as measures of importance placed by study authors on the independent variables they select to be used in the formulation and development of MOE's. These ratios are presented in Table 5.

Referring to Table 5, the following observations can be made:

(1) On the average, in the formulation of MOE's over twice as many independent variables for the friendly force are used relative to the total number of independent variables for threat and/or target. In a sense, this means that as far as the study authors are concerned friendly force considerations are at least twice as important as those for threat and/or target. This particular ratio ranges from a low of 1.46 to a high of 6.30. Similarly, friendly force independent variables are regarded as over 1.3 times as important as those involving friendly force interactions with threat and target.

(2) The highest importance ratios for friendly force variables relative to threat and target variables occur in Airborne AAW, Reconnaissance/Intelligence, Airborne ASW and Mine Countermeasures. In the case of Airborne AAW, from the studies examined emphasis appears to be placed more on the aircraft and its weapon performance rather than the characteristics of the threat or target. In Airborne ASW there are over four times as many independent variables considered for the friendly force relative to threat and/or target. The reason for this is that in this particular warfare area the emphasis is typically placed on how well aircraft can investigate

TABLE 5 SELECTED IMPORTANCE RATIOS BY FUNCTION

FUNCTION	FRIENDLY FORCE TO THREAT/TARGET	FRIENDLY FORCE TO FRIENDLY FORCE-THREAT/TARGET INTERACTIONS
AAW	2.12	.84
Airborne	6.30	.70
Surface	1.48	1.01
ASW	2.00	1.20
Airborne	4.27	2.51
Submarine	1.55	.80
Surface	1.51	.92
Attack	1.87	1.08
Airborne	1.95	1.06
Submarine	1.78	.68
Surface	1.58	1.34
Electronic Warfare	2.49	1.21
Mining and Mine Countermeasures	2.41	2.54
Mining	1.60	2.71
Mine Countermeasures	4.08	2.73
Reconnaissance/Intelligence	5.24	8.44
Surveillance	1.87	1.40
Ocean	1.46	1.31
Undersea	1.67	1.08
All	2.31	1.34

contacts, detect, localize and kill submarines, lay sonobuoy barriers and use dipping sonars. Consequently, the threat or target is not regarded as important in comparison to how well these operations are performed. Similarly, in the case of Mine Countermeasures, the real interest is in how well the countermeasures operation is conducted, and is also assessed as being at least four times as important as the threat and/or target. In the reconnaissance/intelligence area, the emphasis is placed on system performance in the sense of how well the system can collect, evaluate and process information rather than the characteristics of the object(s) being observed; consequently, we see this reflected in the 5.24 importance ratio. This is further illustrated by the 8.44 ratio of friendly force variables to friendly force interactions with threat and target, showing a "lack" of interaction.

(3) An importance ratio of less than 1.0 for friendly force variables relative to friendly force interactions with threat and target indicates that effectiveness analysis of the encounter requires consideration of situations where total information is not generally available, such as tactics and the reaction to tactics, thus necessitating the analysis of complex interactions rather than being able to express the model in terms of variables from single categories such as friendly force. This is indicated in the areas of Airborne AAW, Surface ASW, Submarine ASW and Submarine Attack where, indeed, tactics and the reaction to tactics play an important role in the effectiveness analysis.

(4) In the cases of Airborne ASW, Mining, Mine Countermeasures and Reconnaissance/Intelligence, the lack of emphasis on interactions of the friendly force with the threat and target is indicated by the importance ratios ranging from 2.51 to 8.44. In these warfare areas, apparently either there exists virtually no requirement for interaction variables at the lowest level or the interaction effects can be more easily modeled and decomposed into lower level

independent variables.

As an exercise to determine the percent distribution of variables by evaluation level of studies, the three levels given by force, system and subsystem were examined for all warfare areas combined to obtain the following results, corresponding to Tables 4 and 5:

TABLE 6 PER CENT DISTRIBUTION OF PARAMETERS BY TYPE AND STUDY LEVEL

STUDY LEVEL	PHYSICAL ENVIRONMENT AND INTERACTIONS	THREAT/ TARGET	FRIENDLY FORCE	FRIENDLY FORCE-THREAT/TARGET INTERACTIONS
Force	1.6	22.6	39.2	36.6
System	3.5	17.6	45.3	33.5
Subsystem	1.7	21.0	59.5	17.8

TABLE 7 SELECTED IMPORTANCE RATIOS BY STUDY LEVEL

STUDY LEVEL	FRIENDLY FORCE TO THREAT/TARGET	FRIENDLY FORCE TO FRIENDLY FORCE-THREAT/TARGET INTERACTIONS
Force	1.73	1.07
System	2.57	1.35
Subsystem	3.83	3.34

No explanation is readily apparent for the trend exhibited by the percentages for the physical environment and its interactions and for the threat and target percentages as the study level decreases from force to subsystem. However, as one would intuitively expect, the percent distribution of variables associated with the friendly force category increases in going from force level to subsystem level and, similarly, the percent distribution of variables

associated with friendly force-threat and friendly force-target interactions decreases in going from force level to subsystem level. Also, from Table 7, we observe that the importance attributed to friendly force variables vis-a-vis threat and target variables increases in going from force level to subsystem level. A similar effect occurs for friendly force variables vis-a-vis friendly force interactions with threat and target. These trends can be rationalized from the point of view that, in contrast to a force level study, at the subsystem level there is less interest in the threat and target characteristics as well as their interactions with the friendly force.

VI. ANALYSIS OF MOE'S BY STUDY LEVEL AND TYPE

In the 213 study reports examined, there is a total of 933 MOE's, both primary and additional, to be found in the Study Review Summaries and the MOE Reviews. In Table 8 is presented a summary of these MOE's by level (force, system or subsystem) and by type (probabilistic, statistical, deterministic or other).

TABLE 8 MOE DISTRIBUTION BY STUDY LEVEL AND TYPE

	TYPE								
	PROBABILISTIC		STATISTICAL		DETERMINISTIC		OTHER		
STUDY LEVEL	NO.	%	NO.	%	NO.	%	NO.	%	TOTAL
Force	57	26.1	84	38.5	70	32.1	7	3.3	2[illegible]
System	183	38.4	100	21.0	178	37.3	16	3.3	477
Subsystem	103	43.3	47	19.7	84	35.3	4	1.7	2[illegible]
	343	36.8	231	24.8	332	35.6	27	2.8	933

By type of MOE in Table 8, probabilistic includes MOE's that represent the probability of occurrence of one or more events; statistical MOE's include median, standard deviation, variance, average or expected value, and bias; deterministic MOE's include costs, kill rates, sortie rates, etc.; other MOE's include exchange ratios and cost-effectiveness type ratios. In particular, we observe that probabilistic MOE's are more prevalent as the study level goes from force to subsystem; however, statistical MOE's (primarily those that are expected values or averages) are more prevalent as the study level goes from subsystem to force. The former is a plausible trend since system and subsystem level studies are generally concerned with system and equipment performance measured in a probabilistic way; whereas, in the latter case, force level studies typically involve more interactions (see Table 6) and the modeling of more complex situations and numerous dependent events, thus making the use of expected value type measures more appealing than the derivation of probabilistic measures of these situations. On the other hand, there appears to be little or no correlation between the use of deterministic MOE's and the study level involved.

VII. MOE SELECTION PROCESS

The basic steps to be followed in the selection of an MOE can be patterned after the Study Flow Summary of Figure 1 as follows:

(1) Select function (i.e., warfare area)
(2) Select evaluation level (e.g., force, system or subsystem)
(3) Select mission or tactical situation
(4) Identify platforms, systems and subsystems
(5) Select success criterion
(6) Identify applicable MOE's
(7) Review rationale for MOE selection
(8) Select MOE(s)

The choice of the function, or warfare area, can be made from the areas of Strike Warfare, Antisubmarine and Undersea Warfare, Command Support, and Operational Support as outlined in Table 1, representing the General Operational Requirements areas.

In selecting the evaluation level of interest typical subsystems are a radar, sonar, gun, missile or computer, whereas typical systems are an aircraft, destroyer, submarine, aircraft carrier or satellite. A force level study then constitutes a mix of systems of this type, such as aircraft and destroyers or destroyers and submarines, etc. This type of distinction between the three levels is the convention that has been used in reviewing the studies presented in the summary formats of Volumes 2-4.

The choice of a mission or tactical situation depends not only on the warfare area of interest but also on the evaluation level. In this study report no attempt has been made to standardize the definitions of missions or tactical situations. The primary reason for this is that in many areas there does not appear to be common agreement amongst analysts as to the definition of a mission with a specified name. To illustrate this point and, at the same time, to provide a shopping list of missions and tactical situations addressed in Naval warfare, in Appendix D are presented in summary form the missions and tactical situations found in the 139 Study Review Summaries of Volumes 2 and 3.

The identification of the platforms, systems and subsystems in a given mission or tactical situation is important for several reasons. First, this is necessary in order to determine the data requirement areas for MOE computation. For example, in Section C of each Study Review Summary are presented the data requirements for a given mix of platforms, systems and subsystems in a specified mission or tactical situation. Second, the choice of a success criterion and a measure of effectiveness will depend on the platform, system and subsystem mix being considered.

In choosing a success criterion, one must examine the objective of the mission or tactical situation. The measure of effectiveness then represents a quantification of how well this success criterion is met. For example, in the Area Preparation Mission the objective is to destroy or suppress enemy offensive and defensive firepower before the operation begins. A possible success criterion would be destruction or suppression of enemy offensive and defensive firepower. In an Interdiction Mission the objective is to reduce an enemy's capability to wage war by impeding his freedom of movement through slowing or stopping the flow of enemy supplies, destruction of materials and/or the vehicles used to transport it, and destruction of transportation routes. In this case, a possible success criterion would be the reduction of the enemy's capability to wage war. For each of the missions and tactical situations found in the Study Review Summaries of Volumes 2 and 3, the corresponding success criteria are presented in Appendix D. These tables are not intended to be exhaustive but merely illustrative of what was used in the study reports examined.

The choice of a measure of effectiveness for a given combination of success criterion, mission or tactical situation, platform, system and subsystem mix, evaluation level and warfare area is not necessarily unique. This can be easily observed by reviewing the tables presented in Appendix D. When there is more than one candidate MOE available, one needs to assess its merits and the eventual use of the MOE in decision-making. If an absolute score is desired such as targets destroyed in a specified interval of time, then the MOE given by the number of targets destroyed is a logical choice; on the other hand, if a rate of destruction measure is desired, then the number of targets destroyed per unit time is a logical choice.

To further illustrate the process of selecting an MOE, consider an antiradiation missile which is designed to home-on and to destroy radars. At first glance it would seem logical to define the success criterion as destruction of radars, and the MOE as the probability of radar kill. However, in reality, the objective is to suppress enemy radar transmissions or to cause the enemy radars to cease radiating. This can be done in several ways such as:

(1) the missile can physically destroy the radar as it is designed to do;

(2) the missile can be fired at the radar target, and if the radar operator is aware that the missile has been launched at him, he may shut the radar off the air rather than risk being destroyed;

(3) the mission can be accomplished if the pilot turns the aircraft carrying the antiradiation missile toward the target, preparing for or feigning a missile launch, and then the radar operator, anticipating a missile attack, shuts down.

Consequently, the mission objective can be accomplished without firing any missiles at all. In the case of strike warfare where the antiradiation missile is employed to protect penetrating aircraft, a candidate measure of effectiveness would be the probability that either no surface-to-air missiles are fired or, given that at least one SAM is fired, all aircraft survive.

In Figure 4 is presented in flow chart form the MOE selection process as given by steps (1)-(8), using as warfare areas those that were found in the 213 study reports examined. To further illustrate this process at the force, system and subsystem levels, respectively, Figures 5-7 provide examples in the area of airborne attack. In each figure an identification is made between a Study Review Summary or MOE Review in the data base provided by Volumes 2-4 and the warfare area, the evaluation level, the mission, the platform, system and subsystem mix, the success criterion, and the MOE selected. This identification is, of course, optional but it does provide a means for using this rather extensive data base.

To further provide assistance in the selection of success criteria and measures of effectiveness, in Appendix E is given a table of success criteria

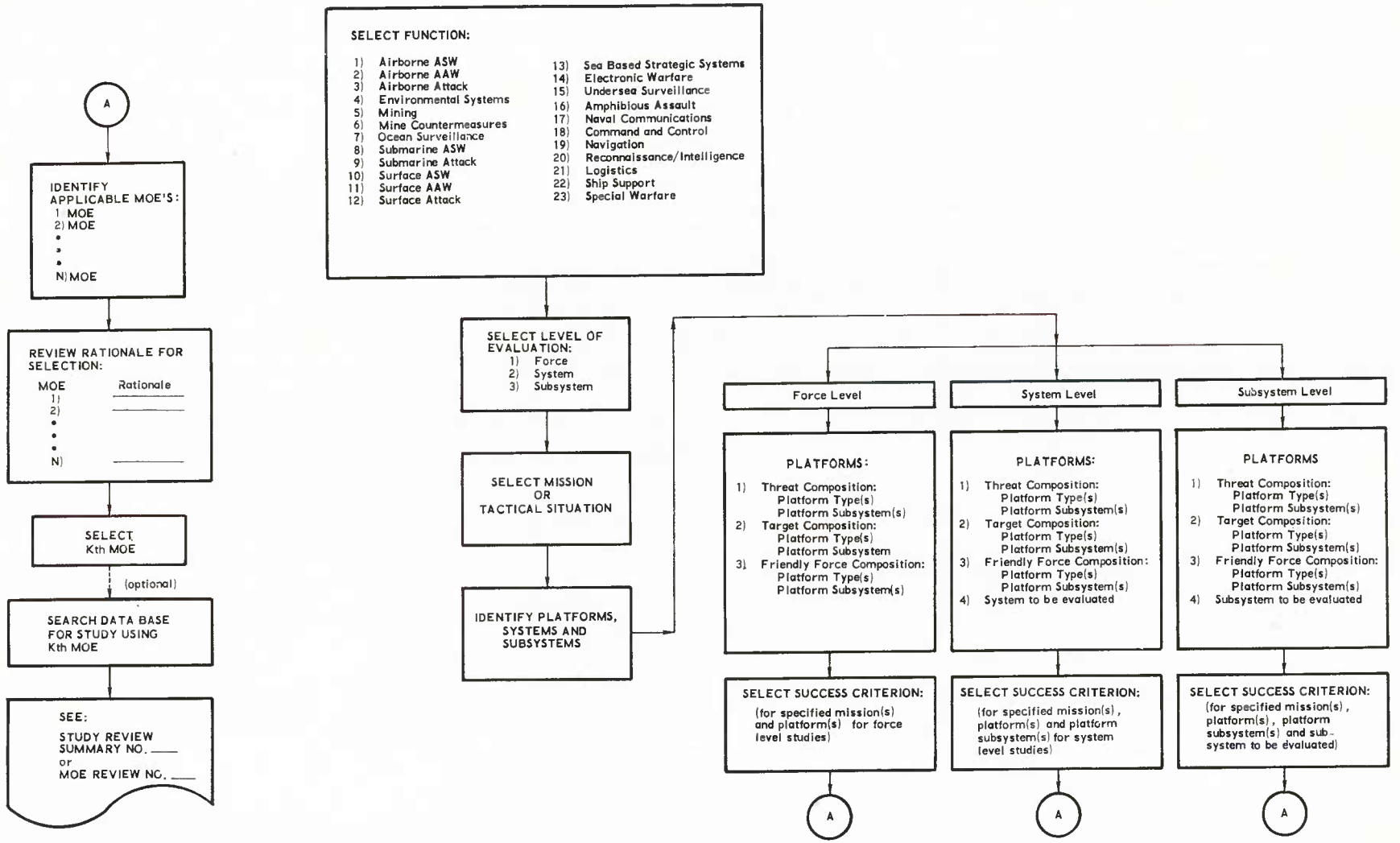


FIGURE 4 DETAILED MOE SELECTION PROCESS

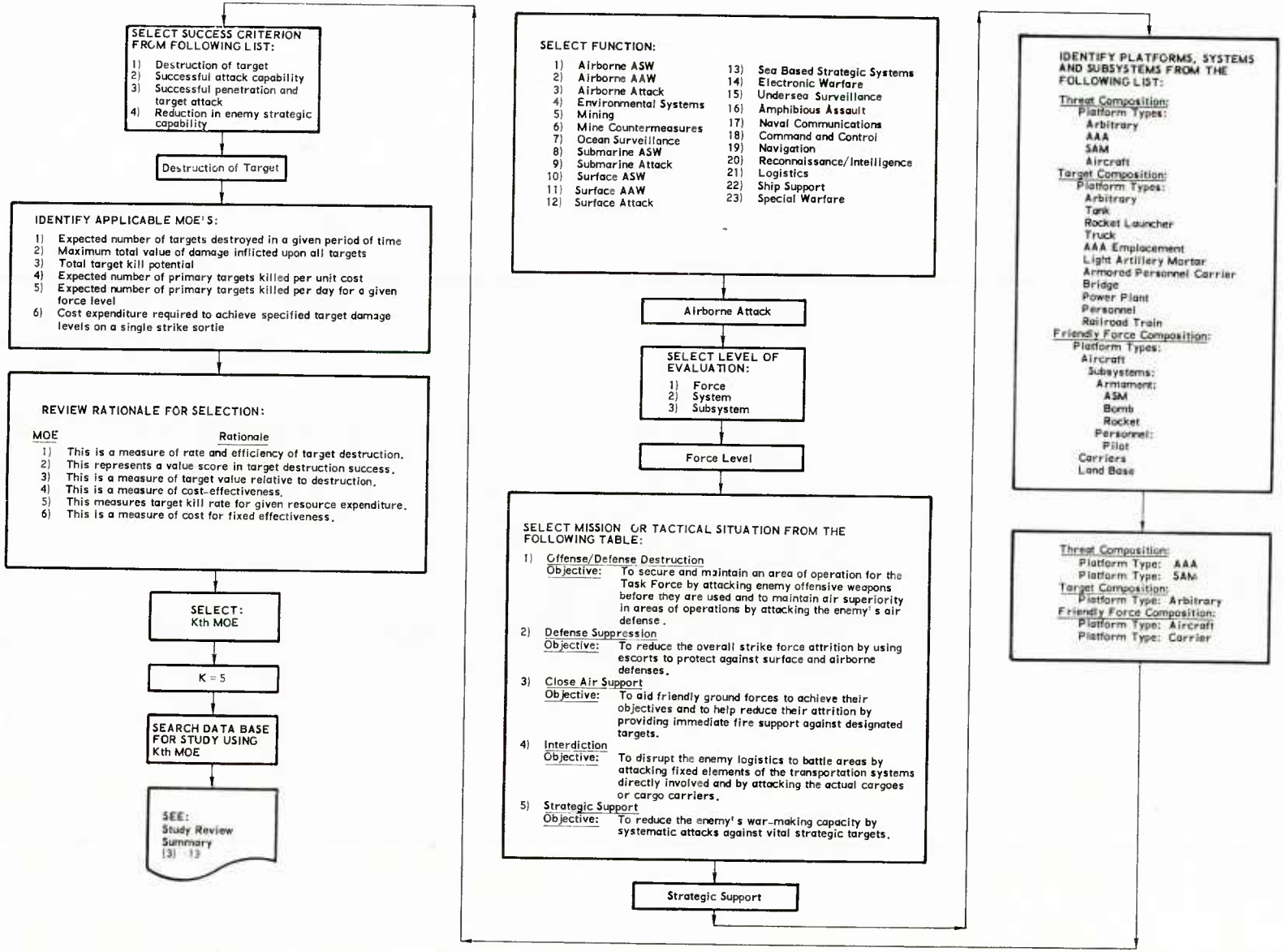


FIGURE 5 AIRBORNE ATTACK FORCE LEVEL MOE SELECTION

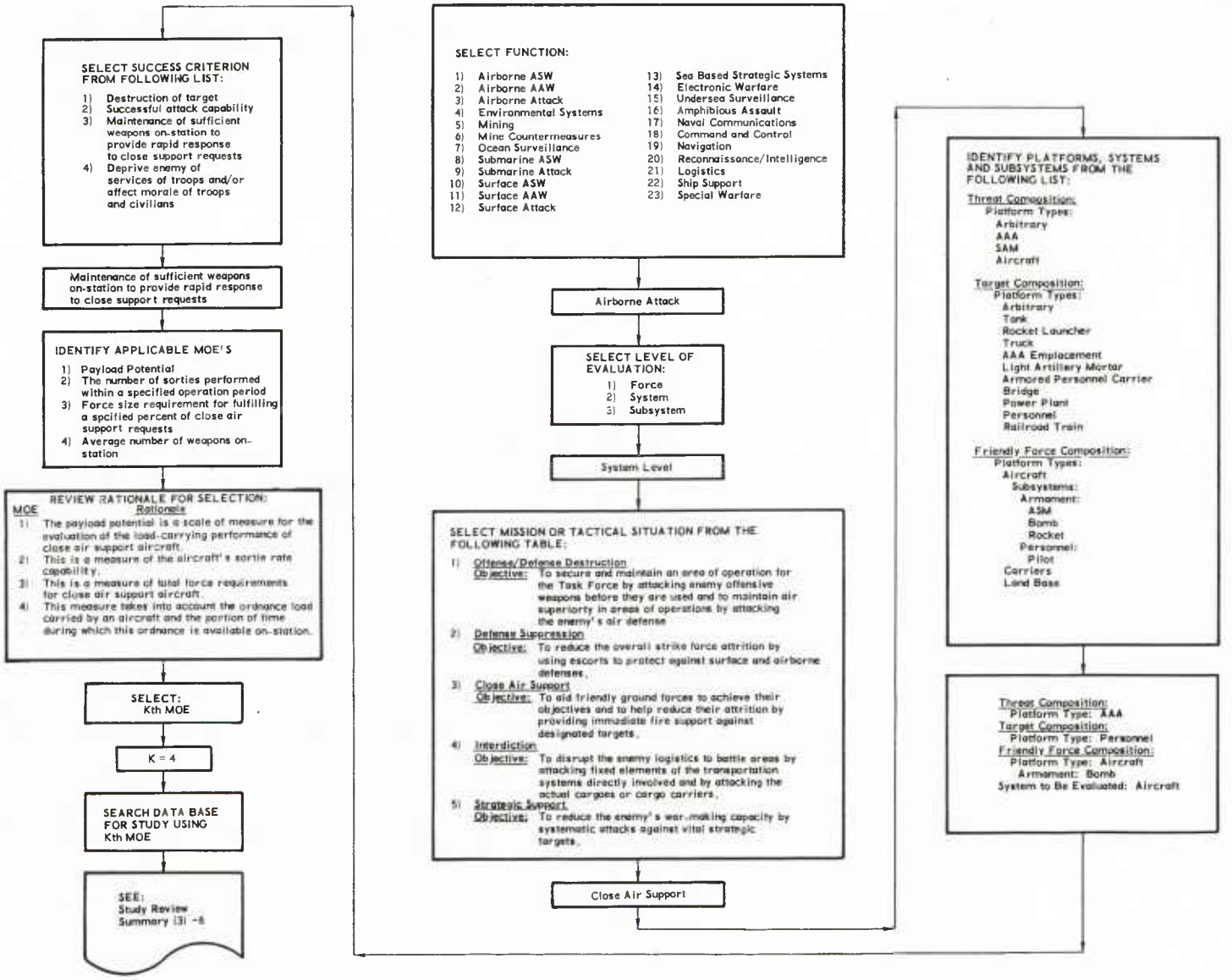


FIGURE 6 AIRBORNE ATTACK SYSTEM LEVEL MOE SELECTION

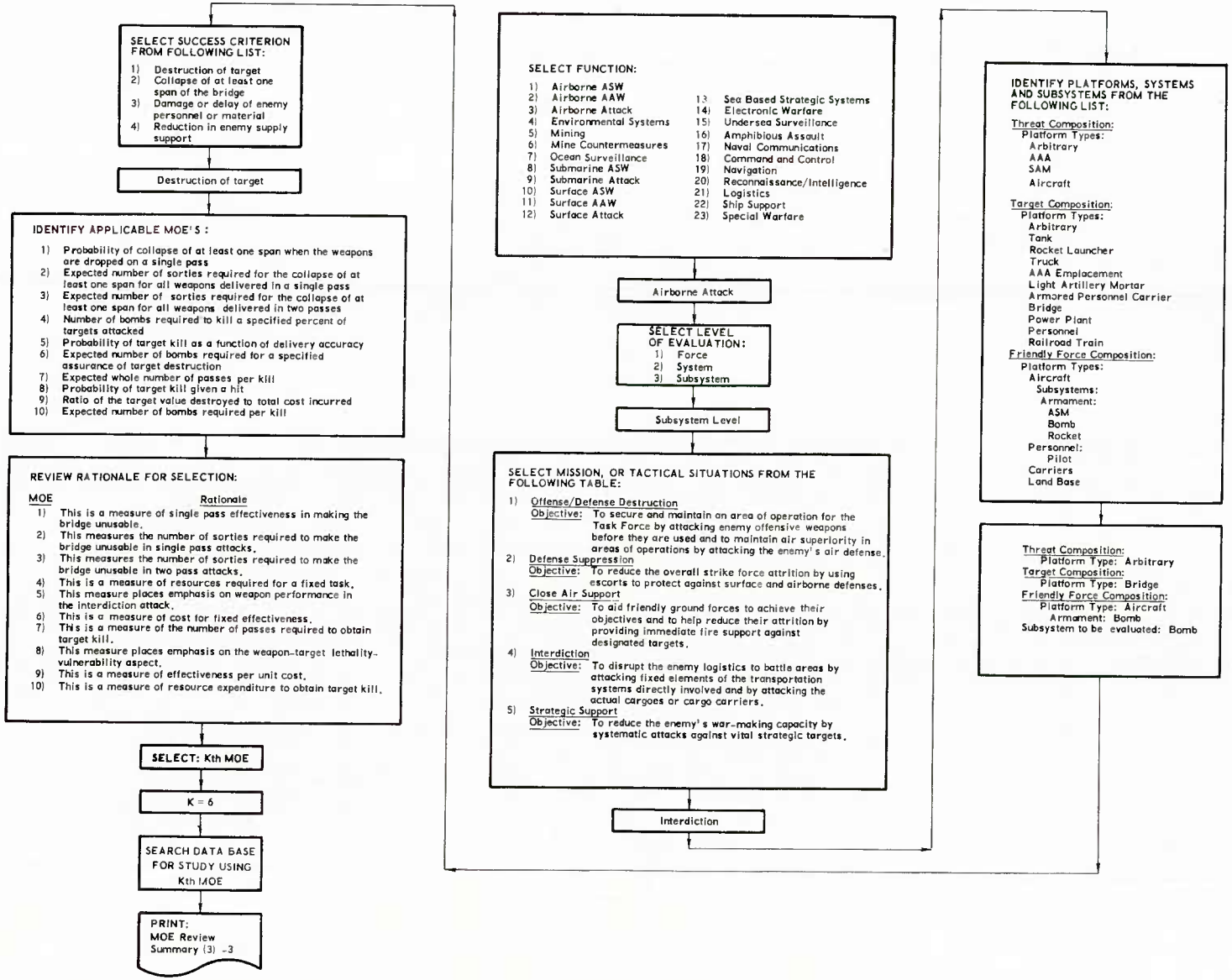


FIGURE 7 **AIRBORNE ATTACK SUBSYSTEM LEVEL MOE SELECTION**

and MOE's for each platform, system and subsystem-warfare area-situation found in the review of the 213 studies. In this table "platform" is used to denote the platform, system or subsystem chosen. The utility of this table is expected to be that it provides a ready reference, for a given choice of "platform," warfare area and situation in which the "platform" is being used, to applicable success criteria and measures of effectiveness. This table is not intended to be exhaustive but merely illustrative of the type of such information found in Naval warfare via the review of 213 (somewhat arbitrarily chosen) studies.

A few final remarks are in order concerning the type of MOE to be chosen. As was pointed out in VI, the types of MOE's found used in studies range from probabilistic to statistical to deterministic. In particular, one type of commonly occurring MOE is that of an expected value measure. This type is derived from an analytical model which produces for a given set of input conditions a single, uniquely determined result, namely, the "expected value" of the engagement or campaign. Such models have the disadvantage of not reflecting the variance from the "expected" results that should be anticipated in the real world, and, further, they do not reflect the effect of improbable, but possible, events or results. One example of the latter situation would be an AAW system for which the mean time to acquire a target is greater than the time a given high-speed, low-altitude target is engageable (from crossing the radar horizon to impact). The "expected value" of this encounter is zero kills by the AAW system. However, if there is a reasonable probability (say 20%) that the AAW system would acquire the target in time to fire a salvo (even though its mean reaction time was too long), then a Monte Carlo or similar model that could reflect this fact would predict both zero and non-zero results. Many repetitions would, of course, be required to obtain a mean value and establish a variance. However, unless the AAW system acquisition time distribution function is accurately known, errors would be generated by the tails of the assumed distribution functions. The expected value result is also likely to be erroneous to the extent that accurate reflection of the distribution functions of the many probabilistic events involved in AAW is important, but data on these functions may be totally lacking and, as a result, no calculation can be advertised as accurately reflecting them.

Typically (see Table 8), in force level studies the measure of effectiveness is given as an expected value. There is a major difficulty in obtaining the expression for the MOE, since it is the expected value of some random variable Y which is generally a nonlinear function of a number of other random variables, say, X_1, X_2,... In this case we have MOE = $E[Y(X_1,X_2,...)] = \overline{Y}(X_1,X_2,...)$. Since, in many cases, at most the expected values $\overline{X}_1$, $\overline{X}_2$,..., etc. are known, this has led to the approximation given by MOE = $Y(\overline{X}_1,\overline{X}_2,...)$. This is only a satisfactory approximation under the two conditions that (1) Y is approximately linear, and (2) dispersion of each of the random variables X_i about its mean $\overline{X}_i$ is sufficiently small. Condition (1) is, in general, rarely met. A model in which the variables X_i are markedly dispersed about their expected value $\overline{X}_i$ is called (due to Dr. B. O. Koopman) a dispersive model, while when on the contrary all the variables have such small dispersions that these can be neglected, a non-dispersive model. Clearly, for a given effectiveness model structure leading to $Y = Y(\overline{X}_1,\overline{X}_2,...)$, then MOE = $Y(\overline{X}_1,\overline{X}_2,...)$ is to assume that the model is non-dispersive. The cause of dispersion in dispersive models can be found in the variability of the environment, the equipment performance, and in the unpredictability of enemy action as well as the uncertainty of the friendly force reaction. The point to be made here is that one should be aware of the inherent assumptions and limitations involved in using expected values either for MOE's or as data inputs in their computation.

APPENDIX A STUDY FORMATS

TABLE A-1 STUDY REVIEW SUMMARY FORMAT

A. STUDY DESCRIPTION

1) Originating Activity
2) Report Title
3) Author(s)
4) Report Number (or source, if a journal article)
5) Date
6) Classification
7) Contract (including sponsoring agency)
8) Abstract
9) Descriptors

B. EFFECTIVENESS MEASUREMENT

1) Evaluation Level
2) Function
3) Mission(s) (or Tactical Situation(s))
   - 3.1) Mission (or Tactical Situation) Type(s)
     - 3.1.1) Definition
     - 3.1.2) Criterion For Success
     - 3.1.3) MOE(s) Selected
       - 3.1.3.1) Rationale For Selection
     - 3.1.4) Functional Form Of MOE
     - 3.1.5) Additional MOE's Identified
4) MOE Usage In Study
5) Special Study Assumptions (including rationale)

C. EFFECTIVENESS FACTORS

1) Physical Environment
   - 1.1) Qualitative Factors
   - 1.2) Quantitative Factors

2) Threat Composition
   2.1) Platform Types
      2.1.1) Qualitative Factors
      2.1.2) Quantitative Factors
      2.1.3) Sensors
         2.1.3.1) Qualitative Factors
         2.1.3.2) Quantitative Factors
         2.1.3.3) Deployment
            2.1.3.3.1) Qualitative Factors
            2.1.3.3.2) Quantitative Factors
         2.1.3.4) Tactics
            2.1.3.4.1) Qualitative Factors
            2.1.3.4.2) Quantitative Factors
      2.1.4) Armament
         2.1.4.1) Qualitative Factors
         2.1.4.2) Quantitative Factors
         2.1.4.3) Deployment
            2.1.4.3.1) Qualitative Factors
            2.1.4.3.2) Quantitative Factors
         2.1.4.4) Tactics
            2.1.4.4.1) Qualitative Factors
            2.1.4.4.2) Quantitative Factors
      2.1.5) Deployment
         2.1.5.1) Qualitative Factors
         2.1.5.2) Quantitative Factors
      2.1.6) Tactics
         2.1.6.1) Qualitative Factors
         2.1.6.2) Quantitative Factors
3) Target Composition
   3.1) Platform Types
      3.1.1) Qualitative Factors
      3.1.2) Quantitative Factors
      3.1.3) Sensors

3.1.3.1) Qualitative Factors
3.1.3.2) Quantitative Factors
3.1.3.3) Deployment
3.1.3.3.1) Qualitative Factors
3.1.3.3.2) Quantitative Factors
3.1.3.4) Tactics
3.1.3.4.1) Qualitative Factors
3.1.3.4.2) Quantitative Factors
3.1.4) Armament
3.1.4.1) Qualitative Factors
3.1.4.2) Quantitative Factors
3.1.4.3) Deployment
3.1.4.3.1) Qualitative Factors
3.1.4.3.2) Quantitative Factors
3.1.4.4) Tactics
3.1.4.4.1) Qualitative Factors
3.1.4.4.2) Quantitative Factors
3.1.5) Deployment
3.1.5.1) Qualitative Factors
3.1.5.2) Quantitative Factors
3.1.6) Tactics
3.1.6.1) Qualitative Factors
3.1.6.2) Quantitative Factors

4) Friendly Force Composition
4.1) Platform Types
4.1.1) Qualitative Factors
4.1.2) Quantitative Factors
4.1.3) Sensors
4.1.3.1) Qualitative Factors
4.1.3.2) Quantitative Factors
4.1.3.3) Deployment
4.1.3.3.1) Qualitative Factors
4.1.3.3.2) Quantitative Factors

- 4.1.3.4) Tactics
  - 4.1.3.4.1) Qualitative Factors
  - 4.1.3.4.2) Quantitative Factors
- 4.1.4) Armament
  - 4.1.4.1) Qualitative Factors
  - 4.1.4.2) Quantitative Factors
  - 4.1.4.3) Deployment
    - 4.1.4.3.1) Qualitative Factors
    - 4.1.4.3.2) Quantitative Factors
  - 4.1.4.4) Tactics
    - 4.1.4.4.1) Qualitative Factors
    - 4.1.4.4.2) Quantitative Factors
- 4.1.5) Deployment
  - 4.1.5.1) Qualitative Factors
  - 4.1.5.2) Quantitative Factors
- 4.1.6) Tactics
  - 4.1.6.1) Qualitative Factors
  - 4.1.6.2) Quantitative Factors

5) Threat - Target Interaction

- 5.1) Platform - Platform
  - 5.1.1) Type
    - 5.1.1.1) Quantitative Factors
- 5.2) Platform - Sensor
  - 5.2.1) Type
    - 5.2.1.1) Quantitative Factors
- 5.3) Sensor - Platform
  - 5.3.1) Type
    - 5.3.1.1) Quantitative Factors
- 5.4) Platform - Armament
  - 5.4.1) Type
    - 5.4.1.1) Quantitative Factors
- 5.5) Armament - Platform
  - 5.5.1) Type
    - 5.5.1.1) Quantitative Factors

5.6) Sensor - Sensor
5.6.1) Type
5.6.1.1) Quantitative Factors
5.7) Armament - Armament
5.7.1) Type
5.7.1.1) Quantitative Factors
5.8) Sensor - Armament
5.8.1) Type
5.8.1.1) Quantitative Factors
5.9) Armament - Sensor
5.9.1) Type
5.9.1.1) Quantitative Factors
6) Friendly Force - Threat Interaction
6.1) Platform - Platform
6.1.1) Type
6.1.1.1) Quantitative Factors
6.2) Platform - Sensor
6.2.1) Type
6.2.1.1) Quantitative Factors
6.3) Sensor - Platform
6.3.1) Type
6.3.1.1) Quantitative Factors
6.4) Platform - Armament
6.4.1) Type
6.4.1.1) Quantitative Factors
6.5) Armament - Platform
6.5.1) Type
6.5.1.1) Quantitative Factors
6.6) Sensor - Sensor
6.6.1) Type
6.6.1.1) Quantitative Factors
6.7) Armament - Armament
6.7.1) Type
6.7.1.1) Quantitative Factors

6.8) Sensor - Armament
6.8.1) Type
6.8.1.1) Quantitative Factors
6.9) Armament - Sensor
6.9.1) Type
6.9.1.1) Quantitative Factors
7) Friendly Force - Target Interaction
7.1) Platform - Platform
7.1.1) Type
7.1.1.1) Quantitative Factors
7.2) Platform - Sensor
7.2.1) Type
7.2.1.1) Quantitative Factors
7.3) Sensor - Platform
7.3.1) Type
7.3.1.1) Quantitative Factors
7.4) Platform - Armament
7.4.1) Type
7.4.1.1) Quantitative Factors
7.5) Armament - Platform
7.5.1) Type
7.5.1.1) Quantitative Factors
7.6) Sensor - Sensor
7.6.1) Type
7.6.1.1) Quantitative Factors
7.7) Armament - Armament
7.7.1) Type
7.7.1.1) Quantitative Factors
7.8) Sensor - Armament
7.8.1) Type
7.8.1.1) Quantitative Factors

7.9) Armament - Sensor
7.9.1) Type
7.9.1.1) Quantitative Factors
8) Threat - Physical Environment Interaction
8.1) Platform
8.1.1) Type
8.1.1.1) Quantitative Factors
8.2) Sensor
8.2.1) Type
8.2.1.1) Quantitative Factors
8.3) Armament
8.3.1) Type
8.3.1.1) Quantitative Factors
9) Target - Physical Environment Interaction
9.1) Platform
9.1.1) Type
9.1.1.1) Quantitative Factors
9.2) Sensor
9.2.1) Type
9.2.1.1) Quantitative Factors
9.3) Armament
9.3.1) Type
9.3.1.1) Quantitative Factors
10) Friendly Force - Physical Environment Interaction
10.1) Platform
10.1.1) Type
10.1.1.1) Quantitative Factors
10.2) Sensor
10.2.1) Type
10.2.1.1) Quantitative Factors
10.3) Armament
10.3.1) Type
10.3.1.1) Quantitative Factors

11) Threat - Target - Friendly Force Interaction

11.1) Platform - Platform - Platform

11.1.1) Type

11.1.1.1) Quantitative Factors

11.2) Platform - Sensor - Platform

11.2.1) Type

11.2.1.1) Quantitative Factors

11.3) Sensor - Platform - Platform

11.3.1) Type

11.3.1.1) Quantitative Factors

11.4) Platform - Armament - Platform

11.4.1) Type

11.4.1.1) Quantitative Factors

11.5) Armament - Platform - Platform

11.5.1) Type

11.5.1.1) Quantitative Factors

11.6) Sensor - Sensor - Platform

11.6.1) Type

11.6.1.1) Quantitative Factors

11.7) Armament - Armament - Platform

11.7.1) Type

11.7.1.1) Quantitative Factors

11.8) Sensor - Armament - Platform

11.8.1) Type

11.8.1.1) Quantitative Factors

11.9) Armament - Sensor - Platform

11.9.1) Type

11.9.1.1) Quantitative Factors

11.10) Platform - Platform - Sensor

11.10.1) Type

11.10.1.1) Quantitative Factors

11.11) Platform - Sensor - Sensor

11.11.1) Type

11.11.1.1) Quantitative Factors

11.12) Sensor - Platform - Sensor
11.12.1) Type
11.12.1.1) Quantitative Factors
11.13) Platform - Armament - Sensor
11.13.1) Type
11.13.1.1) Quantitative Factors
11.14) Armament - Platform - Sensor
11.14.1) Type
11.14.1.1) Quantitative Factors
11.15) Sensor - Sensor - Sensor
11.15.1) Type
11.15.1.1) Quantitative Factors
11.16) Armament - Armament - Sensor
11.16.1) Type
11.16.1.1) Quantitative Factors
11.17) Sensor - Armament - Sensor
11.17.1) Type
11.17.1.1) Quantitative Factors
11.18) Armament - Sensor - Sensor
11.18.1) Type
11.18.1.1) Quantitative Factors
11.19) Platform - Platform - Armament
11.19.1) Type
11.19.1.1) Quantitative Factors
11.20) Platform - Sensor - Armament
11.20.1) Type
11.20.1.1) Quantitative Factors
11.21) Sensor - Platform - Armament
11.21.1) Type
11.21.1.1) Quantitative Factors
11.22) Platform - Armament - Armament
11.22.1) Type
11.22.1.1) Quantitative Factors

11.23) Armament - Platform - Armament
11.23.1) Type
11.23.1.1) Quantitative Factors
11.24) Sensor - Sensor - Armament
11.24.1) Type
11.24.1.1) Quantitative Factors
11.25) Armament - Armament - Armament
11.25.1) Type
11.25.1.1) Quantitative Factors
11.26) Sensor - Armament - Armament
11.26.1) Type
11.26.1.1) Quantitative Factors
11.27) Armament - Sensor - Armament
11.27.1) Type
11.27.1.1) Quantitative Factors
12) Threat - Target - Physical Environment Interaction
12.1) Platform - Platform
12.1.1) Type
12.1.1.1) Quantitative Factors
12.2) Platform - Sensor
12.2.1) Type
12.2.1.1) Quantitative Factors
12.3) Sensor - Platform
12.3.1) Type
12.3.1.1) Quantitative Factors
12.4) Platform - Armament
12.4.1) Type
12.4.1.1) Quantitative Factors
12.5) Armament - Platform
12.5.1) Type
12.5.1.1) Quantitative Factors
12.6) Sensor - Sensor
12.6.1) Type
12.6.1.1) Quantitative Factors

12.7) Armament - Armament
12.7.1) Type
12.7.1.1) Quantitative Factors
12.8) Sensor - Armament
12.8.1) Type
12.8.1.1) Quantitative Factors
12.9) Armament - Sensor
12.9.1) Type
12.9.1.1) Quantitative Factors
13) Friendly Force - Target - Physical Environment Interaction
13.1) Platform - Platform
13.1.1) Type
13.1.1.1) Quantitative Factors
13.2) Platform - Sensor
13.2.1) Type
13.2.1.1) Quantitative Factors
13.3) Sensor - Platform
13.3.1) Type
13.3.1.1) Quantitative Factors
13.4) Platform - Armament
13.4.1) Type
13.4.1.1) Quantitative Factors
13.5) Armament - Platform
13.5.1) Type
13.5.1.1) Quantitative Factors
13.6) Sensor - Sensor
13.6.1) Type
13.6.1.1) Quantitative Factors
13.7) Armament - Armament
13.7.1) Type
13.7.1.1) Quantitative Factors
13.8) Sensor - Armament
13.8.1) Type
13.8.1.1) Quantitative Factors

13.9) Armament - Sensor
13.9.1) Type
13.9.1.1) Quantitative Factors

14) Friendly Force - Threat - Physical Environment Interaction
14.1) Platform - Platform
14.1.1) Type
14.1.1.1) Quantitative Factors
14.2) Platform - Sensor
14.2.1) Type
14.2.1.1) Quantitative Factors
14.3) Sensor - Platform
14.3.1) Type
14.3.1.1) Quantitative Factors
14.4) Platform - Armament
14.4.1) Type
14.4.1.1) Quantitative Factors
14.5) Armament - Platform
14.5.1) Type
14.5.1.1) Quantitative Factors
14.6) Sensor - Sensor
14.6.1) Type
14.6.1.1) Quantitative Factors
14.7) Armament - Armament
14.7.1) Type
14.7.1.1) Quantitative Factors
14.8) Sensor - Armament
14.8.1) Type
14.8.1.1) Quantitative Factors
14.9) Armament - Sensor
14.9.1) Type
14.9.1.1) Quantitative Factors

TABLE A-2 MOE REVIEW FORMAT

A. STUDY DESCRIPTION

1) Originating Activity
2) Report Title
3) Author(s)
4) Report Number (or source, if a journal article)
5) Date
6) Classification
7) Contract (including sponsoring agency)
8) Abstract
9) Descriptors

B. EFFECTIVENESS MEASUREMENT

1) Evaluation Level
2) Function
3) Applicable Situation(s)
   3.1) Type
      3.1.1) Criterion For Success
      3.1.2) MOE(s) Selected
             Rationale For Selection
             Limitations And Assumptions

TABLE B-1 ORIGINATING ACTIVITIES FOR STUDY REVIEW SUMMARIES AND MOE REVIEWS

ORIGINATING ACTIVITY	STUDY REVIEW SUMMARY NUMBER	MOE REVIEW NUMBER
Admiralty Underwater Weapons Establishment Portland, England	(5,6)-1, (9,10)-2	
Aerojet General Corporation El Monte, California	(10,12)-1	
AMEX Products, Inc. Rialto, California	(11,14)-1	
Anti-Submarine Warfare Force (Pacific) San Francisco, California		(1)-4
Analytic Services, Inc. Falls Church, Virginia	(3)-9, (3)-11	
Arthur D. Little, Inc. Cambridge, Massachusetts	(4)-1, (10)-3, (10)-4, (10)-5, (1,10)-4	
ARINC Research Corporation Washington, D.C.	(2)-4	
Atlantic Research, A Division of the Susquehanna Corporation Alexandria, Virginia	(14)-1, (14)-3	

ORIGINATING ACTIVITY	STUDY REVIEW SUMMARY NUMBER	MOE REVIEW NUMBER
Bell Aerosystems Company Buffalo, New York	(10)-15	
Bell Helicopter Company Fort Worth, Texas	(1)-3	
Boeing Airplane Company Seattle, Washington	(10)-9	
Bureau of Naval Weapons Washington, D.C.	(1)-16, (3)-13, (2,3)-1	(11)-2
Center for Naval Analyses Arlington, Virginia	(1)-4, (1)-13, (3)-10, (3)-14, (8)-14, (8)-15, (9)-2, (9)-4, (10)-1, (10)-2, (10)-6, (10)-11, (11)-2, (11)-5, (12)-5, (20)-1, (21)-1, (3,11)-1, (6,19)-1, (9,10)-1, (2,11,14)-1, (8,9,10)-1, (1,7,8,10,15)-1	(3)-1, (3)-3, (3)-5, (5)-1, (10)-5, (11)-1 (14)-1, (16)-1, (17)-2, (1,10)-1, (1,10)-2, (3,12)-1, (10,12)-1, (12,16)-1, (1,8,9)-1, (2,3,11)-1
Commander, Destroyer Development Group U.S. Atlantic Fleet	(10)-14	
Commander Submarine Force U.S. Atlantic Fleet Commander Submarine Force U.S. Pacific Fleet	(8)-10, (8)-12	

ORIGINATING ACTIVITY	STUDY REVIEW SUMMARY NUMBER	MOE REVIEW NUMBER
Cornell Aeronautical Laboratory, Inc. Buffalo, New York	(1)-11, (1)-12	(1)-5, (15)-1,
Daniel H. Wagner, Associates Paoli, Pennsylvania	(8)-1, (8)-6, (8)-7 (8)-8, (8)-9, (10)-10	(8)-2, (8)-4
Department of National Defense, Defense Research Analysis Establishment Ottawa, Canada	(15)-3	
Falcon Research and Development Company, Thor Division Cockeysville, Maryland		(1)-8
General Precision, Inc., Librascope Group Glendale, California	(10)-12	
General Research Corporation Arlington, Virginia		(13)-1
General Research Corporation Santa Barbara, California	(1,10)-2	
Grumman Aerospace Corporation Bethpage, New York	(21,22)-1	
Honeywell, Inc., Systems and Research Division Minneapolis, Minnesota	(20)-2	

ORIGINATING ACTIVITY	STUDY REVIEW SUMMARY NUMBER	MOE REVIEW NUMBER
IIT Research Institute Chicago, Illinois		(17)-3
Institute for Defense Analyses Arlington, Virginia	(1,8)-1, (8,10)-1, (8,10)-2,(1,8,9,13)-1	
Lockheed California Company Burbank, California	(3)-4	
Lockheed Missiles & Space Company Sunnyvale, California		(2,3,14,17,18,20,21,2[illegible]1
Minesweeping Branch, Bureau of Ships Washington, D.C.	(6)-1, (6)-3, (5,6)-4	
Mystic Oceanographic Company Mystic, Connecticut	(8)-3	
Naval Air Systems Command, Bureau of Naval Weapons Washington, D.C.	(3)-6	
Naval Air Test Center, U.S. Naval Air Station Patuxent River, Maryland		(14)-2
Naval Schools, Mine Warfare Naval Base Charleston, South Carolina		(6)-1

ORIGINATING ACTIVITY	STUDY REVIEW SUMMARY NUMBER	MOE REVIEW NUMBER
North American Rockwell Corporation Columbus, Ohio	(3)-1, (3)-2, (1,10)-1, (11,12)-1	
Office of the Chief of Naval Operations Washington, D.C.	(8)-2, (5,6)-5	(3)-8, (12)-3, (1,7,10)-1, (1,2,10,11)-1, (1,5,8,9,10,21,22)-1
Operations Research, Incorporated Silver Spring, Maryland	(5)-1, (5)-2, (6)-2, (8)-5, (8)-18	(1)-1, (1)-2, (1)-3, (8,18)-1
Planning Research Corporation Los Angeles, California and Washington, D.C.	(7)-1	(1)-6, (7)-1, (7)-2
Presearch, Incorporated Silver Spring, Maryland	(10)-13, (5,6)-2	(6,16)-1
Raff Analytic Study Associates, Inc. Silver Spring, Maryland	(1)-6	(10)-1
Sperry Microwave Electronics Division Clearwater, Florida	(3,12)-1	
Stanford Research Institute Menlo Park, California	(9)-3	(20)-2, (2,3)-1
Submarine Development Group Two Groton, Connecticut	(8)-16	(8)-1

ORIGINATING ACTIVITY	STUDY REVIEW SUMMARY NUMBER	MOE REVIEW NUMBER
Systems Analysis Office, ASW Systems Project Office White Oak, Maryland	(1)-1, (1)-5, (1)-7 (1)-9, (1)-10, (1)-15 (8)-11, (1,10)-3	(10)-4
Tetra Tech, Inc. Arlington, Virginia	(1,15)-1	
The John Hopkins University Applied Physics Laboratory Silver Spring, Maryland	(3,12,16)-1	
The Rand Corporation Santa Monica, California	(13)-1	
TRW Systems Group, Washington Operations Washington, D.C.		(9,10)-1
University of Wisconsin Madison, Wisconsin	(1)-2	
U.S. Naval Air Development Center Johnsville, Pennsylvania	(3,20)-1	(1)-7, (15)-2, (20)-1,
U.S. Naval Electronics Laboratory Center San Diego, California	(7)-3, (11)-3, (11)-4, (12)-2	(10)-2, (17)-1, (17)-[illegible] (18)-1, (14,17)-1
U.S. Naval Missile Center Point Mugu, California	(2)-2, (3)-12	

ORIGINATING ACTIVITY	STUDY REVIEW SUMMARY NUMBER	MOE REVIEW NUMBER
U.S. Naval Ordnance Laboratory White Oak, Maryland	(1)-14, (8)-4, (13)-2 (15)-2, (5,6)-3	(5)-2, (8)-5, (11,12)-1
U.S. Naval Ordnance Station Indian Head, Maryland		(12)-1
U.S. Naval Postgraduate School Monterey, California	(3)-8, (7)-2, (8)-17 (9)-1, (10)-7, (10)-8, (14)-2, (3,12,23)-1, (8,9,10,12)-1	(3)-4, (11,18)-1 (21,22)-1
U.S. Naval Radiological Defense Laboratory San Francisco, California	(11)-6, (23)-1	(7)-3, (9,12)-1
U.S. Naval Research Laboratory Washington, D.C.	(8)-13, (11)-1, (12)-3, (15)-1, (7,14)-1	(3)-7
U.S. Naval Ship Engineering Center Hyattsville, Maryland	(12)-4	
U.S. Naval Weapons Center China Lake, California	(2)-3, (3)-5, (12)-6, (11,12)-2	(3)-6, (3)-9, (10)-3, (3,20)-1
U.S. Naval Weapons Center, Corona Laboratories Corona, California		(3)-2
U.S. Naval Weapons Laboratory Dahlgren, Virginia	(16)-1	(8)-3, (12)-2

ORIGINATING ACTIVITY	STUDY REVIEW SUMMARY NUMBER	MOE REVIEW NUMBER
U.S. Naval Weapons System Analysis Office, Marine Corps Air Station Quantico, Virginia	(2)-1	
U.S. Navy Mine Defense Laboratory (U.S. Naval Ship Research and Development Laboratory) Panama City, Florida	(5,6)-5	(6)-2, (6,18,19)-1
Veda Incorporated Ann Arbor, Michigan	(1)-8	
Vitro Laboratories Silver Spring, Maryland	(1)-17	
Vought Aeronautics Division, LTV Aerospace Corporation Dallas, Texas	(3)-3, (3)-7	
Westwood Research, Inc. Los Angeles, California	(12)-1	

APPENDIX C REPORT TITLES

TABLE C-1 REPORT TITLES FOR STUDY REVIEW SUMMARIES AND MOE REVIEWS

REPORT TITLE AND ORIGINATING ACTIVITY	STUDY REVIEW SUMMARY NO.	MOE REVIEW NUMBER
A Case for the Continuation of the Surface Minecraft Naval Schools, Mine Warfare Naval Base		(6)-1
A Classification System, Measures of Effectiveness, and Model for Countersurveillance Stanford Research Institute		(20)-2
A Comparative Analysis of VP Lofar Tactics Against a Nuclear Target Systems Analysis Office, ASW Systems Project Office	(1)-5	
A Cost Effectiveness Study of the F4B Airborne Missile Control System ARINC Research Corporation	(2)-4	
Acoustic Countermeasures Study - Tactical Techniques to Improve ASW Early Warning in Task Force Operations Cornell Aeronautical Laboratory, Inc.		(15)-1
Addendum to Cost-Effectiveness Evaluation for Mixes on Naval Air Weapons Systems North American Rockwell Corporation	(3)-2	
Additional Analysis of Particular Phases of The Problem of Integrating Minesweeping and Minehunting in Assault Operations Minesweeping Branch, Bureau of Ships	(5,6)-4	
Advance Carrier Based V/STOL Close Air Support Aircraft Requirements Study and Appendices Vought Aeronautics Division, LTV Aerospace Corporation	(3)-7	
Advanced Submarine Weapon System Studies U.S. Naval Ordnance Laboratory		(8)-5
Advanced Surface Effect Vehicles for Antisubmarine Warfare Missions Center for Naval Analyses	(10)-6	
A Finite Markov Chain Computer Model for Determining the Vulnerability of a Task Force with an Active SAM Defense Against Successive Waves of Attackers Center for Naval Analyses	(11)-5	

REPORT TITLE AND ORIGINATING ACTIVITY	STUDY REVIEW SUMMARY NO.	MOE REVIEW NUMBER
A Formulation of the Allocation of Attack Aircraft to Fixed Location Targets U.S. Naval Postgraduate School	(3)-8	
A General Localization Probability Model for EM Emitters in a DF Network U.S. Naval Electronics Laboratory Center	(7)-3	
A Helicopter Versus Submarine Search Game University of Wisconsin	(1)-2	
Air ASW MOE Systems Analysis Office, ASW Systems Project Office	(1)-9	
Air ASW Sonobuoy Effectiveness in Prosecution Operations Operations Research Incorporated		(1)-2
Air Interdiction: Analysis of Self-Contained Operations Against Mobile Targets Analytic Services, Inc.	(3)-9	
Air Interdiction: Models for Armed Reconnaissance in a Permissive Environment Analytic Services, Inc.	(3)-11	
A Lanchester-Type Model for Combat Between Submarines, Carrier Task Group, and Hunter-Killer Groups Center for Naval Analyses	(8,9,10)-1	
A Linear Programming Analysis of Antisubmarine Aircraft Planning Research Corporation		(1)-6
A Measure of Detection Performance Submarine Development Group Two	(8)-16	
A Model for Force Attrition Admiralty Underwater Weapons Establishment	(9,10)-2	
A Model of Carrier-Submarine Interactions Center for Naval Analyses	(9,10)-1	
An Airborne Jamming Effectiveness Study Concerning the Tactical Employment of the EA-6B Against Surface-to-Air Defenses U.S. Naval Postgraduate School	(14)-2	

REPORT TITLE AND ORIGINATING ACTIVITY	STUDY REVIEW SUMMARY NO.	MOE REVIEW NUMBER
Analysis of Amphibious Communications Requirements for the Assault Phase, Ship-to-Shore Movement U.S. Naval Electronics Laboratory Center		(17)-4
Analysis of Design Goals for ASW Submarine Torpedoes Operations Research Incorporated	(8)-5	
Analysis of Moored Sonobuoy Data Department of National Defense, Defense Research Analysis Establishment	(15)-3	
Analysis of the Effectiveness of an SSK Barrier Center for Naval Analyses	(8)-15	
Analysis of U.S. Destroyer Countermeasures Effectiveness Capability Against the Cruise Missile Threat AMEX Products, Inc.	(11,14)-1	
Analytical Model and Proposed Umpiring Procedures for Initial Nuclear Weapons Effects U.S. Naval Radiological Defense Laboratory	(23)-1	
Analytical Models of ASW Sonobuoy Effectiveness: III.Kill Operations Research Incorporated		(1)-3
Analytical Study of Shore-Bombardment Weapons U.S. Naval Weapons Center	(12)-6	
Analytical Tool for Cost-Effectiveness Trade-Offs for the Light Airborne ASW Vehicle (LAAV) Systems Analysis Office, ASW Systems Project Office	(1,10)-3	
An Analysis of the Factors Effecting the Probability of Survival for Carrier Pilots in a Combat Environment U.S. Naval Postgraduate School		(3)-4
An Analytical Procedure for Optimizing Buoy Patterns Systems Analysis Office, ASW Systems Project Office	(1)-15	
An Analytic Model Describing the Encounter of a Surface Vessel and a Number of Missile Launching Boats U.S. Naval Weapons Center	(11,12)-2	

REPORT TITLE AND ORIGINATING ACTIVITY	STUDY REVIEW SUMMARY NO.	MOE REVIEW NUMBER
An Anti-SLBM Engagement Model Institute for Defense Analyses	(1,8,9,13)-1	
A Naval Anti-Air Warfare Model Emphasizing Accessibility in Defense System Optimization and R&D Decision-Making U.S. Naval Radiological Defense Laboratory	(11)-6	
An Evaluative Model for SSN Active Sonar Missions Mystic Oceanographic Company	(8)-3	
An Investigation of ASW Surface Ship FADAP Data to Estimate Distributions of Classification, Confirmation, Attack, and Total Prosecution Time Systems Analysis Office, ASW Systems Project Office		(10)-4
A Non-Stationary Markov Model for SSBN Training Operations Institute for Defense Analyses	(1,8)-1	
AN/SPS-12 EMCON Effectiveness Evaluation Atlantic Research, A Division of the Susquehanna Corporation	(14)-1	
Anti-Ship Missile Terminal Seeker Study Sperry Microwave Electronics Division	(3,12)-1	
Application of Cost Effectiveness Techniques to Selection of Preferred Warship Characteristics U.S. Naval Postgraduate School	(10)-8	
Application of Differential Games to Problems of Military Conflict: Tactical Allocation Problems, Part I U.S. Naval Postgraduate School	(3,12,23)-1	
Application of Differential Games to Problems of Naval Warfare: Surveillance-Evasion, Part I U.S. Naval Postgraduate School	(8,9,10,12)-1	
Application of Lanchester Analysis to a Mining Campaign U.S. Naval Ordnance Laboratory	(5,6)-3	
Applications of the Surface Effect Vehicle to Anti-Submarine Warfare Missions, Volume II Mission Analysis, Final Report Bell Aerosystems Company	(10)-15	

REPORT TITLE AND ORIGINATING ACTIVITY	STUDY REVIEW SUMMARY NO.	MOE REVIEW NUMBER
A Preliminary Treatment of Mobile SLBM Defense: A Game Theoretic Analysis The Rand Corporation	(13)-1	
A Simplified Anti-Shipping Campaign Model Center for Naval Analyses		(1,8,9)-1
Assessment Models and Methodologies of the Value of Tactical Early Warning and Surveillance in Naval Warfare Standord Research Institute		(2,3)-1
A Study of Airborne ASW Center for Naval Analyses	(1)-4	
A Study of the Application of an Indeterminacy Metric to ASW Systems Development Processes North American Rockwell Corporation	(1,10)-1	
A Study of the Mix of Fighter and Attack Aircraft for Attack Carriers Bureau of Naval Weapons	(2,3)-1	
A Study of United States Mine Countermeasures-1972 (MCM 72), Vols. 1 and 2 Office of the Chief of Naval Operations and U.S. Navy Mine Defense Laboratory	(5,6)-5	
A Study on Force Level Setting and Exchange Ratios U.S. Naval Research Laboratory	(12)-3	
A Submarine Barrier Detection Model Institute for Defense Analyses	(8,10)-2	
A Summary Report of Cost and Effectiveness of Selected Ocean-Area Surveillance Systems Planning Research Corporation		(7)-2
ASW Effectiveness Inside a Screen U.S. Naval Weapons Center		(10)-3
ASW Fixed Wing Aircraft Evaluation Project Anti-Submarine Warfare Force (Pacific)		(1)-4
ASW Force Level Study, Vols. I-VI Office of the Chief of Naval Operations		(1,5,8,9,10, 21,22)-1
ASW Hold-Contact and Attack Performance Center for Naval Analyses		(10)-5

REPORT TITLE AND ORIGINATING ACTIVITY	STUDY REVIEW SUMMARY NO.	MOE REVIEW NUMBER
ASW Ship Command and Control: The Expected Increase in ASW Force Effectiveness U.S. Naval Electronics Laboratory Center		(18)-1
ASW Systems Simulations for Surface Escorts and Submarines TRW Systems Group, Washington Operations		(9,10)-1
A Technique for Analysis of Intermittent Search Operations Applicable to ASW Boeing Airplane Company	(10)-9	
A Three-Parameter Stochastic Submarine Trailing Model Institute for Defense Analyses	(8,10)-1	
Barrier Effectiveness Daniel H. Wagner, Associates	(8)-6	
Barrier Measure of Effectiveness Daniel H. Wagner, Associates	(8)-7	
Candidate Measures of Effectiveness for Air Strike Systems U.S. Naval Weapons Center		(3,20)-1
Capability Measures for System Effectiveness Lockheed Missiles & Space Co.		(2,3,14,17 18,20,21,23)-1
Close Support Effectiveness of VAX and Other Aircraft Naval Air Systems Command, Bureau of Naval Weapons	(3)-6	
Comparative Tactical Effectiveness of Advanced ASW Fire Control Computers Center for Naval Analyses	(10)-2	
Computer Software Approach to Link 11 Jamming Protection U.S. Naval Electronics Laboratory Center		(14,17)-1
Concept Formulation Study for Independent ASW Localization and Attack System for Surface Ships, Vol. 8 Cost Effectiveness Vitro Laboratories	(1)-17	
Cost and Effectiveness of Selected Ocean-Area Surveillance Systems Planning Research Corporation	(7)-1	

REPORT TITLE AND ORIGINATING ACTIVITY	STUDY REVIEW SUMMARY NO.	MOE REVIEW NUMBER
Cost-Effectiveness Analysis of Alternative Configurations of an AIRS (Airborne Integrated Reconnaissance System), Vol. 1 Concepts and Math Model Descriptions and Vol. 2 Configuration Descriptions and Cost-Effectiveness Results U.S. Naval Air Development Center		(20)-1
Cost-Effectiveness Analysis of Oceangoing Fully Supported Small-Displacement Mine-Clearance Ships Operations Research Incorporated	(6)-2	
Cost-Effectiveness Analysis of Sensor and Non-Sensor Alternatives in Selected Operational Situations Center for Naval Analyses	(20)-1	
Cost-Effectiveness Comparison Between ASW Air/Sea Craft and Conventional ASW Aircraft Cornell Aeronautical Laboratory, Inc.	(1)-11	
Cost-Effectiveness Comparison of ASW Screen Systems U.S. Naval Electronics Laboratory Center		(10)-2
Cost-Effectiveness Evaluation for Mixes of Naval Air Weapons Systems North American Rockwell Corporation	(3)-1	
Cost-Effectiveness - Mechanical BT vs. Expendable BT Arthur D. Little, Inc.	(4)-1	
Cost Effectiveness Models for Airborne ASW Search and Detection Systems Veda Incorporated	(1)-8	
Cost Effectiveness of Carrier Based ASW Aircraft Bureau of Naval Weapons	(1)-16	
Cost-Effectiveness of CONDOR Bureau of Naval Weapons	(3)-13	
Cost-Effectiveness of Navigation, Command and Control Capability for Mine Countermeasures U.S. Navy Mine Defense Laboratory		(6,18,19)-1
Crisis at Sea II: A Force Mix Study of Sea-Based and Land-Based Air ASW Systems Office of the Chief of Naval Operations		(1,7,10)-1

REPORT TITLE AND ORIGINATING ACTIVITY	STUDY REVIEW SUMMARY NO.	MOE REVIEW NUMBER
Criteria for Aerial Minelaying Accuracy Center for Naval Analyses		(5)-1
Delay as a Measure of Mine Effectiveness U.S. Naval Ordnance Laboratory		(5)-2
Design of Antisubmarine Attack Models Center for Naval Analyses	(10)-11	
Distribution of Losses in an Idealized Antishipping Campaign Center for Naval Analyses	(9)-4	
Effectiveness of Acoustic Simulators Center for Naval Analyses	(10)-1	
Effectiveness of Deceptive Devices in Fleet Anti-Air Warfare Bureau of Naval Weapons		(11)-2
Effectiveness of Imperfect Decoys Center for Naval Analyses	(2,11,14)-1	
Effectiveness of 5"/54 Mark 42 and Mark 45 and 175mm Gun Suites Against a Moving Target Using Non-Adaptive Linear Prediction U.S. Naval Weapons Laboratory		(12)-2
Effectiveness Study of a Coastal Gunboat in a Southeast Asia Theater U.S. Naval Ordnance Laboratory		(11,12)-1
Efficient Use of Combat Air Patrol Against Cruise Missiles U.S. Naval Weapons Center	(2)-3	
EMCON Effectiveness Models for Fire Control Radars Atlantic Research, A Division of the Susquehanna Corporation	(14)-3	
Evaluating the Effectiveness of a Surface Ship ASW Screen U.S. Naval Postgraduate School	(10)-7	
Evaluation of the AN/ALT-35, Final Report Naval Air Test Center, U.S. Naval Air Station		(14)-2

REPORT TITLE AND ORIGINATING ACTIVITY	STUDY REVIEW SUMMARY NO.	MOE REVIEW NUMBER
Evaluation of the Military Worth of Information, Vol. I Principles U.S. Naval Air Development Center	(3,20)-1	
Final Report Navy Close Support Aircraft Study Lockheed California Company	(3)-4	
Harrier Aircraft for Amphibious Air Fire Support U.S. Naval Weapons Center		(3)-9
Hydrofoil Effectiveness Study, Vol. V Secret Supplement North American Rockwell Corporation	(11,12)-1	
Improved Air ASW Effectiveness by the Employment of Acoustic Countermeasures in Task Force Operations Cornell Aeronautical Laboratory, Inc.	(1)-12	
Influence of Human Factors on Air ASW Sonobuoy Systems Effectiveness Operations Research Incorporated		(1)-1
Inherent Vulnerability, Survival, and Protection Analyses of the S-3A Aircraft Falcon Research and Development Company		(1)-8
Integration of Minesweeping and Minehunting in Assault Operations Minesweeping Branch, Bureau of Ships	(6)-1	
Landing Force Support Ship (LFS) Study Center for Naval Analyses		(12,16)-1
LFSW Cost-Effectiveness and Tradeoff Analyses The John Hopkins University, Applied Physics Laboratory	(3,13,16)-1	
Major Fleet Escort Force Level Study, Vols. 1-3 and Supplement on Endurance Office of the Chief of Naval Operations		(1,2,10,11)-1
Mathematical Model for Cost Effectiveness Analysis of Small Acoustic Sensors Raff Analytic Study Associates, Inc.	(1)-6	
Max-Min Parameter Sensitivity Study U.S. Naval Ordnance Laboratory	(13)-2	

REPORT TITLE AND ORIGINATING ACTIVITY	STUDY REVIEW SUMMARY NO.	MOE REVIEW NUMBER
MCM Operations in Small Amphibious Assaults Presearch, Incorporated		(6,16)-1
Measure of Effectiveness Model for the SSK Versus Transitor Mission Commander Submarine Force, U.S. Atlantic Fleet and Commander Submarine Force, U.S. Pacific Fleet	(8)-12	
Measure of Effectiveness Model for a Submarine in the Intruder Role Commander Submarine Force, U.S. Atlantic Fleet and Commander Submarine Force, U.S. Pacific Fleet	(8)-10	
Measures of Effectiveness for Harbor Defense Center for Naval Analyses		(10,12)-1
Measures of Effectiveness in Submarine Warfare and their Relation to an Integrated Research Program Center for Naval Analyses	(9)-2	
Measures of Effectiveness of Ship-to Air Missiles Center for Naval Analyses		(11)-1
Methodological Basis for an Evaluation of New Pressure Minesweeper Concepts Presearch, Incorporated	(5,6)-2	
Methodology for a Submarine Weapons Endurance and Effectiveness Study, the Submarine Weapons Expenditure Model U.S. Naval Weapons Laboratory		(8)-3
Minesweeper/Minehunting Effectiveness Study U.S. Naval Ship Research and Development Laboratory		(6)-2
Minimizing the Approach Time of an SSK to its Target Center for Naval Analyses	(8)-14	
Mission Analysis of Advanced Active Sensors U.S. Naval Air Development Center		(1)-7
Mission Effectiveness Models for Comparing Air Cushion Vehicles and Hydrofoil Craft in Selected Missions Westwood Research, Inc.	(12)-1	
Mission Success U.S. Naval Missile Center	(2)-2	

REPORT TITLE AND ORIGINATING ACTIVITY	STUDY REVIEW SUMMARY NO.	MOE REVIEW NUMBER
Model and Computer Program for Calculating the Kill Probabilities for Certain ASW Tactics Center for Naval Analyses	(1)-13	
Monte Carlo Simulations of Submarine Barrier Operations U.S. Naval Research Laboratory	(8)-13	
Naval AA Target Designation and Acquisition Systems: A Probability Method for Their Evaluation Center for Naval Analyses	(11)-2	
Naval Gunfire Support Vols. I-III Center for Naval Analyses		(16)-1
Navy Shipboard Communications Technical Control Systems Analysis-Part I: Functional Analysis and Systems Synthesis, and Part II: Mathematical Modeling and Final Results U.S. Naval Electronics Laboratory Center		(17)-1
Nuclear Bullpup vs. Unguided Nuclear Weapons: Comparative Effectiveness in Limited War Center for Naval Analyses		(3)-5
Ocean-Surveillance-Radar Vulnerability to ECM U.S. Naval Research Laboratory	(7,14)-1	
Open Ocean ASW Air-Sea Craft System Feasibility Study, Vols. I-VI Cornell Aeronautical Laboratory, Inc.		(1)-5
Operational Analysis of Aerial Minelaying Systems 1970-1975, Vol. I The Analysis of Aerial Minelaying Systems Operational Research Incorporated	(5)-2	
Operational Analysis of Aerial Minelaying Systems 1970-1975, Vol. II The Theory of Aerial Minelaying Operational Research Incorporated	(5)-1	
Operational Effectiveness of the 8-Inch, 55-Subcaliber Fin-Stabilized Gunfighter Projectile U.S. Naval Ordnance Station		(12)-1

REPORT TITLE AND ORIGINATING ACTIVITY	STUDY REVIEW SUMMARY NO.	MOE REVIEW NUMBER
Optimal Allocation of Pacific Fleet Patrol Aircraft Among Selected Deployment Sites U.S. Naval Postgraduate School	(7)-2	
Optimal Distribution of Passive Sensors for Underwater Detection U.S. Naval Research Laboratory	(15)-1	
Optimal Probabilities for Air Target Identification Models U.S. Naval Electronics Laboratory Center	(11)-4	
Optimal SAM Defense System - An Application of Optimal Control Concept to Operations Research U.S. Naval Research Laboratory	(11)-1	
Optimum Utilization of the C-2A(COD) in Logistic Support of Carrier Forces, Vol. 1-Summary Report and Vol. 2-Methodology and Data Report Grumman Aerospace Corporation	(21,22)-1	
Passive and Active Escort Sonar Performance Raff Analytic Study Associates, Inc.		(10)-1
Passive Defense Aspects of Dispersed Formation Operation Under EMCON Center for Naval Analyses	(3)-14	
Patrol Hydrofoil Ships PXH-G and PXH-M, Vol. 1 Analysis of Hydrofoil Ships for Coastal Patrol Operations U.S. Naval Ship Engineering Center	(12)-4	
Performance of Search Attack Units in Fleet Exercises 1961-1965 Center for Naval Analyses		(1,10)-1
Phase III of Navy Evaluation of Advanced Reconnaissance Systems (NEARS) Honeywell, Inc., Systems and Research Division	(20)-2	
Polaris FBM System: A Survey and Analysis of Support Operations U.S. Naval Postgraduate School		(21,22)-1

REPORT TITLE AND ORIGINATING ACTIVITY	STUDY REVIEW SUMMARY NO.	MOE REVIEW NUMBER
Potential Effects of Defensive Electronic Countermeasures in Fleet Anti-Air Warfare Center for Naval Analyses		(14)-1
Probabilistic Model of Air Target Identification U.S. Naval Electronics Laboratory Center	(11)-3	
Project Ocean Scan - A Study of the Utility of Satellite Imagery in Ocean Surveillance, Vol. 2 - Methodology for Requirements Analysis and System Synthesis U.S. Naval Radiological Defense Laboratory		(7)-3
Proposed ASW Measure of Effectiveness, MOE-7 Systems Analysis Office , ASW Systems Project Office	(1)-7	
REACT (Response Evaluation Against Current Threats), A Detailed DDG-2 TARTAR Weapons System Simulation Model in GPSS/360 U.S. Naval Postgraduate School		(11,18)-1
Redetecting an Inexactly Located Submarine Bell Helicopter Company	(1)-3	
Report of PAROSS Committee U.S. Naval Ordnance Laboratory	(15)-2	
Research Investigations in Naval Attack Aircraft, Including Armament Vols. 1-3 Vought Aeronautics Division, LTV Aerospace Corporation	(3)-3	
Risk to Mine Countermeasures Vessels in Assault Operations Minesweeping Branch, Bureau of Ships	(6)-3	
Sealog Ship Concept Study-Phase I Center for Naval Analyses	(21)-1	
Secure Sweep Width as a Measure of Detection Effectiveness Daniel H. Wagner, Associates		(8)-2
Selected Topics in Submarine Force Effectiveness General Research Corporation	(1,10)-2	

REPORT TITLE AND ORIGINATING ACTIVITY	STUDY REVIEW SUMMARY NO.	MOE REVIEW NUMBER
Ship Vulnerability Methodology for the ASW Force Level Study U.S. Naval Radiological Defense Laboratory		(9,12)-1
Simulation Models of Search in the Presence of Decoys Stanford Research Institute	(9)-3	
Single Helicopter Tactical Effectiveness Study Systems Analysis Office, ASW Systems Project Office	(1)-1	
Single Ship Search Tactic Commander, Destroyer Development Group, U.S. Atlantic Fleet	(10)-14	
Some Results of a Preliminary Study of Measures of Effectiveness for Air ASW Systems Analysis Office, ASW Systems Project Office	(1)-10	
Some Search Problems with False Contacts Arthur D. Little, Inc.	(1,10)-4	
Some Studies of the Effectiveness of Major Caliber Guns Center for Naval Analyses	(12)-5	
SPARROW III Effectiveness and Cost Comparison U.S. Naval Weapon Systems Analysis Office	(2)-1	
SSK Effectiveness Using Active/Passive Search and Tradeoffs With Passive-Only Search Daniel H. Wagner, Associates		(8)-4
STANDARD ARM (Mod 0) Weapon System Performance Analysis U.S. Naval Missile Center	(3)-12	
Study of Concepts for Navy Tactical Voice Communications IIT Research Institute		(17)-3
Study of Land/Air Trade-Offs (Short Title: SLAT), Vol. I Summary and Vol. VI The Evaluation Summary Center for Naval Analyses		(3,12)-1

REPORT TITLE AND ORIGINATING ACTIVITY	STUDY REVIEW SUMMARY	MOE REVIEW NUMBER
Submarine Analyses Notebook Submarine Development Group Two		(8)-1
Submarine Measures of Effectiveness Systems Analysis Office, ASW Systems Project Office	(8)-11	
Submarines as ASW Escorts for Attack Carriers Daniel H. Wagner, Associates	(8)-9	
Surface Effect Vehicle Naval Aircraft Carrier Study Aerojet General Corporation	(10,12)-1	
Surveillance of a Region by Detection and Tracking Operations Arthur D. Little, Inc.	(10)-3	
Tactical Air Armament Study Part II Phase 1B Vols. I,II U.S. Naval Weapons Center		(3)-6
Tactical Air Armament Study Phase 1B, Vol. I Summary Report and Vol. II Analyses of Specific Subjects Chapter 4 - Utility and Cost Effectiveness of Data Link Controlled Electro Optical Guided Glide Weapons U.S. Naval Weapons Center	(3)-5	
Tactical Air Armament Study -- Fiscal Year 71, Vols. I-III Office of the Chief of Naval Operations		(3)-8
Tactical Air Warfare Study II, Volume I - Summary Report and Volume III - Effectiveness Analysis Center for Naval Analyses	(3)-10	
Target Motion Analysis and System Effectiveness General Precision, Inc., Librascope Group	(10)-12	
Technical Requirements and Cost Effectiveness Study for U.S. Naval Limited War Systems, Part II -- Analytical Solution for ASM U.S. Naval Research Laboratory		(3)-7

REPORT TITLE AND ORIGINATING ACTIVITY	STUDY REVIEW SUMMARY NO.	MOE REVIEW NUMBER
The Analysis of Future Naval Weapons Systems Center for Naval Analyses		(2,3,11)-1
The Application of Operations Analysis to Weapon Systems Development U.S. Naval Ordnance Laboratory	(8)-4	
The Application of the Theory of Game to Mine Countermeasures Tactics Admiralty Underwater Weapons Establishment	(5,6)-1	
The ASW Classification Problem in a Multj-contact Environment - A Queuing Approach Operations Research Incorporated		(8,18)-1
The Defense of the Continental United States Against the Submarine-Launched Missile Threat: 1965-1975 Center for Naval Analyses	(1,7,8,10,15)-1	
The Development of Submarine Tactics for Antisubmarine Warfare Office of the Chief of Naval Operations	(8)-2	
The Effectiveness of A-1 Bombing Attacks on Bridges Center for Naval Analyses		(3)-1
The Effect of Accurate Navigation on Mine Countermeasures Center for Naval Analyses	(6,19)-1	
The Effect of Adding Passive Sensors to the SH-3D Helicopter for Barrier Screening and Datum Investigation Missions U.S. Naval Ordnance Laboratory	(1)-14	
The Effect of Multiple Contacts on Passive Sonar Classification - An Analytic Approach Operations Research Incorporated	(8)-18	
The Effect of Sea-Based Surface-to-Surface Missiles on U.S. Naval Operations in the Tonkin Gulf Center for Naval Analyses	(3,11)-1	

REPORT TITLE AND ORIGINATING ACTIVITY	STUDY REVIEW SUMMARY NO.	MOE REVIEW NUMBER
The Evaluation of Submarine Weapon Systems Effectiveness: An Analytical Approach U.S. Naval Postgraduate School	(8)-17	
The Factors Affecting Antisubmarine Warfare Inside the Screen U.S. Naval Postgraduate School	(9)-1	
The False Attack Question in ASW Center for Naval Analyses		(1,10)-2
The Feasibility of Surface Effect Vehicles in ASW Missions Arthur D. Little, Inc.	(10)-5	
The Influence of Destroyer Silencing on Mission Effectiveness Daniel H. Wagner, Associates	(10)-10	
The Static-Weapon Target Allocation Model (SAM) U.S. Naval Weapons Laboratory	(16)-1	
The Technical Evaluation and Cost Analysis of the Deep-Water Moored Buoy ASW System P-499 Vol. I Summary and Vol. II Analysis and Appendices Planning Research Corporation		(7)-1
The Utility of Shore Bombardment Missiles for Amphibious Support Office of the Chief of Naval Operations		(12)-3
Transfer of Detection Contacts to Tracking Contacts in Surveillance Arthur D. Little, Inc.	(10)-4	
Two Pairs of Measures of Submarine Barrier Performance Daniel H. Wagner, Associates	(8)-8	
ULMS Effectiveness Studies: Missiles Per Submarine General Research Corporation		(13)-1

REPORT TITLE AND ORIGINATING ACTIVITY	STUDY REVIEW SUMMARY NO.	MOE REVIEW NUMBER
Utility of Satellite Communications in Naval Operations Center for Naval Analyses		(17)-2
Value of Acoustic Countermeasures Employed by ASW Escorts Against Submarine Sonars Presearch Inc.	(10)-13	
Weapons Selection for Attacks by Naval Air Upon Tactical Targets Center for Naval Analyses		(3)-3

APPENDIX D

MISSIONS, TACTICAL SITUATIONS, SUCCESS CRITERIA AND MOE'S

TABLE D-1 AIRBORNE ASW MISSIONS AND TACTICAL SITUATIONS

MISSION/TACTICAL SITUATION NAME AND DEFINITIONS

1. Submarine Search

    1. A helicopter searches for a submarine using a dipped sonar. Upon detection, localization is attempted using either the dipped sonar or MAD. The helicopter then flies to datum and launches a torpedo.

    2. Search is conducted over an operational area containing a force of submarines. Detected submarines are tracked as long as possible.

    3. Search is conducted over an area for a submarine. If a contact is made, the search is interrupted, an investigation started, and continued until the contact has been identified. If the contact is the target, the search is stopped. If the contact is a false target, its location is recorded and the position marked, perhaps with a buoy, so that another investigation will not be made, should it be contacted again. Then search is resumed.

    4. A carrier based ASW aircraft searches for enemy submarines.

2. Contact Investigation

    1. Sonar-carrying helicopters are dispatched to search for a submerged submarine that had been sighted earlier.

    2. An aircraft starts its search from a datum and lays out a pattern of sonobuoys, called a course pattern. When one of the sonobuoys in this pattern indicates the presence of a submarine, the aircraft will then lay a pattern of sonobuoys, called a fine pattern, in the immediate vicinity of the indicated contact.

3. Given an initial contact, an ASW unit attempts to detect, track and localize a submarine target.

4. SOSUS first detects a submarine and then provides a search aircraft with a datum of sufficient accuracy that it can lay its buoy field in a position so that it can detect the submarine. Given the detection, the aircraft then has available SOSUS signature data to aid in recognizing the signal as the target.

5. A carrier task force (CTF) transits through an area in which it is likely that enemy submarines may be encountered. ASW aircraft are being used to provide support against any contacts obtained in the vicinity of the CTF or along its projected track. Initial contact is made by a remote surveillance system and then aircraft respond by planting a pattern of sonobuoys in the contact area in order to detect and localize the position of the submarine.

6. A helicopter flies to a datum (obtained as an initial contact by some platform within the task force or convoy) and attempts to reacquire it passively. If a passive redetection can be achieved, the helicopter will then attempt to convert to an active detection.

3. Contact Investigation/Prosecution

1. An enemy submarine is first detected by an escort's long-range sonar. A helicopter flies from the escort to redetect, localize, classify and, if necessary, kill the target.

2. A Light Airborne ASW Vehicle (LAAV) carrying as many as two torpedoes conducts an ASW attack independently of a surface ship, which has provided the initial detection and datum.

3. A destroyer-based ASW helicopter places a sonobuoy barrier in an attempt to redetect, localize, classify and attack a previously detected submarine.

4. Contact Prosecution

   1. A missile-carrying submarine force is subjected to a bombing attack.

   2. A helicopter, assisting a weapon delivery aircraft in an attack on an evading submarine, has a firmly established sonar contact with the submarine. The weapon delivery aircraft must await communications and direction from the assisting helicopter and then delay for at least some minimum time before maneuvering to the predicted position and dropping the weapon.

5. Sonobuoy Barrier Patrol

   1. An aircraft patrols a specified area listening for submarines on passive sonobuoys. Once detected, a submarine is localized using Codar buoys and final fix is obtained by MAD. The submarine is then attacked by torpedoes.

   2. Aircraft attempt to detect, localize, and kill enemy submarines which pass through a sonobuoy field.

6. Barrier Placement/Patrol

   1. An ASW aircraft places Jezebel buoys in either a circular (containing barrier) or straight line pattern to redetect a previously contacted submarine.

   2. A submarine attempts to penetrate a sonar buoy barrier, established by aircraft deployed sonar buoys.

   3. An aircraft patrols a barrier according to a prescribed path using a sensor, either radar or sonar. If the presence of a submarine is detected, the patrolling aircraft performs a contact investigation or localization procedure.

   4. A helicopter, using a passive sonar system, maintains a barrier a specified distance from a task force or convoy. Upon receipt of a passive contact, the helicopter attempts to convert to an active sonar contact.

   5. Lofar buoys are deployed according to a containing barrier tactic in the search for transiting submarines.

7. Submarine Trailing

   1. A remote surveillance system detects, classifies and localizes a ballistic missile submarine (SSBN). One or more trailing platforms then initiates a convert trail which is to be maintained, at least intermittently, during the SSBN's transit and patrol phase.

   2. A countering force, using various combinations of attack submarines (SSN) and aircraft as trailing platforms, maintain trail over strategic ballistic missile submarines (SSBN's) and attack any SSBN which attempts an SLBM launch.

8. Ocean Surveillance

   1. A barrier force comprises a perimeter barrier designed to detect submarines as they cross the barrier in transiting to stations. In conjunction with the barrier force and a surveillance force, a shadowing force attempts to maintain contact on as many submarines as possible during their on-station patrol.

TABLE D-2 AIRBORNE ASW SUCCESS CRITERIA AND MOE'S

CRITERION FOR SUCCESS AND MOE'S

1. Detection of Submarine
    1. Probability of detection
    2. Ratio of total mission cost to the probability of detecting a submarine at least once as it passes through the barrier
    3. Expected proportion of time for which a submarine is undetected
    4. Percent of a specified area in which the probability of submarine detection by the ASW support forces is equal to or greater than a stated level
    5. Maximum width of barrier that can be maintained and still ensure a 50% probability of initial detection.
    6. Minimum expected time to find the target
    7. Number of detection opportunities converted to active contacts
2. Detection, Localization and Kill of Submarine
    1. Probability of submarine detection, localization and kill
    2. Average effective length of air ASW (sonobuoy) barrier that can be maintained per enemy submarine
3. Localization and Destruction of Submarine
    1. Dollar cost per submarine kill
4. Detection and Localization of Submarine
    1. Cumulative probability of reacquiring and converting the target to an active contact
5. Suppression of Submarine Activity
    1. Probability of killing an enemy submarine

2. Ratio of the difference of a reference level of damage sustained minus the potential damage sustained to the total damage capability

3. Ratio of average effective barrier length to total number of enemy submarines

4. Ratio of average effective barrier length to total damage capability of enemy submarines

5. Ratio of fraction of submarines killed to damage sustained by own forces

6. Ratio of damage averted by own force to total damage capability of enemy submarines

7. Reciprocal of damage sustained by own forces

8. Fraction of submarines killed

9. Ratio of the product of damage averted by own forces and the total damage sustained by own force to total damage capability of enemy submarines

6. Localization of Submarine

1. Total cost for a specified probability of localization

2. Entropy of location uncertainty as a function of time

7. Maintenance of At Least Intermittent Trail

1. Expected fraction of SSBN's which would be under trail at various points along their transit and patrol routes

8. Destruction of Submarine-Carried Missiles

1. Cost of the total force to achieve a specified level of survival

9. Prevention of Launch of Sea Launched Ballistic Missiles

1. Total expected number of missiles successfully launched

10. Achieve Maximum Contact Investigation Capability in Contacts Per Day at Least Cost

    1. Total lifetime cost to achieve maximum contact investigation capability
    2. Total mission cost to achieve maximum contact investigation capability

11. Destruction of Submarine

    1. Average kill probability

12. Tracking of Submarine

    1. Fraction of enemy submarines being shadowed (tracked) at a specified time within a surveillance or objective area

13. Maintain On-Station Search Capability

    1. Aircraft operating cost per on-station hour
    2. Aircraft operating cost per search mile

14. Performance of Mission Requirements at Least Cost

    1. Total system cost for specified level of wartime and peacetime utilization

15. Detection, Localization and Classification of Submarine

    1. Miss distance (datum accuracy), defined as the distance between the position at which the aircraft reported the target to be and the center of the SEP updated to the time of localization with the information on target course and speed transmitted to the aircraft

TABLE D-3 AIRBORNE ASW STUDY REVIEW SUMMARY DESCRIPTIONS

STUDY REVIEW SUMMARY NUMBER	MISSION/TACTICAL SITUATION NAME	DEFINITION	CRITERION FOR SUCCESS	MOE(S) SELECTED
(1)-1	1	1	2	1
(1)-2	2	1	1	1
(1)-3	3	1	1	1
(1)-4	5	1	5	1
(1)-5	6	1	1	1
(1)-6	2	2	6	1
(1)-7	5	2	5	2
(1)-8	6	3	1	2
(1)-9	5	2	2	2
(1)-10	5	2	5	3-9
(1)-11	6	2	10	1,2
(1)-12	2	5	1	4
(1)-13	4	2	11	1
(1)-14	2	6	4	1
	6	4	1	5,7
(1)-15	6	5	1	1
(1)-16	1	4	13	1,2
(1)-17	3	3	14	1
(1,8)-1	7	1	7	1
(1,10)-1	2	3	6	2
(1,10)-2	1	2	1	3
	4	1	8	1
(1,10)-3	3	2	3	1
(1,10)-4	1	3	1	6
(1,15)-1	2	4	15	1
(1,3,9,13)-1	7	2	9	1
(1,7,8,10,15)-1	8	1	12	1

TABLE D-4 AIRBORNE AAW MISSIONS AND TACTICAL SITUATIONS

MISSION/TACTICAL SITUATION NAME AND DEFINITIONS

1. Defense Against Bomber Attack

    1. Aircraft equipped with air-to-air missiles are engaged in anti-air warfare in a standard CAP operation to defend against bomber aircraft having no self-defense capability.

2. Air Superiority

    1. Aircraft equipped with air-to-air missiles are engaged in anti-air warfare in a standard CAP operation to defend against fighter aircraft which are also equipped with air-to-air missiles.

    2. Fighter aircraft attack airborne targets.

    3. An attack carrier with both fighter and attack aircraft conducts strikes against enemy airfield targets and is itself subjected to attacks by enemy attack aircraft. The fighter complement on board the carrier provide for the defense of the carrier while enemy fighters provide for the defense of enemy airfields.

3. Surface Ship Defense

    1. CAP aircraft, on-station at a designated point relative to a CVA, are used to intercept cruise missiles directed at a surface ship formation.

4. Passive Defense of Target

    1. A mixture of real targets and decoys is presented to an attacking force. As a result, the attacker must assign his weapons on the basis of imperfect classification of the targets.

TABLE D-5 AIRBORNE AAW SUCCESS CRITERIA AND MOE'S

CRITERION FOR SUCCESS AND MOE'S

1. Destruction of Bombers
    1. Probability that friendly aircraft will destroy a bomber
    2. Expected number of kills a friendly aircraft will achieve if it is directed against two bombers per sortie
2. Survival of Friendly Aircraft and Destruction of Enemy Interceptor
    1. Probability that aircraft will kill the enemy interceptor
    2. Probability that aircraft will survive the engagement with enemy interceptor
3. Destruction of Target
    1. Ratio of the incremental improvement in accomplishing the mission to the incremental monetary cost of such an improvement
4. Successful Attack on Enemy Airfield Targets
    1. Expected number of strike sorties during a specified number of engagements
    2. Expected number of enemy aircraft destroyed during a specified number of engagements
    3. Ratio of the cost of enemy losses during a specified number of engagements to the cost of friendly losses
5. Detection of Cruise Missile Raid at a Range Which Allows for Missile Intercept at Useful Ranges
    1. Detection range of raid relative to vital area center (CVA) for a given intercept range
6. Survival of Target
    1. Probability distribution function of the number of real targets classified as real targets and the number of decoys classified as decoys

2. Expected number of real targets attacked

3. Expected number of weapons assigned to each real target attacked

4. Expected number of surviving real targets

TABLE D-6 AIRBORNE AAW STUDY REVIEW SUMMARY DESCRIPTIONS

STUDY REVIEW SUMMARY NUMBER	MISSION/TACTICAL SITUATION NAME	DEFINITION	CRITERION FOR SUCCESS	MOE(S) SELECTED
(2)-1	1	1	1	1,2
	2	1	2	1,2
(2)-2	2	2	3	1
(2)-3	3	1	5	1
(2,3)-1	2	3	4	1-3
(2,11,14)-1	4	1	6	1-4

TABLE D-7 AIRBORNE ATTACK MISSIONS AND TACTICAL SITUATIONS

MISSION/TACTICAL SITUATION NAME AND DEFINITIONS

1. Air Strike
    1. Mix of attack aircraft, defense aircraft, and missiles attack a variety of targets in a mix of war types.
    2. Aircraft launched from a carrier penetrate area and local defenses to attack a mix of targets.
    3. A mix of attack aircraft are allocated to attack fixed location targets.
2. Close Air Support
    1. Attack on hostile ground targets which are close to friendly forces.
    2. Carrier based aircraft attempt to remain on-station near the vicinity of a ground force operating area.
    3. Aircraft, under the direction of a forward controller, provide air support to ground forces in attacking a variety of ground targets.
3. Interdiction
    1. Aircraft launched from an offshore CVA penetrates through an area defended by AAA and SAM sites to attack a bridge and a power plant.
    2. A self-contained search and attack aircraft conducts an air interdiction campaign against mobile targets located in a lines-of-communication network.
    3. An attack aircraft attempts to inflict damage on targets of opportunity that he meets and attacks in a time-limited hunt in a permissive environment.

4. Carrier based aircraft attempt to destroy enemy supplies and supply convoys, and to cut supply routes.

4. Air Superiority

1. An attack carrier with both fighter and attack aircraft conducts strikes against enemy airfield targets and is itself subjected to attacks by enemy attack aircraft. The fighter complement on board the carrier provide for the defense of the carrier while enemy fighters provide for the defense of the enemy airfields.

2. Carrier based aircraft seek out and engage airborne aircraft, attack aircraft on the ground, and attempt to close airfields by cutting runways.

5. Amphibious Fire Support

1. A Navy task force stationed off the beach provides fire support (guns, missiles and aircraft) to assault troops invading a beachhead objective area.

6. Surface Ship Defense

1. Aircraft patrol a barrier so as to provide early warning information to surface ships regarding the approach of enemy surface craft carrying surface-to-surface missiles. Aircraft attempt to attack these surface craft before they launch their missiles. In their defense, surface ships fire surface-to-air missiles to intercept enemy launched missiles.

7. Aircraft Attack on Task Force

1. A carrier task force conducts air strike operations with ships dispersed over a large area and in "random" stations to disguise its appearance. An enemy aircraft searches for the task force in order to locate and identify (either correctly or incorrectly) the aircraft carrier within it.

8. Surface Ship Attack

    1. An anti-ship missile is launched from either another surface ship or an aircraft to attack a surface ship.

9. Bomber Versus Surface Defenses

    1. A bomber attacks defended ground target areas.

TABLE D-8 AIRBORNE ATTACK SUCCESS CRITERIA AND MOE'S

CRITERION FOR SUCCESS AND MOE'S

1. Destruction of Target
    1. Weighted maximum effectiveness for a mix of conflicts, tactical profiles and war importance factors
    2. Expected number of targets destroyed in a given period of time
    3. Expected number of targets killed per day
    4. Expected number of targets killed during the system's lifetime
    5. Probable destroyed value of the target
    6. Cost per target killed
    7. Number of targets the system can engage as a function of time
    8. Maximum total value of damage inflicted upon all targets
    9. Expected number of targets (or target elements) destroyed per sortie
    10. Expected cost per target destroyed
    11. Expected aircraft lost per target destroyed
    12. Total target kill potential
    13. Total damage expected in a hunt of specified duration
    14. Expected number of primary targets killed per unit cost
    15. Expected number of primary targets killed per day for a given force level
    16. Maximum expected fraction of strategic value destroyed
2. Successful Attack Capability
    1. Payload potential
    2. Number of sorties performed within a specified operational period
    3. Force size requirement for fulfilling 90% of close air support requests

3. Maintenance of Sufficient Weapons On-Station to Provide Rapid Response to Close Support Requests

    1. Average number of weapons on-station

4. Successful Attack on Enemy Airfield Targets

    1. Expected number of strike sorties during a specified number of engagements

    2. Expected number of enemy aircraft destroyed during a specified number of engagements

    3. Ratio of the cost of enemy losses during a specified number of engagements to the cost of friendly losses

5. Detection and Identification of Aircraft Carrier

    1. Probability that a search aircraft will locate the task force, and find and correctly classify the aircraft carrier within it

6. Acquisition of Target

    1. Maximum target acquisition range

    2. Maximum target tracking range

7. Successful Defense of Surface Ships

    1. Probability of successful defense

8. Reduction or Elimination of Enemy Air Activity

    1. Difference between flying hours denied the enemy and flying hours expended by the attackers in carrying out the strike

9. Reduction or Elimination of Enemy Combat Capability

    1. Difference between ton miles denied the enemy and the equivalent ton miles lost by attackers due to aircraft attritions, repair hours incurred by damaged aircraft, and the total flight time of the mission.

TABLE D-9 AIRBORNE ATTACK STUDY REVIEW SUMMARY DESCRIPTIONS

STUDY REVIEW SUMMARY NUMBER	MISSION/TACTICAL SITUATION NAME	DEFINITION	CRITERION FOR SUCCESS	MOE(S) SELECTED
(3)-1	1	1	1	1
(3)-2	1	2	1	2
(3)-3	2	1	2	1-3
(3)-4	2	1	1	3,4
(3)-5	3	1	1	5
(3)-6	2	2	3	1
(3)-7	2	3	1	6
(3)-8	1	3	1	8
(3)-9	3	2	1	9-11
(3)-10	1	3	1	12
(3)-11	3	3	1	13
(3)-13	1	2	1	14,15
(3)-14	7	1	5	1
(2,3)-1	4	1	4	1-3
(3,11)-1	6	1	7	1
(3,12)-1	8	1	6	1,2
(3,20)-1	4	2	8	1
	3	4	9	1
(3,12,16)-1	5	1	1	7
(3,12,23)-1	9	1	1	16

TABLE D-10 MINING MISSIONS AND TACTICAL SITUATIONS

MISSION/TACTICAL SITUATION NAME AND DEFINITIONS

1. Minelaying Force Versus Mine Countermeasures Force

    1. Ground influence mines are placed on a channel sea bed by a hostile Minelayer. To provide safe passage for ships, a minesweeper conducts sweeping operations through the channel.

    2. Two major powers confront each other in a war-at sea context. One opponent seeks to blockade the ports of the enemy by means of air (or submarine) delivered mines. The defender counters this by both "prevention" and "cure" measures. The "prevention" consists of a force of fighter aircraft (or SSK submarines) with airborne radar support. The "cure" consists of a force of minesweepers.

    3. Mine countermeasures force attempts to clear a minefield planted in an amphibious objective area.

    4. Mine countermeasures force attempts to clear a minefield planted by a hostile submarine in a port or line of communication.

2. Mine Clearance

    1. A combination of minesweepers and minehunters search for mines in a area to be traveled by assault ships.

    2. A mixed mine countermeasure force clears an amphibious objective area that has been mined.

    3. Mine countermeasure forces defend a port or line of communication choke point against a sustained attrition mining attack.

3. Aerial Minelaying

    1. A wave of minelaying aircraft flies a specified number of sorties, in which a sortie consists of planting a series of mines and returning to a staging area. During any segment of the sortie, the aircraft may come under attack from airborne and/or surface anti-aircraft weapons.

TABLE D-11 MINING CRITERIA FOR SUCCESS AND MOE'S

CRITERION FOR SUCCESS AND MOE'S

1. Survival of Ships
    1. Expected number of ships lost in passage through the channel
2. Clearance of Minefield
    1. Fraction of mines which fire against traffic ships
    2. Risk to ships in the assault operation
    3. Total weighted casualties of traffic ships in an assault operation
    4. Total traffic ship casualties in the war
3. Blockade of Ports
    1. Ratio of mine countermeasure force total spending to minelayer force spending for a specified value of port utilization fraction for target class vessels
4. Survival of Aircraft and Planting of Mines
    1. Probability that a specified number of aircraft are killed and a specified number of mines are unplanted
5. Survival of Aircraft
    1. Total threat delivered to penetrating aircraft

TABLE D-12 MINING STUDY REVIEW SUMMARY DESCRIPTIONS

STUDY REVIEW SUMMARY NUMBER	MISSION/TACTICAL SITUATION NAME	DEFINITION	CRITERION FOR SUCCESS	MOE(S) SELECTED
(5)-1	3	1	4	1
(5)-2	3	1	5	1
(5,6)-1	1	1	1	1
(5,6)-2	2	2	2	1
	2	3	2	1
(5,6)-3	1	2	3	1
(5,6)-4	2	1	2	2
(5,6)-5	1	3	2	3
	1	4	2	4

TABLE D-13 MINE COUNTERMEASURES MISSIONS AND TACTICAL SITUATIONS

MISSION/TACTICAL SITUATION NAME AND DEFINITIONS

1. Minelaying Force Versus Mine Countermeasures Force

    1. Ground influence mines are placed on a channel sea bed by a hostile Minelayer. To provide safe passage for ships, a minesweeper conducts sweeping operations through the channel.

    2. Two major powers confront each other in a war-at-sea context. One opponent seeks to blockade the ports of the enemy by means of air (or submarine) delivered mines. The defender counters this by both "prevention" and "cure" measures. The "prevention" consists of a force of fighter aircraft (or SSK submarines) with airborne radar support. The "cure consists of a force of minesweepers.

    3. Mine countermeasures force attempts to clear a minefield planted in an amphibious objective area.

    4. Mine countermeasures force attempts to clear a minefield planted by a hostile submarine in a port or line of communication.

2. Mine Clearance

    1. A combination of minesweepers and minehunters search for mines in an area to be traveled by assault ships.

    2. Mine-clearance ships operate in support of offensive amphibious assault operations and/or in support of defensive operations, such as defense of harbors and over-the-beach logistic supply sites.

    3. A mixed mine countermeasure force clears an amphibious objective area that has been mined.

    4. Mine countermeasure forces defend a port or line of communication choke point against a sustained attrition mining attack.

3. Mine Hunting with Mine Watching

    1. Minehunters attempt to locate mines in a minefield with the aid of mine watching reports.

4. Mine Hunting without Mine Watching

    1. Minehunters attempt to locate mines in a minefield without the aid of mine watching reports.

TABLE D-14 MINE COUNTERMEASURES CRITERIA FOR SUCCESS AND MOE'S

CRITERION FOR SUCCESS AND MOE'S

1. Survival of Ships
    1. Expected number of ships lost in passage through the channel
2. Clearance of Minefield
    1. Risk to ships in the assault operation
    2. Total force level required to clear a given area in a given time
    3. Fraction of mines which fire against traffic ships
    4. Time required to search or sweep the entire channel with a 95 percent probability of locating each mine
    5. Risk to the countermeasures vessels
    6. Total weighted casualties of traffic ships in an assault operation
    7. Total traffic ship casualties in the war
3. Blockade of Ports
    1. Ratio of mine countermeasure force total spending to minelayer force spending for a specified value of port utilization fraction (average fraction of port capacity in use) for target class vessels
4. Localization of Mines
    1. Standard deviation of minehunter navigation error to insure locating a reported mine with 95 percent probability in one half hour

TABLE D-15 MINE COUNTERMEASURES STUDY REVIEW SUMMARY DESCRIPTIONS

STUDY REVIEW SUMMARY NUMBER	MISSION/TACTICAL SITUATION NAME	DEFINITION	CRITERION FOR SUCCESS	MOE(S) SELECTED
(6)-1	2	1	2	1
(6)-2	2	2	2	2
(6)-3	2	1	2	5
(5,6)-1	1	1	1	1
(5,6)-2	2	3	2	3
	2	4	2	3
(5,6)-3	1	2	3	1
(5,6)-4	2	1	2	1
(5,6)-5	1	3	2	6
	1	4	2	7
(6,19)-1	3	1	4	1
	4	1	2	4

TABLE D-16 OCEAN SURVEILLANCE MISSIONS AND TACTICAL SITUATIONS

MISSION/TACTICAL SITUATION NAME AND DEFINITION

1. Surveillance of Ocean Area

    1. A satellite using an optical sensor scans the ocean-area in search of ships.
    2. Patrol aircraft provide surveillance coverage of specific coastal or ocean areas.
    3. A network of direction finding sites is distributed so as to provide surveillance over a large ocean area in which a patrolling submarine may, on occasion, come to the surface and transmit a brief radio message. This electromagnetic emission, when detected at one or more DF sites, initiates a submarine localization effort.
    4. A satellite-borne radar is used for the purpose of ocean surveillance of shipping activities.
    5. A barrier force comprises a perimeter barrier designed to detect submarines as they cross the barrier in transiting to stations. In conjunction with the barrier force and a surveillance force, a shadowing force attempts to maintain contact on as many submarines as possible during their on-station patrol.

TABLE D-17 OCEAN SURVEILLANCE SUCCESS CRITERIA AND MOE'S

CRITERION FOR SUCCESS AND MOE'S

1. Surveillance and Establishment of the Track of Ships at Sea
    1. Probability of successful tracking of a vessel for a voyage of specified duration
2. Provide Required Patrol Coverage at Least Cost
    1. Minimum cost of providing the required on-station hours
3. Successful Determination of Bearing of Transmitting Submarine
    1. Probability that at least one pair of direction finding sites successfully determines bearings and the localization area to a specified size
4. Detection and Localization of Shipping in the Open Ocean
    1. Returned signal from the target
5. Tracking of Submarines
    1. Fraction of enemy submarines being shadowed (tracked) at a specified time within a surveillance or objective area

TABLE D-18 OCEAN SURVEILLANCE STUDY REVIEW SUMMARY DESCRIPTIONS

STUDY REVIEW SUMMARY NUMBER	MISSION/TACTICAL SITUATION NAME	DEFINITION	CRITERION FOR SUCCESS	MOE(S) SELECTED
(7)-1	1	1	1	1
(7)-2	1	2	2	1
(7)-3	1	3	3	1
(7,14)-1	1	4	4	1
(1,7,8,10,15)-1	1	5	5	1

TABLE D-19 SUBMARINE ASW MISSIONS AND TACTICAL SITUATIONS

MISSION/TACTICAL SITUATION NAME AND DEFINITIONS

1. SSK Versus Transitor

    1. A submarine covers a frontage against which enemy submarines attempt to penetrate or to transit past.
    2. An SSK is deployed as a single-unit in an operational area through which enemy submarines must transit in order to arrive at their own patrol stations.
    3. An attacking submarine tracks a transiting submarine with passive sonar. At some point in time, the attacker launches a wire-guided torpedo. When the torpedo sonar is enabled, the target is alerted and turns away from the torpedo.
    4. SSK's are deployed as a barrier through which enemy submarines attempt to transit.
    5. An SSK is to detect, attack and kill any enemy submarine which transits the SSK patrol area.

2. Submarine Search

    1. A submarine searches an area for submarine targets which are presumed to be hiding at some unknown point in the area.

3. Search and Destroy

    1. A submarine searches for hostile submarines and attacks all those that it detects and for which it has an opportunity for attack.
    2. A submarine in the role of an intruder is to seek out and destroy an enemy submarine in the enemy submarine's own patrol area.

4. Carrier Escort

    1. Attack submarines are used as ASW escorts for a carrier task force passing through an area known to contain hostile submarines.

5. Submarine Trailing

1. A remote surveillance system detects, classifies, and localizes a ballistic missile submarine (SSBN). One or more trailing platforms then initiates a covert trail which is to be maintained, at least intermittently, during the SSBN's transit and patrol phase.

2. A trailing platform maintains trail, at least intermittently, of an enemy submarine without being counter-detected and with or without outside assistance.

3. A countering force, using various combinations of attack submarines (SSN) and aircraft as trailing platforms, maintain trail over strategic ballistic missile submarines (SSBN's) and attack any SSBN which attempts an SLBM launch.

4. A tracker attempts to keep a hostile vehicle under constant surveillance.

6. Barrier Placement/Patrol

1. A submarine barrier is placed so as to detect a transiting submarine whose initial position and heading is given.

2. To prevent an enemy submarine's transit into the open ocean, submarine barriers are used in the forward area controlled by enemy forces.

3. An SSK, patrolling a barrier, attempts with passive sonar to detect enemy submarines transiting through this barrier.

7. Duel Between Submarines and Carrier Protection Forces

1. Submarines seek and attack carriers that are protected by ASW screens supported by a HUK group.

8. Contact Prosecution

1. A killer submarine detects an enemy submarine and attempts to place himself a specified distance directly ahead of the enemy submarine as quickly as possible.

9. Ocean Surveillance

   1. A barrier force comprises a perimeter barrier designed to detect submarines as they cross the barrier in transiting to stations. In conjunction with the barrier force and a surveillance force, a shadowing force attempts to maintain contact on as many submarines as possible during their on-station patrols.

   2. Submarine passive sonar system is used to classify all contacts received.

10. Submarine versus Submarine

   1. A friendly submarine engages an enemy submarine in a one-on-one situation.

   2. A friendly submarine force engages an enemy submarine force that is operating in an ocean area.

TABLE D-20 SUBMARINE ASW SUCCESS CRITERIA AND MOE'S

CRITERION FOR SUCCESS AND MOE'S

1. Obtain Secure Detection of Submarine
    1. Secure sweep width
    2. Secure sweep rate
2. Detection and Destruction of Submarine
    1. Number of kills per engagement opportunity
    2. Average cost per kill
    3. Probability that the intruder will detect a target present in the patrol area in a specified time
    4. Probability that the intruder will kill the target given that he has detected the target
    5. Rate at which enemy targets are killed as a function of intruder area size
    6. Exchange ratio
    7. Probability of the SSK killing a transiting enemy submarine given a detection opportunity
    8. Probability of accurate counterattack by the SST given a detection opportunity for the SSK
3. Destruction of Submarine
    1. Expected value of target killed
    2. Maximum range-to-target, for a particular target aspect, at which a torpedo can be fired to achieve 90 percent probability of acquiring the target with sufficient endurance remaining for overtaking an alerted submarine that evades by running directly away at maximum speed

3. Expected percentage of enemy submarines killed attempting to penetrate barrier

4. Expected number of enemy submarines killed in a specified period of time

4. Detection of Submarine

1. Maximum probability of detection

2. Conceptual detection range

5. Suppression of Submarine Activity

1. Expected enemy submarine activity

2. Expected number of successful enemy transits

3. Expected total number of enemy submarine months of activity from the start of the campaign up to a specified time

4. Expected fractional portion of possible activity lost by the enemy because of the barrier

5. Expected total enemy submarine activity for the entire campaign

6. Expected cumulative fractional loss of possible activity by the enemy

7. Probability that the transiting submarine will be intercepted

8. Probability of detection per transitor

9. Expected proportion of enemy submarine traffic destroyed by the SSK's

6. Survival of Carriers

1. Expected number of enemy torpedo hits on a carrier for given detection range of the SSE active sonar

7. Maintenance of At Least Intermittent Trail

1. Expected fraction of SSBN's which would be under trail at various points along their transit and patrol routes

2. Mean holding time until loss of contact of duration greater than a specified time

8. Prevention of Launch of Sea Launched Ballistic Missiles

    1. Total expected number of missiles successfully launched

9. Preparation for Attack in the Least Possible Time without being Counterdetected

    1. Minimum approach time

10. Tracking of Submarine

    1. Fraction of enemy submarines being shadowed (tracked) at a specified time within a surveillance or objective area

11. Destruction of Enemy Submarine and Survival of Friendly Submarine

    1. Conditional probability that friendly submarine obtains a hit on enemy submarine, given that friendly submarine survives the engagement and has an initial detection opportunity

12. Classification of Contact

    1. Probability of classifying a contact on a look starting at a specified time after the last look, given a specified number of contacts in the system when the last look began

13. Survival of Carriers and Submarines

    1. Probability that a specified combination of carriers and submarines have survived by a given time

14. Maintenance of Continuous Trail

    1. Time for evader to escape

TABLE D-21 SUBMARINE ASW STUDY REVIEW SUMMARY DESCRIPTIONS

STUDY REVIEW SUMMARY NUMBER	MISSION/TACTICAL SITUATION NAME	DEFINITION	CRITERION FOR SUCCESS	MOE(S) SELECTED
(8)-1	1	1	1	1
	2	1	1	2
(8)-2	1	2	2	1
(8)-3	3	1	3	1
(8)-4	1	2	2	2
(8)-5	1	3	3	2
(8)-6	1	4	5	1
(8)-7	1	4	5	2
(8)-8	1	4	5	3-6
(8)-9	4	1	6	1
(8)-10	3	2	2	3-6
(8)-11	1	4	3	3
(8)-12	1	5	2	6-8
(8)-13	6	2	5	7,8
(8)-14	8	1	9	1
(8)-15	1	4	5	9
(8)-16	6	3	4	2
(8)-17	10	1	11	1
	10	2	3	4
(8)-18	9	2	12	1
(1,8)-1	5	1	7	1
(8,10)-1	5	2	7	2
(8,10)-2	6	1	4	1
(8,9,10)-1	7	1	13	1
(1,8,9,13)-1	5	3	8	1
(8,9,10,12)-1	5	4	14	1
(1,7,8,10,15)-1	9	1	10	1

TABLE D-22 SUBMARINE ATTACK MISSIONS AND TACTICAL SITUATIONS

MISSION/TACTICAL SITUATION NAME AND DEFINITIONS

1. Submarine Attack on Convoy

    1. A merchant convoy forms the target for an attacking submarine. The convoy is protected by destroyers in a circular area patrol screen. The submarine attempts to penetrate the screen in order to fire torpedoes at the convoy ships.

    2. A Naval force composed of two classes of ships, called important ships (such as carriers, tankers, etc.) and escort ships, is subjected to a random and independent attack by a force of conventional submarines.

    3. Submarines attack individual merchant ships and merchant ship convoys.

    4. Submarines cycle between a base and an operating area in which they attack surface ships defended by barriers and ASW screens.

2. Duel Between Carrier and Submarines

    1. A carrier is operating in the same general area for a period of time during which hostile submarines are present. The submarines are armed with missiles and torpedoes, or torpedoes only, and randomly search for carriers to attack.

3. Duel Between Submarines and Carrier Protection Forces

    1. Submarines seek and attack carriers that are protected by ASW screens supported by a HUK group.

4. Submarine Trailing

    1. A countering force, using various combinations of attack submarines (SSN) and aircraft as trailing platforms, maintain trail over strategic ballistic missile submarines (SSBN's) and attack any SSBN which attempts an SLBM launch.

5. Target Search

    1. A submarine searches for a high value target (HVT) in a specified area.

6. Capture

    1. A pursuer attempts to capture an evader.

TABLE D-23 SUBMARINE ATTACK SUCCESS CRITERIA AND MOE'S

CRITERION FOR SUCCESS AND MOE'S

1. Destruction of Ships
    1. Expected number of ships hit
    2. Number of ships sunk per unit time spent in area
2. Survival of Carrier
    1. Probability that carrier can remain on-station for a specified length of time
3. Survival of Ships and Submarines
    1. Probability that a specified number of important ships, escorts and submarines have survived up to a given time
4. Survival of Carriers and Submarines
    1. Probability that a specified combination of carriers and submarines have survived by a given time
5. Prevention of Launch of Sea Launched Ballistic Missiles
    1. Total expected number of missiles successfully launched
6. Detection of Target
    1. Elapsed time to target detection
7. Survival of Submarines and Destruction of Ships
    1. Probability distribution of the number of successful patrols per submarine
    2. Probability distribution of total shipping losses
8. Capture of Target
    1. Capture time

TABLE D-24 SUBMARINE ATTACK STUDY REVIEW SUMMARY DESCRIPTIONS

STUDY REVIEW SUMMARY NUMBER	MISSION/TACTICAL SITUATION NAME	DEFINITION	CRITERION FOR SUCCESS	MOE(S) SELECTED
(9)-1	1	1	1	1
(9)-2	1	3	1	2
(9)-3	5	1	6	1
(9)-4	1	4	7	1,2
(9,10)-1	2	1	2	1
(9,10)-2	1	2	3	1
(8,9,10)-1	3	1	4	1
(1,8,9,13)-1	4	1	5	1
(8,9,10,12)-1	6	1	8	1

TABLE D-25 SURFACE ASW MISSIONS AND TACTICAL SITUATIONS

MISSION/TACTICAL SITUATION NAME AND DEFINITIONS

1. Carrier Task Group Versus Submarine

    1. A carrier task group, in the vicinity of an enemy coast, launches conventional strikes against inland targets. The carrier follows a constant speed evasive pattern of movement consistent with aircraft launch requirements, while the escort ships patrol their AAW stations. Opposing the carrier operations in the area is a single submarine, using passive sonar.

2. Contact Prosecution

    1. An ASW fire control computer receives target information from a sonar and then transmits aiming orders to a weapon. The weapon is then fired at a submerged target.

    2. An attack unit attacks an enemy submarine which has been detected and correctly classified.

3. Ocean Surveillance

    1. A region of the ocean is kept under surveillance to determine the existence of enemy submarines in the region and their locations. If a submarine is detected, either as it enters the region or after it is in the region, it will be tracked. If tracking contact is lost, a procedure to regain contact will be used. If contact is regained, the submarine again will be tracked.

    2. Surface ships monitor restricted areas to accumulate observations concerning gathering places of potentially hostile submarines.

    3. ASW patrol vessels cover a specified area by sonar surveillance within a specified period of time on a continuing basis.

    4. A barrier force comprises a perimeter barrier designed to detect submarines as they cross the barrier in transiting to stations.

In conjunction with the barrier force and a surveillance force, a shadowing force attempts to maintain contact on as many submarines as possible during their on-station patrols.

4. Contact Investigation

   1. Submarine contact has been made by a sensor field and a tracker has been directed to the area to conduct a search for the suspected submarine.

   2. Given an initial contact, an ASW unit attempts to detect, track and localize a submarine target.

   3. Surface ships attempt to develop any submarine contact, initially made by SOSUS, to the point where a kill can be made.

   4. A single destroyer searches in the vicinity of the point of last contact for a submarine contact which has been momentarily lost.

5. Contact Investigation/Prosecution

   1. A Light Airborne ASW Vehicle (LAAV) carrying as many as two torpedoes conducts an ASW attack independently of a surface ship, which has provided the initial detection and datum.

   2. Surface ships investigate submarine probable area obtained by SOSUS contact and fix to obtain more precise localization and then attack with torpedoes.

6. Barrier Placement/Patrol

   1. Surface ships are either placed in the path of a detected submarine, on a known transit track, to shield a convoy or amphibious landing, or to guard relatively narrow portions of the sea.

   2. Lines of sensors are positioned in a stationary strip that must be crossed by the threat submarines in carrying out their mission. Classification and localization are done for each detection by each sensor in the barrier and, in the shooting scenario, attacks are made for all detections classified as real targets.

12. Escort Versus Submarine

1. An escort ship in a carrier screen gains contact with a submarine and then launches one or more sonar countermeasures beacons.

13. Duel Between Submarines and Carrier Protection Forces

1. Submarines seek and attack carriers that are protected by ASW screens supported by a HUK group.

TABLE D-26 SURFACE ASW SUCCESS CRITERIA AND MOE'S

CRITERION FOR SUCCESS AND MOE'S

1. Prevention of Detection and Classification of the Carrier
    1. Median time to closure
2. Destruction of Submarine
    1. Maximum probability of a hit
    2. Probability that submarine is damaged
    3. Probability of target kill
    4. Probability of target acquisition
3. Detection of Submarine
    1. Probability that a submarine has been detected by the tracker
    2. Kinetic search rate
    3. Static search rate
    4. Total weapons system cost, over a specified period of time, to produce a specified degree of effectiveness
    5. Probability of submarine detection
    6. Effective sweep rate
    7. Expected proportion of time for which a submarine is undetected
    8. Maximum probability of detection
    9. Minimum expected time to find the target
    10. Maximum exposure time of the submarine
4. Detection and Destruction of Submarine
    1. Ratio of the 10-year system cost for area search to the product of the overall kill probability and the area swept

2. Ratio of the 10-year system cost for ASW barriers to the product of overall kill probability and the length of the barrier

5. Localization of Submarine

   1. Entropy of location uncertainty as a function of time
   2. Target uncertainty area

6. Localization and Destruction of Submarine

   1. Dollar cost per submarine kill

7. Detection, Classification and Localization of Submarine

   1. Minimum effective surface ship speed

8. Detection and Tracking of Submarine

   1. Expected number of submarines in the region that are being tracked at time t
   2. Expected number of submarines in the region that are not being tracked at time t because contact has been lost
   3. Expected number of submarines in the region that are not detected at time t
   4. Expected number of submarines in the region that are being tracked by a mobile unit in the vicinity of the submarine at time t
   5. Expected number of previously tracked submarines in the region at time t that are in the state of being recently lost and local search is being made to regain tracking contact
   6. Expected number of submarines in the region at time t that are in the state of being previously tracked, search to regain contact discontinued, new detection recently made by area search, and tracking unit(s) now en route to area or searching in an effort to obtain tracking contact
   7. Expected number of submarines in the region at time t that are in the state of being previously tracked, search to regain contact discontinued and no new detection made

8. Expected number of submarines in the region at time t that are in the state of being not previously tracked, recently detected by area search, and tracking unit(s) now en route to area or searching in an effort to obtain tracking contact

9. Expected number of submarines in the region that are detected by the barrier as it enters the region, and tracking unit(s) now en route to the area or searching in an effort to obtain tracking contact

10. Expected number of submarines in the region at time t that are not previously tracked and no previous detection, if any, is being used in an effort to obtain tracking contact

9. Insurance of the Safe Passage of Convoys, Strike Groups, and Amphibious Forces in the Presence of Hostile Submarines

1. Probability that the submarine fails to attack the main body by direct or indirect action of the screen units

10. Prevention of Submarine Penetration of Convoy Screen

1. Expected number of merchant vessels sunk during a single attack by a diesel submarine

2. Probability that a diesel submarine is sunk at some point during a single attack on a convoy

3. Probability that a destroyer is sunk during a single attack on a convoy by a diesel submarine

4. Expected number of merchant vessels sunk by diesel submarines during one month

5. Expected number of diesel submarines sunk during one month

11. Maintenance of at Least Intermittent Trail

1. Mean holding time until loss of contact of duration greater than a specified time

12. Survival of Carrier

    1. Probability that carrier can remain on-station for a specified length of time

13. Survival of Ships and Submarines

    1. Probability that a specified number of important ships, escorts and submarines have survived up to a given time

14. Prevention of Submarine Interception of Screened Units

    1. Minimum effective surface ship speed
    2. Minimum effective surface ship speed in retrieving sonar buoys
    3. Minimum effective surface ship speed in laying sonar buoys

15. Constant Close Contact of Submarine While in the Trailing Area

    1. Minimum effective surface ship speed

16. Evade Detection or, Given Detection, Survive During the Cruise-to-Rendezvous and Dispersal and Cruise-to Base Phases of the Mission, and Successful Completion of the Offensive Phase of the Mission

    1. Product of the relative effectiveness figures of merit for detection, survival and offensive performance

17. Tracking of Submarine

    1. Fraction of enemy submarines being shadowed (tracked) at a specified time within a surveillance or objective area

18. Denial of Tracking Information

    1. Time from countermeasures activation until tracking information is regained

19. Survival of Carriers and Submarines

    1. Probability that a specified combination of carriers and submarines have survived by a given time

20. Maintenance of Continuous Trail

    1. Time for evader to escape

TABLE D-27 SURFACE ASW STUDY REVIEW SUMMARY DESCRIPTIONS

STUDY REVIEW SUMMARY NUMBER	MISSION/TACTICAL SITUATION NAME	DEFINITION	CRITERION FOR SUCCESS	MOE(S) SELECTED
(10)-1	1	1	1	1
(10)-2	2	1	2	1
(10)-3	3	1	8	1-10
(10)-4	4	1	3	1
(10)-5	6	1	3	2,3
	7	1	3	2,3
	5	2	3	2,3
	3	2	3	2,3
(10)-6	9	1	4	1
	6	2	4	2
(10)-7	7	2	9	1
(10)-8	3	3	3	4
	7	3	3	4
(10)-9	7	4	3	5
(10)-10	7	5	10	1-5
	8	1	3	6
(10)-11	2	2	2	2
(10)-12	2	1	2	3,4
(10)-13	12	1	18	1
(10)-14	4	4	3	10
(10)-15	7	6	14	1-3
	10	2	15	1
	8	3	7	1
	4	3	5	2
(1,10)-1	4	2	5	1
(1,10)-2	8	2	3	7
(1,10)-3	5	1	6	1
(1,10)-4	8	4	3	9

STUDY REVIEW SUMMARY NUMBER	MISSION/TACTICAL SITUATION NAME	DEFINITION	CRITERION FOR SUCCESS	MOE(S) SELECTED
(8,10)-1	10	1	11	1
(8,10)-2	6	3	3	8
(9,10)-2	11	1	13	1
(10,12)-1	6	4	16	1
(8,9,10)-1	13	1	19	1
(8,9,10,12)-1	10	3	20	1
(1,7,8,10,15)-1	3	4	17	1

TABLE D-28 SURFACE AAW MISSIONS AND TACTICAL SITUATIONS

MISSION/TACTICAL SITUATION NAME AND DEFINITIONS

1. Surface Ship Defense

    1. A group of enemy missiles attack a ship which is defended by SAM's.
    2. Aircraft make simultaneous attacks on a ship. Director-controlled guns are brought to bear on air targets.
    3. An SLCM attack is made against a single defending destroyer. After detection of the launch platform or site, the defending ship deploys decoys and operates active electronic counter-measures to avoid penetration of the defenses by the SLCM.
    4. A bomber group, carrying air-to-surface missiles, attacks a carrier task group whose defense capabilities reside in surface-to-air missiles.
    5. Surface ships provide AAW defense of a surface fleet using SAM's against a missile raid.
    6. Hydrofoil craft assist in protecting a task force against an airborne attack.
    7. A single surface vessel defended by surface-to-surface and surface-to-air missiles encounters missile launching boats.
    8. Aircraft patrol a barrier so as to provide early warning information to surface ships regarding the approach of enemy surface craft carrying surface-to-surface missiles. Aircraft attempt to attack these surface craft before they launch their missiles. In their defense, surface ships fire surface-to-air missiles to intercept enemy launched missiles.

2. Surveillance and Identification

    1. A carrier task force provides aircraft identification of all air traffic passing through the force surveillance zone.

3. Passive Defense of Target

1. A mixture of real targets and decoys is presented to an attacking force. As a result, the attacker must assign his weapons on the basis of imperfect classification of the targets.

TABLE D-29 SURFACE AAW SUCCESS CRITERIA AND MOE'S

CRITERION FOR SUCCESS AND MOE'S

1. Protection of the Ship(s) from Missiles
    1. Minimum of the sum of the expected cost of total SAM's to be launched and the expected cost of the damage caused by the final impact of surviving enemy missiles
    2. Expected number of hits per ship
    3. Expected cost effectiveness per mission
2. Acquisition of All Targets in the Raid Within Sufficient Time to Attack Them
    1. Probability of acquiring all the planes in the attacking raid
3. Accurate Identification of All Aircraft
    1. Weighted sum of the rewards to be obtained from each possible designation-identification combination of aircraft
    2. Total error probability
    3. Probability of correct decision
    4. Maximum weighted sum of the rewards to be obtained from each possible designation-identification combination of aircraft
4. Prevention of Reduction in Task Force Effectiveness by Attacking Enemy Aircraft
    1. Expected number of attack aircraft killed per salvo
5. Prevention of Destroyer's Defenses Being Penetrated
    1. Probability of the destroyer's countermeasure defense being penetrated by an SLCM
6. Successful Defense of Surface Ships
    1. Probability of successful defense

7. Survival of Target

    1. Probability distribution function of the number of real targets classified as real targets and the number of decoys classified as decoys
    2. Expected number of real targets attacked
    3. Expected number of weapons assigned to each real target attacked
    4. Expected number of surviving real targets

8. Interception of Attacking Missiles

    1. Expected proportion of attacking missiles which are intercepted or terminated beyond a specified safe holdoff distance

TABLE D-30 SURFACE AAW STUDY REVIEW SUMMARY DESCRIPTIONS

STUDY REVIEW SUMMARY NUMBER	MISSION/TACTICAL SITUATION NAME	DEFINITION	CRITERION FOR SUCCESS	MOE(S) SELECTED
(11)-1	1	1	1	1
(11)-2	1	2	2	1
(11)-3	2	1	3	1-3
(11)-4	2	1	3	4
(11)-5	1	5	1	2
(11)-6	1	4	7	1
(3,11)-1	1	8	6	1
(11,12)-1	1	6	4	1
(11,12)-2	1	7	1	3
(11,14)-1	1	3	5	1
(2,11,14)-1	3	1	6	1-4

TABLE D-31 SURFACE ATTACK MISSIONS AND TACTICAL SITUATIONS

MISSION/TACTICAL SITUATION NAME AND DEFINITIONS

1. Surface Ship Defense
    1. Defense platforms are employed as gunboats in defense of ships in an amphibious objective area from the threat of high-speed surface attack vessels.
    2. An escort ship provides defensive gunfire support against an attacking torpedo boat.
    3. A single surface vessel defended by surface-to-surface and surface-to-air missiles encounters missile launching boats.
2. Barrier Patrol
    1. Interdiction of infiltration of enemy men and supplies across and along the border area waterways and weakening/destruction of enemy influence on the indigenous population by barrier patrol of inland and contiguous waterways.
3. Surface Ship Attack
    1. An anti-ship missile is launched from either another surface ship or an aircraft to attack a surface ship.
    2. Surface ships are used in a strike against a naval force composed of cargo vessels with destroyer escort type vessels.
4. Amphibious Fire Support
    1. A Navy task force stationed off the beach provides fire support to assault troops invading a beachhead objective area.
    2. Naval guns provide gunfire support for amphibious assault operations.

5. Surface Ship Versus Surface Ship

    1. Surface ships engage in one-on-one battles.

6. Coastal Patrol

    1. Tactical units are deployed from a base in friendly territory to a specified coastal or off-shore area of hostile territory or the coastal perimeter of a friendly territory to conduct patrol operations, with or without air-surface support; intercepting for identification or close surveillance and boarding, for inspection and search, coastal steamers or small craft suspected of carrying contraband or of agent smuggling and, if off hostile territory, conducting defensive/offensive operations against hostile escorts or small, high speed craft.

7. Defensive Surface Protection

    1. Hydrofoil ship utilizes missile system for delivery of defensive fires against various types of surface raiders.

8. Offensive Surface Protection

    1. Hydrofoil ship returns the fires of an enemy surface raider who is either attempting to attack a larger force of which the hydrofoil ship is a part or who is attacking the ship itself.

9. Friendly Force Versus Enemy Force

    1. A friendly combat force engages an enemy combat force.

10. Capture

    1. A pursuer attempts to capture an evader.

TABLE D-32 SURFACE ATTACK SUCCESS CRITERIA AND MOE'S

CRITERION FOR SUCCESS AND MOE'S

1. Successful Defense of Surface Ship
    1. Number of gunboats required to provide a given level of defense against a specified threat
2. Detection of Infiltration Crossing Attempts
    1. Probability of detection by barrier units of an infiltrator in one crossing attempt
    2. Probability of ultimate successful crossing
    3. Expected number of attempts necessary to cross, given that an undetected crossing is accomplished
3. Acquisition of Target
    1. Maximum target acquisition range
    2. Maximum target tracking range
4. Destruction of Target
    1. Number of targets the system can engage as a function of time
    2. Number of targets defeated per hour
    3. Percent of equal volume magazines required to defeat the target
    4. Cumulative probability that target is killed before reaching a specified range
    5. Probability of killing an engaged enemy vessel
5. Evade Detection or, Given Detection, Survive During the Cruise-to-Rendezvous and Dispersal and Cruise-to-Base Phases of the Mission, and Successful Completion of the Offensive Phase of the Mission
    1. Product of the relative effectiveness figures of merit for detection, survival and offensive performance

6. Destruction of Surface Ships

    1. Probability that the friendly forces win the war
    2. Expected duration of the war
    3. Expected number of friendly ships which survive the war, given the friendly forces win the war
    4. Probability of friendly forces losing the war for fixed enemy force level if friendly forces make an optimal choice between building more ships or improving exchange ratios within the limits of its budget
    5. Probability of friendly forces losing the war if both friendly forces and enemy forces make optimal choices between building more ships or improving the exchange ratio within the limits of their budget

7. Maintenance of Reasonable On-Station Time, Quick Response to Intercepts and Assurance of Combat Superiority if Attacked

    1. Equivalent number of competitive craft needed to accomplish the mission that a single baseline ship can accomplish

8. Survival of Ship

    1. Probability of survival

9. Protection of the Ship from Missiles

    1. Expected cost effectiveness per mission

10. Destruction of Enemy Force and Survival of Friendly Force

    1. Difference of the utility of the surviving friendly force and the utility of the surviving enemy force
    2. Difference between the ground unit strength of the friendly and enemy survivors
    3. Average firepower potential

11. Capture of Target

    1. Capture time

TABLE D-33 SURFACE ATTACK STUDY REVIEW SUMMARY DESCRIPTIONS

STUDY REVIEW SUMMARY NUMBER	MISSION/TACTICAL SITUATION NAME	DEFINITION	CRITERION FOR SUCCESS	MOE(S) SELECTED
(12)-1	1	1	1	1
(12)-2	2	1	2	1-3
(12)-3	5	1	6	1-5
(12)-4	6	1	7	1
(12)-5	4	2	4	2,3
	1	2	4	4
(12)-6	4	2	4	6
(3,12)-1	3	1	3	1,2
(10,12)-1	3	2	5	1
(11,12)-1	7	1	8	1
	8	1	4	5
(11,12)-2	1	3	9	1
(3,12,16)-1	4	1	4	1
(3,12,23)-1	9	1	10	1-3
(8,9,10,12)-1	10	1	11	1

TABLE D-34 SEA BASED STRATEGIC SYSTEMS MISSIONS AND TACTICAL SITUATIONS

MISSION/TACTICAL SITUATION NAME AND DEFINITION

1. SLBM Versus Defense System

    1. A defense system composed of mobile units attempts to destroy a nearby submarine and its missiles at the time of launch.

2. Retaliator Versus Attacker

    1. A retaliator, whose policy is not to strike first, seeks (by optimal allocation of his strategic weapon systems) to maximize his strike capability (nuclear throw weight) after absorbing a blunting first strike attack. The first strike by an attacker is designed to minimize the retaliator's second strike capabilities.

3. Submarine Trailing

    1. A countering force, using various combinations of attack submarines (SSN) and aircraft as trailing platforms, maintain trail over strategic ballistic missile submarines (SSBN's) and attack any SSBN which attempts an SLBM launch.

TABLE D-35 SEA BASED STRATEGIC SYSTEMS SUCCESS CRITERIA AND MOE'S

CRITERION FOR SUCCESS AND MOE'S

1. Submarine Launch of Missiles
    1. Expected number of submarines which successfully launch their missiles
2. Allocation of Resources to Achieve Retaliation Strike Capability
    1. Survivable throw weight after a first strike
3. Prevention of Launch of Sea Launched Ballistic Missiles (SLBM'S)
    1. Total expected number of missiles successfully launched

TABLE D-36 SEA BASED STRATEGIC SYSTEMS STUDY REVIEW SUMMARY DESCRIPTIONS

STUDY REVIEW SUMMARY NUMBER	MISSION/TACTICAL SITUATION NAME	DEFINITION	CRITERION FOR SUCCESS	MOE(S) SELECTED
(13)-1	1	1	1	1
(13)-2	2	1	2	1
(1,8,9,13)-1	3	1	3	1

TABLE D-37 ELECTRONIC WARFARE MISSIONS AND TACTICAL SITUATIONS

MISSION/TACTICAL SITUATION NAME AND DEFINITION

1. Emission Control
    1. Shipboard radar is maintained in an electromagnetic silence mode of operation as a passive countermeasure.
2. Aircraft Defense
    1. An ECM aircraft provides jamming support to a penetrating attack aircraft against AAA and SAM radar sites.
3. Surveillance of Ocean Area
    1. A satellite-borne radar is used for the purpose of ocean surveillance of shipping activities.
4. Surface Ship Defense
    1. An SLCM attack is made against a single defending destroyer. After defection of the launch platform or site, the defending ship displays decoys and operates active electronic countermeasures to avoid penetration of the defenses by the SLCM.
5. Passive Defense of Target
    1. A mixture of real targets and decoys is presented to an attacking force. As a result, the attacker must assign his weapons on the basis of imperfect classification of the targets.

TABLE D-38 ELECTRONIC WARFARE SUCCESS CRITERIA AND MOE'S

CRITERION FOR SUCCESS AND MOE'S

1. Reduction of Detectability of Ship Originated Electromagnetic Radiation
    1. Probability of intercept per azimuth scan of the radar antenna
    2. Probability of intercept per minute
2. Reduction of Defense Radar Capability
    1. Noise jamming to radar return signal strength ratio as a function of time
3. Detection and Localization of Shipping in the Open Ocean
    1. Returned signal from the target
4. Prevention of Destroyer's Defenses Being Penetrated
    1. Probability of the destroyer's countermeasures defenses being penetrated by an SLCM
5. Survival of Targets
    1. Probability distribution function of the number of real targets classified as real targets and the number of decoys classified as decoys
    2. Expected number of real targets attacked
    3. Expected number of weapons assigned to each real target attacked
    4. Expected number of surviving real targets

TABLE D-39 ELECTRONIC WARFARE STUDY REVIEW SUMMARY DESCRIPTIONS

STUDY REVIEW SUMMARY NUMBER	MISSION/TACTICAL SITUATION NAME	DEFINITION	CRITERION FOR SUCCESS	MOE(S) SELECTED
(14)-1	1	1	1	1
(14)-2	2	1	2	1
(14)-3	1	1	1	2
(7,14)-1	3	1	3	1
(11,14)-1	4	1	4	1
(2,11,14)-1	5	1	5	1-4

TABLE D-40 UNDERSEA SURVEILLANCE MISSIONS AND TACTICAL SITUATIONS

MISSION/TACTICAL SITUATION NAME AND DEFINITION

1. Ocean Surveillance
    1. Passive acoustic sensors are scattered over a large ocean area through which a submarine target is passing.
    2. A barrier force comprises a perimeter barrier designed to detect submarines as they cross the barrier in transiting to stations. In conjunction with the barrier force and a surveillance force, a shadowing force attempts to maintain contact on as many submarines as possible during their on-station patrols.
2. Submarine Surveillance
    1. Passive-active sonobuoys are deployed in pods in an undersea area (control area or basin) to detect and supply tracking information regarding submarines transiting the area.
    2. A field of moored Lofar sonobuoys are planted in an area to detect transiting submarines.
3. Contact Investigation
    1. SOSUS first detects a submarine and then provides a search aircraft with a datum of sufficient accuracy that it can lay its buoy field in a position so that it can detect the submarine. Given the detection, the aircraft then has available SOSUS signature data to aid in recognizing the signal as the target.

TABLE D-41 UNDERSEA SURVEILLANCE SUCCESS CRITERIA AND MOE'S

CRITERION FOR SUCCESS AND MOE'S

1. Detection of Submarine
    1. Minimum cost of sensors for a specified probability of detection
    2. Probability of submarine detection
2. Provide Information Regarding Submarine Passage
    1. Linear density of pods for specified detection probability per transit
3. Detection, Localization and Classification of Submarine
    1. Miss distance, which is defined as the distance between the position at which the aircraft reported the target to be and the center of the SEP updated to the time of localization with the information on target course and speed transmitted to the aircraft
4. Tracking of Submarine
    1. Fraction of enemy submarines being shadowed (tracked) at a specified time within a surveillance or objective area

TABLE D-42 UNDERSEA SURVEILLANCE STUDY REVIEW SUMMARY DESCRIPTIONS

STUDY REVIEW SUMMARY NUMBER	MISSION/TACTICAL SITUATION NAME	DEFINITION	CRITERION FOR SUCCESS	MOE(S) SELECTED
(15)-1	1	1	1	1
(15)-2	2	1	2	1
(15)-3	2	1	1	2
(1,15)-1	3	1	3	1
(1,7,8,10,15)-1	1	2	4	1

TABLE D-43 LOGISTICS MISSIONS AND TACTICAL SITUATIONS

MISSION/TACTICAL SITUATION NAME AND DEFINITION

1. Rapid Deployment
    1. A mix of surface ships and aircraft are used for rapid deployment of ground forces, equipment and supplies.
2. Carrier Task Force Support
    1. A C-2A (COD) aircraft provides high priority items required by carriers and other ships of the fleet on a daily basis.

TABLE D-44 LOGISTICS SUCCESS CRITERIA AND MOE'S

CRITERION FOR SUCCESS AND MOE'S

1. Delivery of Required Tonnage at Least Cost

    1. Minimum cost of the total rapid deployment force necessary to meet delivery requirements in all theaters

2. Satisfaction of Average Daily Demands of the Fleet for Critical Parts to Keep Aircraft in the Air and Ships at Sea in a Constant State of Readiness

    1. Value of the increased number of fleet aircraft made available

TABLE D-45 LOGISTICS STUDY REVIEW SUMMARY DESCRIPTIONS

STUDY REVIEW SUMMARY NUMBER	MISSION/TACTICAL SITUATION NAME	DEFINITION	CRITERION FOR SUCCESS	MOE(S) SELECTED
(21)-1	1	1	1	1
(21,22)-1	2	1	2	1

APPENDIX E MEASURES OF EFFECTIVENESS

TABLE E-1 INDEX OF MOE'S USED IN STUDIES

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
Aircraft		Design		(1) Ratio of useful load to takeoff gross weight		(1)-5
				(2) Cruise efficiency in nautical miles per pound of fuel		(1)-5
				(3) On-station airborne endurance		(1)-5
				(4) On-station waterborne endurance		(1)-5
		Mission Mix		(1) Total number of aircraft necessary to perform the mission		(1)-5
				(2) Number of sorties required to perform the mission		(1)-5
				(3) Total mission cost		(1)-5
				(4) Total aircraft lifetime cost		(1)-5
			Performance of mission requirements at least cost	(1) Total system cost for specified level of wartime and peacetime utilization	(1)-17	
		Utilization		(1) Average utilization per aircraft per month		(3)-9
	Airborne AAW	Aircraft Penetration Defense	Suppression of aircraft penetration	(1) Probability of preventing a single penetration		(2,3,14,17,18, 20,21,23)-1
				(2) Expected fraction of enemy penetrations prevented, given n engagements		(2,3,14,17,18, 20,21,23)-1
				(3) Attrition ratio of hostile to friendly force, given x penetrations		(2,3,14,17,18, 20,21,23)-1
		Air Escort	Successful defense of escorted aircraft	(1) Probability of kill of an attacking enemy aircraft by an escort aircraft		(2,3,14,17,18, 20,21,23)-1
				(2) Expected attrition index of enemy attacking aircraft without loss of an escorted aircraft		(2,3,14,17,18, 20,21,23)-1
				(3) Expected fraction of enemy penetrations prevented without loss of an escort or escorted aircraft		(2,3,14,17,18, 20,21,23)-1
				(4) Probability of successful escort defense against the enemy attack		(2,3,14,17,18, 20,21,23)-1

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
		Air Superiority		(1) Enemy aircraft destroyed		(2,3)-1
				(2) Enemy airfields out of commission		(2,3)-1
				(3) Friendly strikes unengaged		(2,3)-1
				(4) Enemy SAM's launched		(2,3)-1
				(5) Enemy SAM's destroyed		(2,3)-1
				(6) Friendly aircraft destroyed		(2,3)-1
				(7) Enemy aircraft encountered		(2,3)-1
				(8) Friendly strikes engaged		(2,3)-1
				(9) Friendly air superiority weapons launched		(2,3)-1
				(10) Enemy weapons penetrators		(2,3)-1
				(11) Friendly forces committed to air superiority roles		(2,3)-1
				(12) Probability of one aircraft killing another on a firing pass		(2,3,11)-1
				(13) Probability of a single successful air superiority sortie		(2,3,14,17,18, 20,21,23)-1
				(14) Relative attrition ratio of friendly and hostile aircraft in n air-to-air engagements of y duration, given specific mission ranges of engagements		(2,3,14,17,18, 20,21,23)-1
			Survival of friendly aircraft and destruction of enemy interceptor	(1) Probability that aircraft will kill the enemy interceptor	(2)-1	
				(2) Probability that aircraft will survive the engagement with enemy interceptor	(2)-1	
		Defense Against Bomber Attack	Destruction of bombers	(1) Probability that friendly aircraft will destroy a bomber	(2)-1	
				(2) Expected number of kills a friendly aircraft will achieve if it is directed against two bombers per sortie	(2)-1	
		Defense Against Cruise Missile Attack	Detection of cruise missile raid at a range which allows for missile intercept at useful ranges	(1) Detection range of raid relative to vital area center for a given intercept range	(2)-3	

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
	Airborne ASW	Barrier Placement/ Patrol	Detection of submarine	(1) Probability of detection	(1)-5,(1)-15	
				(2) Maximum width of barrier that can be maintained and still ensure a 50 percent probability of initial detection	(1)-14	
				(3) Number of detection opportunities converted to active contacts	(1)-14	
				(4) Maximum time to detection		(1)-7
				(5) Number of buoys required for a specified probability of detection		(1)-7
				(6) Probability that the submarine is contained in the area covered by the pattern		(1)-7
				(7) Ratio of the total mission cost to the probability of detecting a submarine at least once as it passes through the barrier	(1)-8	
				(8) Joint probability of at least one detection and localization to within the performance capability of the final localization technique	(1)-8	
				(9) Probability of detecting a submarine at least once as it passes through the barrier	(1)-8	
			Achieve maximum contact investigation capability in contacts per day at least cost	(1) Total lifetime cost to achieve maximum contact investigation capability	(1)-11	
				(2) Total mission cost to achieve maximum contact investigation capability	(1)-11	
		Bombing Attack on Submarine Force	Destruction of submarine-carried missiles	(1) Cost of the total (submarine) force to achieve a specified level of survival	(1,10)-1	
		Buoyfield Monitoring		(1) Total time monitored		(1)-4
				(2) Median length of monitor periods		(1)-4
				(3) Average number of detections		(1)-4
				(4) Mean monitoring time per detection		(1)-4

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
				(5) Total detection time		(1)-4
				(6) Median length of detection periods		(1)-4
				(7) Percent of time detecting while monitoring		(1)-4
			Detection of submarine	(1) Fraction of opportunities in which detection is made		(1)-4
				(2) Frequency of multiple simultaneous buoy contacts		(1)-4
		Contact Investigation	Detection of submarine	(1) Probability of submarine detection resulting from optimal strategies of aircraft and submarine	(1)-2	
				(2) Percent of a specified area in which the probability of submarine detection by the ASW support forces is equal to or greater than a stated level	(1)-12	
				(3) Probability of detection	(1)-3	
			Detection and localization of submarine	(1) Cumulative probability of reacquiring and converting the target to an active contact	(1)-14	
			Localization of submarine	(1) Total cost for a specified probability of localization	(1)-6	
				(2) Entropy of location uncertainty as a function of time (= expected value of minus one times the natural logarithm of the probability density function of submarine position)	(1,10)-1	
		Contact Investigation/ Prosecution		(1) Probability that aircraft detects submarine		(1,7,10)-1
				(2) Probability that aircraft attacks submarine		(1,7,10)-1
				(3) Probability that aircraft localized submarine, given that the aircraft detected the submarine		(1,7,10)-1

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR. NO.
				(4) Probability that aircraft kills submarine, given that the aircraft localized the submarine		(1,7.10)-1
			Detection, localization and destruction of submarine	(1) Probability of aircraft attack given radar or visual detection of submarine		(1,8,9)-1
				(2) Probability of kill given an attack engagement		(1,8,9)-1
				(3) Aircraft kill width, defined as the aircraft radar-visual detection sweep width multiplied by the probability of attack given detection and the probability of kill given attack		(1,8,9)-1
				(4) Expected number of submarines killed per unit time		(1,8,9)-1
				(5) Probability of kill per snorkel period due to Lofar detection		(1,8,9)-1
				(6) Total one-way attrition of diesel transitors in the barrier due to the combined Lofar, radar and visual search		(1,8,9)-1
			Localization and destruction of submarine	(1) Dollar-cost per submarine kill	(1,10)-3	
				(2) Joint vehicle and weapon effectiveness, which is the joint probability of the vehicle to maintain track, attack, and classify, and of the weapon to function reliably, acquire and kill the target given that the target has been previously localized	(1,10)-3	
		Contact Investigation with Aid of SOSUS	Detection, localization and classification of submarine	(1) Miss distance (datum accuracy)(= the distance between the position at which the aircraft reported the target to be and the center of the SEP updated to the time of localization with the information on target course and speed transmitted to the aircraft)	(1,15)-1	

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
				(2) Unconditional probability of detection and classification of a submarine entering a region of SOSUS coverage by an ASW aircraft	(1,15)-1	
				(3) Frequency of containment (= the probability of the search aircraft laying a buoy field such that it is possible to detect the target)	(1,15)-1	
				(4) Time required to achieve a classification	(1,15)-1	
				(5) The distribution of time from NAVFAC detection to a confirmed classification	(1,15)-1	
		Contact Prosecution		(1) False attack ratio, which is defined as the ratio of false attacks to valid attacks		(1,10)-2
				(2) False attack rate, which is defined as the number of false attacks per 100 hours		(1,10)-2
				(3) Probability of kill per prosecution		(1,7,10)-1
				(4) Cumulative probability of kill over a specified number of days		(1,7,10)-1
				(5) Percent of deployed submarines killed during engagement		(1,7,10)-1
				(6) Expected number of aircraft required at the nearest base to prosecute a given submarine target		(1,7,10)-1
				(7) Probability that an enemy submarine will survive a given period of operations (either in transit or on-station) in the area covered by the aircraft		(1,5,8,9,10, 21,22)-1
				(8) Probability that at any randomly selected instant of time a submarine in the area is being held down by aircraft		(1,5,8,9,10, 21,22)-1
			Destruction of submarine	(1) Average kill probability	(1)-13	

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR. NO.
		Convoy Screen	Denial to a diesel submarine the use of the surface before and during its attack	(1) Kill sweep rate (2) Probability of kill		(1,8.9)-1 (1,8,9)-1
		Response to Flaming Datum	Destruction of submarine	(1) Probability of killing submarine responsible for a flaming datum		(1,7,10)-1
		Sonobuoy Barrier Patrol	Detection, localization and kill of submarine	(1) Average effective length of air ASW (sonobuoy) barrier that can be maintained per enemy submarine	(1)-9	
			Suppression of submarine activity	(1) Probability of killing an enemy submarine	(1)-4	
				(2) Reduction of the enemy submarine force mobility	(1)-4	
				(3) Denial of the surface to the enemy submarine force	(1)-4	
				(4) Ratio of the difference of a reference level of damage sustained minus the potential damage sustained to the total damage capability	(1)-7	
				(5) Ratio of damage averted by own forces to total damage capability of enemy submarines	(1)-7	
				(6) Ratio of average effective barrier length to total number of enemy submarines	(1)-10	
				(7) Ratio of average effective barrier to total damage capability of enemy submarines	(1)-10	
				(8) Ratio of fraction of submarines killed to damage sustained by own forces	(1)-10	
				(9) Ratio of damage averted by own forces to total damage capability of enemy submarines	(1)-10	
				(10) Reciprocal of damage sustained by own forces	(1)-10	

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
				(11) Fraction of submarines killed	(1)-10	
				(12) Ratio of the product of damage averted by own forces and the total damage sustained by own forces to total damage capability of enemy submarines	(1)-10	
		Submarine Search	Detection, localization and kill of submarine	(1) Probability of submarine detection, localization and kill	(1)-1	
			Detection of submarine	(1) Percentage of sorties gaining contact		(1)-4
				(2) Fraction of opportunities detected for a specified range		(1)-4
				(3) Minimum expected time to find the target	(1,10)-4	
				(4) Probability of finding the target by a given elapsed time	(1,10)-4	
				(5) Expected proportion of time for which a submarine is undetected	(1,10)-2	
				(6) Ratio of time undetected to the time of a cycle of detection and escape	(1,10)-2	
			Maintain on-station search capability	(1) Aircraft operating cost per on-station hour	(1)-16	
				(2) Aircraft operating cost per search mile	(1)-16	
				(3) Search hours per day per carrier deckload for a specified mission radius	(1)-16	
				(4) Search miles per day per carrier deckload for a specified mission radius	(1)-16	
		Submarine Tracking	Track of target to obtain accurate fixes for constant surveillance or, if required, a successful weapon drop	(1) Probability that the target can be tracked for a given length of time		(1)-3
				(2) Probability of maintaining contact for a given length of time with a specified number of buoy drops		(1)-3

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
	Airborne Attack	Air Strike	Destruction of target	(1) Maximum total value of damage inflicted upon all targets	(3)-8	
				(2) Total target kill potential	(3)-10	
				(3) Ratio of the target value destroyed to total cost incurred		(3)-2
				(4) Probability of target kill as a function of delivery accuracy		(3)-6
				(5) Expected number of weapon units required per kill		(3)-6
				(6) Expected whole number of passes per kill		(3)-6
		Attack on Task Force	Detection and identification of aircraft carrier	(1) Probability that a search aircraft will locate the task force, and find and correctly identify the aircraft carrier within it	(3)-14	
		Bombing Attack on Bridges	Destruction of target	(1) Probability of collapse of at least one span when the weapons are dropped in a single pass		(3)-1
				(2) Expected number of sorties required for the collapse of at least one span for all weapons delivered in a single pass		(3)-1
				(3) Expected number of sorties required for the collapse of at least one span for all weapons delivered in two passes		(3)-1
		Close Air Support		(1) Aircraft availability, which is defined as the ratio of the number of aircraft available for the mission to the number of aircraft needed for the mission		(3)-9
				(2) Timeliness of aircraft's response, which is defined as the ratio of aircraft response time to target "shelf life"		(3)-9

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
				(3) Ratio of the weapon load carried by the aircraft to the weapon load needed for mission		(3)-9
				(4) Ratio of aircraft ordnance delivery mode to delivery capability needed		(3)-9
				(5) Firepower index		(3)-9
				(6) Average number of sorties per aircraft per day		(3)-9
				(7) Probability of a single successful close air support sortie		(2,3,14,17,18, 20,21,23)-1
				(8) Expected fraction of k targets killed or contained in n sorties without loss of aircraft, given a specific loiter time		(2,3,14,17,18, 20,21,23)-1
				(9) Expected fraction of a target killed per close air support sortie		(2,3,14,17,18, 20,21,23)-1
			Destruction of target	(1) Expected number of targets killed per day	(3)-4	
				(2) Expected number of targets killed during the system's lifetime	(3)-4	
				(3) Total system cost for a prescribed level of effectiveness	(3)-4	
				(4) Cost per target killed	(3)-7	
				(5) Percent of close air support attack sorties for which an expected target kill is achieved at or below a specified weapon weight		(3)-9
			Destruction of target and survival of aircraft	(1) Probability that the target is destroyed		(3)-7
				(2) Probability that the attacking aircraft survives		(3)-7
			Maintenance of sufficient weapons on-station to provide rapid response to close support requests	(1) Average number of weapons on-station	(3)-6	

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
			Successful attack capability	(1) Payload potential	(3)-3	
				(2) Number of sorties performed within a specified operational period	(3)-3	
				(3) Force size requirement for fulfilling 90 percent of close air support requests	(3)-3	
		Counterinsurgency		(1) Probability of a single successful counterinsurgency sortie		(2,3,14,17, 18,20,21, 23)-1
				(2) Fraction of incidents prevented		(2,3,14, 17 18,20,21, 23)-1
		Interdiction	Destruction of target	(1) Probable destroyed value of the target	(3)-5	
				(2) Ratio of the probable destroyed value to total costs incurred while achieving the desired effectiveness	(3)-5	
				(3) Expected number of targets (or target elements) destroyed per sortie	(3)-9	
				(4) Expected cost per target destroyed	(3)-9	
				(5) Expected aircraft lost per target destroyed	(3)-9	
				(6) Maximum expected return, where return is defined as the fraction of strategic value destroyed	(3,12,23)-1	
				(7) Single target kill probability		(2,3,14,17, 18,20,21, 23)-1
				(8) Number of weapons required by x bombers to kill k targets in one pass		(2,3,14,17, 18,20,21, 23)-1
				(9) Expected fraction of k assigned targets killed per sortie without loss of aircraft		(2,3,14,17 18,20,21 23)-1

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
		Interdiction in a Time Limited Hunt	Destruction of target	(1) Total damage expected in a hunt of specified duration	(3)-11	
		Loadout and Carriage Capabilities		(1) Number of bombs carried per aircraft as a function of bomb weight		(3)-6
				(2) Tons delivered on target per aircraft sortie as a function of bomb weight		(3)-6
		Neutralization of Enemy Communication System		(1) Probability of x percent of hostile communications impairment for a specified time duration t		(2,3,14,17 18,20,21, 23)-1
				(2) Expected fraction of hostile communications impaired for a specified time duration t, given n opportunities		(2,3,14,17, 18,20,21, 23)-1
		Personnel Rescue	Rescue of wounded personnel	(1) Survival probability of seriously wounded personnel in enemy territory as a function of the distance rescue aircraft must fly		(3)-9
	Antiair Warfare and Attack	Mission Performance	Destruction of target	(1) Ratio of the incremental improvement in accomplishing the mission to the incremental monetary cost of such an improvement	(2)-2	
		Vulnerability and Survivability	Survival of aircraft	(1) Probability of kill (in a given category: KK,K,A,B,C or E) of the aircraft by a specified weapon		(1)-8
				(2) Kill probability reduction per pound of protection		(1)-8
	Logistics	Airdrops of Troops, Supplies and Equipment		(1) Expected tonnage of material moved by an airlift aircraft per mission of specified range		(2,3,14,17, 18,20,21, 23)-1
				(2) Expected tonnage fraction of material successfully forwarded in n sorties within a specified time		(2,3,14,17 18,20,21, 23)-1

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
				(3) Probability of a successful movement of material upon a single demand, given a minimum tonnage and maximum forwarding time		(2,3,14,17, 18,20,21, 23)-1
	Logistics and Ship Support	Carrier Task Force Support	Satisfaction of average daily demands of the fleet for critical parts to keep aircraft in the air and ships at sea in a constant state of readiness	(1) Value of the increased number of fleet aircraft made available	(21,22)-1	
				(2) Increase in carrier based aircraft sortie rate for COD supported carrier over self-sufficient carrier	(21,22)-1	
	Mining	Aerial Minelaying	Accurate minelaying	(1) Percentage of drops within a specified distance from a target line		(5)-1
				(2) Percentage of errors exceeding four times the median error		(5)-1
				(3) Bias index for errors measured from the target line		(5)-1
			Survival of aircraft	(1) Total threat delivered to penetrating aircraft	(5)-2	
			Survival of aircraft and planting of mines	(1) Joint probability that a specified number of aircraft are killed and a specified number of mines are unplanted	(5)-1	
	Ocean Surveillance	Laying of Sonobuoys		(1) Average time required to lay a buoy successfully		(7)-1
				(2) Average laying time per buoy		(7)-1
				(3) Reliability of lay		(7)-1
		Surveillance of Ocean Area	Provide required patrol coverage at least cost	(1) Minimum cost of providing the required on-station hours	(7)-2	

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
Antiradiation Missile	Airborne Attack	Missile Radar Homing and Warning Subsystem Performance in a Multiradar Environment	Detection of target radar and visual identification of its direction and signal intensity	(1) Probability of specific target radar detection in a multiradar environment and visual identification of its direction and signal intensity	(3)-12	
		Missile Seeker Subsystem Performance in a Multiradar Environment	Detection and acquisition of target	(1) Probability that the missile seeker will detect a specified target radar in a multiradar environment and that the missile will then acquire this radar as a target	(3)-12	
Bathythermograph	Environmental Systems	Ship's Bathythermograph Maneuver	Low cost measurement of the vertical ocean temperature profile	(1) Difference in fuel consumption due to the bathythermograph maneuver	(4)-1	
Bomb	Airborne Attack	Attack on Airfield	Temporary denial of enemy use of his bases and attrition of enemy aircraft and breakdown of facilities	(1) Expected number of bombs required for a specified duration of airfield neutralization		(3)-3
		Attack on Bridge	Collapse of at least one span of the bridge	(1) Expected number of aircraft sorties required for a given probability of success		(3)-3
		Attack on Close Support Targets	Deprive enemy of services of troops and/or affect morale of troops and civilians	(1) Expected number of sorties for a specified level of success		(3)-3
		Attack on Surface Ship	Destruction of target	(1) Probability that a bomb will hit a ship		(2,3,11)-1

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
		Attack on Surface Targets	Destruction of target	(1) Mean area of effectiveness as a function of burst height		(3)-6
		Attack on Transportation Targets	Temporary denial of a transportation route to the enemy and attrition of vehicles	(1) Expected number of bombs required for a specified assurance of target destruction		(3)-3
Carrier	Submarine Attack and Surface ASW	Carrier Versus Submarine	Survival of carrier	(1) Probability that carrier can remain on-station for a specified length of time	(9,10)-1	
Command and Control System	Command and Control	Detection and Tracking Capability	Detection and tracking of target	(1) Probability of detection and tracking within a specified response time		(2,3,14,17, 18,20,21, 23)-1
				(2) Expected fraction of successful real detections and trackings per n opportunities		(2,3,14,17, 18,20,21, 23)-1
		Performance of Command and Control Statusing Data Correlation		(1) Probability of successful identification within a given time		(2,3,14,17 18,20,21, 23)-1
				(2) Expected fraction of real identifications out of n opportunities within a given time		(2,3,14,17, 18,20,21, 23)-1
				(3) Probability of displaying and maintaining current status on n identification/ correlation variables		(2,3,14,17, 18,20,21, 23)-1
	Command and Control and Antisubmarine Warfare	Performance in ASW		(1) Command and control relative effectiveness, defined to be the difference between the corresponding average probabilities of ASW mission success divided by the average probability of ASW mission success of a specified alternative		(18)-1

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
				(2) Average probability of ASW mission success, defined to be the weighted sum of the probability of mission success when a specified ASW role is examined within a given mission type, where the weighting factors are for each mission type and role within a mission		(18)-1
		Performance in Detection, Localization, Classification and Attack of Target		(1) Probability that a target in range for its characteristics (noise level, etc.) is not picked up before it leaves the area given a weighted sum of targets and their priorities		(8,18)-1
				(2) Probability that a target is not picked up until t time units after it was "available" given a weighted sum of targets and their priorities		(8,18)-1
				(3) Probability of losing a contact of priority before complete classification given a weighted sum of targets and their priorities		(8,18)-1
				(4) Expected number of contacts lost in a given time given a weighted sum of targets and their priorities to start with		(8,18)-1
				(5) Expected time to classify given a weighted sum of targets and their priorities in the system to start with		(8,18)-1
				(6) Expected number of targets in a given class in the system at any time		(8,18)-1
				(7) Expected value of a weighted sum of targets and their priorities		(8,18)-1
				(8) Expected total time a target is in the system		(8,18)-1
Communications System	Naval Communications	Message Transfer Capability		(1) Average number of messages in the net queue		(17)-3
				(2) Mean waiting time in the net queue		(17)-3

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
		Performance		(1) Median message delay time		(17)-2
				(2) Percent of messages meeting specified delay standards		(17)-2
				(3) Average message delay time as a function of usage level		(17)-4
				(4) Probability of a single intelligible message being transmitted and received in a given time		(2,3,14,17, 18,20,21 23)-1
				(5) Expected fraction of intelligible messages which can be transmitted and received in a given time		(2,3,14,17, 18,20,21, 23)-1
				(6) Number of intelligible messages which can be transmitted and received within a specified time interval		(2,3,14,17, 18,20,21, 23)-1
		Performance and Support of Weapon Platform		(1) Circuit usage		(17)-1
				(2) Number of circuits required		(17)-1
				(3) Number of equipments required		(17)-1
				(4) Number of personnel required		(17)-1
				(5) Total system lifetime cost		(17)-1
				(6) Size		(17)-1
				(7) Weight		(17)-1
				(8) Power requirement		(17)-1
				(9) Reliability of circuit performance		(17)-1
				(10) Probability that a specified number of a totality of circuits is available at any time		(17)-1
				(11) Flexibility		(17)-1
				(12) Jamming vulnerability		(17)-1
				(13) Vulnerability to enemy detection		(17)-1
				(14) Growth potential		(17)-1
				(15) Efficiency of spectrum use		(17)-1
				(16) Ease of installation		(17)-1
				(17) Survivability		(17)-1
				(18) Ease of implementation		(17)-1
				(19) Maximum confidence level for flash traffic, defined as the probability that each flash message is serviced within the time threshold specified for that precedence		(17)-1

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
		System Location Security		(1) Detectability of transmissions		(17)-2
		System Security from Jamming		(1) Ratio of jammer power to signal power		(17)-2
		Traffic Volume Capability		(1) Average data rate (in words per minute) (2) Peak data rate (in words per minute) (3) Average daily traffic load		(17)-2 (17)-2 (17)-2
Counter-measures System	Airborne ASW, Submarine ASW, Submarine Attack, and Surface ASW	Performance		(1) Degraded hit probability due to countermeasures (2) Degraded detection probability due to countermeasures		(1,5,8,9, 10,21,22) (1,5,8,9, 10,21,22)
	Reconnaissance/ Intelligence	Employment of Counter-Surveillence Techniques	Reduction in enemy surveillance capability of friendly forces	(1) Probability of detection (2) Probability of recognition (3) Probability of identification (4) Timeliness of surveillance data generated (5) Area coverage (6) Range of detection (7) Time of search before location (8) Number of targets detected (9) Percentage of targets located (10) Accuracy of intelligence data in terms of targets correctly identified, false alarms, targets missed and targets incorrectly located (11) Ratio of the reflectance of the material to the reflectance of the background (contrast) as a function of wave-length (12) Emissivity of the material and background (13) Correlation between the apparent pattern and the pattern of the background (14) Signal-to-noise ratio (15) False-alarm rate (16) Time to set up		(20)-2 (20)-2 (20)-2 (20)-2 (20)-2 (20)-2 (20)-2 (20)-2 (20)-2 (20)-2 (20)-2 (20)-2 (20)-2 (20)-2 (20)-2

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
Data Link	Naval Communications	Employment of Antijamming Schemes	Prevention of successful jamming	(1) Total number of jamming units (i.e., the power-bandwidth-time product required by the jammer to insure the alteration of a single bit) per frame which the jammer must expend to insure the nullification of data transmitted in a data frame		(14,17)-1
				(2) Ratio of the number of bits which must be altered by jamming to nullify the transmission to the total number of bits transmitted per message		(14,17)-1
		Transmission Efficiency		(1) Ratio of the number of actual nonredundant data bits per frame to the total number of bits per frame		(14,17)-1
Decoy	Antiair Warfare and Electronic Warfare	Passive Defense of Target	Survival of target	(1) Probability distribution function of the number of real targets classified as real targets and the number of decoys classified as decoys	(2,11,14)-1	
				(2) Expected number of real targets attacked	(2,11,14)-1	
				(3) Expected number of weapons assigned to each real target attacked	(2,11,14)-1	
				(4) Expected number of surviving real targets	(2,11,14)-1	
				(5) Probability distribution function of the number of surviving real targets	(2,11,14)-1	
				(6) Standard deviation of the number of surviving real targets	(2,11,14)-1	
				(7) Probability of correctly classifying all targets	(2,11,14)-1	
Electronic Countermeasures System	Electronic Warfare	Aircraft Defense by ECM Jamming	Reduction of aircraft susceptibility to detection	(1) Blip-scan ratio, which is defined as the number of times that a particular target is observed to the number of times it could have been observed		(14)-2
				(2) Burnthrough range		(14)-2

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
			Reduction of defense radar capability	(1) Noise jamming to radar return signal strength ratio as a function of time	(14)-2	
				(2) Cumulative lethal exposure time	(14)-2	
				(3) Number of projectiles fired at strike aircraft	(14)-2	
				(4) Cumulative attack aircraft survival probability	(14)-2	
		Ship-Based ECM Defense against Missile Attack		(1) Probability that the missile is locked on the ship at end of flight		(14)-1
Equipment		Equipment Readiness and/or Operation		(1) Equipment operational readiness (EOR, which is defined as the probability that a given system will function throughout an engagement (mission) interval of specified duration (EOR = availability X reliability)		(1,5,8,9, 10,21, 22)-1
				(2) Availability, which is defined as the fraction of a specified time interval that a given system will be capable of performing the function for which it was designed		(1,5,8,9, 10,21, 22)-1
				(3) Reliability, which is defined as the conditional probability that a system which is functioning satisfactorily at a given time will continue to function throughout a specified interval of time		(1,5,8,9, 10,21, 22)-1
		Utilization	Performance of mission functions when utilized	(1) Total system operating costs over a specified time for a specified system utilization	(2)-4	
Fire Control Computer	Antisubmarine Warfare	Contact Prosecution	Destruction of submarine	(1) Maximum probability of a hit	(10)-2	

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
Force Mix	Airborne AAW and Airborne Attack	Air Superiority	Successful attack on enemy airfield targets	(1) Expected number of strike sorties during a specified number of engagements	(2,3)-1	
				(2) Expected number of enemy aircraft (targets) destroyed during a specified number of engagements	(2,3)-1	
				(3) Exchange ratio, which is defined as the ratio of the cost of enemy losses during a specified number of engagements to the cost of friendly losses	(2,3)-1	
	Airborne ASW and Surface ASW	CVA Escort Force Performance	Protection of CVS	(1) Probability of detection of submarine attempting to penetrate screen as a function of the escort spacing factor, which is defined as the total length of screen line divided by the sum of sonar sweep width		(1,7,10)-1
				(2) CVS survivability, which is defined as the probability the CVS will not be damaged by an attacking submarine force		(1,7,10)-1
	Airborne Attack	Air Strike	Destruction of target	(1) Weighted maximum effectiveness for a mix of conflicts, tactical profiles (mission profile and tactics) and war importance factors	(3)-1	
				(2) Weighted effectiveness per aircraft (or missile) (= [effectiveness of any vehicle in destroying a target class per aircraft (or missile)] X (relative value of the target))	(3)-1	
				(3) Targets destroyed per aircraft over a given time period	(3)-1	
				(4) Number of bombers attacked against a point raid for a given time period	(3)-1	

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
				(5) Expected number of targets destroyed in a given period of time	(3)-2	
				(6) Expected number of primary targets killed per unit cost	(3)-13	
				(7) Expected number of primary targets killed per day for a given force level	(3)-13	
				(8) Cost expenditure required to achieve specified target damage levels on a single strike operation	(3)-13	
	Airborne Attack and Reconnaissance	Air Strike Force in Close Air Support	Provide assistance to friendly ground forces in achieving their objectives by helping to minimize attrition	(1) Reduction in overall losses to friendly forces while they are being assisted in holding a position, gaining territory, reducing enemy forces and material, or retreating		(3,20)-1
				(2) Response time, i.e., the time between the initial call for support (by ground forces) and the arrival of support in the objective area		(3,20)-1
				(3) Ratio of the product of our fire support time and the duration of support to the response time		(3,20)-1
				(4) Percent of time the system can be used		(3,20)-1
				(5) Time for ground forces to achieve their objectives		(3,20)-1
		Air Strike Force in Defense-Busting	Reduce attrition in subsequent air operations by achieving and maintaining air superiority	(1) Long-term reduction in enemy antiair warfare capability per strike		(3,20)-1
				(2) Mean time between defense-busting strikes		(3,20)-1
				(3) Reduction in en route attrition on other strikes		(3,20)-1
				(4) Change in effort required to maintain low attrition on direct routes to targets		(3,20)-1
				(5) Change in time to secure air superiority en route to and at target areas		(3,20)-1

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
		Air Strike Force in Defense-Suppression	Reduction of the overall attrition of strike forces	(1) Change in number of aircraft lost to enemy action as a result of defense-suppression efforts		(3,20)-1
				(2) Reduction in overall attrition per strike		(3,20)-1
				(3) Decreased intensity of defenses during strikes		(3,20)-1
				(4) Increased probability of achieving the supported mission's objectives		(3,20)-1
				(5) Degree to which optimum tactics can be used against defended targets		(3,20)-1
		Air Strike in Friendly-Force-Defense	Reduction of friendly force attrition by attacking the enemy's long-range offensive capability	(1) Reduction in losses to friendly forces		(3,20)-1
				(2) Change in friendly casualties per unit time		(3,20)-1
				(3) Reduction in enemy's potential to produce casualties in battle areas		(3,20)-1
				(4) Ratio of the product of our fire support and duration of support to the response time		(3,20)-1
				(5) Targets destroyed per unit of time		(3,20)-1
		Air Strike Force in Interdiction-Fixed-Target	Reduction of the flow of enemy resources between sources of supply and the battle-field by attacking the transportation system	(1) Reduction in goods reaching the battle area		(3,20)-1
				(2) Reduction in capacity of the transportation system per strike		(3,20)-1
		Air Strike Force in Interdiction-Search-and-Attack	Reduction of the flow of enemy resources between sources of supply and the battle-field by attacking the cargo and cargo carriers en route	(1) Reduction in goods reaching the battle area		(3,20)-1
				(2) Reduction in capacity of the transportation system per strike		(3,20)-1
				(3) Goods destroyed en route		(3,20)-1

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
		Air Strike Force in Own-Force-Defense	Gain and maintain the security of a carrier task force in the area of operation	(1) Time to secure operating area		(3,20)-1
				(2) Long-term reduction in threat to the operating area per unit time		(3,20)-1
				(3) Reduction in own-force-defense effort required per unit time		(3,20)-1
				(4) Intelligence required per strike		(3,20)-1
		Air Strike Force in Strategic Support	Progressive disablement of the enemy's warmaking capability to a point where he no longer retains the ability or the will to wage war	(1) Percentage of enemy's total resources denied to him		(3,20)-1
				(2) Reduction in material that can be sent to the battle area		(3,20)-1
				(3) Ratio of the rate of destruction of strategic support targets to the rate of rebuilding strategic support targets		(3,20)-1
				(4) Reduction in basic necessities available to population		(3,20)-1
				(5) Ratio of "cost of target" to the "cost to kill target"		(3,20)-1
		Air Strike Force in Tactical Reconnaissance	Obtain (1) information on current or potential enemy activity, (2) information on the metecrological and geographical characteristics of an area, and (3) bomb damage assessment	(1) More rapid and reliable information per supported sortie		(3,20)-1
				(2) Percent of time the needed information is obtained, processed and made available		(3,20)-1
				(3) Percent of needed information that is obtained, processed and made available		(3,20)-1
		Air Superiority	Reduction or elimination of enemy air activity	(1) Difference between flying hours denied the enemy and flying hours expended by the attackers in carrying out the strike		(3,20)-1

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
		Interdiction	Reduction or elimination of enemy combat capability	(1) Difference between ton miles denied the enemy and the equivalent ton miles lost by attackers due to aircraft attritions, repair hours incurred by damaged aircraft, and the total flight time of mission	(3,20)-1	
	Airborne Attack and Surface Attack	Engagement Between Opposing Ground and Tactical Air Forces	Destruction of target	(1) Kill rate, expressed in fraction of target unit strength destroyed per 24 hours of combat		(3,12)-1
	Airborne Attack, Surface Attack and Amphibious Assault	Amphibious Fire Support	Destruction of target	(1) Firepower, which is defined as the number of targets the system can engage as a function of time	(3,12,16)-1	
				(2) Expected number of rounds to achieve 30 percent casualties	(3,12,16)-1	
				(3) Number of rounds required to yield 90 percent assurance of 30 percent casualties	(3,12,16)-1	
				(4) Number of missiles required on the average per target for personnel targets	(3,12,16)-1	
				(5) Number of aircraft sorties per target	(3,12,16)-1	
	Antisubmarine Warfare	Convoy Vulnerability to Submarine Attack		(1) Expected number of torpedoes that strike the primary target		(1,5,8,9,10,21,22)-
				(2) Expected number of torpedoes that strike a chance target		(1,5,8,9,10,21,22)-
				(3) Probability a ship is sunk		(1,5,8,9,10,21,22)-
				(4) Expected number of ships damaged		(1,5,8,9,10,21,22)-
				(5) Expected off-line times of damaged ships		(1,5,8,9,10,21,22)-
				(6) Expected loss (=(expected number of ships sunk) X (cost of one ship) + (expected number of ships damaged) X (cost of one ship) X (expected repair time)/(length of war))		(1,5,8,9,10,21,22)-

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
		Force Requirements in ASW		(1) Total cost of the protected forces and ASW forces necessary to insure that given requirements for protected forces are met		(1,5,8,9, 10,21,22)-1
		Sea-Based and Land-Based Air ASW	Minimize the cost of the air ASW forces needed to fulfill the mission requirements	(1) Total cost of a given mix of sea-based and land-based air ASW forces which are needed to achieve a specified level of submarine attrition		(1,7,10)-1
		Submarine Search	Destruction of target	(1) Maximum probability of detecting and killing a submarine in a specified ocean area		(1)-6
			Detection of submarine	(1) Expected proportion of time for which a submarine is undetected	(1,10)-2	
				(2) Ratio of time undetected to time of a cycle of detection and escape	(1,10)-2	
		Submarine Trailing	Maintenance of at least intermittent trail	(1) Expected fraction of SSBN's which would be under trail at various points along their transit and patrol routes	(1,8)-1	
	Antisubmarine Warfare and Surveillance	Ocean Surveillance	Tracking of submarine	(1) Fraction of enemy submarines being shadowed (tracked) at a specified time within a surveillance or objective area	(1,7,8,10,15)-1	
	Antisubmarine Warfare, Antiair Warfare and Attack	Vulnerability of Escorts		(1) Probability of a hit, given acquisition of the ship		(1,2,10,11)-1
				(2) Probability of damage, given a hit		(1,2,10,11)-1
				(3) Expected number of days off the line		(1,2,10,11)-1
				(4) Expected number of surviving escorts after an attack		(1,2,10,11)-1
				(5) Probability of the loss of an escort		(1,2,10,11)-1

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
	Antisubmarine Warfare, Attack and Sea Based Strategic Systems	Trailing of Ballistic Missile Submarines	Prevention of launch of sea launched balistic missiles (SLBM's)	(1) Total expected number of missiles successfully launched	(1,8,9,13)-1	
				(2) Expected number of SLBM's (per deployed SSBN) prevented from reaching their targets	(1,8,9,13)-1	
				(3) Expected fraction of missiles prevented from reaching their targets	(1,8,9,13)-1	
	Attack and Special Warfare	Attacker Versus Defender		(1) Combat ratio, which is the ratio of the attacker combat power to the defender combat power		(12,16)-1
		Engagement of Opposing Forces	Destruction of enemy force and survival of friendly force	(1) Net survivor utility, which is defined as the difference of the utility of the surviving friendly force and the utility of the surviving enemy force	(3,12,23)-1	
				(2) Difference between the ground unit strength of the friendly and enemy survivors	(3,12,23)-1	
				(3) Average firepower potential	(3,12,23)-1	
	Logistics	Rapid Deployment of Ground Forces, Equipment and Supplies	Delivery of required tonnage at least cost	(1) Minimum cost of the total rapid deployment force necessary to meet delivery requirements in all theaters	(21)-1	
	Mine Countermeasures	Amphibious Assault Preparation or Support to Defensive Operations	Clearance of minefield	(1) Risk to ships in the assault operation	(6)-1	
				(2) Expected number of casualties	(6)-1	
				(3) Expected fraction of mines not found in minehunting operation	(6)-1	
				(4) Expected percentage clearance obtained in the minehunting operation	(6)-1	
				(5) Total force level required to clear a given area in a given time	(6)-2	
				(6) Expected number of mines neutralized in minehunting operation	(6)-2	
				(7) Expected number of neutralization units required per day in minehunting operation	(6)-2	

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
				(8) Risk to the countermeasures vessels, which is defined as the expected value of the ratio of the number of mines exploded within the damage radius of the countermeasures vessels to the number of mines initially in the channel or area in which countermeasures are carried out	(6)-3	
	Mining and Mine Countermeasures	Mine Clearance of an Amphibious Objective Area	Clearance of minefield	(1) Fraction of mines which fire against traffic ships when the optimal division of mine countermeasures effort is employed and the optimal mix of sweepable and unsweepable mines is planted	(5,6)-2	
				(2) Expected value of traffic ships lost	(5,6)-2	
				(3) Expected value of all ship casualties	(5,6)-2	
				(4) Risk to ships in the assault operation. For the wide area case the risk is defined to be the fraction of mines initially in the area or channel which are expected to be exploded by the ships. For the narrow channel case the risk is defined to be the ratio of the expected number of mines in the channel of width six times the standard deviation of the navigational error for assault ships.	(5,6)-4	
				(5) Expected number of casualties	(5,6)-4	
				(6) Variance of ship casualties	(5,6)-4	
				(7) Risk to ships in the assault operation for a combination of narrow channel and wide area operations	(5,6)-4	
				(8) Total weighted casualties of traffic ships in an assault operation for optimal deployment of mines by the miner and optimal allocation of resources by mine countermeasures force	(5,6)-5	
				(9) Probability of assault success for a given level of countermeasures effort		(6,16)-1

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
				(10) Probability that amphibious ship casualties do not result in the loss to troops or cargo sufficient to jeopardize the mission		(6,16)-1
		Mine Clearance of Port or Line of Communication Choke Point	Clearance of minefield	(1) Fraction of mines which fire against traffic ships when the optimal division of mine countermeasures effort is employed and the optimal average ship count setting is used	(5,6)-2	
		Minelaying Force Versus Mine Countermeasures Force	Blockade of ports to achieve shipping attrition	(1) Ratio of mine countermeasure force total spending to minelayer force spending for a specified value of port utilization fraction (average fraction of port capacity in use) for target class vessels	(5,6)-3	
				(2) Total cost of defender's initial force inventory required to achieve stalemate	(5,6)-3	
				(3) Minimum initial force investment by the defender to achieve stalemate given a specified value of spending ratio and shipping level	(5,6)-3	
				(4) Expected number of lethal attacks by mines laid in one month per mile of "average target vessel" track through the minefield	(5,6)-3	
			Clearance of minefield	(1) Total traffic ship casualties in the war for optimal deployment of mines by the miner and optimal allocation of resources by the mine countermeasures force	(5,6)-5	
				(2) Total casualties per mine planted for optimal deployment of mines by the miner and optimal allocation of resources by the mine countermeasures force	(5,6)-5	

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
			Survival of ships	(1) Probability the ship is sunk in passage through the channel if the minelayer and mine countermeasures commander both employ optimal strategies	(5,6)-1	
				(2) Expected number of ships lost in passage through the channel if the minelayer and mine countermeasures commander both employ optimal strategies	(5,6)-1	
				(3) Probability the ship is sunk when all mines are set on ship count j and i sweeper passes have been made	(5,6-1	
				(4) Expected number of ships lost when all mines are set on ship count j and i sweeper passes have been made	(5,6)-1	
				(5) Variance of the number of ship losses	(5,6)-1	
				(6) Probability of m or more ship losses	(5,6)-1	
	Sea Based Strategic Systems	Attack on Missile Carrying Submarines	Submarine launch of missiles	(1) Expected number of submarines which successfully launch their missiles when both submarines and defense units are optimally deployed	(13)-1	
				(2) Expected number of defense zones from which at least one submarine successfully launches its missiles when both submarines and defense units are optimally employed	(13)-1	
		Retaliator Versus Attacker	Allocation of resources to achieve retaliation strike capability	(1) Survivable throw weight after a first strike, given optimal investment by the retaliator in individual systems and by the attacker in countermeasures	(13)-2	
	Submarine ASW	Submarine Force Versus Submarine Force	Destruction of submarine	(1) Expected number of enemy submarines killed in a specified period of time	(8)-17	

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
	Surface AAW	Carrier Defense with Employment of Decoys		(1) Number of hits on the carrier achieved by the offense		(11)-2
				(2) Cost to the defense		(11)-2
				(3) Probability that the decoy deceives the offense		(11)-2
		Convoy or Carrier Task Force Defense		(1) Ratio of naval forces lost to enemy air forces lost		(2,3,11)-1
		Identification of Air Traffic in Surveillance Zone	Accurate identification of all aircraft	(1) Expected reward, which is the weighted sum of the rewards to be obtained from each possible designation-identification combination of aircraft	(11)-3	
				(2) Total error probability	(11)-3	
				(3) Probability of correct decision	(11)-3	
				(4) Maximum expected reward, which is the maximum of the weighted sum of the rewards to be obtained from each possible designation-identification combination of aircraft	(11)-4	
		Surface Ship Defense against Missile Attack	Interception of attacking missiles	(1) Expected proportion of attacking missiles which are intercepted or terminated beyond a specified safe hold-off distance	(11)-6	
			Protection of the ships from missiles	(1) Expected number of hits per ship	(11)-5	
				(2) Variance of the number of ship's hits	(11)-5	
			Successful defense of surface ships	(1) Probability of successful defense	(3,11)-1	
	Surface ASW	Escort/Screen	Detection of submarine	(1) Total weapon system cost, over a specified period of time, to produce a specified degree of effectiveness	(10)-8	
				(2) Number of ships necessary to meet the specified escort requirements	(10)-8	
				(3) Number of ships required to maintain one ship in continuous escort duty	(10)-8	

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
			Prevention of submarine interception of screened units	(1) Minimum effective escort ship speed in retrieving sonar buoys	(10)-15	
				(2) Minimum effective escort ship speed in laying sonobuoys	(10)-15	
				(3) Minimum effective escort ship speed	(10)-15	
			Prevention of submarine penetration of convoy screen	(1) Expected number of merchant vessels sunk during a single attack by a diesel submarine	(10)-10	
				(2) Probability that a diesel submarine is sunk at some point during a single attack on a convoy	(10)-10	
				(3) Probability that a destroyer is sunk during a single attack on a convoy by a diesel submarine	(10)-10	
				(4) Expected number of merchant vessels sunk by diesel submarines during one month	(10)-10	
				(5) Expected number of diesel submarines sunk during one month	(10)-10	
				(6) Expected number of merchant vessels sunk during a six-month period	(10)-10	
				(7) Expected number of merchant vessels sunk during a single attack by a nuclear submarine	(10)-10	
				(8) Probability that a nuclear submarine is sunk at some point during a single attack on a convoy	(10)-10	
				(9) Probability that a destroyer is sunk during a single attack on a convoy by a nuclear submarine	(10)-10	
				(10) Expected number of merchant vessels sunk by a nuclear submarine during one month	(10)-10	
				(11) Expected number of nuclear submarines sunk during one month	(10)-10	
				(12) Expected number of destroyers sunk by diesel submarines during one month	(10)-10	
				(13) Expected number of destroyers sunk by nuclear submarines during one month	(10)-10	

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
		Fleet Escort Requirements		(1) Efficient number of escorts required, which is defined as that number which on the margin, reduces losses to the escort force by an amount equal to or greater than the cost of the escort; i.e., the last escort provided by each escorted force must reduce losses to that force by an amount at least equal to the cost of the escort		(1,2,10,11)-1
		Ocean Surveillance	Detection and tracking of submarine	(1) Expected number of submarines in the region that are being tracked at time t	(10)-3	
				(2) Expected number of submarines in the region that are not being tracked at time t because contact has been lost	(10)-3	
				(3) Expected number of submarines in the region that are not detected at time t	(10)-3	
				(4) Expected number of submarines in the region that are being tracked by a mobile unit in the vicinity of the submarine at time t	(10)-3	
				(5) Expected number of previously tracked submarines in the region at time t that are in the state of being recently lost and local search is being made to regain tracking contact	(10)-3	
				(6) Expected number of submarines in the region at time t that are in the state of being previously tracked, search to regain contact discontinued, new detection recently made by area search, and tracking unit(s) now en route to area or searching in an effort to obtain tracking contact	(10)-3	
				(7) Expected number of submarines in the region at time t that are in the state of being previously tracked, search to regain contact discontinued and no new detection	(10)-3	

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
				(8) Expected number of submarines in the region at time t that are in the state of being not previously tracked and tracking unit(s) now en route to area or searching in in an effort to obtain tracking contact	(10)-3	
				(9) Expected number of submarines in the region that are detected by the barrier as it enters the region and tracking unit(s) now en route to area or searching in an effort to obtain tracking contact	(10)-3	
				(10) Expected number of submarines in the region at time t that are not previously tracked and no previous detection, if any, is being used in an effort to obtain tracking contact	(10)-3	
				(11) Probability that a submarine is being tracked	(10)-3	
				(12) Probability that a submarine is not being tracked because contact has been lost	(10)-3	
				(13) Probability that a submarine is not detected	(10)-3	
				(14) Expected number of submarines in the region at time t	(10)-3	
			Detection of submarine	(1) Total weapons system cost, over a specified period of time, to produce a specified degree of effectiveness	(10)-8	
				(2) Number of ships required in the area at all times to accomplish the assigned task	(10)-8	
				(3) Number of ships that must be contained in the system to maintain one ship on-station continuously	(10)-8	

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
		Protection of Carrier from Submarine Attack		(1) Escort kill capacity		(1,2,10,11)-1
				(2) Expected number of successful enemy submarine attacks per patrol		(1,2,10,11)-1
				(3) Expected number of torpedo hits on the carrier		(1,2,10,11)-1
				(4) Expected number of escort ships out of action		(1,2,10,11)-1
				(5) Probability that an enemy submarine is destroyed during the engagement		(1,2,10,11)-1
			Survival of carriers and submarines	(1) Probability that a specified combination of carriers and submarines have survived by a given time	(8,9,10)-1	
				(2) Expected value of the number of carriers afloat	(8,9,10)-1	
				(3) Probability that a carrier has survived to time t	(8,9,10)-1	
				(4) Expected fraction of carrier force remaining afloat as a function of time	(8,9,10)-1	
		Protection of Carrier from Submarine Attack by Use of Simulators	Prevention of detection and classification of the carrier	(1) Median time to closure	(10)-1	
				(2) Percentage increase in closure probability at the end of a specified period of time attributable to the simulators	(10)-1	
		Protection of Carrier while Conducting Strike Operations		(1) Number of escorts surviving at the end of the engagement		(1,2,10,11)-1
				(2) Carrier survivability, which is defined as the probability that a carrier has minimum capability to launch aircraft (at least one catapult and operative assisting gear) at the end of the engagement		(1,2,10,11)-1
				(3) Cumulative carrier days on-line, which is defined as the number of days on-line from arrival in the area to time of last attack not taking into consideration time off for replenishment		(1,2,10,11)-1

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
				(4) Total effective carrier days on-line, which is defined as the task group total days on-line from arrival in area to the end of the war taking into account all time off the line		(1,2,10,11)-1
				(5) Pace of operations (sorties/day, targets killed/day or ordnance delivered/day)		(1,2,10,11)-1
	Surface Attack	Engagement Between Surface Ship Forces	Destruction of surface ship	(1) Probability that the friendly forces win the war	(12)-3	
				(2) Expected duration of the war	(12)-3	
				(3) Expected number of friendly ships which survive the war, given the friendly forces win the war	(12)-3	
				(4) Probability of friendly forces losing the war for fixed enemy force level if friendly forces make an optimal choice between building more ships or improving exchange ratios within the limits of its budget	(12)-3	
				(5) Probability of friendly forces losing the war if both friendly forces and enemy forces make optimal choices between building more ships or improving the exchange ratio within the limits of their budget	(12)-3	
Gun	Surface Attack	Gunfire Support		(1) Average rate (casualties per minute) at which casualties are inflicted on friendly forces from the time the enemy weapon or force opens fire until it runs out of ammunition or withdraws		(12,16)-1
				(2) Number of rounds required for preparation fire on a specified area		(12,16)-1
				(3) Ratio of the number of rounds delivered to the number of rounds required		(12,16)-1

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
			Destruction of target	(1) Number of targets defeated per hour	(12)-5	
				(2) Percent of equal volume magazines required to defeat the target	(12)-5	
				(3) Number of targets destroyed per hour for equal cost weapon suite alternatives	(12)-5	
				(4) Number of rounds to defeat the target	(12)-5	
				(5) Expected number of rounds required to achieve at least one hit	(12)-6	
				(6) Expected number of targets damaged per ship magazine	(12)-6	
				(7) Accuracy required to damage a target with a specified number of rounds	(12)-6	
				(8) Maximum number of defeated targets	(16)-1	
				(9) Maximum value of the defeated targets	(16)-1	
		Gunfire Support against Approaching Target	Abortion of an attack by the target	(1) Cumulative kill probability for a specified range		(12)-2
				(2) Number of rounds and range necessary for a specified percent kill		(12)-2
			Destruction of target	(1) Cumulative probability that target is killed before reaching a specified range	(12)-5	
		Gun Suite Performance		(1) Accuracy of the gun		(16)-1
				(2) Range of the gun		(16)-1
				(3) Firing rate of the gun		(16)-1
				(4) Expected number of rounds required to achieve some specified damage or casualty level on a particular type of target		(16)-1
Gunboat	Surface Attack	Patrol of Inland Waterway	Detection of infiltration crossing attempts	(1) Probability of detection by barrier units of an infiltrator in one crossing attempt	(12)-2	
				(2) Probability of ultimate successful crossing (i.e., eventually crossing undetected)	(12)-2	
				(3) Expected number of attempts necessary to cross, given that an undetected crossing is accomplished	(12)-2	

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
		Surface Ship Defense	Successful defense of surface ship	(1) Number of gunboats required to provide a given level of defense against a specified threat	(12)-1	
Harbor Defense System	Surface ASW and Surface Attack	Combat Information Center Performance in Harbor Defense		(1) Probability of initiating an attack on the detected raid		(10,12)-1
				(2) Probability that the evaluator is presented correct information on weapons		(10,12)-1
		Detection Performance in Harbor Defense		(1) Probability of detection of a given target		(10,12)-1
				(2) Effective search (or sweep) width		(10,12)-1
				(3) Sweep-width, defined as the area under the curve of the probability of detection as a function of the lateral range (closest approach abeam) from the detection gear to the target		(10,12)-1
				(4) Effective search rate, defined as the product of the effective search width and the relative speed of the searching vehicle with respect to the targets		(10,12)-1
		Performance	Prevention of raids on port facilities and shipping	(1) Probability of raid prevention		(10,12)-1
				(2) Expected damage per raid type attempted		(10,12)-1
				(3) Expected damage to the defended area per raid attempted		(10,12)-1
				(4) Damage profile vector, defined to be a vector whose i^{th} component represents the expected damage per raid type i attempted		(10,12)-1
				(5) Raids attempted per raid reaching vicinity of harbor		(10,12)-1
		Performance of Harbor Defense Functions		(1) Probability that a sneak craft of a given type will be detected by at least one component in the harbor defense detection system		(10,12)-1
				(2) Probability that a detected raid is acted on		(10,12)-1

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
				(3) Kill probability of the action taken against the specific type of raid		(10,12)-1
				(4) Weapon kill probability for the given type of raid		(10,12)-1
				(5) Average system delay time, defined as the average time elapsed between the moment the raid crosses the outermost barrier and the moment the raid is prevented		(10,12)-1
		Weapon Performance in Harbor Defense		(1) Kill probability of the weapon system for the specific type of raid		(10,12)-1
Human	Airborne Attack	Carrier Pilots in a Combat Environment	Pilot survival	(1) Pilot attrition probability for a single combat mission		(3)-4
				(2) Pilot attrition probability for a specified number of combat sorties		(3)-4
				(3) Number of pilot attritions for a specified sortie rate		(3)-4
				(4) Number of pilot attritions for a specified number of missions		(3)-4
				(5) Number of pilot attritions for a specified number of months of combat		(3)-4
	Antisubmarine Warfare	Jezebel Operator or ASCAC Analyst Performance	Accurate classification of Lofargram signatures	(1) Conditional probability that the operator correctly classifies a submarine signature		(1)-4
				(2) Fraction of valid submarine signatures present on the Lofargram that are recognized by the analyst		(1)-4
				(3) Probability of detection and correct classification of all valid Lofargram signatures		(1)-4
		Sonar Operator Performance	Accurate classification of false targets	(1) Rate of occurrence of incorrectly classified false contacts		(1)-2

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
	Naval Communications	Radio Operator Performance		(1) Grade of service, defined as the probability an operator will encounter a delay given he wishes to send a message		(17)-3
				(2) Mean access delay, defined as the average time for an operator to get on the air given he has encountered a delay		(17)-3
Logistics	Logistics and Ship Support	Fleet Support Requirements		(1) Number of replenishment ships required in each underway replenishment group		(1,5,8,9, 10,21,22)-1
				(2) Total number of underway replenishment group ships required		(1,5,8,9, 10,21,22)-1
		Logistic Support to FBM Weapon Systems	Maintain a high state of readiness of FBM submarines	(1) Operational availability of an SSBN on patrol, which is defined as the ratio of the number of days in the operating area that a given number of missiles are ready for firing to the total scheduled patrol length in days		(21,22)-1
		Maintenance and Repair of SSBN	Rapid repair of system failures while on patrol	(1) SSBN repair effectiveness, which is defined as the ratio of the product of total number of components repaired during patrol times maximum available SSBN man-hour capacity to the product of number of system components that failed during patrol times total man-hours expended on repair of components		(21,22)-1
		Mobile Support Group (MSG) Support of SSBN	Furnish logistic support to the SSBN fleet	(1) Mobile support group effectiveness, which is defined as the ratio of the product of total number of job orders completed during an SSBN upkeep times maximum available MSG man-hour capacity during an SSBN upkeep to the product of total number of job orders submitted to the MSG per SSBN upkeep times total MSG man-hours expended on completed job orders		(21,22)-1

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
MAD	Airborne ASW	Performance	Detection of submarine	(1) Probability of obtaining a MAD contact		(1)-1
				(2) Probability of the aircraft obtaining a MAD detection given an initial datum		(1)-2
				(3) Cost per sortie		(1)-2
				(4) Detection range		(1,7,10)-1
				(5) Standard deviation associated with MAD detection range		(1,7,10)-1
				(6) Probability of submarine escape		(1)-3
				(7) Probability of missing the submarine per aircraft cycle		(1)-3
				(8) Probability of successfully performing MAD hunting operations		(1)-3
				(9) Probability of detection on a single cycle		(1)-3
Mine	Mining	Minefield Performance	Reduction in the total ship force engaged in a mission	(1) Delay or lost-time per cycle due to minefield presence		(5)-2
			Destruction of submarine	(1) Probability that an enemy transitor will survive the minefield		(1,5,8,9, 10,21,22)-1
Minehunter	Mine Countermeasures	Mine Clearance		(1) Number of minehunters required to accomplish a specified countermeasures task		(6)-2
				(2) Total dollar cost of mine casualties resulting when a fixed force is employed		(6)-2
		Minehunting Equipment Performance		(1) Characteristic moored detection width		(6,18,19)-1
				(2) Moored detection probability		(6,18,19)-1
				(3) Characteristic influence detection/classification width		(6,18,19)-1
				(4) Influence detection/classification probability		(6,18,19)-1
				(5) Ship loss width to moored mines		(6,18,19)-1
				(6) Ship loss width to acoustic mines		(6,18,19)-1
				(7) Probability of ship loss to acoustic mines		(6,18,19)-1

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
				(8) Probability of ship loss to moored mines		(6,18,19)-1
		Neutralization Equipment Performance		(1) Single pass probability that a neutralization charge is placed within kill radius of a mine		(6,18,19)-1
				(2) Time per neutralization attack		(6,18,19)-1
		Vulnerability to Mine Explosions		(1) Aggregate hunter damage width		(6)-2
				(2) Probability of immobilizing damage		(6)-2
	Mine Countermeasures and Navigation	Minehunting with Mine Watching	Localization of mines	(1) Standard deviation of minehunter navigation error to insure locating a reported mine with 95 percent probability in one half hour	(6,19)-1	
		Minehunting without Mine Watching	Clearance of minefield	(1) Time required to search or sweep the entire channel with a 95 percent probability of locating each mine	(6,19)-1	
		Navigation through Minefield		(1) Average cost reduction per operation per yard of standard deviation reduction in navigation error		(6,18,19)-1
				(2) Coverage rate for specified standard deviation of navigation error		(6,18,19)-1
				(3) Percent clearance actually achieved		(6,18,19)-1
Minesweeper	Mine Countermeasures	Minesweeping Equipment Performance		(1) Characteristic actuation width		(6,18,19)-1
				(2) Nominal effective range of sweep		(6,18,19)-1
				(3) Characteristic actuation probability		(6,18,19)-1
				(4) Sweeper actuation width		(6,18,19)-1
				(5) Probability of sweeper actuation		(6,18,19)-1
				(6) Damage probability		(6,18,19)-1
		Sweeping of Minefield	Clearance of minefield	(1) Sweep rate		(6)-1
				(2) Cost per swept mile		(6)-1

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
				(3) Number of minesweepers required to accomplish a specified mine countermeasures task		(6)-2
				(4) Total dollar cost of mine casualties resulting when a fixed force is employed		(6)-2
				(5) Ratio of aggregate damage width of the sweeper to aggregate sweep actuation width		(6)-2
		Vulnerability to Mine Explosions		(1) Aggregate sweeper damage width		(6)-2
				(2) Probability of immobilizing damage		(6)-2
Missile	Airborne Attack	Attack on Missile Battery		(1) Kill probability of the air-to-surface missiles against a surface-to-air missile battery		(2,3,11)-1
				(2) Expected number of air-to-surface missiles that survive the surface-to-air missile defenses in an attack		(2,3,11)-1
		Attack on Surface Targets	Acquisition of target	(1) Maximum target acquisition range	(3,12)-1	
				(2) Maximum target tracking range	(3,12)-1	
			Destruction of target	(1) Probability of killing k targets with n missiles		(2,3,14,17, 18,20,21, 23)-1
				(2) Expected fraction of k targets killed with n missiles		(2,3,14,17, 18,20,21, 23)-1
				(3) Expected fraction of a target killed within a given time		(2,3,14,17, 18,20,21, 23)-1
				(4) Probability of target kill with one missile		(2,3,14,17, 18,20,21 23)-1
				(5) Expected fraction of a target killed with one missile		(2,3,14,17, 18,20,21, 23)-1
				(6) Total kill probability, defined as the product of reliability, probability of hit and probability of kill given hit		(8)-5

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
		Guidance and Control System Performance	Acquisition of target	(1) Probability of terminal seeker acquisition of target		(3)-7
				(2) Probability of missile successfully settling		(3)-7
				(3) Expected terminal miss distance of missile		(3)-7
				(4) Probability of target acquisition		(3)-8
				(5) Probability of continuous lock-on		(3)-8
				(6) Probability of successful control section operation		(3)-8
				(7) Probability of successful guidance		(3)-8
				(8) Probability of a hit		(3)-8
		Nuclear Attack on Surface Targets	Destruction of target	(1) Target kill probability, which for a point or line target is the probability that the circle of destruction covers the desired ground zero, and for an area target is the average fraction of the total area destroyed by one drop		(3)-5
				(2) Yield required to kill a specified percent of targets attacked		(3)-5
	Antiair Warfare	Missile Defense against Attacking Aircraft		(1) Missile single shot kill probability		(11)-1
				(2) Exchange ratio of missiles expended per aircraft destroyed		(11)-1
				(3) Number of missiles required to destroy a target		(11)-1
				(4) Open fire range, which is defined as the range at which the missile must be launched to meet the target at a desired engagement range		(11)-1
	Sea Based Strategic Systems	Undersea Long-Range Missile System Performance		(1) Survivable throw weight per unit cost		(13)-1
				(2) Number of missiles maintained on-station per billion dollars of system cost		(13)-1
				(3) Cost exchange ratio required for blunting, which is defined as the ratio of enemy cost to blunt a system to cost to develop and deploy it		(13)-1

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
	Surface AAW	Launcher Loading Doctrine Evaluation		(1) Mean number of missiles fired		(11,18)-1
	Surface Attack	Shore Bombardment		(1) Fraction of ship capacity which must be expended to achieve an 80 percent probability of damaging a target (or, in the case of troop targets, the fraction of capacity to achieve 30 percent expected damage)		(12)-3
				(2) Logistic cost in cubic feet to achieve an 80 percent probability of damage (or 30 percent expected coverage for troop targets)		(12)-3
Projectile	Antiair Warfare and Attack	Performance Requirements	Destruction of target	(1) Ratio of attendant cost to system effectiveness (probability that a system can successfully meet its operational demands throughout a given time period when operated in a specific environment)		(12)-1
				(2) Number of rounds required for the completion of a particular mission		(12)-1
Radar	Airborne ASW, Ocean Surveillance and Surface ASW	Periscope Detection Radar Performance	Detection of target	(1) Detection probability for a snorkeling submarine as a function of range		(1,7,10)-1
				(2) Detection range for a surfaced submarine as a function of radar altitude		(1,7,10)-1
	Antiair Warfare and Attack	Radar Detection Performance	Detection of target	(1) Probability that the signal exceeds a threshold which has been set to keep the false alarm rate at some suitable level		(20)-1
	Electronic Warfare	Shipboard Radar Emission Control	Reduction of detectability of ship-originated electromagnetic radiations	(1) Probability of intercept per azimuth scan of the radar antenna	(14)-1	
				(2) Probability of intercept per minute	(14)-3	
				(3) Probability of intercept per scan	(14)-3	

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
Reconnaissance System	Airborne Attack	Performance in Aiding Aircraft Penetration of SAM Barrier	Survival of penetrating strike aircraft	(1) Total attrition due to SAM's that is prevented by the information provided by the reconnaissance sortie		(20)-1
				(2) Total attrition due to hostile interceptors that is prevented by information provided by the reconnaissance sortie		(20)-1
		Performance in Aiding Air Strikes against Truck Targets	Destruction of trucks	(1) Expected number of trucks destroyed per convoy as a function of reconnaissance system localization accuracy		(20)-1
	Reconnaissance/ Intelligence	Performance		(1) Number of reconnaissance sorties needed to support an operational situation		(20)-1
				(2) Probability that operationally useful information about a particular target is on hand		(20)-1
				(3) Number (or percentage) of targets about which quality information is delivered by surveillance		(20)-1
				(4) Fraction of operational time in which "live" information of acceptable quality and quantity is on hand		(20)-1
				(5) Number of reconnaissance sorties needed to deliver "live" or operationally useful information		(20)-1
				(6) Fraction of targets for which the detectability/identifiability is greater than a given value as a function of revisit time		(20)-1
				(7) Total number of attack sorties saved as a function of the time delay between the gathering of and the using of information from a reconnaissance sortie		(20)-1

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
				(8) Reduction in the strike effort (required to perform a specific task) which is made possible by the use of information gathered by reconnaissance		(20)-1
				(9) Number of strike sorties not wasted		(20)-1
				(10) Life cycle cost per flight hour of the reconnaissance system and its associated equipments		(20)-1
				(11) Cost of attack sorties that are not wasted		(20)-1
				(12) Strike costs saved as a function of reconnaissance sortie cost		(20)-1
				(13) Probability of obtaining and transmitting x specified items of intelligence on n passes, given a specific resolution of data		(2,3,14,17, 18,20,21, 23)-1
				(14) Expected fraction of x items of intelligence obtained in a specified time duration t, given a specific resolution of data		(2,3,14,17, 18,20,21, 23)-1
			Meet coverage, timeliness, location and identification detail needs	(1) Probability that the reconnaissance system meets the specified needs of coverage, presentation, timeliness, location accuracy and identification detail	(20)-2	
			Successful collection of target identification and position information	(1) Average probability that the system or sensor is capable of detecting targets of interest		(20)-1
				(2) Average probability that the system or sensor is capable of both detecting and correctly identifying targets of interest		(20)-1
				(3) System or sensor ability to localize targets once the targets have been identified		(20)-1

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
				(4) System or sensor time late, which is defined as the time between detection by the system or sensor and the first availability of the information for operational use		(20)-1
		Photo Interpretation Performance		(1) Rate at which target data can be evaluated using imagery provided by a reconnaissance system		(20)-1
				(2) Time required to extract intelligence data from imagery		(20)-1
				(3) Probability of keying on a given frame		(20)-1
				(4) Number of target images analyzed per manhour of effort		(20)-1
				(5) Fraction of available target images which have been evaluated as a function of the average delay time, where delay time is defined as the time interval between the gathering of the raw data and the availability of the evaluated information		(20)-1
Satellite	Ocean Surveillance	Communication Subsystem Performance		(1) Probability of system communication during one orbit		(7)-1
				(2) Probability of ground station-to-satellite communication		(7)-1
				(3) Probability of satellite-to-sensor communication		(7)-1
				(4) Probability of sensor-to-satellite communication		(7)-1
				(5) Probability of satellite-to-ground station communication		(7)-1
		Monitoring of Buoy Barrier		(1) Satellite communication time, i.e., the time the satellite is in communication view of the buoy		(7)-1
				(2) Effectiveness of satellite coverage of a barrier, which is defined as the ratio of the time available to obtain data to the time required to obtain all data		(7)-1

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURE OF EFFECTIVENESS	SRS NO.	MR NO.
				(3) Number of satellites required to monitor a given buoy configuration for a specified effectiveness of satellite coverage		(7)-1
				(4) Percentage of buoys that can be interrogated by a satellite		(7)-1
				(5) Effectiveness of satellite coverage of a barrier, as measured by the success in obtaining the data available in the effective length of a barrier in the seath of the satellite		(7)-1
		Support System Performance		(1) Time required to establish a specified number of operational satellites in orbit		(7)-1
				(2) Expected number of launchings required to establish and maintain a satellite system for a specified period of time		(7)-1
				(3) Utilization factor on the launch pad to maintain satellite system		(7)-1
				(4) Probability of successfully launching an operating satellite		(7)-1
		Surveillance of Ocean Area		(1) Fifteen year cost of system necessary to maintain a specified percent coverage of worldwide shipping		(7)-2
				(2) Total system cost for a specified operating life and probability of successful orbit		(7)-2
			Detection and localization of shipping in the open ocean	(1) Returned signal from the target	(7,14)-1	
			Surveillance and establishment of the track of ships at sea	(1) Probability of successful tracking of a vessel for a voyage of specified duration	(7)-1	

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURE OF EFFECTIVENESS	SRS NO.	MR NO.
				(2) Number of satellites required to provide a specified level of surveillance	(7)-1	
Sensor	Airborne Attack	Airborne Target Tracking	Acquisition of target	(1) Probability of acquisition of the target		(3)-7
	Electronic Warfare	Performance in Electronic Warfare Environment		(1) Probability that k of n deployed sensors will provide a defined set of correlatable signals for a specified time period		(2,3,14,17, 18,20,21, 23)-1
				(2) Expected fraction of correlatable signals receivable from n sensors		(2,3,14,17, 18,20,21, 23)-1
				(3) Probability of obtaining a defined set of correlatable signals from a sensor, given a specified sensor discrimination efficiency, radiated power, security and spurious signal rejection		(2,3,14,17, 18,20,21, 23)-1
	Ocean Surveillance	Surveillance of Ocean Area Using Direction Finding Sensors	Successful determination of bearing to transmitting submarine	(1) Probability that at least one pair of direction finding sites successfully determines bearing and the localization area to a specified size	(7)-3	
	Reconnaissance/ Intelligence	Reconnaissance of Amphibious Assault Objective Area	Provide information concerning enemy troop movement or buildup in objective area	(1) Total cost of sensor employment	(20)-1	
		Sensor-Aided Harrassing and Interdiction Artillery Fire	Acquisition of targets for direction of artillery fire	(1) Relative cost of H & I fires and sensor directed H & I fires	(20)-1	
		Sensor-Aided Road Sweep	Detection of mine emplacements	(1) Total cost of sensor employment	(20)-1	

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURE OF EFFECTIVENESS	SRS NO.	MR NO.
		Sensor-Aided Small Unit Ambush	Provide detection and early warning of enemy activity	(1) Total cost of sensor employment (2) Total dollar cost of the additional casualties (killed or wounded) that might result when men are used as the security element rather than sensors (3) Expected number of casualties per security element per year	(20)-1 (20)-1 (20)-1	
Sonar	Antisubmarine Warfare	Performance	Classification of contact	(1) Probability of classifying a contact on a look starting at a specified time after the last look, given a specified number of contacts in the system when the last look began	(8)-18	
			Detection of target	(1) Sonar detection range for specified probability of detection		(1)-5
Sonobuoy	Airborne ASW	Julie Performance	Localization of target	(1) Probability of localizing the target (2) Probability of obtaining a fix from an omni-directional Julie contact		(1)-3 (1)-3
	Ocean Surveillance and Antisubmarine Warfare	Barrier		(1) Effectiveness of the barrier, which is defined to be the product of buoy reliability times a weighted sum of the probability of detection, classification, track and localization (2) Ratio of the effectiveness of the barrier to the number of buoys in the barrier (3) Number of buoys required for a barrier for specified probabilities of detection, track and containment (4) Expected number of buoys required for the installation and maintenance of a barrier over a given time period		(7)-1 (7)-1 (7)-1 (7)-1

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
			Detection of submarine	(1) Minimum cost of sensors for a specified probability of detection	(15)-1	
				(2) Probability of at least one detection by the field per snorkel period for a given buoy spacing		(1,8,9)-1
			Provide information regarding submarine passage	(1) Linear density of pods for specified detection probability per transit	(15)-2	
				(2) Rate of expenditure of reporting buoys	(15)-2	
				(3) Average number of buoys reporting	(15)-2	
		Performance		(1) Sonobuoy lifetime		(1,7,10)-1
			Detection of submarine	(1) Detection range, which is defined as the range at which the probability of detection is 50 percent		(1,7,10)-1
				(2) Probability of submarine detection	(15)-3	
				(3) Average detection range achieved for a specified sonobuoy depth		(15)-2
SOSUS	Ocean Surveillance	Performance		(1) Performance index (PI) which is defined by: PI = (ambient noise level at the line frequency) + (transmission loss) - (array gain) + (operational recognition differential)		(1,7,10)-1
				(2) Mean localization area		(1,7,10)-1
				(3) Probability that contact is held at a random moment		(1,7,10)-1
				(4) Mean holding time		(1,7,10)-1
				(5) Mean recovery time		(1,7,10)-1
				(6) Probability of detecting a snorkel exposure		(1,7,10)-1
				(7) Cumulative probability of detection against a single target submarine over a specified number of days		(1,7,10)-1

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
	Undersea Surveillance	SOSUS Early Warning Assistance to Carrier Task Force	Reduction of the sleeve of no SOSUS coverage about a proposed carrier task force track	(1) SOSUS no-detection area, which is defined as the geographic area adjacent to the carrier task force track in which SOSUS cross-fix capability is below a selected probability level		(15)-1
Submarine	Submarine ASW	Barrier Placement/ Patrol	Detection and destruction of submarine	(1) Probability that an enemy submarine will survive the barrier		(1,5,8,9, 10,21,22)-1
				(2) Exchange ratio between transitors and barrier submarines		(1,5,8,9, 10,21,22)-1
				(3) Expected fraction of transitors that survive an N-line barrier of given strength		(1,5,8,9, 10,21,22)-1
			Detection of submarine	(1) Conceptual detection range, which is defined as the range at which the probability that the closest point of approach does not exceed this range is equal to the total probability of detection	(8)-16	
				(2) Mean detection range	(8)-16	
				(3) Area under the cumulative probability of detection curve	(8)-16	
				(4) Ratio of detections to opportunities	(8)-16	
				(5) Area under the lateral range curve	(8)-16	
				(6) Maximum probability of detection	(8,10)-2	
			Prevention of enemy transits of barrier	(1) Expected number of successful enemy transits during the campaign		(8)-4
			Suppression of submarine activity	(1) Probability that the transiting submarine will be intercepted	(8)-13	
				(2) Probability of detection per transitor	(8)-13	

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
		Carrier Escort	Survival of carrier	(1) Expected number of enemy torpedo hits on a carrier for a given detection range of the submarine's active sonar	(8)-9	
				(2) Probability that the penetrator will attack before the task force has an opportunity to classify and react	(8)-9	
		Contact Prosecution	Preparation for attack in the least possible time without being counterdetected	(1) Minimum approach time	(8)-14	
			Destruction of submarine	(1) Expected value of target killed	(8)-3	
				(2) Probability of target kill	(8)-3	
		Search and Destroy	Detection and destruction of submarine	(1) Probability that the submarine will detect a target present in the patrol area in a specified time	(8)-10	
				(2) Probability that the submarine will kill the target given that he has detected the target	(8)-10	
				(3) Kill rate which is defined as the rate at which enemy targets are killed as a function of submarine area size	(8)-10	
				(4) Exchange ratio, which is defined as the expected number of targets killed for each submarine killed	(8)-10	
				(5) Probability of kill by submarine as a function of time	(8)-10	
				(6) False attack ratio for submarine	(8)-10	
				(7) Probability that the submarine will detect a specified number of targets, given a specified number of targets present in the patrol area, as a function of time	(8)-10	

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
				(8) Probability that the submarine will detect at least a specified number of targets, given a specified number of targets present in the patrol area, as a function of time	(8)-10	
				(9) Effective sonar sweep width of submarine	(8)-10	
		Intruder Search for Enemy Submarine On-Station	Obtain secure detection of submarine	(1) Secure sweep rate, which is defined as the product of the area of region in which target is equally likely at all points times the expected fraction of targets on which own ship makes secure detections divided by the searching time	(8)-1	
			Seek out and destroy, or gain intelligence of, an enemy submarine in its own patrol area	(1) Kill rate, defined as the rate at which enemy targets are killed as a function of the intruder area size		(8)-1
				(2) Probability that the intruder will detect a target present in a specified area as a function of time		(8)-1
				(3) Probability that the intruder will kill the target given that he has detected the target		(8)-1
				(4) Expected number of targets killed for each intruder killed		(8)-1
				(5) Search rate, defined as the number of square miles per day which the intruder can effectively search		(8)-1
				(6) Effective sonar sweep width		(8)-1
				(7) False alarm ratio, defined as the ratio of the number of non-submarine contacts of friendly submarine contacts which are classified enemy submarine to the total number of sonar contacts		(8)-1

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
				(8) Wrong identification ratio, defined as the ratio of the number of friendly submarines identified as enemy submarines to the total number of friendly submarines detected		(8)-1
				(9) False attack ratio, defined as the ratio of the number of non-submarine sonar contacts or friendly submarine contacts which are prosecuted to an attack, and which would or did result in tne expenditure of a weapon by the intruder, to the total number of sonar contacts		(8)-1
		Submarine Trailing	Maintenance of at least intermittent trail	(1) Mean holding time until loss of contact of duration greater than a specified time	(8,10)-1	
				(2) Probability that a platform will regain contact at least once in a time t since loss of contact	(8,10)-1	
				(3) Unconditional probability of regaining contact	(8,10)-1	
			Maintenance of continuous trial	(1) Time for evader to escape if both pursuer and evader adopt optimal strategies	(8,9,10, 12)-1	
		Submarine Versus Submarine		(1) Probability that SSK kills transitor given the SSK is not being tracked at the firing circle and given an SSK approach		(8)-4
				(2) Probability that SSK kills transitor given the SSK is being tracked at the firing circle and given an SSK approach		(8)-4
				(3) Probability that transitor kills SSK given the SSK is not being tracked at the firing circle and given an SSK approach		(8)-4
				(4) Probability that transitor kills SSK given the SSK is being tracked at the firing circle and given an SSK approach		(8)-4

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
			Destruction of enemy submarine and survival of friendly submarine	(1) Conditional probability that friendly submarine obtains a hit on enemy submarine, given that friendly submarine survives the engagement and has an initial detection opportunity	(8)-17	
			Destruction of submarine	(1) Firing-range limit, defined as the maximum range-to-target, for a particular target aspect, at which a torpedo can be fired to achieve a specified probability of acquiring the target with sufficient endurance remaining for overtaking an alerted submarine that evades by running directly away at maximum speed	(8)-5	
				(2) Attack range, defined as the maximum lateral range (less than or equal to the sonar detection range) at which a transiting hostile submarine can be successfully attacked while passing a barrier submarine	(8)-5	
				(3) Fraction of targets detected that can be attacked by a particular submarine weapon system	(8)-5	
				(4) Number of hostile submarines sunk during a war of specified duration	(8)-5	
				(5) Expected percentage of enemy submarines killed attempting to penetrate barrier	(8)-11	
				(6) Expected number of enemy submarines killed attempting to penetrate barrier	(8)-11	
				(7) Expected number of targets killed		(8)-3
			Detection and destruction of submarine	(1) Number of kills per engagement opportunity	(8)-2	
				(2) Average cost per kill	(8)-4	

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
				(3) SSK/Transitor effectiveness, which is defined as the probability of the SSK killing a transiting submarine given a detection opportunity	(8)-12	
				(4) SSK/Transitor vulnerability, which is defined as the probability of accurate counterattack by the SST, given a detection opportunity for the SSK	(8)-12	
				(5) Exchange ratio, defined as the expected number of transitors killed per SSK lost	(8)-12	(1,8,9)-1
				(6) Probability of killing a transiting submarine		(1,8,9)-1
				(7) Probability that on a given transit the SSK kills the transitor minus three times the probability that the transitor kills the SSK		(8)-4
			Detection of submarine	(1) Expected number of targets detected		(8)-3
			Obtain secure detection of submarine	(1) Secure sweep width, which is defined as the product of the width of frontage over which target crossings are equally likely at all points times the expected fraction of targets on which own ship makes secure detection	(8)-1	
				(2) Expected number of secure detections the SSK will make on transitors	(8)-1	
				(3) Secure sweep width, which is defined as the area under the secure detection lateral range curve; that is, the area under the graph of the probability that the SSK makes a secure detection (a detection which has not been preceded by counterdetection by the target) at some point during the intruder's pass		(8)-2

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURE OF EFFECTIVENESS	SRS NO.	MR NO.
				(4) Secure sweep rate, which is defined as the secure sweep width times the search rate		(8)-2
				(5) Average number of secure detections		(8)-2
			Suppression of submarine activity	(1) Expected enemy submarine activity	(8)-6	
				(2) Expected number of successful enemy transits	(8)-7	
				(3) Probability that the transitor is killed in an encounter	(8)-7	
				(4) Expected total number of enemy submarine months of activity from the start of the campaign to time t	(8)-8	
				(5) Expected fractional portion of possible activity lost by the enemy because of the barrier	(8)-8	
				(6) Expected total enemy submarine activity for the entire campaign	(8)-8	
				(7) Expected cumulative fractional loss of possible activity by the enemy	(8)-8	
				(8) Expected number of enemy submarine months lost to the SSK's because of the barrier	(8)-8	
				(9) Expected proportion of enemy submarine traffic destroyed by the SSK's	(8)-15	
				(10) Number of enemy submarines sunk in a given interval of time, if a specified number of SSK's are maintained on-station continuously during the same period	(8)-15	
				(11) Number of enemy submarines sunk in a given interval of time by a specified number of submarines available for use as SSK's	(8)-15	
				(12) Probability of killing a transiting submarine		(8)-1

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
				(13) Probability of being killed by an enemy submarine transiting the SSK patrol area		(8)-1
				(14) Exchange ratio, defined as the expected number of transitors killed per SSK lost		(8)-1
				(15) Expected enemy submarine activity if there is no attrition of enemy forces	(8)-6	
	Submarine Attack	Attack on Convoy	Detection of ship	(1) Detection sweepwidth		(1,8,9)-1
				(2) Probability of closure		(1,8,9)-1
				(3) Engagement sweepwidth		(1,8,9)-1
			Destruction of ships	(1) Expected number of ships hit	(9)-1	
				(2) Number of ships sunk per unit time spent in area	(9)-2	
			Successful attack on ship	(1) Probability of no hit on the ship		(1,8,9)-1
				(2) Probability of damage to the ship		(1,8,9)-1
				(3) Probability of sinking the ship		(1,8,9)-1
				(4) Expected number of torpedoes fired		(1,8,9)-1
				(5) Expected number of merchant ships sunk per engagement		(1,8,9)-1
				(6) Probability that the submarine is sunk in a single convoy engagement		(1,8,9)-1
				(7) Probability that a submarine survives an on-station period		(1,8,9)-1
			Survival of submarines and destruction of ships	(1) Probability distribution of the number of successful patrols per submarine	(9)-4	
				(2) Probability distribution of the total shipping losses (total number of surface ships hit)	(9)-4	
				(3) Probability distribution of the total number of submarines surviving after completion of as many patrols as possible	(9)-4	

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
		Ocean Area Search	Capture of traget	(1) Capture time if both evader and pursuer adopt optimal strategies	(8,9,10,12)-1	
			Detection of target	(1) Elapsed time to target detection	(9)-3	
Surface Ship	Amphibious Assault	Multiple Ship Gunfire Support		(1) Live target time, defined as the time interval from the occurrence of a target until some weapon system has fired the expected number of rounds required to achieve the required effects upon the target		(16)-1, (1,2,10,11)-1
				(2) Target firing time, defined as the time interval measured to the impact of the first fire-for-effect volley or salvo		(16)-1, (1,2,10,11)-1
				(3) Number of lost targets, defined as the number of targets which have occurred within the fire support system but which disappear before fire-for-effect commences, either because they displace and are lost to the observer or because they close with (or are closed by) landing force units and can no longer be attacked by the fire support system		(16)-1, (1,2,10,11)-1
				(4) Maximum length of the target queue, defined as the largest number of targets, for which, at any one time, call-fire missions had been requested but not completed		(16)-1
				(5) Amount of ammunition available to the force for other than call-fire missions		(16)-1
		Single Ship Gunfire Support		(1) Amount of time a battery must fire to achieve specified damage or casualty levels against a representative spectrum of targets at various ranges		(16)-1

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
				(2) Percentage of a ship's ammunition of a given type that must be expended in order to accomplish the desired results against representative targets at various ranges		(16)-1
				(3) Reduction in the number of marine casualties due to action of enemy weapons or forces		(12,16)-1
				(4) Number of combat-capable marines on the beachhead at the end of the assault phase		(12,16)-1
	Attack	Vulnerability of Ships		(1) Probability that a ship will be in a given condition after a specified number of weapon hits		(9,12)-1
				(2) Expected off-line time, which is defined as the sum of the transit time and the expected repair time		(9,12)-1
				(3) Probability of firepower damage, which is defined as the probability of loss of any key component or combination of key components in the surface ship weapon system that results in the ship being unable to effectively fire or control a weapon		(3)-8
				(4) Probability of seaworthiness damage, which is defined as the probability the enemy ship will sink within an hour after attack		(3)-8
				(5) Kill probability		(3)-8
	Mine Countermeasures and Navigation	Merchant Ship Penetration of Minefield	Remain within channel	(1) Standard deviation of merchant ship navigation error if the ship is confined to the channel with 95 percent probability	(6,19)-1	

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
	Special Warfare	Nuclear Weapon Attack on Surface Ship	Survival of surface ship	(1) Percent of weapon-delivery impairment to surface ship	(23)-1	
				(2) Percent of aircraft on deck of surface ship expected to be out of action	(23)-1	
				(3) Probability that a person on surface ship will become a combat ineffective due to at least one of the weapon effects	(23)-1	
				(4) Percent of surface ship's personnel complement expected to become combat ineffectives	(23)-1	
				(5) Percent of seaworthiness impairment to surface ship	(23)-1	
				(6) Percent of mobility impairment to surface ship	(23)-1	
	Surface AAW	Convoy or Carrier Task Force Defense		(1) Probability of survival of a CVA against an attack of a given size		(2,3,11)-1
				(2) Expected number of escort ships lost in a given size of attack		(2,3,11)-1
				(3) Effectiveness of defenses for a given total cost		(2,3,11)-1
		Surface Ship Defense against Missile Attack	Protection of ship, using SAM's against missiles	(1) Minimum of the sum of the expected cost of total SAM's to be launched and the expected cost of damage caused by the final impact of surviving enemy missiles	(11)-1	
			Prevention of destroyer's defenses being penetrated by SLCM's	(1) Probability of the destroyer's counter-measures defenses being penetrated by an SLCM	(11,14)-1	
			Protection of the ship from missiles	(1) Expected cost effectiveness per mission	(11,12)-2	

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
		Surface Ship Defense against Aircraft	Acquisition of all targets in the raid within sufficient time to attack them	(1) Probability of acquiring all the aircraft in the attacking raid	(11)-2	
				(2) Maximum raid size such that the probability of acquiring all members is at least a specified constant	(11)-2	
				(3) Percent of those aircraft that attack a particular sector of the task force and are acquired	(11)-2	
			Prevention of reduction in task force effectiveness by attacking enemy aircraft	(1) Expected number of attack aircraft killed per salvo	(11,12)-1	
	Surface ASW	Barrier Placement/ Patrol	Detection and destruction of submarine	(1) Ratio of the 10-year system cost for ASW barriers to the product of overall kill probability and the length of the barrier	(10)-6	
			Detection of submarine	(1) Maximum probability of detection	(8,10)-2	
		Contact Investigation	Detection of submarine	(1) Probability that a submarine has been detected by the tracker	(10)-4	
				(2) Expected time to find the submarine after the tracker reaches the area	(10)-4	
				(3) Maximum exposure time of the submarine	(10)-14	
			Localization of submarine	(1) Target uncertainty area	(10)-15	
				(2) Entropy of location uncertainty as a function of time (= expected value of minus one times the natural logarithm of the probability density function of submarine position)	(1,10)-1	

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURE OF EFFECTIVENESS	SRS NO.	MR NO.
		Contact Prosecution		(1) Classification time, which is defined as the time between the initial contact and the classification of the initial contact		(10)-4
				(2) Confirmation time, which is defined as the time between the initial contact and the gain of the same contact by a sensor of another ASW platform		(10)-4
				(3) Attack time, which is defined as the time from initial contact to the launching of a weapon by the ship holding contact		(10)-4
				(4) Prosecution time, which is defined as the time from initial contact to the time the contact was broken by the ship holding the initial contact		(10)-4
				(5) False attack ratio, which is defined as the ratio of false attacks to valid attacks		(1,10)-2
				(6) False attack ratio, which is defined as the number of false attacks per 100 hours		(1,10)-2
			Destruction of submarine	(1) Probability that submarine is damaged	(10)-11	
				(2) Probability of target kill	(10)-12	
				(3) Probability of target acquisition	(10)-12	
			Detection and destruction of submarine	(1) Ratio of the 10-year system cost for area search to the product of the overall kill probability and the area swept	(10)-6	
			Localization and destruction of submarine	(1) Dollar-cost per submarine kill	(1,10)-3	
				(2) Joint vehicle and weapon effectiveness, which is the joint probability of the vehicle to maintain track, attack, and classify, and of the weapon to function reliably, acquire and kill the target given that the target has been previously localized	(1,10)-3	

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
		Employment of Deception Devices	Denial of tracking information	(1) Time from countermeasures activation until tracking information is regained	(10)-13	
		Escort/Screen		(1) Number of ships required to screen a convoy for a given speed of advance		(10)-2
				(2) Hourly operating cost to screen a convoy for a given speed of advance		(10)-2
				(3) Number of men required to screen a convoy for a given speed of advance		(10)-2
			Detection and destruction of submarine	(1) Probability that an enemy submarine, having reached the outer periphery of the screen, will subsequently be able to shoot at the protected force		(1,5,8,9, 10,21,22)-1
				(2) Probability that the submarine, having encountered the screen, will survive the engagement		(1,5,8,9, 10,21,22)-1
				(3) Exchange ratios between surface escorts and submarines		(1,5,8,9, 10,21,22)-1
				(4) Probability that an enemy submarine, attempting to penetrate the screen, is not detected		(1,5,8,9, 10,21,22)-1
				(5) Probability that an enemy submarine, attempting to penetrate the screen, is detected but not classified		(1,5,8,9, 10,21,22)-1
				(6) Probability that an enemy submarine, attempting to penetrate the screen, is unsuccessfully attacked by the screen and unsuccessfully avoided by the escorted force		(1,5,8,9, 10,21,22)-1
				(7) Probability that an enemy submarine attempting to penetrate the screen, is unsuccessfully attacked by the screen but successfully avoided by the escorted force		(1,5,8,9, 10,21,22)-1
				(8) Probability that an enemy submarine, attempting to penetrate the screen, is successfully attacked, i.e., killed		(1,5,8,9, 10,21,22)-1

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
				(9) Expected number of ships sunk in the escorted force or when the escorted force is a carrier group, the expected number of carrier hits		(1,5,8,9, 10,21,22)-1
				(10) Expected number of escorts sunk		(1,5,8,9, 10,21,22)-1
				(11) Expected number of weapons expended by surviving surface screen ships		(1,5,8,9, 10,21,22)-1
				(12) Expected number of weapons expended by that fraction of enemy submarines surviving the screen		(1,5,8,9, 10,21,22)-1
			Detection of submarine	(1) Cumulative probability of one sonar ship detecting the submarine at a specified range from submarine to task force		(10)-1
			Insurance of the safe passage of convoys, strike groups, and amphibious forces in the presence of hostile submarines	(1) Probability that the submarine fails to attack the main body by direct and indirect action of the screen units	(10)-7	
			Prevention of submarine penetration of a convoy	(1) Probability that the submarine is killed		(9,10)-1
				(2) Probability that the submarine successfully penetrates the screen		(9,10)-1
				(3) Expected number of escort losses to submarine attacks		(9,10)-1
			Protection of carrier	(1) Maximum effective circular-screen radius for weapon placement close to the carrier		(10)-3
		Response to Flaming Datum	Deterrence of submarine from launching its second attack	(1) Probability of submarine kill within a specified period of time		(10)-3

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
		Submarine Search	Detection, classification, and localization of submarine	(1) Minimum effective surface ship speed	(10)-15	
			Detection of submarine	(1) Kinetic search rate, which is defined to be the expected number of targets detected per unit time in a kinetic search procedure from a uniform distribution of targets spread with unit density over the area	(10)-5	
				(2) Static search rate, which is defined to be the expected number of targets detected per unit time in a static search procedure from a uniform distribution of targets spread with unit density over the area	(10)-5	
				(3) Probability of submarine detection	(10)-9	
				(4) Effective sweep rate	(10)-10	
				(5) Minimum expected time to find the target	(1,10)-4	
				(6) Probability of finding the target by a given elapse time	(1,10)-4	
				(7) Expected proportion of time for which a submarine is undetected	(1,10)-2	
		Submarine Trailing	Constant close contact of submarine while it is in the trailing area	(1) Minimum effective surface ship speed	(10)-15	
			Maintenance of at least intermittent trail	(1) Mean holding time until loss of contact of duration greater than a specified time	(8,10)-1	
				(2) Probability that a platform will regain contact at least once in a time t since loss of contact	(8,10)-1	
				(3) Unconditional probability of regaining contact	(8,10)-1	

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
			Maintenance of continuous trail	(1) Time for evader to escape if both pursuer and evader adopt optimal strategies	(8,9,10,12)-1	
		Surface Ship Versus Submarine		(1) Estimated mean-contact time, which is defined as the ratio of total contact time to the number of lost contacts where the total contact time includes all engagements		(10)-5
			Detection and destruction of submarine	(1) Attack rate, which is defined as the number of attacks in an engagement		(10)-5
				(2) Probability of submarine kill per engagement		(10)-5
				(3) Units attacked ratio, defined as the ratio of the number of submarines attacked at least once to the number of destroyers attacked at least once		(1,10)-1
	Surface Attack	Defensive/Offensive Operations	Destruction of target	(1) Probability of killing an engaged enemy vessel	(11,12)-1	
				(2) Kill probability for a shipboard battery firing against a target		(2,3,11)-1
			Maintenance of reasonable on-station time, quick response to intercepts and assurance of combat superiority if attacked	(1) Equivalent number of competitive craft needed to accomplish the mission that a single baseline ship can accomplish	(12)-4	
		Ocean Search	Capture of target	(1) Capture time if both evader and pursuer adopt optimal strategies	(8,9,10,12)-1	
			Detection of ship	(1) Maximum probability of detection	(8,9,10)-1	
			Detection of target	(1) Maximum probability of detection	(8,9,10,12)-1	
		Shore Bombardment	Inflict troop casualties	(1) Expected number of troops killed in the target area		(11,12)-1

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
				(2) Fraction of casualties		(11,12)-1
		Surface Ship Defense	Survival of ship	(1) Probability of survival	(11,12)-1	
		Surface Ship Engagement		(1) Probability that weapon kills the enemy craft during the engagement		(11,12)-1
				(2) Duration of the engagement		(11,12)-1
				(3) Average range at which the enemy craft sustains lethal damage from the weapon		(11,12)-1
Surveillance System	Antiair Warfare and Attack	Early Warning Performance		(1) Probability of detection, correct identification and correct threat evaluation		(2,3)-1
				(2) Probability of either false alarm, incorrect identification or incorrect threat evaluation		(2,3)-1
				(3) Reaction time, which is defined as the time elapsed from the commencement of an attack to warning of it		(2,3)-1
				(4) Fraction of the required time which a system is able to monitor for the phenomena to be detected		(2,3)-1
				(5) Availability		(2,3)-1
				(6) Accuracy		(2,3)-1
				(7) Resolution		(2,3)-1
				(8) Delay time, which is defined as the interval from initial detection to first weapon assignment when the task force is in readiness condition one		(2,3)-1
	Ocean Surveillance	Classification Capability	Classification of target	(1) Probability of correctly classifying a detected target within a specified time after detection with a specified percent confidence		(7)-3

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
		Detection Capability	Detection of target	(1) Probability of correct detection decision		(7)-3
				(2) Number of targets found per hour within R miles of the search vehicle		(7)-3
				(3) Probability of target detection in the surveillance area		(7)-3
				(4) Mean delay time in target detection after it has arrived in the surveillance area		(7)-3
				(5) Cumulative probability of detection after n observations		(7)-3
		Localization Capability	Localization of target	(1) Maximum area of uncertainty, which is defined as the circle in which the target is located with a specified percent confidence		(7)-3
				(2) Probability of localization within a specified radius from actual location with a specified percent confidence		(7)-3
		Tracking Capability	Establishment and maintenance of track over a period of time	(1) Probability of predicting target location within a specified radial accuracy with a specified percent confidence		(7)-3
				(2) Probability of establishing a track as a function of time		(7)-3
				(3) Ratio of the number of ships in the surveillance area to the number tracked		(7)-3
				(4) Average holding time of track		(7)-3
				(5) Ratio of losing contacts to average holding time		(7)-3
				(6) Probability of regaining a contact		(7)-3
Torpedo	Antisubmarine Warfare	Performance		(1) Endurance		(1,7,10)-1
				(2) Maximum homing range		(1,7,10)-1
			Destruction of target	(1) Target acquisition radius		(10)-3
				(2) Probability of target acquisition		(10)-3
				(3) Probability of hit given acquisition		(10)-3
				(4) Time required to hit target		(10)-3
				(5) Single shot kill probability		(1,7,10)-1

PLATFORM	APPLICABLE FUNCTION(S)	SITUATION	CRITERION FOR SUCCESS	MEASURES OF EFFECTIVENESS	SRS NO.	MR NO.
		Torpedo Drop in Vicinity of Target Datum	Acquisition of target	(1) Probability of target acquisition by the torpedo		(1)-3
Weapon System	Antiair Warfare	Performance of Antiair Weapon	Destruction of target	(1) Single pass probability of at least one hit on the aircraft		(11,12)-1
	Attack	Area Denial Weapon Attack	Damage or delay enemy personnel or material	(1) Expected number of potential casualties (2) Expected number of virtual casualties		(3)-6 (3)-6
		Attack against Hard Targets	Destruction of target	(1) Weapon penetration required to achieve a specified kill level (2) Probability of target kill given a hit (3) Pounds of explosive required at specified penetration depth to kill target		(3)-6 (3)-6 (3)-6
		Performance		(1) Probability of weapon malfunction (2) Probability of target miss not caused by weapon failure (3) Probability that target is hit (4) System reliability		(9,10)-1 (9,10)-1 (9,10)-1 (21,22)-1

APPENDIX F INDEX OF DESCRIPTORS

TABLE F-1 DESCRIPTORS USED FOR STUDY REVIEW SUMMARIES AND MOE REVIEWS

DESCRIPTORS	STUDY REVIEW SUMMARY NUMBERS	MOE REVIEW NUMBERS
acoustic decoy	(1)-12, (9)-3, (10)-1, (10)-13	
airborne attack	(3)-1 to (3)-14, (11)-6, (14)-2, (2,3)-1, (3,11)-1, (3,12)-1, (3,20)-1, (11,12)-1, (3,12,16)-1, (1,8,9,13)-1	(3)-1 to (3)-9, (11)-2, (2,3)-1, (3,12)-1, (2,3,14,17,18,20,21,23)-1
aircraft	(1)-4 to (1)-13, (1)-15 to (1)-17, (2)-1 to (2)-4, (3)-1, (3)-3 to (3)-5, (3)-8 to (3)-14, (5)-1, (5)-2, (7)-1, (7)-2, (10)-14, (11)-2, (11)-6, (12)-4, (14)-2, (20)-1, (20)-2, (21)-1, (23)-1, (1,8)-1, (1,10)-1, (1,10)-2, (1,15)-1, (2,3)-1, (3,11)-1, (3,12)-1, (3,20)-1, (5,6)-3, (11,12)-1, (21,22)-1, (3,12,16)-1, (1,8,9,13)-1, (1,7,8,10,15)-1	(1)-1 to (1)-8, (3)-1 to (3)-3, (3)-5 to (3)-9, (7)-1 to (7)-3, (10)-5, (11)-1, (11)-2, (14)-1, (14)-2, (17)-4, (20)-1, (2,3)-1, (3,12)-1, (3,20)-1, (11,12)-1, (1,7,10)-1, (1,8,9)-1, (2,3,11)-1, (1,2,10,11)-1, (1,5,8,9,10,21,22)-1, (2,3,14,17,18,20,21,23)-1
aircraft identification	(11)-3, (11)-4	
air superiority	(2)-1, (3)-10, (3,20)-1	(2,3)-1, (3,20)-1, (2,3,14,17,18,20,21,23)-1
air-to-air missile	(2)-1, (2)-4, (5)-2	(1)-8

DESCRIPTORS	STUDY REVIEW SUMMARY NUMBERS	MOE REVIEW NUMBERS
air-to-surface missile	(3)-12, (3)-13, (11)-6	(3)-2, (3)-5, (3)-7, (3)-8, (11)-1, (11)-2, (12)-3, (14)-1
air traffic monitoring	(11)-3, (11)-4	
amphibious operation	(10)-5, (12)-1, (12)-5, (12)-6, (16)-1, (5,6)-5, (3,12,16)-1, (6,18,19)-1	(3)-9, (6)-2, (12)-3, (16)-1, (17)-4, (20)-1, (6,16)-1, (11,12)-1, (12,16)-1, (1,2,10,11)-1
antiaircraft defense	(3)-5, (3)-8, (3)-9, (3)-13, (5)-2, (14)-2	(3)-7, (11)-1
antiaircraft gunnery	(3)-4, (3)-5, (3)-13, (5)-2, (14)-2	(3)-7
antiair warfare	(2)-1 to (2)-3, (3)-14, (5)-1, (5)-2, (11)-1 to (11)-6, (2,3)-1, (3,11)-1, (11,12)-1, (11,12)-2, (11,14)-1, (10,11,12)-1	(1)-8, (11)-2, (14)-1, (11,12)-1, (11,18)-1, (2,3,11)-1, (1,2,10,11)-1, (2,3,14,17,18, 20,21,23)-1
antimissile missile	(11)-6, (11,12)-2, (1,8,9,13)-1	(13)-1
antiship missile	(3,12)-1	

DESCRIPTORS	STUDY REVIEW SUMMARY NUMBERS	MOE REVIEW NUMBERS
antisubmarine missile	(1,8,9,13)-1	
antisubmarine warfare	(1)-1 to (1)-17, (8)-1 to (8)-7, (8)-18, (9)-4, (10)-1 to (10)-15, (15)-1 to (15)-3, (1,8)-1, (1,10)-1 to (1,10)-3, (1,15)-1, (8,10)-1, (8,10)-2, (9,10)-1, (9,10)-2, (10,12)-1, (8,9,10)-1, (1,8,9,13)-1, (8,9,10,12)-1, (1,7,8,10,15)-1	(1)-1 to (1)-7, (7)-1, (8)-1 to (8)-5, (10)-1 to (10)-5, (13)-1, (15)-1, (15)-2, (18)-1, (1,10)-2, (8,18)-1, (9,10)-1, (10,12)-1, (1,7,10)-1, (1,8,9)-1 (1,2,10,11)-1, (1,5,8,9,10,21,22)-1
ASCAC		(1)-4
assault ship	(6)-1, (6)-3, (5,6)-4	(6,16)-1
attrition	(3)-5, (3)-7 to (3)-10, (5)-1, (5)-2, (8)-15, (9)-4, (12)-3, (12)-4, (23)-1, (3,20)-1, (5,6)-5, (9,10)-1, (9,10)-2, (11,12)-2, (3,12,23)-1	(3)-2, (3)-4, (6)-2, (3,20)-1
availability	(1)-16, (2)-4, (3)-10, (3)-13, (8)-11, (11)-5, (16)-1, (20)-2, (2,3)-1, (21,22)-1	(3)-9, (7)-3, (2,3)-1, (21,22)-1, (1,5,8,9,10,21,22)-1
barrier	(1)-4 to (1)-12, (1)-14, (1)-15, (1)-17, (8)-4, (8)-6 to (8)-8, (8)-11, (8)-13, (8)-15, (9)-4, (10)-3, (10)-5, (10)-6, (10)-10, (12)-2, (15)-2, (3,11)-1, (8,10)-2, (1,7,8,10,15)-1	(1)-5, (7)-1, (8)-1, (8)-3, (8)-4, (13)-1, (10,12)-1, (1,8,9)-1, (1,5,8,9,10,21,22)-1

DESCRIPTORS	STUDY REVIEW SUMMARY NUMBERS	MOE REVIEW NUMBERS
bathythermo-graph	(4)-1	
beta density function	(11,14)-1	
binomial density function	(5)-1, (9)-4, (11)-5, (15)-1, (10,12)-1	(7)-1
biological sensor		(20)-1
bomb	(1)-13, (3)-5 to (3)-7, (3)-9, (3)-13, (1,10)-2	(3)-1, (3)-3, (3)-6 to (3)-8, (1,2,10,11)-1
bomber defense	(2)-1	
bridge	(3)-5	(3)-1
cargo ship		(1)-6, (3,20)-1
carrier	(1)-9, (1)-11, (1)-12, (1)-16, (2)-3, (3)-1, (3)-2, (3)-6, (3)-10, (3)-14, (8)-9, (10)-1, (10)-13, (11)-6, (23)-1, (2,3)-1, (9,10)-1, (10,12)-1, (21,22)-1, (8,9,10)-1	(1)-6, (1)-8, (3)-4, (11)-2, (12)-3, (1,7,10)-1, (2,3,11)-1, (1,2,10,11)-1, (1,5,8,9,10,21,22)-1

DESCRIPTORS	STUDY REVIEW SUMMARY NUMBERS	MOE REVIEW NUMBERS
carrier based aircraft	(1)-7, (1)-9, (1)-10, (1)-11, (1)-16, (3)-1, (3)-2, (3)-6, (3)-7, (3)-13, (10)-1, (2,3)-1, (3,20)-1, (21,22)-1	(1)-6, (3)-4, (12)-3, (20)-1, (1,5,8,9,10,21,22)-1
Cass	(1)-11, (1)-17	
chemical sensor		(20)-1
circuit performance		(17)-1, (17)-4
classification	(1)-17, (8)-2, (8)-9, (8)-18, (3,11)-1, (2,11,14)-1	(1)-1. (1)-2, (1)-4, (10)-4, (20)-2, (8,18)-1
classification probability	(3)-14, (8)-10, (8)-12, (8)-17, (8)-18, (10)-6, (1,10)-3	(7)-3, (1,8,9)-1, (1,5,8,9,10,21,22)-1
close air support	(3)-3, (3)-4, (3)-6, (3)-10, (3,12,16)-1	(3)-3, (3)-8, (3)-9, (3,20)-1, (2,3,14,17,18,20,21,23)-1
Codar	(1)-4	
combat air patrol	(2)-1, (2)-3, (21,22)-1	
combat information center		(18)-1

DESCRIPTORS	STUDY REVIEW SUMMARY NUMBERS	MOE REVIEW NUMBERS
command and control	(6,18,19)-1	(17)-4, (18)-1, (8,18)-1, (10,12)-1, (11,18)-1, (2,3,14,17,18,20,21,23)-1
communications	(7)-3, (6,18,19)-1	(17)-1 to (17)-4, (14,17)-1, (2,3,14,17,18,20,21,23)-1
computer	(10)-2, (10)-12	(11,18)-1, (14,17)-1
contact investigation	(1)-2, (1)-6, (1)-11, (1)-12, (1)-14, (1)-15, (1)-17, (10)-5, (10)-14, (1,10)-1, (1,10)-3, (1,10)-4, (1,15)-1	(1)-4, (1)-5, (1)-7, (1)-8, (10)-4, (1,5,8,9,10,21,22)-1
contact prosecution	(1)-13, (1)-17, (8)-14, (8)-17, (10)-2, (10)-5, (10)-6, (10)-11, (10)-12, (1,10)-2, (1,10)-3	(10)-4, (10)-5
convoy defense	(9)-1, (9)-4, (10)-5, (10)-13, (10)-15, (11)-5, (5,6)-5, (9,10)-2, (8,9,10)-1	(10)-2, (10)-3, (1,8,9)-1, (1,2,10,11)-1, (1,5,8,9,10,21,22)-1
convoy escort	(10)-8 to (10)-10, (10)-13	(1)-5, (1)-6, (10)-1, (10)-2, (9,10)-1
cost	(1)-8, (1)-11, (1)-16, (1)-17, (2)-2, (2)-4, (3)-3, (3)-7, (3)-9, (3)-10, (3)-13, (5)-1, (7)-1, (7)-2, (10)-8, (11)-1, (12)-3, (12)-5, (15)-2, (20)-1, (21)-1, (1,7)-1, (1,10)-2, (1,10)-3, (2,3)-1, (3,12,16)-1, (6,18,19)-1	(1)-2, (1)-5, (1)-6, (3)-8, (6)-1, (6)-2, (7)-1 to (7)-3, (8)-5, (13)-1, (16)-1, (20)-1, (12,16)-1

DESCRIPTORS	STUDY REVIEW SUMMARY NUMBERS	MOE REVIEW NUMBERS
cost effectiveness	(1)-6, (1)-8, (1)-11, (1)-17, (2)-4, (3)-1, (3)-2, (3)-4, (3)-7, (3)-13, (8)-4, (12)-5, (21)-1, (1,10)-3, (21,22)-1, (3,12,16)-1, (6,18,19)-1	(1)-5, (3)-1, (3)-2, (6)-1, (7)-1 to (7)-3, (12)-1, (13)-1, (20)-1, (12,16)-1, (1,5,8,9,10,21,22)-1
countermeasure	(1)-12, (2)-2, (3)-13, (9)-3, (10)-13, (14)-2, (11,14)-1	(11)-2, (14)-1, (14)-2, (20)-1, (20)-2, (2,3)-1, (14,17)-1, (1,5,8,9,10,21,22)-1
counterguerrilla warfare	(20)-1	(2,3,14,17,18,20,21,23)-1
cruise missile	(11,14)-1	
damage assessment	(12)-5, (23)-1, (3,20)-1, (9,10)-1	(3)-8, (9,12)-1
data link	(3)-5, (20)-1, (20)-2	(3)-8, (7)-3, (17)-3, (17)-4, (14,17)-1
decoy	(9)-3, (11)-5, (2,11,14)-1	(14)-1, (20)-2
design	(3)-3, (21)-1	
destroyer	(1)-17, (10)-10, (10)-14, (23)-1, (11,14)-1	(1)-7, (10)-5, (12)-2, (1,10)-1
destroyer escort	(1)-3	

DESCRIPTORS	STUDY REVIEW SUMMARY NUMBERS	MOE REVIEW NUMBERS
detection	(1)-4, (1)-9, (1)-10, (1)-11, (1)-17, (2)-3, (3)-4, (3)-14, (5)-2, (7)-1, (7)-3, (8)-1, (8)-2, (8)-4, (8)-15 to (8)-17, (9)-1 to (9)-3, (10)-3, (10)-4, (10)-13, (10)-14, (12)-4, (20)-1, (20)-2, (1,10)-1, (1,10)-2, (1,10)-4, (3,11)-1, (3,12)-1, (7,14)-1, (11,12)-1, (11,14)-1, (8,9,10,12)-1, (1,7,8,10,15)-1	(1)-6, (8)-2 to (8)-4, (10)-4, (14)-1, (14)-2, (15)-1, (15)-2, (1,10)-1, (2,3)-1, (8,18)-1, (10,12)-1, (1,8,9)-1 (2,3,14,17,18,20,21,23)-1
detection probability	(1)-1 to (1)-3, (1)-5, (1)-8, (1)-12, (1)-14, (1)-15, (3)-9, (3)-11, (3)-12, (5)-2, (8)-3, (8)-10, (8)-12, (8)-13, (8)-17, (9)-3, (10)-6, (10)-9, (12)-2, (14)-1, (14)-2, (15)-1 to (15)-3, (1,10)-4, (1,15)-1, (8,10)-2, (8,9,10,12)-1	(1)-3, (1)-6, (7)-3, (8)-1, (10)-1, (20)-1, (20)-2, (1,7,10)-1, (1,8,9)-1, (1,5,8,9,10,21,22)-1
Difar	(1)-14, (1)-17	(1)-2, (15)-2, (1,7,10)-1
dipping sonar	(1)-1, (1)-2, (1)-14, (10)-9, (10)-15	(1)-5, (1)-7
direction finding	(7)-3	
dynamic programming	(11)-1	
electronic warfare	(3)-13, (14)-1 to (14)-3, (7,14)-1, (11,14)-1	(14)-1, (14)-2, (20)-1, (14,17)-1, (2,3,14,17,18,20,21,23)-1

DESCRIPTORS	STUDY REVIEW SUMMARY NUMBERS	MOE REVIEW NUMBERS
emission control	(3)-14, (14)-1, (14)-3	
environmental system	(4)-1	
Erlang density function	(8)-6, (8)-11	
escort ship	(10)-1, (10)-13, (12)-5	(10)-2, (1,7,10)-1, (2,3,11)-1, (1,2,10,11)-1, (1,5,8,9,10,21,22)-1
escort submarine	(8)-9	
exponential density function	(3)-3, (8)-6 to (8)-9, (8)-13, (8)-18, (15)-2, (3,11)-1, (5,6)-5	(10)-5, (17)-3
FADAP		(1,10)-1
false target	(1)-17, (3)-9, (3)-11, (1,10)-4	(8)-1, (20)-2, (1,10)-2
fire control	(2)-4, (3)-12, (8)-3, (10)-2, (10)-11, (10)-12, (11)-2, (12)-5	(12)-1, (9,10)-1, (11,18)-1
firepower	(3,12,23)-1	(3,12)-1, (12,16)-1

DESCRIPTORS	STUDY REVIEW SUMMARY NUMBERS	MOE REVIEW NUMBERS
fire support	(16)-1	(3,20)-1, (12,16)-1
fleet ballistic missile	(1,8)-1	(21,22)-1, (1,7,10)-1
force allocation	(3)-8, (3)-10, (7)-2, (21)-1, (1,7)-1, (3,20)-1, (5,6)-5, (3,12,23)-1	(1)-6, (3,12)-1
game theory	(1)-2, (6)-1, (6)-3, (12)-3, (13)-1, (5,6)-1, (5,6)-2, (5,6)-4, (5,6)-5, (3,12,23)-1, (8,9,10,12)-1	(6)-2, (8)-2, (8)-4
gun	(3)-4, (3)-7, (3)-13, (12)-4 to (12)-6, (11,12)-1	(12)-1, (16)-1, (12,16)-1
gun director	(5)-2, (11)-2, (12)-5	
harbor defense		(10,12)-1
helicopter	(1)-1 to (1)-3, (1)-13, (1)-14, (1,10)-3	(1)-7, (6)-1, (17)-4, (1,7,10)-1
hit probability	(8)-9, (8)-17, (9)-1, (9)-2, (10)-2, (11)-5, (12)-4 to (12)-6, (3,11)-1, (3,12)-1	(3)-3, (3)-7, (3)-8, (8)-5, (10)-3, (9,10)-1, (11,12)-1, (2,3,11)-1, (1,5,8,9,10,21,22)-1
hunter-killer group	(8,9,10)-1	

DESCRIPTORS	STUDY REVIEW SUMMARY NUMBERS	MOE REVIEW NUMBERS
infiltration	(12)-2	
information theory	(7)-3, (1,10)-1	
infrared sensor		(3)-8, (7)-3, (20)-1
intelligence	(15)-2, (20)-1, (20)-2, (3,20)-1, (7,14)-1	(20)-1, (20)-2, (3,20)-1, (2,3,14,17,18,20,21,23)-1
interception probability	(5)-2, (11)-6, (9,10)-1, (11,12)-2	
interdiction	(3)-5, (3)-9 to (3)-11, (12)-2, (3,20)-1	(3,20)-1
iteration	(5,6)-5	
Jezebel	(1)-4, (1)-5, (1)-14, (1,7,8,10,15)-1	(1)-4
Julie	(1)-14, (1,7,8,10,15)-1	(1)-3
kill	(3)-10, (8)-2, (8)-5, (8)-15, (20)-1	(8)-3, (2,3)-1, (12,16)-1, (2,3,14,17,18,20,21,23)-1

DESCRIPTORS	STUDY REVIEW SUMMARY NUMBERS	MOE REVIEW NUMBERS
kill probability	(1)-1, (1)-4, (1)-7, (1)-9, (1)-10, (1)-13, (2)-1, (2)-2, (3)-4, (3)-5, (3)-7 to (3)-9, (3)-11, (3)-13, (5)-2, (8)-3, (8)-4, (8)-7 to (8)-12, (8)-17, (9)-2, (10)-6, (10)-11, (10)-12, (11)-5, (12)-3 to (12)-6, (1,10)-3, (2,3)-1, (3,20)-1, (9,10)-1, (11,12)-1, (11,12)-2, (2,11,14)-1, (3,12,16)-1, (1,8,9,13)-1	(1)-6, (1)-8, (3)-2, (3)-3, (3)-5, (3)-7, (3)-8, (8)-1, (8)-4, (8)-5, (10)-5, (11)-1, (12)-2, (13)-1, (1,10)-1, (9,10)-1, (11,12)-1, (1,7,10)-1, (1,8,9)-1, (2,3,11)-1, (1,5,8,9,10,21,22)-1
kill rate	(3,12,23)-1	(8)-1, (12,16)-1
Lanchester equations	(5,6)-3, (3,12,23)-1	(8)-4, (3,12)-1
land mine warfare	(20)-1	
laser sensor		(3)-8
lethality		(11)-1, (12,16)-1
linear programming	(3)-1, (3)-2, (7)-2, (11)-4, (16)-1, (21)-1, (1,7)-1	(1)-6
localization	(1)-6, (1)-9 to (1)-12, (1)-17, (7)-3, (1,10)-1, (1,7,8,10,15)-1	(1)-7, (7)-3, (8,18)-1

DESCRIPTORS	STUDY REVIEW SUMMARY NUMBERS	MOE REVIEW NUMBERS
localization probability	(1)-1, (1)-14, (10)-6, (1,10)-3, (1,15)-1	(1)-3, (20)-1, (1,7,10)-1
Lofar	(1)-4, (1)-5, (1)-8, (1)-11, (1)-14, (1)-15, (10)-14, (15)-3, (1,7,8,10,15)-1	(1)-4, (1,7,10)-1, (1,8,9)-1
logistics	(21)-1, (21,22)-1	(12)-3, (21,22)-1, (1,5,8,9,10,21,22)-1
MAD	(1)-1, (1)-4, (1)-17, (10)-6	(1)-1 to (1)-3, (1,7,10)-1
maintainability	(1)-17, (2)-4	
Markov process	(1)-1, (1)-4, (10)-7, (11)-1, (11)-5, (1,8)-1 (9,10)-2, (11,14)-1, (1,8,9,13)-1	(17)-3
merchant ship	(9)-2, (10)-10	
message traffic		(17)-1 to (17)-4, (2,3,14,17,18,20,21,23)-1
mine	(6)-1 to (6)-3, (20)-1, (5,6)-1 to (5,6)-5, (6,19)-1, (6,18,19)-1	(5)-2, (6)-2, (6,16)-1, (9,12)-1
mine countermeasure	(6)-1 to (6)-3, (5,6)-1 to (5,6)-5, (6,19)-1, (6,18,19)-1	(6)-2, (6,16)-1

DESCRIPTORS	STUDY REVIEW SUMMARY NUMBERS	MOE REVIEW NUMBERS
minehunter	(6)-1, (6)-3, (5,6)-4, (6,19)-1	
minehunting	(6)-2, (5,6)-2, (5,6)-5, (6,19)-1	(6)-2, (6,16)-1
minesweeper	(6)-1, (6)-3, (5,6)-1, (5,6)-3, (5,6)-4, (6,19)-1	(6)-1
minesweeping	(6)-2, (5,6)-2, (5,6)-5	(6)-1, (6)-2, (6,16)-1
mining	(5)-1, (5)-2, (5,6)-1 to (5,6)-5	(3)-6, (5)-1, (5)-2, (6)-2, (1,5,8,9,10,21,22)-1
missile	(2)-2, (2)-4, (3)-1, (3)-6, (3)-12, (10)-10, (11)-5, (12)-4, (12)-6, (13)-2, (1,10)-2, (11,12)-1	(1)-5, (8)-5, (11)-1, (14)-1, (11,12)-1, (12,16)-1, (2,3,11)-1
missile seeker	(3,12)-1	(3)-7, (14)-1
Monte Carlo method	(8)-13, (9)-3, (10)-1, (10)-9, (10)-11, (10)-13, (12)-6, (21,22)-1, (3,12,16)-1, (6,18,19)-1	(1)-2, (6)-2, (8)-3, (10)-1, (10)-3, (11)-2, (12)-2, (15)-1, (16)-1, (9,10)-1, (9,12)-1, (11,12)-1, (11,18)-1, (1,7,10)-1, (2,3,11)-1, (1,2,10,11)-1, (1,5,8,9,10,21,22)-
naval gun-fire support	(12)-5, (12)-6, (16)-1	(16)-1, (12,16)-1, (1,2,10,11)-1, (1,5,8,9,10,21,22)-1

DESCRIPTORS	STUDY REVIEW SUMMARY NUMBERS	MOE REVIEW NUMBERS
navigation	(10)-12, (6,19)-1	(6,18,19)-1
Newton-Raphson method	(5,6)-5	
nomograph	(1)-6	
nonlinear integer programming	(3)-8, (11)-1, (15)-1	
normal density function	(1)-12 to (1)-14, (7)-3, (8)-1, (8)-5, (8)-16, (8)-17, (9)-4, (10)-2, (10)-10 to (10)-12, (12)-5, (12)-6, (15)-1, (1,10)-1, (3,12)-1, (6,19)-1, (11,14)-1, (3,12,16)-1	(7)-1, (8)-2, (8)-4
nuclear warhead	(11)-6, (23)-1	(3)-5
optical detection	(7)-1	
optical sensor	(7)-1	(3)-8, (7)-3, (20)-1
optical tracking	(7)-1	
optimal control	(11)-1, (3,12,23)-1, (8,9,10,12)-1	

DESCRIPTORS	STUDY REVIEW SUMMARY NUMBERS	MOE REVIEW NUMBERS
optimization	(1,10)-4, (3,12,23)-1, (8,9,10,12)-1	
patrol craft	(12)-2	(11,12)-1
personnel	(20)-1, (23)-1	(10)-2, (3,12)-1
photo interpretation		(20)-1
Poisson density function	(3)-3, (3)-9, (3)-12, (5)-1, (6)-2, (8)-6 to (8)-8, (8)-17, (8)-18, (10)-10, (15)-1, (5,6)-1, (5,6)-5, (9,10)-2, (8,9,10)-1	(7)-1, (17)-3
prediction	(10)-2	
projectile	(5)-2, (12)-6	(12)-1
queuing	(8)-18	(17)-3, (8,18)-1
radar	(1)-4, (1)-8, (2)-4, (3)-4, (3)-7, (3)-12 to (3)-14, (5)-2, (10)-4, (11)-5, (12)-1, (12)-4, (14)-1 to (14)-3, (1,15)-1, (7,14)-1, (6,18,19)-1	(3)-7, (3)-8, (7)-2, (7)-3, (13)-1, (14)-1, (14)-2, (20)-1, (2,3)-1, (1,7,10)-1, (1,8,9)-1
radiological contamination sensor	(23)-1	(20)-1

DESCRIPTORS	STUDY REVIEW SUMMARY NUMBERS	MOE REVIEW NUMBERS
radio sensor	(6,18,19)-1	
Rayleigh density function	(15)-3	
receiver	(14)-1, (14)-3	
reconnaissance	(3)-11, (20)-1, (20)-2, (3,20)-1, (7,14)-1	(20)-1, (20)-2, (3,20)-1, (2,3,14,17,18,20,21,23)-1
reliability	(1)-6, (1)-17, (2)-1, (2)-2, (2)-4, (3)-5, (3)-13, (8)-9, (11)-5, (15)-2, (11,12)-1, (11,12)-2, (21,22)-1, (3,12,16)-1	(7)-3, (8)-5, (2,3)-1, (21,22)-1, (1,5,8,9,10,21,22)-1
rescue		(3)-9
resources	(21)-1, (3,12,23)-1	(3,12)-1, (3,20)-1
rocket	(3)-6, (12)-6	(3)-6 to (3)-8
satellite	(7)-1, (7,14)-1	(7)-1 to (7)-3, (17)-2, (7,14)-1
screen	(9)-4, (10)-5, (10)-7 to (10)-9, (10)-13, (10)-15, (11)-3, (11)-4	(1)-5, (1)-7, (10)-1 to (10)-3, (9,10)-1, (1,7,10)-1, (1,5,8,9,10,21,22)-1

DESCRIPTORS	STUDY REVIEW SUMMARY NUMBERS	MOE REVIEW NUMBERS
sea based strategic system	(13)-1, (13)-2, (1,8,9,13)-1	(13)-1
sea launched missile	(13)-2	(13)-1
search	(1)-2, (1)-8, (1)-16, (3)-11, (3)-14, (8)-3, (8)-10, (8)-17, (9)-3, (10)-3 to (10)-6, (10)-8 to (10)-10, (10)-15, (1,10)-2, (1,10)-4, (8,9,10,12)-1	(1,10)-1
sensor	(20)-1, (20)-2	(2,3,14,17,18,20,21,23)-1
ship counter device	(6)-3, (5,6)-1 to (5,6)-3, (5,6)-5	
ship defense	(2)-3, (11)-2, (11)-5, (11)-6, (3,11)-1, (11,12)-1, (11,12)-2, (11,14)-1	(10)-2, (10)-3, (11)-1, (14)-1, (2,3,11)-1
ship support	(21,22)-1	(21,22)-1, (1,5,8,9,10,21,22)-1
smoke bomb	(1)-17	
sonar	(1)-13, (1)-14, (1)-17, (8)-1, (8)-3, (8)-13, (8)-15, (8)-16, (8)-18, (10)-8, (10)-11 to (10)-14, (1,7,8,10,15)-1	(8)-1, (8)-2, (8)-4, (10)-1, (10)-2, (10)-4, (13)-1, (1,10)-1, (8,18)-1, (9,10)-1

DESCRIPTORS	STUDY REVIEW SUMMARY NUMBERS	MOE REVIEW NUMBERS
sonobuoy	(1)-3 to (1)-12, (1)-14, (1)-15, (1)-17, (10)-5, (10)-6, (10)-15, (15)-2, (15)-3, (1,15)-1	(1)-1 to (1)-3, (1)-5, (1)-7, (1,7,10)-1
SOSUS	(1)-12, (10)-5, (10)-15, (1,15)-1, (1,7,8,10,15)-1	(1)-4, (1)-5, (7)-3, (15)-1, (1,7,10)-1, (1,5,8,9,10,21,22)-1
statistics	(8)-16	(5)-1
submarine	(1)-1 to (1)-15, (1)-17, (7)-3, (8)-1 to (8)-18, (9)-1 to (9)-4, (10)-1 to (10)-14, (13)-1, (13)-2, (15)-1 to (15)-3, (1,8)-1, (1,10)-1 to (1,10)-4, (1,15)-1, (5,6)-5, (8,10)-1, (8,10)-2, (9,10)-1, (9,10)-2, (8,9,10)-1, (1,8,9,13)-1, (8,9,10,12)-1, (1,7,8,10,15)-1	(1)-1 to (1)-7, (5)-2, (7)-1, (8)-1 to (8)-5, (10)-1 to (10)-5, (15)-1, (15)-2, (1,10)-1, (1,10)-2, (8,18)-1, (9,10)-1, (21,22)-1, (1,7,10)-1, (1,8,9)-1, (2,3,11)-1, (1,5,8,9,10,21,22)-1
submarine attack	(8)-17, (9)-1, (9)-2, (9)-4, (10)-13, (9,10)-1, (9,10)-2, (8,9,10)-1, (1,8,9,13)-1, (8,9,10,12)-1	(8)-5, (10)-2, (8,18)-1, (9,12)-1, (1,8,9)-1, (1,5,8,9,10,21,22)-1
supply	(3,20)-1, (21,22)-1	(3,20)-1, (2,3,14,17,18,20,21,23)-1
surface attack	(12)-1 to (12)-3, (12)-5, (3,11)-1, (3,12)-1, (10,12)-1, (11,12)-1, (11,12)-2, (3,12,16)-1, (8,9,10)-1, (8,9,10,12)-1	(12)-1 to (12)-3, (3,12)-1, (9,12)-1, (10,12)-1, (11,12)-1

DESCRIPTORS	STUDY REVIEW SUMMARY NUMBERS	MOE REVIEW NUMBERS
surface effect vehicle	(10)-5, (10)-6, (10)-9, (10)-15, (12)-1, (12)-4, (10,12)-1, (11,12)-1	(10)-2
surface ship	(3)-1, (4)-1, (9)-4, (10)-2, (10)-7, (10)-8, (10)-12, (10)-13, (11)-1, (11)-5, (12)-3 to (12)-6, (13)-2, (21)-1, (23)-1, (1,10)-1 to (1,10)-3, (3,11)-1, (3,12)-1, (5,6)-5, (8,10)-1, (8,10)-2, (9,10)-2, (11,12)-1, (11,12)-2, (3,12,16)-1, (8,9,10,12)-1	(1)-7, (1)-8, (3)-8, (5)-2, (6)-2, (7)-3, (8)-5, (10)-1, (10)-3 to (10)-5, (11)-2, (12)-1, (12)-3, (16)-1, (17)-4, (1,10)-1, (1,10)-2, (9,10)-1, (9,12)-1, (11,12)-1, (12,16)-1, (2,3,11)-1, (1,2,10,11)-1, (1,5,8,9,10,21,22)-1
surface target	(3)-4, (3)-9	(3)-7, (12)-2, (3,12)-1
surface-to-air missile	(3)-5, (3)-7, (3)-12, (3)-13, (5)-2, (11)-5, (11)-6, (14)-2, (3,11)-1, (11,12)-1, (11,12)-2	(1)-8, (3)-7, (11)-1, (11)-2, (2,3)-1, (11,18)-1, (1,2,10,11)-1
surface-to-air missile defense	(11)-1	
surface-to-surface missile	(12)-4, (3,11)-1, (11,12)-1, (11,12)-2	(12)-3, (14)-1, (12,16)-1, (1,2,10,11)-1
surveillance	(1)-12, (1)-16, (7)-1 to (7)-3, (8)-18, (10)-3, (10)-4, (10)-8, (10)-10, (11)-3, (11)-4, (15)-2, (20)-1, (20)-2, (1,7)-1, (7,14)-1, (8,9,10,12)-1, (1,7,8,10,15)-1	(1)-4, (1)-8, (3)-4, (7)-1 to (7)-3, (20)-2, (2,3)-1, (1,7,10)-1

DESCRIPTORS	STUDY REVIEW SUMMARY NUMBERS	MOE REVIEW NUMBERS
survivability	(2)-1, (2)-2, (3)-2 to (3)-4, (3)-8 to (3)-10, (3)-13, (5)-1, (5)-2, (9)-4, (11)-6, (12)-3, (12)-4, (14)-2, (2,3)-1, (9,10)-1, (9,10)-2, (10,12)-1, (11,12)-1, (11,12)-2, (2,11,14)-1	(1)-8, (3)-4, (3)-7, (3)-9, (6)-2, (2,3)-1, (3,12)-1, (1,7,10)-1, (2,3,11)-1, (1,2,10,11)-1
tactics	(8)-15, (9)-3, (10)-11, (10)-13, (14)-2, (20)-1, (1,10)-4, (8,9,10,12)-1	(11)-1, (3,20)-1
tanker ship		(1)-6
target acquisition	(3)-13, (10)-12, (11)-2, (8,9,10,12)-1	(3)-7, (3)-8, (10)-3
target mix	(3)-1 to (3)-4, (3)-7 to (3)-11, (3)-13, (12)-5, (12)-6, (16)-1, (3,20)-1, (2,11,14)-1, (3,12,16)-1	(3)-2, (3)-3, (3)-5 to (3)-9, (12)-1, (12)-3, (12,16)-1
task force	(1)-12, (1)-14, (3)-14, (4)-1, (10)-1, (11)-5, (2,3)-1, (11,12)-1	(11)-2, (12)-3, (15)-1, (3,20)-1
torpedo	(1)-1, (1)-6, (1)-17, (8)-3 to (8)-5, (8)-9, (8)-13, (8)-15, (8)-17, (9)-1, (9)-2, (10)-6, (10)-10, (10)-12, (10)-13, (12)-1, (1,10)-3,	(1)-3, (1)-5, (3)-8, (8)-4, (10)-2, (10)-3, (10)-5, (1,10)-2, (9,10)-1, (9,12)-1, (1,7,10)-1, (1,8,9)-1, (1,2,10,11)-1
tracking	(1)-4, (7)-1, (10)-2 to (10)-4, (10)-11, (15)-2, (1,10)-1, (1,10)-2, (8,9,10,12)-1, (1,7,8,10,15)-1	(1)-4, (7)-3, (8)-4

DESCRIPTORS	STUDY REVIEW SUMMARY NUMBERS	MOE REVIEW NUMBERS
trailing	(10)-15, (1,8)-1, (8,10)-1, (1,8,9,13)-1, (8,9,10,12)-1	(1)-5
transitor	(1)-8, (1)-15, (8)-1, (8)-2, (8)-4 to (8)-8, (8)-11 to (8)-13, (8)-16, (14)-1, (15)-2, (15)-3, (1,7,8,10,15)-1	(8)-1, (8)-2, (1,8,9)-1, (1,5,8,9,10,21,22)-1
transmitter	(14)-1 to (14)-3	(14,17)-1
transportation system		(3,20)-1
undersea surveillance	(8)-18, (10)-15, (15)-1 to (15)-3, (1,15)-1	(15)-1, (15)-2
undersea warfare	(9,10)-1	(8,18)-1
underwater-to-air missile	(13)-1	
underwater-to-surface missile	(13)-1, (1,8,9,13)-1	

DESCRIPTORS	STUDY REVIEW SUMMARY NUMBERS	MOE REVIEW NUMBERS
underwater-to-underwater missile	(8)-4	(8)-5
visual	(1)-4, (3)-4, (3)-14	(1,10)-1, (1,8,9)-1
vulnerability	(3)-7, (5)-2, (8)-6, (8)-7, (8)-12, (11)-5, (12)-5, (13)-2, (5,6)-3, (10,12)-1	(1)-8, (3)-6, (8)-1, (11)-1, (9,12)-1, (1,2,10,11)-1
warhead		(3)-8, (8)-5, (11)-1
weapon mix	(3)-4, (3)-6, (3)-7, (3)-11, (8)-4, (12)-5, (16)-1	(11,12)-1, (12,16)-1