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A PERSPECTIVE ON TRANSITIONING TECHNOLOGY FROM EXPLORATORY TO A--ETC(U)
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A PERSPECTIVE ON TRANSITIONING TECHNOLOGY FROM EXPLORATORY TO ADVANCED DEVELOPMENT R&D categories 6.2 to 6.3

Test Technology Office (Code 921)
Electronics Engineering and Sciences Department (Code 92)

January 1981

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A N A C T I V I T Y O F T H E N A V A L M A T E R I A L C O M M A N D

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This perspective on transitioning technology from exploratory to advanced development (R&D Categories 6.2 to 6.3) is written primarily for engineers and scientists who develop a technology and believe it is ready for the transition from exploratory development to advanced development. Work was performed by the Naval Ocean Systems Center Test Technology Office with the aid of Megatek Corporation of New Jersey (Contract N00123-79-C-0422) and Logistics Management Institute of Washington, DC (Contract MDA903-77-C0370), under O&MN funding. This perspective is intended for use by DoD and industry technical personnel performing research and development.

The author thanks the Navy Test Technology Strategy Team for their review and recommendations during the development of this document. Appreciation is also expressed to George W Newman, Naval Material Command (NMAT04T) Technical Director, for his assistance and suggestions.

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<p>The objective of advancing a technology is to solve a fleet need. This paper is written primarily for the engineers and scientists who develop a technology and believe it is ready for the transition from Exploratory Development to Advanced Development. Its purpose is to provide them with a basic understanding of the role of Exploratory Development efforts in the overall Navy R&D program and of their role in transitioning technology. This overview presents certain basic concepts of the Navy R&D process in relation to the acquisition cycle. It is important to understand these concepts because the way in which R&D projects are established and funded has a major impact on the work of the engineers and scientists in Navy R&D laboratories.</p>			

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A PERSPECTIVE ON TRANSITIONING TECHNOLOGY
FROM EXPLORATORY TO
ADVANCED DEVELOPMENT
(R&D Categories 6.2 to 6.3)

INTRODUCTION

The objective of advancing a technology is the filling of a Fleet need. This paper is written primarily for the engineers and scientists who develop technologies and believe them to be ready for transition from Exploratory Development to Advanced Development. Its purpose is to provide them with a basic understanding of their role in Exploratory Development efforts as it applies to the overall Navy R&D program, and of their role in transitioning technology.

THE ACQUISITION CYCLE AND THE NAVY RESEARCH AND DEVELOPMENT PROCESS

This overview presents certain basic concepts of the Navy R&D process in relation to the acquisition cycle. It is important to understand these concepts because the method by which R&D projects are established and funded has a major impact on the work of the engineers and scientists in Navy R&D laboratories.

The Acquisition Cycle

The acquisition cycle begins with identification of mission needs and culminates in deployment and maintenance of weapon systems. The Office of Management and Budget (OMB) has established a policy for major system acquisition by Federal agencies which provides that the agencies will:

1. Express needs and program objectives in mission, not equipment, terms.

2. Encourage innovation and competition in creating, exploring, and developing alternative system design concepts.
3. Allow competitive exploration of alternative system design concepts in response to mission needs.
4. Establish clear lines of authority, responsibility, and accountability for management of major system acquisition programs, with agency head approval required at key decision points in the evolution of each acquisition.

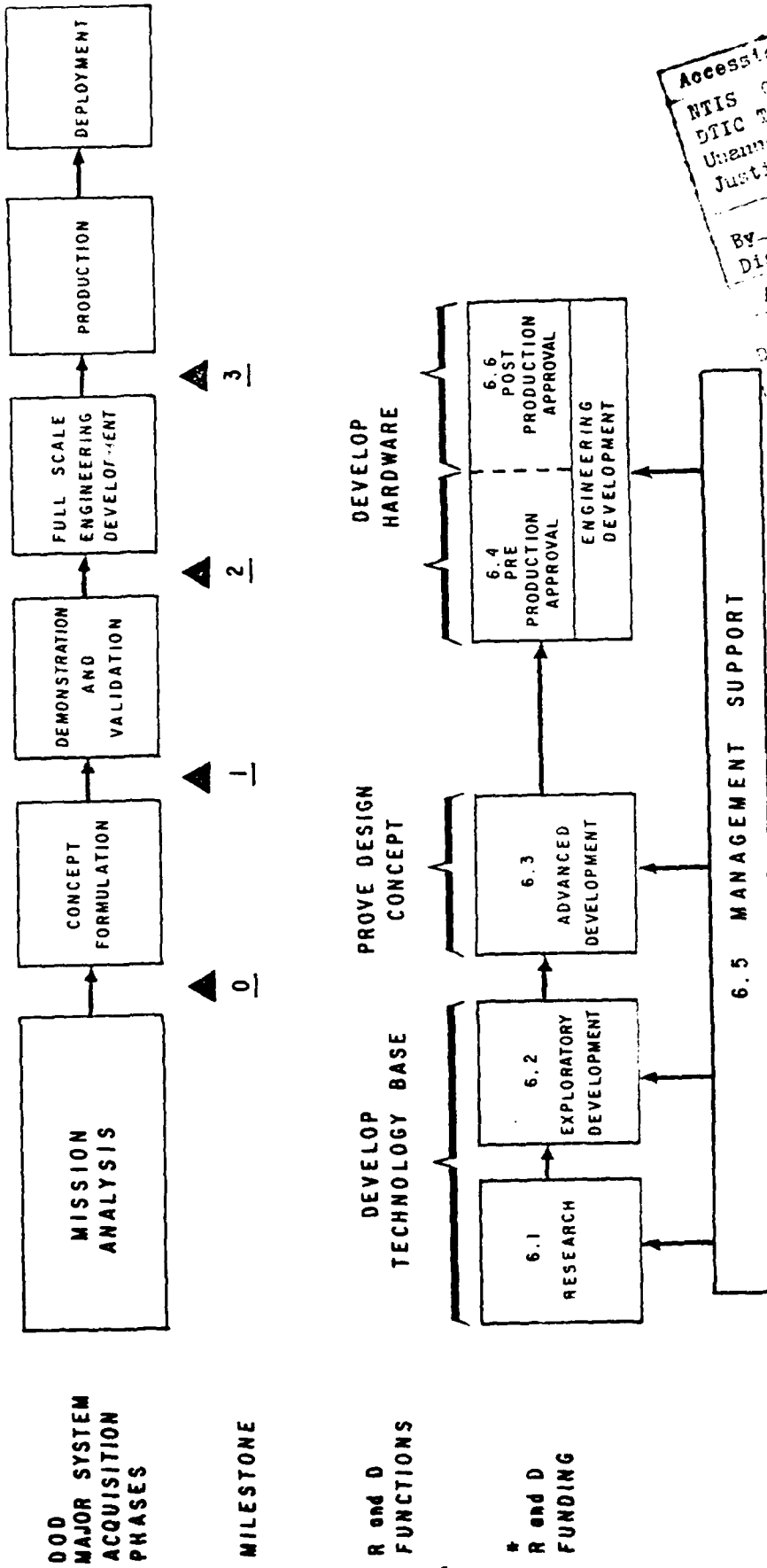
DoD's implementation of this basic Federal policy provides that non-major systems will be governed by the same general rules.

Figure 1 depicts the acquisition cycle and related R&D functions. The process begins with the identification of needs or deficiencies in the Navy's capability to perform assigned missions. The available technology is then screened to determine whether a potential solution exists. When that technology holds sufficient promise of successful application to the need or deficiency, a program is initiated and funded. The milestones shown in Figure 1 are the key decision points. For major programs these decisions require approval by the Secretary of Defense.

The need for senior levels of approval at various points in the acquisition process has resulted in the establishment of advisory councils and a series of prescribed documents to support the decision making process. For administrative management purposes, Navy programs are divided into a series of Acquisition Categories (ACATs), based on the size and importance of the program. Program thresholds and the associated approval levels of the Navy's ACATs are shown in Figure 2.

The method by which acquisition plans and programs obtain the necessary resources within the DoD (and within each military service) is governed by the DoD Planning, Programming and Budgeting System (PPBS). The key to this system is a continuously updated Five-Year Defense Program (FYDP). The FYDP is the official statement of the

FIGURE 1
ACQUISITION CYCLE WITH R and D FUNDING



- * BUDGET SPONSORS
- 6.1 CNR
 - 6.2 CNO
 - 6.3 OP-098
 - 6.4 OP-098
 - 6.5 OP-098
 - 6.6 OP-098

Accession For
NTIS Special
DTIC Tab
Unannounced
Justification

By _____
Distribution/
Availability _____
Dist Avail and/
Special _____

FIGURE 2

ACQUISITION CATEGORIES (ACAT)

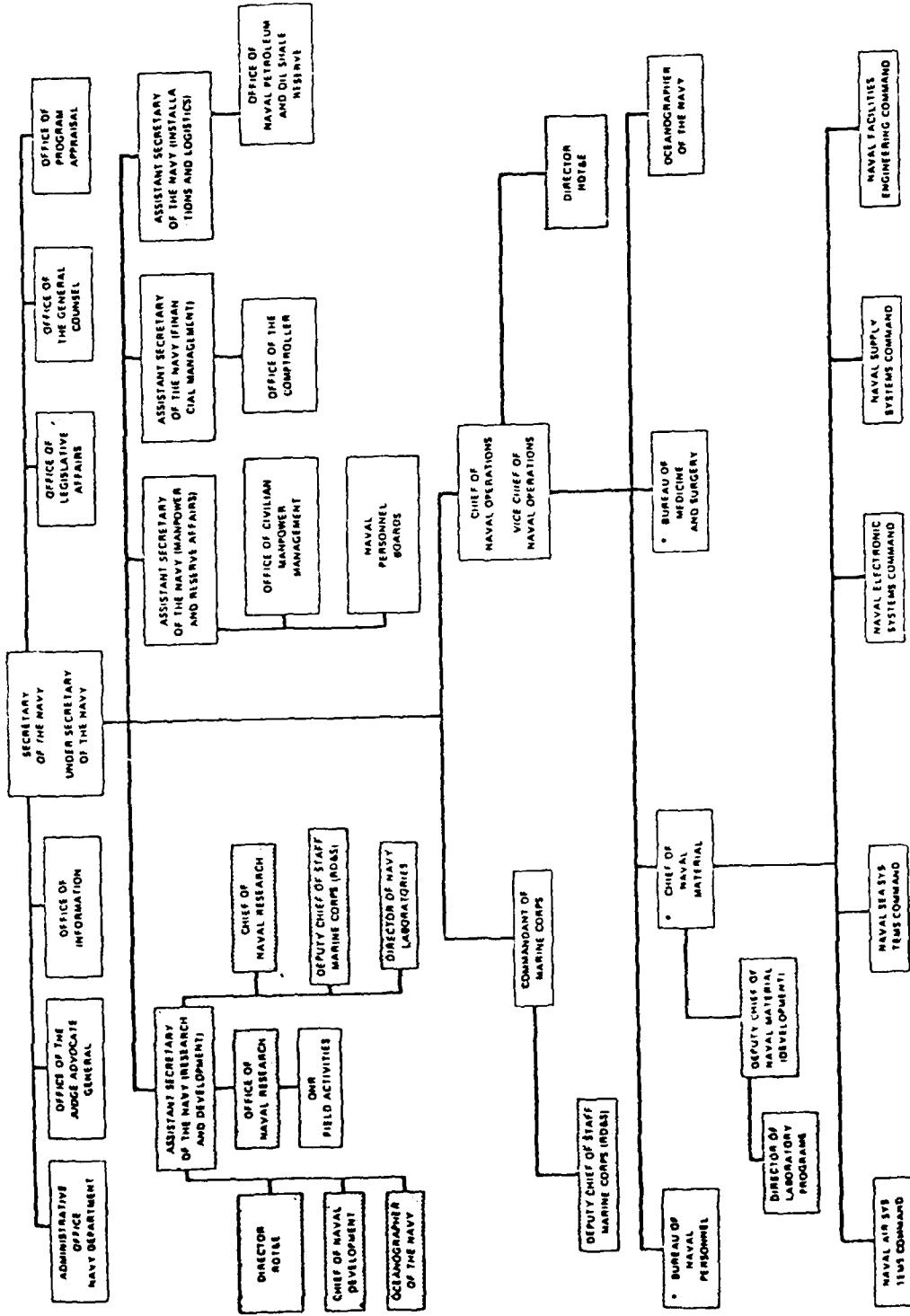
<u>ACAT</u>	<u>DECISION AUTHORITY</u>	<u>REVIEW BOARD</u>	<u>DECISION DOCUMENT</u>	<u>NORMAL DOLLAR VALUE THRESHOLD</u> <u>RDTEP: Production</u>	<u>CRITERIA</u>
I	SECDEF	DSARC	DCP	75M 300M	Any program designated by SECDEF based on dollar value, public interest, sensitivity, and/or technical risk.
IIA	SECNAV	DNSARC	NDCP	50M 200M	ACAT I programs returned to SECNAV decision authority and any lesser program designated by SECNAV.
IIB	CNO	CEB/ARC	NDCP	50M 200M	ACAT IIA programs returned to CNO decision authority and programs recommended by OP-090, OP-098, DCNO/PSMO, and/or CINAVMAT. Any lesser program designated by CNO.
III	DCNO/DMSO (Program Sponsor)	ARC	NDCP	10M 40M	ACAT IIB programs returned to DCNO/DMSO by CNO and programs recommended by CINAVMAT or the Developing Agency. Any lesser program designated by DCNO/DMSO.
IV	CNM	ARB	NDCP	<10M 40M	All programs not designated ACAT I, IIA, IIB or III.

DoD's plans and programs. It is the result of a highly complex process to allocate the anticipated available resources (people, materials, services and money) to the national security objectives of the United States. DoD Instructions 7045.7 and 7045.8 establish the procedural guidance for this planning/resource allocation system. Individuals involved in technology development must recognize that plans are made and resources allocated over a five-year cycle and that the timely exploitation of emerging technologies must be fitted into the FYDP cycle.

The Navy Research And Development Process

Navy R&D efforts are aimed at developing the scientific and technical information needed to produce and maintain the weapon systems and other hardware required for meeting Navy mission responsibilities. The Navy headquarters organization for R&D is shown in Figure 3.

The Navy's primary guide for establishing R&D projects is its R&D plan. This plan (which reflects the FYDP) is maintained by the Director, Research Development Test and Evaluation (DRDT&E), (OP-098) and states Navy needs in the form of Science and Technology Objectives (STOs) and approved operational requirements (ORs). STOs describe, in broad terms, the Navy needs and problems requiring R&D solutions, and are based on the Navy's objectives and the threats anticipated within the next 10 to 20 years. ORs are concise statements of operational needs. While STOs engender efforts to increase the technology base, ORs engender the R&D effort necessary for applying new technologies. To be consistent with the concepts and the terminology used in the OMB policy guidance for major systems acquisition, the Navy is in the process of substituting the use of Mission Element Need Statements (MENS) for ORs. The MENS express a need



*DDAS - Also responsible for R&D in CMC for Marine Corps needs

FIGURE 3 - Department of the Navy Headquarters Organization for R&D (Principals for R&D highlighted)

for new or improved capability in terms of mission; Operational Requirements state needs for operational hardware.

In addition to the Navy R&D plan, Fleet needs and deficiencies are reported in Fleet Exercise Reports, Board of Inspection and Survey (INSURV) Reports, Commander-in-Chief (CINC) Reports, Fleet Readiness Reports, and Fleet Commanders' Semi-Annual Deficiency Reports. Scientists and engineers engaged in Exploratory Development effort should be familiar with the R&D program goals, and be aware of changes in requirements and threat assessments affecting their discipline.

For budget and control purposes, there are six categories of R&D (6.1 through 6.6). This paper addresses the transition of work from Category 6.2 to 6.3. Category 6.2, Exploratory Development, includes all efforts directed toward the solution of specific military problems, short of major development projects. It links new knowledge and purposeful development based on that knowledge. Category 6.2 efforts vary from fundamental applied research to sophisticated breadboard hardware, programming, and planning efforts. The category includes studies, investigations, and minor development efforts. Category 6.3, Advanced Development, includes all effort directed toward projects which have moved into the development of hardware for test. It also includes efforts directed toward proving technology feasibility. The prime result of this type of effort is proof of design concept, rather than the development of hardware for service use. In unusual cases, especially those where there is an urgent need, a project may move directly from Category 6.2 to 6.4.

The following definitions of R&D categories are taken from the Defense Acquisition Regulation (DAR) 4-101:

Research (6.1)

Includes all effort of scientific study and experimentation directed toward increasing knowledge and understanding in those fields of the physical, engineering, environmental and life sciences related to long-term national security needs. It provides fundamental knowledge required for the solution of military problems. It forms a part of the base for (a) subsequent exploratory and advanced developments in defense related technologies, and (b) new or improved military functional capabilities in areas such as communications, detection, tracking, surveillance, propulsion, mobility, guidance and control, navigation, energy conversion, materials and structures, and personnel support.

Exploratory Development (6.2)

Includes all effort directed toward the solution of specific military problems, short of major development projects. This type of effort may vary from fundamental applied research to sophisticated bread-board hardware, study, programming and planning efforts. It would thus include studies, investigations and minor development effort. The dominant characteristic of this category of effort is that it be pointed toward specific military problem areas with a view toward developing and evaluating the feasibility and practicability of proposed solutions and determining their parameters.

Advanced Development (6.3)

Includes all effort directed toward projects which have moved into the development of hardware for test. The prime result of this type of effort is proof of design concept rather than the development of hardware for service use. Projects in this category have a potential military application.

Engineering Development (6.4)

Includes those projects in full-scale engineering development for Service use but which have not yet received approval for production or had production funds included in the DoD budget submission for the budget or subsequent fiscal year. This area is characterized by major line item projects, and program control will be exercised by review of individual projects.

Management and Support (6.5)

Includes all effort directed toward support of installations or operations required for general research and development use. Included would be military construction of a general nature unrelated to specific programs, maintenance support of laboratories, operation and maintenance of test ranges, and maintenance of test aircraft and ships. Costs of laboratory personnel, either in-house or contract-operated, would be assigned to appropriate projects or as a line item in the Research, Exploratory Development, or Advanced Development Program areas, as appropriate.

Operational System Development (6.6)

Includes those projects still in full-scale engineering development but which have received approval for production through DSARC or other action, or production funds

have been included in the DoD budget submission for the budget or subsequent fiscal year. All items in this area are major line item projects which appear as RDT&E Costs of Weapons Systems Elements in other programs. Program control will thus be exercised by review of the individual projects.

Note that the transition from Category 6.2 to 6.3 generally involves a move from the development of a technology to its more specific application. It is between Category 6.2 and 6.3 that acquisition programs as such are initiated. Funding of work in Category 6.2 is identified as technology development in the budget process. Funding of work in Category 6.3 is identified to specific programs and shown as such in the budget submissions to the Congress. The transition from Category 6.2 to 6.3 can occur in a time span ranging from just prior to Milestone O through Milestone 1. When the transition from Category 6.2 to 6.3 takes place, the Navy budget sponsor changes from the Chief of Naval Development to the Office of Director, Research Development, Test and Evaluation in CNO.

The remainder of this paper addresses the documentation and review procedures necessary for transitioning work from Category 6.2 to 6.3.

THE TRANSITION PROCESS

The method by which specific projects move from Category 6.2 to 6.3 or 6.4 generally reflects both the reason the effort was initiated and the magnitude of the project. Exploratory Development efforts generally respond to STOs, that is, to needs and problems anticipated 10 to 20 years in the future. When a technology being developed under an Exploratory Development program appears ready to enter Advanced Develop-

ment within the next five years, an Advanced System Concept (ASC) is prepared by the cognizant scientist or engineer. This document, accompanied by a Master Information Paper Summary (Mini-MIP), is forwarded via the appropriate Systems Command (SYSCOM) or the Office of Naval Research (ONR) to the Chief of Naval Development (CND). Accepted ASCs are ranked by the SYSCOM or ONR in order of contribution to improved mission effectiveness. CND publishes a compendium of accepted ASCs in the Navy Advanced Concepts (NAC). In the annual budget process, CNO (OP-098) selects a number of these concepts for initiation of Advanced Development projects.

Currently, ORs are required for all Advanced and Engineering Development programs (Categories 6.3 and 6.4 respectively). It is presumed that this requirement will be changed to a MENS in the forthcoming revision of OPNAV Inst. 5000.42A. Ordinarily, ORs are initiated by OPNAV or other Fleet sources in response to perceived operational need. However, published ASCs may precipitate preparation of, and serve as input to, ORs to take advantage of an emerging technology. If an OR for the emerging technology has already been promulgated, the ASC is not required. In this situation, just a Mini-MIP may be submitted to the Mission Sponsor via the appropriate SYSCOM or ONR.

In response to the OR, the Chief of Naval Material (CNM), together with the SYSCOMs and the laboratories, prepares a Development Proposal (DP) which presents alternatives and tradeoffs to achieve a particular range of capabilities. The DP constitutes the producer's (NAVMAT) proposed alternatives to meet the user's (CNO) requirement as set forth in the OR.

CNO reviews the DP, selects the desired alternative, and issues a Navy Decision Coordinating Paper (NDCP). Depending on the dollar value and level of interest, an

approved NDCP either authorizes the start of a new ACAT II, III, or IV program in Category 6.3 or 6.4, or becomes the basis of a Decision Coordinating Paper (DCP) which goes to the Secretary of Defense for approval of an ACAT I program in Category 6.3 or 6.4.

When ASCs are not recommended for inclusion in the NAC, the originator is advised of the reasons for rejection. Similarly, originators are advised of the CNO's suggested course of action for each ASC included in the NAC.

In some areas of technology, ASCs may be accepted and used to generate an NDCP without resort to ORs or DPs. In such cases, the laboratory input to the NDCP preparation may be significant.

The following paragraphs explain the preparation and processing of the supporting documentation required for transition from Category 6.2 to 6.3.

Documentation

The following table is a quick guide to locating Navy guidance on the documents discussed above.

<u>Document</u>	<u>Instruction</u>
ASC	NAVMATINST 3910.20 (Chapter 10)
Mini-MIP	NAVMATINST 3910.20 (Chapter 4)
NAC	NAVMATINST 3910.20 (Chapter 10)
MENS	DOD Inst. 5000.2
OR	OPNAVINST 5000.42A
DP	OPNAVINST 5000.42A, NAVMATINST 5000.22A
NDCP	OPNAVINST 5000.46
NDCP (Abbreviated)	DRDT&E Memo Ser 987/6500028 of 24 Aug 1978
DCP	OPNAVINST 5000.46

Advanced System Concept (ASC): An ASC is a concise description of a proposed technological solution to an operational problem. Information from Navy, Marine Corps, and other sources (including industry) may be used to prepare ASCs. The ASC should address a particular Navy and/or Marine Corps operational need or problem, or offer an opportunity for a specific new capability for the operating forces. Each ASC must be accompanied by a Mini-MIP, which is basically a summary of the ASC, and be submitted to the appropriate SYSCOM/ONR for review and approval. ASCs that may substantially reduce a serious military deficiency or promise attainment of a significant new capability should be proposed for initiation as a new project in the NAC (see below).

ASCs (with Mini-MIPs) are submitted by their originators to the SYSCOMs and ONR, who forward no more than 30 ASCs to CND for consideration semiannually; i.e., by 1 March and 1 August each year. These submissions reflect a perception of the most needed improvements in Navy operating capabilities. CND reviews the ASCs and compiles the NAC.

Key dates for ASC submission and review are as follows:

1 March	Deadline for ASC submission
30 April	NAC review by MAT 08T
1 June	NAC published
1 August	Submission of new high priority ASCs
15 October	Approved ASC supplement to NAC published

Key Points to Remember When Preparing an ASC:

- (1) Only those ASCs that may substantially reduce a serious military deficiency or promise attainment of significant new capability will generally be considered for initiation as a new project by CND.
- (2) The ASC is limited to seven pages including figures and tables. The Mini-MIP is limited to one page.

- (3) The ASC must conform to the ASC submission format.
- (4) ASC language must be simple, clear, and concise.
- (5) The ASC must contain a Mini-MIP.
- (6) Submission of ASCs must be in accordance with the ASC/NAC schedule.

For guidance on ASC preparation including ASC format, a checklist, and a more detailed ASC schedule, see Chapter 10 of NAVMATINST 3910.20, "Exploratory Development Program Management Manual," and Chapter 4 of the same instruction for the Mini-MIP format for Exploratory Development.

Navy Advanced Concepts (NAC): NAC is a compendium of selected ASCs ready for transition to Advanced Development within five years. NAC is submitted by CND annually to CNO/CMC. Since the objective of the NACs is to provide candidate concepts for initiation as new starts within a five-year period, items already in the FYDP should not be submitted for the NAC.

Guidance on the NAC/ASC relationship is given in Chapter 10 of NAVMATINST 3910.20, "Exploratory Development Program Management Manual."

Mission Element Need Statement (MENS): A MENS is a statement prepared by a DoD component to identify and support the need for a new or improved mission capability at a dollar or interest level requiring approval by the Secretary of Defense. It is submitted to the Secretary of Defense for a Milestone O decision. When approved, it engenders the exploration and development of alternative system concepts to satisfy the need. The content of the MENS is prescribed in DoD 5000.2.

Operational Requirement (OR): An OR is a concise statement of operational needs. It has been the basic requirements document for all Navy acquisition programs requiring R&D effort. The purpose of the OR is to initiate a conceptual effort to meet an operational need. The OR solicits DPs from the Naval Material Command or SYSCOMS,

as appropriate. The format of an OR is presented in OPNAVINST 5000.42A, "Weapon Systems Selection and Planning." Impending changes to this instruction will reflect the substitution of the MENS for the OR.

Development Proposal (DP): The DP is a formal response to an OR, prepared by CNM/SYSCOM. The DP presents a range of technical alternatives and tradeoffs to achieve the operational capability called for in the OR. It also provides an analysis of the appropriate technical and economic information to aid in the selection of the alternative concepts to be further explored. The DP forms the basis for the NDCP or DCP, depending on the thresholds and/or degree of interest in the program. The format of a DP can be found in OPNAVINST 5000.42A, "Weapon Systems Selection and Planning." A DP review checklist can be found in NAVMATINST 5000.22A, "Weapon System Selection and Planning."

Navy Decision Coordinating Paper (NDCP): The NDCP is the Navy acquisition management document which supports and promulgates the SECNAV/CNO decision to initiate a development program and establish an appropriate advanced or engineering development line item. Approved NDCPs authorize program starts and subsume associated DPs. For an ACAT I program, the NDCP will serve as the basis for the DCP. The NDCP format is the same as that of the DCP. In practice, the NDCP has developed into an elaborate document which is unnecessary for many programs, especially those in ACAT III and IV. For these kinds of programs, an abbreviated NDCP is used.

Specific guidance on the preparation and format of the NDCP can be found in OPNAVINST 5000.46, "Preparation and Processing of DCPS, PMs, and NDCPs." Guidance on the abbreviated NDCP can be found in DRDT&E memo Ser 987/650028 of 24 August 1978, "Guidance for Preparation of NDCPs for Small Programs."

Decision Coordinating Paper (DCP): The DCP is a decision document, not more than 20 pages long, designed to provide the DEPSECDEF and his DSARC principals with essential program information. It is the principal document for recording and promulgating major program decisions and SECDEF guidance therein. Guidance on the preparation and format of the DCP is given in OPNAVINST 5000.46, "Preparation and Processing of DCPS, PMs, and NDCPs."

Relationship With Sponsors:

The preceding guidance relates to the formal process for transitioning projects from Category 6.2 to 6.3. Another important aspect of that process is the interface between laboratory personnel and the various R&D sponsors in the Navy.

Laboratory personnel should be familiar with the Navy activities sponsoring R&D efforts and maintain close liaison with appropriate personnel. Technological progress data should flow from the laboratory to the sponsor, and technological needs data from the sponsor to the laboratory. Adequate liaison between sponsors and engineers/scientists can lessen the possibility of developing technological advances which have been rendered unnecessary by changing requirements, changing threat assessments, or advances in other disciplines.

While formal communications from the engineer/scientist to the R&D sponsor can be maintained by the Research and Technology Work Unit Information System (DD 1498) and the Research and Development Planning Summary (DD 1634), regular informal exchanges of progress and requirements are encouraged.

The particular sponsoring activities with which laboratory personnel should be familiar are:

1. The Deputy Chief of Naval Operations or Major Staff Office in OPNAV which is the program sponsor for the exploratory development effort being conducted (OP-01, 02, 03, 05, 095).
2. The Division of the Navy RDT&E Appropriation Sponsor (OP-981, 982, 983, 985, 986) applicable to the Exploratory Development effort (the money people).
3. The Project Manager or Systems Command office directly providing the funding for the Exploratory Development effort being conducted.

Maintenance of close liaison with sponsoring activities will generally ensure responsiveness to current operational needs. It will facilitate communication of changes in requirements or other needs that may affect the course of an R&D program. When a

technology is maturing, close liaison with the sponsors is essential to determine whether or not an ASC is required, and whether the DD 1634s and DD 1498s are understood. Once the ASC is submitted, open communication can enhance understanding of the proposed technology. If the ASC is published, the extent to which laboratory personnel will participate in the preparation of NDCPs and DCPs may be increased, and the effectiveness of their inputs will be greater if communication channels have already been established.

GLOSSARY

ACAT	Acquisition Category
ASC	Advanced System Concept
CMC	Commandant of the Marine Corps
CND	Chief of Naval Development
CNM	Chief of Navy Material
CNO	Chief of Naval Operations
DA	Developing Agency
DCP	Decision Coordinating Paper
DLP	Director of Laboratory Programs
DNL	Director of Navy Laboratories
DNT	Director of Navy Technology
DP	Development Plan
DRDT&E	Director, Research, Development, Test & Engineering (OP-098)
DSARC	Defense System Acquisition Council
EDP	Exploratory Development Program
EDPP	Exploratory Development Program Plan
FYDP	Five Year Defense Program
GOR	General Operational Requirement
IED	Independent Exploratory Development
INSURV	Board of Inspection and Survey
IOT&E	Initial Operational Test & Evaluation
IR&D	Independent Research & Development
LPS	Laboratory Program Summary
MENS	Mission Element Need Statement
MINI-MIP	(RDT&E) Master Information Paper Summary
NAC	Navy Advanced Concepts
NDCP	Navy Decision Coordinating Paper
NIF	Navy Industrial Fund
NMC	Naval Material Command
OMB	Office of Management and Budget
ONR	Office of Naval Research
OPNAV	Office of the Chief of Naval Operations
OR	Operational Requirement
OI&E	Operational Test & Evaluation
PE	Program Element

PEA	Program Element Administrator
PEDS	Program Element Descriptive Summary
PM	Project Manager, Project/Program Memorandum
POM	Program Objectives Memorandum
PPBS	Planning, Programming and Budgeting System
R&D	Research & Development
RD&E	Research, Development & Engineering
RD&S	Research, Development & Studies
RDТ&E	Research, Development, Test & Evaluation
RDТ&E,N	Navy Research, Development, Test & Evaluation
SAR	Selected Acquisition Report
STO	Science & Technology Objective
SYSCOMS	Systems Commands
TAD	Technology Area Description
TAP	Task Area Plan

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