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UNITED STATES NAVY

CHIEF OF NAVAL OPERATIONS

MILITARY MANPOWER VERSUS HARDWARE PROCUREMENT STUDY

(HARDMAN)

FINAL REPORT

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
WASHINGTON, D.C. 20350

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Subj: Military Manpower Versus Hardware Procurement (HARDMAN) Report; promulgation of

Encl: (1) Military Manpower Versus Hardware Procurement (HARDMAN) Study Report

1. The HARDMAN Study was initiated to analyze the compatibility of the manpower and training requirements determination functions with the Weapons Systems Acquisition Process (WSAP), the institutionalized setting in which all man/machine or capital/labor tradeoffs must occur.

2. The study, forwarded as enclosure (1), concludes that manpower/hardware tradeoffs occur too late in the WSAP; that key participants in the WSAP lack incentives with respect to determining and insuring visibility for manpower and training requirements; that WSAP related functions such as test and evaluation and logistic support planning are not always consistent with requirements for manpower/training planning. The study discusses procedural changes needed and proposes an analytic plan for improving the WSAP process.

3. The study recommends that a HARDMAN Project Office be established to ensure manpower issues are properly integrated into the WSAP; that hardware/manpower tradeoff capabilities be developed to support early identification of manpower requirements; that analytical tools and review procedures be implemented to support HARDMAN functions; that a reporting and control system for HARDMAN functions in the WSAP be implemented; that HARDMAN improvements be developed through revised procedures and a HARDMAN information system.

4. The study further recommends a specific allocation of resources (dollars and billets) to accomplish its recommended procedures. Some Navy reviewers of the study believe that its resource recommendations are not adequately justified by study documentation. Others believe that the HARDMAN resource recommendations are logically derived. All would agree if HARDMAN recommendations are implemented, the effort should be carefully reviewed annually to ensure that goals of the program are being achieved at minimum cost.

D. C. Davis

D. C. DAVIS
Director
Navy Program Planning

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INTRODUCTORY NOTE

This final report on the HARDMAN study is based, in part, on the formal weapon system acquisition process and Navy organization existing in 1976 when this study was conducted. During that period and since, there have been significant changes.

For one, procurement policies at the Federal and DoD levels have been under review and modification. The Office of Management and Budget in August 1976 issued Circular No. A-109, concerning major system acquisitions, and, early in 1977, Circular No. A-11, concerning fiscal year guidance for 1979 budget submissions. Partly in response, DoD 5000.1 and DoD 5000.2 directives on the procurement process were revised to reflect these policy changes.

For another, the Naval Material Command has undergone major reorganization providing an organizational framework which may be more responsive to the needs of manpower/training requirements determination.

The findings and recommendations in this report retain their validity. In some instances, proposed actions are already the subject of new policy and new initiatives stemming from these changes.

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EXECUTIVE SUMMARY

A. Problem

The Weapon System Acquisition Process (WSAP), currently committing more than $90 billion in procurement dollars, has been subject to extensive specification and control. This formal process, however, is striking for its lack of explicit recognition of the manpower and training implications associated with weapon system development.

With the recent dramatic increases in manpower costs within the Department of Defense and the prospective reductions in the size of the national labor pool, there has been a new impetus on the part of policy-makers to assess.manpower and training requirements in terms of their affordability and availability during weapon system development.

In 1976, concerns voiced by a variety of organizations including the Congress, DoD, and the Navy focused on the ability of planners to adequately anticipate, identify and program manpower and training requirements and resources.[1] During POM-78, the Chief of Naval Operations (CNO) directed the DCNO (Manpower) (OP-01) and the DCNO (Program Planning) (OP-090) to develop a plan to improve the management and control of Navy manpower requirements growth.

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[1] Senate Armed Services Report No. 94-878
Deputy SECDEF Memorandum to Service Secretaries, Feb. 28, 1976
CNO Policy Statement for POM's-77, 78, 79

In response to this direction, the "Military Manpower versus Hardware Procurement Study" (HARDMAN) was established as part of the CNO Studies and Analysis Program (CSTAP76/7T) to study the problem and develop recommendations to insure that manpower and training requirements, analysis and review procedures and methodologies would be integrated into the WSAP planning process.

The problem addressed in the HARDMAN study is two-fold. First, determination, identification and programming of the manpower and training resources often do not occur until late in hardware system development; as a result, there is a frequent inability to supply sufficient numbers of qualified, properly trained personnel to meet operational requirements in timely fashion.

Second, manpower is treated in a responsive mode. Hardware design determines manpower requirements rather than an iterative procedure in which manpower requirements influence equipment design and vice-versa. Supportability of manpower requirements is often not addressed before the program decisions concerning new weapon systems are made.

A not uncommon piece of folklore, or perhaps reality, is that if all systems currently under development are deployed, there will not be sufficient manpower to support the weapon systems. In fact, no one seems to really know.

The final report, prepared with contractor support by the System Automation Corporation, presents the findings and recommendations of the HARDMAN study. Procedures have been identified, along with analytical tools and supporting methodologies, which are complementary to the WSAP and which will ensure that manpower and training information is available to the CEB and the DNSARC. The procedures call for OP-01 to play a monitoring role - ensuring that the supportability of manpower and training requirements is explicitly considered throughout the acquisition decision-making process.

These procedures will enable the DCNO (Manpower) to play a more active role in early system planning. The formalization of this approach and the standardization of procedures will provide for more credible and responsive planning actions.

While the thrust of the HARDMAN study was to identify as early in the development cycle as possible manpower and training support requirements for supportability assessment and system tradeoff, it is recognized that effective planning by itself will not ensure more effective utilization of manpower and training resources. Effective programming, budgeting and execution are also essential.

B. Purpose of Study

The CNO directed the HARDMAN study be conducted to analyze the current manpower and training requirements reporting and review structure as it applies to the systems acquisition process and to develop, to the extent necessary, a new manpower and training requirements, analysis and review process which could be integrated into the acquisition process. The study's principal objective was to:

INSURE EXPLICIT CONSIDERATION OF MANPOWER/TRAINING RESOURCE REQUIREMENTS EARLY IN THE WEAPON SYSTEM ACQUISITION PROCESS.

As such, the study was divided into four main tasks:

Task	Purpose
1	To describe the existing WSAP and to evaluate its strengths and weaknesses (especially as related to manpower and training requirements, reporting, and review procedures);
2	To identify improvements to the reporting and review structure of the WSAP;
3	To develop an implementation plan for improvements and to determine the marginal resource requirements;
4	To prepare a final report describing the major findings and recommendations.

C. Findings

As a result of the analysis, the HARDMAN study found that:

- requirements for manpower planning and tradeoff analysis in the WSAP occur too late and fail to address the major issues;

- DoD and DoN directives and instructions concerning WSAP are piecemeal and fail to reflect a systematic statement of procurement policy and guidance for managers to follow.
- Key participants in the acquisition process often lack the analytical tools for determining and insuring visibility for manpower and training requirements early in system development.

These and related findings provide considerable rationale for improving the WSAP with respect to the treatment of manpower and training resources. Specific effort in the study focused on developing modified resource requirements determination, analysis, reporting and review procedures which fully integrate manpower/training considerations into the acquisition process.

D. Recommendations

The basic findings of the HARDMAN study and the importance of improving the WSAP with respect to the treatment of manpower and training planning have resulted in the following recommendations:

- Establish a HARDMAN Project Office with the mission to insure that manpower and training analysis is conducted timely during the WSAP;
- Develop HARDMAN capabilities to support the early identification and review of manpower and training requirements;
- Implement analytical tools and review procedures supporting HARDMAN functions;
- Implement a reporting and control system for HARDMAN functions in the WSAP;
- Develop HARDMAN improvements through revised procedures and a HARDMAN Information System.

E. HARDMAN Improvements

HARDMAN improvements to the WSAP consist of procedural changes and a supporting information system. The new HARDMAN procedures will:

- Ensure identification of manpower and training requirements early in the WSAP
- Provide incentives for major WSAP participants to fulfill their responsibilities
- Provide for explicit organizational responsibility for the conduct of manpower and training requirements analysis associated with weapon system development

The procedures also feature expanded roles for OP-01 and OP-99 through the WSAP.

The HARDMAN Information System is composed of three major subsystems:

- Reporting and Control
- HARDMAN Analysis
- Required Documents Processing

The Reporting and Control subsystem focuses on the capture and reporting of key milestone data for all weapon systems throughout the WSAP, and will enable OP-01 and OP-99 to determine the status of all systems under development as well as related manpower/training requirements and analysis. The HARDMAN Analysis portion of the information system will support the identification of manpower and training requirements as well as life cycle costing and tradeoff analysis. HARDMAN Analysis will be performed during all phases of the WSAP, becoming more detailed and precise as the WSAP progresses. Required Documents Processing then occurs in the later stages of the WSAP, and involves automated capture of key data elements for use in documents such as Navy Training Plans and Ship Manpower Documents, and automated typing for production of the documents.

F. HARDMAN Implementation Plans

An OP-01 HARDMAN Project Office would be created to coordinate the system development, and to assume increasing responsibilities as the system becomes operational. Manning requirements will be approximately fifteen billets by the end of the first year, and would increase in future years as the scope of HARDMAN expands. Some of the HARDMAN Project Office missions would be the following:

- To coordinate and monitor activities of the HARDMAN development including laboratories and contractors;
- To serve as the staff coordinator to the CEB and DNSARC with respect to coordinating the presentation of manpower/training planning analysis;
- To ensure that HARDMAN procedures are adequate;
- To monitor system development progress based on the reporting and control milestone reports;
- To ensure that POM proposals are compatible with aggregate resource requirements and long-term projections resulting from HARDMAN.

The recommended implementation plan calls for a phased approach over seven years of development activities which include the following:

- Develop and Implement Requirements Determination Procedures

  Develop procedures for determining HARDMAN information requirements, evaluating their use, and distributing instructions and guidance to program staff engaged in meeting those information requirements.

- Develop and Implement Analytical Techniques for HARDMAN Analysis

  Develop methodologies for life cycle costing, manpower/training requirements determination, and hardware vs. manpower/training tradeoffs.

- Develop and Implement Review Procedure

  Develop procedures for reviewing HARDMAN analysis and provide required training and documentation to support review.

- Develop a HARDMAN Reporting and Control System

  Design, develop and implement computer-based reporting and control system to monitor the status of all weapon systems and track the completion of HARDMAN analyses.

- Develop Required Document Processing

  Develop appropriate text processing capabilities to support the preparation of required documents which can be developed extensively based on the HARDMAN data base.

G. Costs and Benefits

The cost of HARDMAN improvements to the WSAP will be:

- $10.2 million over seven years for development of HARDMAN capabilities
- 30 billets for operation of HARDMAN, some of which can be reprogrammed
- $200,000 annually for HARDMAN computer support

The major benefit resulting from HARDMAN improvements to the WSAP will be:

- Early consideration of manpower and training issues in the WSAP so that effective tradeoffs between hardware design and manpower can be made.

Other benefits include:

- the ability to monitor the status of all weapon systems and associated manpower/training requirements in the acquisition process
- the ability to produce standard Navy documentation more quickly and efficiently
- overall coordination and monitoring of the manpower/training aspects of weapon system development

H. Report Organization

The final report consists of seven chapters and supporting appendices. Chapter I provides an introduction including a discussion of the purpose and a more detailed overview of the report. Chapter II presents an analysis of the weapon system acquisition process with specific attention devoted to the manpower/training planning aspects of the process.

This analysis provides the basis for identifying improvements to the acquisition process. The recommended improvements focus on two areas: 1) procedures and 2) a supporting information system. Procedural improvements are discussed in Chapter III, while the information system is described in Chapter IV.

Chapter V identifies alternative implementation plans for developing HARDMAN capabilities as well as for performing the recommended functions and operating the information system support. Chapter VI outlines a recommended plan of action and discusses the marginal resource requirements.

The last chapter summarizes the study with respect to its major conclusions, recommendations, benefits, and costs. Finally, the appendices provide further amplification and detail concerning the issues discussed in the body of the report.

CHAPTER I

INTRODUCTION

A. Purpose of this Report

This is the final report describing the findings and recommendations of the HARDMAN Study. The purpose of this report is two-fold; first, to present a detailed analysis of the manpower and training planning activities in the Weapon System Acquisition Process (WSAP), and secondly, to provide a planning document for implementation of new procedures and information systems to allow for earlier and more effective consideration of manpower/training requirements, analysis, reporting,and review in the WSAP.

B. Background

The U.S. Navy, like the other military services, engages in a weapon systems acquisition program on a continuous basis. The purposes attached to the acquisition program include modernization, upgrading, and replacement of equipment. Navy weapon systems procurement is dominated by large systems, particularly ships and aircraft. In addition, there are numerous smaller systems which are also subject to the acquisition process. All told, there are currently 700 different Navy projects involving approximately $90 billion in procurement.

There has been a continuing concern on the part of Navy planners with respect to their capability to adequately anticipate as well as meet the manpower and training requirements associated with these weapon systems. Too often, explicit identification of manpower and training requirements is excluded during the early acquisition stages in order to avoid exceeding thresholds for management review. A not uncommon piece of folklore, or perhaps reality, is that if all systems currently under development are deployed, there will not be sufficient manpower to support the weapon systems. In fact, no one seems to really know.

Another important aspect of the Weapon System Acquisition Process emphasizing the need for early consideration and analysis of manpower and training requirements is that when a proposed system has only gone through the conceptual phase, a substantial portion of the life cycle costs have already been predetermined. Consequently, very early during the development of a weapon system, the costs and resource commitment, particularly for manpower and training, have already been made.

Out of these circumstances, a study of military manpower versus hardware procurement (HARDMAN) was established as part of the CNO Studies and Analysis Program FY 1976/7T (CSTAP 76/7T). Contractor support was provided by System Automation Corp. Appendix A contains the study directive and plan.

The objectives of the HARDMAN Study were to evaluate the existing manpower/training planning process associated with weapon system acquisition and to develop more effective ways in which to insure early and complete consideration of the tradeoff between manpower/training requirements analysis and equipment design. Improvements to the existing reporting and review process are proposed which when integrated into the acquisition process will provide a means to manage and control manpower requirements growth.

The HARDMAN Study was performed over a ten month period. The work was divided into four tasks:

Task	Purpose
1	To describe the existing Weapon System Acquisition Process and to evaluate its strengths and weaknesses;
2	To identify improvements to the reporting and review structure of the WSAP;
3	To develop an implementation plan and determine the marginal resource requirements;
4	To prepare a final report describing the major findings and recommendations.

The first three tasks each culminated in working papers which were reviewed during the course of the study by the project study and advisory groups. This final report is based on those earlier papers.

C. Current Navy Weapon Systems and Manpower/Training Planning Activities

The overall activities presented in this report must be viewed in the context of the current acquisition program within the Navy. This includes approximately 700 projects which can be classified by Acquisition Category (ACAT).[1] In some cases, they represent systems such as the CVN-68 which involves total expenditures of over one billion dollars, while others such as the Mine Improvement project are much smaller. The project distribution by System Command can be seen in Table I-1, and by OPNAV Program Sponsors in Table I-2.

In discussing the manpower/training planning in WSAP, attention is being focused on a sizeable Navy effort. The Navy devotes both in-house and contract supported efforts in performing the planning functions discussed in this report.

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[1] Acquisition Categories are described in Chapter II.

Table I-1

Number of Projects * by ACAT and SYSTEM COMMAND

ACAT	NAVSEA	NAVAIR	NAVELEX	OTHER**	TOTAL
I	32	24	12	-	68
II	91	62	37	15	205
III	83	96	61	53	293
IV	25	44	45	16	130
Total	231	226	155	84	696

* *Quarterly Index of Navy Acquisition Projects*, October 15, 1976

** NAVFAC, NAVSUP, PM2, Strategic Programs, BUMED, ONR, BUPERS, Naval Observatory, Lab Projects.

Table I-2

Number of Projects by ACAT and OPNAV Sponsor

		OPNAV Program Sponsor											
		01	02	03	04	05	06	09	94	95	98	99	Total
ACAT	I	-	1	26	-	30	-	-	5	6	-	-	68
	II	-	33	85	2	45	-	2	18	13	7	-	205
	III	2	28	57	10	79	1	7	49	12	43	5	293
	IV	-	5	10	12	36	-	4	26	4	11	13	130
	Total	2	67	187	24	190	1	13	98	35	61	18	696

1. In-house Navy Resources

The in-house resources are clearly identified personnel within the Navy hierarchy performing management, review, reporting and analysis functions. The contractor supported efforts generally augment these activities.

Based on an analysis conducted as part of the HARDMAN Study, the Navy in-house level of effort which is annually being expended on manpower/training activities related to the WSAP is estimated to be approximately 1,300 man-years. This is shown graphically in Figure I-1. and described in further detail in Appendix B. This represents the Navy's current commitment of in-house resources exclusive of contractor support.

2. Approximation of Navy Expenditure of Manpower/Training Planning

An analysis, presented in detail in Appendix C, was attempted during the course of the study to determine the monies expended for manpower/training planning activities. It became evident that the lack of complete and reliable data and the necessity to incorporate gross assumptions make the results of this analysis inexact and inconclusive. However, as a very rough approximation, the analysis indicates that monies for manpower/training planning related to WSAP might approach 9-15 percent of the RDT&E budget.[1] This percentage would translate to an approximate annual expenditure of $340-570 million.

These expenditures, largely for contractor support, combined with the proceding estimate of Navy in-house resources reflect a large effort devoted to manpower/training planning activities. This study is concerned with the range of these activities and their impact on the WSAP.

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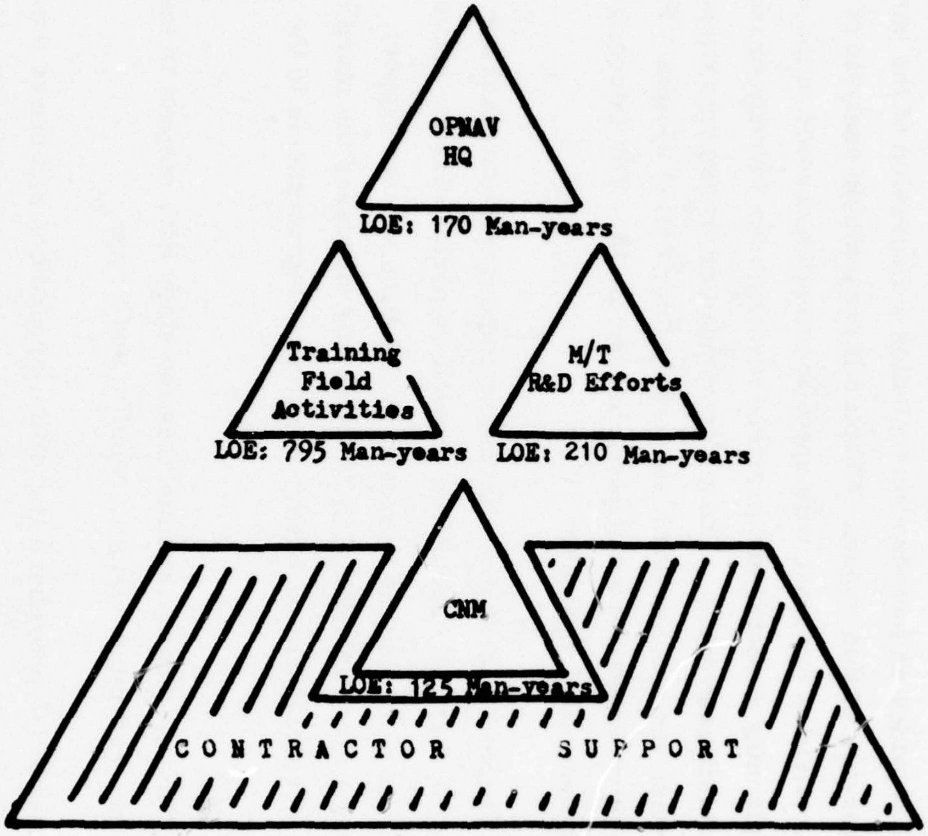
[1] This comparison to RDT&E expenditures is used for purposes of a frame of reference and is not meant to imply that all manpower/training planning expenditures are RDT&E expenditures; a substantial portion is derived from SCN and other procurement expenditures.

Figure I-1

Summary of Existing Navy In-House Level of Effort for Manpower/Training Planning Activities



Total Level of In-House Navy Effort for Manpower/Training Planning = 1300 Man-years

D. Structure of Report and Overview

Figure I-2 illustrates the approach used in the HARDMAN Study as well as the organization of this report.

The report consists of seven chapters and supporting appendices. Chapter I provides an introduction including a discussion of the purpose and an overview of this report. Chapter II presents an analysis of the weapon system acquisition process, with specific attention devoted to the manpower/ training planning aspects, and provides the basis for identifying improvements to the acquisition process. The recommended improvements concentrate in two areas: procedures and a supporting information system. Procedural improvements are discussed in Chapter III. The information system is described in Chapter IV.

Chapter V identifies alternative implementation plans for developing HARDMAN capabilities as well as performing the recommended functions and operating the proposed information system support. Chapter VI outlines a recommended plan of action and discusses the marginal resource requirements necessary to achieve improvements in the acquisition process.

The last chapter summarizes the study with respect to its major conclusions, recommendations, benefits and costs.

Table I-3 provides a list of the appendices and shows the chapters to which these relate. The appendices provide further amplification and detail concerning the issues discussed in the body of the final report.

Figure I-2

Study Approach

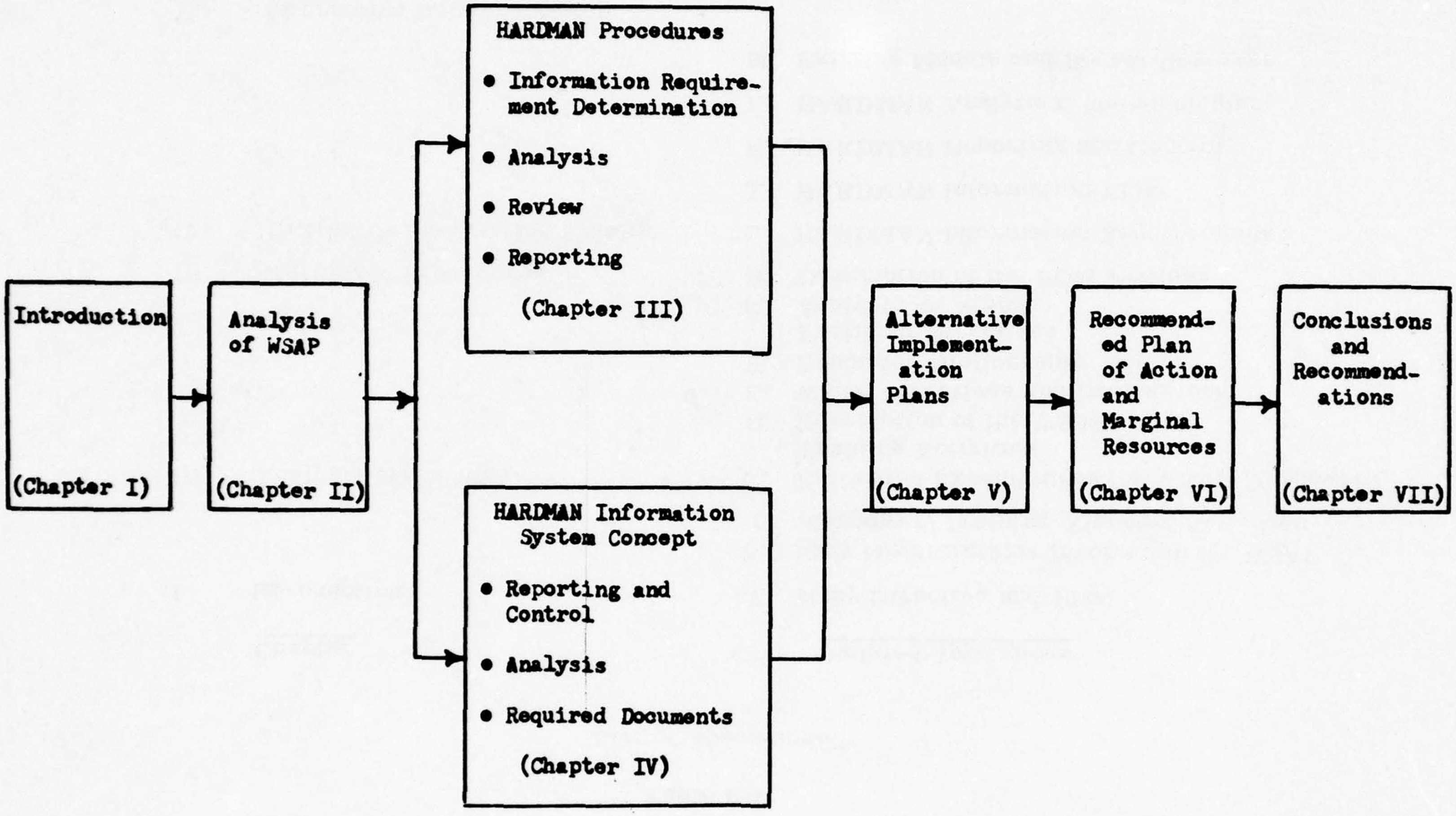


Table I-3

List of Appendices

	Chapter		Related Appendices
I.	Introduction	A.	Study Directive and Plan
		B.	Navy Organizations Involved in the WSAP Manpower/Training Planning Activities
II.	Analysis of the WSAP	C.	Estimated Expenditures for WSAP Manpower / Training Activities
		D.	Description of the WSAP
		E.	WSAP Directives and Instructions
		F.	Annotated Bibliography of Pertinent Directives
		G.	Analysis of WSAP
III.	HARDMAN Procedures	H.	Description of the POM Process
IV.	HARDMAN Information System	I.	HARDMAN Information Requirements
		J.	HARDMAN Information Flow
		K.	HARDMAN Reporting and Control
		L.	HARDMAN Analytical Methodologies
		M.	Existing Models and Recent Research
V.	Alternative Implementation Plans		
VI.	Recommended Plan of Action and Marginal Resources	N.	Task Descriptions for HARDMAN Implementation
VII.	Conclusions and Recommendations		
		O.	References

CHAPTER II

ANALYSIS OF THE WEAPON SYSTEM ACQUISITION PROCESS

A. Introduction

The purpose of this chapter is to describe the Weapon System Acquisition Process and to present an assessment of its present shortcomings with respect to the occurrence of manpower vs. hardware tradeoff analysis.

This chapter first presents a description of the Weapon System Acquisition Process. Second, the major problems associated with the present process are identified and discussed; this evaluation leads to recommendations for improved reporting and review procedures which are presented in the last section.

B. Overview of Weapon System Acquisition Process[1]

There are four phases in the Navy Weapon Systems Acquisition Process: Concept Formulation (Program Inititation), Design (Validation), Full-Scale Development, and Production. As Table II-1 indicates, the level of review and decision protocol vary depending on the cost and complexity of the system to be acquired; however, the analysis and

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[1] A more detailed description of the Weapon System Acquisition Process is contained in Appendix D. In addition WSAP related directives and instructions are described and annotated in Appendices E and F.

Table II-1

WEAPON SYSTEMS DESIGNATIONS

ACAT*	Cost Threshold	Type of System	Review	Approval
I	$ 50M (RDT&E) $200M (Procurement)	DOD (Major)	DSARC DNSARC CEB/ARC	SECDEF
II	$ 20M (RDT&E) 50M (Procurement)	DON (Major)	DNSARC CEB/ARC	DSARC
III	$ 5M (RDT&E) 20M (Procurement)	Designated Non-Major	OPNAV STAFF	CNO
IV	None	Non-Designated	OPNAV STAFF	CNO

* ACAT - Acquisition Category

**DNPP - Director Navy Planning and Programming development which take place during each phase are in principal the same. For ease of discussion, specific procedures are described in terms of DoD major systems ($50M or more RDT&E, or $200M or more procurement); these are classified as Acquisition Category (ACAT) I systems.

The Operational Requirement (OR) submitted by any fleet activity or Navy Command to the cognizant force and mission sponsor initiates the conceptual effort to meet an operational need. Threat and current operational problems are discussed, and required capabilities are suggested in terms of performance goals and quantity and cost objectives. The Chief of Naval Material (CNM) responds to the OR by appointing a program manager and preparing a Development Proposal (DP). In the DP, various alternatives to fulfill the requirement are enumerated, effectiveness and cost comparisions (development and unit production costs only) are made, and critical performance tests are identified. With OPNAV approval, the DP and OR are incorporated into a Navy Decision Coordinating Paper (NDCP) and/or Decision Coordinating Paper (DCP).

The (NDCP) is used to define program issues, considerations which support the operational need, program objectives, program plans, performance parameters, areas of risk, and development alternatives. Cost estimates are validated by the Cost Analysis Improvement Group (CAIG), and the program is reviewed by the Defense Systems Acquisition Review Committee (DSARC). The Secretary of Defense then decides whether to continue into Phase II (Design).

In the Design Phase, Requests for Proposals (RFPs) are sent out and contracts awarded to study, design, and build the equipment. Extensive testing is conducted to determine if the equipment is ready for full-scale development. After updating the DCP with the test results, the program is reappraised for operations suitability and assessed for technical and managerial readiness to proceed. Additions to the old DCP include an evaluation of support and operations costs (validated by CAIG), and an evalutation of the cost-effectiveness of the proposed system compared with competing alternative ways of satisfying the military need. After this second major review (DSARC II), SECDEF makes the decision to proceed with full scale development.

During full scale development, further testing is conducted to ensure that the system developed will meet the operational need and is the best available alternative. Issues concerning production, logistic support, and facilities and maintenance are identified; plans are made for resolving them. Quantity, resource, and schedule estimates are revised. DSARC III then makes a review of the updated DCP with final CAIG audit, and the Secretary of Defense decides to produce or deploy the system.

In the final phase, the equipment is manufactured, the personnel complete training, the logistics support is finalized, and the entire system is tested and subsequently made operational. Although the program manager continues to monitor the process after production commences, the formal review is essentially complete.

Although the management principles guiding the acquisition of weapon systems are the same for DoD Major Systems as well as for DoN Major, DoN Non-Major, and Non-Designated Systems; the procedures for each differ somewhat. Table II-2 indicates the decision authority and the amount of scrutiny required for different system categories, while each is discussed in the following paragraphs.

ACAT II (DoN Major) Systems can themselves be of four types: (1) those designated for special review by a DSARC principal, (2) those designated as ACAT II by SECNAV, (3) other programs below the ACAT I threshold which have an estimated RDT&E cost in excess of $20M, or an

Table II-2
WSAP Characteristics for Weapon System Categories

Type of System	Decision Document	Review	Decision Authority
ACAT I: Major DoD Systems	DCP	DSARC DNSARC CEB/ARC	SECDEF
ACAT II: Major DoN Systems			
(1) Selected by DSARC Principal	PM	DSARC CEB/ARC	DSARC Principal
(2) Designated by SECNAV	NDCP	DNSARC CEB/ARC	SECNAV
(3) Others meeting dollar threshold	NDCP	CEB/ARC	CNO
(4) Ship Acquisitions less than ACAT I	NDCP	CEB/SAIP	CNO
ACAT III: Non-Major DoN Systems	NDCP	OPNAV Staff	Program Sponsor
ACAT IV: Non-Designated Systems	NDCP	As directed by CNM	CNM

estimated production cost in excess of $50M, or are so recommended by CNO, CNM, or a Program Sponsor, and (4) all ship acquisition programs not requiring DSARC review.

For those systems designated for special review by a DSARC principal, the WSAP differs from that of Major DoD Systems in that the Program Memorandum (PM) is the decision vehicle and contains the essential program information (instead of the DCP), and the DSARC principal is the decision authority rather than SECDEF. Also, DNSARC review is no longer required: after CNO selection of a preferred alternative (usually done by DNPP (OP 090) acting for CNO for all ACAT II systems), the PM goes directly to the DSARC for review.

The NDCP is the decision vehicle for SECNAV designated ACAT II Weapon Systems, with SECNAV the decision authority. Neither DSARC reviews nor decisions by SECDEF are required.

The NDCP is also the decision vehicle for other systems below the ACAT I level but still meeting ACAT II dollar thresholds. No DSARC or DNSARC reviews are required for these systems.

For all ship acquisition programs not requiring DSARC review, the decision vehicle is the NDCP and the decision authority is the CNO. However, in early stages of review, the Ship Acquisition Improvement Panel (SAIP) takes the place of the ARC in acting as a subpanel of the CEB to make recommendations to the CNO.

ACAT III program (DoN Non-Major) requires even less scrutiny with the NDCP still acting as the decision vehicle (in abbreviated form if appropriate) and the decision authority now resting with the Program Sponsor. Programs are reviewed by the OPNAV staff.

ACAT IV programs are reviewed as directed by CNM, who is also the decision authority. Abbreviated NDCPs are still prepared to document essential program information.

C. Shortcomings in the WSAP [1]

An evaluation of the acquistion process reveals major shortcomings with respect to effective consideration of manpower vs. hardware tradeoffs and manpower/training requirements determination. The principal findings are:

- manpower vs. hardware tradeoff analysis generally fails to occur at sufficiently early stages in the WSAP to influence life cycle manpower/training requirements;
- key participants in the acquisition process lack incentives with respect to determining and insuring visibility for manpower and training requirements;
- objectives and procedures traditionally associated with WSAP-related development activities such as test and evaluation, logistic support, among others, are not always consistent with requirements for manpower/training planning.

Following are discussions of these principal findings.

1. Early Consideration of Manpower Requirements

Although a substantial portion of life cycle costs are committed by the end of the Concept Formulation stage, manpower requirements are generally not adequately identified until later stages of the WSAP. This results in the initial understatement of resource requirements and the subsequent necessity of reprogramming manpower and training resources.

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[1] A more detailed discussion for this WSAP analysis is contained in Appendix G.

OP-01 is the major organization interested in the early identification of manpower and its associated impact. However, the present institutional setting does not encourage a constructive partnership of mutual interests with other organizations participating in the weapon system development. For example, in the surface/subsurface new ship construction area one of the major reasons for this problem is the late identification of contractor furnished equipment (CFE); all too often the CFE is not identified to the government until very late in the construction program. OP-01 generally must react to requirements identified by Program Sponsors. When requirements determination occurs late and tradeoff analyses are absent, there are significant adjustments required in order to accomodate the manpower requirements.

In sum, early identification of manpower requirements in the acquisition process is important in order to:

- Insure projected manpower will be sufficient to support new requirements
- Evaluate impacts on training requirements
- Conduct manpower vs. hardware tradeoff analyses at a time when resource requirements may truly be influenced.

2. Early Consideration of Training Requirements

Determination of training requirements and potential tradeoffs also suffer from the lack of early consideration in the WSAP. These shortcomings manifest themselves in:

- Late availability of training and supporting facilities in relation to the timely training of personnel;
- Training plans which go unfunded for lack of coordination with the system development.

Inadequately trained personnel result from the long leadtime necessary to formulate and establish training programs and related facilities. Navy Training Plans (NTP) and the convening of an NTP conference are supposed to occur at least three years in advance of the planned fleet introduction date. All too frequently, this does not happen. Training plans which are prepared are often incomplete and subsequently not useable.

When training plans have been approved, the resources required are supposed to be programmed in the POM. Because of the two year gap between the POM year and the year training is to start, the resources required to support the new training must be programmed in the year the NTP is approved in order for personnel to be trained in sufficient time for fleet introduction. All too frequently, the resource programming is neglected and trained personnel cannot be made available at the appropriate time.

3. Incentives for Effecting Planning

The WSAP does not always provide incentives to key participants to identify and monitor the manpower and training requirements associated with the weapon system development.

A CNM-designated program manager has major responsibility to the CNM for design, development and production of an individual weapon system within the Navy. Consistent with the Navy's view of decentralized decision-making, his assigned responsibilities include planning, organizing, directing, evaluating and coordinating all project activities. This central role in the WSAP provides a unique opportunity, rarely exercised, to influence manpower and training planning.

In program reviews throughout the acquisition process, the program manager is the individual who is trying to "sell" his program to the Navy and subsequently, through the DSARC process, to the Secretary of Defense.

Because the manpower/training dollars of any project will increase the costs in the operating and support categories and because in the early stages the program manager is only budgeted for development dollars, the program manager is not highly motivated to identify significant manpower/training expenditures. The likelihood of his program being disapproved increases in direct proportion to its dollar impact.

Effective reporting and review also suffers from the lack of proper incentives. OP-01 and OP-99 have responsibility for Navy-wide requirements for manpower and training, respectively. This responsibility focuses on policy development and long-term planning. The lack of a planning framework which readily integrates life cycle resource requirements with extended manpower and training plans thwarts effective review and control by these mission sponsors. In addition, the absence of an accessible set of data summarizing the status of all weapon systems and significant manpower and training milestones further dilutes OP-01 and OP-99 capabilities to effectively monitor manpower and training in the weapon system development.

4. Impact of Other WSAP-Related Activities

Various WSAP-related activities also discourage or distort consideration of manpower and training requirements:

- Testing and Evaluation - T & E is oriented to determining whether or not the equipment functions to specifications. The factory trained personnel which are used to conduct the testing tend to be more highly skilled and motivated than personnel available to the fleet commands. Thus, T & E tends to understate the manpower and training requirements.

- Integrated Logistics Support - Little progress has been made in adequately determining support manpower and training requirements. The Navy uses a fixed percentage

(25% for force acquisition) of operational manpower to determine support manpower. Use of a fixed percentage for all procurements precludes valid tradeoff analysis. There can be cases where operating manpower requirements are higher for a particular design alternative, but where overall manpower requirements are lower because of drastically reduced support requirements. Current methods fail to take advantage of such tradeoffs.

- Reliability and Maintainability - Current emphasis is on trading off equipment designs to meet R&M goals rather than trading off R&M goals against manpower/training requirements. R&M goals are actually used as contractual incentives to reward contractors; whereas manpower requirements receive no explicit consideration.
- The POM Process[1] - While the focus of the POM is five years, major weapon systems often take much longer to develop. Table II-3 indicates the lag time between concept formulation and fleet introduction for several recent acquisitions. What happens is that in the early stages, the POM may reflect only R&D dollars, while the decisions being made actually commits the majority of the life cycle resources. The life cycle resources for which basic commitments are made during R&D are substantially greater than the concept and design dollars approved in the POM.

D. HARDMAN Improvements to the WSAP

As a result of the analysis of the Weapon System Acquisition Process, a number of improvements with respect to manpower and training planning are necessary in order to eliminate present shortcomings.

The overall objective associated with these improvements is to:

INSURE EARLY CONSIDERATION IN THE WSAP OF
THE MANPOWER/TRAINING RESOURCES REQUIRED
TO SUPPORT EQUIPMENT UNDER DEVELOPMENT.

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[1] Appendix H presents a description of the POM process.

Table II-3

Length of Time From Concept Formulation (FY) to Fleet Introduction (FY) for Several Ship Classes

Name	Concept	Introduced to Fleet
CVAN-68 (NIMITZ Class)	1965	1976
CGN-38 (Virginia Class)	1967	1976
LHA	1967	1976
DD-963	1967	1975
FFG-7	1970	*1977
AO-177	1971	1979

*Current best estimates (future projections)

Improvements to the process are identified in two major areas: procedures and supporting information systems. Figure II-1 shows a schematic display of the HARDMAN improvements to the WSAP.

The HARDMAN procedures include four functions:

Function	Description
Information Requirements Determination	Identification of information requirements and analytical procedures to be used
Analysis	Development of manpower/training requirements and costs; conduct of tradeoff analysis
Review	Review of analysis to validate analytical methods and estimates
Reporting	Systematic reporting and monitoring of estimated and actual requirements and costs

These HARDMAN functions are described in terms of specific assignments of responsibility and by procedures and methodologies.

The information system component consists of three modules supporting the HARDMAN procedures. These include:

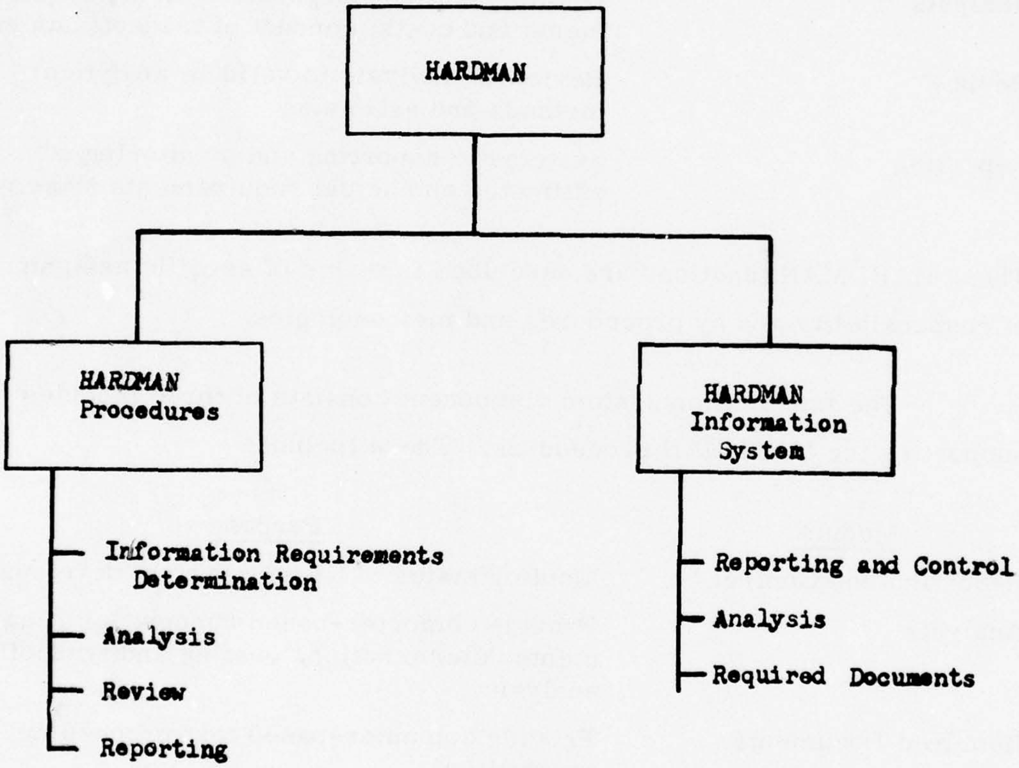
Module	Purpose
Reporting and Control	Monitor status of weapon system development
Analysis	Provide computer-based support for requirements determination, costing and tradeoff analysis
Required Documents	Provide computer-based text processing capabilities

A valuable supplement to the HARDMAN information and procedures would be a strong human factors engineering (HFE) effort in each project. By taking an active part in the design process, HFE specialists can work actively to reduce manpower and training requirements in new systems.

In sum, HARDMAN refers to a total concept of revised procedures and supporting information systems to insure early and effective consideration of manpower/training resources. Chapters III and IV describe these improvements in further detail.

Figure II-1

HARDMAN Concept



CHAPTER III

HARDMAN PROCEDURAL IMPROVEMENTS

A. Introduction

This chapter describes the overall procedural changes necessary to insure earlier and more effective consideration of manpower and training planning during the WSAP. These procedures will:

- insure identification of manpower/training requirements early in the WSAP;
- provide incentives for major WSAP participants to fulfill their responsibilities;
- provide for explicit organizational responsibility for the conduct of manpower/training requirements analysis and review associated with weapon system development.

This chapter contains three sections. First, four major HARDMAN functions which will enable the planning process to operate more effectively are identified and discussed. Using this as a framework, Navy organizations responsible for carrying out these functions are then identified. Finally, the explicit procedural improvements are described, including the extent of responsibility and the authority of management and review agencies, and the timing of their actions during the acquisition process.

B. HARDMAN Functions

There are four basic HARDMAN functions which must be addressed if manpower/training planning is to be fully and adequately considered in the WSAP:

- Information Requirements Determination
- Analysis

- Review
- Reporting

Although these functions are currently being partially performed throughout the Navy there is generally no coordinated or focused effort related to the acquisition process itself. Rather, these activities are often performed in a reactive or incomplete manner.

1. Information Requirements Determination

Many instructions allude to the necessity that the manpower/training aspects of a new weapon system be addressed early in the WSAP. However, there are no directives or instructions specifying what information is to be gathered or how it is to be analyzed, displayed or used in the WSAP. OP-01 has recognized that the review within these phases should be standardized and has developed a series of questions for his representatives to present during the CEB review process. This, however, does not address the problem of specifying to the Program Manager or NAVMAT agencies early in the Concept Phase exactly what manpower/training information is needed and how it may be developed.

Along with other activities associated with the WSAP, there should be an explicit function devoted to information requirements determination. This function will entail the specification of types of information regarding manpower and training requirements resources which must be provided by the Program Managers at various stages of system development. The function is designed to provide a basic standardized set of information requirements to which Program Managers can respond.

Once initial information requirements have been determined, the only further functional requirement is maintaining the information requirements up-to-date.

2. Manpower/Training Analysis

HARDMAN analysis involves the development of information indicating the manpower and training requirements and the life cycle costs associated with a weapon system, the impact of the required manpower on the Navy force structure, and the manpower versus hardware tradeoffs involved in the system development.

Currently, the Program Manager is responsible for the analysis function of the WSAP. While the Program Sponsor has the responsibility for insuring that the manpower requirements for a new system are developed, the Program Manager has the resources to conduct the analysis of manpower/ training requirements.

Existing manpower and training analyses are, for the most part, limited to the identification of billet requirements and the types of training information detailed in the Navy Training Plan. The majority of this analysis is accomplished during the Full-Scale Development Phase. In the Concept Formulation and Design phases, analysis performed varies from system to system depending upon the desires of the Program Manager. There are no general guidelines for the Program Manager to use in costing manpower and training in the overall system or in evaluating the potential tradeoffs between hardware design and manpower.

The HARDMAN analysis function entails three specific activities:

- identifying manpower/training requirements
- life cycle costing
- manpower versus hardware tradeoff analysis

While costing and requirements determination activities already occur in the WSAP, they do not always focus on manpower/training issues explicitly and fail to occur sufficiently early in the WSAP. The HARDMAN analysis function is being prescribed to improve and ensure effective consideration of manpower/training resource issues early in the acquisition process.

3. Manpower/Training Review

Review is that function which involves investigation of the manpower/ training information dealing with a particular system acquisition in order to ensure that manpower/training costs has been properly taken into account, that manpower versus hardware tradeoffs have been analyzed where appropriate and that the procedures for determining manpower/training requirements are acceptable.

There are three major facets to the review function. One is to validate the manpower/training requirements analysis with respect to its technical and methodological adequacy and consistency. Second is to review the analysis with respect to the adequacy of its supportability assessment. And finally, there is the review requirement to determine the supportability of the manpower/training requirements.

As a result of HARDMAN review, weapon system development will be allowed to proceed only if adequate analysis of manpower and training requirements has taken place.

4. Manpower/Training Reporting

Reporting is the dissemination and monitoring of the manpower/ training related information to the individuals and organizations requiring it. This includes not only the reports submitted by the parties engaged in manpower/training analysis to the review authorities but also any information which must be exchanged to carry out the determination, analysis or review functions.

The overall objectives of HARDMAN reporting are to ensure that there is a single source of information regarding the status of all weapon systems under development, that major milestones with respect to development and particularly manpower/training determination and tradeoff analysis are monitored, and that a standard set of information about the manpower/ training requirements of a weapon system are available as they are developed and refined throughout the WSAP.

C. Organizations Responsible for HARDMAN Functions

As a result of evaluating alternative organizations to have responsibility for these HARDMAN functions, the following approach, summarized in Table III-1, is recommended:

- Information Requirements Determination

  OP-01 and OP-99 are considered most qualified to determine what manpower and training information is required during the various phases of the WSAP.

- Manpower/Training Analysis

  The identification of manpower and training requirements and the determination of weapon systems costs are the responsibility of the CNM. A CNM-designated program manager is responsible to the CNM for conducting hardware versus manpower tradeoff analysis and is designated as the responsible agent for this HARDMAN function.

- Manpower/Training Review

  A working group consisting of OP-01, OP-99, CNM-designated program manager and others would conduct a working level review of the information to validate its technical and methodological adequacy. OP-01 and OP-99 would be responsible to review the information with respect to the adequacy of its supportability assessment and present findings to a review committee (e.g., pre-CEB, ARB, or other existing decision forum) for final decision.

- Manpower/Training Reporting

  This function can be carried out by each of the organizations previously identified. It should be recognized that OP-01 and OP-99 are the organizations responsible for the reporting and monitoring of estimated and actual manpower and training requirements.

Table III-1

Proposed HARDMAN Organizational Responsibilities

Function	Organization
Information Requirements Determination	OP-01/99
Manpower/Training Analysis	CNM-designated Program Manager
Manpower/Training Review	
Validation	Working Group
Supportability Assessment Review	OP-01/99
Supportability Assessment	Review Committee (e.g., CEB, or other existing forum)
Manpower/Training Reporting	Program Manager (for the CNM), Program Sponsor, OP-01, OP-99, working group

Where the organizations and missions already exist, the recommended approach generally constitutes a refinement and, in some cases, an expansion of responsibilities. In no case does the implementation of HARDMAN relieve an organization of previously assigned responsibilty or authority.

Assignment of organizational responsibility was determined by an analysis of organizational alternatives. The major alternatives considered are shown in Table III-2. The principal considerations in this analysis were:

- Capability and incentives to perform function
- Consistency with existing mission and organizational responsibility
- Overall authority
- Ease of implementation

D. Procedures

To demonstrate the procedural improvements to be realized throughout the WSAP, a description of their relationships to the WSAP

Table III-2

Alternative Organizations Responsible For HARDMAN Functions

Alternative Organizations	Information Requirements Determination	M/T Analysis	M/T Review	M/T Requirements Reporting
CNM	x	x*	x	x
Program Sponsor	x	x	x	x
OP-01	x		x*	x
OP-99	x		x*	x
OP-01/99 Representatives with Project Manager		x		x
HARDMAN Working Group	x		x	x
Review Committee (e.g., CEB, or other existing decision forum)			x *	x

* Organization already fully or partially performs function

as a whole is given in this section. The primary emphasis will be on:

- expanded roles of OP-01 and OP-99 throughout the WSAP
- institutional consideration of manpower/training requirements of new weapon systems.

This section is developed in two parts. The first presents a discussion of improvements in the Concept Phase and the second describes the changes in the last three phases of the WSAP.

1. Concept Phase

The present Concept Phase is depicted in a simplified format in Figure III-1

Figure III-2 shows the proposed HARDMAN procedural improvements for this phase. From the OR and from discussions with the OPNAV Sponsor and NAVMAT representatives, OP-01 and OP-99 would identify for NAVMAT the specific manpower/training information required for inclusion in the DP and the methods for collecting that information. Upon development of the DP, OP-01 and OP-99 would evaluate the manpower and training information contained in that document. Information shortfalls would be identified for the OPNAV Sponsor along with further information which would be required within the DCP. The Sponsor would require NAVMAT to make changes in the DP if necessary, as the Sponsor does now if he is dissatisfied with the results. Also, at this time OP-01 and OP-99 would inform the appropriate review committee of any manpower or training problems anticipated with the system acquisition.

Based upon the manpower/training information requirements, defined by OP-01/OP-99, the OPNAV sponsor and the CNM-designated Program Manager would perform the necessary analyses. Upon completion of the draft DCP, OP-01/OP-99 would again evaluate the results based upon

Figure III-1

Present Weapons System Acquisition Process
Conceptual Phase

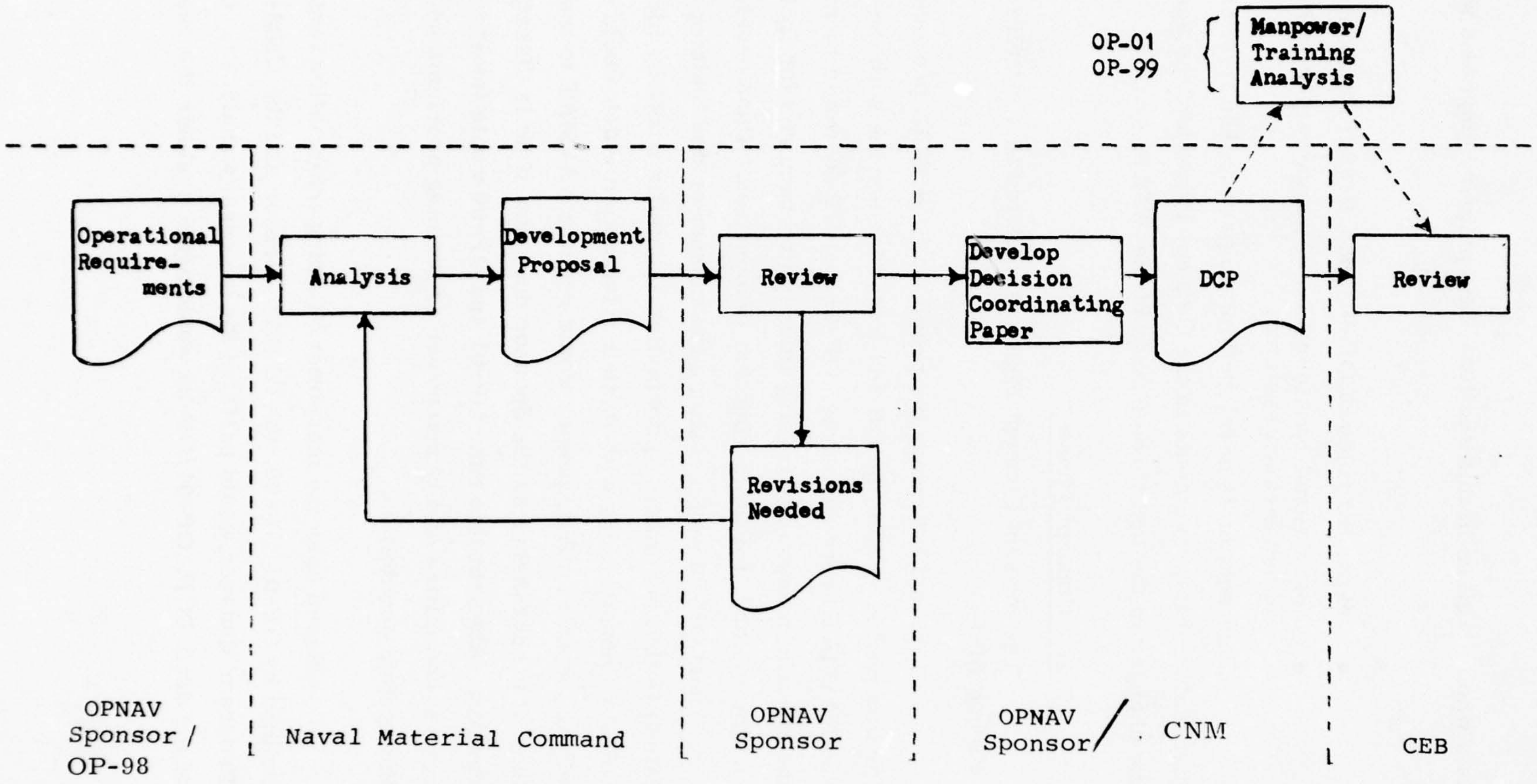
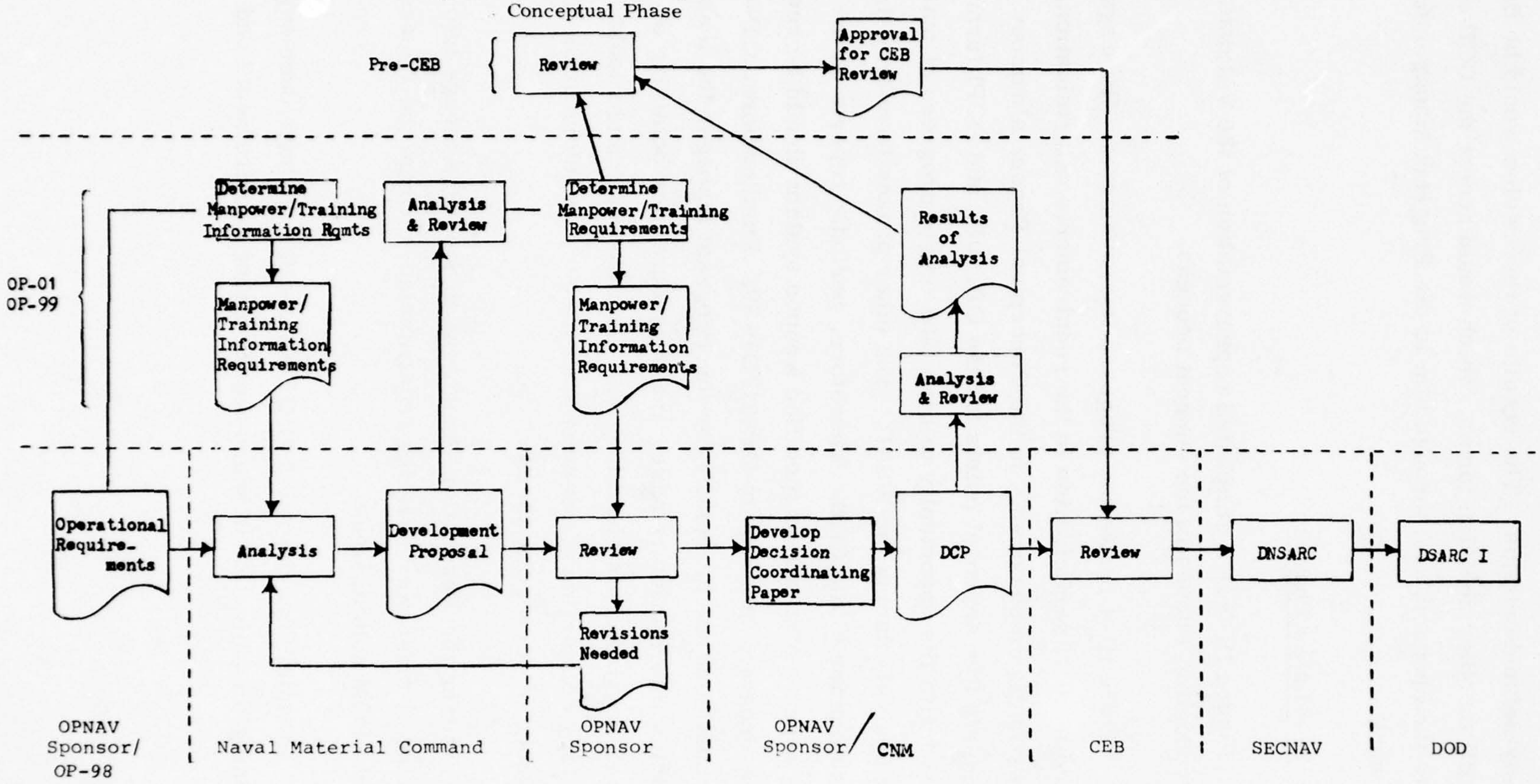


Figure III-2

Proposed HARDMAN Procedural Improvements
Conceptual Phase



previously defined criteria. The results of this review would be provided to the CEB or other decision forum, which would accept the DCP or send it back to the Sponsor, and through him to the Program Manager for further work.

2. Later Phases

Figure III-3 is a simplified representation of the Validation/Full Scale/Production Phases in the current process.

Figure III-4 shows the proposed improvements. Here again, the increased level of participation in the requirements determination, review, and reporting is emphasized. In the Conceptual Phase, a number of logical review points (the approval points for the OR, DP, and DCP) furnish OP-01 and OP-99 with the opportunity to keep tabs on the progress of manpower/training analysis during the WSAP. The other phases have only the DCP submission prior to the CEB. Therefore, periodic reports on the manpower/training aspects of a new or modified weapon system should be required from the Program Manager to OP-01/OP-99. Furthermore, OP-01 and OP-99 must continue to identify for the Program Manager the manpower and training information required and procedures for obtaining it. These manpower requirements should be on a periodic basis and should identify satisfactory completion of requirements to date, or information deficiencies and methods of correcting them.

During the Production Phase, the procedures merge into the monitoring of manpower/training requirements through the Program Sponsor's POM submissions.

In summary, the roles of OP-01 and OP-99 have been expanded in the early identification of manpower/training requirements and review

Figure III-3

Present Weapons System Acquisition Process
Validation/Full-Scale Development Phase/Production

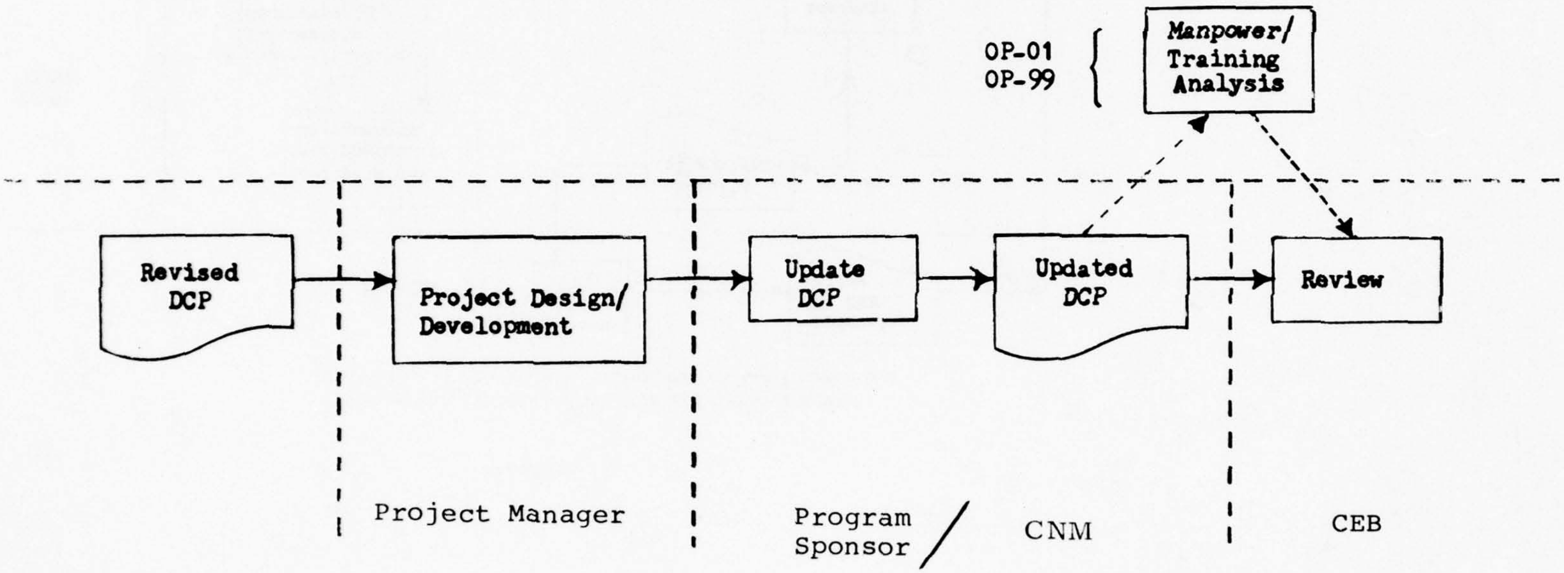
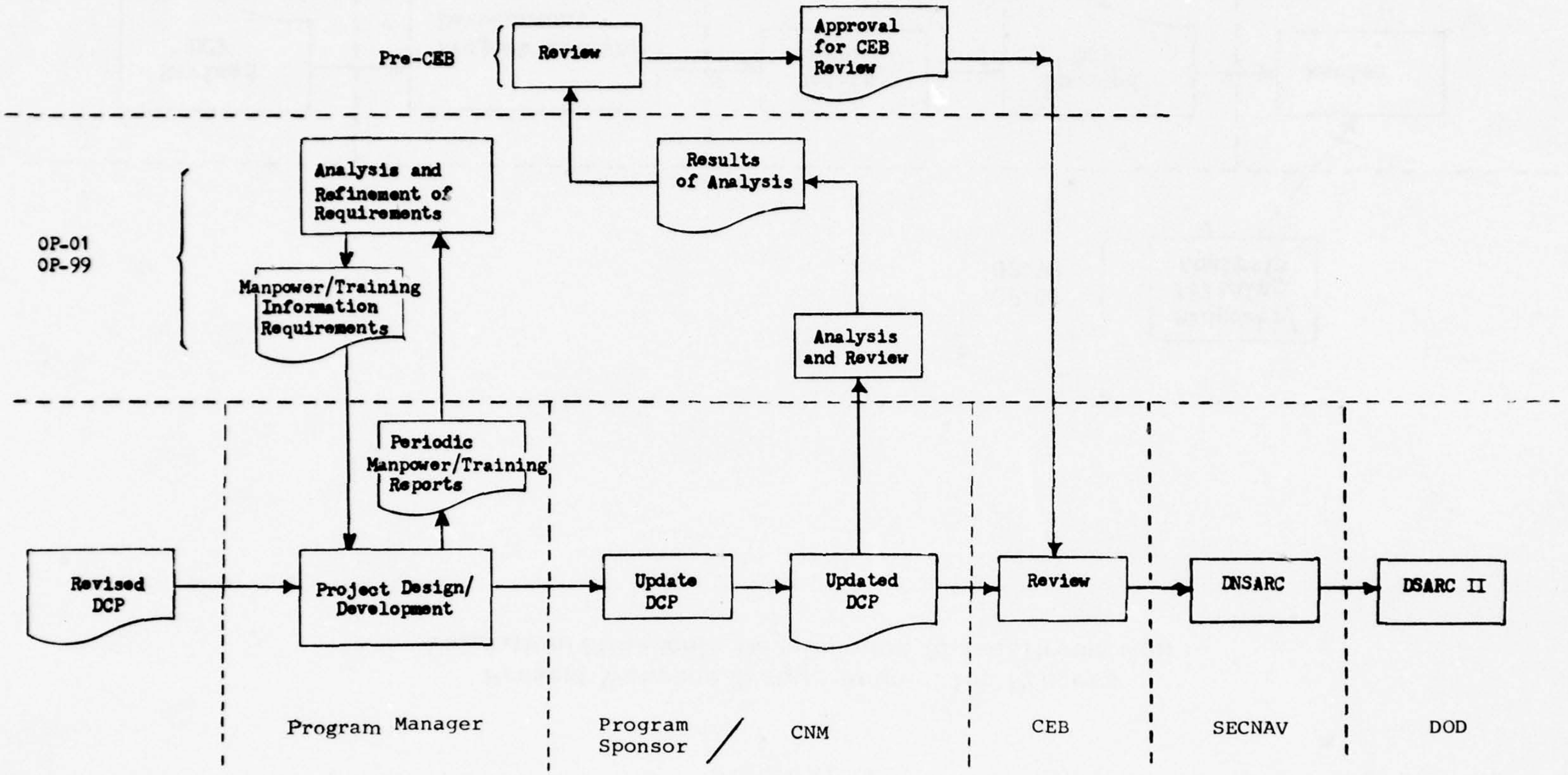


Figure III-4

Proposed HARDMAN Procedural Improvements
Validation/Full-Scale Development Phase Production



of analysis performed by the CNM. In addition, the responsibility of a working level group to guarantee overall completeness of manpower/training analyses prior to formal CEB review is emphasized.

CHAPTER IV

HARDMAN INFORMATION SYSTEM CONCEPT

A. Introduction

The purpose of this chapter is to describe the concept of an information system which can be used to support HARDMAN functions in the WSAP. The presentation of the information system concept in this chapter takes as its point of departure the existing reporting and reviewing process of the WSAP. Improvements to the existing process are first described in general terms. This general statement is then translated into a functional description of an information system supporting major functional requirements:

- Reporting and Control
- HARDMAN analysis
  - manpower/training requirements determination
  - life cycle costing
  - tradeoff analysis
- Required Documents Processing

B. General System Concept[1]

The framework provided by the existing weapon system acquisition procedure serves as the basis for developing a HARDMAN information system. Improvements in the existing procedures, particularly the development and implementation of information system support can provide Navy

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[1] See Appendix I. for a detailed discussion of HARDMAN information requirements and Appendix J for a description of the information flow.

weapon system planners with earlier, more explicit consideration of manpower versus hardware tradeoffs, as well as the means for reporting and controlling significant resource impacts.

Figure IV-1 illustrates the concept of the HARDMAN Information System and its relation to the existing WSAP. The existing process consists of four stages, separated from each other by the three high level DSARC reviews. The illustration shows the flow with respect to major weapon systems (ACAT I) for which DSARCs are convened and approval is given to continue the development effort.

In Chapter II it was noted that in the current process, consideration of manpower/training implications occurs generally too late in the WSAP to influence design decisions having major resource impact. The HARDMAN Information System is designed to provide analytical support during the early stages as well as reporting and control throughout the WSAP.

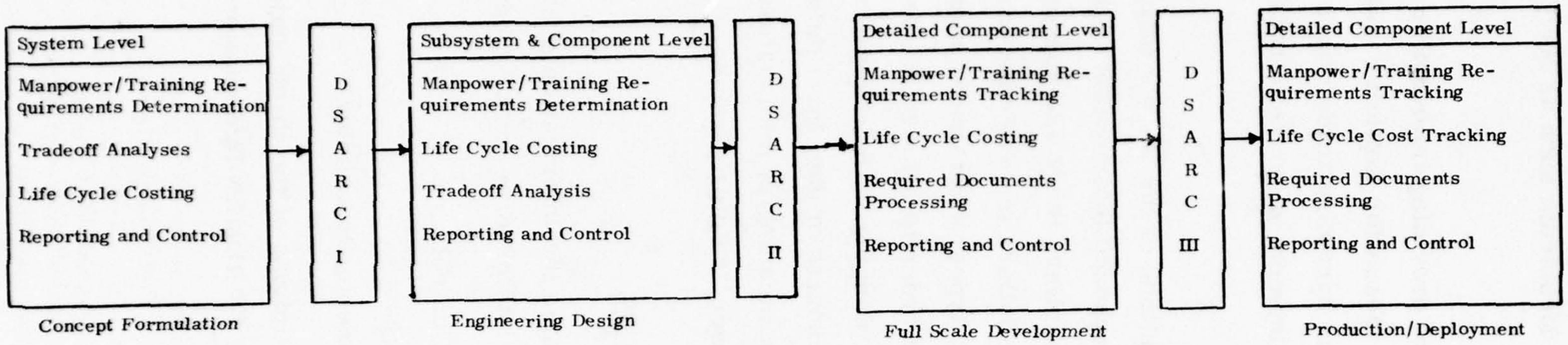
During the Concept Formulation stage, HARDMAN analysis is carried out at the system level. While analysis at this stage is relatively gross and uncertain, these initial resource and hardware design estimates provide benchmarks for subsequent analysis as well as for monitoring and control of resource requirements.

During the Engineering Design stage, the analysis is more refined, focusing on major subsystems and components. Design tradeoffs continue to be made while reporting and control occurs at a more detailed level.

During the last two phases the emphasis focuses on cost and requirements estimation and away from tradeoff analysis. Reporting and control continues as before but at an even greater level of detail.

Figure IV-1

Use of the HARDMAN Information System in the WSAP



In addition, the required documents processing capabilities supporting the preparation of required documents such as Navy Training Plans is introduced.

The overall effect of providing information system support at these stages is to provide a means for explicit consideration and control of potential manpower versus hardware tradeoffs, particularly at very early stages of system development when meaningful design changes may still occur.

Because of the magnitude of the Navy's weapon system development program, the proposed information system should be computer-based. As noted earlier, there are approximately 700 projects involving billions of dollars in development costs. There are numerous milestones and types of data pertaining to each project which should be monitored in order to achieve the desired improvements in manpower/training planning. The computer's capability to store and process large amounts of data (particularly on an exception basis) is critical in achieving meaningful information support to the WSAP in the areas of manpower/training planning.

C. Functional Description

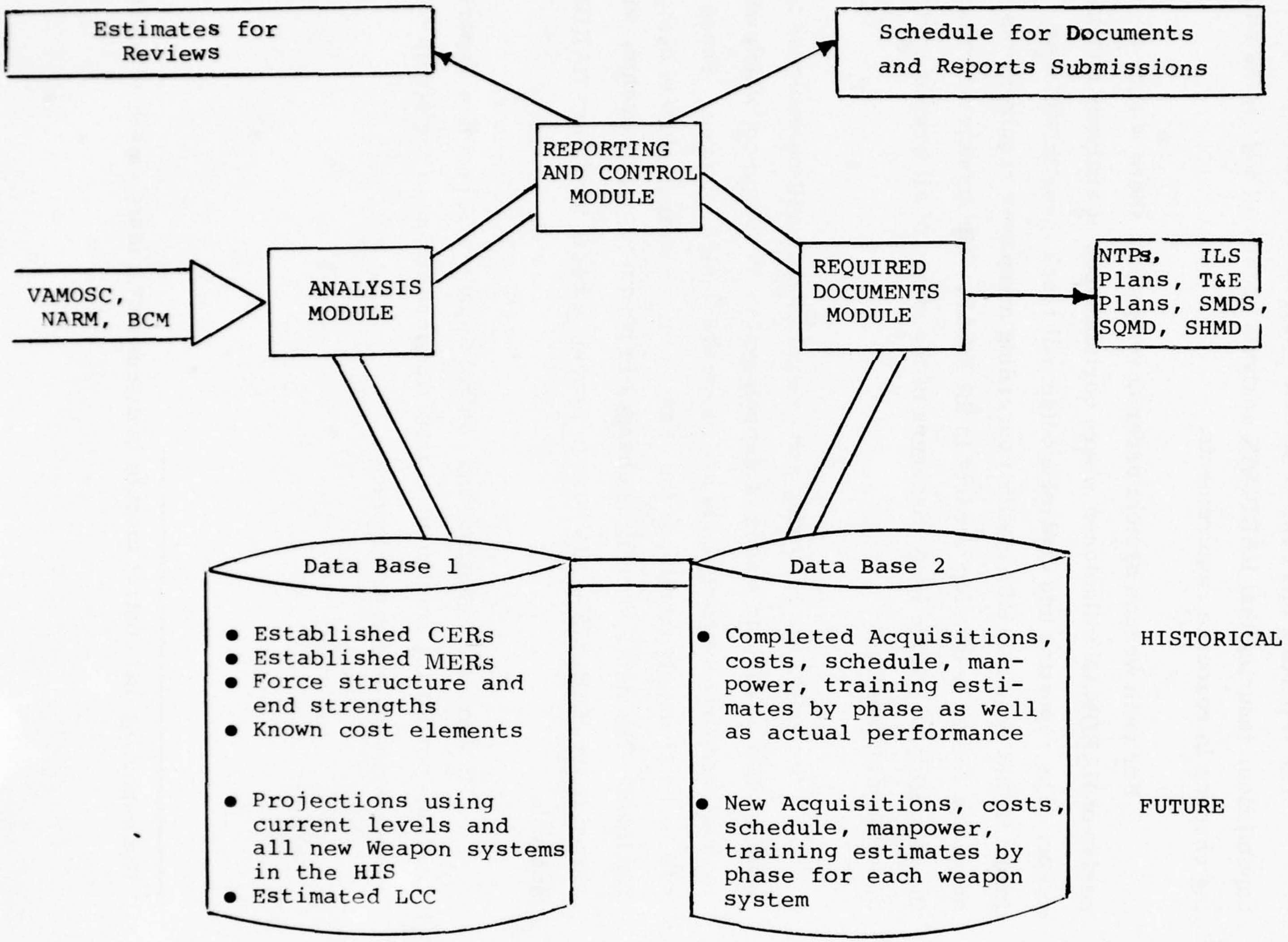
Figure IV-2 illustrates the information system from the functional viewpoint. The system consists of three major modules:

- Reporting and Control
- HARDMAN analysis
- Required Documents Processing

Following are descriptions of the three major modules as well as the data bases supporting the HARDMAN Information System.

Figure IV-2

HARDMAN Information System Concept



1. Reporting and Control Module[1]

The reporting and control module provides several important capabilities, insuring that HARDMAN analysis occurs as well as monitoring changes in resource requirements.

For each weapon system under development, there will be a series of HARDMAN milestones where certain types of analyses should occur. The reporting and control module will track these milestones insuring that required information concerning manpower requirements and hardware design is developed early in the WSAP. The module will have the capability to inform Navy managers of the status of all weapon systems under development.

Secondly, the reporting and control module will be designed to acquire data at various stages of weapon system development which will indicate resource requirements and hardware design features. These data will be continuously monitored for changes as the weapon system design is finalized. The data, as well as changes in resource requirements, will be stored in the HARDMAN data base to provide a basis for future HARDMAN analysis.

In sum, the reporting and control module will perform important functions permitting continuous control and monitoring of the status of weapon systems under development.

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[1] The reporting and control module is discussed in more detail in Appendix K.

2. HARDMAN Analysis Module[1]

The HARDMAN Analysis Module includes the analytical capabilities required for conducting hardware versus manpower tradeoff analysis.

The particular capabilities include:

Manpower/Training Requirements Determination

This submodule assists in the estimation of the unit and life cycle manpower/training requirements at the system, subsystem and component levels, as appropriate.

Life Cycle Costing

Using the manpower/training requirements along with hardware design characteristics and cost factors, the life cycle costing submodule estimates life cycle costs by system, subsystem and components.

Tradeoff Analysis

This last submodule permits a formalization of tradeoff analysis by providing a structure for the analyst to array alternative manpower-training mixes with hardware designs and estimate the effects on costs and performance.

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[1] A detailed discussion of the HARDMAN Analysis Module is contained in Appendix L. Descriptions of related analytical models and research are included in Appendix M.

The HARDMAN Analysis Module will deal with increasingly detailed information as the WSAP progresses, furnishing gross estimates in the conceptual stage while computing life cycle costs and manpower requirements using detailed cost elements and manning factors in later stages of development.

Some of the inputs to this module will be historical operating and support costs from the VAMOSC MIS, cost factors from the NARM, various manpower costs from the Billet Cost Model, and system component and cost element data from the Program Manager. During the early stages of a system's development, the analysis module will assist in establishing various Cost Estimating Relationships (CERs) and Manpower Estimating Relationships (MERs) using historical data from similar systems and components. These CERs and MERs will be used to estimate life cycle costs and manpower requirements for different alternatives, and will be put in the data base for future use. As detailed cost elements are known, these will also be put in the data base. In addition to estimating manpower and costs for each weapon system, the module maintains data on current Navy force levels and endstrengths, and projects future end strengths by summing the estimates for all systems under development.

Preliminary output will go to the CNM to support tradeoff analysis, and will subsequently be used as the basis for the official estimates for each DSARC review. As the system acquisition progresses past each point of review, the approved estimates will be put in the second data base for use by the other modules.

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[1] See Appendix M for a description of the various models.

3. Required Documents Module

Since a significant amount of detailed system data (both cost and manpower) will reside in the two data bases as weapon system development progresses, efficiencies can be realized by using this information to generate certain documents. The Required Documents Module will include a series of extract programs which find the data for each document, e. g., Navy Training Plans, Ship Manpower Documents, etc. and generate statistical tables suitable for use in the preparation of these documents.

The Required Documents Module will also incorporate a text processing capability (i. e., computer-based typing). Great efficiencies can be realized through the use of text processing for production of documents which require repetitive typing of boiler plate material through several iterations. Many of the documents required during the course of acquisition process fit into this category and will be produced more quickly and efficiently with text processing.

CHAPTER V

ALTERNATIVE IMPLEMENTATION PLANS

A. Introduction

The purpose of this chapter is to describe alternative plans for implementing HARDMAN procedures and information systems. The process of specifying alternatives requires two steps. First, the major implementation tasks required for providing the HARDMAN capabilities are briefly described. There are five principal tasks which underlie a detailed plan of action. Second, alternative ways in which these tasks may be accomplished are identified. The alternatives are based on four different organizational arrangements, two different time frames, and two weapon system phase-in options. A final section in this chapter discusses the recommended approach and rationale.

B. Basic HARDMAN Implementation Tasks

Independent of when and by whom HARDMAN is developed, there are five major implementation tasks which must be undertaken:

Task 1: Develop and Implement Requirements Determination Procedures

Develop procedures for determining HARDMAN information requirements, evaluating their use and distributing instructions and guidance to project managers engaged in meeting those information requirements.

Task 2: Develop and Implement Analytical Techniques for Conducting HARDMAN Analysis

Develop methodologies for life cycle costing, identifying manpower/training requirements, and hardware vs. manpower/training tradeoffs; prepare training material and provide support to develop necessary Navy capability.

Task 3: Develop and Implement Review Procedures

Develop procedures for reviewing HARDMAN analysis and provide required training and documentation to support review.

Task 4: Develop Reporting and Control System

Design, develop and implement a computer-based reporting and control system to monitor the status of all weapon systems and track the completion of HARDMAN analyses.

Task 5: Develop Required Documents Processing

Develop appropriate text processing capabilities to support the preparation of required documents which can be developed extensively based on the HARDMAN data base.

In sum, these five tasks must be implemented in order for the HARDMAN capabilities to be realized. The rate at which these capabilities are developed, and the specific weapon systems to which they are applied will determine the pay offs to be realized by the Navy.

C. Framework for Specifying Alternative Implementation Plans

There are a variety of ways in which the HARDMAN capabilities may be implemented. To facilitate the process of specifying alternatives, a framework consisting of three major elements is identified. The elements are:

Organizational Structure	Who has responsibility for implementing HARDMAN?

Time Frame	What period of time should be allowed before major capabilities are in place and the entire development is completed?
Weapon Systems	Should HARDMAN be implemented for groups of weapon systems or for the entire Navy at once?

Table V-1 identifies the major options considered in developing a recommended implementation plan.

1. Organizational Structures

The first element is the selection of an organizational entity which will be responsible for the development and operation of the HARDMAN capabilities. There are a number of different ways of organizing the HARDMAN development efforts. Four principal approaches were considered:

a. Ad-Hoc Project Assignments

Within existing areas of responsibility, Navy laboratories, system commands, OPNAV sponsors and others would undertake projects consistent with the development goals of HARDMAN. No special organizational entity would be created; rather, assignments would be made within the framework of existing missions and responsibilities. Activities would be reprogrammed where possible to support the HARDMAN development.

b. OP-01 HARDMAN Project Management

A second approach involves establishing a formal project management office in OP-01 with responsibility for coordinating all development activity as well as monitoring the effectiveness of the recommended HARDMAN improvements.

Table V-1

FRAMEWORK FOR SPECIFYING ALTERNATIVE IMPLEMENTATION PLANS

Major Elements	Options
Organizational Structure	1. Ad-Hoc Project Assignments 2. OP-01 HARDMAN Project Management 3. OP-01 HARDMAN Task Force 4. OPNAV HARDMAN Office
Time Frame	1. 3 years 2. 7 years
Weapon Systems	1. All 2. Ships/Air/Other

c. HARDMAN Task Force

A third approach is to establish a temporary project in OP-01 and to detail the staff from existing organizations to function as a HARDMAN Task Force for full implementation of HARDMAN. The Task Force would be formally composed of members whose overall responsibility is the development of HARDMAN and who would have formal responsibilities with respect to development of certain system components. At the completion of development, the task force would be disbanded.

d. OPNAV HARDMAN Office

A fourth approach is to create a new OPNAV organization for the purpose of HARDMAN development. This organization would draw on resources within and outside of the Navy for HARDMAN implementation. In this instance, a HARDMAN project would be officially designated and authority and resources made available to the HARDMAN office to insure development of the requisite capabilities.

2. Time Frame

Two different options were considered with respect to time frame for implementation of HARDMAN:

- 3 years
- 7 years

Each approach is designed to develop substantial capabilties within the first year. They differ with respect to the speed development will occur thereafter.

a. 3 Years

The first option is responsive to the need for early implementation of HARDMAN capabilities throughout the Navy acquisition program. Three years represents the shortest time period in which all principal HARDMAN capabilities might be developed.

b. 7 Years

An alternative approach allows longer elapsed time for development. While the overall level of effort would be the same, development would be stretched out to allow interim reassessments and change in development activity based on progress. This option is also responsive to accomodating major procedural and institutional change over a sufficiently long period allowing personnel to adjust.

3. Weapon Systems Phase-In Option

The third element of the framework is the sequence, if any, by which weapon systems are phased in under HARDMAN. Two approaches are considered:

- All
- Ships/Air/Other

a. All

Generalized methodology and procedures may be developed for all weapon systems and implemented across the board. This approach presumes that general HARDMAN procedures can be sufficiently differentiated to be responsive to different types of weapon systems.

b. Ships/Air/Other

An alternative approach is to sequence the development in stages based on general types of weapon systems. This approach is based on development of ships first (HARDMAN/Ships) followed by aircraft and other major groups.

For either option, it is expected that weapon systems will be included under HARDMAN regardless of their stage of development. Systems already under development will continue development within the HARDMAN framework to the extent practical.

C. Recommended Approach for HARDMAN Implementation

Considering the various options for HARDMAN implementation, the following approach is recommended:

- OP-01 HARDMAN Project Management
- Seven year time frame
- Phased implementation: Ships/Air/Other

OP-01 HARDMAN Project Management offers several advantages over the other organizational alternatives. It calls for specific assignment of responsibility to a permanent organizational entity compared with the temporary development responsibility of the Task Force or the ad-hoc assignment of projects. The WSAP is a lengthy, ongoing process; to have real impact requires continuous monitoring and coordination. A task force or the ad-hoc approach would not be able to provide the continuity to ensure successful implementation of HARDMAN. Also, there is more incentive for implementation and follow-up when the developing organization is also responsible for operation of the system. In addition, HARDMAN Project Management is compatible with OP-01's mission and can be instituted with a minimum of disruption. It will have the OPNAV exposure which provides needed impetus for achievement of HARDMAN objectives.

The seven year time frame was chosen because of the magnitude of the WSAP and the proposed HARDMAN development. Stretching out improvements and capabilities instead of instituting sudden major changes ensures a smooth transition. Also, the seven year development time frame provides a long-term stimulus for upgrading Navy HARDMAN capabilities.

The phased implementation based on groups of similar weapon systems (Ships/Air/Other) allows the feasibility of HARDMAN improvements to be demonstrated quickly on a small group of acquisition projects. Then, the experience gained from the initial implementation can be used to more efficiently develop and implement HARDMAN capabilities for the remaining groups of weapon systems. Implementing HARDMAN capabilities for all procurements simultaneously would be cumbersome, and would allow little leeway for change as design deficiencies in the original HARDMAN concept are found through development experience.

Ships were chosen as the first group because they include a wide range of onboard equipment, and will thus provide a wide range of HARDMAN applications while focusing on a small number of acquisition projects.

CHAPTER VI

RECOMMENDED PLAN OF ACTION AND MARGINAL RESOURCES

A. Introduction

This chapter contains four sections. First it presents a plan of action and resource estimates for developing the HARDMAN capabilities and thereafter performing the various HARDMAN activities. The second section discusses OP-01 project management; how the HARDMAN Project Office may be organized, its staffing, and its roles and responsibilities. The third section describes the activities and resources required for development of HARDMAN. Finally, the fourth section discusses HARDMAN functions and responsibilities during operations, and estimates the resources required for HARDMAN operations.

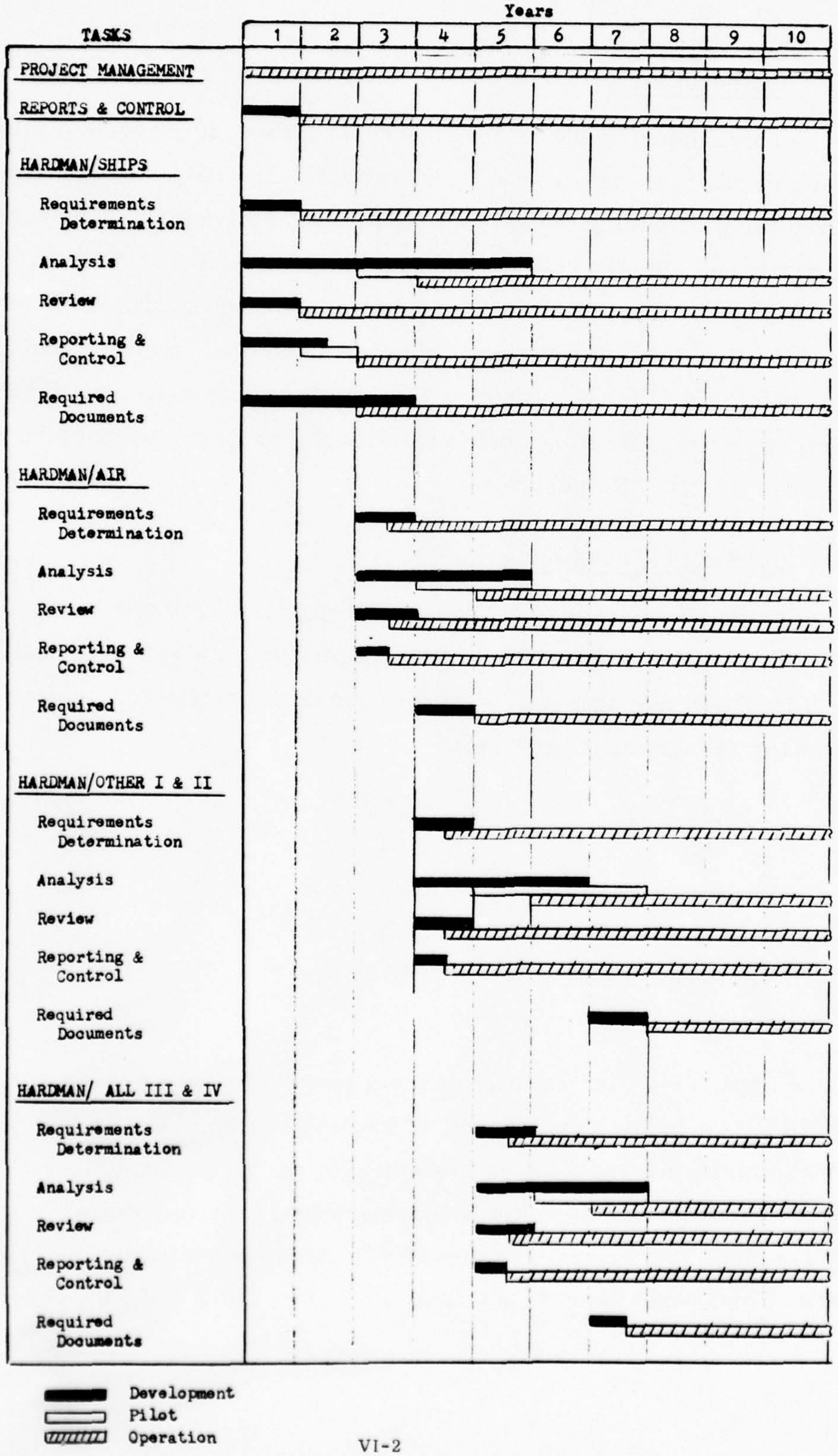
B. HARDMAN Development

In the discussion that follows, development of HARDMAN is based upon the recommended alternative presented in Chapter V, which calls for OP-01 HARDMAN management, a seven year development time frame, and the following sequential progression:

	TYPE	ACAT
1.	Ships	I, II
2.	Air	I, II
3.	Other	I, II
4.	All	III, IV

Figure VI-1 illustrates in general terms the development and operation of HARDMAN. Complete development of HARDMAN/Ships is to occur in five years, with significant capabilities available for operation at the end of the first year. HARDMAN/Air development will commence in the third year, while development for the other two weapon categories will be phased in during the fourth and fifth years. Total development costs will amount to $10.2 million over seven

Figure VI-1
HARDMAN Development and Operations



years. For purposes of operations, 30 billets will eventually be required to man the HARDMAN project office, and approximately $200,000 annually in computer support costs. Cost estimates are not included for the resources required by HARDMAN activities external to the OP-01/99 HARDMAN Project Office. Identification of these costs was not an objective of the study. External HARDMAN activities must assess the impact of HARDMAN on their organization and identify required assets.

C. Project Management and Organization

Coordination and support of the HARDMAN activities will come about from the HARDMAN Project Office. Initially created in the first year of system development to coordinate the development, this office would also assume increasing responsibilities for coordinating the operational activities associated with HARDMAN. In fact, when the developmental activities have been completed, the Project Office would continue to function as the overall coordinator and monitor of the HARDMAN initiatives.

The principal mission of the HARDMAN office will be to insure that adequate analysis of manpower/training requirements occurs. The HARDMAN Project Office would have the following specific missions:

1. To identify required HARDMAN procedures, developing major procedures and tasking HARDMAN activities to develop others;
2. To monitor the conduct of all HARDMAN activities and the functioning of all systems;
3. To insure that HARDMAN procedures are effective and where inadequate that further development occur;
4. To serve as the coordinator between the line operations in OP-01/99, CNM and others involved in manpower/training planning associated with weapon system development;
5. To provide the necessary support resources for computer-based capabilities such as reporting and analysis;

6. To monitor system development progress based on the reporting and control milestone reports;

7. To evaluate progress achieved in HARDMAN/Ships development and recommend further development into air, and other weapon systems;

8. To evaluate periodically HARDMAN operational activities and results and redirect efforts as necessary;

9. To provide the necessary training resources to support the implementation of HARDMAN procedures and methodologies;

10. To serve as the staff coordinator to the CEB and DNSARC with respect to coordinating the presentation of manpower/ training planning analyses;

11. To insure that POM proposals are compatible with aggregate resource requirements and long term projections resulting from HARDMAN;

12. To coordinate and monitor activities of the HARDMAN development effort including laboratories and contractors.

The HARDMAN Project Office will function as part of the OP-01/99 resources to support review, training and other operational HARDMAN activities. Also other agencies, laboratories, and commands will provide support according to HARDMAN requirements.

The purpose of the billets in the proposed organization would largely be to support operational HARDMAN requirements such as operating the reporting and control system, supporting HARDMAN analysis, etc. Six billets initially, however, will be required to provide project management specifically for the development effort described in the next section. Operationally, there will be 12 billets initially and 25 when development has been fully completed.

Project Office Billet Requirements	Initial	Fully Operational
Project Development	6	5
Supervisory Mgmt	1	2
Manpower Assessment New Rqmts	6	8
Training Assessment New Rqmts	5	8
Data Services - Reporting & Control	0	3
FMP Coordination	0	4
TOTAL	18	30

D. Development Activities and Costs

Development activities for HARDMAN consist of five principal tasks corresponding to the development of major HARDMAN procedures and systems. The tasks have been time-phased in such a manner as to provide significant operational capabilities after the first year. The first year actions include:

- Establishment of specific information requirements determination procedures
- Development of HARDMAN review procedures
- Installation of a computer-based reporting and control system tracking milestones for all systems under development

Current estimates put resource requirements for development at $4.7 million for HARDMAN/Ships, $2.3 million for HARDMAN/Air, and $3.2 million needed for the remainder; total cost for development will be $10.2 million.

A certain portion of the early effort is common to all four weapon system categories, and does not necessarily have to be attributed solely to HARDMAN/Ships. If, for example, HARDMAN/Air was developed first, its cost would rise to $3.7 million, while requirements for HARDMAN/Ships would fall to $3.3 million. This indicates that approximately $1.4 million can be viewed as common costs, including the cost of project management and initial reporting and control. Project management for HARDMAN development will require three billets to coordinate and monitor the effort.

In sum, the recommended plan of action will require $10.2 million over seven years. The cost estimate is based on 225 man-years of effort of which about 80% would be contracted; $200,000 in computer support costs are also included. Table VI-1 displays the cost estimate by weapon category and by year. Table VI-2 then shows a detailed breakout of resource requirements by the tasks.

Brief summaries of each of the five principal tasks follow; detailed descriptions are contained in Appendix N.

Table VI-1

HARDMAN Development Costs
(in millions of dollars)

		YEARS							
	ACAT	1	2	3	4	5	6	7	Total
Ships	I, II	1.5	1.4	1.0	.5	.3	0	0	4.7
Air	I, II	-	-	.9	.8	.6	0	0	2.3
Other	I, II	-	-	-	.8	.5	.6	0	1.9
All	III, IV	-	-	-	-	.6	.2	.5	1.3
		1.5	1.4	1.9	2.1	2.0	.8	.5	10.2

Table VI-2

Detailed Level of Effort for HARDMAN Development

	Year							
	1	2	3	4	5	6	7	
SHIPS I & II								
Project Management	3	3	2	1	1/2	-	-	
Requirements Determination	5	-	-	-	-	-	-	
Analysis Modules	11	12	12	10	7 1/2	-	-	
Review Procedures	5	-	-	-	-	-	-	
Reporting & Control System	6	4	-	-	-	-	-	
Required Documents Processing	3	9	7	-	-	-	-	
Total Man-years	33	29	21	11	8	-	-	
Costs (Thousands of Dollars)	1410	1390	990	490	340	-	-	4620

	Year							
	1	2	3	4	5	6	7	
AIR I & II								
Project Management	-	-	1	1	1/2	-	-	
Requirements Determination	-	-	3	-	-	-	-	
Analysis Modules	-	-	8	8	8	-	-	
Review Procedures	-	-	3	-	-	-	-	
Reporting & Control System	-	-	5	-	-	-	-	
Required Documents Processing	-	-	-	7	7 1/2	-	-	
Total Man-years	-	-	20	16	16	-	-	
Costs (Thousands of Dollars)	-	-	910	740	620	-	-	2270

Table VI-2, cont.

Year

OTHER I & II	1	2	3	4	5	6	7	
Project Management	-	-	-	1	1	1	-	
Requirements Determination	-	-	-	2	-	-	-	
Analysis Modules	-	-	-	8	9	8	-	
Review Procedures	-	-	-	2	-	-	-	
Reporting & Control Systems	-	-	-	4	-	-	-	
Required Documents Processing	-	-	-	-	-	7	-	
Total Man-years	-	-	-	17	10	16	-	
Costs (Thousands of Dollars)	-	-	-	760	470	620	-	1850

Year

OTHER III & IV	1	2	3	4	5	6	7	
Project Management	-	-	-	-	1	1	1	
Requirements Determination	-	-	-	-	2	-	-	
Analysis Modules	-	-	-	-	4	4	4	
Review Procedures	-	-	-	-	2	-	-	
Reporting & Control System	-	-	-	-	4	-	-	
Required Documents Processing	-	-	-	-	-	-	5	
Total Man-years	-	-	-	-	13	5	10	
Costs (Thousands of Dollars)	-	-	-	-	530	220	440	1190

TOTAL - ALL CATEGORIES								
Man-years	33	29	41	44	47	21	10	25
Costs (Thousands of Dollars)	1410	1390	1900	1990	1960	840	440	9930

Task 1: Develop Information Requirements Determination Procedure

Certain information is required to carry out the manpower/training management function in the WSAP. Under this task, the initial information requirements supporting the HARDMAN Information System will be determined based on identification of information focal points within OPNAV and NAVMAT. Procedures will then be developed for reviewing and revising information requirements periodically in the future. This task will require five man-years for HARDMAN/Ships, with completion scheduled for the end of the first year.

Task 2: Develop Analytical Techniques and Models

Three major areas of analytical support are required for treating manpower considerations in the WSAP: manpower/training requirements determination, life cycle costing (LCC), and tradeoff analysis. The manpower/training requirements determination module will provide the capability to analyze manpower and training requirements during the Concept Formulation stage and later stages in the WSAP. Estimating relationships, and data sources will first be developed. Subsequently a computer-based model will be built and user procedures specified.

The LCC model will provide the capability to rapidly estimate manpower/training and other costs that are comparable and subject to tradeoff analysis. An LCC concept will first be identified along with a cost element structure; then data sources and estimating relationships will be developed and finally actual programming of the computer based model will take place.

The tradeoff analysis module will integrate various HARDMAN methodologies into a computer-based system supporting weapon designers early in the WSAP. This subtask will also involve specifying the procedural framework for conducting and reviewing tradeoff analysis. Training user analysts and pilot testing of all three modules make up the remainder of Task 2, bringing the level of effort required to 49 man-years over five years for HARDMAN/Ships.

Task 3: Develop Review Procedures

This task is concerned with identifying specific review items, setting up review procedures, and specifying organizational activities responsible for enforcing the procedures. The initial specification of procedures will be completed by the end of the first year and can be implemented immediately thereafter. With evaluation and refinement occurring in the second year, the total level of effort will be five man-years for HARDMAN/Ships.

Task 4: Develop Reporting and Control Systems

Reporting and control will take the form of a management information system designed to 1) track milestones in the WSAP and 2) keep track of actions required to satisfy HARDMAN review procedures and data collection. The computer based system will be designed, coded, and implemented by the end of the first year. An additional six months will be needed for evaluating and modifying the system, with the total level of effort coming to ten man-years for HARDMAN/Ships. The initial system will capture milestone data for all weapon categories.

Task 5: Develop Required Documents Processing System

Substantial savings can be realized by the Navy by automating the transfer of data from the HARDMAN data base to documents such as Navy Training Plans and Ship Manpower Documents. Additional economies can be effected by the utilization of text processing techniques to produce the actual documents. This task consists of activities to design and implement a computer-based system for producing the required documents. It will require 19 man-years of effort over three years for HARDMAN/Ships.

E. Operational Activities and Resource Requirements

Table VI-3 shows estimated start-up dates for HARDMAN operations. Three of the five HARDMAN capabilities will be operational after the first year of development. Interim capabilities supporting the analytical requirements will be available during the second year, with full support available at the conclusion of the third year. This support will include computer assistance for estimating manpower/training requirements, life cycle costs, and the conduct of tradeoff analysis. The following paragraphs describe the operational activities that will take place under the five HARDMAN functional areas.

1. Determining Manpower/Training Information Requirements

OP-01/99 would have responsibility for developing information requirements associated with each stage of the WSAP and providing instructions and training of the program managers and their staffs. The requirements are designed to highlight major manpower/training issues associated with each major weapon system development.

Under HARDMAN, there would be information requirements which must be met at each stage of the acquisition process. These requirements would underlie the review criteria used subsequently for approving the analyses presented by the program managers.

These information requirements, once specified, probably will not drastically change. However, some staffing is required simply to provide training support to the CNM and his staff in understanding the nature of the requirements and the nature of the expected information for meeting these requirements. The Weapons System Acquisition Management School (WSAM) may be one vehicle for providing program managers with the requisite background and early understanding.

Table VI-3

HARDMAN/SHIPS Operations
Expected Start-up Date

Function	Estimated Start-up Date (months after development begins)
Project Management	0
Information Requirements Determination	12
HARDMAN Analysis	36
Review	12
Reporting and Control	12
Document Preparation	36

2. Performing HARDMAN Analysis

The CNM has responsibility for conducting HARDMAN analysis. In some respects, this requirement exists already. particularly in the later stages of development. Nevertheless, under HARDMAN there are uniform analytical requirements which must be met at each WSAP stage.

The principal elements will be supported by computer models developed to support the analysis function:

- Manpower/training requirements determination
- Life Cycle costing
- Tradeoff analysis

These analyses must be conducted in each WSAP phase although the opportunity for making tradeoffs between equipment and manpower/ training resources becomes limited in the later stages of the WSAP.

As part of the ongoing management of the HARDMAN activities, the Project Office will insure that available training resources and opportunities are available to develop and maintain a level of expertise in HARDMAN analysis.

In each stage of the acquisition process, the analysis would be repeated refining the resource estimates and determining changes from original estimates. These data would be useful in future equipment development as far as anticipating changes in resources and recognizing the opportunities for achieving effective tradeoffs. Key indicators from these analyses would be included in the standard reporting and control procedures so that the HARDMAN data base would accumulate valuable historical data of the changes in resources required for weapon systems.

The data from the analysis must be assembled to correspond to the information requirements that when review of HARDMAN analysis occurs, the data will satisfy the requirements which have been established.

3. Reviewing HARDMAN Analysis

The purpose of the review will be to insure that the HARDMAN analysis has been satisfactorily performed. The initial review will be conducted by a HARDMAN working group composed of manpower/training analysts.

The review will be limited to whether the standard information requirements have been satisfied, not whether the estimates indicate favorable or unfavorable requirements; the latter is a judgment reserved for the CEB.

A HARDMAN Review Committee will be established, and will consist of flag-level officers representing such organizations as OP-01, OP-99, OP-96, OP-90 as well as the Program Sponsor. The Review Committee will review the recommendations of the working group to insure that adequate procedures for determining manpower/training requirements have been used. If the data is inadequate, the Review Committee will indicate the shortfalls and instruct the working group to provide guidance to the weapon systems analysts in improving the analysis. When the review finally reaches a satisfactory conclusion, the analysis will be provided to the CEB for their review.

4. Reporting and Control

The reporting and control activity is supported through a computer system designed to capture milestones and key data regarding weapon system development.

The computer system will be operated for OP-01/99 through the auspices of NAVCOSSACT or BUPERS or some other Navy activity.

Program Sponsors and CNM-designated Program Managers will submit progress reports to the HARDMAN Project Office and the data will be key-entered into the computer system. The milestones reported will conform to reports already being filed so that the additional work on the part of the CNM will be limited.

There will eventually be a form on which key indicators regarding the system resource requirements are displayed as well as milestones so that status of the weapon system may always be known.

5. Required Documents Processing

This is also a computer activity in which the production of standard Navy documents such as Ship Manpower Documents, Navy Training Plans, among others, are supported in terms of text processing. The data as it exists in the HARDMAN data base and the formatted text can be called from the computer to support the preparation of these documents.

Utilizing these capabilities, the professional time devoted to these documents may be reduced by an estimated twenty percent and the clerical time by at least one-third.

When all HARDMAN capabilities are operational, an estimated 30 billets will be required; computer support costs will be approximately $200,000 annually. Of the 30 billets, some portion may be reprogrammed from existing Navy activity; no estimate however is made here of the extent to which reprogramming may occur. Table IV-4 indicates the phased level of billets as well as estimated costs for computer support for HARDMAN operational activities to take place.

In addition to these explicit operational resource requirements, redirection of current Navy efforts devoted to weapon system analysis and document preparation may be anticipated. With respect to analysis, redirection will occur with respect to the necessity for conducting early analyses of manpower/training resource requirements; some portion of the already substantial Navy effort devoted to manpower/training planning will assume responsibility for these early analyses. In terms of document preparation, less professional and clerical effort will be required when computer-based text processing capabilities have become operational.

TABLE VI-4

Estimated Resource Requirements for HARDMAN Project Office

YEAR	1	2	3	4	5	6	7
Annual Computer Costs ($000)	0	50	100	150	200	200	200
HARDMAN Development	6	6	5	5	5	5	5
HARDMAN Office Operations	12	19	25	25	25	25	25
Project Office Total Billets	18	25	30	30	30	30	30

CHAPTER VII

CONCLUSIONS AND RECOMMENDATIONS

A. Introduction

The purpose of this chapter is to summarize the principal conclusions and recommendations of the HARDMAN Study. First, the three major conclusions are presented and discussed. Then, the resulting recommendations are presented, along with the costs and benefits associated with their implementation. The discussion here is based on the preceding chapters.

B. Conclusions

An evaluation of the acquisition process reveals major shortcomings with respect to effective consideration of manpower vs. hardware tradeoffs and manpower/training requirements determination. The principal conclusions are:

- Requirements for manpower planning and tradeoff analysis in the WSAP occur too late and fail to address the major issues.
- Key participants in the acquisition process lack incentives with respect to determining and insuring visibility for manpower and training requirements.
- Objectives and procedures traditionally associated with WSAP-related development activities such as test and evaluation, logistic support, among others, are not always consistent with requirements for manpower/training planning.

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These are briefly summarized below:

1. Manpower/Training Requirements Too Late

Although a substantial portion of life cycle costs are committed by the end of the Concept Formulation stage, manpower requirements are generally not adequately identified until later stages of the WSAP. This results in the initial understatement of resource requirements and the subsequent necessity of reprogramming manpower resources.

Determination of training requirements and potential tradeoffs also suffer from the lack of early consideration in the WSAP. This has resulted in the late acquisition of training equipment and facilities, and unfunded training plans. All too frequently, the resource programming is neglected and trained personnel cannot be made available at the appropriate time.

2. Lack of Incentive

The CNM has major responsibility for design, development and production of an individual weapon system within the Navy. In program reviews throughout the acqusition process, the program manager is the individual who is trying to "sell" his program to the Navy and subsequently, through the DSARC process, to the Secretary of Defense.

Because the manpower/training dollars of any project will increase the costs in the operating and support categories and because in the early stages the program manager is only budgeted for development dollars, the program manager is not highly motivated to identify significant manpower/training expenditures. The likelihood of his program being disapproved increases in direct proportion to its dollar impact.

3. Related Development Activities Inconsistent

Various WSAP-related activities tend to discourage or distort consideration of manpower and training requirements. These activities include testing and evaluation, integrated logistics support planning, and the POM process.

Testing and evaluation is oriented to determining whether or not the equipment functions to specifications. The factory trained personnel which are used to conduct the testing tend to be more highly skilled and motivated than personnel available to the fleet commands. Thus, testing and evaluation tends to understate the manpower and training requirements.

In integrated logistics support planning, little progress has been made in adequately determining support manpower and training requirements. The Navy uses a fixed percentage of operational manpower to determine support manpower requirements. Use of a fixed percentage for all procurements precludes valid tradeoff analysis. There can be cases where operating manpower requirements are higher for a particular design alternative, but where overall manpower requirements are lower because of drastically reduced support requirements. Current methods fail to take advantage of such tradeoffs.

Finally, the POM process tends to discourage early consideration of manpower requirements. While the focus of the POM is five years, major weapon systems often take much longer to develop. What happens is that in the early stages, the POM may reflect only R & D dollars, while the decision being made actually commits the majority of the life cycle resources. The total life cycle resources are substantially greater than the concept and design dollars approved in the POM.

C. Recommendations

As a result of the analysis of the Weapon System Acquisition Process, a number of improvements with respect to manpower and training planning are necessary in order to eliminate present shortcomings. The overall objective associated with these improvements is to insure early consideration in the WSAP of the manpower/training resources required to support equipment under development. With this in mind, the following actions are recommended:

- Establish a HARDMAN Project Office with the mission to insure that manpower and training analysis is conducted in a timely fashion during the WSAP
- Develop HARDMAN capabilities to support the early identification and review of manpower and training requirements
- Implement analytical tools and review procedures supporting HARDMAN functions
- Implement a reporting and control system for HARDMAN functions in the WSAP.

The major benefit resulting from these HARDMAN improvements to the WSAP is the early consideration of manpower and training issues in the WSAP so that tradeoffs can be made before it is too late. Other benefits include the ability to monitor the status of all weapon systems in the acquisition process, the ability to produce standard Navy documentation more quickly and efficiently, and the overall coordination and monitoring of the manpower/training aspects of weapon system development.

Each of the recommendations is discussed briefly in the ensuing paragraphs, followed by estimates of the development and operating costs associated with implementation.

1. HARDMAN Project Office

The project office would initially be tasked with overseeing the development and implementation of the various HARDMAN capabilities.

However, the WSAP is a lengthly, on-going process; to have real impact requires continuous monitoring and coordination. Establishment of the HARDMAN project office would assure a permanent organizational entity responsible for providing this continuous monitoring and coordination.

2. Manpower/Training Requirements Determination

Part of the problem in the early identification of manpower/training requirements is the lack of guidance to the CNM as to the actual manpower/training information required for analysis. This direction would be provided to the Program Manager and review authorities in the form of computer based models designed to determine manpower and training requirements early in the acquisition process.

3. Analytical Tools and Review Procedures

Currently there are no general guidelines for the Program Manager to use in costing manpower and training in the overall system or in evaluating the potential tradeoffs between hardware design and manpower. The recommended analytical tools to alleviate this situation include a life cycle costing model oriented specifically to providing visibility to manpower and training costs, and a tradeoff analysis module supporting the balancing of these costs and requirements against alternative designs.

Review procedures would then be instituted to insure that the CNM determines manpower requirements early in the WSAP, adequately analyzes system life cycle costs, and takes advantage of the resulting tradeoffs that present themselves. The HARDMAN review authority would only determine if these issues have been adequately addressed, and would not weigh the merits of the alternatives considered.

4. Reporting and Control System

Reporting and control is the dissemination and monitoring of the manpower/training related information to the individuals and organizations requiring it. This includes not only the reports submitted by the parties engaged in manpower/training analysis to the review authorities but also any information which must be exchanged to carry out the determination, analysis, or review functions.

The overall objectives of a HARDMAN reporting and control system would be to insure that there is a single source of information regarding the status of all weapon systems under development, that major milestones with respect to development and particularly manpower/training determination and tradeoff analysis are monitored, and that a standard set of information about the manpower/training requirements of a weapon system are available as they are developed and refined throughout the WSAP.

5. Cost of Implementation

The costs associated with implementing the above recommendations in the manner described in this report would be:

- $10.2 million over seven years for development of HARDMAN capabilities
- 30 billets for operation of HARDMAN, some of which can be reprogrammed
- $200,000 annually for HARDMAN computer support.

In addition, there would be additional costs associated with HARDMAN activities external to OP-01/99; to a significant extent, existing resources devoted to manpower/training planning activities may be reprogrammed to incorporate the HARDMAN requirements.

APPENDIX A

STUDY DIRECTIVE AND PLAN

DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
WASHINGTON, D.C. 20350

IN REPLY REFER TO
Ser 96/588086

28 APR 1976

From: Chief of Naval Operations
To: Distribution List

Subj: Study Directive for Military Manpower versus Hardware Procurement

Ref: (a) CNO SECRET ltr ser 96/S60018 of 28 Aug 1975; Subj: CNO Studies and Analyses Program for FY-1976/7T (CSTAP-76/7T)

Encl: (1) Guidance for CNO Studies and Analyses
(2) Manning Requirements for the Military Manpower versus Hardware Procurement Study

1. Title. Military Manpower versus Hardware Procurement.

2. Type. CNO in-house study.

3. Background. In its pursuit of more cost effective weapons systems, the Department of Defense has structured a process to be followed by all armed services in the development and acquisition of major weapons systems. While each service is allowed considerable discretion in its approach to the development process, each must nevertheless meet common minimum requirements and milestones. The process as implemented within the Navy is quite complex in detail and involves many working and management echelons in the Navy and OSD.

a. Despite the detail and depth of documentation and directives governing the acquisition process, serious problem areas regarding the establishment of manpower and training requirements, requisite skill levels, and their true costs have emerged. With the recent dramatic increase in manpower costs, insufficient concern has been placed upon early identification of the manpower requirements and skills associated with the acquisition of the new higher technology weapons systems. This failure to fully identify manpower implications in the early stages of program development, coupled with rising manpower costs, has led to the development and production of systems which require specialized skills in excess of those available and generate life cycle costs far in excess of those estimated at the time the production decision was made. In such cases, earlier and more rigorous consideration of the manpower implications in the cost benefit analyses supporting system development might have caused development concept decisions to move toward more cost-effective system alternatives. Major gains in system cost-effectiveness may be realized through the development and implementation of a process for trading off hardware versus manpower costs for all new acquisition beginning in the early stages of program development.

b. Further complicating the problem is the structuring of the DOD Weapon System Acquisition Process around the program costs. High priority/expensive major programs (>200M) receive high visibility, and consequently closer scrutiny. Lower priority/less expensive programs (<20M) often receive less thorough manpower analyses. Taken individually, the less expensive programs may not appear to have significant manpower implications. Because of this, the personnel system is often expected to provide the needed individuals without special planning and programming. However, the aggregate requirements generated by many small acquisition programs have a major impact on manpower and training requirements, and consequently on weapons system costs.

c. The proliferation of directives regarding the systems acquisition process has made it increasingly difficult to pinpoint the responsibilities and milestones for early definition of manpower requirements on both system cost effectiveness and Navy-wide manning levels.

4. Objective. Analyze the current manpower and training requirements reporting and review structure as it applies to the systems acquisition process. Develop to the extent necessary a new manpower and training requirements analysis and review process to be integrated into the acquisition process for all new hardware acquisition categories. The study will explicitly define:

a. Who is required to make what decisions regarding manpower/training for new systems and what reporting system does he have or should he be using.

b. What authority the decision maker has and to whom he is explicitly responsible.

c. When during the development cycle these decisions must be made.

d. What manpower/hardware tradeoffs must be analyzed in reaching these decisions.

e. What methodologies (analysis tools) are available or should be developed in order to credibly perform such tradeoff analyses.

f. What manpower data are or should be available to the decision maker to support the analyses.

5. Specific Guidance

a. Working within the framework of the existing weapons system acquisition process, the study will conduct a critical examination of the manpower determination process associated with new procurements and the procedures employed to obtain funded billets. Building upon this foundation, a new or improved process will then be developed. The new concept will be clearly oriented to emphasize the impact of system acquisition decisions on Navy manning and skill levels and ultimately on the life cycle cost of new procurements.

b. A manpower costing rationale will be developed capable of treating manpower as a capital asset when performing system cost effectiveness tradeoffs. Methodologies available or needed to reflect life cycle manpower costing impact of skill levels, attrition and training will be identified.

c. The new structure will clearly identify decision points in the acquisition cycle where manpower hardware tradeoffs should be analyzed, the manpower, personnel and training issues which should be addressed, and the methodologies and data sources available or needed to credibly perform such analyses.

d. The study will identify where in the acquisition process the examinations of the various technical, managerial and organizational alternatives are to be performed. It will establish the reporting and review structure needed to support identification of manning implications early in system development, and to ensure consideration of these implications in program decisions at all levels.

e. The results of the above tasks will be incorporated into a recommended plan of action for the development of needed methodologies and implementation of the study developed process.

6. Coordination and Review

a. The Study Sponsor is the Deputy Chief of Naval Operations (Manpower) (Op-01).

b. The CNO Project Officer is LCDR J. K. Ruland, USN, (Op-124D).

c. An Advisory Committee, chaired by the Assistant Deputy Chief of Naval Operations (Manpower Planning and Programming) (Op-01C), is established. Members will include representatives of Op-02, 03, 04, 05, 06, 090, 96, 094, 095, 098, 099, and Chief of Naval Material. The President, Center for Naval Analyses and the Chief of Naval Education and Training are invited to participate. It is requested that each organization cited above forward identification of the representative and of a point of contact to the Project Officer within ten days of the date of this directive. It is also requested that each addressee forward identification of a point of contact to the Project Officer.

d. Study Group membership is designated in enclosure (2).

e. The Director, Systems Analysis Division (Op-96) shall conduct a technical review to monitor progress and ensure quality of the study. During the course of the study, this effort shall review the working papers and reports for validity and completeness and shall provide an independent technical evaluation of the final report. Results from the review shall be promulgated to the Advisory Committee and the CNO Project Officer by Op-96.

f. LCDR S. K. Laabs, USN, is designated Op-96 Study Monitor.

7. Reporting.

a. The study plan is to be submitted to the Advisory Committee within four weeks of the date of this directive.

b. The Project Officer will submit monthly progress reports to Op-96 in accordance with current directives.

c. Meetings of the Advisory Committee shall be called by the Chairman at appropriate times to review and evaluate study progress and trends. The committee shall meet at least once each quarter.

d. Working papers will be submitted to the Advisory Committee as they become available.

e. A report of work accomplished and study findings on the first phase of the study will be submitted to the Advisory Committee by 31 October 1976.

D. C. Davis

D. C. DAVIS
Director
Navy Program Planning

Distribution:
(see page 5)

Ser 96/588086

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CNO (Op-01, 02, 03, 04, 05, 06, 090, 96, 094, 095, 098, 099)
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GUIDANCE FOR CNO STUDIES AND ANALYSES

1. The assumptions which are of great importance to the outcome of the analysis shall be clearly stated in the introduction to the report. Also, at the beginnning of each chapter, annex, or appendix, the complete set of assumptions which are applicable shall be listed. The analysis shall determine the effects of alternative assumptions when these are critical to the study results.

2. The analysis shall identify the key parameters (weapons systems effectiveness values, costing techniques) which greatly affect the study results. Best estimates shall be used for the values of these parameters; in addition, greater and lesser values spanning the range of reasonable values for each parameter shall be used to determine the sensitivity of the study results to changes in these key parameters.

3. A clear and concise description of each model or simulation shall be included in an appendix to the report unless such description is available in an already published document and is referenced in the report. This description shall explain in qualitative terms (including a logic diagram) the general methodology which provides the basis for the model. Detailed design specifications for each model, or reference to a permanent OPNAV file in which these design specifications are held, shall be included inthe permanent files of this study.

MANNING REQUIREMENTS FOR THE MILITARY MANPOWER VERSUS HARDWARE PROCUREMENT STUDY

1. General

a. Personnel assigned to the Study Group should have general or specific knowledge of the weapons system acquisition process, and should also be familiar with the methodology for determination and programming of manpower requirements. Each representative will be responsible for keeping his parent command informed of the progress of the study and making the view of this parent command known to the Study Project Officer.

b. It is appreciated that personnel having the above qualification will be involved in other aspects of the overall acquisition manpower/personnel/training system. The level of effort required of Study Group members will therefore be limited to part-time participation.

2. Composition

Command	Rank	Specialty
Op-01 (Op-124D)	LCDR	CNO Project Officer
Op-01 (Op-121)	CDR/LCDR	Manpower Analyst
Op-02 (Op-29)	CDR/LCDR	Submarine Manpower Requirements - New Acquisitions
Op-03 (Op-37)	CDR/LCDR	Ship Acquisition Programs
Op-03 (Op-39)	CDR/LCDR	Surface Warfare Manpower Requirements and Acquisitions
Op-05 (Op-59)	CDR/LCDR	Aviation Manpower Requirements - New Acquisitions
Op-94	CDR/LCDR	Communications Manpower Requirements - New Acquisitions
Op-95	CDR/LCDR	ASW and Ocean Surveillance Manpower Requirements - New Acquisitions
Op-96	CDR/LCDR	Manpower Analyst
Op-09B	YN/Clerk Typist (GS 4-5)	

Command	Rank	Specialty
Op-96 (Op-96D)	CDR/LCDR or Civ. Equiv.	Life Cycle Cost Analyst
Op-099	CDR	Navy Training Plans
CHNAVPERS (Pers-21)	CDR/LCDR or Civ. Equiv.	Enlisted Billet Cost Model Analyst
CHNAVPERS (Pers-23)	CDR	Occupational Systems Plans & Programs
CHNAVPERS (Pers-5)	CDR	Enlisted Rating Coordinator
NAVSEASYSCOM (SEA-047)	CDR/LCDR or Civ. Equiv.	Personnel & Training Support Analyst
NAVSEC (6110)	CDR/LCDR or Civ. Equiv.	Design Work Study Analyst
CHNAVMAT (NMAT-034)	CDR/LCDR or Civ. Equiv.	Shipboard Manning and Automation Analyst (MRTO)
CNET	CDR/LCDR or Civ. Equiv.	Training Support - New Acquisitions

3. Reporting. All personnel shall report by telephone to the CNO Project Office not later than ten days from the date of this directive.

STUDY PLAN FOR MILITARY MANPOWER VERSUS HARDWARE PROCUREMENT (HARDMAN)

1. Tasks

a. Task 1. Describe and analyze the Navy's current manpower and training requirments determination, analysis, reporting and review process and structure as it applies to the Weapons System Acquistion (WSA) process (including Integrated Logistic Support (ILS)).

(1) Sub-Task 1-1. Conduct a literature search of instructions, directives and research efforts pertaining to this analysis.

(2) Sub-Task 1-2. Identify the key points in the WSA process where manpower/training decisions are made.

(3) Sub-Task 1-3. Identify the manpower/hardware tradeoff analyses currently used in reaching manpower and training decisions. Identify the methodologies and data bases used in these analyses.

(4) Sub-Task 1-4. Identify and interview key personnel/ decision makers involved in the WSA process.

(5) Sub-Task 1-5. Prepare a working paper consolidating the data gathered in the above sub-tasks into a description of the current WSA process, upon which improved procedures may be developed.

b. Task 2. Develop, to the extent necessary, a new manpower/ training requirements determination, analysis, reporting and review process and structure which fully integrates manpower/training considerations into the WSA decision-making process.

(1) Sub-Task 2-1. Develop, as necessary, a life cycle costing rationale that more accurately reflects the true costs of manpower and training.

(2) Sub-Task 2-2. Document the factors which must be considered in the development of manpower and training/hardware tradeoff analyses.

(3) Sub-Task 2-3. Determine what manpower/hardware tradeoff methodologies and supportive data bases require development.

(4) Sub-Task 2-4. Prepare a working paper consolidating the findings of the above sub-tasks, and proposing improvements in incorporating manpower and training requirements into the WSA process.

c. Task 3. Develop alternative implementation plans and conduct marginal resource requirements analyses to assess their impact on existing Navy organizations and WSAP.

(1) Sub-Task 3-1. Establish baseline estimates of existing resource requirements associated with current weapon system-related manpower and training planning.

(2) Sub-Task 3-2. Identify alternative implementation plans for establishing HARDMAN Concept as part of the WSAP.

(3) Sub-Task 3-3. Evaluate marginal resource requirements associated with each alternative implementation plan.

(4) Sub-Task 3-4. Prepare a working paper describing the alternative implementation plans and summarizing the major resource requirements.

d. Task 4. Incorporate the results of Tasks 1,2, and 3 into a recommended plan of implementation of a new, or modified, or more rigidly enforced manpower/training analysis and review process.

e. Tasks not engaged

(1) Methodologies requiring development in order to perform hardware/manpower tradeoff analyses will be defined, described, and assessed as to feasibility. Their detailed development, however, will await acceptance of the final report by higher authority.

(2) Present methods for portraying manpower and training costs in life cycle cost (LCC) computations will be examined, and rationale for any changes recommended will be provided. Resolution of differences between alternative sources of LCC data will require policy decision by higher authority.

2. Scope and Depth. The study will encompass a cross-section of acquisitions which have manpower/training implications: new weapons systems, new equipment, new programs. The types of manpower analyses will vary with the kind and category of acquisition, and the phase of system development. The study will identify the level of detail required to institutionalize analyses and review systems which will support identification and assessment of manpower and training implications beginning in the earliest stages of system development, in order to ensure consideration of these implications at program decision-making levels.

3. Manpower Allocation. Tasks 1 through 4 will require the services of the project officer, all members of the study group within their functional areas of expertise, and contractor support. The projected level of contractor support is 27 man-months of effort extending over a period of 10 months.

Study group members will provide initial points of contact for contractor information, will nominate candidate programs and hardware systems for investigation, will review working papers and reports, and will assess the adequacy of present charters, functions and controls. Any changes to Navy management decision policies will originate within the Navy study group and will be submitted to the advisory committee for consideration.

4. Funding Allocation. System Automation Corporation will support this study under ONR contract. Approximate funding is $27,000 for Task 1, $40,000 for Task 2, $39,000 for Task 3, and $13,000 for Task 4.

5. Other Resources. None.

6. Task Schedule

a. Study Directive signed: 28 April 1976

b. Contractor on board: 3 May 1976

c. Study Plan approval: 2 June 1976

d. Task 1: 3 May - 30 June 1976

e. Task 2: 1 July - 30 Sep 1976

f. Task 3: 15 Oct - 15 Dec 1976

g. Task 4: 16 Dec - 15 Feb 1977

7. Specific Guidance.

a. The principal thrust of the study is to identify the level of detail required to structure a requirements determination, analysis, reporting and review system which will support identification of manning/training implications early in system development, and ensure consideration of these implications in program decisions at all levels. Therefore, the analysis of the current manpower and training requirements reporting and review structure should answer the following questions:

(1) How early (or late) are manning implications identified in the weapons acquisition process?

(2) What benefit, and to whom, would it be to identify manning earlier and/or with greater precision (quality, rates, NEC)?

(3) How does the quality and availability of manpower data presently impact on program decisions?

(4) What benefit would increasing the availability of data have on the decision process?

(5) What changes, other than improving the timeliness and accuracy of manpower data and tradeoff methodologies, would improve consideration of these (manpower) implications in program decisions?

8. Methodology

Task 1

Sub-Task 1-1. Existing DoD, SECNAV, CNO, NAVMAT, SYSCOMS, and NAVCOMP directives concerning the WSA process will be reviewed. A matrix will be developed showing the manpower and training analysis requirements of each document for each phase of the WSA process. Areas of inconsistent requirements will be identified. The study will be particularly alert to official documents outside the normal directive system which influence the decision makers. Major research relevant to this study will be examined. Sources for this information include, but are not limited to, the following: the Defense Documentation Center (DDC), the Center for Naval Analyses Technical Library, the Defense Logistic Studies Information Exchange (DLSIE), the Op-01 Personnel Studies Library, and other libraries or information centers deemed appropriate.

Sub-Task 1-2 and 1-3. The key points during the WSA process when the manpower/training decisions are currently being made will be identified. The manpower/hardware tradeoff analyses that are currently performed in reaching these decisions, the current methodologies that are available for the performance of the tradeoffs, and the manpower data that is available to support the tradeoffs, will also be identified.

Sub-Task 1-4. The personnel who make the key decisions during the WSA process (i.e., program sponsors, OPNAV coordinators, program managers, project officers, principal developing activities) will be identified and an assessment made of their responsibilities and authority. These personnel will be interviewed to determine their concepts of the process and its related manpower, personnel and training problems. Insight will be provided into the actual procedures that are followed. Informal as well as formal procedures will be identified and the causes for deviations from institutionalized procedures will be determined.

Sub-Task 1-5. A working paper will be prepared outlining in precise detail the procedures that are currently employed to acquire new equipment and weapons systems and to formulate and execute new programs. In consolidating the data gathered by the previous sub-tasks, the working paper will describe how the acquisition process actually works as well as how it is supposed to function. Recommendations will be provided for the resolution of conflicting information and requirements. For each phase of the acquisition process, the working paper will identify the key decision points, the organizations having responsibility for staffing and decision-making, the data requirements as well as data available, the relationship of manpower assessments and planning to the key decision points, and the current methods that are used to calculate manpower requirements. The working paper will provide the baseline from which a new manpower/training requirements analysis and review process may be structured.

Task 2

Sub-Task 2-1. Existing data sources, such as the Navy Billet Cost Model, the NARM, and others, will be evaluated to determine their adequacy for use in the performance of manpower/hardware tradeoffs. The resources required to develop meaningful manpower life cycle costing techniques will be identified for each phase of the WSA process. This will include the establishment of an appropriate cost breakdown structure for manpower LCC and an investigation of cost estimating relationships (CER's).

Other capabilities which will be considered for inclusion in the costing techniques include: the relative importance of short-term and long-term break-even points; how retrofit programs may provide greater benefits of labor and skill savings than new construction.

Sub-Task 2-2. Factors which impact manpower/hardware tradeoff analyses and methodologies available or needed to reflect the impact of these factors on manpower LCC will be reviewed. Examples of factors to be studied are as follows:

Productivity	- effect of substitution of hardware for manpower
	- impact on each stage of the development cycle
	- present capability of making valid estimates of productivity
Recruiting, training and attrition	- consideration of turnover and recruiting costs
	- difficulties of recruiting
	- future trends of economy
Reliability/Maintainability	- determine importance of tradeoffs between R/M and manpower costs
	- estimate reduction in manning levels due to R/M improvements
	- implications of new skill categories not in Navy inventory or in short supply
	- consideration of difficulty/limitations to acquiring higher skill levels

	- consideration of NEC requiring new training programs
Design Work Study	- effect of ship design, equipment selection, arrangements and operating/maintenance procedures and manpower and training requirements

Sub-Task 2-3. Methods will be developed by which the results of sub-tasks 2-1 and 2-2 can be used in performing manpower/hardware tradeoff analyses. The various factors will be integrated into a series of alternatives and methodologies that can be applied to the types of hardware and programs under consideration by the Navy. Selected case studies of new hardware acquisitions/new programs will be utilized to determine that the full range of decision points and corresponding methodologies have been identified. Decision points in the acquisition process will be identified where manpower/hardware tradeoffs should be analyzed and where examinations of the various technical, managerial and organizational alternatives should be performed. Additionally, the level of detail of manpower/training information required at specific decision points will be delineated.

Sub-Task 2-4. A working paper will be prepared summarizing the findings of sub-tasks 2-1 through 2-3. Methods and techniques for a manpower and training requirements, determination, analysis, reporting and review process will be described in relation to key decision points in the weapons system acquisition process. The working paper will establish the reporting and review structure needed to support identification of manpower/training implications early in system development, and to ensure consideration of these implications at program decision-making levels.

Task 3

Sub-Task 3-1. In order to establish a baseline for marginal resource requirements analysis, the organizational resources required by existing manpower and training implications assessment procedures will be identified. Organizations within OPNAV and NAVMAT which presently perform HARDMAN related functions will be identified and their required resources to perform these functions, in terms of billets and manpower costs, determined. Existing data bases, analytical methodologies and reporting and control procedures will be identified. Copies of presently required reports and documentation will be acquired for review, organizational responsibilities for preparation identified, and required levels of effort determined.

Sub-Task 3-2. Alternative implementation plans will be identified based on HARDMAN functions and procedures and subsets of weapon systems. Weapon systems may be categorized in terms of ACAT's, warfare sponsorship, WSAP status, etc. HARDMAN functions and information system modules may be variously combined in alternative implementation plans. Three or four alternatives will be specified which will be subjected to marginal resource requirements analysis.

Sub-Task 3-3. The resources required for each implementation plan will be fully identified. The costs and number of billets required to support organizational activities will be delineated, including increments and decrements within the organizations. Resources such as ADP and equipment costs will be specified where applicable. All resources will be aggregated into initial investment and annual operating costs.

Sub-Task 3-4. A working paper will be prepared summarizing the findings of sub-tasks 3-1 through 3-3. The key findings related to the alternative implementation plans and resource estimates for these plans will be provided.

Task 4

The results of Tasks 1,2, and 3 will be evaluated, correlated and incorporated into a final report. This final report will provide a recommended plan for the development of needed methodologies, acquisition of required data, and changes in decision or reporting authority required to implement the study findings.

9. Effectiveness Criteria. Not applicable

10. Reports.

a. Monthly progress reports will be submitted to OP-96 in accordance with OPNAV Instruction 5000.30.

b. Working papers and a final report will be submitted to the Advisory Committee in accordance with Sections 1 and 8 of this Study Plan.

c. Interim briefings will be presented as required.

11. Coordination

The study group will coordinate with mission sponsors, program and project managers, Navy Personnel R&D Center, Bureau of Naval Personnel, Naval Postgraduate School, Office of Naval Research, Center for Naval Analyses, Navy Human Resources R&D Advisory Council, Navy Research Advisory Committee, and other organizations as appropriate.

STUDY GROUP

HARDMAN

NAME	RANK	ORGANIZATION	CODE	PHONE	BLDG/ROOM
J. K. Ruland	LCDR	OPNAV Op-01	Op-124D	694-1087	AA/2633
M. Letsky	GS-14	OPNAV Op-01	Op-121C1	694-3413	AA/1606
G. R. Anderson	CDR	OPNAV Op-02	Op-291	692-4870	BT-1/1113
M. D. Kiefer	CDR	OPNAV Op-03	Op-37C	697-6383	PNT/4A720
A. J. Megna	LCDR	OPNAV Op-03	Op-393R	695-2309	PNT/2C329
R. Cole	LCDR	OPNAV Op-05	Op-597C	697-6739	PNT/4E412
P. Lewis	CDR	OPNAV Op-094	Op-940C1	697-7457	PNT/5C640
H. S. Bronson	CDR	OPNAV Op-095	Op-951H	697-3096	PNT/5D581
D. H. Demand	CDR	OPNAV Op-96	Op-964D4	695-0356	PNT/4A478
R. Clark	CDR	OPNAV Op-96	Op-96D21	697-7088	PNT/2C340
S. Underhill	CDR	OPNAV Op-099	Op-992F2	692-4745	BT-1/1214
L. Mairs	LCDR	CHNAVPERS	Pers-21222	694-5108	AA/2628
J. Gaul	LCDR	CHNAVPERS	Pers-233	694-2992	AA/1515
S. Edwards	CDR	CHNAVPERS	Pers-5W	694-1684	AA/1819
R. Grillo	GS-14	NAVSEA	Sea-047CB	433-2510	WNY/3301B
A. Plato	GS-14	NAVSEC	NSEC 6110	436-1040	CTRBG/325
J. Corder	GS-14	DTNSRDC	2784	(a) 281-2764	100/2YY
J. Carroll	GS-13	CNET	N-3131	(a) 922-2195	624/200

Contractor (System Automation Corporation) 565-9400

Mr. H. Kramer
Mr. A. Akman
Dr. L. Ettlinger
Mr. R. Luhring
Mr. F. Peterson
Dr. R. Sheinman

ADVISORY COMMITTEE

HARDMAN STUDY

RADM W. R. Smedberg	Chairman, Op-01C
RADM C. A. Trost	Op-96
RADM G. R. Nagler	Op-094B
RADM J. B. Stockdale	Op-60B
RADM J. J. Ekelund	Op-099B
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CAPT W. R. Rose	Op-592
CAPT W. T. Johnson	Op-951
CAPT J. R. Wilkins	NAVSEC
CAPT J. R. White	CNET N-31
Mr. D. B. Kassing	CNA
DR. R. G. Smith	Op-987H
MR. A. Rubenstein	MAT 0344

APPENDIX B

NAVY ORGANIZATIONS INVOLVED IN WSAP MANPOWER/TRAINING PLANNING

A. Introduction

The primary Navy organizations, shown in Figure B-1, which have responsibility for the manpower and training aspects of the WSAP are:

Organization	Area of Responsibility
OPNAV	Plans & Policy
NAVMAT	Technical Development
NAVY LABS	Research & Development
CNET	Training Field Activities

Although these organizations have responsibilities which extend far beyond manpower and training areas, they all make specific contribution in the areas of interest in this inquiry. The following sections describe each of these four organizations and the levels of in-house effort attributable to manpower/training planning activities.

B. Office of Naval Operations (OPNAV) Planning

The first major organization, the Office of Naval Operations (OPNAV), carries out the headquarters activities emphasizing planning and policy development. This organization as shown in Figure B-2 consists of warfare sponsors, manpower/training planning, command support, ocean surveillance, and RDT&E. Within each of these subgroups, substantial efforts are devoted to the WSAP manpower/training planning process. By

Figure B-1
Management Overview of WSAP

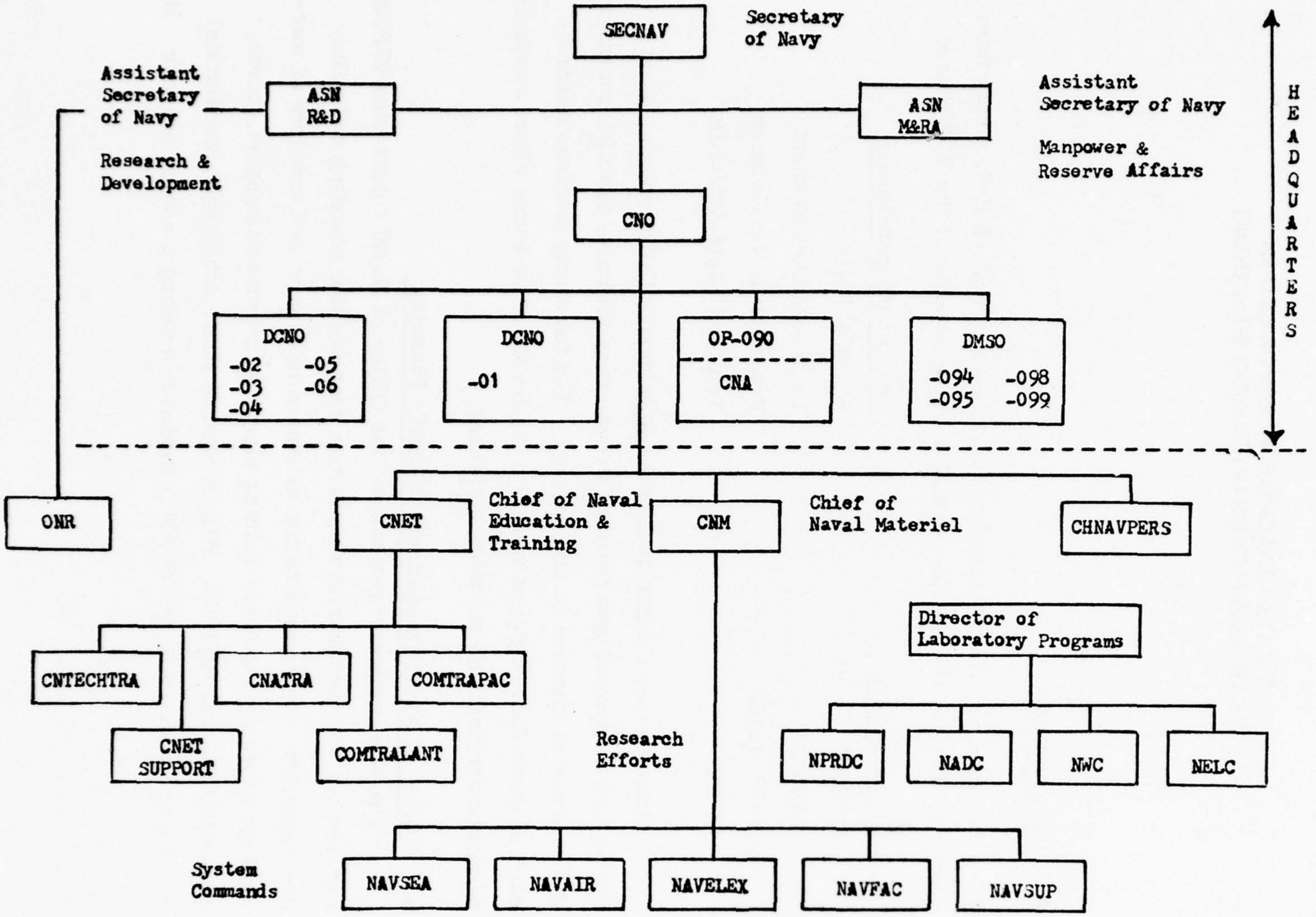
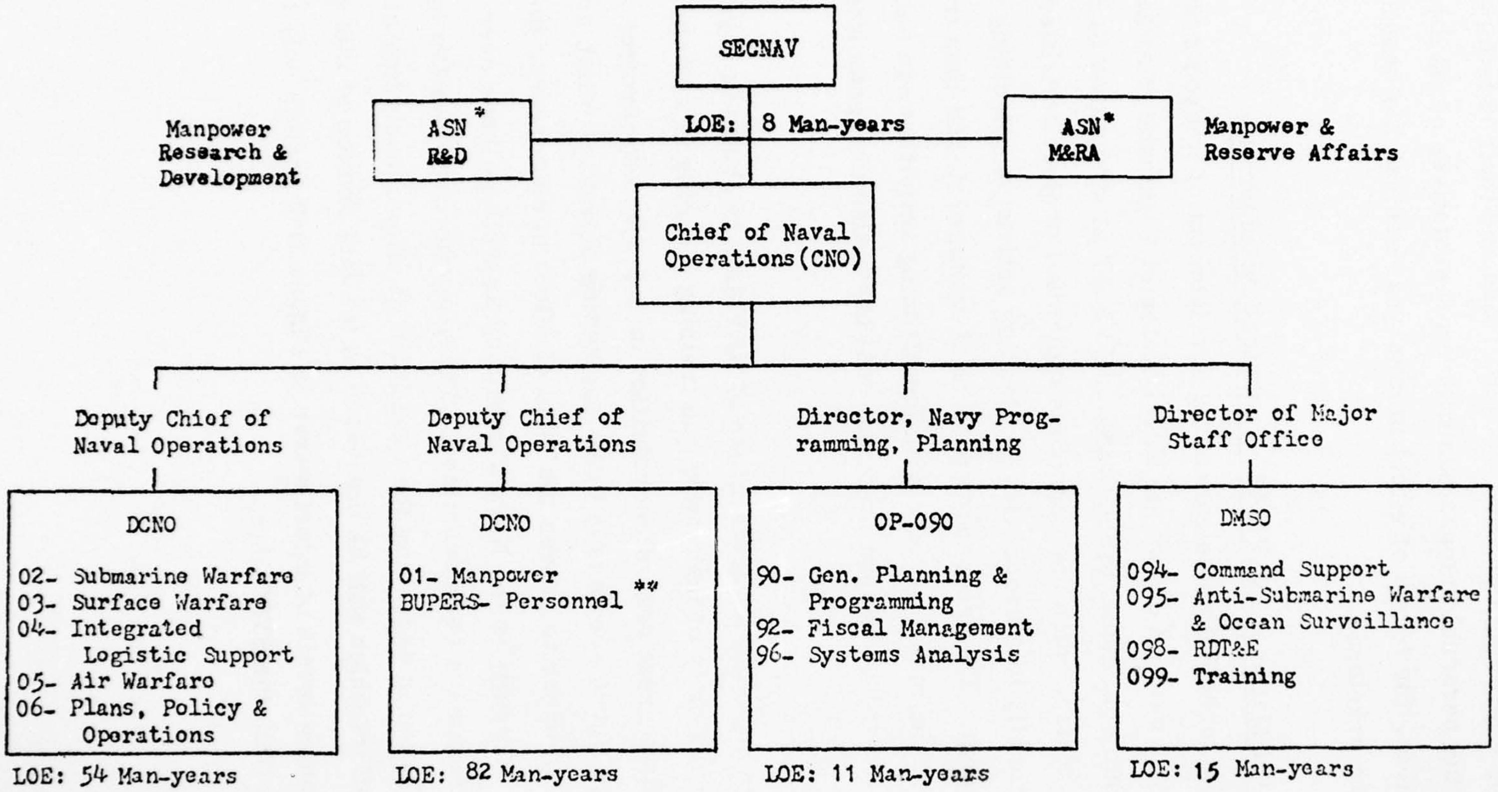


Figure B-2
OPNAV Planning Activities



* Not actually within OPNAV, shown for completeness
** Not actually within OPNAV, claimant to OP-01

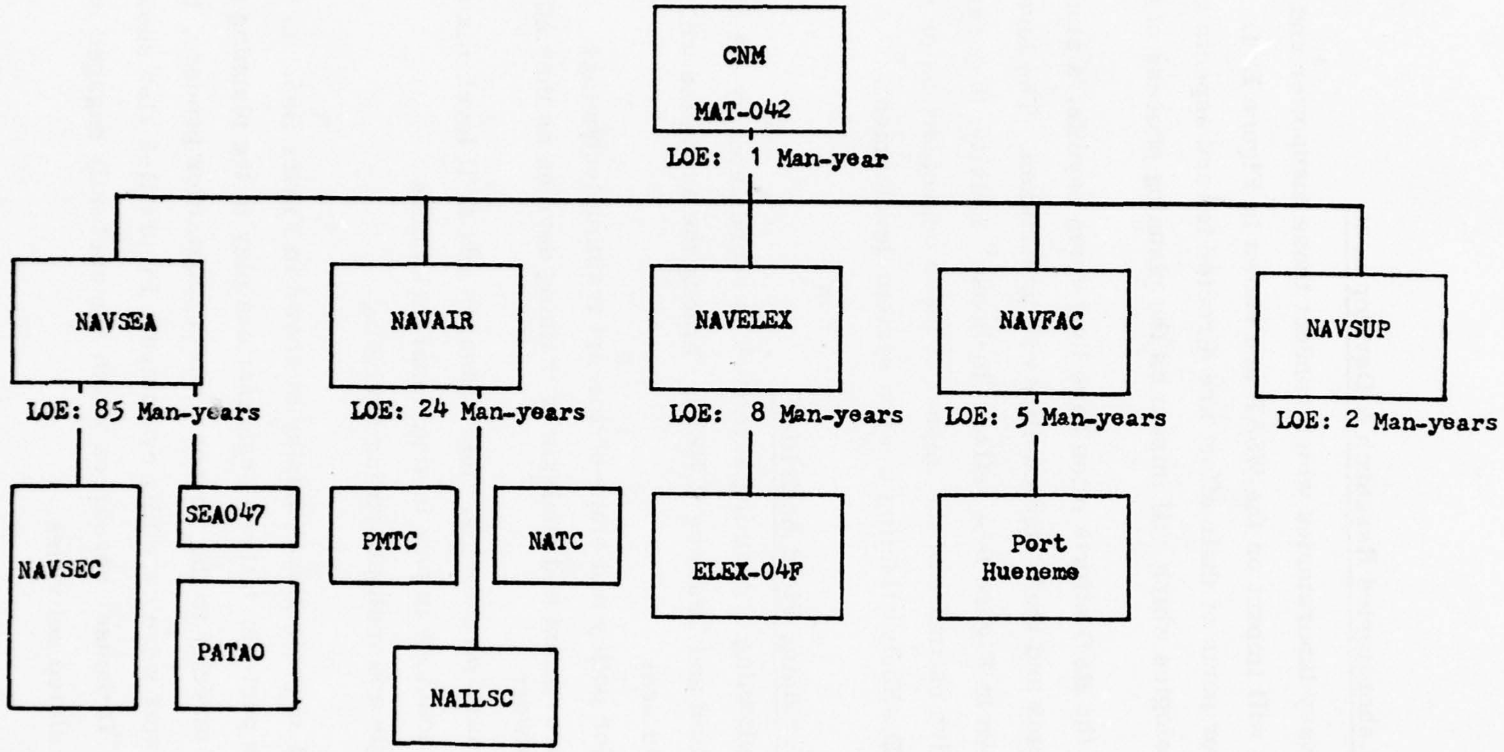
Total Level of Effort (LOE) for Manpower/Training Planning = 170 Man-years carefully assessing the organizational roles and their relationships, and by conducting personal discussions with representatives of all the major organizations, the levels of effort in man-year equivalents shown in Figure B-2 were developed.

C. Naval Material (NAVMAT) Technical Development

The technical and engineering development of weapon systems in the Navy is carried out by the Naval Materiel Command (NAVMAT) via the system commands (SYSCOMS). NAVMAT is structured in a decentralized fashion, which, when one considers individual project activities, leads quite naturally to a sequencing of planning activities coinciding with engineering development. This sequence consists of manpower, and then training. Since both the manpower and training planning activities can easily be related to individual weapon systems, NAVMAT also concerns itself with these.

The organizational structure of NAVMAT is shown in Figure B-3. Since the majority of manpower and training planning is system related, and entails a great deal of coordination on a project-by-project basis, the figure shows only those supporting activities which are functionally related. In order to assess the level of effort in man-years, the weapon systems currently in the Navy's inventory as well as those over the short-term horizon have been examined. Thus, a very conservative approach has been taken in assessing the total level of effort, excluding all contractor support effort which will be discussed in the last section of this chapter. The estimated levels of effort shown in Figure B-3 pertain only to Navy resources within the SYSCOMS.

Figure B-3
NAVMAT Technical Development



Total Level of Effort (LOE)
for Manpower/Training Planning = 125 Man-years

D. Navy Laboratories Research & Development

The Navy laboratories which conduct those manpower and training studies that will impact on the WSAP are shown in Figure B-4. In some cases, major parts of their effort are directed toward aspects of analysis and methodologies which will impact on the planning process of the WSAP.

Since the R&D efforts often have long-term payoffs, a study of R&D programs and their applicability was undertaken. The level of effort figures shown in Figure B-4 reflect "in-house" activity; they represent a conservative estimate of the impact of these organizations or manpower/ training R&D efforts affecting weapon system development.

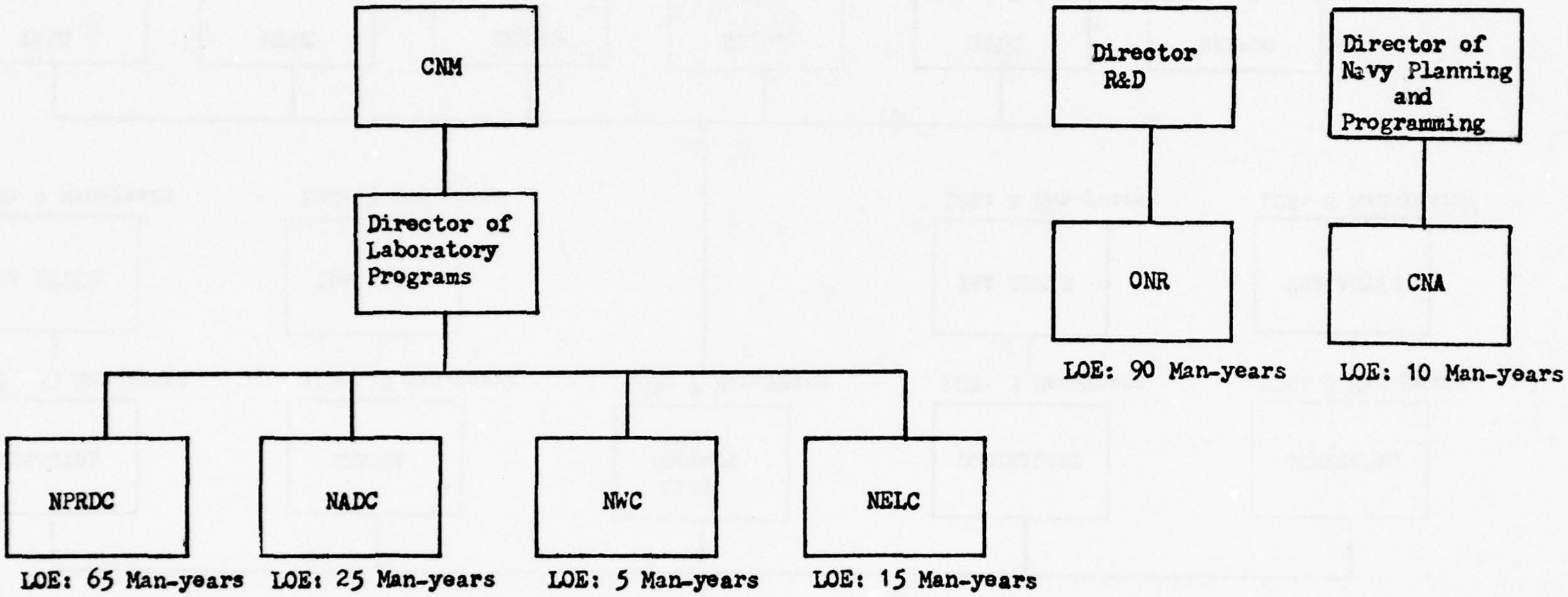
E. CNET Training Field Activities

Most planning of training activities is coordinated by the Chief of Navy Education and Training (CNET). Among the activities which have been included are:

- major policy and state-of-the-art training technology
- improvement and analysis of training devices as they affect hardware
- job-task inventories, field research and skill level mix analysis
- methodology in new instructional techniques
- single and multiple rating analysis

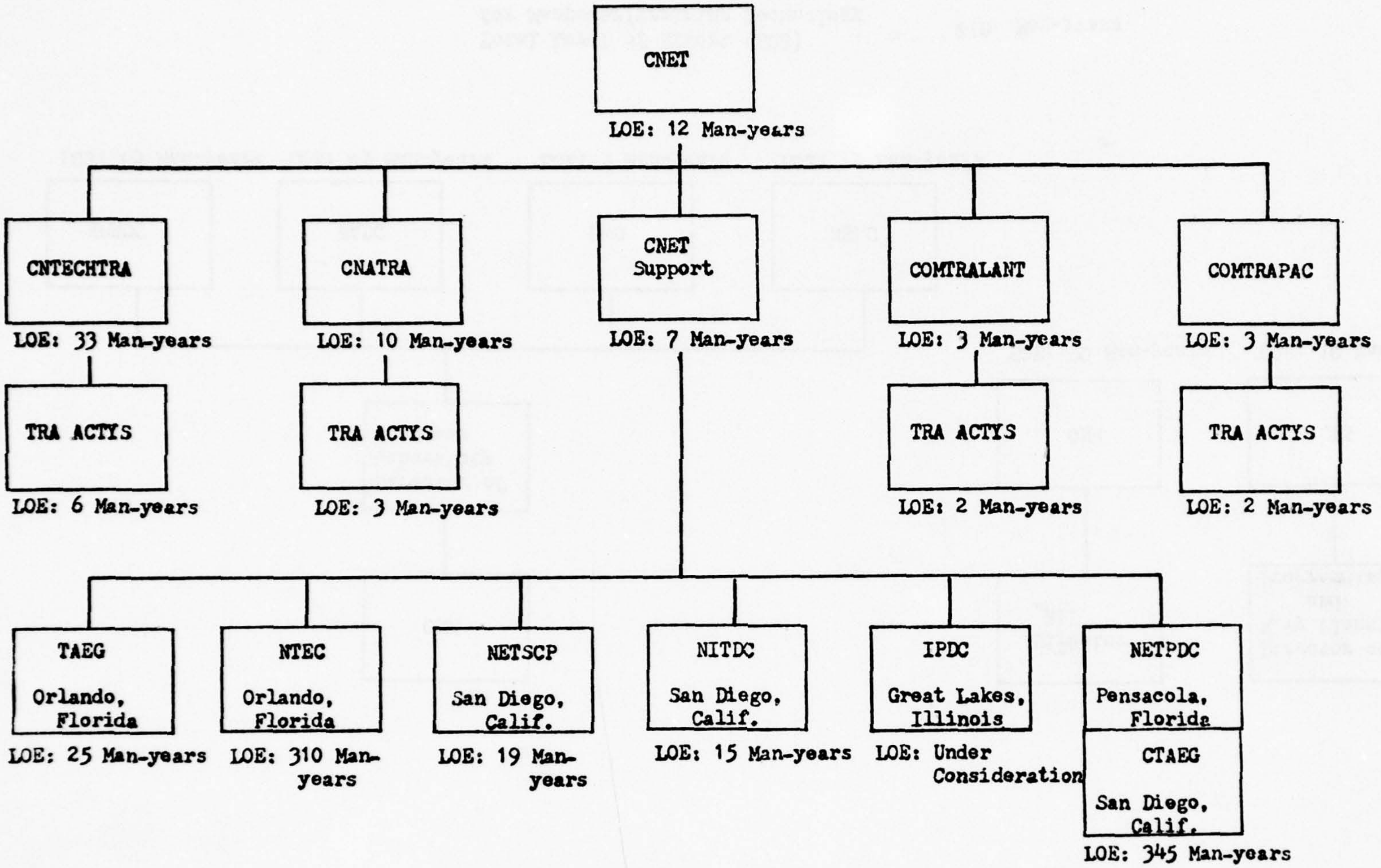
A CNET organizational display is shown in Figure B-5. In order to assess the part which these organizations play in the planning process as it relates directly to the weapon system acquisition process, the overall CNET programs were carefully evaluated. Figure B-5 also shows the levels of effort for "in-house" resources which are currently engaged in specifically HARDMAN-related activities.

Figure B-4
Navy Laboratory R&D Efforts



Total Level of Effort (LOE) for Manpower/Training Technology = 210 Man-years

Figure B-5
CNET Training Field Activities



Total Level of Effort (LOE) for Manpwoer/Training Planning = 795 Man-years

APPENDIX C

ESTIMATED NAVY EXPENDITURES FOR MANPOWER/TRAINING PLANNING ACTIVITIES

In order to develop an understanding of the magnitude of the manpower/training planning activities which are the subject of the HARDMAN study, estimates of Navy expenditures are useful. At the same time, it is relatively difficult to explicitly identify such expenitures because existing accounting and reporting systems do not lend themselves to isolating specific WSAP-related costs for purpose of such an analysis.

Some insight, however, into the magnitude of these expenditures can be gained by analyzing specific weapon systems. This appendix describes the results of one such analysis conducted during this study to support estimates of the level of expenditures for manpower/training activities. The analysis was based on three specific ships for which data was provided by the Ship Acquisition Project Managers (SHAPM).

This appendix first describes the ship classes included in the analysis. Second, estimates are made of the expenditures for manpower planning activities. Third, similar estimates are made for personnel and training planning activities. Finally, this analysis is summarized with respect to the overall magnitude of these planning expenditures for the Navy.

A. Ship Classes

Ships were chosen for this analysis for three distinct reasons. First, ships contain a large and varied assortment of equipment, and hence may be representative of more generalized weapon systems. Second, the records of funds which have been expended were made available by the Ship Acquisition Project Manager (SHAPM). Finally, ship design and construction management has been developed quite extensively within the Navy, which allows some of the planning functions to be subdivided.

The ships included in this analysis were:

- CGN-38 (Virginia) - Cruiser
- CVN-68 (Nimitz) - Carrier
- AO-177 - Oiler

In assembling the data for these ships, extensive cooperation was provided by individuals within NAVSEC, PMS-378, PMS-392, and PMS-383. In addition supporting information was obtained from the offices of Budget Analysis and Comptroller.

The actual design work for these particular ships included the following broad general areas:

- Feasibility Studies
- Concept Design
- Preliminary Design
- Contract Design

All these ships were followed from the "beginning" of their respective lives to their current status. The CGN-38 and CVN-68 are completed, whereas, the AO-177 is currently under construction.

Individual contracts for each ship class were examined to determine their applicability to the planning categories, and then were subsequently tabulated. In some cases the budgeting process provided support from RDT&E funds during the early phases, and in others, from ship construction (SCN), during the latter.

B. Budget Expenditures for Manpower Planning

The overall expenditures for these three ships are shown in Table C-1. As can be seen from the table, the total expenditure varies for these ships almost by a factor of 10, and hence they represent three

Table C-1

Funds Expended For a Variety of Ship Types

		(Thousands Of Dollars)			
Ship	Time to Develop Years	RDT & E	SCN	TOTAL	Manpower Planning
CGN-38	1967-1976	20, 400	279, 200	299, 600	600
AO-177	1971-1976	6, 312	130, 800	137, 112	200
CVN-68	1965-1976	98, 000* 275, 000**	667, 000	1, 040, 000	2, 200***

* Navy Expenditure

** ERDA/AEC Expenditure

*** Under estimate, best information available distinct examples. The manpower planning category, shown in the last column includes cost for the following activities:

- Manning estimates for feasibility studies
- Studies of ships subsystems and manning reduction efforts
- Computer modeling for manpower requirements
- Development of Operation Station Books
- Development of Ship Manning Documents
- Cost Estimates
- Cross utilization studies

Since RDT&E funds can be viewed as supporting both planning and early development activities, it is reasonable to compare the manpower planning costs to RDT&E dollars. As can be seen, from Figure C-1, this ratio is very nearly constant for the three ships under study. Hence it appears in this particular ease:

Manpower Planning Expenditures = 3% (RDT&E) Expenditures

C. Training & Personnel Planning

The costs for training and personnel planning are much more difficult to ascertain. Figure C-2 shows a partial listing of training planning activities for the CGN-38. One of the problems in tabulating specific costs, was that training planning involved facility construction and training device construction as well as large equipment purchases. The estimates given here do not include any construction activities or equipment purchases. Another difficulty was that the manpower planning dollars were spread over the years of construction of the ship itself. As a result, training and personnel planning involved more than one ship, and hence it is difficult to relate the planning dollars to one particular ship.

The approach we have taken is to examine the budget documents of the CGN-38 carefully,and in particular, the ILS expenditures. For the

Figure C-1

Manpower Planning as a Percentage of RDT&E

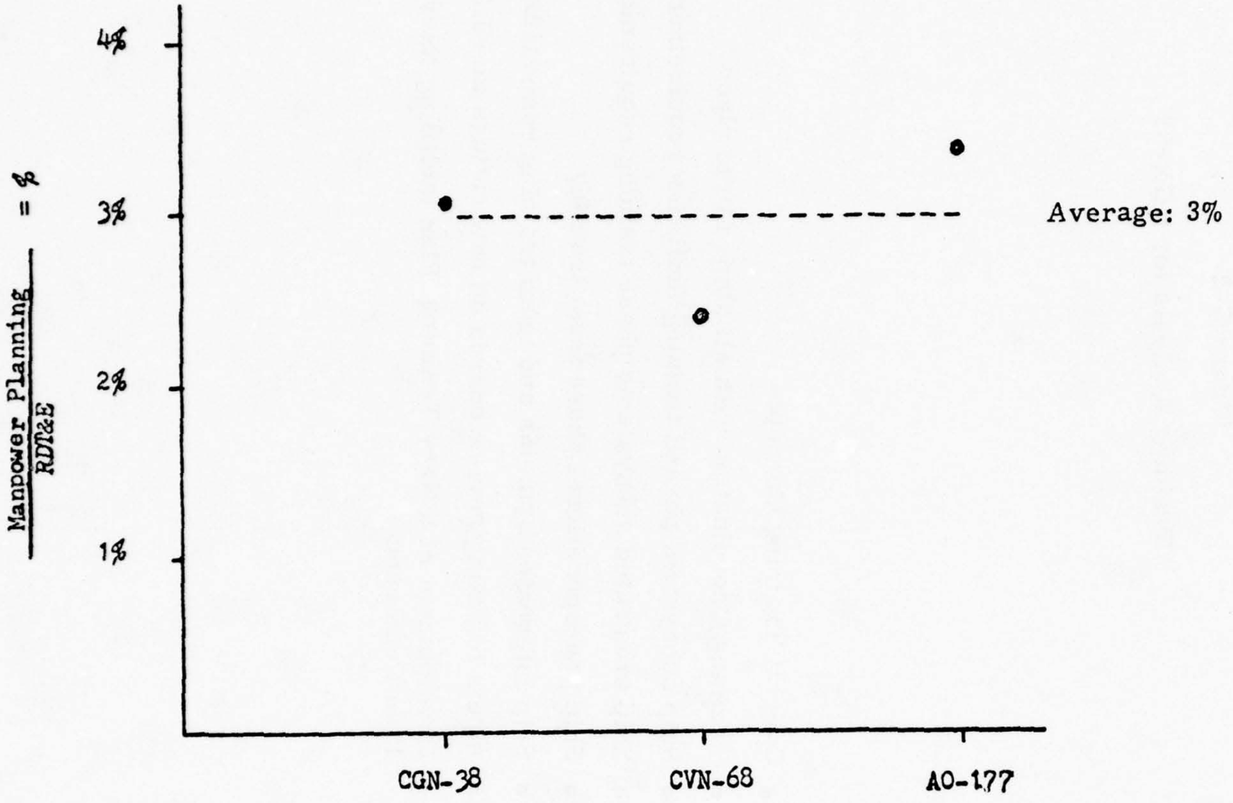


Figure C-2

Training Analysis for CGN-38

- Overall Training Concepts
- Training Coordination with all ships of the class
- Ship subsystem phased training facilities requirements
- Ship integrated subsystems phase training requirements
- Ship pre-operational phase team training
- Ship integrated systems and team training responsibilities
- Inputs to rating review boards on new ratings or NEC proposals
- Development of a Navy Training Plan including Navy Training Plan Conference

ship itself, the entire ILS planning cost was $3.6 million dollars. This is approximately six times the manpower planning cost. Since the ILS function involves more than just training and personnel planning, this is an overestimate.

An effort to estimate the training expenditures was undertaken by studying some of the planning activities for the following systems:

- DD963
- FFG7
- PHM
- High Energy Laser
- FLTSAT COM
- AD-41
- AEGIS
- LAMPS

Shown in Figure C-3 a listing of training planning functions related to the analysis and document production of the SMD and NTP for these systems. The expenditures for these planning functions are estimated to be approximately $350,000 for a typical ship.[1] The iterative nature of the effort, and the scheduling and coordination problems makes this an arduous and expensive task.

To put this in some perspective in FY-78, the training resources provided in the POM were $1.65 billion.[2] These resources spanned many planning categories; however, the major one was related to specialized skills, which of course are related to weapon systems.

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[1] provided by PATAO

[2] CNA Working Paper, (CNA 76-0727), The Specialized Training Planning Process, 19 October 1976.

Figure C-3
Training Planning Functions for a Typical Ship

- Preliminary Ship Manning Document (1st Iteration)
- Manpower Conference
- Preliminary Ship Manning Document (2nd Iteration)
- Maintenance if Preliminary Ship Manning Document (3rd Iteration) (Change in Configuration)
- Preliminary Ship Manning Document (4th Iteration)

- Development of Navy Training Plan (Strawman)
- Navy Training Plan (Update)
- Navy Training Plan Conference
- Navy Training Plan (Proposed)
- Navy Training Plan (4th Iteration)

It is clear, therefore, that both training and personnel planning involve more level of detail and analysis than that involved in manpower planning alone. A more realistic approach may be to estimate that the training and personnel planning activities combined must be more than twice, and less than four times, the manpower costs.

$$\text{(Personnel + Training) costs} \sim \text{(2 to 4) times Manpower planning costs} \approx \text{(6\% to 12\%) of RDT\&E}$$

$$\text{Hence the total (Manpower, Personnel, Training) planning costs} \approx \text{(9\% to 15\%) of RDT\&E}$$

While these expenditures are significant in terms of RDT&E, they represent less than one percent of the total acquisition costs for the three ships included in this analysis. Figure C-4 shows the RDT&E expenditures as a percent of the acquisition costs. They average approximately 7%, considering that 9 to 15% (of the 7%) comprise manpower and training planning activities, we estimate:

$$\boxed{\text{(Manpower, Personnel, Training) Costs} \approx .6 \text{ to } 1\% \text{ (Total Acquisition Cost)}}$$

D. Summary of Analysis

Based on the preceding analysis, for the three ships studied, we estimate:

- Approximately 9-15% of the RDT&E budget is currently being spent on manpower, personnel and training planning;
- Approximately 1% or less of the total acquisition budget is being spent on manpower, personnel, and training planning.

Further, if we can extend these findings to the Navy as a whole, hundreds of millions of dollars would be estimated to be spent annually on manpower, personnel and training activities. Figure C-5 shows the RDT&E funding by warfare area and fiscal year. Using FY1977 expenditures of approximately $3. 8 billion:

- Approximately $342-570 million may be spent annually for manpower, personnel and training planning.

Figure C-4

RDT&E as a Percentage of Total Acquisition

SHIP	RDT&E / Total (%)
CGN-38	6.8
AO-177	4.6
CVN-68	9.4

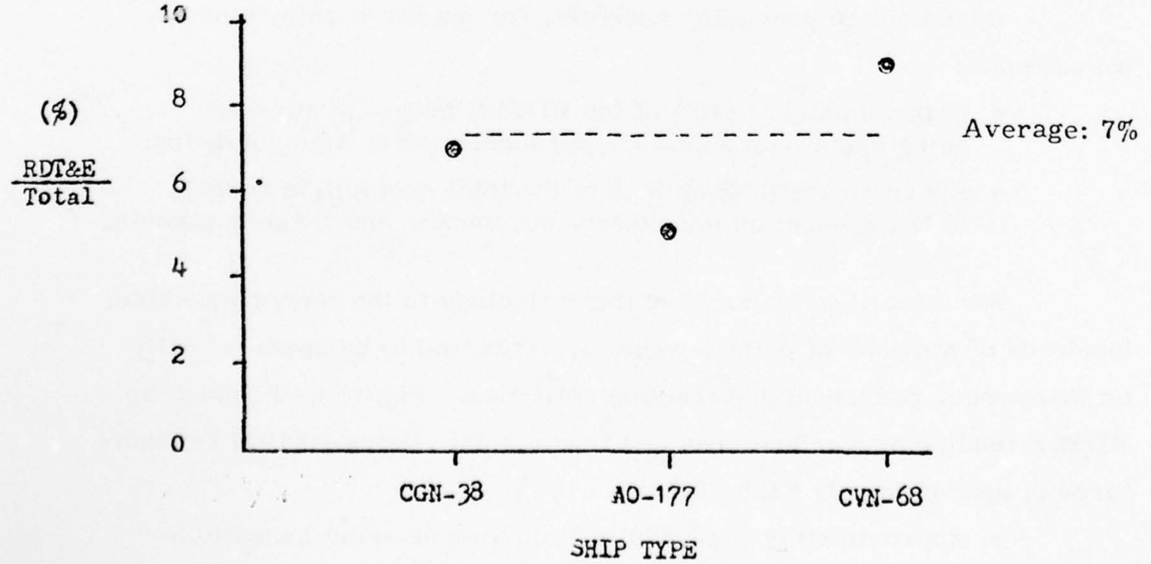
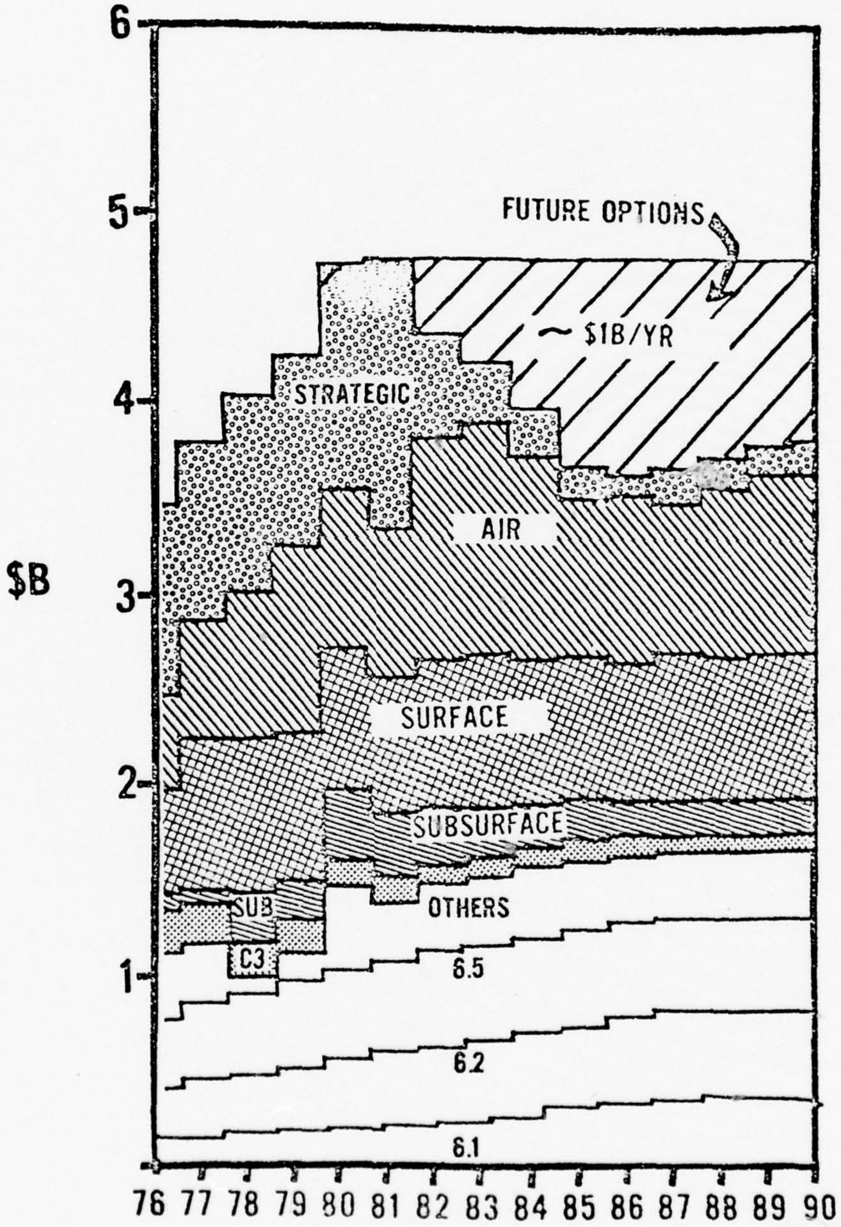


Figure C-5

R & D RESOURCE ALLOCATION BY WARFARE AREA*



* Navy Planning, Programming & Budgeting Course, Nov. 18, 1976

In sum, based on three ships studied, large amounts of monies are devoted to manpower, personnel and training planning associated with weapon system acquisition. At the same time, in relation to the total acquisition cost, the allocation of resources to these activities appears to be very small.

APPENDIX D

DESCRIPTION OF THE WEAPON SYSTEMS ACQUISITION PROCESS

A. Introduction

This appendix presents a description of the weapon systems acquisition process. The purpose of this presentation is to establish a baseline definition of the WSAP as well as to provide the basis for identifying key activities and decision points where more effective manpower planning may provide improved use of manpower.

To these ends, there are three major sections in this appendix. First, a description of the acquisition process for major DoD weapon systems is presented. The narrative based on detailed diagrams of the process includes discussion of the principal decision and information flow as well as identification of the logistics, training, reliability, maintenance and testing and evaluation issues at each phase.

The second section of this appendix discusses the differences in the acquisition process for non-major DoD weapon systems. These include major DoN systems, non-major systems and others.

Finally, there is an identification and discussion of the key decision points and activities in the WSAP to which expanded manpower planning procedures and decision making may be added.

B. WSAP for Major DoD Weapon Systems

Weapon systems whose R&D costs exceed $50 million or whose productions costs exceed $200 million are designated as major DoD weapon systems and are subject to the highest levels of analysis and review in the Department of Defense. The acquisition procedures as promulgated through DoD directives dictates the analytical and decision requirements for these systems. All the services have, in turn, modeled their own acquisition systems for small weapons based on the DOD procedures. There are two major differences between major DOD acquisitions and smaller ones: 1) the level of review and 2) the amount of resources available to the acquisition manager to prepare comprehensive ILS plans or to monitor manpower , personnel, and training requirements.

To facilitate the discussion in this chapter, initially attention is focused on major DOD systems. In the succeeding section, differences are discussed for the other weapon systems.

In this section each of the four phases of the WSAP are discussed in detail. The four phases include concept formulation, validation, full-scale development and, finally, production. Where necessary to facilitate the discussion, the process has been simplified. For example, in the Conceptual Phase, the process by which Science and Technology Objectives (STOs) are prepared and impact on system development is quite complex; the diagram and discussion are not comprehensive with respect to the variety of ways each step may take place. Emphasis is on a typical way in which the process is carried out.

1. Conceptual Phase

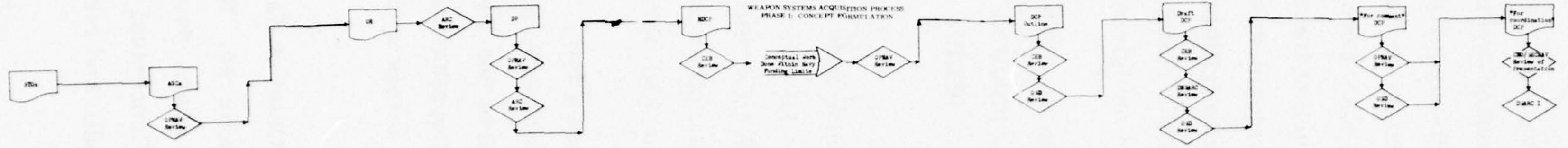
Based upon pure research studies and long range R&D planning, broad needs are sequentially refined to permit initiation and pursuit of an acquisition program.

Within this refinement process, the purpose of the Conceptual Phase is to identify alternative performance/operating characteristics for systems required to meet a particular threat, and to consider alternative systems which might possess these characteristics. Figure D-1 illustrates and annotates the basic procedures followed in this phase.

The origins of the Conceptual Phase can be found in the preparation of Science and Technology Objectives (STOs) by DRDT&E. STOs describe in broad terms the Navy role and objectives anticipated in a particular warfare area in the 10-20 year future timeframe. These documents are analyzed and reviewed by the Naval Material Command (NAVMAT), with possible solutions to the STOs documented in Advanced Systems Concepts (ASCs) which are in turn reviewed by OPNAV. At this point, a decision is made as to which ASCs are in fact advanced enough to allow fulfillment of an STO requirement.

Figure D-1

WEAPON SYSTEMS ACQUISITION PROCESS
PHASE I: CONCEPT FORMULATION



STOs are prepared by CNO for each warfare area and updated annually.

NAVMAT analyzes and reviews STOs documents possible solutions in ASCs which in turn are reviewed by the cognizant OPNAV sponsor. OPNAV decides which ASCs are advanced enough to allow fulfillment of an STO requirement.

ORs are then prepared by the cognizant OPNAV sponsor with concurrence from CNO. They can also be submitted to the sponsor through the chain of command by any fleet activity or Navy command. They are reviewed by the ARC, and promulgated by CNO.

The OR is analyzed by NAVMAT which responds with a DP. The DP is reviewed by the OPNAV sponsor and the ARC.

OPNAV prepares an NDCP which is reviewed by the CEB. Approval at this point authorizes only extended system planning and conceptual effort within Navy authorized funding levels.

CNM charters a **Program Manager**, RFPs are prepared, contractors selected, conceptual work performed. When conceptual phase milestones have been met, **program** manager submits program results to OPNAV.

OPNAV reviews the results and prepares a DCP outline which is reviewed by the CEB and the OSD action officer.

The OPNAV sponsor then prepares a draft DCP (with assistance from NAVMAT, Navy labs, and other commands), a preferred alternative is chosen by CNO after CEB review, and by SECNAV after DNSARC review. SECNAV submits the DCP with the DoN preferred alternative to OSD and requests scheduling of DSARC I. OSD reviews the draft, inserts proposal revisions, and issues a "for comment" draft.

OPNAV reviews and prepares comments for OSD, the DCP is modified, and a "for coordination" draft is issued.

The **program** manager and program sponsor present the DCP to CNO and SECNAV for a critique of the presentation. The DCP is then presented to DSARC I. A DSARC I report, with recommendations is prepared and submitted to SECDEF for his decision.

Science and Technology

Objective: Describes in broad terms the Navy role and objectives anticipated in a particular warfare area in the 10-20 year future time frame.

Advanced System Concepts

Addresses particular problems or offers specific new capabilities. ASCs contain a technical approach; cost estimates; discussion of operational effectiveness, critical technologies, and associated R&D activities; and an estimate of when the concept will be ready for advanced development. Limited to 6 pages.

Operational Requirement

The basic requirement document for all Navy acquisition programs requiring research and development effort. The OR describes the threat and the operational need, the concept and capabilities required (including performance goals and cost objectives), and the principal and selected warfare areas. Limited to 3 pages.

Development Proposal

Formally responds to the OR. The DP discusses program issues, requirements and program objectives, program alternatives (including cost and effectiveness of alternatives), risks, and conceptual phase milestones and thresholds. Limited to 20 pages.

Navy Decision Coordinating Paper

Promulgates CNO decisions to initiate conceptual development programs. The NDCP defines program issues, program objectives, program plans, performance parameters, areas of risk, the considerations and development alternatives. Limited to 20 pages.

Decision Coordinating Paper

A summary management document to provide DEPSECDEF and his DSARC principals essential program information. The format is the same as that used for the NDCP, also limited to 20 pages.

DSARC I:

- Need for system exists
- Program issues are defined:
  - Special logistics problems
  - Program objectives
  - Program plans
  - Performance parameters
  - Areas of major risk
  - System alternatives
  - Acquisition strategies

Based on that decision, an Operational Requirement (OR) is prepared by the cognizant OPNAV sponsor and concurred in by the Director of Navy Programming and Planning (DNPP). Draft ORs can also be submitted by any fleet activity or Navy Command via the chain of command to the cognizant OPNAV Force and Mission Sponsor. The OR is the basic requirement document for all Navy acquisition programs requiring research and development effort. Limited to three pages, the purpose of the OR is to initiate conceptual effort to meet an operational need and to focus the effort by establishing parameters for the concept or system envisioned.

The sponsor in coordination with the DNPP schedules and arranges a review of the OR by the Acquisition Review Committee, a subpanel of the CNO Executive Board (CEB). Upon approval the OR is promulgated by DRDT&E.

NAVMAT analyzes the OR and responds by preparing a Development Proposal (DP). Identified in the DP are major issues, program objectives, program alternatives, effectiveness and cost comparisons of alternatives, risks, milestones, and other factors. The DP is reviewed by OPNAV and submitted to the ARC for approval.

Upon approval, OPNAV prepares a Navy Decision Coordination Paper (NDCP), very similar in content to the DP. The NDCP is approved by the CEB and promulgated by the DRDT&E. The approval at this point authorizes only extended systems planning and conceptual effort within Navy authorized funding levels until program initiation approval is received.

The NDCP is forwarded to the Chief of Naval Material (CNM) at which time a program manager is chartered. RFPs are prepared, contractors selected, and work begun to study, design, build, and test the conceptual hardware. When the Conceptual Phase milestones have been met, NAVMAT submits the results and recommendations to OPNAV.

If, after review, OPNAV feels the project is ready to start its Validation Phase, it prepares a Decision Coordinating Paper (DCP) outline and gets CEB and OSD approval. A draft DCP is than prepared by OPNAV with assistance as needed from NAVMAT, the program manager (PM), other commands, and Navy laboratories. The program manager or program sponsor presents the program with issues and alternatives by CNO. Next, the program manager/program sponsor presents the program with the CNO preferred alternative to the Department of Navy Systems Acquisition Review Council (DNSARC) for selection of a preferred alternative by SECNAV and approval of the draft DCP.

SECNAV forwards the draft document to OSD as the Navy position and requests the scheduling of DSARC I, the Defense Systems Acquisition Review Council. OSD reviews the document, inserts proposed revisions, and issues a "for comment" draft. OPNAV prepares comments for OSD review, the DCP is modified, and a "*for coordination*" draft is issued. The program manager and program sponsor present the proposed DSARC presentation to a SECNAV and CNO pre-DSARC review (for critique of presentation) and then to the DSARC itself.

DSARC I reviews the DCP to ensure that the military need exists for the proposed system, that alternative Defense systems have been considered (including system improvements), that performance requirements are adequately defined and economically plausible, that anticipated quantity, resource, and schedule estimates are realistic and acceptable, (and cost estimates validated), that major problems, issues, and risks are identified with plans for resolution, that critical logistic support costs have been identified, and that statements of questions and issues along with test objectives and schedules are adequate. The review also ensures that sufficient trade-offs have been made, that design to cost goals have been established, and that the program plan for the validation phase is adequate.

After review, the DSARC chairman prepares the DSARC draft report, with recommendations, and forwards it to the DEPSECDEF/SECDEF for his decision. The DEPSECDEF/SECDEF decision is promulgated in a revised DCP within 30 days, and the Validation Phase begins.

2. Validation Phase

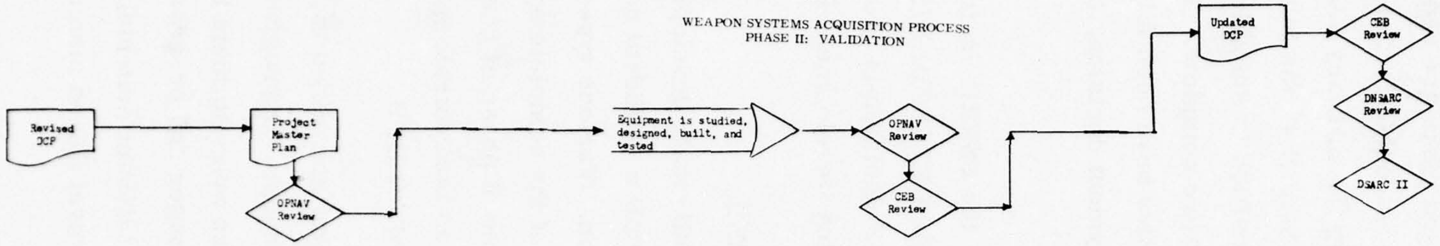
The purpose of the Validation Phase is to provide tentative answers to the issues defined during the conceptual phase in order to allow DSARC II to determine whether to proceed with full-scale development. In this phase, the range of design alternatives is more completely defined and the issues narrowed. The phase is depicted in Figure D-2.

With SECDEF approval, OPNAV issues the necessary implementing instructions to NAVMAT which in turn issues the instructions to the program manager. The project manager prepares a Project Master Plan (PMP) outlining the effort to be undertaken and actions required from other elements of the Navy. Upon OPNAV approval of PMP, an RFP is prepared by the program manager with inputs from OPNAV, OPTEVFOR, and Navy labs for operational and developmental testing requirements.

The RFP is issued, contractor(s) selected, and the equipment studied, designed, and built. Tests of the prototype are conducted by the contractor(s), Navy labs, and OPTEVFOR and are monitored by the program manager to determine if the equipment is ready for full-scale development. The test results are forwarded to OPNAV for review and approval; after which they are reviewed and approved by CNO/CEB and returned to OPNAV. OPNAV (the program sponsor) and the program manager update the DCP with the test results and submit it back to the CEB for review and approval. The updated draft DCP is coordinated through

Figure D-2

WEAPON SYSTEMS ACQUISITION PROCESS
PHASE II: VALIDATION



A revised DCP containing SECDEF's decision is promulgated within 30 days, the validation phase begins.

Program Manager prepares a Project Master Plan, submits it to OPNAV for approval.

RFPs are issued, contractors selected, the equipment is studied, designed, built, and tested.

Test results are reviewed and approved by the OPNAV sponsor and then the CEB.

The Project Manager updates the DCP with the test results and program progress, and presents the updated DCP to the CEB, the DNSARC, and finally to DSARC II for approval to proceed with full scale development.

Project Master Plan

Provides uniform guidance for work planning and scheduling. The PMP is a compilation of planning documents which places in context the plans, schedules, costs, and scope of all work and resources to be provided by each participating organization.

DSARC II:

- Need for system still exists in consideration of threat, system alternatives, special logistic needs, estimates of development costs, preliminary estimates of life cycle costs and potential benefits in context with overall DoD strategy and fiscal guidance.
- Development risks have been identified and solutions are in hand.
- The plan for full-scale development is realistic.

the DNSARC and the DSARC II reviews just as in the conceptual phase. In addition to reaffirming the considerations in the DSARC I review, DSARC II ensures that major uncertainties and risks are reduced to acceptable levels, that the proposed system is cost-effective compared with competing alternative ways of satisfying the military need, that the test and evaluation has progressed satisfactorily, the future test program is sound, the proposed fall-back position is suitable and the program management structure and plan are complete. Finally the review ensures that appropriate contracting principles have been followed and that requisites for the production/deployment decision, including logistics support, have been established.

Again, the DSARC chairman prepares the DSARC draft report, with recommendations, and forwards it to the DEPSECDEF/SECDEF for his decision. The DEPSECDEF/SECDEF decision is promulgated within 30 days, and the full-scale Engineering Development Phase begins.

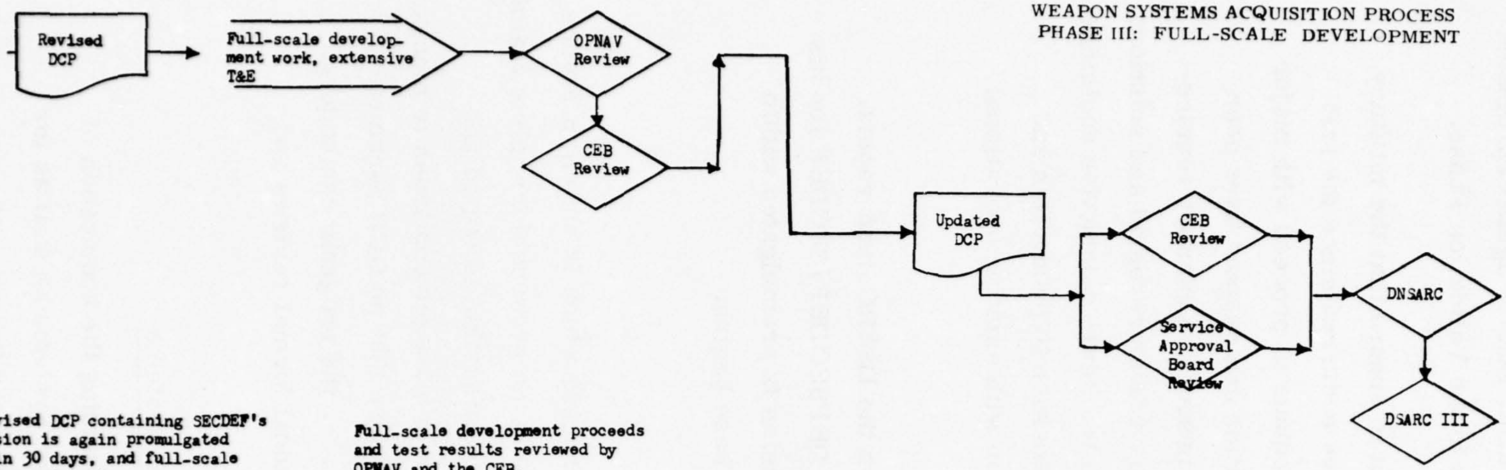
3. Full-Scale Engineering Development

The primary purpose for conducting full-scale development is to ensure completion of sufficient effort to permit a confident commitment of resources required for quantity production. Various types of prototyping and considerable test and evaluation of the complete system or subsystems would characterize the development phase of non-ship acquisitions, while major ship construction may concentrate more on achieving design parameters in the updated draft DCP.

The procedures for review and approval are shown in Figure D-3 and are similar to those in the Validation Phase: the program manager forwards test results to OPNAV which in turn submits them to the CNO/CEB for review and approval. The program manager and program sponsor update the DCP with the test results and all other relevant material, and submit it to the CEB for review. The Service Approval Board also reviews

Figure D-3

WEAPON SYSTEMS ACQUISITION PROCESS
PHASE III: FULL-SCALE DEVELOPMENT



A revised DCP containing SECDEF's decision is again promulgated within 30 days, and full-scale development begins.

Full-scale development proceeds and test results reviewed by OPNAV and the CEB.

The Project Manager again updates the DCP with approved test results. CEB reviews the updated DCP while the Service Approval Board reviews it to make recommendations for "approval for service use". If appropriate, CNO gives "approval for service use" and makes the decision to proceed with production at the same time. DNSARC is next to review, and finally DSARC III.

DSARC III:

- Need for producing system exists in consideration of threat.
- Acquisition and ownership costs and potential benefits are within context of overall DoD strategy and fiscal guidance.
- Practical engineering design with adequate consideration of production and logistic problems is complete.
- All previously identified technical uncertainties have been resolved and operational suitability has been determined by T&E.
- The plan for the remainder of the program is realistic.

the DCP to recommend to the CNO approval for service use. The CNO decision for full production and approval for service use may be combined into one action, if practical. The updated draft DCP is again coordinated through the DNSARC and DSARC III just as in the Validation Phase.

The thrust of the DSARC III review is to ensure that the military need still exists in light of changes that have occurred since the last SECDEF decision, that test results are adequate to proceed with major production, that cost estimates for acquisition and support have been validated by independent assessment, that production quantity requirements are valid, that all major problems have been revealed and solutions to residual risks identified, that requisites for future production decisions have been defined, and that the plan for transition to production and deployment is adequate including integration with existing operational systems and logistics support.

Again, the DSARC chairman prepares the DSARC draft report, with recommendations, and forwards it to DEPSECDEF/SECDEF for his decision. The DEPSECDEF/SECDEF decision is promulgated within 30 days, and the Production/Deployment Phase begins.

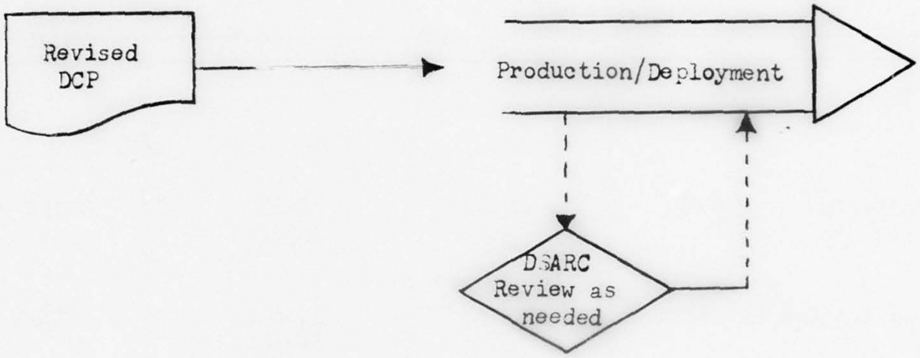
4. Production/Deployment Phase

In this last phase of the acquisition process which is shown in Figure D-4, the equipment is actually manufactured, the personnel complete training, the logistics support is readied, and the entire system is tested and subsequently made operational. The program manager continues to monitor the program for quality assurance and to ensure that no DCP parameter thresholds are breached. If there is a breach, the program can undergo another DSARC review; otherwise no additional formal reviews and approvals are required.

C. Differences in the WSAP for Non-DoD Systems

Although the management principles guiding the acquisition of weapon systems are the same for DoD Major Systems as well as for DoN Major, DoN Non-Major, and Non-Designated Systems; the procedures for each differ somewhat. Table D-1 illustrates the decision

Figure D-4
WEAPON SYSTEMS ACQUISITION PROCESS
PHASE IV: PRODUCTION



A revised DCP containing SECDEF's decision is promulgated within 30 days, and Production/Deployment begins.

The equipment is manufactured, personnel trained, logistics support organized, the system is tested and made operational. Additional DSARC reviews occur only as needed; e.g., when a DCP threshold is breached.

Table D-1

WSAP Characteristics for Weapon System Categories

Type of System	Decision Document	Review	Decision Authority
ACAT I: Major DoD Systems	DCP	DSARC DNSARC CEB/ARC	SECDEF
ACAT II: Major DoN Systems			
(1) Selected by DSARC Principal	PM	DSARC CEB/ARC	DSARC Principal
(2) Designated by SECNAV	NDCP	DNSARC CEB/ARC	SECNAV
(3) Others meeting dollar threshold	NDCP	CEB/ARC	CNO
(4) Ship Acquisitions less than ACAT I	NDCP	CEB/SAIP	CNO
ACAT III: Non-Major DoN Systems	NDCP	OPNAV Staff	Program Sponsor
ACAT IV: Non-Designated Systems	NDCP	As directed by CNM	CNM

authority and the amount of scrutiny required for different system categories, while each is discussed in the following paragraphs.

ACAT II (DON Major) Systems can themselves be of four types: (1) those designated for special review by a DSARC principal, (2) those designated as ACAT II by SECNAV, (3) other programs below the ACAT I threshold which have an estimated RDT&E cost in excess of $20M, or an estimated production cost in excess of $50M, or are so recommended by CNO, CNM, or a Program sponsor, and (4) all ship acquisition programs not requiring DSARC review.

For those systems designated for special review by a DSARC principal, the WSAP differs from that of Major DoD Systems in that the Program Memorandum is the decision vehicle and contains the essential program information (instead of the DCP), and the DSARC principal is the decision authority rather than SECDEF. Also, DNSARC review is no longer required: after CNO selection of a preferred alternative (usually done by DNPP (OP 090) acting for CNO for all ACAT II systems), the PM goes directly to the DSARC for review.

The NDCP is the decision vehicle for SECNAV designated ACAT II Weapon Systems, with SECNAV the decision authority. Neither DSARC reviews nor decisions by SECDEF are required.

The NDCP is also the decision vehicle for other systems below the ACAT I level but still meeting ACAT II dollar thresholds. No DSARC or DNSARC reviews are required for these systems.

For all ship acquisition programs not requiring DSARC review, the decision vehicle is the NDCP and the decision authority is the CNO. However, in early stages of review, the Ship Acquisition Improvement Panel (SAIP) takes the place of the ARC in acting as a subpanel of the CEB to make recommendations to the CNO.

ACAT III program (DoN Non-Major) requires even less scrutiny with the NDCP still acting as the decision vehicle (in abbreviated form if appropriate) and the decision authority now resting with the Program Sponsor. Programs are reviewed by OPNAV staff with membership designated by the Program Sponsor.

ACAT IV programs are reviewed as directed by CNM, who is also the decision authority. Abbreviated NDCPs are still prepared to document essential program information

APPENDIX E

WSAP DIRECTIVES AND INSTRUCTIONS

A. Introduction

The purpose of this appendix is to describe the principal policy directives and instructions controlling the weapon systems acquisition process. While not all directives and instructions are identified, the most important ones are included.

The directives system in some respects contributes in part to an unclear policy and planning framework. Policy directives are issued by DoD; implementation instructions are then promulgated by SECNAV, OPNAV, and other agencies.

The directives and instructions necessarily are issued on a piecemeal basis as need for policy arises. Follow-up efforts to coordinate new directives with previously issued directives into a consistent, singular statement of policy do not occur.

Consequently, there is no single reference. The one attempt to remedy this weakness is to include references in each new directive and instruction to preceding policy which is related. Without control, this is not very satisfactory. As Table E-1 shows, of the 30 directives and instructions included in this analysis, there is no single reference identifying all relevant directives. If regulations on manpower are issued, for example, they may reference previous directives; however, if one reviews the controlling regulations, such as DoD 5000. 1, there are never new references added to facilitate locating related policy.

Directives/ Instructions Referenced			WSAP												M/P/T									T&E			ILS			R&M	OTHER
Key Directives/ Instructions			D-5000.1	-5000.2	-5000.4	-5000.26	S-5000.1	-5420.172A	-5430.67A	O-4720.2D	-5000.42A	-5000.46	-7040.5A	-9010.300	-5312.10C	O-1000.16C	-1000.19A	-1500.8H	-1500.44	-3500.23B	-5250.1D	-5310.12	-5312.10C	D-5000.3	O-3960.10	-4720.9D	D-4100.35	S-4000.29A	O-4100.3A	S-3900.36A	
WSAP	DoD	5000.1	●																												
		5000.2	●	●	●	●																		●							5
		5000.4			●																										2
		5000.26	●	●	●	●																		●							
	SECNAV	5000.1	○				●																								1
		5420.172A	●					●																							
		5430.67A					●		●																						3
	OPNAV	4720.2D								●																					5
		5000.42A					●	●		●	●															●			●		4
		5000.46		●	●	●	●	●			●	●													●				●		2
		7040.5A									●		●																		
		9010.300								●				●																	
M/P/T	SECNAV	5312.10C													●																
	OPNAV	1000.16D					●		●	●	●		●		●	●	●	●	●									●	●		6
		1000.19A														●	●														2
		1500.8H					●											●	●									●			7
		1500.44																●	●												2
		3500.23B																		●											15
		5250.1D																			●										
		5310.12																				●									3
		5312.10C													●								●								
T&E	DoD	5000.3	●																					●							
	OPNAV	3960.10	●				●																	●	●	●					
		4720.9D					●				●															●			●		2
ILS	DoD	4100.35																									●				1
	SECNAV	4000.29A																									●	●			
	OPNAV	4100.3A					●											●										●	●		1
R&M	SECNAV	3900.36A																												●	4

Table E-1 WSAP Directives and References

As a result, WSAP policy as reflected in the directives is fragmented and incomplete. A particularly compelling example in the context of this study is that the manpower regulations are not referenced whatsoever by any other regulation.

The succeeding sections describe and assess the principal directives and instructions controlling WSAP. To facilitate the presentation, the directives have been divided into four major groups:

- weapon systems acquisition process
- manpower/personnel/training
- testing and evaluation
- integrated logistics support

Within each group, the prevailing DoD directives are discussed as well as the implementing instructions from SECNAV and OPNAV.

B. Weapon Systems Acquisition Process

Figure E-1 identifies twelve directives and instructions which provide the principal guidance for the weapon systems acquisition process. The figure illustrates the interrelationships between the various directives. As may be seen, there are four major regulations at the DoD level, the principal one being DoD Directive 5000. 1, Acquisition of Major Defense Systems.

Table E-2 provides a summary table useful as reference to the various directives and instructions controlling the weapon systems acquisition process. The table indicates which WSAP phases are affected by the regulations as well as the stages at which various decisions (◇) are required.

Figure E-1

WSAP Directives and Instructions

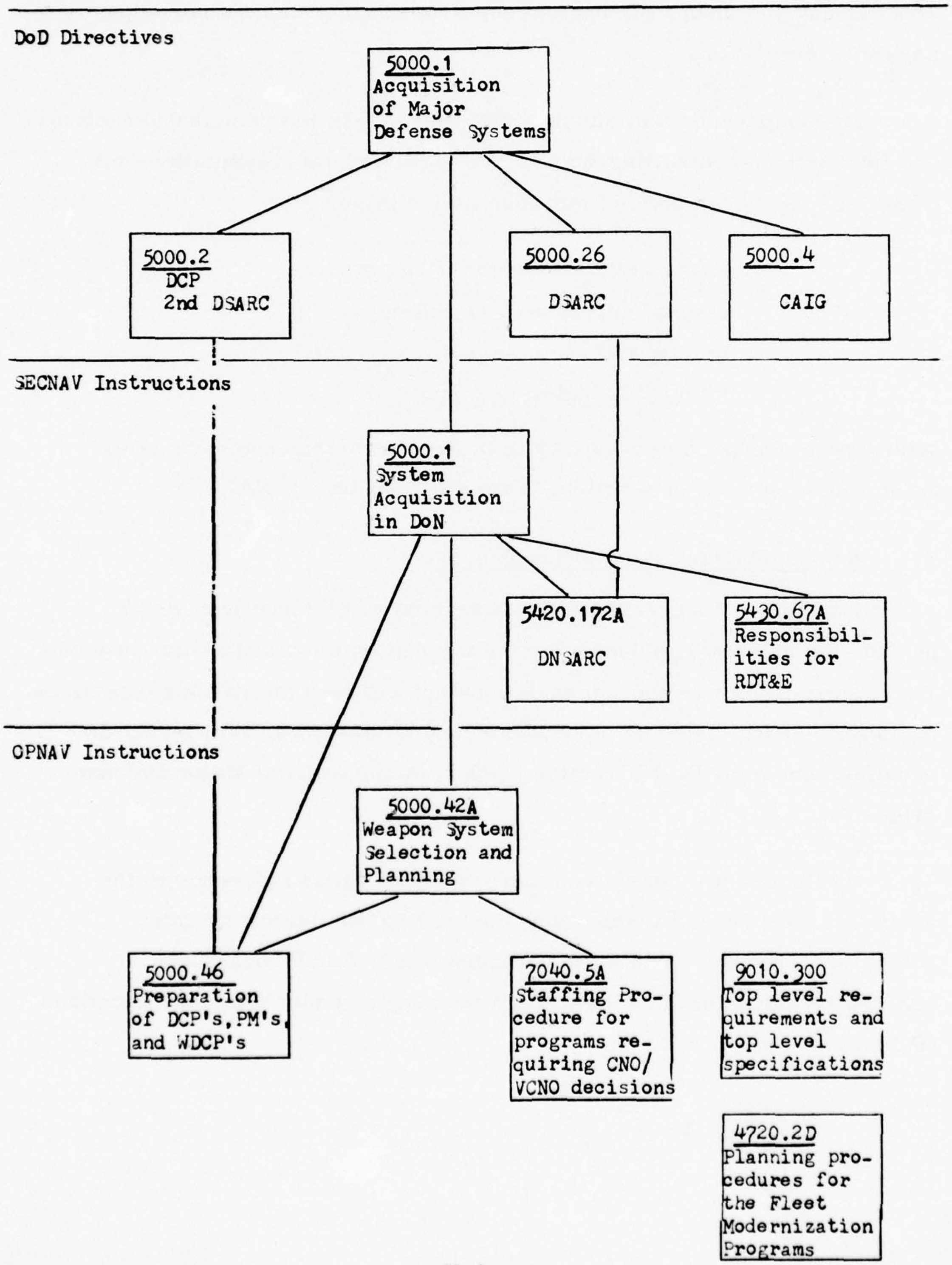


Table E-2

WSAP Directives and Instructions

	DESCRIPTION	REFERENCES	APPLICABILITY (◇ = Decision Point)			
			Concept	Design	Development	Production
DoD Directives:						
5000.1 Acquisition of Major Defense Systems	Establishes policy for major defense system acquisition		◄	—	—	►
5000.2 DCP and DSARC	Establishes policy and guidelines governing use of DCP and the DSARC in the WSAP	DoD 5000.1, 5000.3, 5000.4, 5000.26, 7045.7, 7250.5, 6050.1, 7000.3, DoD Budget Guidance Manual	◄	—	►	
5000.4 CAIG	Establishes charter for the Cost Analysis Improvement Group	DEPSECDEF Memo, May 30,1969,"DSARC"; SECDEF Memo, Jan. 25,72"Cost Estimating"	◇	◇	◇	
5000.26 DSARC	Provides a permanent charter for the Defense Systems Acquisition Review Council		◇	◇	◇	
SECNAV Instructions:						
5000.1 System Acquisition in DoN	Implements DoD 5000.1, establishes policy and management principles for acquisition of systems in DoN	DoD 5000.1 (Encl.), SECNAV 5400.13	◄	—	—	►
(Continued)						

Table E-2, con't.

	DESCRIPTION	REFERENCES	APPLICABILITY (◇ = Decision Point)			
			Concept	Design	Development	Production
SECNAV Instructions, continued						
5420.172 DNSARC	Establishes the Department of Navy Systems Acquisition Review Council, defines its organization, mission, functions, and procedures	DoD 5000.1	◇	◇	◇	
5430.67 Responsibilities for RDT&E	Assigns responsibility for department wide policy supervision of RDT&E to ASN (R&D) with DRDT&E, CNR, CNO advising	SECNAV 5000.1, 5000.16D, 5400.13, 5430.57	↔	↔	↔	↔
OPNAV Instructions:						
4720.2 Planning Procedures for the Fleet Modernization Programs	Establishes planning procedures for the installation of ship alterations as part of the FMP	OPNAV 5420.77, NAVSHIP 4720.27, CNO ltrs ser 035P36 of 26JAN73, C153 of 14MAY73, 973G/140 of 12APR73				
5000.42 Weapon System Selection and Planning	Amplifies SECNAV 5000.1, establishes procedures for identifying OR's, review procedures for non-major and non-designated programs	SECNAV 5000.1, 5420.172, OPNAV 3910.16B, 4100.3A, 4720.2D, 4720.9D, 5000.41B, 5420.2J, Navy Programming Manual	↔	↔	↔	↔
5000.46 Preparation and processing of DCPs, PMs, and NDCPs	Supplements WSA policies of SECNAV 5000.1, 5200.30, and OPNAV 5000.42A To be incorporated into DoN Programming Manual	DoD 5000.2, 5000.4, 5000.26, 5000.28, 7000.2, SECNAV 5000.1, 5200.30, 5420.172A; OPNAV 3960.10, 4100.3A, 5000.42	↔	↔	↔	
(Continued)						

Table E-2 con't.

				APPLICABILITY (◇ = Decision Point)			
		DESCRIPTION	REFERENCES	Concept	Design	Development	Production
OPNAV Instructions, continued							
7040.5	Staffing procedures for programs requiring CNO/VCNO decisions	Outlines procedures for identifying and presenting funding requirements for proposed program costs and manpower implications to the CNO	OPNAV 5000.42	◄──	────	──►	
9010.300	Top level requirements and top level specifications	Establishes policy guidance and procedures for the orderly documentation of Navy fleet needs into ship requirements and specifications	OPNAV 4720.2D, 7720.2A	◄──	──►		

Four DoD directives comprise OSD policy for major defense systems acquisition; DoD 5000. 1 (Acquisition of Major Defense Systems) establishes overall policy and tasks the services to implement the policy within 90 days. DoD 5000. 2 (The DCP and the DSARC) establishes policies and guidelines governing the use of decision coordinating papers (DCP) and Defense Systems Acquisition Review Council (DSARC). DoD 5000. 4 (CAIG) gives the Cost Analysis Improvement Group its charter, and DoD 5000. 26 provides a permanent charter for the DSARC itself.

SECNAV 5000. 1 (System Acquisition in DoN) then implements DoD 5000. 1, providing the Program Manager with his charter, establishing review procedures within the Department of Navy for major defense systems, and discussing in detail various program considerations such as cost estimating and integrated logistics support. OPNAV 5000. 42A (Weapon System Selection and Planning) further amplifies SECNAV 5000. 1, establishing procedures for identifying operational requirements (OR), producing development proposals (DP), and updating R&D plans. It goes on to identify the Navy Decision Coordinating Paper (NDCP) as the decision vehicle for non-major and non-designated programs and establishes the review procedures for them.

A fairly complete explanation of the WSAP can be garnered from the recently issued OPNAV 5000. 46 (Preparation and Processing of DCPs, PMs, and NDCPs). This instruction, issued in March of 1976, is intended to provide guidance for action officers as the document (DCP, PM, NDCP) evolves from initial outline and draft to a fully approved and signed decision. In so doing, it references 12 different directives and instructions, including SECNAV 5000. 1 and OPNAV 5000. 42A instructions. It also references SECNAV 5420. 172A, which establishes the Department of Navy Systems Acquisition Review Council (DNSARC) and defines its organization, mission and functions, and procedures.

Finally, there are four additional instructions dealing with less major aspects of the weapon systems acquisition process: OPNAV 7040.5A (Staffing Procedures for Programs Requiring CNO/VCNO Decisions) attempts to ensure that new programs have undergone adequate staffing with the budgeting personnel in OP-92 and manpower and training planners in OP-01 and OP-099 before being submitted to the CNO for decision. OPNAV 9010.300 (Top-level Requirements and Top-level Specifications) establishes policy guidance and procedures for the orderly documentation of Navy Fleet needs into ship requirements and specifications by defining OPNAV/NAVMAT responsibilities and interactions. SECNAV 5430.67A (Responsibilities for RDT&E) then references SECNAV 5000.1 and assigns responsibility to the ASN(R&D) for department-wide Research and Development policy supervision. Finally for Fleet Modernization Program acquisitions and developments, OPNAV 4720.2D details the planning procudures.

In sum, by reviewing existing directives, specific regulations affecting the weapon systems acquisition process may be identified and organized into a statement of procedural requirements, albeit not complete or entirely systematic. The effort required to locate directives and organize them for purposes of this report indicate that acquisition managers do not frequently engage in corresponding efforts.

C. Manpower/Personnel/Training

Table E-3 shows ten instructions dealing with manpower, personnel, or training considerations, with OPNAV 5300.3A (Development and Review of Manpower Requirements) being especially relevant to the weapon systems acquisition process. This instruction is one of two in this group

Table E-3

Manpower/Personnel/Training Instructions

			APPLICABILITY (◇ = Decision Point)			
	DESCRIPTION	REFERENCES	Concept	Design	Development	Production
SECNAV Instructions:						
5300.3 Development and review of manpower requirements	Establishes policy and assigns responsibility for determination and programming of manpower requirements associated with new ships, programs, etc.	SECNAV 4000.29A, 5000.1; OPNAV 1500.8H, 1500.44, 4100.3A, 4720.2D, 5000.42, 5430.67A, 7040.5A, SMD Manual, DoN Program Manuals	←	—	—	→
5312.10 Manpower Planning Systems	Consolidates DoN policies in regard to determination, documentation, and utilization of manpower resources. Gives CNO responsibility for manpower		←	—	—	→
OPNAV Instructions:						
1000.16 Policies and procedures regarding Manpower Authorization	Sets forth CNO policy concerning Navy military manpower. Provides examples of manpower authorization requests	OPNAV 1000.19A, 1211.16C, 5300.3, 5311.4A; Officer and Enlisted Classification Manuals		←	—	→
1000.19 Implementation of Organizational manning in Fleet Units	Tasks CNO with developing and documenting minimum manpower requirements for organizational manning via SMDs and SQMDs.	SECNAV 5310.2A; OPNAV 1000.16A, 03501.2A		←	—	→
(Continued)						

Table E-3, con't.

			APPLICABILITY (◇ = Decision Point)			
	DESCRIPTION	REFERENCES	Concept	Design	Development	Production
OPNAV Instructions, continued						
1500.8H Navy Training Plans (NTPS)	Establishes policies and procedures for preparing and implementing Navy Training Plans, supporting the principles of DoD 5000.1 and SECNAV 4000.29A (ILS)	SECNAV 4000.29A, 4350.8A, 5000.1, 5300.3; OPNAV 1500.26, 1500.9C, 1500.11C, 1500.44, 4490.2B, 4950.1F; NAVCOMPT Manual, Vol. 7		←	—	→
1500.44 Responsibilities for Training Plans and Requirements	Assigns responsibilities for the development of training requirements and Navy Training Plans	OPNAV 1500.8G, 1542.2, CNO ltr OP-14/MC scr 1415 4P 14		←	—	→
3500.23 Assembly, Training of Crews for Ships	Assigns responsibilities and states policy related to precommissioning training of crews	OPNAV 1500.8F, 1500.19B, 1500.26, 4490.2B, 4700.8E, 4950.6A, 5300.3, 5401.4, 9030.2F, 9080.2H, 9080.3D, 11101.24; Navy Support Plan, Navy Regulations, NAVCOMPT Manual			←	→
5250.1 Work Study Program	Advises how to request work studies, how they can be used					↔
(Continued)						

Table E-3, con't.

	DESCRIPTION	REFERENCES	APPLICABILITY (◇ = Decision Point)			
			Concept	Design	Development	Production
OPNAV Instructions, continued						
5310.12 SHORSTAMPS	Implements SHOROC, establishes procedures for determining shore manning requirements	DoD 5010.15H, CNO Ctr 125C/12069, OPNAV Note 5310		←	—	→
5312.10 Navy Manpower Survey Program	Describes the organization and objectives of the Navy Manpower Survey Program; to develop and promulgate manning documents	SECNAV 5312.10B		←	—	→

that references the major DON weapon systems acquisition instruction, SECNAV 5000. 1. OPNAV 5300. 3A establishes policy and assigns responsibilities for the determination and programming of manpower requirements associated with new programs, and emphasizes the importance of presenting the requirements during the annual Program Objectives Memorandum (POM) cycle. Thus this instruction has begun to redirect attention to the substantive manpower issues which are inextricably tied to weapon systems acquisition. Finally, it emphasizes that manpower and training requirements should be developed early in the acquisition process.

OPNAV 1500. 8H (Navy Training Program) is the other instruction that references SECNAV 5000. 1. It establishes policies and procedures for preparing and implementing Navy Training Plans (NTPs), supporting the principles of DoD 5000. 1 and SECNAV 4000. 29A (ILS). Besides describing the components of an NTP, OPNAV 1500. 8H stresses that they should be promulgated three years prior to fleet introduction to correspond with the three year window in the POM process. Companion to this instruction is OPNAV 1500. 44 (Responsibilities for Training Plans and Requirements) which assigns responsibilities for the development of training requirements and training plans.

There are four instructions which address the need to improve manpower planning methods. First, SECNAV 5312. 10C (Manpower Planning Systems) consolidates DON policies in regard to determination, documentation, and utilization of manpower resources, and tasks CNO to develop a manpower planning system. OPNAV 5312. 10C responds by describing the organization and objectives of the Navy Manpower Survey Program. Then there is OPNAV 5310. 12 (SHORSTAMPS) which implements

SHOROC and establishes procedures for determining shore manning requirements. Finally, OPNAV 5250.10 (Work Study Program) advises how to request work studies, and how they can be used to increase the accuracy of manpower planning factors.

Manpower requirements must be documented in Ship Manpower Documents (SMDs) or Squadron Manpower Documents (SQMDs) which form the basis for manpower authorization. OPNAV 1000.19A (Implementation of Organizational Manning in Fleet Units) describes the process of preparing SMDs to determine the organizational manning level for the Navy, while OPNAV 1000.16C (Policies and Procedures Regarding Manpower Authorizations) sets forth the policies and procedures involved in preparing manpower authorizations and getting them approved. Finally OPNAV 3500.23B (Assembly, Training of Crews for Ships) suggests the timing for these manpower authorizations and pulls together 15 different instructions and directives to repromulgate procedures for assembling, organizing, and training crews for U.S. Navy ships.

This set of manpower and related instructions is perhaps as good an example as any of the inadequacies of the directives systems as the source of major policy guidance. First of all, there are no DoD directives establishing overall guidance for manpower planning and related decision making as it relates to WSAP. Second, OPNAV 5300.3A, despite its recognition as a major statement of manpower planning requirements at the OPNAV level, is a general statement of principal short on specific requirements. Its significance, however, should not be overlooked in view of the efforts and time required to promulgate the instruction. Finally, there are generally no references built into the WSAP directives and instructions to these manpower instructions.

There simply is not an integrated coordinated statement of WSAP and related manpower planning policy.

D. Testing and Evaluation

Table E-4 shows three directives dealing with the testing and evaluation aspects of the WSAP: DoD 5000. 3 (Testing and Evaluation) references DoD 5000. 1 in establishing policy for testing and evaluation of weapon systems throughout the acquisition process. OPNAV 3960. 10 (Testing and Evaluation) implements this directive, and further establishes procedures for planning, conducting, and reporting tests and evaluations. Finally, OPNAV 4720. 90 (Approval for Service Use) establishes policy and uniform procedures for approval of systems and equipment for service use. Approvals take place after the design phase testing for provisional approval, or after the full-scale development phase testing for full approval for service use.

Testing and evaluation requirements are divided into two major areas: developmental and operational. With respect to each area, the instructions define evaluation issues which must be formulated during the conceptual and design and development phases of acquisition, as well as the procedures for making assessments on the adequacy of the weapon systems to meet the developmental and operational requirements established by the test criteria.

E. Integrated Logistics Support

Table E-5 shows three major ILS directives, all very closely related. DoD 4100. 35 (Development of Integrated Logistic Support for Systems/Equipments) establishes policy and assigns responsibility for carrying out the integrated logistics support program as an integral part of the weapon system acquisition process. Guidance is given concerning the amount of ILS planning that should be accomplished during each phase of the acquisition process. SECNAV 4000. 29A (Development of ILS for Systems/

Table E-4

Testing and Evaluation Instructions

	DESCRIPTION	REFERENCES	APPLICABILITY (◇ = Decision Point)			
			Concept	Design	Development	Production
DoD Directives:						
5000.3 Testing and Evaluation	Establishes policy for Testing and Evaluation within DoD	DoD 5000.1	←	—	—	→
OPNAV Insructions:						
3960.10 Testing and Evaluation	Implements DoD 5000.3, establishes policy for testing and evaluation in Navy Acquisition programs; procedures for planning, conducting, and reporting testing and evaluation	DoD 5000.1, 5000.3 (Encl.); SECNAV 5000.1; OPNAV 4720.9D	←	—	—	→
4720.9D Approval for Service Use	Establishes policy and uniform procedures for approval of systems and equipment for service use	SECNAV 5000.1; OPNAV 3930.8B, 3960.8, 4100.3A, 5000.42			◇—◇	

Table E-5

Integrated Logistics Support Instructions

			APPLICABILITY (◇ = Decision Point)			
	DESCRIPTION	REFERENCES	Concept	Design	Development	Production
DoD Directives:						
4100.35 ILS	Establishes policy and assigns responsibility for carrying out the integrated logistic support program as an integral part of the acquisition process	DoD Guide 4100.35G	←	—	—	→
SECNAV Instructions:						
4000.29A ILS	Implements DoD 4100.35; establishes policies and responsibilities for the Navy ILS concept	DoD 4100.35(Encl)	←	—	—	→
OPNAV Instructions:						
4100.3A ILS	Directs the development and implementation of the ILS concept within DoN; establishes basic CNO policies governing ILS organization, responsibilities, and application	SECNAV 4000.29A, 5000.1; OPNAV 1500.8G, 5311.4A	←	—	—	→

Equipments) then implements DoD 4100.35, establishing policies and responsibilities for the Navy ILS concept. OPNAV 4100.3A (Department of the Navy ILS System) is more detailed, directing the development and implementation of the ILS concept within DoN and establishing basic CNO policies governing ILS organization, responsibilities and applications. Early planning is stressed and application of the ILS system is made mandatory throughout the life cycle from the conceptual phase through fleet introduction. Manpower considerations (Personnel and Training) are mentioned as one of nine ILS planning elements along with other areas such as maintenance plans and transportation.

F. Reliability and Maintainability

Table E-6 shows only one instruction dealing with Reliability and Maintainability at the OPNAV level or higher. SECNAV Instruction 3900.36A (Reliability and Maintainability of Navy Material) sets forth basic R&M policy guidance and assigns responsibility for its implementation. Cited are four references detailing R&M definitions and program planning guidelines. R&M factors are intended to be considered throughout the WSAP.

Table E-6
Reliability and Maintainability Instructions

			APPLICABILITY (◇ = Decision Point)			
	DESCRIPTION	REFERENCES	Concept	Design	Development	Production
SECNAV 3900.36A Reliability and maintainability of Navy Material	Establishes policy guidance for efforts to increase Reliability and Maintainability of Navy systems and assigns responsibility for implementation	MIL STD 721B, 109B, 785A, 470	◄──	────	────	──►

APPENDIX F

Annotated Bibliography of Pertinent Directives

INDEX

ANNOTATED BIBLIOGRAPHY

MANPOWER REQUIREMENTS DOCUMENTS
(DOD/SECNAV/OPNAV/NAVMAT/SYSCOMS)

PURPOSE: To identify, to the extent practicable, all Department of Defense and Department of the Navy existing documents governing the determination of Navy Manpower Requirements for ships, squadrons shore establishments and new hardware.

DOD DIRECTIVES:

DOD Directive 5000.3 of 19 January 1973
Subj: Test and Evaluation

Development test and evaluation and operational test and evaluation guidance is given. Development test and evaluation is conducted to: demonstrate that the engineering design and development process is complete; demonstrate that the design risks have been minimized; demonstrate that the system will meet specifications; and estimate the system's military utility when introduced. Operational test and evaluation is conducted to estimate the prospective system's military utility, operational effectiveness, operational stability, and need for any modifications. In addition, operational test and evaluation provides information on organization, personnel requirements, doctrine and tactics. Modifications to the procedures outlined for major ships of a class and one-of-a-kind systems.

A brief description of the Defense Systems Acquisition Review Council (DSARC)/Development Concept Paper (DCP) procedures for major defense systems is included in the directive along with the responsibilities of the Deputy Director of Defense Research and Engineering, Test and Evaluation.

DOD Directive 5000.26 of 21 January 1975
Subj: Defense Systems Acquisition Review Council (DSARC)

The directive addresses the function, composition, and responsibilities of the members of the Defense Systems Acquisition Review Council (DSARC).

DSARC I Reviews are generally conducted to consider the readiness to proceed with the Program Initiation (Validation Phase). During this review, it must be shown that future support costs including a comparison with those of current systems have been considered.

DSARC II Reviews are usually conducted to consider major decisions for initiation of full-scale engineering development. During this review, it must be shown that requisites for the production/deployment decision, including logistics support, have been established.

DSARC III Reviews are conducted, in general, to consider production/deployment decisions. During this review, it must be shown that the relative cost estimates of support and operation have been evaluated for 10 years where relevant.

DOD INSTRUCTIONS:

DOD Instruction 5000.2 of 21 January 1975
Subj: The Decision Coordinating Paper (DCP) and the Defense Systems Acquisition Review Council (DSARC)

This instruction contains policy guidance for the Defense Systems Acquisition Review Council (DSARC) and the Decision Coordinating Paper (DCP). The scheduled program decision points are identified and discussed along with guidance for unscheduled program decisions.

Relationships between the DCP/DSARC process and the Planning, Programming and Budgeting System (PPBS) and between the DCP/DSARC process and the Program Memorandum (PM) are outlined.

Enclosure (1) to the subject instruction goes into great detail for preparation and processing of the DCP. General guidance, DCP objectives, and assigned responsibilities are all included in this enclosure.

SECNAV INSTRUCTIONS:

SECNAVINST 4000.29A of 13 January 1971
Subj: Development of Integrated Logistic Support for Systems/Equipments

This instruction implements a DOD Instruction and establishes Department of the Navy policy and responsibility for the Navy integrated logistic support system concept. The policy requires that logistic support planning be included in the design, development, test, evaluation, productions and operation of systems/equipments at all stages beginning with early conceptual studies.

The Chief of Naval Operations is assigned responsibility for overall direction of actions applying the policies and principles of integrated logistic support within the Department of the Navy (less Marine Corps). He is specifically directed to ensure the development of missions scenarios (time, place, unit size), availability, maintenance concepts, and manning criteria and their incorporation in all required operational requirements documents which initiate development and/or acquisition of weapons systems and equipment.

The Chief of Naval Material, under the direction of the Chief of Naval Operations, is directed to implement, monitor, and coordinate the application of integrated support planning to all acquisition of systems and equipments developed and/or procured by Naval Material Command. He is tasked to develop and promulgate techniques for predicting life cycle costs and for optimizing these costs through analysis of potential trade-offs between reliability, maintainability, design and manning interface, and other logistic support alternatives.

Enclosure (2) to this instruction lists the Principles of Integrated Logistic Support, one of which requires the documented engineering analysis of maintenance and operational requirements inherent in the equipment design and the plan for use.

SECNAVINST 5000.1 of 13 March 1972
Subj: System Acquisition in the Department of the Navy

This instruction implements within the Navy Department the DOD policies for major defense system acquisition. In July 1971, DOD delegated to the Secretary of the Navy considerable responsibility and authority previously reserved to OSD in the area of system acquisition. SECNAVINST 5000.1 cancelled eight SECNAV INSTRUCTIONS, seven OPNAV INSTRUCTIONS, and thirteen NAVMAT INSTRUCTIONS. The DOD directive established dollar thresholds for major programs (more than $50 million RDT&E or $200 million production cost) and required the services to eatablish project managers for such acquisition. The SECNAV implementing instruction requires project managers to examine trade-off possibilities, to compute life cycle costs, and to consider logistic support cost as a principle design parameter. Operating and support costs, including manpower costs, must be considered at each stage of the acquisition process. New acquisition includes conversions, major modifications, and modernizations. Validation of support costs for test equipment, personnel and training, maintenance and operation of the whole system is required.

SECNAVINST 5000.30A of 16 July 1975
Subj: Department of the Navy Management Headquarters Activities

This instruction implements provisions of DOD Directive 5100.73 within the Department of the Navy to establish a system for the management of the number and size of Department of the Navy management headquarters activities. Policy guidance is given and enclosure (1) lists those organizations which are currently designated as DOD management headquarters activities.

The Chief of Naval Operations is assigned responsibility to designate a single office for management headquarters matters for Navy organizations and establish management information systems to identify and maintain control of the number and size of all headquarters activities under the management of the Department of the Navy. Management headquarters are to be monitored to ensure that they are organized and staffed to provide effective accomplishment of assigned responsibilities with a minimum number of personnel.

SECNAVINST 5312.9C of 22 September 1972
Subj: Report on Improved Manpower Management

This instruction assigns responsibilities for reporting improved manpower management (military personnel, direct and indirect hire civilians, and contractor personnel) for all Department of the Navy organizational components to the Chief of Naval Operations. These reports are submitted to the House Committee on Post Office and Civil Service for consolidation into an overall Federal Government report semi-annually and describe actions, programs, and plans to improve the efficiency with which manpower is used.

SECNAVINST 5312.10C of 29 October 1974
Subj: Manpower Planning Systems

This instruction differentiates between manpower management and personnel administration and assigns responsibilities for the development of manpower planning systems for the Navy. It calls for precise determination of military and civilian manpower requirements to achieve operational and missions demands. Manpower requirements and maintenance responsibilities for new weapons, systems, equipments, and initiatives are to be specified in advance of fleet introduction to allow for consideration in the programming cycle.

SECNAVINST 5420.172A of 22 May 1975
Subj: Establishment of the Department of the Navy
Systems Acquisition Review Council (DNSARC)

This instruction establishes the DNSARC to provide review and appraisal of management procedures and systems acquisition programs to assist the Secretary of the Navy in making decisions concerning initiation, continuation of, or substantial change to these programs or procedures. The DNSARC recommendations will establish the Department of the Navy official position for those programs requiring Defense Systems Acquisition Review Council action.

SECNAVINST 5430.67A of 22 May 1975
Subj: Assignment of responsibilities for research, development, test, and evaluation

This instruction assigns specific duties and responsibilities for the administration of the Navy research, development, test, and evaluation program.

The Chief of Naval Personnel is assigned responsibility to:

(1) formulate and execute policy for research and development in support of BUPERS programs.

(2) provide for development of personnel for a weapon or support system in order to provide properly trained personnel, in sufficient numbers, for an operational system when it becomes available.

(3) provide manpower capability estimates for use by CNO in appraising military potential and CNM in developing new systems.

(4) advise and assist, with Chief of Naval Education and Training, CNM in determining training facilities, program requirements, skills and numbers of personnel to support systems which are planned for fleet introduction.

(5) direct a program of applied research in personnel operations and related behavioral sciences to develop techniques, concepts, and standards for use in the creation and improvement of personnel systems; methods for determination of qualitative and quantitative manpower and training requirements for naval personnel planning and administration, and develop, apply, and evaluate human factors and operations research consideration in the development for new systems.

OPNAV INSTRUCTIONS:

OPNAVINST 1000.16C of 5 February 1973
Subj: Manpower Authorizations; Policies and Procedures Regarding Changes to

This instruction provides procedures for submitting requests for changes to manpower authorizations. The manpower authorizations call for detailed expression of the numbers and types of Navy military manpower authorized for each Navy activity. Particular emphasis is placed on identifying areas in which manpower may be saved and for skill levels reduced without adverse effects on mission accomplishment. The probability of approval of increases for which compensatory decreases are not identified is extremely low.

This instruction details the responsibilities for commanding officers, the administrative chain of command, military manpower claimants, program element sponsors, and officer designator advisors.

OPNAVINST 1000.19A of 21 September 1970
Subj: Implementation of Organizational Manning in Fleet Units

In this instruction the Chief of Naval Operations is tasked with developing and documenting minimum manpower requirements for organizational manning in fleet units. This is carried out in the Ship Manning Documents and Squadron Manning Documents. These are delineated by individual billets of the minimum quantitative and qualitative personnel needs essential to the performance of assigned mission areas and required operational capabilities prescribed for a fully ready unit.

Conditional manning is defined and implementation is explained in this document. Conditional manning will occur when inadequate end-strength is authorized by the Secretary of Defense, fleet personnel inventory falls below authorized levels, or ship on-board personnel fall below authorized levels.

OPNAVINST 1300.6D of 30 January 1975
Subj: Priority Manning

This instruction deals with priority manning to handle shortages that exist in many categories of personnel. Priority manning provides for manning of an activity above the general manning level when it is considered especially essential to the national defense. Priority manning may be on a continuous basis or may last only for a specified period of time. Priority 1 and priority 2 manning will be directed by the Chief of Naval Operations, while priority 3 manning may be directed by the manning control authorities. No activity will be priority manned except as authorized by the Chief of Naval Operations, the Chief of Naval Personnel, or the fleet commanders in chief. The procedures for requesting priority manning are contained in this instruction.

OPNAVINST 1500.2E of 3 April 1973
Subj: Establishment and Coordination of Factory Training Programs for Military and Civilian Personnel; Responsibility and Procedures for

This instruction generally limits factory training to the training of a initial cadre of maintenance, operator, instructor or supervisory personnel on new systems, equipments, training aids or devices or modification thereto and instruction concerning equipment for which there are no schools or courses in the Navy or other military services which would not justify establishment of formal, continuing courses in Navy training schools, or incorporation in formal training programs.

The responsibilities of the Chief of Naval Operations include ensuring that planning for factory training is coordinated with overall plans for operational installation. Responsibilities for carrying out this instruction are also spelled out for the Chief of Naval Material; Commander in Chief, U. S. Atlantic Fleet; Commander in Chief, U. S. Pacific Fleet; Chief of Naval Training; Chief, Bureau of Medicine and Surgery; Chief of Naval Reserve; and Chief of Naval Personnel.

OPNAVINST 1500.8H of 3 July 1975
Subj: Preparation and Implementation of Navy Training Plans (NTPs) in Support of Hardware and Non-Hardware Oriented Developments

This instruction establishes policies and procedures, and assigns responsibilities for planning, programming, and implementing actions necessary to provide training support for systems, sub-systems, sub-system components and non-hardware oriented developments.

This instruction calls for planning and programming training requirements concurrently with hardware development and production, coordinating of training requirements for operational life of hardware, identification of manpower needs, identification of training requirements, and identification of facility requirements.

The responsibilities of the Chief of Naval Operations; Commandant of the Marine Corps; Chief of Naval Material, Systems Commanders; Project Managers and other Principal Development Activities designated by the Chief of Naval Material; Chief of Naval Personnel; Chief of Naval Education and Training; Commander in Chief, U.S. Atlantic Fleet; Commander in Chief, U.S. Pacific Fleet; Chief, Bureau of Medicine and Surgery; and Chief of Naval Reserve are all included in this instruction. A guide for preparing and implementing a Navy Training Plan is also included as enclosure (1).

OPNAVINST 1500.11G of 19 June 1974
Subj: Naval Aviation Training Program Policies, Responsibilities, and Procedures

This instruction calls for coordination of manpower requirements, training support requirements, and training program planning concurrently with equipment development and production; and efficient and adequate training and qualification programs phased with equipment introduction, modification, and use in the Naval Aviation Training Program.

The Deputy Chief of Naval Operations (Air Warfare) is responsible for aviation personnel, planning and identification of aviation manpower requirements, requirements and priorities for aviation bases, sponsorship and funding of aircraft, related equipment and programs; and establishment of policy, requirements, and priorities for aviation training and the development of aviation training plans. The Chief of Naval Material and the Commanders, Naval Systems Commands, are to furnish to the DCNO (Air Warfare) a recommended training plan for each new weapon system component and item of support equipment requiring establishment of in-house Navy training. The responsibilities of the Director, Naval Education and Training (Op-099) and the Chief of Naval Education and Training are also explained in this instruction.

OPNAVINST 1500.22C of 28 March 1975
Subj: General Military Training Program

General Military Training Program is the initial orientation and follow-up on-board training in those non-technical areas which serve the purpose of preparing Navy personnel to fulfill the obligations of their oath of service; and providing guidance and information on matters affecting their welfare, both as citizens and as members of the Navy. It is the Chief of Naval Operations responsibility to insure that GMT conforms to the policies of the Secretary of the Navy; designate appropriate bureaus, offices, and commands as sponsors of the GMT program elements; and approve training requirements for GMT. Enclosure (1) contains an explanation of the GMT program operation and a GMT Command Planning Guide.

OPNAVINST 1500.44 of 24 October 1973
Subj: Responsibilities for Development of Training Requirements and Training Plans

Each DCNO and DMSO must assure that training programs satisfy identified training needs of the operational environment based on appropriate validation, test and evaluation of the training programs; training activities receive proper resource support in terms of manpower, funding, facilities, and equipment; and his training priorities are identified and documented.

This instruction amplifies and clarifies the responsibilities for OPNAV offices concerning category 1 training requirements, continuing need for the supply of replacement of trained personnel; and category 2 training requirements, new training needs identified in relation to new developments in hardware or operating techniques. In the area of category 2 training requirements a DCNO or DMSO will provide definitive guidance which identifies:

(a) minimum personnel performance standards required to operate and maintain new systems

(b) number and quality by rank, rating, NEC, code category, or other specifications required

(c) timing of the initial supply of trained personnel required

(d) special operational problems which require new training equipments, facilities, or techniques for training

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OPNAVINST 1510.10 of 10 June 1974
Subj: Navy Integrated Training Resources and Administration System (NITRAS); Reporting Procedures for Implementation of

This instruction combines the most desirable features of the Formal Training Data System (FTDS) and the Training Administration System (TRADS) into the Navy Integrated Training Resources and Administration System (NITRAS) and provides the automated capability to manage and support the Navy training effort. The system operates under the management responsibility of the Chief of Naval Education and Training.

The NITRAS consists of four files which provide the automated capability to manage and support the Navy training effort. The Master Course Reference File (MCRF) which collects and standardizes at one central point, the course data elements and class schedules on all formal school training; and compiles by course, Training Plan information in the form of the Past, Current, and Current Fiscal Year +1 Training Input Plan and the Training Requiremens for the next five fiscal years. The Student Master File (SMF) is designed to provide timely information by name on all personnel undergoing training in Navy courses, and Navy personnel receiving training in "other-Services"courses, which are 10 calendar days or more in length, or which award a Navy Enlisted Classification Code (NEC); and will contribute to the enlisted personnel distribution system by transferring student availability dates and other personnel data to the New Enlisted System (NES). The Training Summary File (TSF) includes statistics on all other courses which are less than 10 calendar days in length, and not otherwise required to be reported in the Student Master File. The Activity Support File (ASF) is designed to collect data on resources necessary to support each course and/or training activity.

This instruction also assigns areas of responsibility to the Chief of Naval Education and Training; the Chief, Bureau of Medicine; the Commanders in Chief, Atlantic and Pacific Fleets; the Chief of Naval Reserve; the Chief of Naval Material; the Chief of Naval Personnel; and the Officer in Charge, Naval Training Command Data Services Center, Pensacola, Florida.

OPNAVINST 1550.6A of 25 October 1973
Subj: Review of Navy Formal School Curricula and Instructional Literature.

Directs technical commands to provide initial and subsequent reviews of curricula and instructional literature when requested by Navy Training agencies.

OPNAVINST 1550.8 of 17 January 1974
Subj: Approval of Curriculum Outlines and Curricula for Navy Training Courses.

Requires SYSCOMS to provide contractor-developed curriculum outlines and curricula for factory training and school courses and that CNET have an opportunity to review and approve the training materials.

OPNAVINST 3500.23B of 5 May 1972
Subj: Assembly, Organization, and Training of Crews for U.S. Navy Ships Commissioned in Time of Peace

This instruction states policy and assigns responsibilities related to precommissioning training for crews of U.S. Navy ships during peacetime. The instruction calls for training of the nucleus crew as well as the balance crew. The balance crews will receive from four to twelve weeks of training, depending on the ship type. The training of members of the nucleus crew normally will be of much greater length and will depend on the specific skill needs of the individuals and the command.

All personnel of the crew will have completed precommissioning training as appropriate to nucleus or balance crew prior to crew certification for fast cruise for vessels requiring such certification and prior to the commissioning date for all other types. Manpower authorizations should be promulgated twelve to fourteen months prior to the commission date in order to allow for the special or general training required.

A Navy training plan for the total ship will be prepared for each crew requiring precommissioning training. In accordance with the plan as approved and the promulgated manpower authorization, personnel will be ordered to the ship and to other locations for training and assembly.

This instruction also assigns areas of responsibility to the Chief of Naval Operations; Chief of Naval Material; Chief of Naval Training; Chief of Naval Personnel; Fleet Commanders in Chief; Commander, Naval Surface Reserve; District Commandants; and Prospective Commanding Officers.

OPNAVINST 3500.34A of 20 August 1971
Subj: Personnel Qualification Standard (PQS) Program

Directs the CNM to review all new and revised PQS related to systems and other technical areas under cognizance to ensure technical accuracy; also to determine the desirability, feasibility, and procedure for development and use of PQS in connection with training materials supporting new systems and equipments.

OPNAVINST 3910.16B of 12 February 1969
Subj: Research and Development Planning Summary (DD Form 1643) for Research and Development Program Planning Review

This instruction implements DOD Instruction 7720.16 within the Department of the Navy. DD forms are to be submitted on 15 May, on the plans and status of all projects and task areas, as technical backup to assist in the review of the annual apportionment submission and out-year review, and on 15 Sep, on revisions or changes to the above reported projects and task areas, as technical backup to assist in the review of the annual budget submission. Revisions or changes are required only where a change in funding has had a significant impact on the technical content of the project or task area.

OPNAVINST 3960.10 of 22 October 1975
Subj: Test and Evaluation

This instruction establishes policy for test and evaluation in Navy acquisition programs. DOD Directive 5000.3 with CH-2, certification of readiness for OPEVAL, test and evaluation master plan (TEMP), and requests for fleet RDT&E support, and report symbols are enclosures to this instruction.

Four acquisition categories (ACATs) are established to govern acquisition procedures, including T&E. ACAT-I programs are controlled by decision coordinating papers (DCPs). ACAT-II programs designated by a DSARC principal are controlled by program memorandums (PMs); those designated by SECNAV or CNO are controlled by Navy development concept papers (NDCPs). CNO (Op-098) will publish, quarterly, an index of all Navy acquisition programs, by ACAT, showing appropriate status information.

There are three types of T&E. Development T&E (DT&E), Operational T&E (OT&E), and Production Acceptance T&E (PAT&E)--and authority for each is delegated to a different organization.

OPNAVINST 3960.11 of 12 March 1976
Subj: Policy and Responsibilities for the Selection, Development, Acquisition, Standardization, and Application of Automatic Test, Monitoring, and Diagnostic Systems and Equipments; implementation of

This instruction implements the policy established in SECNAVINST 3960.4 of 12 October 1973. Responsibility is assigned as the automatic and semi-automatic test monitoring, and diagnostic systems and equipment (ATE) coordinator within the Office of the Chief of Naval Operations. All DCNOs and DMSOs are responsible for (a) ensuring that the policy established in SECNAVINST 3960.4 is implemented and that operational requirement documents and other planning documents incorporated this policy; and (b) cooperating with Op-04 and the ATEMAT office in the overall budgeting and funding for development, acquisition, and logistic support of ATE hardware and software, to assure a viable Navy-wide program.

OPNAVINST 4100.3A of 6 November 1972
Subj: Department of the Navy Integrated Logistic Support (ILS) System

This instruction implements the Navy ILS concept, policies and principles set forth in SECNAVINST 4000.29A and amplified in SECNAVINST 5000.1. It emphasizes the applicability of the ILS concept to all acquisitions and modifications of systems and equipment. The Chief of Naval Operations is responsible for overall direction of action applying the principles of ILS within the Department of the Navy, except for the Marine Corps. In this instruction, he directs that "the development of effective logistic support, including manpower requirements, shall be systematically planned and managed as an integrated whole by interlocking the elements of logistic support to obtain maximum material and manpower readiness and optimum cost effectiveness in the same manner as is done for hardware." ILS plans are to be developed utilizing existing Navy-wide maintenance, transportation, training, supply, and support assets. The DCNO (Logistics) (Op-04) is assigned responsibility for overall direction and coordination of Navy ILS effort. Program sponsors are directed to ensure that the requisite funds are provided to conduct the required tradeoff studies in ILS planning elements such as:

The Maintenance Plan
Support and Test Equipment
Supply Support
Transportation and Handling

Technical Data
Facilities
Personnel and Training
Logistic Support Resource Funds
Logistics Support Management Information

Enclosure (1) to this instruction describes the ILS planning requirements at each stage of the acquisition process. Enclosure (2) describes the information required in preparation for DSARC Milestones III.

OPNAVINST 4490.2B of 11 November 1971
Subj: Availability of Equipment for Training Purposes

Establishes policy that availability of equipment for training purposes has a higher priority and more demanding schedule for availability than the operational installations. States that approval of the CNO must be obtained when, for compelling reasons, it is not feasible to provide the first production equipment for training.

OPNAVINST 4720.9D of 23 August 1974
Subj: Approval of Systems and Equipments for
Service Use

This instruction establishes the policy that all systems or equipments developed by the Navy and/or which the Navy intends to support must be "approved for service use" prior to commitment to major production. This requires adequate testing, proven operational suitability and logistics supportability. This approval must be obtained prior to recommending the system or equipment for production.

Approval authority, depending on the cost of the program, is defined. The instruction also defines:

a. Approval for service use.
b. Provisional approval for service use.
c. Approval for production.
d. Approval for limited production.
e. Acceptance for service use.

Procedures for obtaining approval for service use require:

a. the results of the technical and operational test and evaluations conducted to date,

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(b) the status of the ILS plan,
(c) plans for correcting deficiencies identified in the test and evaluation.

The role of the Service Approval Review Board (SARB) is explained. Procedures for deviations from established procedures in the case of extreme urgency or military necessity are discussed. Enclosure (1) portrays the dollar thresholds which determine who may grant approval for service use. Enclosure (2) illustrates in graphic form the steps in obtaining approval for service use for major programs, and Enclosure (3) provides similar information for less than major programs.

OPNAVINST 5000.30C of 8 June 1970
Subj: CNO Studies and Analyses Program; Policies and Responsibilities and Procedures for

This instruction provides guidance concerning policies, responsibilities and procedures for the supervision and conduct of the CNO Studies and Analyses Program including procedures for the review and forwarding of completed CNO studies. It notes the designation of the Director, Navy Program Planning (DNPP), as the central coordinator for Department of the Navy Studies and Analyses which are concerned with policy; strategic, and operational concepts; force levels and program planning (OPNAVINST 5000.37). In this capacity, the DNPP also coordinates and supervises CNO Studies and Analyses conducted within OPNAV and the external study efforts required by the Chief of Naval Operations. The need for an orderly program of study and research is explained. Detailed responsibilities of the DNPP, OP-96, and designated study sponsors are set forth. Review and distribution procedures for individual studies are explained and reporting instructions to support the updated data bank in underway and completed studies are established. Enclosure (1) sets forth the duties and responsibilities of the Advisory Committee. Enclosure (2) shows the format to be used in compiling the monthly report of the officers assigned to OPNAV staff studies relating to program planning, as well as to CNA/In House/Joint Studies.

OPNAVINST 5000.42A of March 1976
Subj: Weapons Systems Selection and Planning

This instruction amplifies policy set forth in SECNAVINST 5000.1 on weapons system acquisition. It establishes a revised R&D planning procedure, and establishes procedures for identifying operational requirements and conducting management reviews during the system acquisition. The guidance contained in this instruction applies to all Navy acquisition programs, which are categorized according to dollar cost and required reporting and documentation procedures. A comprehensive list of definitions is provided. Specific activities of the Acquisition Review Committee (ARC) are provided. This is a key instruction in the manpower planning and programming area. The Operational Requirement (OR), Development Proposals (DP), and Navy Decision Coordinating Papers (NDCP) are explained, as are review and promulgation procedures in graphic form. Enclosure (2) defines and describes the Navy R&D Plan, which consists of Science and Technology Objectives (STO), and approved Operational Requirements (OR). The format for Development Proposals (DP) is contained in Enclosure (3).

OPNAVINST 5000.46 of 10 March 1976
Subj: Decision Coordinating Paper (DCPs) Program Memorandum (PMs) and Navy Decision Coordinating Papers (NDCPs), preparation and processing of

This instruction establishes procedural guidelines governing the preparation and processing of Decision Coordinating Papers (DCPs), Program Memoranda (PMs), and Navy Decision Coordinating papers (NDCPs). It is planned to incorporate this instruction in the Navy Programming Manual to replace portions of Appendix NE relating to DCP and PM preparation and processing.

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. The DCP supports the decision making process and establishes an agreed commitment for major programs.

The PM serves the same function as the DCP for non-major programs. Format, content, and processing for a PM, within the Navy Department, are identical to those for a DCP.

An NDCP is the Navy acquisition management document which supports and promulgates a CNO or SECNAV decision to initiate a conceptual development program and establish an appropriate advanced or engineering development line item. For a SECDEF or DSARC principal designated program, the NDCP will serve as the basis for the DCP or PM. NDCP format is the same as that of the DCP.

The process involved in the preparation of a DCP is presented in detail, together with responsibilities of reviewers. Updating requirements are explained.

Enclosure (1) provides the format for a DCP. Enclosure

(2) provides a DCP Work Schedule for general guidance.

OPNAVINST 5250.1D of 21 January 1975
Subj: Work Study Program

This instruction describes the organization and objectives of the Navy Work Study Program and prescribes procedures for its operation and direction.

Definitions are provided for:

Work Study
Method Study
Work Measurement

The program is operated under the policy directions and control of the DCNO (Manpower Planning and Programming) (OP-01C) who approve work study requests, establishes priorities, and provides guidance and direction to the Navy Manpower and Material Analysis Centers, Atlantic and Pacific who conduct the studies.

Procedures for requesting a work study are set forth. Implementation of study recommendations is discussed. Work Study reports are forwarded to the Chief of Naval Operations via the requesting activity. Distribution of the reports is made by the CNO.

Enclosure (1) to this instruction provides the format for requesting a work study.

OPNAVINST 5300.3A of 25 September 1975
Subj: Development and Review of Manpower Requirements
for New Ships, Programs, Systems, and Hardware

This instruction establishes policy and assigns responsibilities for the determination and programming of manpower requirements associated with new programs, ships, systems, or hardware, and emphasizes the importance of timely action to ensure that such requirements are presented during the annual Program Objective Memorandum (POM) cycle.

The policy of the Chief of Naval Operations that manpower and training requirements be developed early in the weapons system selection process is stated. Programming constraints are discussed and the activity sponsoring the new system or program is charged with responsibility for determining the manpower and training requirements, following through with appropriate action to obtain the billets, and developing the Navy Training Plan in a timely manner.

Responsibilities of other participants in the manpower determination and programming process are set forth.

Addressees are enjoined to coordinate their manpower planning with OP-01, OP-90, and OP-92.

This instruction repeats and restates responsibilities and requirements set forth in a number of other directives. A companion instruction, OPNAVINST 1500.8H provides additional detailed instructions on the preparation of Navy Training Plans.

OPNAVINST 5310.12 of 15 November 1974
Subj: Shore Requirements, Standards, and Manpower Planning System (SHORSTAMPS)

This instruction describes the SHORSTAMPS program for the determination of manpower requirements in the Navy Shore Establishment. SHORSTAMPS employs industrial engineering principles in the development of Navy Staffing Standards and in their application to determine the minimum manpower required by Navy Shore Activities to perform tasks assigned in the SHOROC subsystem.

The program operates under the policy direction and guidance of the DCNO (Manpower Planning and Programming) and when fully implemented will provide a major input to the Navy Manpower Planning System (NAMPS).

The role of the NAVMACS in the development of staffing standards is explained. Three enclosures to this instructionprovide:

(1) SHOROC Dictionary
(2) SHOROC Development Guide
(3) SHOROC Implementation Schedule

OPNAVINST 5330.8A (DRAFT)
Subj: Navy Standard Workweek for Enlisted Personnel; promulgation of

As a preliminary to the determination and documentation of minimum manpower necessary to accomplish to workload required of a fleet unit or shore activity, a determination of the number of hours individuals are expected to work is required. This instruction discusses the rationale employed in determining Navy Standard Workweeks for enlisted personnel afloat and ashore.

The standard workweek afloat is established at 70 hours while at sea in a wartime environment with the unit steaming in Condition III (Wartime Cruising Readiness) on a three section watch basis.

The in-port portion of the afloat workweek assumes the unit to be in Condition V (In-port Peacetime Readiness) with a minimum of six duty sections and a one-in-three watch rotation. This results in a 43 hour workweek.

The workweek ashore is established as follows:

CONUS Activities and Overseas Bases where accompanying dependents are authorized: 40 hours

Shore activities where accompanying dependents are not authorized: 66 hours

Enclosure (1) provides definitions and terminology. Enclosure (2) gives the detailed calculations for workweeks for personnel afloat. Enclosure (3) gives the detailed calculations for enlisted personnel ashore. Enclosure (4) sets forth standard workweeks for activities ashore during mobilization.

OPNAVINST 5430.53 of 2 September 1975
Subj: Program Coordinator for Surface Ship Aviation Integration

This instruction updates and re-promulgates the authority of the Program Coordinator for Surface Ship Aviation Integration (Op-03H). He is assigned responsibility for coordination of all matters involving the development and procurement and management of the fleet employment of integrated surface ship aviation systems on ships other than aircraft carriers. He coordinates the LAMPS and VSTOL and Air Mine Counterneasures programs.

Three key billets are described:

Op-03H	RADM (1110)	Program Coordinator
Op-321E	CAPT (1310)	Deputy Program Coordinator
Op-321E1	CDR (1110)	Assistant for Ship Subsystems

OPNAVINST 5440.47D of 6 March 1973
Subj: Mission and Functions of Operational Test
and Evaluation Force (OPTEVFOR)

This instruction sets forth the mission and functions of OPTEVFOR. OPTEVFOR "has been and will continue to be a competent, independent test and evaluation agency providing the CNO with the necessary operational information to aid the decision making process". He advises the CNO on the capability of new weapons systems to satisfy established Operational Requirements (ORs) and performance specifications. OPTEVFOR operationally tests and evaluates specific weapon systems, ships, aircraft, and equipments, including procedures and tactics, where required, and when directed by CNO, assists development agencies in the accomplishment of necessary Development Test and Evaluation.

The Commander, Operational Test and Evaluation Force is under the direct command of the CNO who provides policy direction, technical and procedural guidance and financial support. The Director, RDT&E (Op-098) acting for the CNO, is the OPNAV focal point for COMOPTEVFOR contact in matters relating to OT&E. However, COMOPTEVFOR is authorized direct access to CNO and all subordinate offices as necessary to perform the assigned mission.

COMOPTEVFOR's supervision of type development groups and OPTEVFOR's relationships with shore activities are described.

OPNAVINST 7040.5A of 22 November 1974
Subj: Staffing Procedures for Proposed Programs
Requiring CNO/VCNO Decisions

This instruction outlines procedures for identifying, validating, and presenting funding requirements for proposed program costs and manpower implications to the Chief of Naval Operations.

Instruction states: "All cost and manpower implications must be identified, validated, and documented in order to ensure total program funding". Coordination of manpower requirements with Op-01 is required.

A Flow Chart showing program coordination procedures is attached as Enclosure (1). Cost estimating categories are contained in Enclosure (2). Format for providing financial and manpower information is set forth in Enclosure (3).

OPNAVINST 7700.1 of 31 August 1973
Subj: Configuration of Combat Direction Systems and Combat Systems for the General Purpose Forces

This instruction establishes a program for the determination of characteristics and the implementation of appropriate configurations of combat systems and combat direction systems, including communications link requirements, for use with the general purpose forces. It establishes guidelines and criteria for system selection and promulgates a glossary of standard terms for use in the management of the subject area.

As regards to manpower considerations, the instruction states:

"The economic analysis must consider the full dollar impact of the proposals and the alternatives, including the investment costs in both hardware and initial programming, installation cost, hardware maintenance, program maintenance, and manpower costs, both in numbers and skill levels."

OPNAVINST 9010.300 of 4 January 1974
Subj: Top Level Requirements and Top Level Specifications for the Development of Naval Ships.

This instruction establishes policy guidance and procedures for the orderly documentation of Navy Fleet needs into ship requirements and Top Level Specification Documents and the review of these documents is described. A number of definitions are set forth in Enclosure (1) and a format for the presentation of Top Level Requirements are contained in Enclosure (2).

As regards manpower, the instruction states:

Section 2.10 of the TLR Document "sets forth manning philosophy together with operational items which affect manning, such as degree of systems automation, watch requirements, and experience level and such other personnel related matters which constrain ship manning."

NAVMAT INSTRUCTIONS

NAVMATINST 1550.2B of 12 April 1974
Subj: Review of Training Data and Technical Audit of Specialized Navy Training Schools

Assigns responsibility to SYSCOMS for conducting techincal reviews of training data used at Navy schools prior to introduction of training software associated with a new equipment; on request of CNET; and on a continuing basis where problems exist or higher command interest is evident. It also requires personnel and funding support for technical audits of training schools having courses under their technical cognizance.

NAVMATINST 1500.2C of 17 April 1975
Subj: Preparation and Implementation of Navy Training Plans for New Developments

Assigns actions to SYSCOMS to prepare and implement NTPs, to ensure optimum training programs in support of cognizant Fleet introductions time-phased with development and production, and requires submission semi-annually of a recommended schedule for convening Navy Training Plans Conferences (NTPC) and Update Conferences.

NAVMATINST 1500.4A of 25 May 1973
Subj: Establishment and Coordination of Factory Training Programs

Delegates CNM responsibilities to SYSCOMS for action to develop requirements for, arrange, and administer factory training programs in support of cognizant introductions. Arrangements provide for an initial set of associated training materials: provision for the Training Agent to monitor development; and instructor advisory services.

NAVMATINST 3500.2A of 22 August 1973
Subj: Personnel Qualification Standards Program

Directs the SYSCOMS to develop and provide PQS in accordance with CNET specifications for each new system, equipment, or technical discipline introduced.

NAVMAT INST 4000.2B of 27 June 1975
Subj: Integrated Logistic Support (ILS) Planning Policy

The purpose of this instruction is to establish the Chief of Naval Material policies and principles for the life cycle support of systems/equipments. ILS is described as a "process which identifies, in a systematic and orderly manner, the functions which must be performed in support of operation and maintenance and the resources required to accomplish those functions".

This instruction is actually a 55-page manual which describes the ILS concept, sets forth organizational responsibilities, and provides detailed procedures for the implementation of the ILS approach to systems development. Appendix F contains instructions concerning the development of Life Cycle Costs with the objective of seeking the lowest total cost of ownership in system/equipment acquisitions.

NAVMATINST 4350.10B of 14 October 1968
Subj: Engineering and Technical Services - Management and Control

Establishes Department of the Navy policies, procedures, and criteria for management, programming, use, and administration of engineering and technical services under which training advisory services are provided.

NAVMATINST 4490.1B of 28 July 1972
Subj: Availability of Equipment for Training Purposes

Defines "equipment for training"; states that equipment for training shall not be utilized to resolve multi-purpose requirements; and that the CNM (MAT-04) shall be advised in writing when it becomes evident that a condition is developing which may preclude compliance with this instruction.

NAVMAT INST 4720.1 of 13 December 1974
Subj: Approval of Systems and Equipments for
Service Use (ASU)

This instruction implements OPNAVINST 4720.9D which establishes policy and uniform procedures for approval of systems and equipments for service use. Approval for Service Use (ASU) is now a prerequisite to obtaining a production decision and therefore a very critical point in systems acquisition.

As regards to manpower, the following policy is set forth:

"Personnel requirements for fleet operation and maintenance: Full ASU will not be granted until there is assurance that the equipment operating and maintenance procedures can be carried out effectively by personnel with the level of skill anticipated to be available within the rates and ratings to be assigned these responsibilities".

Detailed procedures and guidelines for obtaining Approval for Service Use (ASU) are contained in Enclosure (1) to this instruction.

NAVMATINST 5450.28/CNETINST 5450.8 of 14 December 1972
Subj: Additional Duty Functions of the Commanding Officer, NAVTRAEQUIPCEN (Naval Training Equipment Center, Orlando, Florida) to CHNAVMAT (Chief of Naval Material) and Relationship between NAVTRAEQUIPCEN and Systems Commanders, Project Managers, and Others

Directs: consultation with the CO, NAVTRAEQUIPCEN concerning training device requirements prior to reaching a position concerning acquisition of approved devices, and advance notification to CNM and CNET of intention to utilize a source other than NAVTRAEQUIPCEN for acquisition of required devices; using NAVTRAEQUIPCEN for development, acquisition and life cycle management of devices by direct assignment; or tasking to provide technical cognizance, as appropriate, during acquisition and to perform life cycle management when SYSCOMS determine that some other source is the best means to provide the training device.

NAVMAT INST 5311.1 of 15 June 1973
Subj: Manpower Requirements Determination for Systems and Equipments

The purpose of this instruction is to establish focal points for manpower requirements determination for systems and equipments.

CNM's policy is stated: "Manpower requirements determination shall be an integral part of the development of Navy systems and equipments and shall be established in a timely manner in order that appropriate planning, budgeting, and acquisition of personnel may be accomplished in time to meet the operational introduction of systems and equipment or their modifications."

The DCNM (Logistic Support) (MAT 042) is designated as the focal point within NMC for ensuring the development and maintenance of current manpower "to support the acquisition, introduction, operation, maintenance, and overhaul of systems and equipments."

Systems' commanders are directed to ensure the development of manpower requirements for cognizant systems, equipments, and modifications and to ensure the manpower requirements are a part of program planning submissions (i.e., POM, PMP, and Navy Training Plan).

Commanders, AIRSYSCOM and SHIPSYSCOM are directed to identify the officers which will ensure aggregation of manpower requirements for equipments under their cognizance, and to provide the CNM with copies of their procedures.

NAVMAT INST 5311.2 of 19 Jun 1973
Subj: Military Personnel and Training Requirements

This instruction notes the functional change wherein the determination of qualitative/quantitative military personnel and training requirements to operate and maintain ships and equipments is transferred from the cognizance of CNP to CNM effective 30 June 1973.

Assigns DCNM (Logistics) (MAT 04) responsibility for exercising staff supervision within the NMC over the process of determining military personnel and training requirements associated with the operation and support of ships and shore facilities, systems, and equipments.

Assigns similar responsibilities to DCNM (Development) (MAT 03) for RDT&E support of the manpower determination process.

Directs Commander NAVSHIPSYSCOM, to maintain, manage, and support a "personnel and training analysis" organization with units in Washington and San Diego operating as a single organization. This organization (PATAO) is to provide technical services on a reimburs   basis to project manager, Systems Commands, and Laboratories to determine military manning and training requirements for the operation and maintenance of ships and shipborne equipment, and of systems and equipments ashore as appropriate.

NAVSHIPSYSCOM is further directed to develop and publish, subject to prior CNM approval, detailed policy and procedures, governing the relationships between this organization (PATAO) and its customers (including those external to the NMC), particularly with regard to tasking, funding, and reporting.

Project managers, Systems Commands, and Laboratories are enjoined to utilize the capabilities of PATAO as the normal and usual method of determining personnel and training requirement inputs to Navy Training Plans, ILS Plans, manning documents, Fleet Modernization Programs, and related program/requirement documents.

NAVMAT INST 5311.3 of 9 May 1974
Subj: Personnel and Training Analysis Office: procedures for the utilization of

This instruction establishes procedures within NMC for utilizing the capabilities of PATAO. Capabilities are described and general operating concept is set forth. Procedures for identifying new items for M, P, & T requirements development are established.

Program and project managers are directed to budget funds for the analytical support. "Tasking and funding projection should cover the budget year plus two additional years, when feasible, to provide PATAO with lead time for support planning."

NAVMATINST 9860.1A of 19 March 1975
Subj: Incorporation of Self-Contained Training Capabilities into Shipboard Equipments and Systems.

Assigns responsibility to SYSCOMS and CNM-designated Project Managers for planning and providing operational training capabilities as integral functions of equipments and systems provided for shipboard installations; directs that all plans for development and production or acquisition address the feasibility for built-in training mechanisms/components; where feasible, include mechanisms/components in design, considering and utilizing the experience available at the Naval Training Equipment Center and the Chief of Naval Education and Training where appropriate.

SYSTEMS COMMANDS INSTRUCTIONS

NAVSEA INST 1543.1 of 19 Aug 1975

Subj: Manpower, Personnel, and Training Support for NAVSEA-Cognizant Ship, System, Equipment, and Non-Hardware Developments

This instruction establishes policy, and assigns responsibilities, and provides guidance within NAVSEA for planning and providing Manpower, Personnel, and Training Support (MP&TS) for ships systems and non-hardware oriented technical programs under the cognizance of Commander Naval Sea Systems Command.

The roles and duties of NAVSEA, Deputy Commander for Fleet Support (SEA 04) and the Manpower, Personnel, and Training Support Program Coordinator (SEA 047) are detailed along with those of the Ship Acquisition Project Managers (SHAPM's) and the Ship Logistic Managers (SLM's).

Enclosure (1) provides a valuable listing and abstracts of pertinent manpower instructions.

Enclosure (2) provides a form for use in reporting Manpower, Personnel, and Training Requirements (NAVSEA 1543.1 (8-75).

NAVSEA INST 3900.2

Subj: Reliability and Maintainability Program of the Naval Sea Systems Command; policy and procedures for

This instruction promulgates NAVSEA policy, procedures, and specific direction for defining and implementing the NAVSEASYSCOM Reliability and Maintainability (R&M) Program. Responsibilities for various NAVSEA offices are set forth.

Enclosure (1) provides a Guide for R&M Program Planning for Life Cycle Phases. Enclosure (2) provides a similar guide for R&M Requirements in Advance Procurement Plans (APPS). Enclosure (3) provides a matrix showing R&M elements required at various stages of the acquisition process, requirement documentation, and references.

NAVSEA INST 5400.7 of 12 Dec 1974

Subj: Ship life-cycle Management of TMDE (Test, Measuring, and Diagnostic Equipment); Policy and Responsibilities for

This instruction promulgates policies and responsibilities relevant to planning requirements, standardization, acquisition, material support, allowance list preparation and maintenance of shipboard TMDE (Test, Measuring, and Diagnostic Equipment) throughout their life cycles. Manpower requirements for the Maintenance of Test Equipment are not specifically addressed.

NAVSEAINST 7110.1 of 4 February 1975
Subj: Training Support Funding Responsibilities in NAVSEASYSCOM

Relates MP&TS responsibility to financial management by appropriation account.

NAVSUP/NAVSHIPS INST 9910.1 of 28 Jan 1972
Subj: Planning and Layout of Afloat Supply and Printing Facilities

This instruction clarifies the relationships between the Naval Sea Systems Command and the Naval Supply Systems Command with regard to the determination of equipment and space requirements for afloat supply and printing facilities. As regards supply department manpower, NAVSUP develops proposed supply department manning requirements and submits them to the SHAPM for review prior to inclusion in Ship Manpower Documents. Overall coordination of NAVSUP participation in the design of afloat supply facilities is vested in SUP 04322. Printing and reproduction matters are the responsibility of Deputy Commander, Navy Publications and Printing Service (SUP 07).

NAVSEC INST 5430.12 of 19 July 1972
Subj: NAVSEC Shipboard Manning Requirement Development; Appointment of Technical Coordinator for

This instruction sets forth areas of responsibility in shipboard manning development and establishes NAVSEC Code 6102B as the Coordinator for all NAVSEC manning development actions. NAVSEC provides Design Work Studied (DWS) manning recommendations during the entire ship design and construction sequences and during major overhauls for the ship.

TECHNICAL MANUALS

OPNAV Publication 10P23 of 3 February 1971, Guide to the Preparation of Ship Manning Documents, Volume I, Policy Statement

OPNAV Publication 12P4 of 7 April 1971 CH-4, Guide to the Preparation of Ship Manning Documents, Volume II, Procedures for Documentation and Development

OPNAV Publication 90P-1D, Department of the Navy Programming Manual

NAVSHIPS 0900-060-0290 of August 1974, DESIGN WORK STUDY

NAVSHIPS 0902-001-5000 of 2 January 1975, General Specifications for Ships of the United States Navy; revised edition. Section 080, Integrated Logistic Support provides guidance for manpower, personnel, and training support for new construction ships and for conversion programs.

APPENDIX G

ANALYSIS OF WSAP

A. Introduction

In order to provide for the successful development of any weapon system, there are many aspects of planning, analysis, and decision making which must be continuously made. The major considerations which affect manpower in the WSAP are Manpower Requirements, Training Requirements, Project Management, Test and Evaluation, Integrated Logistic Support, and Reliability and Maintainability. Within each of these areas, the timing in the WSAP cycle, the data requirements, and the overall management plan must be continuously assessed in order that an accurate and credible determination of manpower implications can be made throughout the entire life cycle of the weapon system. The following describes in detail each of the specific areas and discusses the implications of a new management concept for use during the entire Weapon Systems Acquisition Process.

B. Manpower Requirements

The accurate and timely determination of manpower requirements continues to form the cornerstone of Navy personnel management. It is an area which merits considerable attention and which should be constantly reviewed so that methods for improving and understanding the full implications of the manpower requirements determination process can be identified. The need for early identification of manpower requirements in new weapon systems acquisition is necessary in order to:

- Conduct trade-off analyses between various alternatives,

- Determine the ability of available manpower to support new requirements,
- Determine realistic resource requirements,
- Evaluate the impact on training requirements,
- Determine life-cycle costing for hardware procurements.

Over the years manpower requirements identification has received increasing visibility during resource allocations. The recognition that manpower costs in FY76 comprised 54% of the total DoD budget, that accessions are anticipated at over 100,000 per year and that the demand for qualified manpower may exceed the supply of available manpower within the national labor force, all tend to emphasize the importance of what was once considered a "free commodity" and more recently a scarce resource.

The continuing escalation of military manpower costs has adversely impacted the process of allocating those scarce resources within the Navy Five Year Defense Plan (FYDP). The number of procurement opportunities which are lost by failure to make optimal use of the Navy's manpower resources due to less than optimal control during the planning, programming, budgeting and execution phases of the Department of Defense (DoD) management process is significant. During the last decade, the decline of real purchasing power for new weapon acquisitions has generally been attributed to the increase of that portion of the budget necessary to support operating and support (O&S) costs and associated manpower expenses for new weapon systems. The smallest incremental improvement in manpower and personnel management will yield substantial savings which can then be applied to projects in other high priority areas of Navy operations.

Manpower requirements must not only be identified during the POM process but should also form an integral part of the various phases of the weapon systems acquisition process. Efforts to develop a methodology which will enable analysis of manpower and hardware trade-offs throughout that process will provide the Navy with a much needed management tool.

1. Manpower Planning Problems

The four-phased weapon acquisition process represents a series of steps resulting in successive refinements of the system specifications. At each stage of the process, certain decision options are foreclosed and the range of decisions restricted. In later stages, if the limited choices appear unacceptable to the DSARC, the only choice remaining is termination of the project. Often, because of significant sunk costs, or the absence of viable alternatives, there is reluctance to terminate an effort.

The manpower requirements associated with an equipment acquisition are generally profound. At one time this significance existed simply in terms of the manpower resources required for system support; now, the dollar impact is equally significant.

Without explicit definition of a manpower planning process integrated with the weapon acquisition process, the Navy faces restricted opportunity for manpower utilization. Furthermore, if the manpower needs are assessed very late in the development process, there are few choices which can realistically be made at that stage.

2. Problems in Manpower Decision Making

Life cycle manpower costs are not adequately identified until very late in the development process. Consequently, the initial cost estimates understate the resource commitments which are being undertaken and subsequently require extensive reprogramming of resources.

The present institutional environment does not provide for the coordination and control of manpower during the WSAP. Consequently OP-01's functions result in reacting to manpower requirements levied upon the Navy. Those requirements might have been different if a thorough analysis of manpower and hardware with resultant manpower implications would have been known during the concept formulation phase of the WSAP.

3. Manpower/Hardware Trade-off Analysis

Acquiring new equipment offers significant opportunities to improve the efficiency of the Navy provided analysis is conducted of potential trade-offs. Often this does not occur under present procedures for several reasons.

First, the new systems are often extremely complex. New untried technologies are being applied and integrated with existing technologies for the first time. Anticipating manpower impacts in this type environment requires perception and insight. It further requires imposing definition upon an unclear area; planners often defer consideration of ill-defined problems.

Second, the acquisition process itself is complex with many conflicting interests and parties engaged in the required decision-making. Trade-off analysis often is submerged by more visible decisions which various parties-in-interest are making.

Third, in order to conduct manpower-hardware trade-off analysis, manpower requirements must be identified early enough in the WSAP to permit changes in the design. At present no such analysis is being conducted because of insufficient information.

4. Methodology for Trade-off Analysis

Another major problem has been exactly how to perform manpower/hardware trade-off analysis in the context of weapon systems acquisition. For example, how might productivity gains be factored into the design analysis for particular components or subsystems? How are non-system impacts related to improvements in system operation?

People tend to accomplish tasks that are well-defined. Technology trade-offs are difficult to measure; yet, in order to conserve resources and produce effective weapon systems, this type analysis must occur early in the development process and its projections and forecasts must be effectively tracked thereafter.

5. Summary

The desirability to conduct manpower/hardware trade-off analysis is warranted. Such a procedure will favorably impact at various stages of the WSAP by requiring a close look at manpower. However, the recognition of manpower as a limited resource requires control of its utilization. Therefore, necessary managerial and organizational relationships should be identified which will improve the existing manpower requirements and review system.

C. Training Requirements

The concept of training people to a degree of expertise enabling them to operate and maintain new or improved weapon systems is basic to sound management action. As such there is a plethora of information which is contained in various OPNAV instructions.

1. Navy Training Plans

OPNAVINST 1500.8 titled "Preparation and Implementation of Navy Training plans for New Developments" is generally all-encompassing and complete in detail. A systematic procedure is identified, which enables various organizations concerned with the weapon system to determine the total training requirements for new or modified weapon acquisitions.

The instruction clearly states "A formal Naval training plan is required at least three years in advance of the planned fleet introduction date". It further amplifies the above by requiring frequent updating. Several key elements of the proceeding statements should be expanded. Specifically the term "at least three years" is explicitly defined as three years prior to fleet introduction. As such the general consensus is that following the Full Scale Development Phase of the WSAP a requirement to convene the formal Navy Training Plan Conference exists. However, upon completion of Phase III (Full Scale Development), over 95% of Life Cycle Costs are committed without having taken into consideration the manpower personnel training and support impact. It is not difficult to develop a scenario in which the previously identified resource requirements are increased to a point where production decisions would be altered.

A review of the schedule for Navy training plans are compared with the schedule date of fleet introduction of equipment is displayed in Figure G-1

If the assumption is made, that all UPDATED Navy Training Plans were initially developed in ample time (at least three years prior) to include the manpower-training input in the decision process, then in the sample base of all scheduled training plans, 63 out of 89, or 70 percent, of training plans were formulated at least three years prior to fleet introduction of the weapon systems. This number does not include those training plans which should have been developed but were not funded.

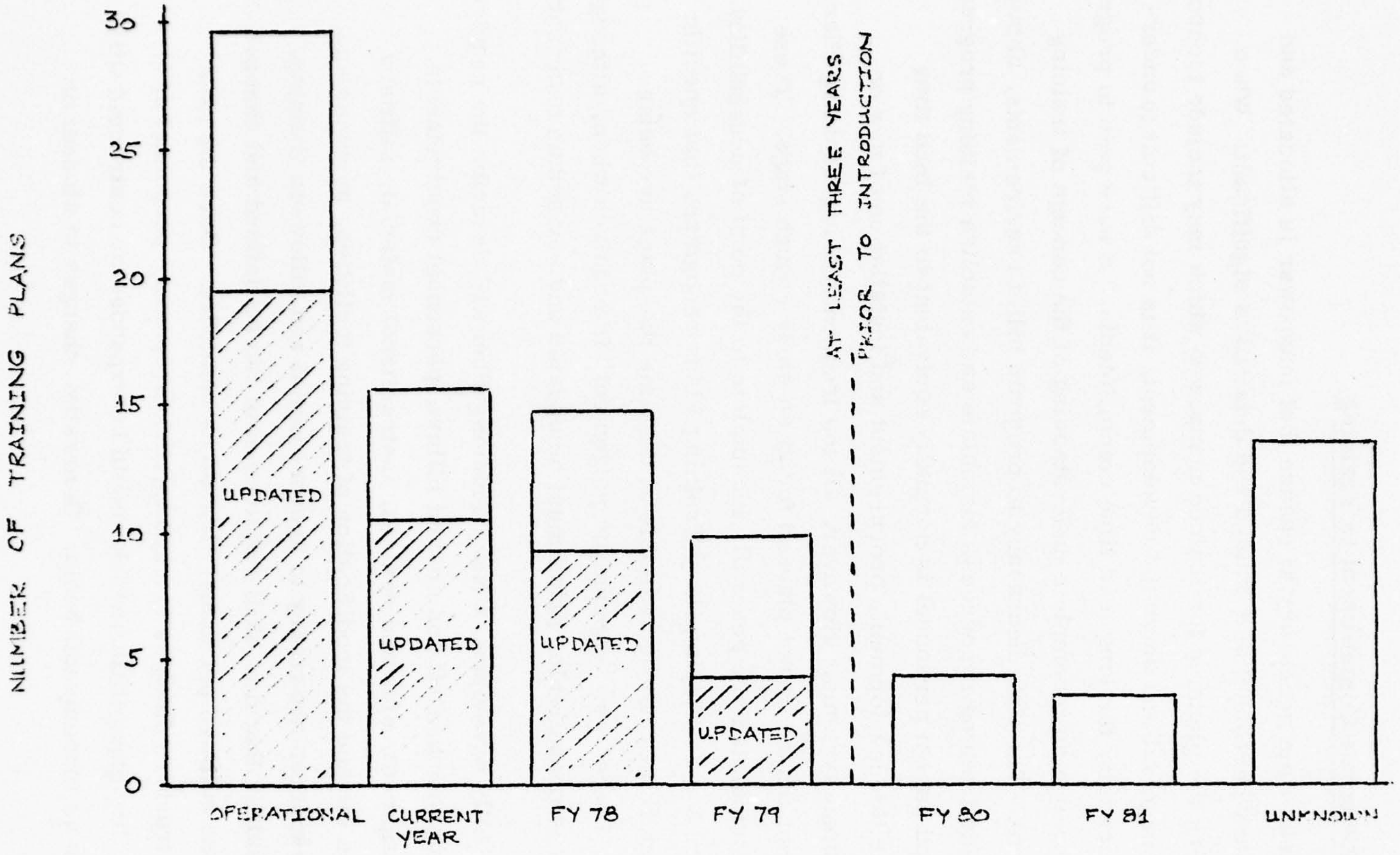


Figure G-1

Summary of Navy Training Plans

12

2. Resource Commitment to Training

The lead time necessary to ensure that manpower is allocated and that necessary personnel are trained and detailed is significant. When one considers the planning for trained manpower which may include technological, managerial and doctrinal development, it is not difficult to understand the necessity for long lead time commitments. A sure path to program failure is through an incomplete understanding of the concept of training requirements. The time necessary to program billet requirements, obtain personnel and training resources, formulate and establish training programs and train and assign personnel is normally equivalent to the lead time required for the development, procurement and installation of new or updated weapon systems. However, all too frequently Navy Training Plans are either not funded or not planned for at an early enough stage. Those which are formulated are generally incomplete to the point of unuseability. The guidance for developing Navy Training Plans recognizes that specific technical detail may not be available at the time the plans are being developed. Therefore, "experience judgement" is required when, although information is unavailable, plans must be updated and revised as necessary.

When fully developed, a Navy Training Plan will describe the requirement for shipboard, staff and student billets, personnel requirements, training equipment, aids and devices, instructional material, military construction ~~for~~ and the modification of training facilities, services and all other resources necessary to support initial and follow-on training. The net result is that new skill requirements can be defined and changes to officer and enlisted personnel structures identified. Once the skill and force structure changes are known, the manpower, personnel and training facility capabilities which should be expanded or contracted will be known on an incremental basis. Generally, changes to student or instructor requirements and training facilities may have significant impact on resource allocations. Incremental training implications may be compounded or totally eliminated when viewed with total training requirements. Therefore, a procedure should be developed which will enable new or modified weapon systems acquisitions which have significant training implications to be evaluated in a timely manner. Presently, training implications are evaluated during POM development. Manpower changes to the Five Year Defense Plan (FYDP) with realistic personnel inventory projections are provided in the form of skill requirements which must be achieved. This new requirement is then evaluated in terms of resource capability. The POM/FYDP training assessment only includes evaluation of weapon systems acquisition training requirements, but only as they are known from completed Navy Training Plan requirements.

3. Defense Science Board Task Force on Training Technology

During the period between July 1974 and February 1976, at the request of the Director of Defense Research and Engineering (DDR&E), the Defense Science Board conducted a study into training technology. Department of Defense Training was classified into six functional areas. For the purpose of the HARDMAN Study, the area of specific interest was the Weapon System Training Subsystem Development category. It was defined as the development of requirements, materials and programs for both individual and collective training of operational and maintenance personnel needed in support of weapon systems acquisition and use. The final report of the task force which reviewed five Navy major programs (F-14, S-3A, DD-963, LAMPS and TRIDENT) stated that the Navy informed them that they had no systematic method to collect or compile such information, and no valid in-service requirement to shred out general-purpose versus weapon-system specific training costs for the development and life-cycle costs of naval systems.

The science board reviewed procedures established within each of the services to identify manpower requirements. Specifically, interest was centered on new or improved methodologies or techniques which had been or were being developed. With the exception of the Air Force, neither the Army nor the Navy had significantly progressed in their manpower requirements determination procedures. The basic shortcoming of the present quantitative qualitative manpower requirements approach is that it is not developed until after hardware design has been finalized. Therefore, the system design trade-off analysis does not include valid manpower information. Without manpower information training impacts are non-existent.

The conclusions of the science board are as follows:

1) During the early development stages of a new weapon system, work should be (and is supposed to be) initiated to define the system's training subsystem -- i. e., those categories of training (skills and equipment) that are required to support the weapon system. This is supposed to be an orderly process by which the tasks required to operate, maintain, and control the system are identified, and by which plans are developed for acquiring the necessary skilled personnel to perform these tasks. What should happen seldom does happen, and there is a clear need for a common methodology that provides visible and reliable estimates and accounting of weapon system training subsystem costs.

2) The training subsystem's impact on the total life-cycle costs of the weapon system should be computed on a continuing basis, especially during the earlier design and development stages so that appropriate design trade-offs can be made to reduce the system's total life-cycle costs. However, current requirements do not provide sufficient incentives to the PM/SPO to give

appropriate consideration to training requirements and analyses early in the system development process. In addition, a positive mechanism or directive is needed that will ensure that the Training Technology R&D community develop comparative, quantitative analyses to support weapon system training subsystem decisions.

4. Summary

Training requirements are determined too late in the acquisition process to impact on procurement decisions. Consequently program selections are made without considering training requirements. The additional resources necessary to support training needs are identified at a point in the acquisition process where design considerations have been formulated and where inherent LCC have been committed.

D. Project Management

The project manager is the nucleus of design, development and production of an individual weapon system within the Navy. Consistent with the Navy's view of decentralized decision-making, his assigned responsibilities include planning, organizing, directing, evaluating and coordinating all project activities. This central role in the WSAP provides a unique opportunity to exercise influence in manpower planning.

A question of paramount importance in addressing this issue is, "Do incentives exist for managers to consider manpower issues?"

1. Institutional Setting

As of April 1975, there were seven Project Managers (PM) reporting to the Chief of Naval Material. The seven PMs consisted of three Flag Officers, three Captains and one Civilian. Reporting to the Systems

Command were 51 PMs consisting of two Flag Officers, 44 Captains, two Commanders, two Colonels, and one Lt. Colonel. All the PMs reporting to the Systems Command were acquisition-oriented except one, the fleet support ship.

For project designation, projects are classified as major and non-major. This designation determines the level of relative importance. Major projects are designated as "major command equivalent" for which a formal selection process is employed in choosing the PM. Selection as a project manager for a major project is equivalent to command designation assignment in the unrestricted line component of the Navy. That designation carries with it the connotation of a career enhancing assignment for specially qualified, hand picked individuals (of the highest competence). Generally PMs are assigned for a minimum of three years with extensions as appropriate. For those projects which are non-major, no formal process exists for designating the PMs. Project managers report to either the Chief of Naval Material or to the Commander of one of the systems commands. This is generally determined by the amount and level of coordination necessary between the various agencies and activities within the Navy.

2. Organization and Operation

The following description is taken from a point paper presented at the Logistics Management School, and is displayed in Figure G-2.

> "The organization and operation of the various Navy projects are, by intent, not stereotyped. Each is structured with a formal charter, approved by the Chief of Naval Material which, among other features, delineates mission and inter-organizational relationships and responsibilities as required.

Figure G-2

Project Management Overview

Reporting Level	Selection Process for Project/Acquisition Managers	Magnitude of Project and Personnel Assigned	Training for Project Managers
Chief of Naval Material	Major Acquisitions • **Formal Selection Board**	Sea Systems Command • Complex interrelationships • Large number of personnel assigned • Elaborate directive system • Rely heavily on in-house design and assets • Consultant assistance	**Naval Post-Graduate School (18-36 months)** Navy Logisitics Management School (1 week) Defense Management School (20 weeks)
Systems Commands	Non-Major Acquisitions • Non-formal selection within BUPERS • WSAM designation and selection	Air Systems Command • Relatively small • Reliance on prime contractors • Small numbers of personnel • Consultant assistance	

Effective interfacing is most important since the Navy utilizes matrix management for its major acquisitions. In matrix management, the designated project management office is the primary level of management authority and determines the "what", "when" and "how much." Special tasks for the project management offices are frequently performed by contract. The functional groups in the systems commands laboratories and field activities provide the in-house scientific, technical, contracting and legal expertise and detailed management and direction of the performing contractors. The degree of matrix management utilized is highly adaptive to the needs of each specific project.

The functional organizations are responsible for the "doing" of the project within the bounds of cost, schedule, control and reporting as stipulated by the manager, with industry providing the principal scientific, technical and production muscle. A very direct tie normally exists between the manager and the performing contractors' management, particularly with regard to cost, schedule and control, but direct ties also exist between Navy functional personnel and their counterparts in the contractors' organizations. The Navy endorses the "involvement concept" completely and exploits the utilization of Navy personnel on-site at the contractors' plants for knowledgeable and timely direction and control. "Dual-hatting" of personnel, including the submission by project managers of concurrent fitness reports on officers performing on project teams, is common.

Projects in Naval Sea Systems Command having the most complex Systems Commands interrelationships, have tended to be the largest, typically numbering from twenty to sixty. An elaborate project directive system is used (similar systems are used by other projects) to direct tasks and money to the Systems Commands and other organizations. In effect, the Ship Project Directive is a contract between the project manager and the participating manager, and it specifies reports and controls appropriate to the task. The amalgamation of the Naval Ship Systems Command and Naval Ordnance Systems Command into the Naval Sea Systems Command (NAVSEA) was implemented specifically to bring increased efficiency into the ship weapon system acquisition process. The ship weapon systems, however, is by far the most complex and expensive weapon system acquired by the DoD, and its project offices will no doubt remain relatively large (in Navy standards).

NAVSEA projects tend to rely heavily on in-house (Navy) design cognizance. While the trend is to transfer this performing role to industry, the transference is relatively slow. This factor creates the need for substantive direction and control by the project management offices, of work effort internal to NAVSEA, which necessitates the continuance of relative large PM organizations.

On the other hand, NAVAIR projects tend to be relatively small and to place heavy reliance on prime contractors, as both the performer and the direct management and control of that performance. Relatively small PM offices are possible and proper, for the role here is one of monitor and overall management and control. Assistant project managers in the functional groups (with cognizant engineers), plant representative offices, technical representatives, laboratories, and field activities provide responsive "technical muscle" as required--but the contractors are the performers with Navy "involvement" to an extent to gain the knowledge required to provide the necessary guidance and direction.

For all Navy project offices, considerable use is made of contractual consultive assistance, on the basis of task assignments, to augment the immediate project staffing as necessary. Such assistance is, of course, also available from SYSCOM functional groups and other Navy activities. By design, Navy project management philosophy provides for modest permanent staffing of the immediate project office and for maximum ability of the project manager to obtain assistance from Navy and contractor activities as necessary."

3. Management Incentives

In program reviews throughout the acquisition process, the program manager is the individual who is trying to "sell" his program to the Navy and subsequently, through the DSARC process, to the Secretary of Defense. Because the manpower dollars of any project will increase the costs in the operating and support categories and because in the early stages the program manager is only budgeted for development dollars, it is highly unlikely that the program manager will be motivated to identify significant manpower expenditures. The likelihood of his program being disapproved increases in direct proportion to its dollar impact.

If there were separate budget allocations given to the program manager which were not transferable to the hardware acquisition category and if those planning budgets were coordinated by OPNAV (OP-01) with appropriate guidance given on manpower planning, the program manager could be held accountable throughout the weapon systems acquisition process.

4. Summary

The program manager, although functionally responsible for the design and development of a weapon system in the hardware areas, finds few incentives for inclusion of manpower planning and assessments.

E. Test and Evaluation

A key element in the Navy's acquisition policy is Test and Evaluation (T&E). The high visibility and service-wide application of T&E procedures are dictated by the continuing need to assess the military worth and acquisition risk at each stage of the weapon systems acquisition cycle. Test and Evalution is subdivided into two major areas: Development Test and evaluation (D&E) and Operational Test and Evaluation (OT&E). The management plan which defines specific tests and evaluations for each stage of the acquisition cycle and coordinates DT&E with OT&E is the Test and Evaluation Master Plan (TEMP).

1. Development Test and Evaluation (DT&E)

DT&E is started very early in the acquisition cycle. It is conducted to demonstrate that the engineering design process is complete and that risks have been identified and minimized. Compatibility and interoperability within systems or subsystems is usually established as a goal by the developing agency. The DCP prepared for use at the time of program initiation (DSARC I) must provide a summary of test objectives, schedules, and milestones, and is updated at future DSARC meetings.

During the design or validation stage (DT&E-II), test and evaluation is often conducted at the component or subsystem level. The tests are often conducted by contractors or Navy laboratories; however, the prime responsibility for test plans and design goals resides with the developing agency and program manager.

The DT&E-III conducted during the development stage is to support the first major production decision. It is conducted to demonstrate that the system configuration meets specifications in performance, reliability, maintainability, survivability, supportability and system safety. The final stage of the DT&E-III is a technical evaluation (TECHEVAL) which is a certification that the system as a whole meets specifications and is ready for operational evaluation (OPEVAL).

The DT&E-IV is conducted after a system has been produced for the fleet. It is instituted primarily to ensure that improvements, corrections, and design changes explicitly defined during the operational evaluations have been effectively implemented.

2. Operational Test and Evaluation (OT&E)

The operational test and evaluation force (OPTEVOR) is required to have an organizational character separate and distinct from those of development, procurement, and fleet command units. The OT&E is performed by operational and support personnel who are expected to conduct a full series of tests in the actual operating environment and is phased throughout the acquisition cycle to both overlap in time, and complement in functional approach, the DT&E.

OT&E-I may be conducted during the conceptual stage for existing systems which are ostensibly to be modified. However, for new acquisitions this is usually omitted.

OT&E-II is conducted during the design or validation stage to provide early measures of operational effectiveness. In actual practice, the system often performs differently in breadboard configuration than in full-system integration; therefore, this stage is instituted to identify issues for OT&E-III.

OT&E-III is the testing and evaluation conducted during development in support of the first major production decision. Information is provided on personnel requirements, logistics, training requirements and data is obtained to support or verify material in operating instructions, publications, and hand-books. The ratings and qualifications of those expected to use and maintain the equipment in the fleet are intended to be the same as the personnel performing the operational test and evaluation and, hence, are expected to be a realistic appraisal of actual operating conditions. This unfortunately is rarely true in actual practice. The operational evaluation (OPEVAL) is the final stage of OT&E-III. This usually uses pilot production hardware and signifies the final stage before the first major production decision.

OT&E-IV, and V are conducted after the first production decisions are made and continue to effect the implementation decisions made on the first prototype.

3. Test and Evaluation Master Plan (TEMP)

The TEMP is the management document which defines the test and evaluation for each system within the acquisition cycle. It contains the requirements for both DT&E (developing agency) and OT&E (OPTEVFOR) as well as schedules and resources required to perform the tasks. Included in the resource summary of the TEMP are: Test Articles, Fleet RDT&E Support, Test Site/Ranges, Targets, Special Instrumentation, Support Equipment, Installation/Removal Requirements, Expendables, Logistic Support, Personnel, and Personnel Training. This document is analogous to the DCP in that it forms the management plan between the development agency and the OPTEVFOR for conducting the entire test and evaluation effort.

4. Summary

Although there is a formal structure for tracking test and evaluation efforts throughout the Weapon Systems Acquisition Process, there is little thought given to the manpower implications either in the development or operational stage. We find little evidence that Human Factors Engineers are being consulted or employed in the actual design or development of any major weapon system. For most weapon systems, the operational testing and evaluation is done by factory-trained personnel who are not representative of the skills and ratings within the fleet. This process, while ensuring the successful testing and evaluation of individual units, does not allow for the actual manpower implications of the fleet as a whole to be judged until the system is actually deployed.

The net result is that the fleet commands view the reduction or optimization of personnel associated with specific hardware items to be in conflict with overall mission requirements and cross-utilization of personnel.

F. Integrated Logistic Support

In order to allow the delivery of weapon systems to the fleet with the support of personnel and services in the actual operational environment, an integrated logistic support concept is developed for all acquisitions in the Navy. The responsibility for development of a phased logistic support plan throughout the Weapon Systems Acquisition Cycle resides with the Chief of Naval Material. Since the actual design and procurement of the weapon systems is delegated to the program manager, it is he who usually assigns a logistic support manager and team. In the large major acquisition categories, the logistic support team may be functionally assigned to a particular program; however, in smaller weapon systems they are often liaison personnel from their parent organizations.

The timing of logistics support throughout the acquisition cycle of any major weapon system is critical to insure that the operational capability of the system in question is guaranteed. Special logistic problems which can be identified during the conceptual design stage are important for long lead time planning since the entire logistic support program must be formalized in a logistic support plan by the program manager at the start of the Development Stage. To insure the timely delivery of hardware and personnel to specific locations, planning and implementation must continue through the production and development stages. It is during these last two phases when the major efforts of the logistic support team are implemented.

1. Integrated Logistic Support Plan

The planning necessary to integrate the requirements for system implementation center around the following general areas:

a) Establishment of a Maintenance Plan

This includes definition of a maintenance concept, including modularity, interchangeability, level of repair and replacement strategy.

b) Planning of Support and Test Equipment

This includes a listing of support and test equipment, both standard and non-standard. Also, an estimating procedure for support and test equipment requirements for maintenance levels in the fleet and at shore establishments.

c) Determination of Supply Support

This includes the method for determining spares and repair parts.

d) Description of Transporation and Handling

This includes transportation and handling requirements personnel and equipment to be used.

e) Establishment of Technical Information

Data are to be provided in the form of drawings and publications which includes information on failure rates and mean times between repairs.

f) Development of Facilities

This includes planning for equipment deliveries, installation, and checkout of system and subsystem assemblies.

g) Planning for Personnel and Training

The skills and levels required to maintain the equipment in the operational environment must be identified and obtained from parent organizations. Plans to update and validate manning documents and training plans are prepared during this stage.

h) Establishment of Logistic Support Resource Funds

The establishment of a total costing schedule is provided at this planning level.

i) Development of Logistic Support Management Information

The continuing updating and validating to provide an overview of the process for the appraisal of management effectiveness.

2. Integrated Logistic Support Data

During the development of solicitation documents including RFPs and RFQs, ILS requirements are often specified as contractual requirements. As the equipment moves from the design stage to production, the accumulated information on subsystem performance must be analyzed and interpreted to allow estimates of mission success to be made. Aspects of mission and operational data necessary for an integrated analysis are:

a) Data on performance functions such as speed, endurance, range, accuracy, and flight profiles.

b) Data on utilization such as geographic areas, frequency of missions, transportability or mobility or hardware, utilization rate, number of miles, hours, or flights per unit time interval.

c) Data on level of repair functions such as the elapsed time from the identification of malfunction to a fully repaired and replaced item.

d) Data on reliability functions such as the probability that the system or subsystem will perform its mission.

e) Data on maintainability in probabilistic terms of equipment used, facilities, personnel, parts and procedures.

These data have three distinct sources: the developing agency, the contractor, and the fleet command. The contractor is required to collect data on reliability, level of repair, and maintainability of equipment. The developing agency monitors and evaluates these data to insure that trade-off decisions and analysis are considered early within the design stage. The fleet command supplies data to the logistic support teams used for validation and projections after the first major production decision.

3. Integrated Logistic Support Analysis

The analysis efforts by the logistic support teams should consist of the integration of system hardware, with personnel during the entire acquisition cycle. The interaction between the logistician and designer is expected to result in a fully operational, supportable, timely, cost effective solution.

At the outset, the analysis should be concerned with developing objectives which are slowly changed into design parameters for use in operational, risk, and trade-off analysis. Initially, alternative hardware designs and support costs should be compared to human reserves in both material and manpower to obtain estimates of logistic requirements.

Support manpower by definition includes all manpower which has not been identified as an integral part of the operating weapon system. If a weapon system has as part of its design minimal operational maintenance requirements, with the concept of heavy reliance on intermediate maintenance activities (IMA), then the IMA manpower in support of the weapon system should be taken into account in any analysis of that system.

Logistic deficiences which are identified as design progresses must become input to trade-off analysis. The design of hardware should be compared to supportability features such as compatibility and accessibility of test equipment. As the system progresses through the acquisition cycle, the analysis feature must provide essential input to areas of integrated logistic support such as maintenance, personnel allocation and training. The use of models and simulation in the design stage should allow for manpower considerations to be estimated before design is frozen. Traditionally, manpower has been a fallout of design features and little consideration has been given to the implications of manpower factors in the design process.

4. Summary

At present little progress has been made in accurately determining the quantity and quality of support manpower. The Navy still uses a percentage of operational manpower to determine support manpower. That percentage is approximately 25% additional manpower for force acquisitions and 16% for support acquisitions. The percentage identification of support manpower is for resource allocation purposes only and is part of POM development.

G. Reliability and Maintainability

Design cannot be treated separately from reliability and maintainability considerations in the development of a weapon system. The responsibilities for adequately treating R&M is given the program manager, and often the problem of building R&M into the design is a difficult one. The aspects which may impact positively in the R&M considerations are:

- Establishment of goals and measures of performance
- Determination of requirements
- Trade-off analysis
- Contractual incentives

These will be discussed below, and explicit examples will be identified.

1. Establishment of Goals and Measures of Performance

Early in the acquisition cycle, reliability and maintainability are often specified as goals, sometimes in the Operational Requirement, (OR) and in specific DCPs. These goals are often unattainable without specific criteria for measuring adherence to these goals. The specification of R&M goals at the outset of a program cannot realistically be separated from design considerations. Unfortunately, demonstration of these goals is often possible only at prohibitive costs.

Studies in Human Factors can often serve to develop principles of operator/system relationship which can be applied to determine explicit measures of performance. Modularity in design, component flexibility and minimum skill levels of operating personnel are aspects capably addressed by Human Factors Engineers. They are employed at the discretion of program managers and often, in the case of budget reductions, are the first to be removed from the program. The short-term demands on producing functional pieces of equipment often mitigates against the design or development of optimum configurations which would reduce manpower in both operational and maintenance personnel.

2. Determination of Requirements

The requirements for reliability are set forth in MIL-STD-785, and those for maintainability in MIL-STD-470. As in reliability programs, the integrated logistic support effort is dependent on the maintenance philosophy which establishes a baseline for support estimates. The results of reliability and maintainability programs establish parameters which influence ILS efforts as well as total operating support costs.

Parameters which are often considered are:

1) component reliability (mean time between failures, MTBF),
2) equipment maintainability (maintenance manhour/flight hour; MMH/FH),
3) maintenance manpower per operating unit,
4) system availability.

Requirements apart from specific mission functions are not realistic and tend to overestimate some performance characteristics while underestimating others.

The approach taken on the F-18 has evolved around development of both a mission and an environmental profile. The mission profile attempts to quantify the operating conditions of the aircraft in the fleet under actual operating conditions, whereas the environmental profile identifies the specific requirements for reliability and maintainability which can be specified with respect to temperature, vibration, fatigue, and other engineering variables. This is a sound procedure and should be instituted for all systems.

3. Trade-off Analysis

The trade-offs which consider the alternatives between manpower on the one hand and reliability and maintainability on the other have the potential for a substantial impact in the WSAP. Of necessity, these analysis must be built into the design procedure and must, to be useful, consider the life support cost of the equipment as well as the total integrated cost of operating and maintenance personnel. Rarely is such an analysis performed. In actual practice the design engineer strives for the most reliable piece of equipment from within the contractor's inventory using specific engineering variables, and considers reliability and maintainability as variables in choosing between components. Unfortunately, manpower is rarely considered a variable in a trade-off analysis.

4. Contractual Incentives

Previous reviews of contractor emphasis on manpower factors in design reveal that reliability and maintainability receive the greatest emphasis because contractual requirements can be explicitly specified. It is clear that when contractual requirements for these efforts are not supported by plans for demonstrating compliance, requirements are easily deleted from the contract.

In the past the aspects which related to manpower have been specified as goals, e.g., mean time between failures, or maintenance manhour per flight hour; however, with new emphasis on R&M in the F-18 program, these have been specified as contractual requirements. Moreover, the R&M policy has been established during the design phase of the F-18 such that if the contractor meets specified requirements at the component level early in development, large cash rewards are obtained. If the reliability and maintainability criteria are not met until much later, the awards for early solutions are void.

5. Examples of R&M Techniques

In the F-18 program the emphasis is in examining aspects of system design which affect long-term operating costs, namely;

a) Are systems and subsystems reliable at breadboard stage?

b) Has reliability been improved relative to current systems in the Fleet?

c) Does the design permit easy maintenance?

d) Have maintenance manpower requirements been reduced compared to current operating systems?

e) Do increases in component reliability and maintainability integrate realistically within the operating environment?

f) Have ground support equipment and personnel requirements been reduced?

The F-18 system has specifically addressed these factors in the following manner:

1) The reduced air crew requirements require one pilot to operate combat systems and fly the plane.

2) The design for reliability has resulted in equipment which minimizes repair demand, and hence, has reduced

demand for maintenance personnel and spare parts. The fire control radar system requires a maintenance action only once every eight hours instead of the conventional two hours.

3) The design and construction of condition monitoring equipment permit maintenance personnel to conduct status checks in 20-30% less time than current systems.

4) The construction of built-in automatic tests for avionics which locate the failed component for the maintenance technician.

5) The design of multiple access doors which reduce component removal and replacement.

6) The construction of a consumable status panel on board, which shows the condition of fuels and lubricants. This eliminates the need for maintenance personnel to personally sample and test for changes.

7) The reduction of ground support equipment has been reduced by design trade-off studies which compared maintenance demand and cost of an on-board power unit to start engines and power aircraft equipment versus the traditional ground power unit. This resulted in a new unit which would perform the same function as the ground unit but would be more easily maintained and serviced. This and other changes and design trade-offs have reduced the total squadron manning levels to an estimated 230 men, a reduction of approximately 25% from the squadron level of the F-14.

6. Summary

The objectives of a weapon systems development program in the preliminary stages is to give performance objectives and criteria dominant consideration. Since maintenance and reliability may drive the operating and support costs in the production and development years to astronomically high levels, adequate considerations of these operational objectives must be given early enough to allow design alternatives.

Trade-off analyses which consider manpower versus R&M as a design tool are rarely used but hold large potential impact for reducing labor in areas of service and maintenance if they are instituted very early in the acquisition cycle.

H. Concluding Remarks

Previous sections of this chapter have identified some of the operational issues in the WSAP which have significant manpower implications. In each case, deficiencies and impacts on the system as a whole have been identified. The emergence of individual efforts which are disjointed, uncontrolled, and non-responsive to an overall plan is quite evident. The need for improved managerial control and varied organizational involvement is clear.

APPENDIX H

DESCRIPTION OF THE POM PROCESS

A. Introduction

Weapon systems acquisition may or may not fall within the POM process. The goal of the POM is to develop a **Five**-Year Defense Plan (FYDP). Whatever resources and billets associated with a weapon system procurement fall within the five-year window will be subject to very explicit institutional and analytical review, leading to the balanced five-year program. Because the POM is a major activity in which manpower receives explicit consideration and because the POM process, where weapon systems are involved, is driven by the resource requirements occurring in the five-year timeframe of the weapon systems acquisition process, the formal procedures documented in the Navy Programming Manual are a part of the baseline analysis in this report.

This section describes the Navy resource programming process and identifies where and by whom in the usual sequence of events decisions about manpower programming are made. In particular, the programming process results in the development of the Program Objective Memorandum (POM) which identifies the time-phased resource requirements of the Navy.

This section includes three parts. First, the DoD PPBS process is described as an overall framework in which to consider Navy resource programming. Second, the POM process is explained. And finally, there is discussion concerning how manpower is programmed.

B. DoD Planning, Programming and Budgeting System

The Department of Defense Planning, Programming, and Budgeting System (PPBS) is an integrated process for the establishment, maintenance, and revision of the DoD Five-Year Defense Program and Budget.

The Five-Year Defense Program (FYDP) is formulated annually on the basis of SECDEF decisions based on the POMs submitted by the military departments. The FYDP is the summary of the approved five-year program for all DoD components. Force requirements are projected for eight years and manpower and cost data for five years. The FYDP is the official program for the Department of Defense and is updated as necessary; there is usually an October issue with a January update in time for the POM preparation.

The annual budget for the Navy is developed each year during the period from July to October on the basis of the forces and programs set forth under the first year program of the FYDP. While derived from the FYDP, budgets are expressed in greater refinement and detail than FYDP programs.

The PPBS process operates over an 18 month period; however, the system is recycled annually and an overlap results. This means simultaneously budgeting for one year, programming for the following year, and planning for succeeding years.

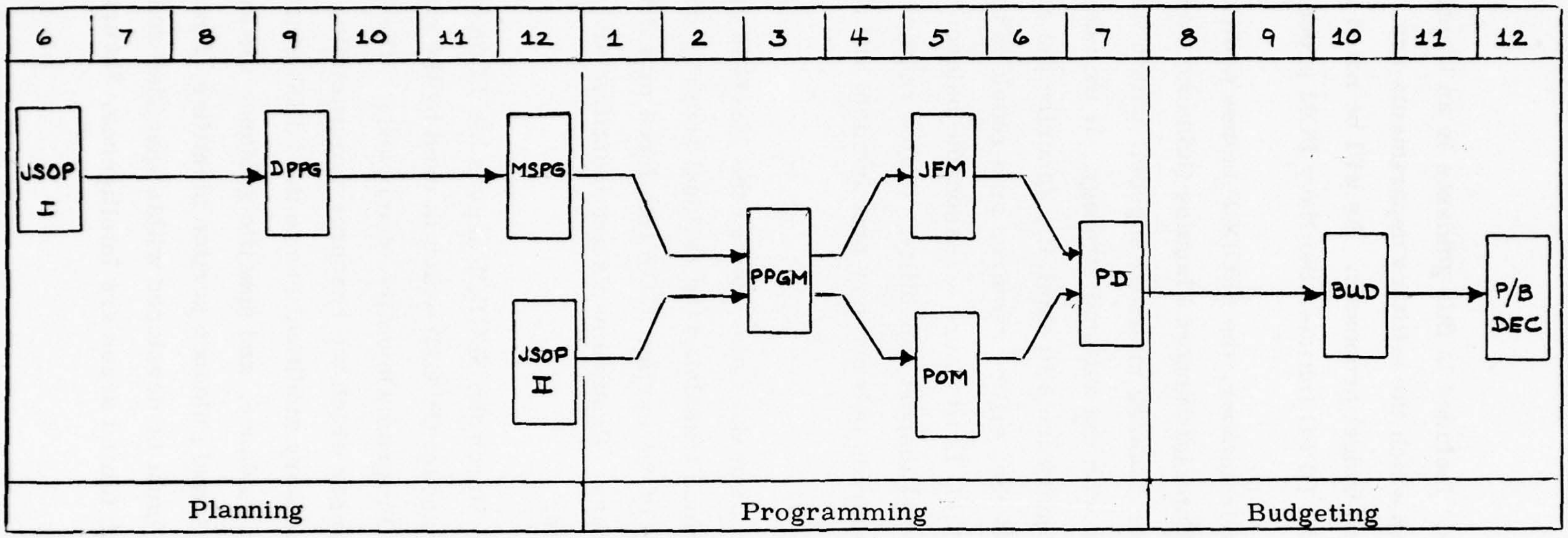
Figure H-1 illustrates the typical procedure occurring during the 18 month period. There are basically ten steps which occur:

Step 1: The Joint Chiefs of Staff (JCS) submit the first part of the Joint Strategic Objectives Plan (JSOP I). This document provides their concept of military strategy and force planning guidance required to attain the national security objective and the military objectives derived therefrom. This usually occurs around June and marks the beginning of the new PPBS cycle.

Step 2: The Secretary of Defense (SECDEF) issues his Defense Planning Policy and Planning Guidance (DPPG) which establishes the preliminary strategic framework for the planning, programming and

Figure H-1

DoD PPBS Cycle



budgeting phases. Included in this guidance is an identification of fiscal constraints within which the military departments are required to develop their program and budget proposals. As will be noted in the next section, the issuance of the DPPG initiates the Navy POM process.

Step 3: By December, the SECDEF issues additional guidance in the form of the Material Support Planning Guidance (MSPG). This provides guidance for planning material support, within fiscal constraints, that is consistent with the national strategy. It includes specific instructions to the military departments to explicitly describe the actual material support capability that will be required as a result of their POMs. The purpose of the MSPG is to insure a reasonable balance between combat forces and material support capability. It also requires an efficient allocation of resources between new procurement and maintenance of existing assets.

Step 4: At about the same time as the MSPG is prepared, the JCS issues JSOP II which translates the national security objectives and military strategy of the earlier JSOP into force objectives required to support the strategy. Requirements are identified and objective forces are recommended.

Step 5: By March the SECDEF issues his Planning and Programming Guidance Memorandum (PPGM) which is used by the military services in developing their Program Objective Memoranda. The PPGM prescribes the constraints under which the resource programming may proceed. It includes any necessary modifications to the DPPG strategy, fiscal guidance, material support guidance, and specific guidance for the preparation of the POMs. The fiscal guidance portion identifies "fenced" areas, that is programs which must be developed within specified resource limitations. Examples of such fenced areas are Intelligence, Security and Support to other nations.

Step 6: By May, the JCS prepares its Joint Force Memorandum (JFM) which represents their views as a corporate body concerning forces developed under the fiscal constraints of the PPGM. Specific recommendations are presented for major forces, force deployments, intelligence, counterintelligence, mapping, charting and geodesy, communications, R&D, logistics, support to other nations, and nuclear stockpile levels---all within specified fiscal constraints.

Step 7: At about the same time as the JFM is prepared, the military departments prepare their Program Objective Memoranda (POMs). The Navy POM is the SECNAV's annual recommendations for the detailed application of Navy resources to meet force objectives. It is structured by the Defense Planning and Programming Categories and special program aggregations as identified in the PPGM. It represents a comprehensive and detailed expression of the total resource requirement associated with the total commitment of the Department of the Navy.

Step 8: Around August, approximately twelve months after the PPBS cycle started, the SECDEF issues Program Decisions Memoranda (PDMs). Reclamas to these decisions are submitted by the military departments before final decisions are issued.

Step 9: At this stage in the cycle, the military departments begin submitting their budgets for the upcoming budget year. These estimates are usually prepared during the Fall of the year and submitted to the SECDEF. These budgets result in the October FYDP, and a revised Resource Allocation Display (RAD). At the same time POM process is beginning anew.

Step 10: By late December, the SECDEF issues his final program and budget decisions. As a result, there is another RAD issued which is the January FYDP.

C. Navy Resource Programming - The POM Process

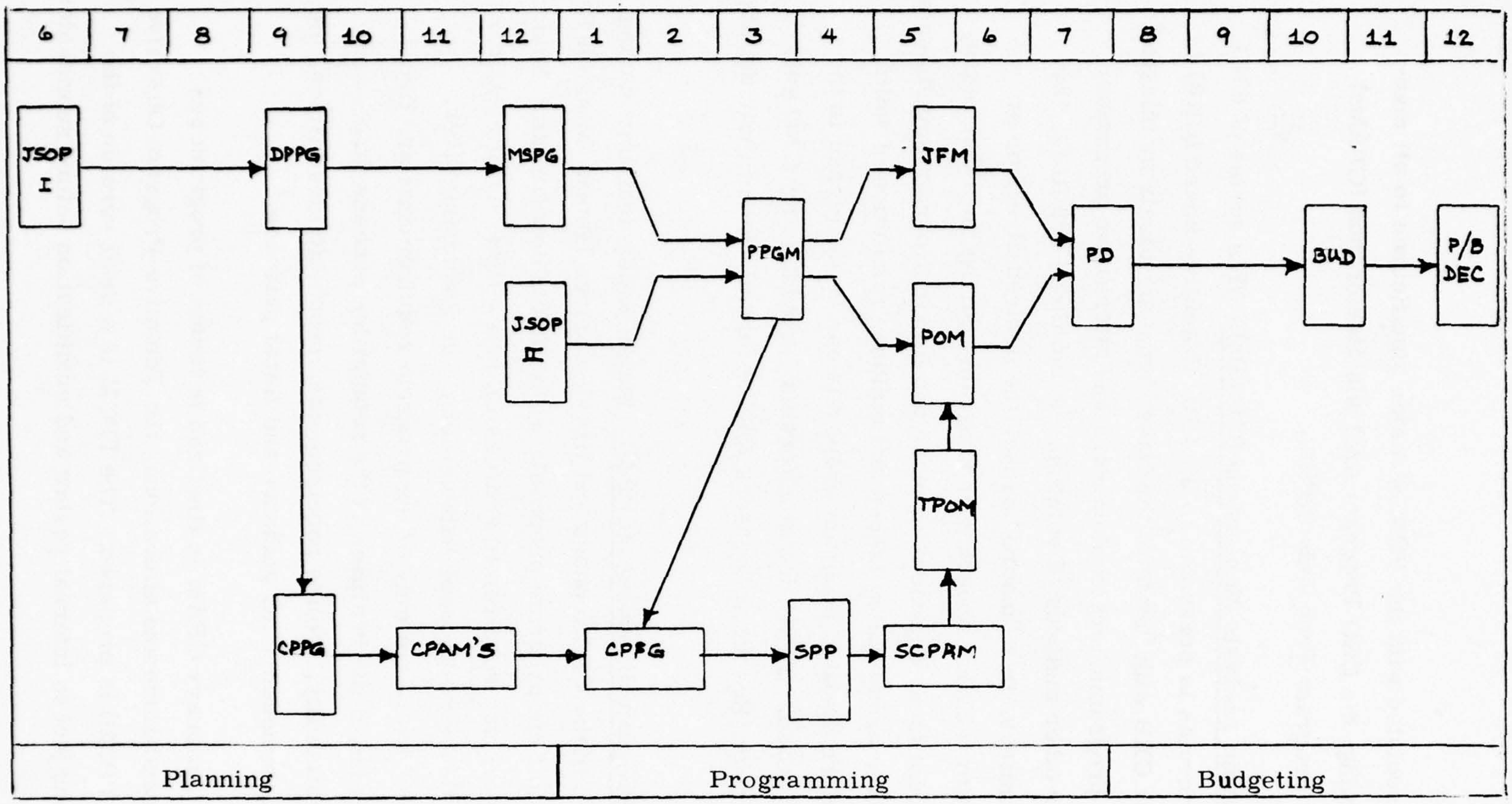
During the nine month period from September to June when DoD planning and programming activities are being conducted, each military department participates in the process by engaging in an analogous and complementary set of planning-programming activities designed to produce the Program Objective Memorandum which is the ultimate goal of the resource programming process. The POM is developed within fiscal guidance constraints which are imposed by the Secretary of Defense. The imposition of the fiscal guidance constraint places a ceiling on the amount of resources which can reasonably be expected to be approved and funded in the FYDP. Consequently there is a limit to the men, monies and material the Navy can expect. The imposed resource limitation therefore precipitates competition between the various requirements for the scarce resources. In order to successfully compete for these scarce resources the recognition of legitimate requirements must be established. Figure H-2 illustrates the programming process as it relates to the DoD PPBS Cycle. An examination of the process is as follows:

The process is initiated when the SECDEF issues his Defense Policy and Planning Guidance (DPPG) in the Fall of the year. The CNO issues his own guidance based on the DPPG. This document translates the SECDEF's guidance into specific terms for the Navy. The document, referred to as the CNO's Policy and Planning Güidance (CPPG) is the basic guidance document for the programming process. The CPPG transmits the essence of the SECDEF's and SECNAV's policy and planning guidance as it applies to the Navy along with his interpretations of this material.

Major POM Events: POM procedures are in a continuous state of flux. Each POM cycle produces revised methods for the development of the POM; however, the end product remains the same. There are

Figure H-2

Navy Resource Programming



two products associated with the POM of major significance to all manpower programming; the CNO Program Analysis Memoranda (CPAMs) and the Sponsor Program Proposals (SPPs).

CNO Program Analysis Memoranda (CPAMs): This series of CNO policy decision forums is presented to the CNO Executive Board (CEB). They provide the CEB with "state of the Navy" type appraisals by mission area of current programs, areas of concern and alternative programs, modifications or other methods of solution. From these briefings, the CNO/CEB determines, in a "macro" sense, the desired direction or change of direction within a program or programs during the POM years. The CPAMs do not focus decision-makers upon minor program adjustments but rather upon the broad policy issues and options, resolution of which is necessary before detailed program proposals can be developed in the subsequent SPP phase. These decision forums provide early CNO guidance to the Mission/Resource Sponsors for the formulation of their detailed programs.

Sponsor Program Proposals (SPPs): Major policy decisions having been established in the CPAM phase and fiscal guidance issued, Mission/Resource Sponsors develop firm program proposals within fiscal constraints. Mission/Resource Sponsors are required to address in their SPPs significant increments included in the Resource Sponsor submissions. In developing SPPs, sponsors must be aware not only of the program requirements and fiscal constraints but also of the realities of the acquisition process (e.g., production base availability, tooling requirements, production lead times, etc.). SPPs must accommodate CNO guidance and fiscal guidance.

When the summary CPAM is finalized in terms of program resource recommendations and allocations, the Tentative Program Objective Memorandum (TPOM) is prepared. The TPOM is a draft version of the POM which is subject to internal review and modification before submission to SECDEF.

D. Manpower Programming

Previous Manpower Programming Efforts: Until recently, manpower was programmed during POM development by identifying only the numbers of enlisted personnel and officers required for the programming actions. This resulted in program decisions being based primarily on end strength and dollar impact. While decision-makers were concerned with the manpower implications of new programs, decisions were made based upon a somewhat imperfect understanding of those implications. Specifically, the process recognized quantitative changes in manpower requirements but failed to consistently present to decision-makers either the qualitative (rate and rating/occupational group) manpower requirements or the ability of the projected personnel inventory to provide assets in the numbers and quantity required by the programming action.

The Manpower Resources Coordination Panel (MRCP): In order to improve POM procedures for comparing and prioritizing competing demands on manpower resources, the Manpower Resources Coordination Panel (MRCP) was formed in FY 75. The functions of the MRCP were to:

-- Identify, as accurately as possible, the qualitative manpower requirements of new programs.

-- Prioritize, in a more effective manner, the competing demands upon trained manpower.

-- Aggregate, in some manageable matrix, the total qualitative manpower requirements for the program years.

-- Project the personnel inventory achievable in the skills required in the program years.

-- Develop a standardized format for presenting this information to decision-makers.

-- Analyze in a more responsive manner the qualitative aspects of increments and/or decrements that result from program decision changes.

-- Assist the Mission Sponsor in developing manpower requirements. Membership of the MRCP includes all sponsors in OPNAV.

The functions of the MRCP were culminated with an assessment presented to the CNO on the Manpower and Personnel Implications resulting from POM decisions.

In order to assist the MRCP in presenting the projected military and civilian manpower implications and the personnel implications of proposed programming actions, it was necessary that the quality (rate, rating and NEC for enlisted personnel; rank, designator and NOBC for officers; and GS and wageboard for civilians) and quantity of direct manpower changes be provided by mission and resource sponsors when proposing increments or decrements to their programs. In addition, the activities affected by the proposed manpower changes were identified by the sponsors. With that information the MRCP was able to provide the CNO with the manpower implications of the proposed changes. Changes to manpower requirements were adjusted by the MRCP to account for support manpower factors (transients, training, pipeline, etc). Neither the military manpower claimants, nor mission or resource sponsors were constrained from modifying requirements during subsequent POM cycles for the out-years, since it was recognized that qualitative projections past the program year are difficult. The MRCP determine the implications of those manpower changes in out-year requirements. The CEB decisions for the programming year were the actions that establish the qualitative and quantitative manpower base for the start year in the POM.

As a result of the success of the MRCP its functions were institutionalized. The MRCP was disbanded in FY 77 and its functions incorporated into OP-01's area of responsibility.

Training and Education Programming

In order to improve previous POM procedures, a Training and Education Requirements Panel (TRP) was established during POM-76.

The TRP, with membership from cognizant commands and staffs, examines and prioritizes education and training requirements and resources. The resultant prioritized list of increments and decrements form the basis for the Education and Training Sponsor Program Proposals (SPPs). An innovation in POM-78 was the establishment of the Training and Education Advisory Committee (TEAC). That committee conducted a review of the education and training resource base and recommended major program alternatives for incorporation in the Manpower and Training CPAM. In POM-79 the responsibility for the SPP shifted from mission sponsor to resource sponsor.

TEAC

The functions of the TEAC are:

a. Determine methodology to relate education and training programs to CNO objectives.

b. Identify programs which will require further explanation or justification.

c. Recommend major program alternatives for proposed input to the Education and Training CPAM.

TRP

The TRP deliberations cover all resources in Program Elements for which OP-099 is designated Mission Sponsor. The TRP is the only forum in which OP-099, as the Training Mission Sponsor, and representatives of the various Resource Sponsors and Training Agents can review, validate, and prioritize the Navy Education and Training Program. Each Resource Sponsor with assets at the training mission intersection in the RAD include those resources and any changes to them in his balanced SPP.

The TRP reviews and prioritizes the resource requirements displayed at the OP-099/OP-099 intersection in the RAD except for certain hardware requirements. There are specific instances in which Resource Sponsors (other than OP-099) provide resources for certain hardware requirements generated by new Fleet initiatives.

Handling of Training Programs in other Resource Sponsor SPPs

A Resource Sponsor having resources at the intersection with the Education and Training Mission line are required to present a training program to the TRP which reflects allocation of assets to support the training mission and must address CNO's approved training mission requirements as stated in the training CPAM. These presentations include individual increment and decrement decisions. Mission Sponsor recommendations regarding program adjustments may be made. In the event that a specific Resource Sponsor has failed to adequately support training mission requirements under his resource cognizance, OP-099 as Mission Sponsor, may highlight these differences and attempt to resolve them during TRP deliberations.

Training Mission Assessment

The Training Mission Sponsor (OP-099) has the opportunity to comment on the training portion of each SPP at its conclusion and make an overall assessment of the Training and Education Mission or present major unresolved issues affecting the mission to the PDRC.

APPENDIX I

HARDMAN INFORMATION REQUIREMENTS

A. Introduction

In order to provide weapon system planners and personnel managers with the appropriate information with which to address both the long range implications of system acquisition as well as the time phasing of detailed resource commitments, a variety of manpower and training information is required. The level of detail, range of accuracy, and specific types change from the Concept Phase to Production and Deployment.

The purpose of this appendix is to identify the information requirements existing at each phase of the Weapon System Acquisition Process in order for system planners to adequately consider and monitor the tradeoffs between manpower and hardware design. The requirements fall into two areas: those supporting HARDMAN analysis and those assisting in its reporting and control.

B. Concept Formulation Phase Requirements

As noted earlier, the Concept Formulation Phase is the point in the weapon system acquisition process where the major portion of life cycle resources are committed. This phase also has been the one where the least amount of definitive information is available to the system planner. The lack of information is due in part to the uncertainties inherent in this early phase as well as simply to a lack of interest or incentives to focus on relevant and available information. There is, however, more information available than is generally used. This information could be used to expand early consideration of manpower/training implications of system development, thus increasing the portion of life cycle resources which are explicitly rather than implicitly committed.

Table I-1 lists the types of information concerning manpower/training considerations required during the Concept Formulation phase. This information should be developed for each alternative system which the planner might consider so that the advantages and disadvantages of each option might be considered prior to selecting a concept for approval at the conclusion of this phase.

This information can be characterized at this stage by several features:

- estimates are aggregate and gross, focusing on broad resource implications
- information may be used to consider tradeoffs between manpower and hardware design at program level
- information may be used as benchmarks to control subsequent changes in gross resource requirements
- significant and relatively large ranges of uncertainty are attached to information elements at this stage.

There are nine major sets of information with an emphasis on manpower/training resource requirements. The information essentially covers three areas important for tradeoff analysis as well as subsequent reporting and control of the HARDMAN planning process:

1. Manpower/training resource requirements and implications
2. Hardware design features and preliminary operational concepts
3. Planning milestones

Table I-1

HARDMAN Information Requirements
-Concept Formulation Phase-

1. Manpower/Training or skill level constraints based on CNO policy and other factors

2. Number of Navy Personnel to operate the system

3. Number of military and civilian personnel to maintain and support the system

4. Training concept
   Number of people to receive training, training methodology
   Type of training hardware MILCON requirements
   } by alternative system

5. Aggregate life cycle cost for:
   manpower/training
   hardware
   total system
   } by {
   R&D
   Investment
   Operating

6. Number of personnel requiring new skills

7. Nature of weapon system
   new technology — ILS concept (prelim)
   mission — Maintenance concept (preliminary)
   replacement

8. WSAP Milestones ⟶ Project Master Plan

9. HARDMAN Milestones

Use Above Information to:

- Analyze advantages and disadvantages of recommended system with other alternatives including replacement system, if any;
- Specify major areas providing tradeoffs
- Identify most sensitive information types
- Report and control HARDMAN resource estimates and planning

During the Concept Formulation Phase, this information may be used for four major purposes. First, it may be used to analyze advantages and disadvantages of recommended systems with other alternatives, including a replacement system if one exists. Second, using the information for consideration of manpower versus hardware tradeoffs, the analysts can identify major areas in which favorable tradeoffs may be realized. Third, as a planning device, early identification of critical information, even if developed amidst considerable uncertainty, permits the planner to focus on the areas involving the most significant marginal impacts. And finally, systematic collection of this information can provide a means for continuous reporting and control of manpower growth and long-term operating and support costs.

The information acquired during the Concept Formulation phase represents a departure point for HARDMAN analysis. There will be a requirement for considerable sharpening and refinement in subsequent stages of development. This improvement will come about through an iterative process in which these information requirements are subject to further analysis in the subsequent stages of system development.

In sum, development of information satisfying the requirements listed in Table I-1 will permit earlier and potentially more effective consideration of manpower/training resource implications than presently occurs. It will furthermore provide the basis for monitoring the development of resource requirements throughout later phases of weapon system development by utilizing this information in a reporting and control framework.

C. Engineering Design Phase Requirements

In the Engineering Design Phase, the weapon system under consideration begins to become more definitive both in hardware and manpower/training configuration. This phase is one of the most important and opportune with respect to HARDMAN tradeoff analysis. Hardware subsystems can still be effectively influenced by manpower/training considerations. During this phase, the hardware configurations become clarified and the uncertainties about specific manpower alternatives are eliminated.

Table I-2 lists the information requirements existing at the Design Phase. While there are some sets of information which originate with this stage of development, most represent expansions of the information requirements set forth in the concept formulation stage. As system definition increases, there is the developmental capability as well as the need for more definitive information about the resources. In effect, the analyst is faced with an iterative procedure in which he uses his previous estimates to develop new and more detailed information.

To facilitate tracking information from one Phase to the next, the information elements are numbered to show to which group they belong. For example, item #2 (Number of Navy personnel to operate the system) has been expanded to three items in the design phase.

2. Number of Navy personnel to operate the system by:
    - 2.1 skill
    - 2.2 occupational grouping
    - 2.3 mission/resource sponsor

The information at the Design Phase has several characteristics differentiating it from the information developed in the preceding phase:

- estimates become more detailed and refined through iterative procedures
- the information permits the analyst to track changes from earlier estimates and monitor the development of resource estimates

Table I-2

Information Requirements
-Engineering Design Stage-

1.1 Manpower/Training or skill level constraints (revised)

2.1 Number of Navy personnel to operate system by skill, occupational grouping and mission/resource sponsor, comparison with personnel inventory projection

3.1 Number of military and civilian personnel by skill, occupational grouping and mission sponsor for general support; comparison with personnel inventory projection

3.2 Number of military and civilian personnel by skill, occupational grouping and mission sponsor for maintenance support; comparison with personnel inventory projection

4.1 Training requirements by skill, occupational grouping and mission sponsor

4.2 Training courses (initial, follow-on specialized)

4.3 Technical training equipment

4.4 Training devices

4.5 MILCON

5.1 Life cycle cost for manpower/training by skill and function, hardware, total system

} by major subsystems (alternative configurations)

7.1 ILS Requirements

7.1.1 Manpower
7.1.2 Equipment
7.1.3 POL

Table I-2 , con't.

7.2 Maintenance Requirements

- 7.2.1 Manpower
- 7.2.2 Facilities
- 7.2.3 Equipment
- 7.2.4 Replacement Parts

7.3 Test and Evaluation Concept

7.4 Reliability Requirements

8.1 WSAP Milestones (revised)

Project Master Plan

9.1 HARDMAN Milestones (revised)

Use Above Information to:

- Analyze advantages and disadvantages of recommended major systems and alternative configurations
- Specify major areas providing tradeoffs
- Prepare draft material for required documents

- information is suitable for HARDMAN tradeoff analysis at the major system level

- there is less uncertainty surrounding resource estimates

Whereas the information developed in the preceding phase facilitated tradeoff analysis at the program level, these sets of information assist in analyzing choices among major subsystems within programs and facilitate the development of alternative system configurations.

The information should serve the same kinds of purposes as it did in the preceding Phase. First, it should allow analysis of the advantages and disadvantages of recommended major systems and alternative configurations. Second, it should facilitate the specification of major areas providing tradeoffs between manpower and hardware. Third, the information developed at this stage should provide the basis for preparation of some material for preliminary drafts for such required documents as Navy Training Plans, Ship Manning Documents, Integrated Logistics Plans, and Test and Evaluation Master Plans. And finally, the information should support continued reporting and control of HARDMAN analyses.

D. Full-Scale Engineering Development Phase Information Requirements

The development phase in the WSAP signifies detailed specification, development, test and evaluation and sometimes pilot production of the entire weapon system. The primary effort is to demonstrate the success of the operating characteristics and the scope of the resource commitments required for production.

From a HARDMAN perspective, the opportunity to influence design regarding tradeoffs between hardware and manpower is significantly limited; options remaining focus primarily on the areas of fleet introduction and actual operation. The design of the weapon system at this stage is considerably advanced as far as being subject to further tradeoff analysis.

Table I-3 lists the information requirements. The table reveals that most of the information elements are not new but simply updated from the preceding Phase. Furthermore, the emphasis at this stage is two-fold: one is on the development of data supporting the preparation of required documentation. In every instance, sufficient manpower/training information should have been gathered at each preceding stage of development so as to facilitate the preparation of the various required documents.

The other is on the continued reporting and control of manpower/ training resource requirements. At this stage of weapon system development, the principal purpose for continuing to gather this information is to track changes in the resource requirements so unexpected requirements do not occur and so that a basis may be developed for future estimation.

Table I-3

HARDMAN Information Requirements
Full-Scale Development Phase

1.1 Manpower requirements by skill, occupational grouping, and mission sponsor

2.1 Operating Personnel

  2.1.1 Updated quantitative and qualitative requirements

  2.1.2 Required personnel actions, e.g., promotion rates, recruitment opportunities

  2.1.3 Billet analysis

3.1 General Support Personnel

  3.1.1 Updated quantitative and qualitative requirements

  3.1.2 Required personnel actions, e.g., promotion rates, recruitment opportunities

  3.1.3 Billet analysis

3.2 Maintenance Support Personnel

  3.2.1 Updated quantitative and qualitative requirements

  3.2.2 Required personnel actions, e.g., promotion rates, recruitment opportunities

  3.2.3 Billet analysis

Ship Manpower Document
Squadron Manpower Document
Shore Manpower Document

Table I-3, con't.

4.1	Training requirements by skill, occupational grouping and mission sponsor	Navy Training Plan
4.2	Training courses	
	4.2.1 Initial	
	4.2.2 Recurring	
	4.2.3 Special	
5.1	Life Cycle, Five Year, and Annual Cost Analysis →	POM Inputs
7.1	Revised ILS Requirements	Integrated Logistic Plan Test and Evaluation Master Plan
7.2	Revised Maintenance Requirements	
7.3	Revised Test and Evaluation Concept	
8.1	Revised WSAP Milestones →	Project Master Plan
9.1	Revised HARDMAN Milestones	

At the same time, existing requirements for information begin to result in the development of information already generally recognized by participants in the WSAP. In particular, there is general acknowledgement and cooperation in the preparation of the various required planning documents. If these documents adequately reflect the manpower information developed in earlier stages, most requirements for HARDMAN would be satisfied.

Two requirements would continue. One is to monitor the changes in the resource estimates building an historical HARDMAN data base which can support the iterative analysis and estimation procedures underlying the information requirements. The other is the revision and updating of WSAP and HARDMAN milestones and, in turn, the Project Master Plan.

In sum, the information requirements at this stage relate to programming of manpower. The planning actions facilitate the orderly and efficient programming necessary during the POM process.

E. Production/Deployment Phase Information Requirements

The final phase of the weapon system acquisition process provides for the manufacture of equipment, training of personnel, organization of logistic support and validation of all actions previously taken as the entire system is made ready for fleet introduction.

Table I-4 lists information requirements at this state. This information largely serves to confirm estimates made in earlier phases and facilitates tracking the final resource requirements.

Table I-4

HARDMAN Production/Deployment Phase Information Requirements

1. Validation and review of planning and programming in previous stages.

2. Funding and authorization of quantitative and qualitative manpower and training requests.

3. Fiscal summaries related to program elements.

4. Revised personnel management actions to achieve desired implementation.

In addition, this information is translated into a framework suitable for Navy manpower programming and budgeting. The information which previously has been tied to the weapon system itself must now be crosswalked to program elements and program units fundamental to the Navy's Five Year Defense Plan.

APPENDIX J

HARDMAN INFORMATION FLOW

A. Introduction

This appendix presents a description of the total information flow through the WSAP. The purpose of the presentation is to highlight the important manpower and training activities which should be taking place as well as the time phasing of these actions. The three key HARDMAN modules, described in Chapter IV will be expanded and developed throughout the four stages of the WSAP.

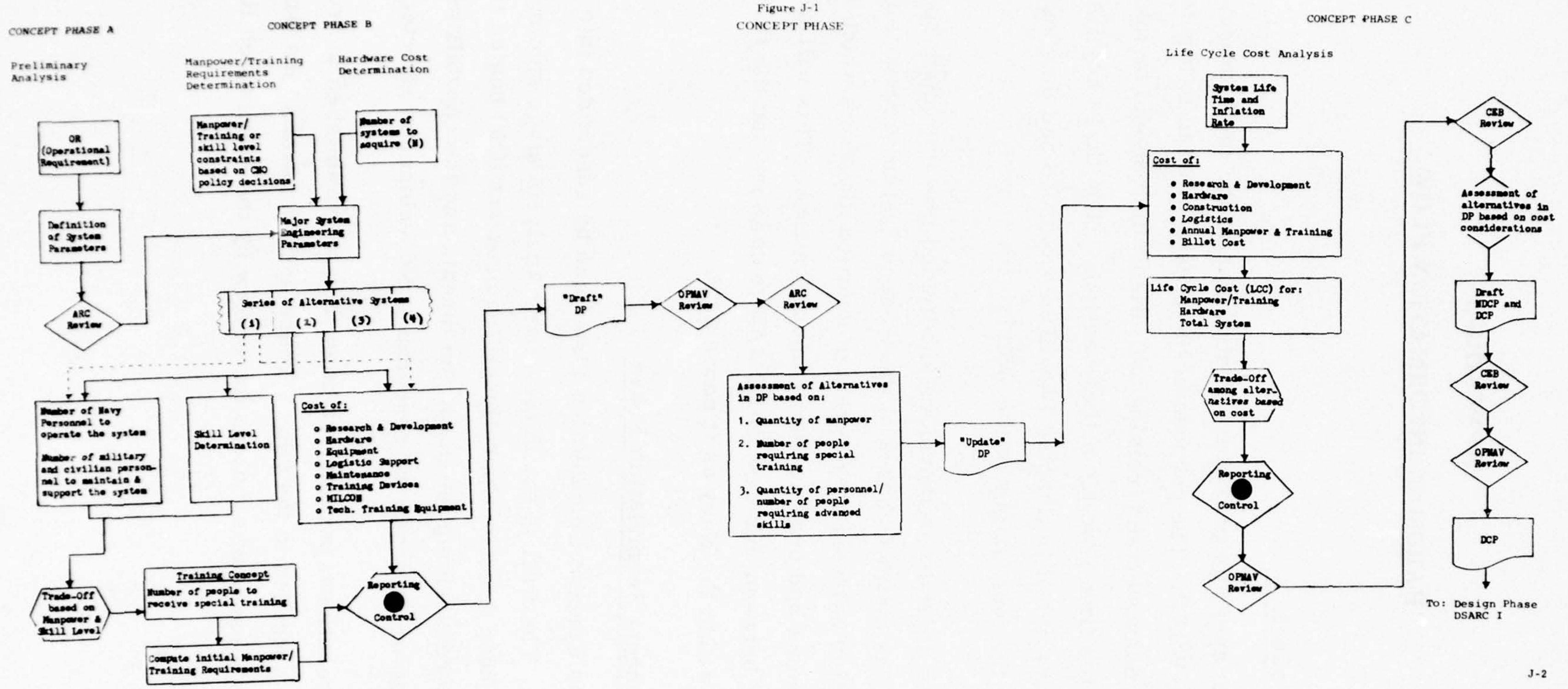
This appendix is therefore subdivided into four main sections, corresponding to the distinct phases of the Weapon System Acquisition Process. The narrative is based on a series of detailed diagrams which include principal decision points and organizational identifications. This will provide an explicit connection between this new HARDMAN framework and the institutional structure within the Navy as it now exists.

B. Concept Formulation Phase

The Concept Formulation Phase can be subdivided into three main elements. The first is the Preliminary Analysis stage shown in Figure J-1, labelled Phase A. The Operational Requirement (OR) begins this stage of analysis by describing the need, the threat, and the capabilities required for Navy acquisitions requiring research and development efforts.

Operational parameters must then be established in order to meet the needs specified in the OR. These system parameters tend to focus the possible range of solutions for review by the Acquisition Review Council (ARC).

Figure J-1
CONCEPT PHASE



The Second Stage, seen in Figure J-1 labelled Phase B, should consist of two major subcomponents; a manpower and training requirement determination and a hardware cost determination. These two efforts should progress in parallel with each other and in conjunction with a determination of major engineering parameters and alternatives developed by NAVMAT.

The inputs to these alternatives should be manpower, training or skill level constraints imposed by CNO policy decisions which in turn may be based on long-term national manpower projections. These inputs allow for external factors which will ultimately affect the size and composition of the Navy.

Once a series of hardware or system alternatives are identified, a branched approach is shown. For each hardware alternative, one of which may be a replacement system, a series of analysis steps must be undertaken. The first consists of determining the number of Navy personnel to operate the system as well as the number of military and civilian personnel necessary to maintain and support it. Concurrently, a skill level determination should be undertaken because the numbers of people required and the skill levels which are expected are intricately connected. In fact, these two variables can be used in an initial trade-off which would weigh quality versus quantity.

The next step is the development of a training concept. This includes determining the gross number of people to receive specialized training, the need for any special training devices and any technical training equipment. Since lead times of at least five years before fleet introduction are needed for military construction programs, and four years for training devices, the early identification of a training concept is absolutely essential.

At this early stage of program definition, the numbers and estimates may of course be subject to change; however, the main point to be emphasized is that these considerations allow for a first cut, initial manpower and training requirements determination.

Concurrently, the costs of research and development, hardware, specialized equipment, logistic support, maintenance, training devices, military construction, if any, and technical training equipment should be estimated.

The Reporting and Control Module which is shown next in the flow, represents a key point at this stage of development. The control function can be satisfied by the issuance of a series of specific reports. The first gives the gross manpower and training resource estimates for each alternative system under consideration, and the second gives the milestones for the formalized reviews such as DPs, NDCPs and DSARC. The generalized reports would include a series of unconstrained and constrained requirement compilations for use at later stages in a manpower growth report.

It is at this point that a draft Development Proposal (DP) can be issued, in which the major issues, program objectives, program alternatives, effectiveness, cost comparisons, risks, milestones, as well as manpower and training factors have been identified for review.

After thorough review by OPNAV and the Acquisition Review Council, an "updated" DP is issued. This document would have identified the specific systems favored by OP-01, and OP-99 for their manpower and training implications, but would still contain the entire set of alternative systems proposed by NAVMAT. The difference from the present WSAP would be that the appropriate manpower and training issues, especially those involving long term availability, would have been identified and flagged for further consideration. These would include the quantity of manpower for each specific alternative system, the numbers of people requiring specialized training, and the quality of personnel, specifically the numbers of people requiring advanced skills.

Upon successful review, all alternatives would enter the life cycle cost analysis phase of Concept Development seen in Figure VIII-1 labelled Phase C. It is during this analysis when the costs of R&D, hardware, construction, logistics, test and evaluation, annual manpower and training, driven by billet costs, can be computed. These figures, supplemented with historical data on similar systems when necessary, will provide the basis for a life cycle cost (LCC) estimate of each of the major elements under consideration, i.e., manpower, training, and hardware.

With the issuance of a Manpower and Training Summary report, a Life Cycle Cost Update, and the Milestones Met and Missed report, each proposed alternative could then come before an OPNAV and CEB review. The assessment of alternatives could be more effectively made on the basis of cost benefit analysis at this stage, since the manpower and training impacts had already been identified. The final choice of recommended alternatives would now be outlined in a draft NDCP and DCP and subjected to further review and refinements by NAVMAT and OPNAV before final presentations at DSARC I.

The advantages of such a systematic approach are threefold. First, the manpower and training community would have substantial impact on decisions, throughout the Concept Phase of the WSAP, on the basis of both availability and affordability. Second, a mechanism exists for the inclusion of trade-off analysis in the early stages of system development. And finally, a provision exists for the monitoring and control of subsequent decisions which can effect both manpower growth and long-term operating and support costs.

C. Engineering Design Phase

For the purposes of this discussion, the Design Phase is subdivided into two main sections, shown in Figure J-2 and J-3. The first, Phase A, deals with Major Subsystems and the second, Phase B, with Component Design. The time scale is not explicitly noted; however, for systems identified as ACAT I or II, the length of time could be several years.

1. Design Phase A Major Subsystems

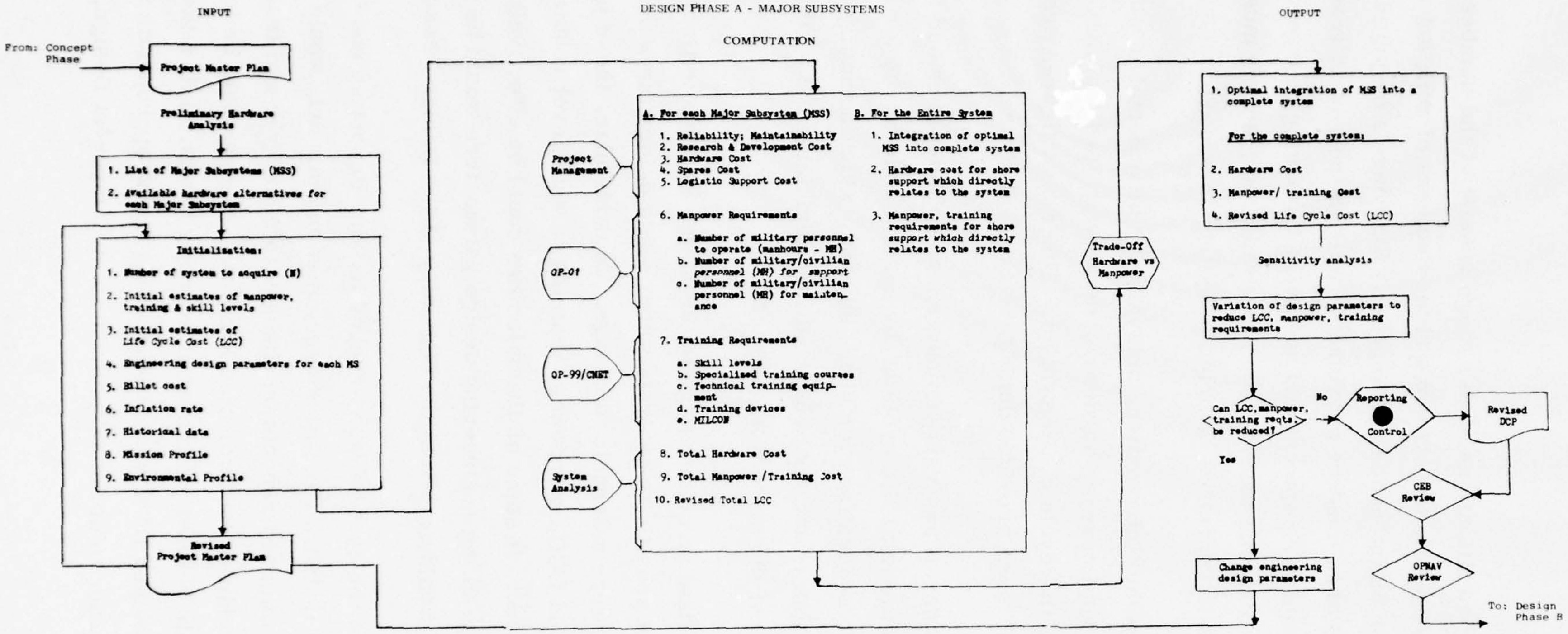
Shown in Figure J-2 is Phase A which in turn consists of three parts: Input, Computation, and Output.

The Input stage begins with the Project Master Plan which provides guidance for work planning and scheduling. This is a compilation of planning documents which places in context the plans, schedules, costs and scope of all work and resources to be provided by each participating organization. Next, an analysis of each major system is conducted which provides a list of each system and available hardware alternatives. The establishment of parameters by design engineers within the Developing Agency will allow for the construction of Mission and Environmental Profiles. The initial Life Cycle Cost estimates developed in the preceding phase, can now be refined based on more readily determined data now that specific design configurations are being considered. This preliminary analysis is now input to the next, or Computation stage.

During the Computation stage, the four main functional areas, i.e., Project Management, OP-01, OP-99/CNET, and System Analysis play a central role in defining, reviewing, and computing both requirements and costs. Shown in Figure J-2 are the elements which must be provided for each major subsystem. Reliability and Maintainability goals and measures of performance must be specified. The costs of R&D, hardware, spare parts, logistics and test and evaluation must be identified. The manpower

Figure J-2

DESIGN PHASE A - MAJOR SUBSYSTEMS



and training specifications at this stage consist of the numbers of military personnel to operate the system and the numbers of military and civilian personnel for maintenance and support. Skill levels by job classification or functional area must be provided as well as the type of training devices, technical training equipment and specialized training courses. If military construction is being considered, long lead time planning must begin early enough so as to guarantee completion by the time of equipment introduction.

Given this information, analysis can be undertaken which will provide the total cost for hardware, manpower, and training annually, and over the life cycle of the system. These cost figures are updated and refined from those provided during the Concept Phase.

A trade-off analysis can now consider manpower and training versus hardware in the total life cycle of the system and strives for an optimal mixture. Considerations for shore support, which normally would be excluded at this point, could be used in determining the total manpower implications of the system in question.

The final or output stage of the Major Subsystem Design stage consists of a sensitivity analysis which would determine which design parameters were amenable to change. In particular, those parameters which reduced LCC, manpower, training or skill level requirements would be investigated. If some of these factors could be effectively reduced, then a change in the engineering design parameters would be initiated and the process would return to the beginning of the Design Phase.

When the system was acceptable, the Reporting and Control Module would be activated. The milestones, met and missed, would be tabulated along with summary reports on changes to manpower and training requirements. In addition, a Projected Resource report would be issued which would contain refined estimates of manning levels, skill mixes, and training costs. A revised DCP would then be issued and appropriate review would be held in order to continue the next step; Component Design.

2. Design Phase B Components

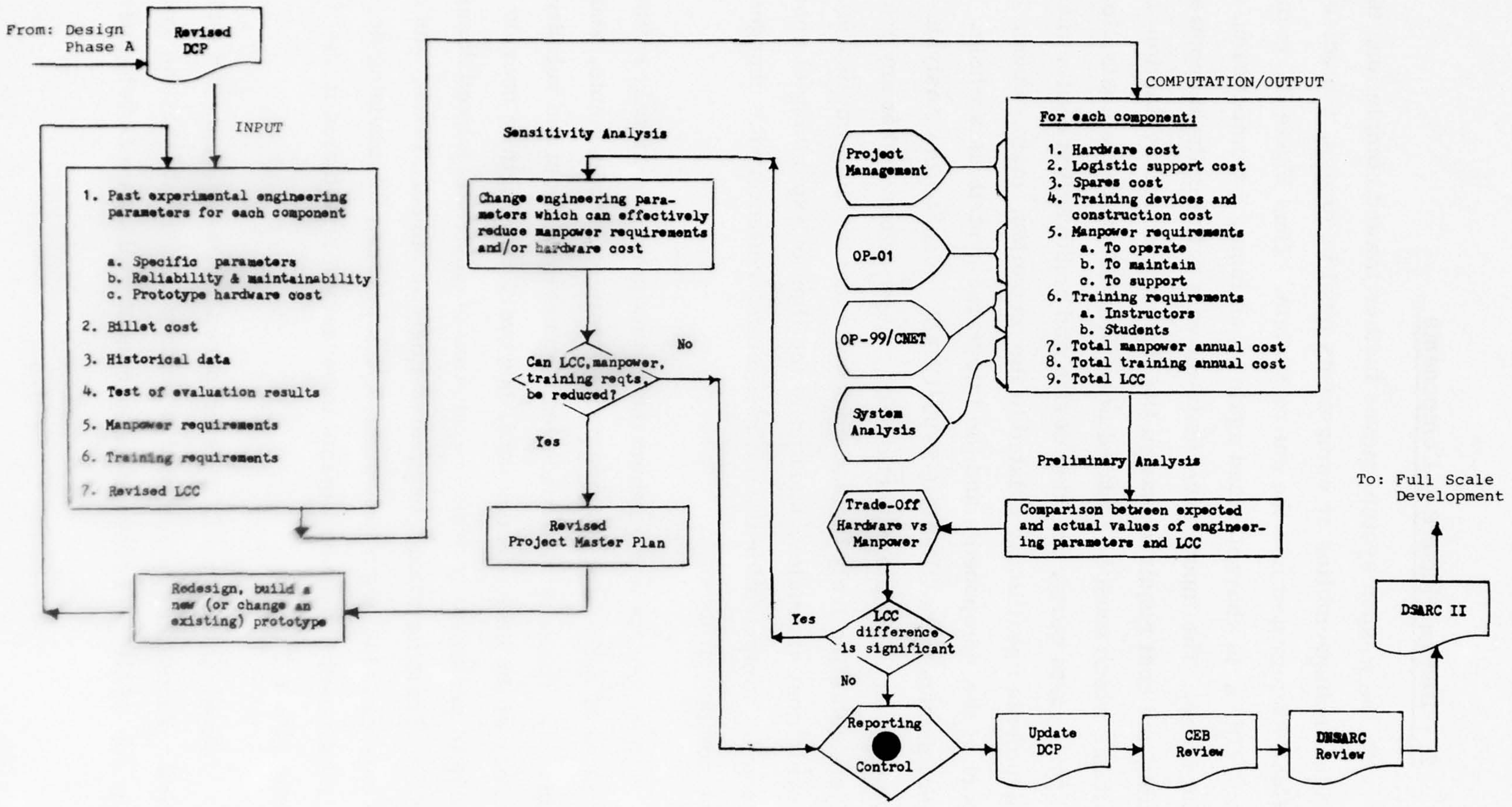
As the weapon system moves further toward completion, the individual subassemblies or components must be design, tested, evaluated, and finally integrated into the entire system. Thus Phase B, seen in Figure VIII-3, is characterized again by an input, a Computation, and an Output stage. The input concerns itself with refining the manpower, training and cost requirements in the light of test and evaluation results. The items which must be updated are: overall hardware costs, logistic and spare parts costs, training device and construction costs, manpower requirements specifically related to the operation, maintenance, and support of the components and the integrated system as a whole. As before, project management OP-01, OP-99/CNET, and System Analysis must provide the appropriate expertise and review in order that any tradeoff analysis can effectively include manpower and training implications. The life cycle cost estimates, updated in the light of experimental results, can now be computed for the entire system, reflecting the changes made at the component level.

The reports being generated at this point are greatly refined estimates of manpower requirements, training requirements, and resource estimates. There is also much less uncertainty about the validity and accuracy of the data. These data, however, can begin to provide information for use in preliminary draft preparation of institutionalized documents such as Navy. Training Plans, Integrated Logistic Support Plans, and others. The data can also begin to provide a link between the planning documents, and subsequent budget documents necessary for inclusion in the Five Year Defense Plan.

Next, an updated DCP is prepared, followed by a CEB and DNSARC review. Successful review at this point would signify that the system was ready for DSARC II review and subsequent Full-Scale Development.

Figure J-3

DESIGN PHASE B - COMPONENTS



In summary, the HARDMAN Information System during the Design Phase has facilitated early requirement determination and tradeoff analysis at the system level. It has also provided a series of reports and controlling documents for resource estimates and aggregate manpower growth.

D. Full-Scale Development

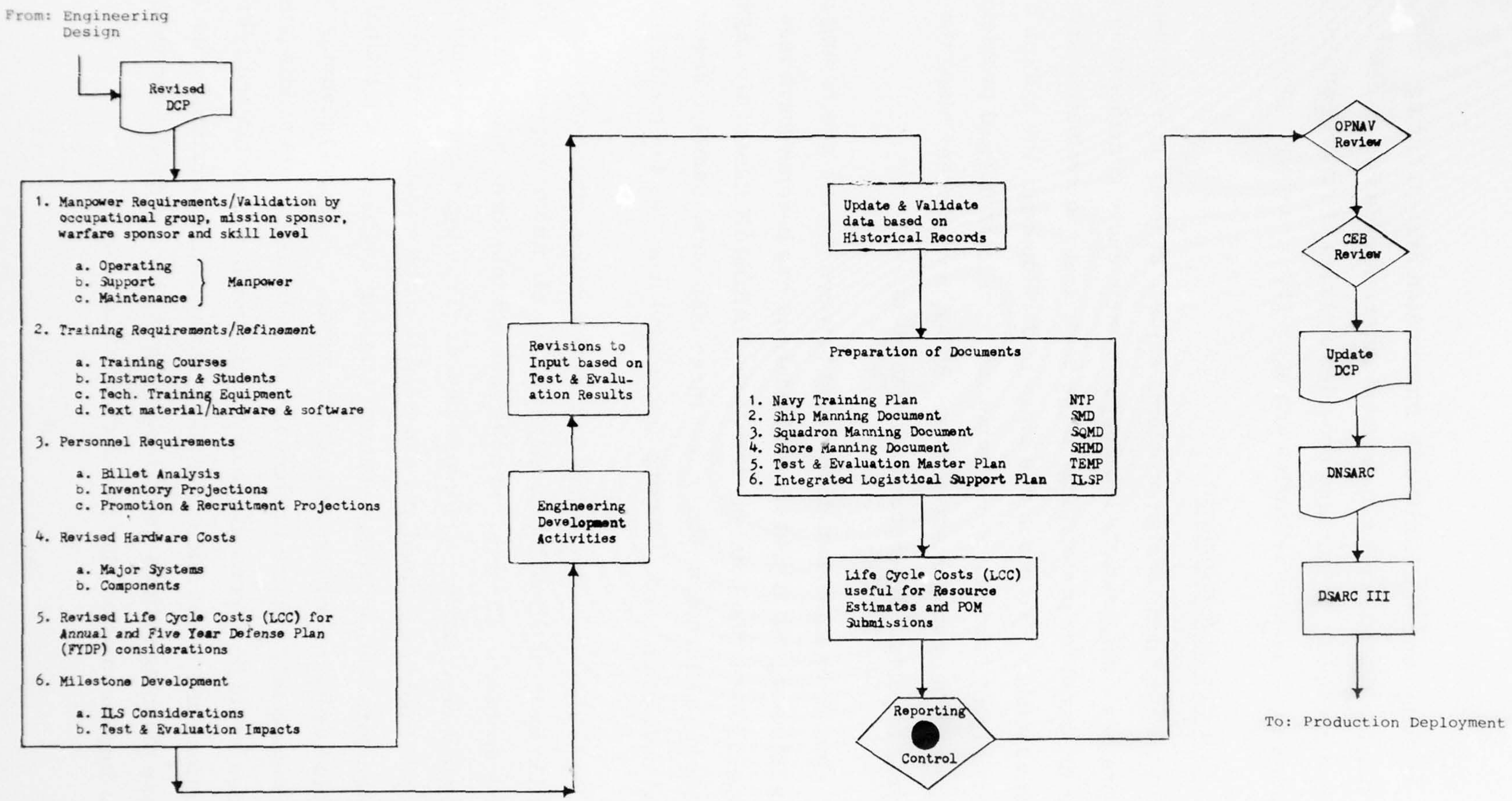
With the major design problems solved, at least on a test bench or laboratory configuration, the weapon system under consideration must now be prepared for prototyping, large scale test and evaluation and subsystem assembly. To reach this stage of development, the system had to pass over many hurdles, some stemming from technological problems and others from management review. As we move further along the acquisition cycle important differences begin to occur.

One of the important differences between the two preceeding phases and the following two is that tradeoff analysis has become much less important. From the point of view of the HARDMAN Information System, the modular construction shows that three elements, namely, requirement review, validation, and reporting and control now play the major roles.

The flow shown in Figure J-4 begins with a manpower requirement validation by occupational grouping, skill level, mission sponsor, and warfare sponsor. These would be broken out into three functional areas, i.e, operations, support and maintenance. Training requirements previously developed would be refined and expanded to include training courses, numbers of instructors and students, technical training equipment and textual material including both hardware and software aids. Personnel planning which will subsequently require implementation must also begin at this point. Included would be current inventory projections, promotion and recruitment projections and a lead time billet analysis by rate and rating. The object of these planning actions would be to provide for a smooth, and well-orchestrated implementation plan for fleet introduction.

Figure H-4
FULL SCALE DEVELOPMENT

Figure J-4
FULL SCALE DEVELOPMENT



Unit hardware costs, including those for major subsystems and components, would be updated along with revised life cycle costs for both annual and five year windows. The life cycle costs would be refined for use in historical analyses on systems similar to the one currently under consideration.

Milestones for HARDMAN reporting as well as those institutionalized within the Navy such as DCP Updates, Test & Evaluation Timetables, and those for Integrated Logistic Support are necessary at this stage of development.

Along with the specific developments associated with engineering activities in hardware areas, a variety of actions are required to complete the validation process. These would naturally lead to the preparation of specific documents such as Navy Training Plans, Ship Manpower Documents, and others.

HARDMAN reports at this point would include Resource Summary reports for manpower, training and life cycle cost, a Milestone Met and Missed report, the Revised Manpower Growth report, and a Scheduling report showing Navy Training Plan Conferences, OPNAV and CEB reviews as well as dates for DCP and DSARC actions.

The data developed through the HARDMAN Information System has been refined, validated and reviewed with new, "unanticipated" requirements being minimized. Those that have occurred have been accumulated into the information network and, at worst, provide for only marginal changes in resource estimates. This will be tremendously valuable when the specific commitments for funding and authorization requests are considered.

E. Production/Deployment Phase

The Production/Deployment Phase is shown in Figure J-5. This is the last phase in the Weapon System Acquisition Process before fleet introduction and is therefore characterized by a plethora of manufacturing and delivery considerations on the engineering side, and programming and budgeting activities on the management side.

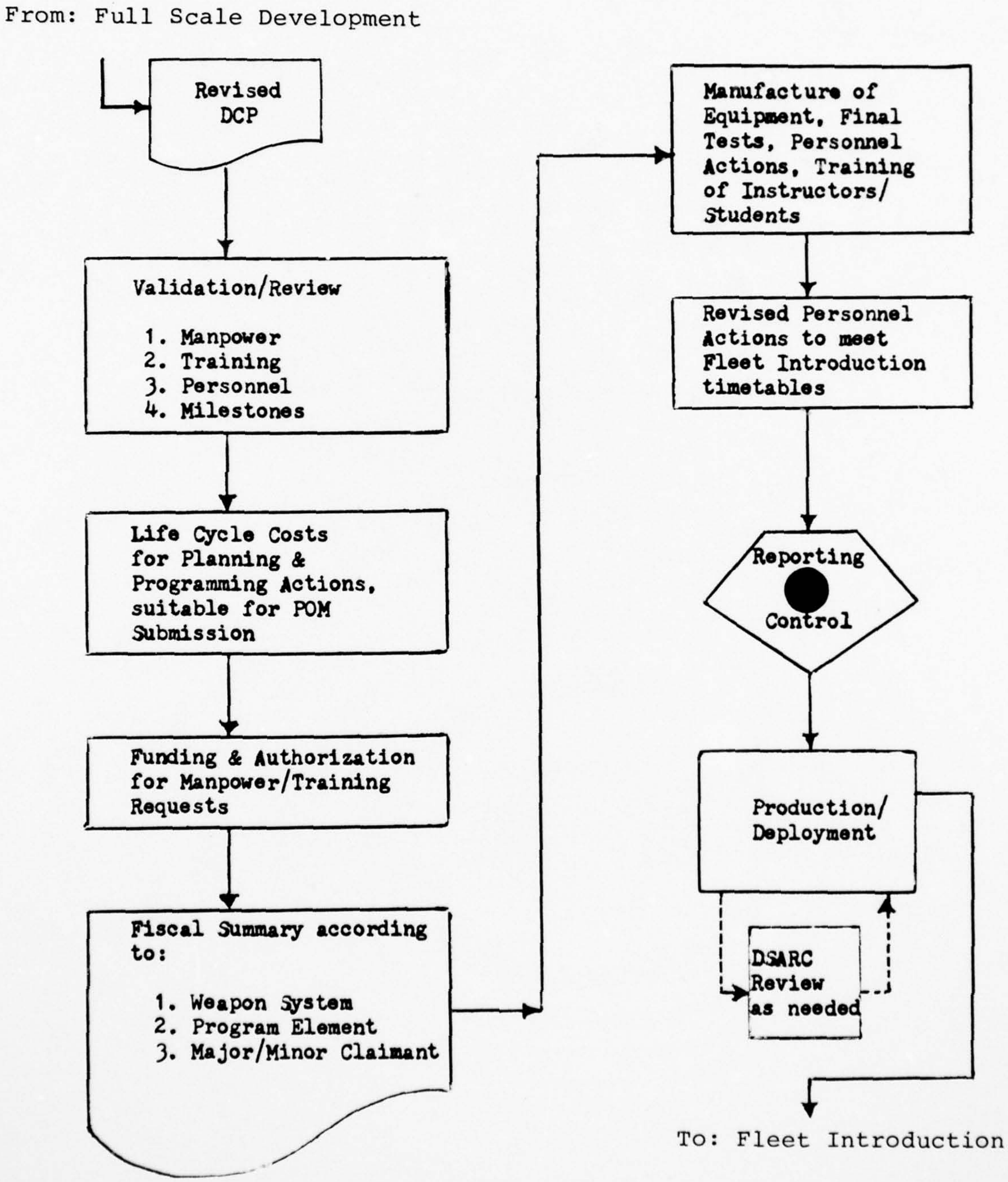
All manpower and training resource estimates previously tracked and refined must now be translated into resource commitments, and personnel actions must result in specific assignments.

Programming actions suitable for POM submissions must be instituted, assuming of course that we are within the five year window of the FYDP. Fiscal summaries according to weapon system, program element, and major/minor claimant should be produced and milestones adjusted to coincide with fleet introduction time tables.

If the early identification of manpower and training requirements has been successfully integrated into the entire WSAP, if tradeoffs have been performed using life cycle cost as a basis for ownership, and finally if the reporting and review structure has provided for informed decisions, then manifest improvements will result in both the control of manpower growth and reductions in operating and support costs.

Figure J-5

PRODUCTION/DEPLOYMENT



APPENDIX K

HARDMAN REPORTING AND CONTROL

A. Introduction

In order for the Navy to gain control of manpower growth in the Weapon System Acquisition Process there must be action taken in two primary areas. First, there must be a continuous and summary reporting of manpower resources on a weapon system level, and second, there must be a controlling mechanism which would provide for discipline of the hardware portion of the WSAP.

This appendix addresses these issues by developing a reporting and control module which can be integrated into the Weapon System Aquisition Process as it currently exists. Although the discussion will develop the ideas for complete reporting and control for systems which begin at the "front end" of the WSAP, many of the concepts can be implemented using weapon systems which already exist and have passed a series of decision points. In fact, the implementation plan indicates such an approach.

The following discussion is presented in three sections. The first gives a brief description of the overall functions to be performed by the module. The second section develops the specific reports to be generated, including their content, preparation and use. The last section provides a description of an operating scenario including a discussion of a computer-based file structure for new weapon systems and those already under development.

B. Functional Description

There are four features of the reporting system which will result in immediate improvements in manpower planning. These include:

- Tracking of Milestones
- Monitoring of Resource Estimates
- Generation of Control Documents and Early Warning Indicators
- Updating of Data Elements

1. Tracking of Milestones

The tracking of milestones is necessary from an overall management point of view. In order to be able to react to new system requirements intelligently, milestones must be identified sufficiently well in advance to permit work schedules to be generated. There are currently well defined decision points based on DSARC, OPNAV, and CEB reviews. Unfortunately, they have been developed on the basis of engineering and production decisions which heretofore have played the only role in system definition. There are, however, other milestones which must be met in order for the proper integration of manpower and hardware to occur. These new, or HARDMAN milestones, must be identified for the performance of requirements definition, cost estimation, and tradeoff analysis. The calendar dates for these points, relative to the hardware decision points would vary from system to system, and will acquire individual attention in order that they be integrated into the entire reporting system.

2. Monitoring of Resource Estimates

The monitoring of resource estimates is obviously required; however, the degree to which the system changes as it progressed through the acquisition cycle, and the credibility of the initial estimates has made such monitoring difficult in the past. The reports generated by the HARDMAN Information System will make this function somewhat easier. Resource estimates be tied directly to requirement definition, and as one changes, so will the other. As these estimates are tracked and recorded throughout the WSAP, they can also be used to develop more credible estimates for future systems.

3. Generation of Control Documents and Early Warning Indicators

The generation of control reports will allow both manpower, and OPNAV/CEB reviews, to function more effectively. Implicit in this concept is the notion that each weapon system under consideration must pass a series of "checkpoints". It would be at these checkpoints when information on manpower configurations, tradeoff analysis, and life cycle cost could be provided. With such information available, it would be possible to construct a Manpower Status Report for each weapon system. Also Milestones Met and Missed could be constructed. These reports along with Overall Resource Summaries could provide the backbone for a controlling mechanism.

The issuance of Early Warning Indicators are also necessary to insure that the appropriate agency is provided enough time for early requirement definition. For example, in order for OP-99 to give serious consideration to a training concept early in system development, a signal must be given which indicates that the weapon system has progressed to the point where such action is necessary. These Early Warning Indicators could easily be tied to milestone definitions previously determined.

4. Updating of Data Elements

Finally, the data which are being developed, be they manpower requirements, resource estimates or life cycle cost must be accumulated and updated for easy access. The objective of such a reporting system would be to communicate effectively with a variety of OPNAV Sponsors, NAVMAT Agencies, OP-96, OP-90 as well as OP-01, OP-99 and others. In order to do so, and to have the information available in a variety of formats for different purposes throughout the phases of the WSAP, a computerized data system is necessary. Computer-based data files could be organized on a weapon system basis for both standardized and ad-hoc reporting.

Given such a computerized system, the organization of data from resource estimates, tradeoff analysis or milestone definitions would be relatively straight forward. This would allow for the continuous and summary reporting necessary for the controlled growth of manpower in the Weapon System Acquisition Process.

C. HARDMAN Reports

The HARDMAN Reports, shown in Table K-1 can be organized into two broad areas:

General Reports

- Providing requirements, resource estimates, life cycle cost, fiscal summaries, and tradeoff information.

Control Reports

- Providing milestones, schedules, manpower growth, early warning indications, and resource summaries.

Table K-1

HARDMAN REPORTS

	REPORT	WSAP PHASE				STATUS	ORIGINATOR	USER
		I	II	III	IV			
General Reports	1. Manpower Requirements	x	x	x	x	NEW	OP-01	Program Manager
	2. Resource Estimates	x	x	x	x		OP-01	Program Sponsor
	3. Training Requirements	x	x	x			OP-99	Program Manager
	4. Resource Estimates	x	x	x	x		OP-99/CNET	Program Sponsor
	5. Life Cycle Cost	x	x	x	x		Program Manager, OP-90 & OP-96 System Analysts	Program Sponsor, Manager, NAVMAT, OP-90 & OP-96 System Analysts, OP-01, OP-99/CNET
	6. Fiscal Summary (POM)			x	x		Program Sponsor, Proj. Manager, NAVMAT, OP-90 & OP-96 System Analysts, OP-01, OP-99/CNET	" "
	7. TRADE-OFF I (Skills)	x					OP-01	" "
	8. TRADE-OFF II (System)	x					Program Manager	" "
	9. TRADE-OFF III (Subsystem)		x				Program Manager	Program Manager
	10. TRADE-OFF IV (Components)		x				Program Manager	Program Manager
Control Reports	11. WSAP Milestone	x	x	x	x		Program Sponsor	Program Sponsor, Proj. Manager, NAVMAT, OP-90 & OP-96 System Analysts, OP-01, OP-99/CNET
	12. HARDMAN Milestones (Met & Missed Report)	x	x	x	x		OP-01	" "
	13. Manpower Growth Report	x	x	x	x		OP-01	Program Sponsor OP-01
	14. Early Warning Report	x	x				OP-01	OP-01, OP-99
	15. HARDMAN Resource Summary Report	x	x	x	x		OP-01, OP-99	Program Sponsor, Proj. Manager OP-01, OP-99

There are ten reports shown under the heading, general, and five under control. The phase within the Weapon System Acquisition Process is shown and indicates when the report will be issued. For example, Report #7, TRADE-OFF I (SKILLS) would be prepared during the first or Concept Phase, whereas Report #2, Manpower Resource Estimates, would be prepared in each of the four phases. The last two columns of the table indicate who would prepare and use the specified report. The list of organizations has been summarized into single groupings, namely:

Program Sponsor
Program Manager
NAVMAT

System Analysts
(OP 90 & OP 96)

OP-01
OP-99/CNET

The areas of responsibility for preparation are also indicated. In some instances all groups will participate, such as Report #6, Fiscal Summaries and POM Submissions. Most often, however, one organization will have the major responsibility for preparation as is depicted in the Table. The range of usefulness and even the degree to which these reports can be utilized is indicated in the last column. For example Report #5, Life Cycle Cost, prepared by the Program Manager and System Analysts would find general use by all participating organizations. The Program Sponsor would use this information for long range planning, the Program Manager for specific design decisions, and OP-01 for its manpower implications. Report #8, Trade-Off II (System) prepared by the Program Manager would be used quite generally; however, Report #10, Trade-Off IV (Components) prepared by the Program Manager would be utilized almost exclusively by him in making specific design decisions.

The last five, or control Reports #11 and #15 have been designed to have general utility, but preparation would be primarily the responsibility of OP-01 and OP-99. Their timing in the Acquisition Process will generally preceed formalized reviews, so that appropriate control could be exercised. The Met and Missed Report would tabulate all checkpoints successfully passed, and those which have been avoided, if any.

The Early Warning report would allow both OP-01 and OP-99 the time and information necessary to begin early requirement definition. The Manpower Growth Report would be a tabulation, system by system, of the rate of growth of manpower throughout system definition. It could then be aggregated to provide a total estimate of manpower growth for all weapon systems.

This reporting structure as shown will allow for:

- long range resource implications to be gauged
- benchmarks to be established for subsequent changes in system development
- overall coordination of manpower in the WSAP

In addition these reports can be effectively tied to documents which are already institutionalized within the Navy seen in Table K-2 to provide for a more efficient, and manageable Weapon System Acquisition Process.

D. Operating Scenario

The Reporting and Control Module within the HARDMAN Information System can be utilized by a variety of users, including OP-C1, OP-99/CNET, Program Sponsor, Program Manager and NAVMAT Agencies. This section

Table K-2

WSAP DOCUMENTS

Report	WSAP Phase				Status	Originator	User
	I	II	III	IV			
1. Operational Requirement	x					Prog. Sponsor	Prog. Sponsor, Proj. Manager, NAVMAT, OP-90&OP-96 Systems Anal OP-01, OP-99/CNET
2. Development Proposal	x					NAVMAT	" "
3. Decision Coordinating Paper	x	x	x	x	EXISTING	Prog. Sponsor, NAVMAT	" "
4. Project Master Plan		x	x	x		Prog. Manager	Prog. Sponsor, Prog. Manager
5. Integrating Logistic Support Plan		x	x	x		Prog. Manager	Prog. Manager
6. Navy Training Plan			x	x		Prog. Manager OP-01, OP-99/ CNET	Prog. Sponsor, Prog. Manager, OP-01, OP-99/CNET
7. Test and Evaluation Master Plan			x	x		Prog. Manager	Prog. Manager
8. Manning Documents			x	x		Prog. Manager	Prog. Sponsor, Prog. Manager, OP-01, OP-99/CNET

will expand the notion of interaction between users in three distinct areas. First, the computer-based file structure will be discussed, second, initialization of weapon systems which begin at the "front end" of the WSAP will be developed, and finally, weapon systems which have already passed some WSAP and HARDMAN milestones will be integrated into the HARDMAN Information System.

1. HARDMAN File Structure

In order for this Information System as a whole to be useful to more than one organization within the Navy, a generalized access system will have to be designed. One possible approach would be to designate to each individual weapon system a unique file. Access to this file could then easily be accommodated via terminal connections at many remote sites. Within each weapon system file there would be a record structure which contained milestones, requirements, resource estimates, and life cycle cost information.

The updates to each weapon system as it moved through the acquisition process would naturally result in more refined, and detailed information. Thus, the records would be accessible based on dates of last review and would show the current status of all information. A historical record would also be developed which contained the most pertinent data for general management review.

In sum, the general file structure for the HARDMAN Information System could be build around particular insertion points, based on HARDMAN Milestones, which would allow for ease of monitoring.

2. Systems at Initial HARDMAN Entry Point

The first time a new weapon system enters the HARDMAN Information System is at the time of OR issuance in the Concept Formulation Phase. It is at this point when an initialization procedure must begin. The functions of such an initialization would be to: establish the overall scheduling requirements during the entire phase, coordinate efforts of various Navy organizations, and allow for accumulation of selected data.

A possible initial approach, or start-up plan to satisfy these objectives would be as follows:

- OP-01 prints out a series of schedule requirements, namely:
  WSAP Milestones: DP, DCP, DSARC
  HARDMAN Milestones: Requirement and cost determination tradeoff analysis, initial reports
- Program Sponsor and NAVMAT submit calendar dates for WSAP milestones.
- OP-01 submits calendar dates for HARDMAN Milestones.
- A work schedule or plan is generated including the issuance of early warning indicators to OP-99/CNET and others,
- Organizations within the Navy such as OP-01, OP-99, CNET, OP-90, OP-96, NAVMAT are signalled to begin work for system definition.
- Information is accumulated in the HARDMAN Data Base.

The HARDMAN Data Base consisting of files from each weapon system can then be delineated into distinct areas or records, containing requirements, resources, and life cycle costs. These areas can be accessed by a wide variety of users for data entry as well as output reporting.

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3. Systems Currently Under Development

For weapon systems already well within the acquisition cycle there are clearly defined insertion points within the framework of the HARDMAN Information System. Within each phase of the WSAP, an approach similar to the one used for initialization in the Concept Phase can be instituted. The data concerning initial estimates and alternative considerations would not be available, but the reporting and review aspects inherent within the HARDMAN Information System are still available. The choices made may not be "optimal" ones; however, the overall coordination between agencies, and the connection to POM development would still be possible. Resources may have to be reprogrammed from existing budgets, but the overall visibility of manpower resources would still be afforded.

In summary, this overall approach would allow for the continuous monitoring of weapon system development, as well as the summary review by OPNAV, and CEB boards. The system envisioned also allows for the full participation of Navy organizations with a unified approach, so that the acquisition process functions in a more responsive and deliberate fashion.

APPENDIX L

HARDMAN ANALYTICAL METHODOLOGIES

A. Introduction

While the Reporting and Control module of the HARDMAN information system has an important role to play in improving the existing WSAP, there are added benefits if methodologies supporting tradeoff analyses are coupled with the Reporting and Control module. Furthermore, methodologies facilitating early analysis of manpower will assist in improving significantly the WSAP itself.

In many respects each new weapon system represents a unique range of analytical issues. Tradeoffs of manpower and hardware design in one system may revolve around alternative maintenance concepts whereas with another system the issues may relate to particular types of skills inherent in the hardware design. Developing methodologies which are capable of solving all HARDMAN problems is really dependent upon knowing in advance what all the possible issues will be with respect to all the potential systems which may be developed. While such an all-knowing view of weapon system development does not exist, there remain significant opportunities to develop methodological approaches which may assist in conducting specific HARDMAN analysis when the situations arise.

The objective of this appendix, therefore, is to outline procedures and approaches which heretofore have not been formalized and to present a framework in which specific tradeoff analyses may be conducted. In many respects, the framework set forth offers many opportunities for methodological development which in turn will support tradeoff analysis. In addition, actual development of these methodologies will serve in themselves as catalysts for increased HARDMAN analysis and improved analytical techniques.

Figure L-1 illustrates the general concept of HARDMAN tradeoff analysis. The concept is predicated on conducting an analysis where performance levels of the weapon system are held constant--in the parlance of the systems analyst, a fixed effectiveness study. As the figure indicates, the basis for the analysis are the Operational Requirements set forth by the program sponsor at the very initial stages of Concept Formulation. As the analysis scheme is formulated in this chapter, hardware designs and supporting resources must be configured in manners which achieve the same Operational Requirements.

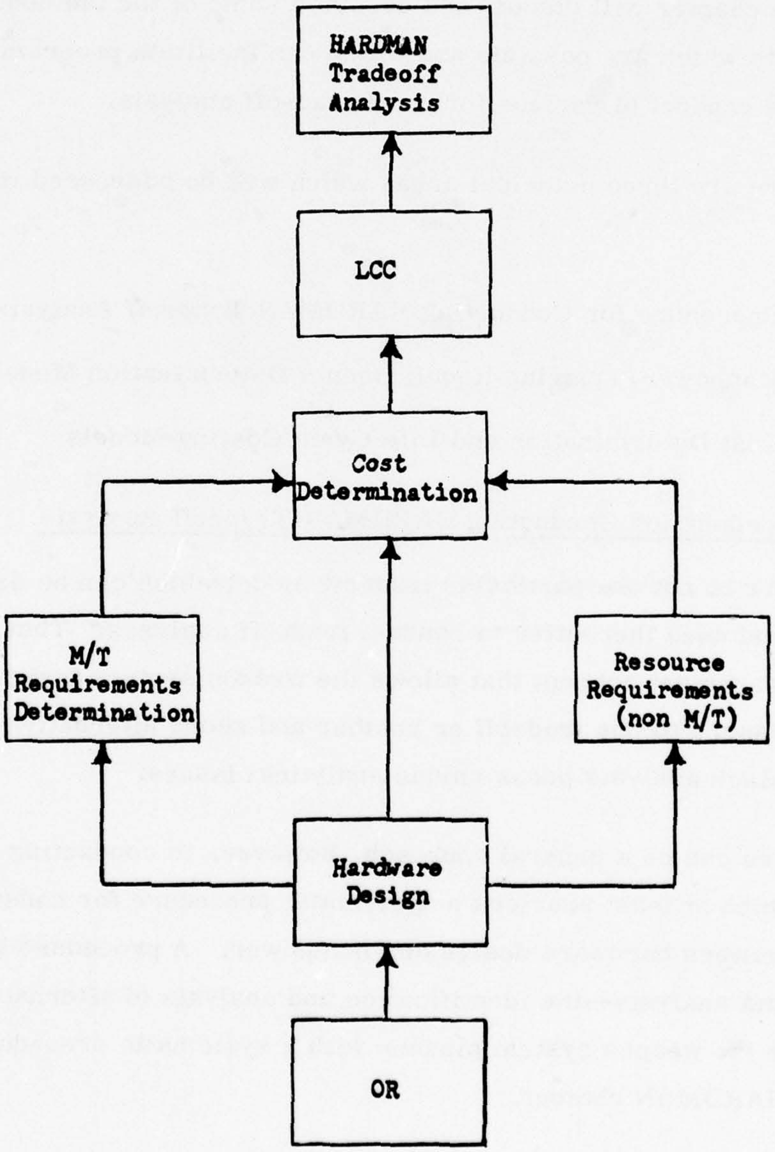
In principal, the analysis proceeds through several stages. First, a hardware design is postulated in response to the Operational Requirement. Based on this design, manpower and training requirements are determined. These and other resource requirements are used in turn to estimate cost factors and life cycle costs. The analysts would develop a number of alternative hardware designs and determine their resource impacts. The various alternatives would then be arrayed and an analysis of which is the preferred alternative. Selection would be dependent upon criteria; manpower/training may or may not be the deciding factor.

The concept is logical and relatively simple. Translating concept into operational models is dependent on the complexities of the weapon systems. The models for analyzing a new radar device are likely to be much simpler than those required for analyzing a new ship. In principle, the approach will be the same.

Figure L-1

HARDMAN Tradeoff Analysis

-General Concept-



Despite the difficulties impeding the development of general purpose models, there are a number of first steps which may be taken in the context of the HARDMAN Information System so that the methodological structure is at least available even if specific models for a particular weapon system must remain until the hardware definition is to be completed.

This chapter will discuss and describe some of the methodological developments which are possible and which can facilitate program analysts in the future conduct of various forms of tradeoff analysis.

There are three principal areas which will be addressed in this chapter:

- Procedure for Conducting HARDMAN Tradeoff Analysis
- Manpower/Training Requirements Determination Model
- Cost Determination and Life Cycle Costing Models

B. Procedure for Conducting HARDMAN Tradeoff Analysis

There is not one particular tradeoff model which can be designed and developed and used thereafter to conduct tradeoff analyses. There is no single measurement concept that allows the weapon system designer to attach a measure to one tradeoff or another and score alternative weapon systems. Each analysis poses unique analytical issues.

There can be a general approach, however, to conducting tradeoff analyses which at least provides a systematic procedure for considering tradeoffs between hardware design and manpower. A procedure based upon systems analysis--the identification and analysis of alternative methods--can provide the weapon system planner with a systematic procedure for analyzing HARDMAN choices.

Tradeoff analyses affecting manpower and training resources can be conducted beneficially during the first two stages of weapon system development. During these stages, the major portion of life cycle resources are committed. The design decisions being made could be significantly improved as a result of the explicit identification of manpower versus hardware design tradeoffs.

As noted previously, there are four major opportunities for tradeoff analyses to occur during the Concept Formulation and Design Phases. The process in effect involves successive refinements. The initial analysis stemming from the OR provides the baseline for subsequent analyses; each builds upon the preceding analysis. Significant changes in conclusions and design options can be monitored so that changes in major constraints can be recognized early.

Figure L-2 summarizes the four major steps included in a HARDMAN tradeoff analysis:

1. Establish HARDMAN Baseline

The first step involves defining a baseline alternatives to which other weapon system designs may be compared and analyzed.

The procedure involves four elements in order to provide a full specification of the baseline hardware alternative. The initial element is the statement of the Operational Requirements, a step which initiates most weapon system developments. This document identifies the mission and capabilities in general which must be satisfied by a weapon system. The preparation of the Operational Requirement marks the beginning of a series of already-established steps leading to the completion of the concept definition and the commencement of the Design Stage. For purposes of conducting HARDMAN tradeoff analysis, the Operational Requirements provide a statement of performance which can be used to define the performance level of the weapon system.

Figure L-2

Procedure For Conducting
HARDMAN Tradeoff Analysis

Steps

I. Establish HARDMAN Baseline (Alt 0)

Procedure:

II. Generate HARDMAN Alternatives

Procedure:

a. With respect to any of the following, specify alternative hardware designs:

- i. Subsystems
- ii. Design Concept
- iii. Maintenance Concept
- iv. Technology
- v. ILS Concept

b. Specify ____ alternatives for analysis

III. For each HARDMAN alternative, estimate M/T requirements and LCC and array in HARDMAN table. Specify strengths and weaknesses with respect to satisfying OR

Alternative	M Rqmts	T Rqmts	LCC	S&W
0 (Base)				
1				
2				
3				
4				

IV. Select preferred alternative. Discuss rationale for selection.

Preferred alternative becomes HARDMAN baseline (Alt 0) for subsequent iterations

While this specification may be refined during the development of the weapon system, the statement of Operational Requirement will be used in the HARDMAN analysis to represent a fixed level of performance. Alternative weapon systems will subsequently be analyzed in the context of attaining the required Operational Requirements.

Based on the Operational Requirement, there will be an initial Hardware Concept. While this will not be a detailed specification, it nevertheless will include sufficient details so that the major subsystem comprising the weapon are identifiable and a basis for resource estimation exists.

Thirdly, based upon the Hardware Concept, estimates of the Manpower/Training Requirements will be made. These requirements will be used finally to make initial estimates of the life cycle costs for the proposed Hardware Design. These initial cost estimates will be aggregate in nature and subject to considerable revision during later stages of system development. Nevertheless, providing they have been developed consistently, the life cycle costs will serve as figures of merit for evaluation of various alternatives.

Collecting the Hardware Concept, Resource Estimates, Manpower/Training Requirements, and Initial Life Cycle Costs together, there is a specification of a Baseline Alternative. Tradeoff analysis will subsequently be conducted using this specifications as the basis.

2. Generate HARDMAN Alternatives

The second step deals with the development of alternative equipment designs based upon potential manpower tradeoffs.

In the past, alternative designs have generally been considered but not always to include manpower/training tradeoffs. For purposes of HARDMAN, there will be an explicit requirement to identify alternative hardware designs offering significant manpower tradeoffs. The alternatives may be specified with respect to any number of criteria depending upon what particular potential tradeoffs are available. Alternative subsystems might be identified, or maintenance concepts, or technology. Each weapon system would involve a particular set of alternatives.

The weapon system planner would have to specify a particular set of alternatives depending upon the weapon system.

3. Estimate Resource Requirements

Each alternative would be subject to analysis of resource requirements. [illegible] analysis would include, as a minimum, estimation of Manpower and Training Requirements as well as estimates of Life Cycle Costs. In addition, each alternative would be analyzed in terms of its strengths and weaknesses in satisfying the operational requirements.

Figure L-2 indicates that a table would be developed summarizing the chief characteristics of the various alternatives. For relatively simple systems, there may in fact simply be a table summarizing the major characteristics. On the other hand, for complex weapon systems, the analysis of each alternative may represent a report of some significant size.

In any event, however, there would be a standard analysis conducted for each alternative.

4. Select Preferred Alternative

The final step in the procedure is the selection of the preferred alternative. The analyst would select one option among the alternatives. He could choose to stay with the baseline alternative or he might find that one of the others is preferrable. A supporting rationale for the recommended alternative would be prepared.

The recommended alternative would become the baseline alternative in the next set of analyses. For example, if the analysis conducted occurs in the concept formulation stage when major system choices are being made, the selected alternative would become the baseline for analysis in the design stage focusing on subsystems.

5. Complexities of Tradeoff Analysis

The procedure outlined in the preceding paragraphs in principle will work. It will be easier to apply in the case of relatively simple weapon systems. The order of complexity and difficulty will increase significantly considering major weapon systems.

In each instance, however, the more efforts made to conduct HARDMAN analysis, the more effective planning and understanding of manpower/training implications attached to weapon system development is possible.

C. Manpower/Training Requirements Determination Model

Two types of computer-based models are required to support HARDMAN tradeoff analysis; one is cost and the other is requirements determination, the subject of this section of the chapter. In order to estimate life cycle costs, there is an initial need for estimates of both Manpower and Training Requirements.

Manpower requirements are estimates of the numbers of Navy and civilian personnel required to operate and support a particular weapon system over its life. Included are the initial crews and operating staffs as well as the replacements needed as a result of attrition or other types of manpower losses.

Training requirements include estimates of the numbers of Navy and other personnel required to provide and participate in training as well as special resources such as simulators, training facilities and others which are required to support a particular training program.

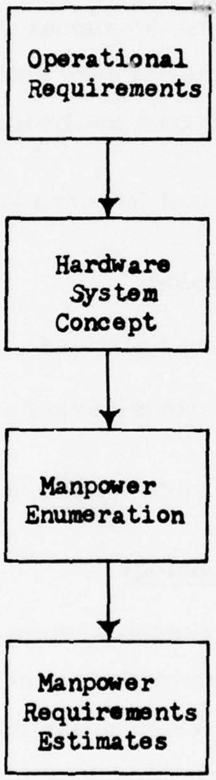
The training manpower is a subset of the total system manpower determined as part of the manpower requirements. Consequently, if there is a methodology for determining the manpower requirements, the training manpower requirements will also be estimated. To complete estimates of training requirements, therefore, involves identifying and estimating resources associated with non-manpower resources.

Figure L-3 illustrates the General Concept for the Manpower/Training Requirements Determination Model. The analysis normally would stem from the Operational Requirements and the hardware system concept. Based upon the Equipment Concept and/or Design, a model would be used to enumerate the manpower requirements to operate the system at a given point in time. In other words, initially, the estimate would be based upon a "timeslice" without any consideration of personnel attrition. For a single unit of the weapon system, an estimate would be made of the number of personnel required to operate it. The estimate would include both operating and support manpower.

Each enumeration would be dependent upon the specific weapon system. Consequently, no single requirements model would satisfy all requirements.

Figure L-3

General Concept for Manpower/Training Requirements Determination Model



Once the unit requirements have been determined, annual and life cycle manpower and training requirements can be readily estimated based on existing techniques. The unit requirements must essentially be translated into billets and personnel requirements. These can be extrapolated further into life cycle requirements using hardware design parameters and manpower planning factors. As the illustration shows, estimates would be made of both the annual and life cycle operating and support manpower requirements. These estimates would be used as resource inputs for subsequent cost analysis.

There are three important features attached to this model concept:

- Generalized Methodology
- Manpower Estimating Relations
- Manpower/Training Requirements Data Elements

The following paragraphs will review each of these.

1. Generalized Methodology

Each different type of weapon system will involve a different set of requirements issues. A determination model must be designed in a manner allowing it to be adapted to different requirements determination problems. Consequently, the Requirements Model is divided into two parts: the Executive Model and the Equipment Model.

The Executive Model is an executive and "housekeeping" routine which controls the operation of the requirements analysis. All functions generally required by a computer-based model such as data entry, data management, and report generation are incorporated in the Executive Model.

Figure L-4 shows that the Executive Model has the ability to accept manpower estimating factors as data input, to retrieve manpower planning factors from a HARDMAN data base, and to produce reports based on predetermined formats.

The Equipment Model contains manpower equations permitting the enumeration of manpower and training requirements. Since each system involves unique design characteristics, these estimates would then be extended to determine fleet requirements and life cycle requirements. Sample algorithms are shown in Table L-1.

Training requirements would consist of two major types of resources. One is manpower and is basically determined as part of the manpower determination process. Manpower required to meet various forms of attrition would be required to receive some training based on types of skill, etc. These training requirements would also be used to determine staffing requirements for classes, instructors, and material.

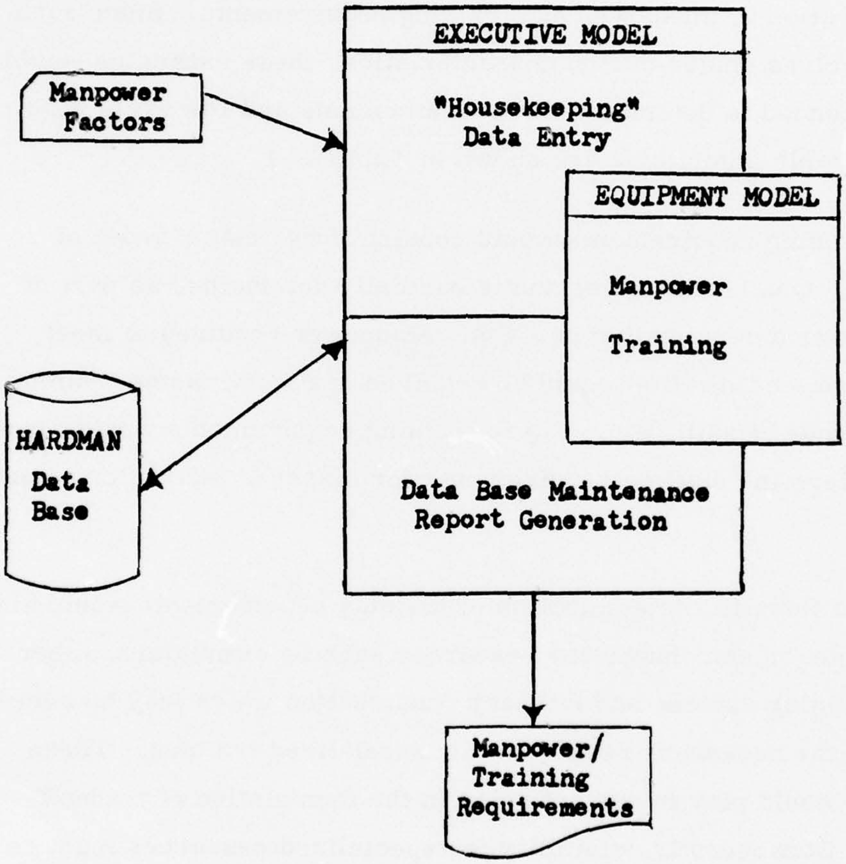
Additionally, determination of training requirements would also have to focus on non-manpower resources such as simulators, other special training devices and military construction which may be necessary to provide the necessary resources for specialized training. These resources would play important roles in the formulation of tradeoff analysis. Consequently, visibility for specialized resources must be given so that various alternatives may be weighed.

3. Manpower/Training Requirements Data Elements

Table L-2 lists data elements which may typically included in a requirements determination. The table indicates that during the Conceptual Phase less detailed data would be developed; whereas, at later stages,

Figure L-4

HARDMAN Manpower/Training Requirements
Model Concept



Manpower Requirements Algorithms

Annual Requirements/Unit

$$M_u = \sum_i m_i (1 + \ell_i) + \sum_j s_j (1 + \ell_j)$$

Annual Fleet Manpower Requirements

$$M_F = n \sum_i m_i (1 + \ell_i) + N \sum_j s_j (1 + \ell_j)$$

Life Cycle Manpower Requirements/Unit

$$LM_u = \sum_i m_i (1 + \sum_t \ell_i) + \sum_j s_j (1 + \sum_t \ell_j)$$

Life Cycle Fleet Manpower Requirements

$$LM_F = \left[n \sum_i m_i (1 + \sum_t \ell_i) + N \sum_j s_j (1 + \sum_t \ell_j) \right]$$

Where:

m_i = Operating manpower with skill i
s_j = Support manpower with skill j
ℓ_i = Attrition rate
n = Number of operating units
N = Number of support units, N = f(n)
t = System life, in years

- These algorithms estimate total man-years required for a weapon system during an operating year or life cycle
- Other algorithms may be used to estimate billets and numbers of personnel

Table L-2

Manpower/Training Requirements Data Elements

Data Elements	Concept Formulation	Engineering Design	
	System	Subsystem	Component
Manpower Requirements			
Officer			
Skill*	x	x	x
Occupational Grouping*		x	x
Mission Sponsor*		x	x
Enlisted			
Skill*	x	x	x
Occupational Grouping*		x	x
Mission Sponsor*		x	x
Civilian			
Skill*	x	x	x
Occupational Grouping*		x	x
Mission Sponsor*		x	x
Training Requirements			
Training Manpower			
Instructors	x	x	x
Students, Trainees	x	x	x
Support	x	x	x
Equipment and Facilities			
Training Devices	x	x	x
MILCON	x	x	x
Materials and Supplies	x	x	x

*Subelements:
- Direct Operating
- Maintenance
- Indirect Operating and Support

requirements estimates at the subsystem and component level by skill, occupational grouping and mission sponsor would be developed. These data would be further broken into categories of direct operating, maintenance, and indirect operating and support.

Specification of training requirements would be a subset of the manpower requirements to the extent that replacement manpower would be subject to training and that support would include instructors and other manpower supporting the training establishment.

Additional development efforts towards implementing a Requirements Determination Model will lead to a refined statement of data elements based on the list presented in Table L-2

D. Cost Determination and Life Cycle Costing Models

This last section of the Chapter discusses the life cycle costing (LCC) model. First, a general concept for costing is presented; like the Requirements Model, it is comprised of two models, an Executive and Equipment Model. In addition, a preliminary cost element structure is presented as a basis for subsequent development of the methodology.

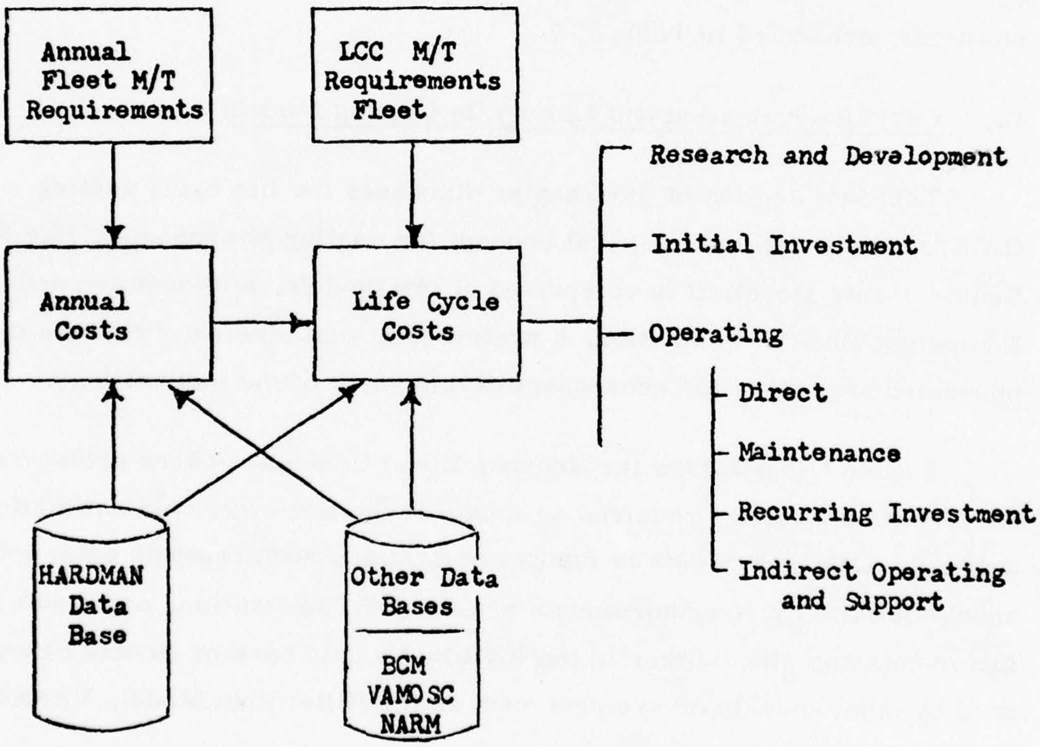
Figure L-5 portrays the General Model Concept. There are several different data sources required as inputs to the life cycle cost estimation process. One type of data is manpower/training requirements data; both annual and life cycle requirements are needed. In addition, cost and other factor data contained either in the HARDMAN data base or in data bases used by other models or systems such as the Billet Cost Model, VAMOSC, NARM, etc. are also required.

These data are combined initially to determine start-up costs as well as annual costs. The annual costs are then translated into time-phased costs over the life of the equipment. Outputs of the model would be in the form of a cost breakout such as illustrated (although the models will provide more detailed data).

Figure L-5

HARDMAN Cost Model
-General Concept-

From Manpower/Training
Requirements Determination



The Billet Cost Model provides cost data tied to the length of time particular billets are filled by personnel. The model can be used to determine billet costs. For purposes of HARDMAN, the manpower costs must be tied to the equipment life, not the length of duty. Consequently, while the Billet Cost Model can provide basic data, further effort will be required before the data is suitable for HARDMAN. A similar case exists with VAMOSC where operating and support costs for particular classes of equipment will be accumulated; these data may support the development of cost factors, but additional effort will be required for equipment types not included under VAMOSC. Furthermore, the issues involved with HARDMAN tradeoffs will have visibility only if cost factors are constructed for that purpose. Existing models have been designed to satisfy numerous other purposes.

Each tradeoff analysis will likely involve issues which are unique to the particular piece of equipment under study. Consequently, no single system cost model can meet all analytical needs. Different types of tradeoff problems will require different cost models.

An LCC model will have the following general characteristics:

1. The total resources implications of the weapon system to be costed are divided into three major cost categories related to its life cycle:

   Research and Development Costs: all those costs associated with the development of the system, typically covering activities and resources expanded during the first three WSAP phases to the point where the system is ready for introduction into the active inventory.

   Initial Investment Costs: one-time or initial outlays required beyond the development phase to introduce a new capability into operational use, typically corresponding to the WSAP Production Phase.

Annual Operating Costs: recurring costs required to maintain and operate the system throughout its projected life in operational use.

2. Each of these three major cost categories is composed of other sets of categories, labelled cost estimates, designed to include all significant cost elements.

3. The relation of each cost element and category is stated quantitatively.

4. The cost model of a particular weapon system is designed in a manner to assist in providing visibility to those cost elements having the greatest impact on the total cost and the tradeoff analysis which it supports.

5. The cost model in its final form usually is composed of a set of equations that state in quantitative terms the type of cost information desired.

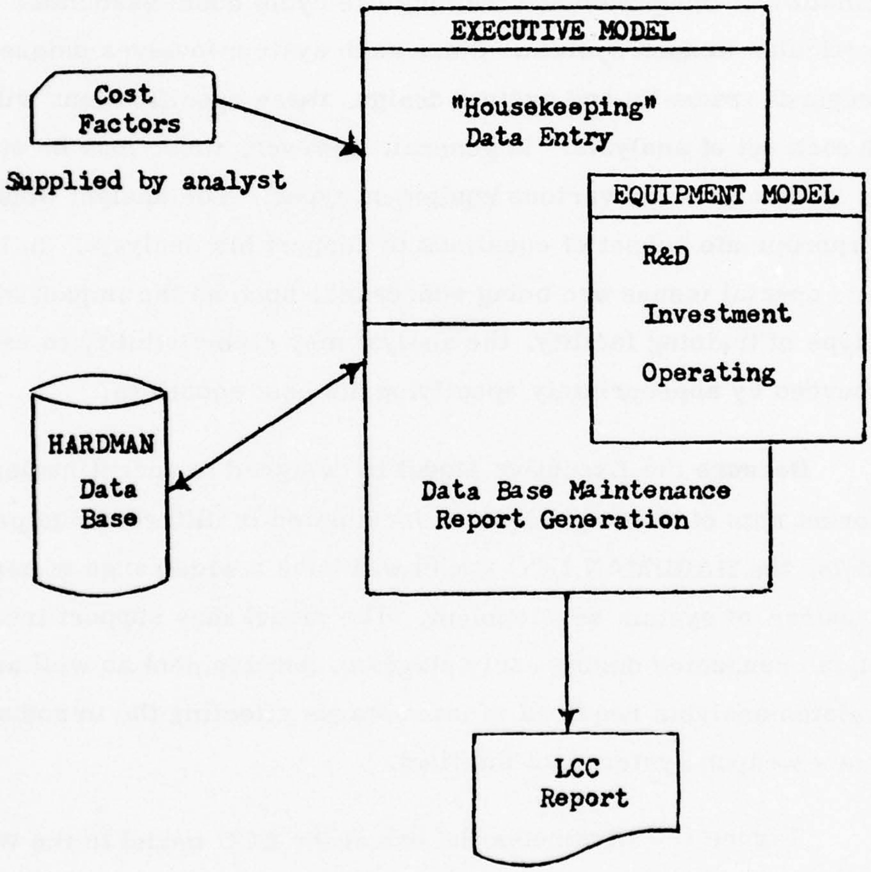
The preceding general characteristics dictate that the HARDMAN LCC methodology assume certain forms in order to effectively support tradeoff analysis. In general, the model must be adaptable to different weapon systems and tradeoff issues and the model must be suitable for refined application through successive stages of system development.

Figure L-6 illustrates the General Model Concept in terms of the adaptability requirement. As with the Requirement Model, the HARDMAN LCC model is divided into two parts; the Executive Model and the Equipment Model.

The Executive Model is an executive and "housekeeping" routine which controls the operation of the cost analysis. All functions generally required by a computer-based model such as data entry, data management, and report generation are incorporated in the Executive Model.

Figure L-6

HARDMAN LCC Model Concept



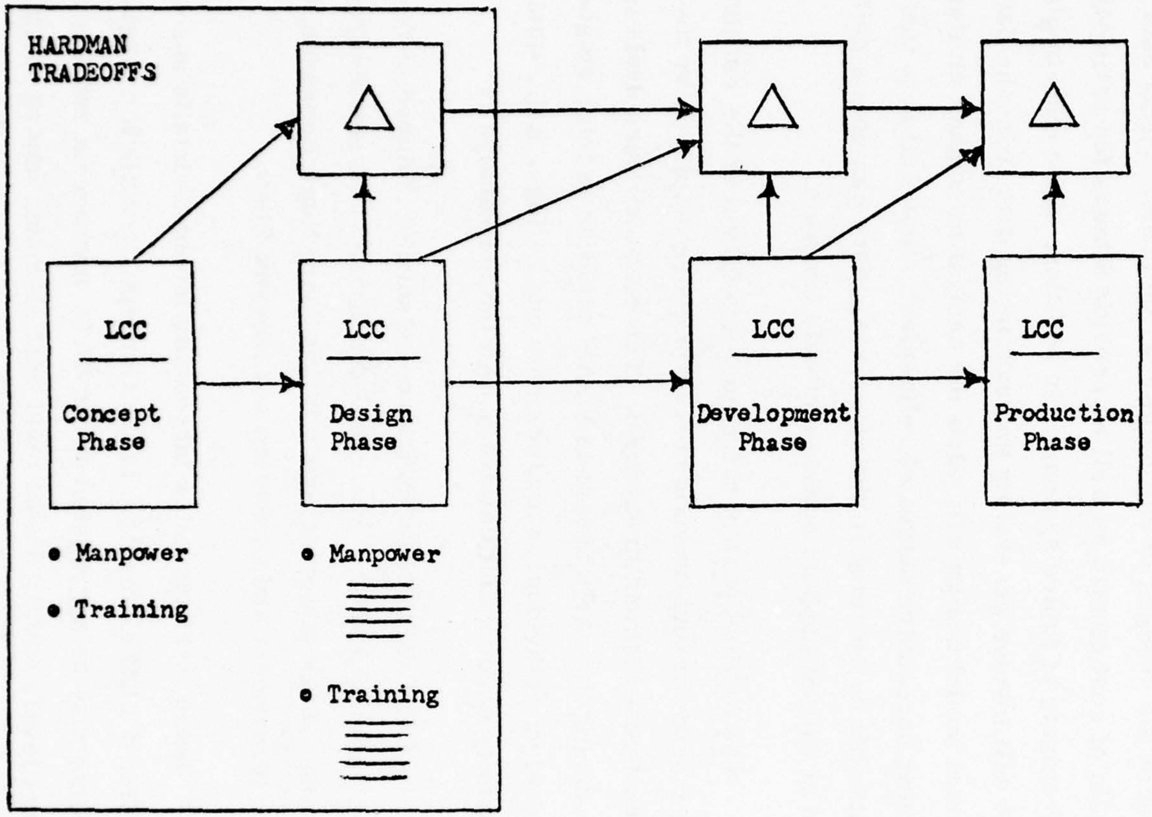
As the illustration shows, the Executive Model has the ability to accept cost factors as data input, to retrieve cost factors from a HARDMAN data base, and to produce reports based on predetermined formats.

The Equipment Model contains cost equations permitting the estimation of manpower and training life cycle costs associated with a particular weapon system. Since each system involves unique issues as regards tradeoffs and system design, these specifications will vary with each set of analysis. In general, however, there may be standard sets of equations for various equipment types. The analyst would select the appropriate subset of equations to support his analysis. In instances where special issues are being addressed, such as the impact of a particular type of training facility, the analyst may give visibility to related resources by appropriately specifying his cost equations.

Because the Executive Model is designed to accept numerous different sets of cost equations as formulated in different Equipment Models, the HARDMAN LCC Model will have a wide range of uses in the course of system development. The model may support tradeoff analysis conducted during early stages of development as well as assist in related analysis required in later stages affecting the introduction of the new weapon system into the fleet.

Figure L-7 illustrates the use of the LCC model in the Weapon System Acquisition Process. During the Concept and Design Phases when tradeoff analysis is occurring, the HARDMAN LCC Model may be used in direct support. During the Concept Phase, the model will be used to estimate aggregate manpower and training resource costs which may be used as benchmarks in the conduct of tradeoff analysis at this stage.

Figure L-7
Use of HARDMAN LCC in
WSAP



In the Design Phase, when the system design is being more specifically defined, the resource estimates may be refined to reflect greater levels of detail. Furthermore, the model is designed to monitor the changes in resource estimates from stage to stage. These changes will be retained in the HARDMAN LCC Data Base so that a complete record of the changes in estimates may be made. These data will facilitate analysis of cost growth as well as provide a basis for estimating resource requirements of future systems. In addition, since each application of the model will involve generating and extracting data from the data base, the proposed model design will allow the analyst to conduct an iterative analysis involving successive stages of refinement. Since all data that the analyst selects will be retained in the data base, there can be a significant accumulation of data to support subsequent data analysis.

The critical part of the Equipment Model is the estimation of life cycle manpower and training costs which are displayed by the model in a standard cost element breakdown. The cost structure deals in aggregate costs during the early stages of WSAP whereas in later stages beginning with design, individual manpower rate and ratings, i. e., quality as well as quantity become critical factors in the cost analysis.

Table L-3. lists the major cost elements included in the HARDMAN LCC equipment model. The costs are divided between Manpower and Training. Each major category is subdivided into Research and Development, Investment and Operating and Support Costs.

Table K-4 illustrates increasing levels of details associated with HARDMAN LCC elements. In the Concept Formulation stage, the cost elements may be aggregated at the R&D, Investment and Operating and Support levels without lower level cost elements having visibility; while

Table L-3

HARDMAN LCC Elements

- 1. Manpower Costs
  - 1.1 Research and Development
  - 1.2 Initial Investment
    - 1.1.1 Recruitment and Acquisition
    - 1.1.2 Initial Training
  - 1.3 Operating and Support
    - 1.3.1 Direct Operating
      - 1.3.1.1 Officers
      - 1.3.1.2 Enlisted
      - 1.3.1.3 Civilian
      - } by skills, occupational grouping, and mission sponsor
    - 1.3.2 Maintenance Support
      - 1.3.2.1 Officers
      - 1.3.2.2 Enlisted
      - 1.3.2.3 Civilian
      - } by skills, occupational grouping, and mission sponsor
    - 1.3.3 Indirect Operating and Support
      - 1.3.3.1 Officers
      - 1.3.3.2 Enlisted
      - 1.3.3.3 Civilian
      - } by skills, occupational grouping, and mission sponsor
- 2. Training Costs
  - 2.1 Research and Development
  - 2.2 Initial Investment
    - 2.2.1 Training Planning
    - 2.2.2 Facilities
    - 2.2.3 Training Aids and Devices
    - 2.2.4 Initial Training
  - 2.3 Operating and Support
    - 2.3.1 Instructors and Other Support Staff
    - 2.3.2 Facilities Maintenance
    - 2.3.3 Aids and Devices Maintenance
    - 2.3.4 Training Material
    - 2.3.5 Students

Table I-4
Cost Element Detail

Level I	Level II	Level III	Level IV
1. Manpower Costs			
1.1 Research and Development			
1.2 Investment	1.2.1 Recruitment 1.2.2 Initial Training		
1.3 Operating and Support	1.3.1 Direct Operating 1.3.2 Maintenance Support 1.3.3 Indirect Operating and Support	1.3.2.1 . . 1.3.2.n by rate and rating, time phased	by UIC and PE, FYDP integration NARM Compatibility
2. Training Costs			
2.1 Research and Development			
2.2 Investment	2.2.1 Training Planning 2.2.2 Facilitation 2.2.3 Training Aids 2.2.4 Initial Training		
2.2 Operating and Support	2.2.1 Training Manpower 2.2.2 Facilitation Mntnce. 2.2.3 Aids and Devices 2.2.4 Training Material 2.2.5 Student Manpower		

WSAP Phase	Cost Detail
Concept Formulation	I, II
Design	II, III
Development	II, III
Production	IV

the costs are derived by aggregating the more detailed elements, during the initial stages of analysis, the aggregate costs appear to have greater significance.

During later stages of analysis, greater levels of detail begin to be displayed. At subsequent stages, the cost elements are exploded in order to provide visibility to quality of manpower as well as quantities. At the very latest stages of development when the system is ready for fleet introduction and operation, the model is designed to restructure the cost elements into categories suitable for identifying costs for unit identifier codes (UIC) and program element (PE) providing a mechanism to integrate the HARDMAN data into the NARM and the FYDP.

At each stage of analysis, the cost estimated will be generated based upon the latest data and factor estimates which have been estimated. Changes in the total manpower and training life cycle costing estimates will be determined and a continuous record of these changes will be maintained.

APPENDIX M

EXISTING MODELS AND RECENT RESEARCH

A. Introduction

There are many formalized models in use today, or under active development, which bear directly on three functional areas developed in this HARDMAN report, namely, early identification of requirements, life cycle costs, and reporting and control.

This appendix is subdivided into five sections corresponding to the following descriptions:

- Billet Cost Model (BCM)
- Navy Resource Model (NARM)
- Visibility and Management of Support Costs (VAMOSC)
- Manpower Determination Model (MDM)
- Logistic Composite Model (LCOM)

The extent to which these models have been developed, including data sources and output reports, as well as their relationship to the HARDMAN effort as a whole will be discussed.

B. Billet Cost Model

The Billet Cost Model (BCM) was developed by the Bureau of Naval Personnel to provide the Navy with a means of computing the true economic cost of alternative types of manpower to the Navy. Base pay plus allowances vastly understates the economic cost of a particular billet to the Navy. The BCM includes the Navy's investment in training costs, as well as the housing, food, medical, and transportation expenses directly incurred by the Navy in the maintenance of a particular billet. The BCM is recognized as the best available estimate of the true costs of Navy manpower. Because it includes costs that, though directly related to manpower, are not included in other cost models, the BCM manpower costs tend to be higher than those projected by other models. For this reason, the BCM has been avoided by those attempting to project the full costs, including manpower costs, of capital acquisitions for the Navy.

1. Processing Features

The Billet Cost Model views each rating as a flow of men through a pipeline (30 years long) computing military manpower costs to the U. S. Government from initial procurement (recruitment) to the end of the 30 years.

An attempt is made to identify costs by rating and by length of service (LOS) and pay grade within that rating. The BCM attempts to distinguish between costs incurred at a particular LOS for which the benefits to the Navy (if any) accrue entirely in that LOS; and costs incurred in a particular LOS for which the benefits accrue to the Navy over future years. The first type of cost, e.g., base pay plus allowances, is allocated completely to that LOS year in which it is incurred. The second type of cost, e.g. recruitment costs and training costs, is amortized over the number of years that the benefits of this cost can be expected to accrue to the Navy. This amortization is based upon the continuation rates of the particular rating. In addition, the BCM attempts to distinguish "operational" costs (up costs) from "non-operational" costs (down costs). Operational costs are the costs arising from the performance of service in a billet that is directly beneficial to the Navy, while non-operational" costs are those costs incurred that are not directly related to the performance of services beneficial to the Navy, e.g., "transient, patient and prisoner" costs. The BCM is a unique costing model in that it includes the expected retirement liability costs of military manpower. Though this does not come from Navy's budget, it is a liability of the Department of Defense and the U. S. Government. The expected retirement liability is computed using actuarial procedures based on continuation rates in a particular rating and, therefore, changes by LOS in a given rating as the conditional probability of retirement changes.

2. Output Reports

Several cost and service statistics are available for output for each rating. In addition to the average billet cost reported by length of service and by pay grade within a given rating, the component costs such as base pay, retirement liability, and amortized school costs are shown. Additional service statistics include average LOS within a rating and within a paygrade of that rating, average paygrade of a particular LOS, and current inventories of ratings by paygrades and LOS.

3. Advantages and Disadvantages

Given manpower requirements, the Billet Cost Model is especially suited for computing manpower costs (as it is designed to). However, it suffers from a lack of acceptance, primarily because it includes all costs incurred by the Federal Government that are associated with Navy military manpower, and not simply those costs that appear on Navy's budget alone. The epitome of this type of cost is the BCM's treatment of retirement cost. Because the BCM includes costs ignored by other cost models, it tends to be shunned by those attempting to demonstrate the low operating costs of proposed capital acquisitions. In addition, the BCM presents, at best, an average total cost of a particular billet, which includes some fixed components. Ideally, a cost model capable of revealing the incremental cost of a particular billet is desirable. There is no such cost model currently available. The BCM is fully operational, and particular categories of costs (for example, retirement cost) can be taken out of the computation of billet cost with relative facility. The Billet Cost Model provides the best source of the military manpower costs of the Navy currently available.

C. Navy Resource Model (NARM)

The purpose of the NARM is to estimate the costs of alternative Navy force structures. The NARM was developed when the Fiscal Guidance Memorandum was incorporated into the PPBS cycle. Navy resource programmers were faced with the need for a method which would allow the rapid cost estimation of various force structures in order to be able to present timely responses to the POM and FYDP. Consequently, the NARM was developed to display five year cost estimates based on changes to ship, aircraft and support activities. The cost estimates are expressed in terms of dollar and non-dollar resources; the latter include military and civilian personnel.

The principal output of the NARM is the Resource Allocation Display (RAD) which serves as one of the key supporting documents in the POM. Figure M-1 illustrates the format of the RAD. As can be seen the RAD is a two dimensional display relating the resources of mission sponsors to those of sponsors of force/functions and Navy-wide support activities. Mission sponsors generally have responsibility for developing five-year plans for their resource needs; however, their decisions affect other sponsors since their resources are used by various force/function sponsors and support sponsors. Figure M-2 shows the RAD display in program element detail for OP-01. As can be seen, there is considerable overlap between OP-01 as mission sponsor and as a sponsor of Navy-wide support. However, it is also clear that many of the program elements belonging to the support sponsor are the responsibility of other mission sponsors. Similarly,

Figure M-1

DEPARTMENT OF THE NAVY
NAVY RESOURCE MODEL
RAD II-JAN FYDP
FEB, 1975

NAVY TOTAL OBLIGATIONAL AUTHORITY

	FORCE/FUNCTION					NAVYWIDE SUPPORT					
	SUBS OP 02	SURFACE OP 03	AIRFORCE OP 05	SURV, OP-95	OP 094	OP 01	OP 04	OP 09B	OP 098	OP 06	NAVY TOA
FY1977											
STRATEGIC											
STRATEGIC, OP-06											
TOTAL STRATEGIC											
GENERAL PURPOSE FORCES											
SEA CONTROL(LESS CV-AIR),OP-095											
SEA CONTROL A/C,OP-095											
SEA CONTROL AIR PLAT,OP-05/095											
PROJECTION A/C,OP-05											
AMPHIBIOUS,OP-03											
MINE & MIW,OP-03											
NAVY SUPT FORCES, MOBILE,OP-03											
MOBILITY,OP-04											
TOTAL GENERAL PURPOSE FORCES											
C CUBED											
INTELLIGENCE,OP-009											
FLEET COMMAND & COMM,OP-094											
CCP,OP-094											
TOTAL C CUBED											
GENERAL SUPPORT & LOGISTICS											
SUPPORT & LOGISTICS,OP-04											
SHORE COMMAND,OP-09B											
R&D SUPPORT,OP-098											
SUPPORT OF OTHER NATIONS,OP-06											
TOTAL GENERAL SUPPORT & LOGISTICS											
MANPOWER & TRAINING											
TRAINING,OP-099											
PERSONNEL SUPPORT,OP-01											
MEDICAL SUPPORT,OP-04											
TOTAL MANPOWER & TRAINING											
TOTAL FY1977											

Figure M-2
RAD Display for OP-01

	OP-02	OP-03	OP-05	OP-95	OP-94	OP-01	OP-04	OP-9B	OP-98	OP-06
OP-05						26126M 52512M				
OP-03						26125M 26211M 26311M 52511M				
OP-04						26496M 41898N 53584N 72896M				
OP-9B						26498M 91113M				
OP-98						63707N				
OP-99						26497M 58112M 58170N 63720N 64703N 81111N 81111M 81113N 81113M 81115N 81117N 81123N 81124N 81125N 81417N 82833N 88097N 91513N				
OP-01	35805N 35809N 88112N				35808N	59520N 88098N 81116N 81213N 81411N 81412N 81413N 81415N 81610N 35811N 58172N 84723N	35801N 35806N 78110N	91503N 91507N 91518N	65903N 65904N 65906N	12602M 35807N 88103N

some of the program elements of OP-01 mission sponsor belong to other sponsor's programs.

Figure M-3 shows the computer program structure of the NARM. The basic set of input data is contained in the working data file, referred to as the WDATA file. The computer programs use this data as well as user instructions to produce the results data file or RDATA file.

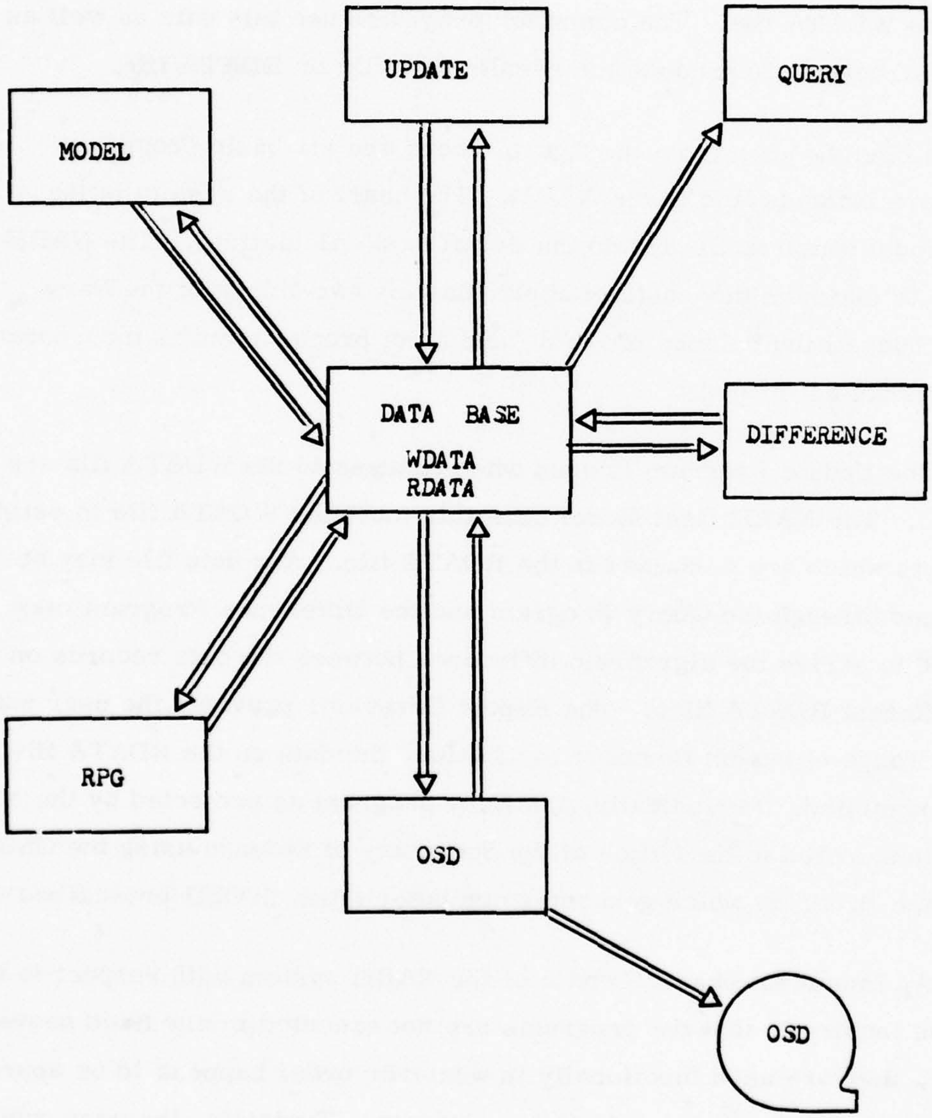
As can be seen from the figure, there are six basic programs which are incorporated in the NARM. The heart of the system is the Cost Model which is used to do the actual cost calculations. The NARM is able to estimate the costs of approximately two-thirds of the Navy O&M budget; the balance of O&M and most procurement is incorporated in the model as thruputs.

The Update Program is used when changes to the WDATA file are desired. The NARM Cost Model uses this modified WDATA file to estimate the costs which are contained in the RDATA file. Any data file may be examined through the Query Program and the Difference Program may be used to derive the algrebraic difference between the data records on two different RDATA files. The Report Generator provides the user with a wide range of report formats; in addition, the data on the RDATA file may be accumulated. Periodically, the Navy program as projected by the NARM is communicated to the Office of the Secretary of Defense using the OSD Interface Program which generates computer tapes in OSD-prescribed formats.

An important characteristic of the NARM system with respect to the present inquiry is that the programs are not executed in any fixed sequence; rather, they are used functionally in whatever order happens to be appropriate for a particular resource estimation problem. Typically, the user would

Figure M-3

NARM II System



execute the Update Program and then the Cost Model; since the budgetary impact of several different kinds of changes may have to be examined, the Update-Cost Model combination might be run any number of times. At any point the Difference and/or Query programs might be run. The Report Generator which is probably the most used program in the NARM System provides a final summary of the proposed Navy budget.

By January 1973, several major operation problems were faced by NARM users. Essentially, a system originally designed to be operated on a batch-oriented computer system using tape drives as major data storage method could not function efficiently in the third generation computer environment of a UNIVAC 1108 whose data storage principles are oriented to mass drum storage. Consequently, the NARM was upgraded to perform more efficiently. The modified system has been called FLAIL NARM for Force Level Analysis Interactive Language which allows for significantly more efficient data handling as well as the ability to operate the system in the interactive mode. Functionally, the system remains basically the same.

1. Advantages and Disadvantages

The NARM presents cost and manpower estimates at high levels of aggregation, but can still be of use in analyzing requirements for specific weapon systems. The primary advantage of using the NARM is that it already exists and can be used immediately. The NARM offers cost factors for various operating and support cost elements which can be used in parametric cost estimation models, aggregates these at the program unit and higher levels, and shows the implications of various force structures on overall budget and end strength within the POM time frame. However, the NARM is oriented to providing input to the FYDP and does not go into sufficient detail to reflect differences that occur from one weapon system to another (e.g. in estimating manpower costs, an average figure is used for all enlisted men, with no distinction made for paygrade or length of service). While these methods are suitable for computing costs in the aggregate, they become a little bit too "rough" for distinguishing between specific weapon systems. Therefore the most beneficial use of the NARM would be in providing cost element values for parametric cost models and historical aggregate costs and manpower requirements to help establish cost and manpower estimating relationships.

D. VAMOSC - Management Information System

The VAMOSC MIS, when implemented, will provide historical operating and support costs by weapon system, subsystems, and components by function and by other categories. The purpose of the system will be not only to illustrate the support costs by weapon and support system, but also to facilitate review and tradeoffs for DSARC consideration. The ship portion of the system design was completed June 30, 1976 with the hope that FY77 data can be provided by March 1978. The VAMOSC-Air MIS scheduled is to be implemented by Dec. 1976. The remainder of this section presents a brief description of the VAMOSC-ships study, the data sources to be used, and potential utility in HARDMAN methodologies.

1. VAMOSC Study

The VAMOSC study group was directed to:

- Review existing Navy cost accounting systems and develop specifications for procedures to identify support cost by weapon and support system, to facilitate review and trade-offs for DSARC consideration and to provide identification of actual support costs of specified systems, subsystems, and components
- Identify unique Navy organizational requirements and data system configurations in order to provide the basis for cost-effectiveness measurements for support cost data system design.

The initial survey of existing data systems involved over 2000 individual data systems, of which 110 were selected as potential data sources for the VAMOSC MIS. These were further whittled down to the less than 20 systems that comprise the proposed system. The following paragraphs discuss the results of the study.

2. Data Sources

There are four broad categories of data sources that are used for the VAMOSC MIS; financial, maintenance, personnel and supply management systems. Within this framework eighteen specific existing data sources were identified and are listed in Figure M-4. These are taken from the draft VAMOSC report dated June 30, 1976, and have been approved for use by the Advisory Committee with the exception of the Billet Cost Model. It was decided to use the Navy Composite Standard Rate for the time being, since it represents more closely the direct personnel costs, and since it is consistent with the Air Force, Army and VAMOSC-Air Systems.

Figure M-4

VAMOSC Data Sources

NAVCOMPT

- NCIS

CNO

- NARM

CNM

- Maintenance Data Collection System (MDCS)
- MSOD
- MEASURE
- Engineering and Technical Services
- Strategic Systems Project Office

NAVSEA

- SHIPMIS
- Shipyard Departure Report
- Management Report of Shipwork Progress
- SAMIS
- NAVSEASYSCOM Internal Reports

NAVSUP

- Navy Publication and Forms Center
- Conventional Amnunition Integrated Management System (CAIMS)

Naval Electrical Systems Command

- NXBFM - Navelex Budget Forecast Model

NAVAIR

- NARF

BUPER

- BCM

Fleet Command

- DPSCCLANT/DPSC Peal Harbor Data Systems

3. System Concept

The key consideration in the VAMOSC objective of achieving visibility for operating and support costs as they relate to specific weapon systems was to include only those direct costs and appropriate indirect costs which would not otherwise be incurred if the system were not procured. For this reason, costs collected are those that are the result of a demand for material or services placed upon the Naval Establishment by an individual ship as a direct result of some increment of activity. Excluded are acquisition, initial outfitting/stocking, other initial integrated logistic support and major conversion costs. Also excluded are indirect costs of functions, activities, material and services not directly related to the operational requirement of a specific ship. Replenishment, repair, or modernization of those items provided for the ship are considered an appropriate Operating and Support cost. Loading of costs is kept to a minimum.

There are two structures used for displaying the cost data at various levels of aggregation: 1) Total Support System (TSS), a management level system, presents an aggregate cost for each of 90 specific cost elements and summation of these costs for each ship. 2) The Maintenance Module System presents maintenance expenses through several levels of equipment work breakdown detail. TSS is the system which is of interest to the HARDMAN effort. Figure M-5 shows the first two levels of the VAMOSC cost element structure reported under TSS.

4. Advantages and Disadvantages of Existing Data Systems

One of the advantages of the proposed VAMOSC MIS is that it will use existing data sources without modification for the most part (the only possible exception is in determining manpower costs: the Billet Cost

Figure M-5

COST ELEMENT BREAKDOWN STRUCTURE SUMMARY

1.0 Direct Unit

- 1.1 Personnel
- 1.2 Material
- 1.3 Purchased Services

2.0 Direct Intermediate Maintenance

- 2.1 Labor
- 2.2 Material

3.0 Direct Depot Maintenance

- 3.1 Scheduled Ship Overhaul
- 3.2 Non-Scheduled Ship Repair (RA/TA)
- 3.3 Fleet Modernization Program
- 3.4 Other Depot

4.0 Direct Recurring Investment Material

- 4.1 Exchanges
- 4.2 Issues

5.0 Indirect Operating and Support

- 5.1 Training
- 5.2 Publications
- 5.3 Engineering and Technical Services

Model is not widely accepted, and the developing Joint Uniform Military Personnel System (JUMPS) was mentioned as an alternative source for obtaining these data). For the same reason, there is a disadvantage in using the VAMOSC MIS in the near term since VAMOSC itself is not an existing system and may run into implementation problems.

Aside from the question of system availability, the VAMOSC concept can be very useful in performing hardware/manpower tradeoff analyses because it offers a historical base for the very costs to be traded-off. Various cost estimating relationships can be established using the VAMOSC data base, and operating and support costs can be predicted for new weapon systems. However, for radically different weapon systems where the same manpower relationships may not hold, the VAMOSC is of little utility, except in perhaps establishing the various cost elements that must be estimated. A disadvantage of the VAMOSC MIS is that in striving to restrict itself to direct costs only (and "appropriate" indirect costs), there have been costs omitted that really are incremental; (i.e., incurred as a result of the weapon system under consideration.) The reason these costs have been excluded is that they are resources that will be used up by the Navy whether or not a specific weapon system is introduced, however, minimizing the use of these resources by one weapon system will allow perhaps another system the opportunity to continue using the same resource. Since it benefits the Navy to minimize the use of these resources; the cost computations for the new system should reflect this.

E. Manpower Determination Model

The Manpower Determination Model (MDM) consists of a system of computer programs developed to determine and compile ship manning requirements during the Concept Formulation Phase of ship acquisitions. It was also designed to generate manpower evaluation baselines during the contract evaluation phase of a weapon system development. Master data files containing manning data are employed which are organized into unique systems and subsystems to permit a user to select alternative functional configurations for which manning requirement information is desired. Stored data are processed by routines which retrieve selected systems representing specific functional configurations, combine manning requirements, cross-utilize personnel, and report manning requirements in both detail and summary form.

This model is used by NAVSEC during feasibility studies to provide manning estimates of new ships and subsystems. These estimates are constructed incrementally from an historical data base. Data from fleet surveys on a variety of ship classes and equipment categories have been recorded, such as 3M corrective maintenance reports associated with existing shipboard systems, as well as best engineering information available on new systems.

The MDM uses data files which relate operational and maintenance manning requirements to specific systems through individual "modules". Modules for non-equipment related functions such as support and administrative manning are also included in the MDM. From the preliminary system and equipment list for a ship, modules are selected for entry into the MDM. The MDM then compiles the modules into a first estimate of total shipboard manning and performs a cross-utilization of personnel to achieve minimum effective manning. This model provides estimates of total manning requirements judged by NAVSEC to be 95% accurate for ship design purposes and allows for both officer and enlisted manning levels to be computed. The breakdown into rate and ratings can be provided but the reliability of these figures are judged to be only 75% accurate since they are simply feasibility estimates. This model provides the initial best estimate of manning requirements for ships and subsystems and is used as input to more detailed analysis in preparation of preliminary ship manning documents.

F. Logistics Composite Model

The Logistics Composite Model (LCOM) is a computerized simulation model used extensively by the Air Force. It permits evaluation at gross or detailed levels of aircraft flight operations by examining the impact of resource levels, maintenance, supply and support policies and practices. The LCOM Model simulates the operations, supply, and maintenance actions of aircraft squadrons operating from shore based activities. It employs a flexible networking concept that allows the user to explore a wide range of problems without excessive modification. Parts failures and supporting maintenance actions can be made a function of flying hours, sorties, calendar time or many other input parameters.

The usefulness of the model is primarily in the conceptual or early design stages of aircraft system acquisitions. Based on an operational scenario, the model simulates maintenance actions that drive manning requirements such as scheduled and unscheduled services, corrective and preventive maintenance, and peak load demands.

The input data required include operating and maintenance tasks from launch to recovery. Data include mission type, sortie length, priorities, aircraft types, flight size, lead and delay times, and spare parts availability. The output of the model is a complete breakout of manning levels to cover operating, maintenance, and shore based activities directly related to the functioning of a flight squadron.

The model was developed by the Air Force Human Resources Laboratory, Wright Patterson Air Force Base, and requires a small group of people including a systems analyst and programmer to generate the appropriate model input descriptions for use each time a new aircraft type is being considered.

The features of this LCOM model allow for trade-off decisions and manpower projections to be employed by planners during a weapon system's development. It has been used successfully in the design of the TAC F-4E and the A-10 weapon system.

APPENDIX N

TASK STATEMENTS FOR HARDMAN/SHIPS DEVELOPMENT

A. Introduction

The purpose of this appendix is to present descriptions of the tasks which comprise the recommended implementation plan. The HARDMAN development effort is broken up into five major tasks: Information Requirements Determination, Development of Analytical Models, Review Procedures Development, Reporting and Control System Development, and Required Documents Processing System Development. A discussion of each task is accompanied by milestone charts depicting the level of effort and the time phasing of the appropriate subtasks. Descriptions of the subtasks are included and follow the general task discussions.

B. Task Descriptions

Task 1: Determine Information Requirements

Certain information is required to carry out the manpower/training management function. This task is to determine what that information is and how to keep future information needs identified and met. The results of this task will be used extensively in the remaining HARDMAN development, providing input to the design of analytical techniques and review procedures, the reporting and control system, and the system for processing required documents.

This task has been broken down into four subtasks: identifying information focal points, determining initial requirements, establishing procedures for determining future requirements, and evaluating and redesigning the requirements and procedures. Figure N-1 depicts the time phasing and level of effort required for completion of this task.

1-1 Assign Responsibilities for Developing and Maintaining Information Requirements: Identify information focal points within OP-01/99 and NAVMAT. These will be the staff elements with the greatest need for manpower/training information, and will become the primary users of the analysis techniques and the MIS after implementation. Assign responsibilities to these focal points as well as to primary information requirements analysts.

1-2 Develop Initial Information Requirements: Determine initial manpower/training information requirements. Conduct comprehensive interviews within focal points and combine with results of previous HARDMAN analysis to formulate basis for requirements.

1-3 Develop Procedures for Reviewing and Revising Information Requirements: Develop procedures for identifying additions to and changes in manpower/training information requirements after HARDMAN implementation. The procedures will provide for the seeking out of new or changing requirements in addition to being responsive to user requests.

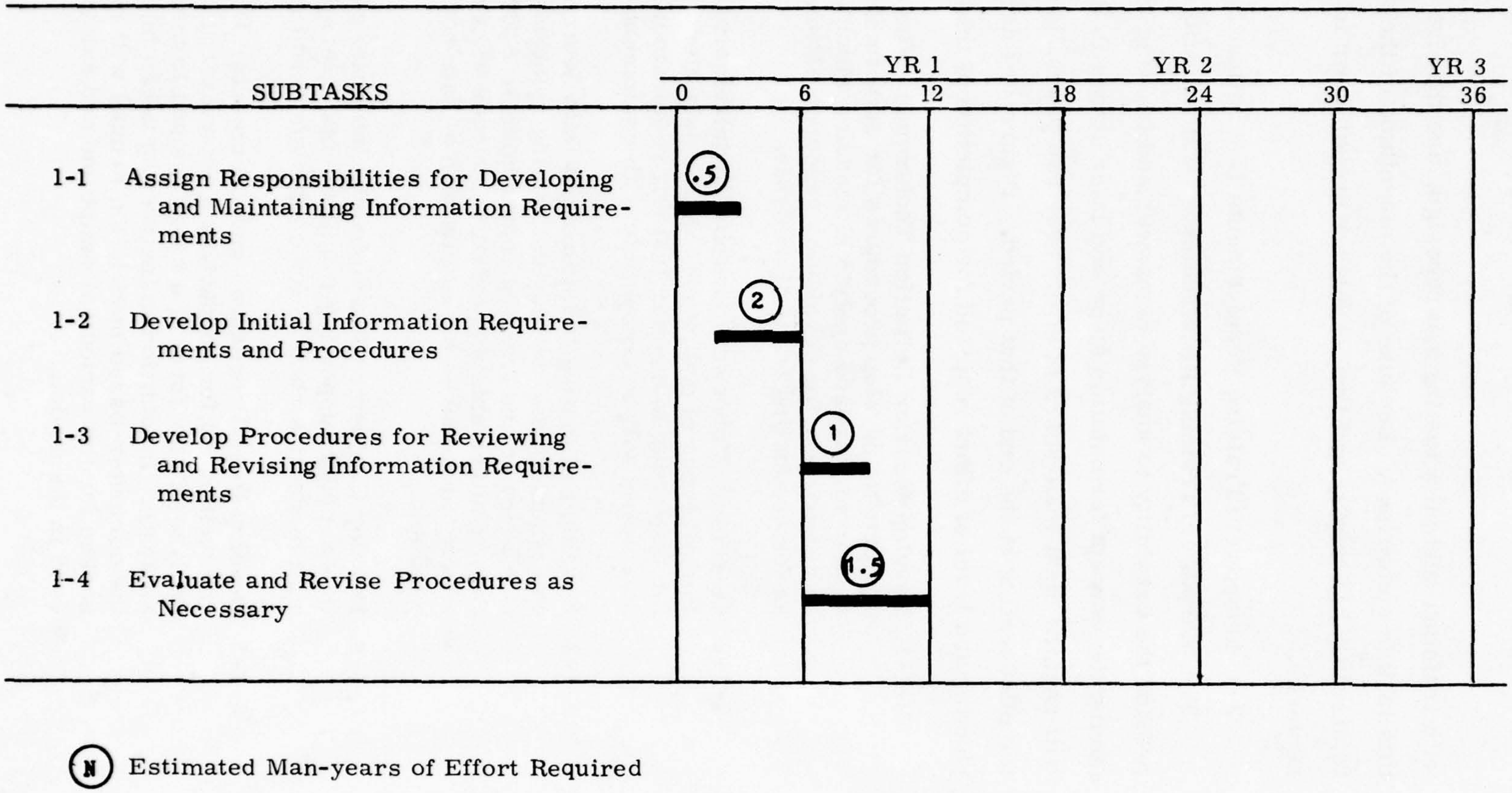
1-4 Evaluate and Revise Procedures as Necessary: Evaluate and redesign both the initial information requirements and the procedures for determining future requirements. This phase will be a series of iterations involving OPNAV sponsors as well as the manpower/training planning community.

Task 2: Develop Analytical Techniques and Models

Three major areas of analytical support are required for treating manpower considerations in the WSAP: manpower/training requirements determination, like-cycle costing, and tradeoff analysis. These, along

Figure N-1

HARDMAN Information Requirements Determination



with training, and pilot testing and redesign, are the five subtasks of which this task is comprised. Because of the magnitude of the subtasks, each is discussed generally and then is further broken down into smaller subtasks.

2-1 Manpower/Training Requirements Determination

The Manpower/Training Requirements Determination module will provide the capability to analyze manpower and training requirements during the concept formulation stage and later stages in the WSAP. It will require eight man-years of effort over two years, becoming ready for pilot testing at the end of that period. Figure N-2 depicts the time-phasing and level of effort required for completion of this subtask.

2-1-1 Develop Modular Definition Techniques: For all types of equipment, develop procedures for structuring the weapon system in standard analytical modules which can be used as components for developing resource estimates as well as for conducting tradeoff analysis.

2-1-2 Determine Manpower/Training Requirements Data Elements: For all types of equipment, define data element structures for displaying manpower training requirements; data element structures will be compatible with equipment modules.

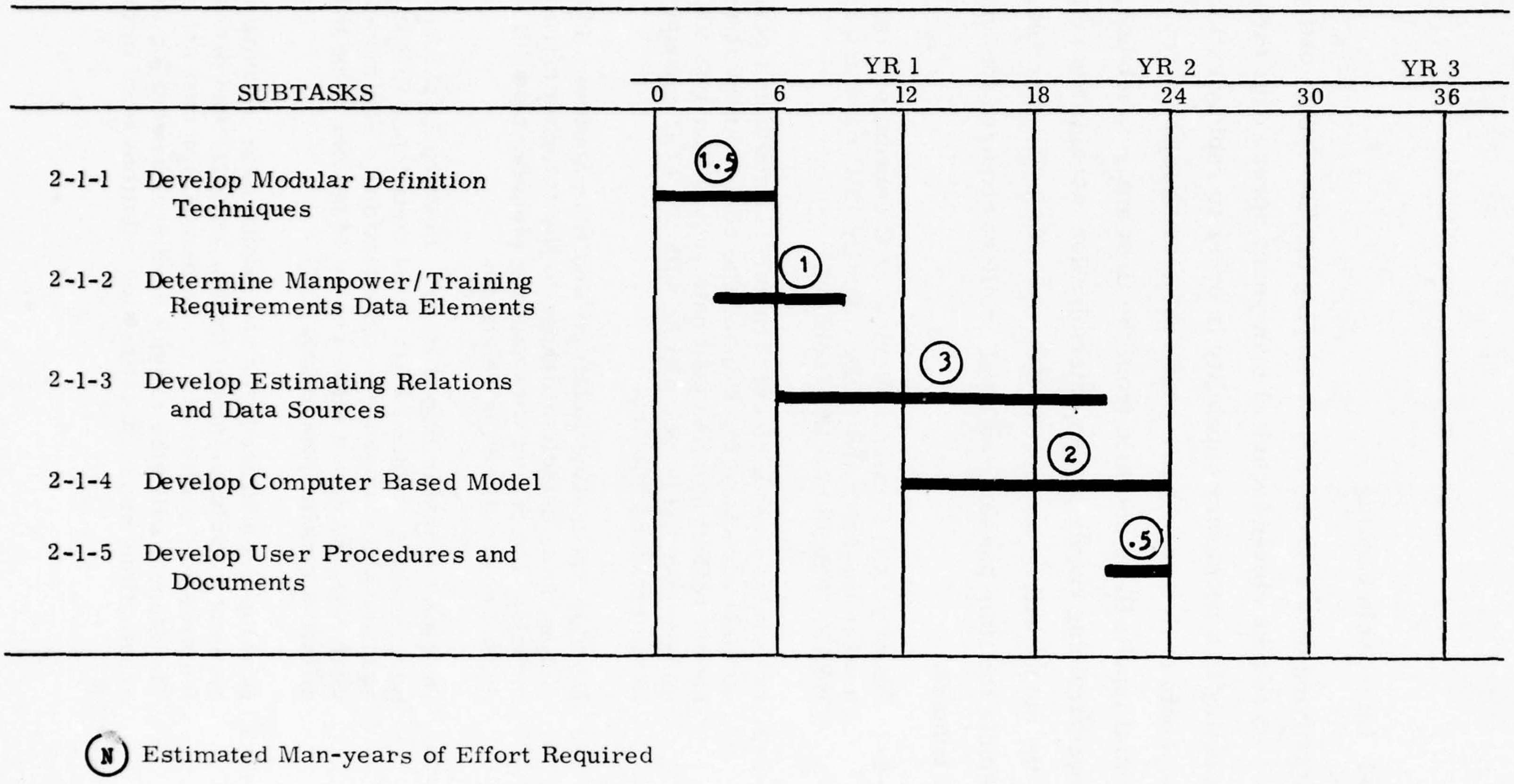
2-1-3 Develop Estimating Relations and Data Sources: For selected equipment types, develop estimating relations for determination of manpower and training requirements. Additionally, identify data requirements and existing sources where they exist; specify procedures for acquisition of data not currently available.

2-1-4 Develop Computer-Based Model: Integrate estimating relations into a model supporting requirements determination compatible with modular structure for equipment definition.

2-1-5 Develop User Procedures and Documents: Document procedures and techniques for conducting manpower/training requirements analyses in the form of a users manual for manpower/training analysts. In addition to instructing users in how to exercise the computer-based model, the manual will provide technical backup for the various assumptions and estimating relations used in the model.

Figure N-2

Manpower Training Requirements Determination Module



2-2 Life-Cycle Costing

Identifying data sources and developing the life-cycle costing model is expected to take eleven technical man-years spread over three years. Life cycle costing is a necessary capability in order to rapidly estimate manpower/training costs such that they are comparable and subject to tradeoff. Substantial input will be obtained from the first analysis module, the manpower/training requirements determination module; and principal use of the output will be as input to the tradeoff analysis module. Figure N-3 depicts the time phasing and level or effort required for completion of this subtask.

2-2-1 Identify LCC Concept: Review LCC conventions and procedures used in the Navy and DOD. Identify LCC parameters in the WSAP. Formulate LCC concept.

2-2-2 Determine Cost Element Structure: Establish a general cost element structure for ships. The cost element structure should reflect existing cost data acquisition systems as much as possible and be compatible with the LCC concept developed in the previous subtask.

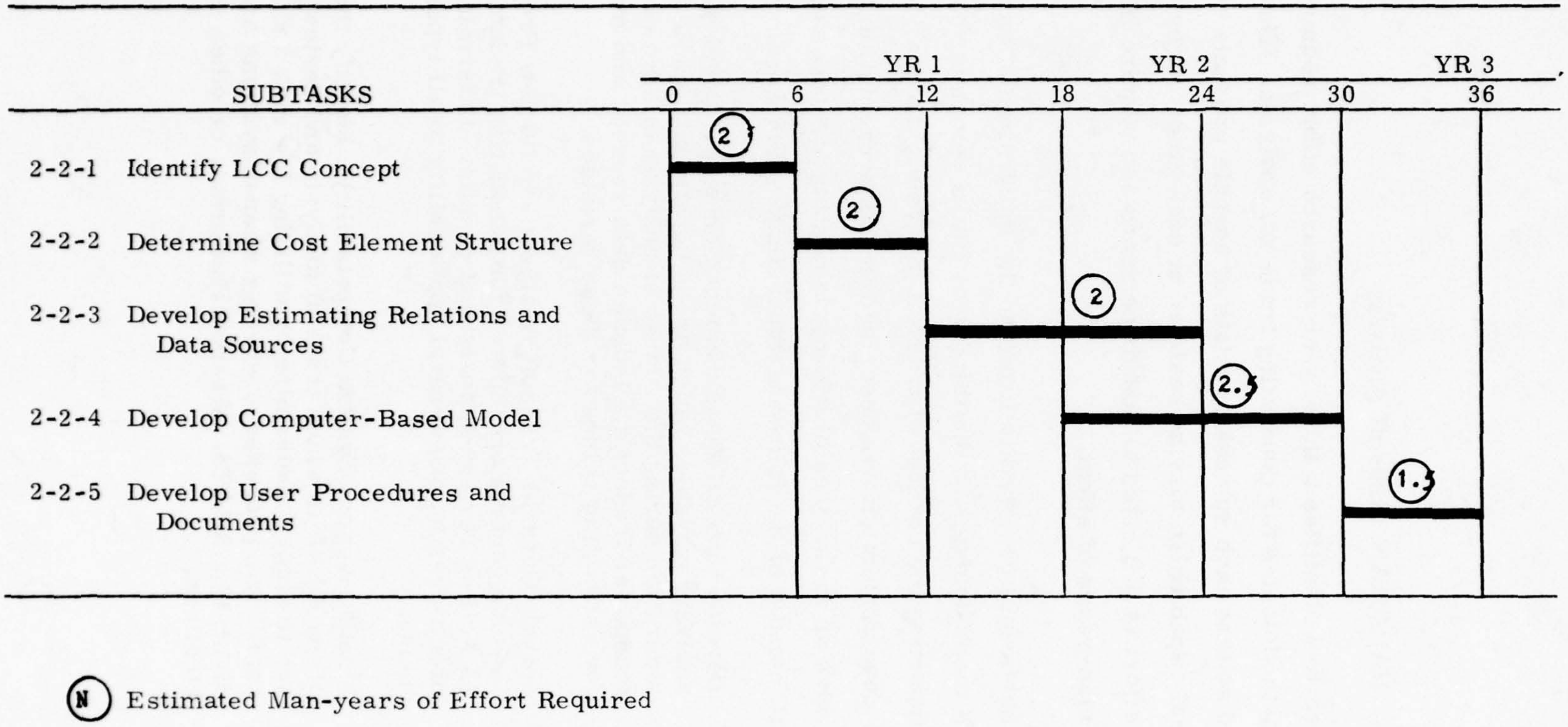
2-2-3 Develop Estimating Relations and Data Sources: Identify sources of cost data, establish linkage to the manpower/training analysis module. In concert with existing planning models, develop needed cost estimating relations.

2-2-4 Develop Computer Based Model: Develop LCC Model including housekeeping module, R&D cost equations, investment cost equations, and operating cost equations. The model should be user oriented with a clear choice of options to be used with different costing problems.

2-2-5 Develop User Procedures and Documents: Document cost element structure, model inputs, outputs, and processing features in the form of a users manual for cost analysts. The manual will also provide technical backup for the assumptions and cost estimating relations used in the model.

Figure N-3

Life Cycle Costing



2-3 HARDMAN Tradeoff Analysis

Figure N-4 identifies a three year research effort required to develop methodologies for conducting trade off analysis. The effort is structured so that each subtask consists of useable products and so that incremental capabilities may be realized at each stage of development. The total effort is projected to last three years and require fifteen technical man-years of effort.

This subtask is designed to focus on the integration of various HARDMAN methodologies in the third year into a computer-based system supporting the conduct of tradeoff analysis. To realize this objective, development efforts described in this presentation as well as others such as in the area of life-cycle costing are necessary. This subtask will consist of the following subordinate subtasks:

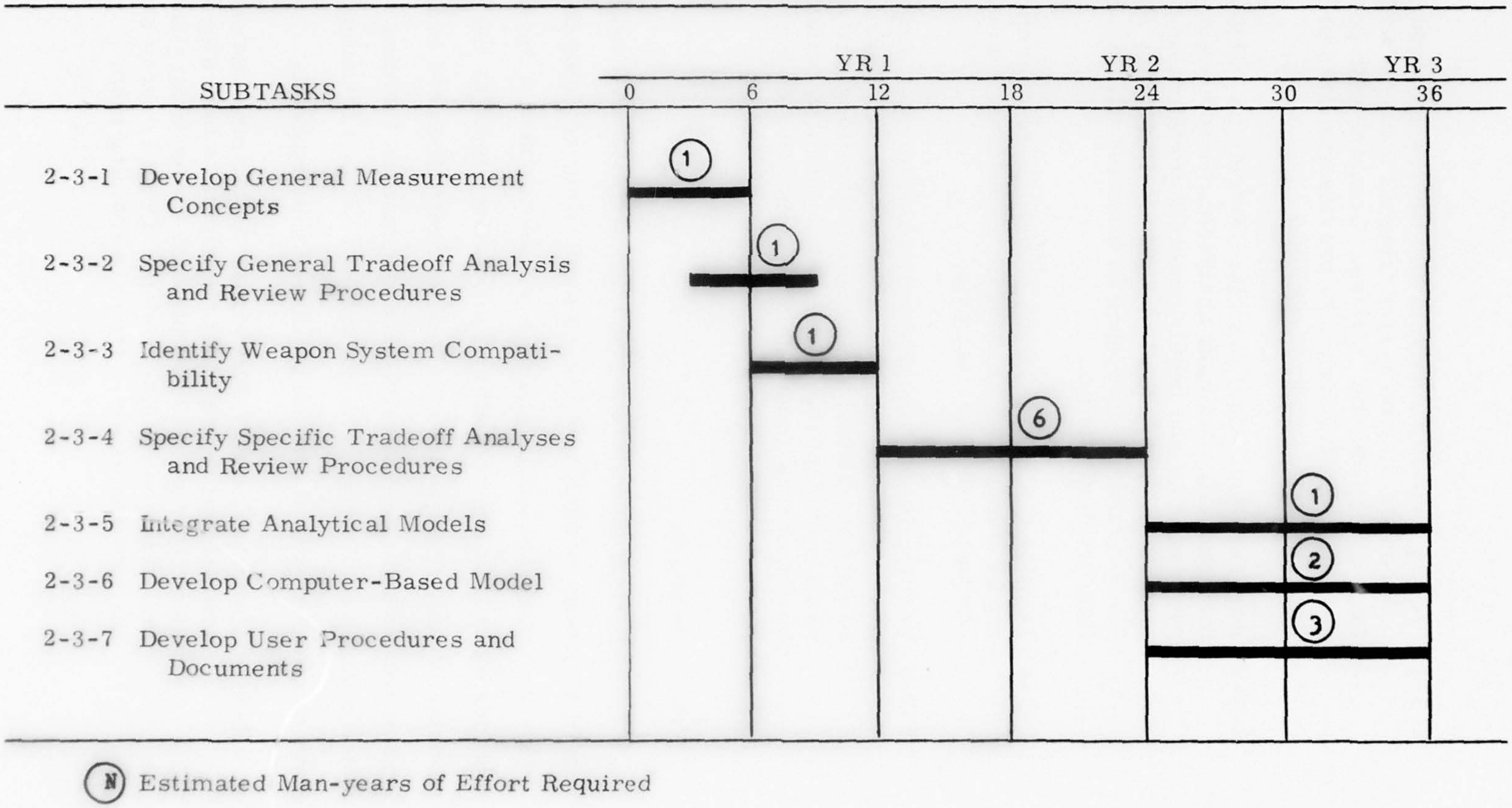
2-3-1 Develop General Measurement Concepts: Develop a set of analysis variables which are generally applicable for consideration during the course of analysis of hardware vs. manpower tradeoffs. Indicate data sources and methods for estimating values for these variables.

2-3-2 Specify General Tradeoff Analysis and Review Procedures: Develop general procedures for conducting tradeoff analysis as well as reviewing analytical results. Determine and specify procedures having general applicability to all types of equipment.

2-3-3 Identify Weapon System Compatability: Identify those components of the WSAP to which tradeoff analysis and review procedures are to apply. Determine by utilizing low risk and level of confidence procedures whether weapon systems are to be divided by ACATs, Weapon Platforms, or other system combinations.

Figure N-4

HARDMAN Tradeoff Analysis



2-3-4 Specify Tradeoff Analysis and Review Procedures: Develop procedures for conducting tradeoff analysis within the framework of weapon acquisitions. Combine with general procedures developed in first year, to provide standard procedure for conducting tradeoff analysis.

2-3-5 Integrate Analytical Models: Develop an integrated model for conducting tradeoff analyses; methodologies for life-cycle costing and requirements determination will be combined with the tradeoff procedures to provide a total system. System concept developed in this task will be the basis for final implementation.

2-3-6 Develop Computer-Based Model: Develop computer-based model integrating analytical capabilities in manner to support conduct of tradeoff analysis.

2-3-7 Develop User Procedures and Documents: Document tradeoff module inputs; outputs, and processing features in the form of a users manual for manpower/training analysts and weapon system designers. The manual will also include technical backup for assumptions and methodologies used within the module.

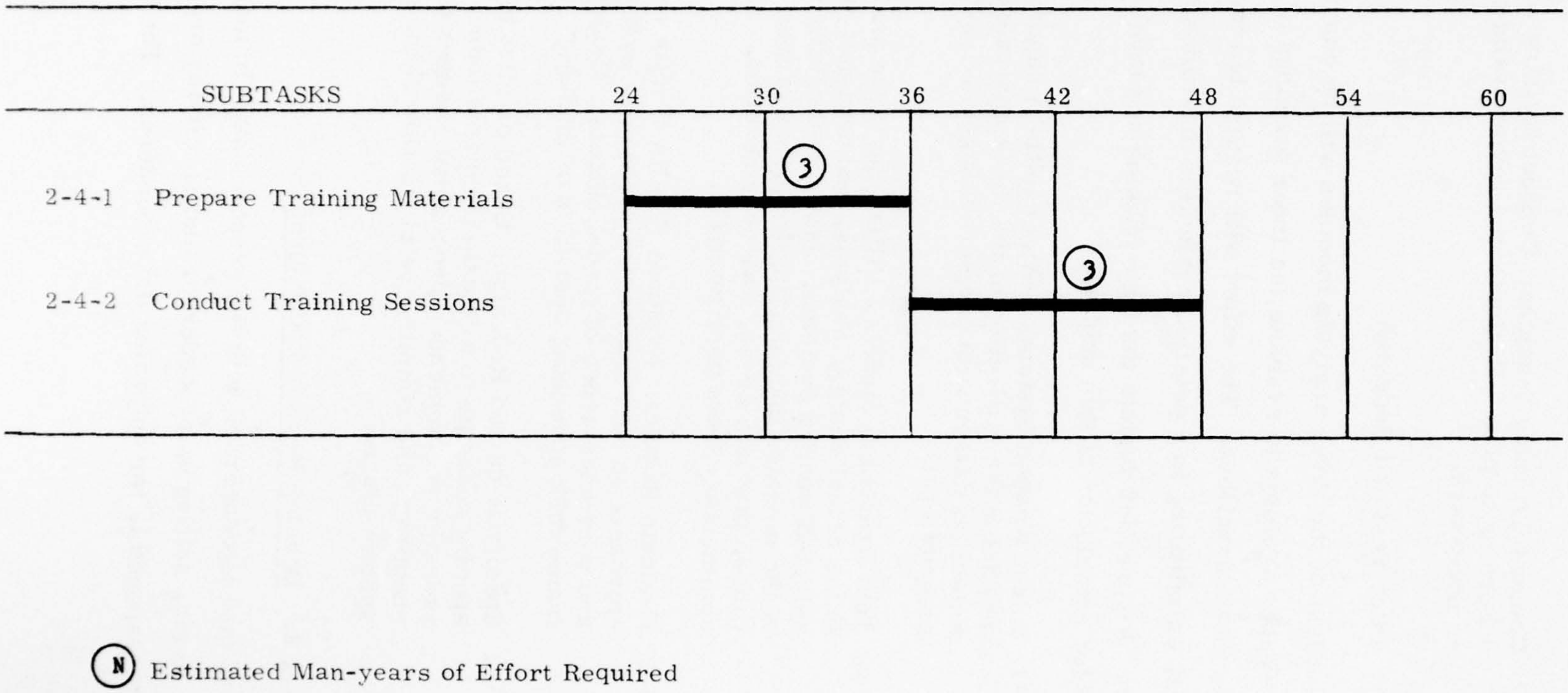
2-4 Training

The analytical models developed under HARDMAN will be of little benefit if nobody is qualified to used them--thus training user analysts is a very important subtask. Analysts will be trained in the analytical methods as well as the operational procedures used by the HARDMAN models. It will require six man years of effort spread over two years to prepare the training materials and conduct the training sessions which comprise this subtask. Figure N-5 depicts the time phasing and level of effort required for completion of this subtask.

2-4-1 Prepare Training Materials: Determine quantity required and selection criteria for analysts to be trained. Identify subject areas which contribute to the understanding of the use of the analytical models. Design course structure, prepare training materials. Prepare training plan.

Figure N-5

Training



2-4-2 Conduct Training Sessions: Conduct training sessions according to plan. Evaluate and revise training materials as necessary.

2-5 Pilot Test and Redesign

A pilot test of the three analysis modules will be conducted with selected weapon systems to evaluate the inner workings of the modules as well as the interactions. The effort will require ten man years over two years, culminating in a detailed evaluation and redesign prior to full operation. Figure N-6 depicts the time phasing and level of effort required for completion of this subtask.

2-5-1 Select Weapon Systems: Select initial weapon systems to maximize the utilization of the three analysis modules. Establish liaison with project managers, issue implementing instructions.

2-5-2 Test Analytical Models: Utilize the three analytical models in the actual design, analysis, and decision process of the selected weapon systems. Monitor carefully the operation of the models, documenting frequency of use, turnaround times, problem areas, and user reaction. Solicit technical commentary from user analysts.

2-5-3 Evaluate Results: Evaluate results of pilot test with special emphasis on data acquisition problems, system interaction, and user acceptance of model outputs. Evaluate procedural framework governing operation of models.

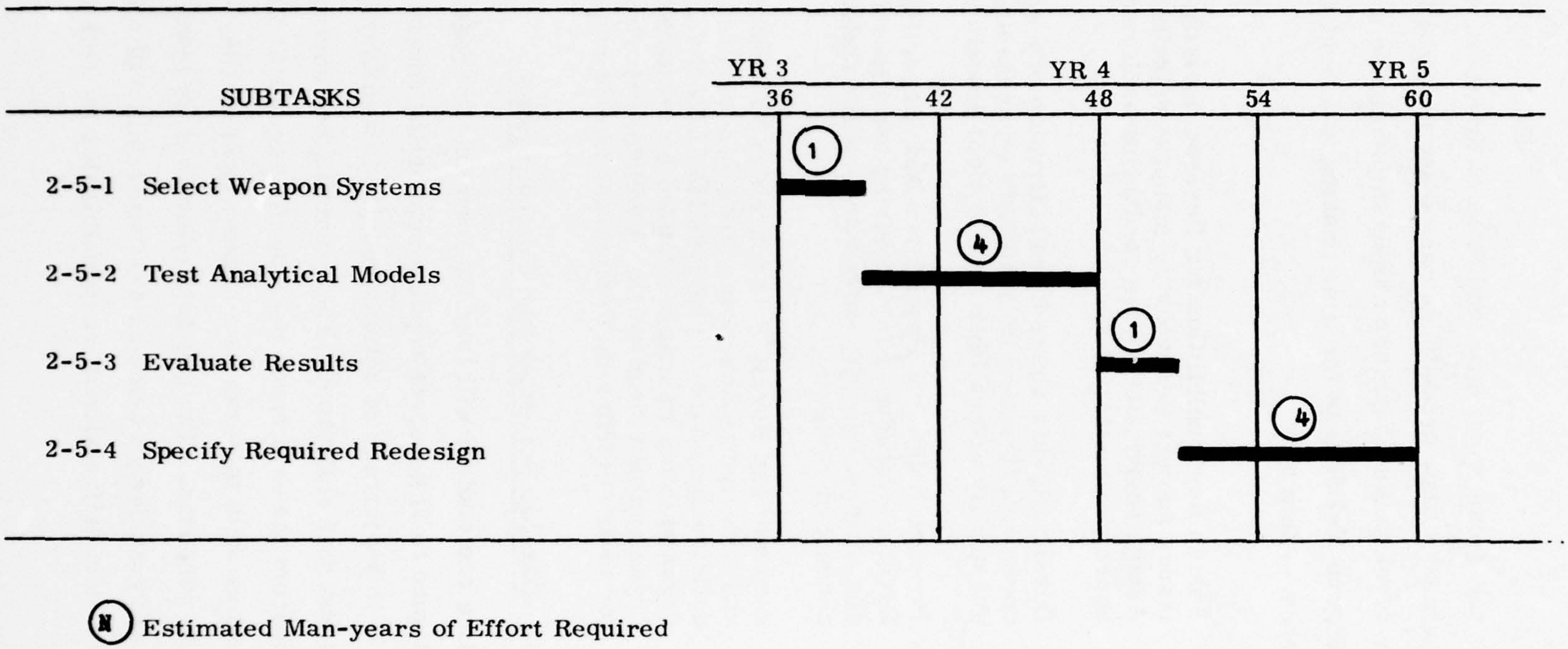
2-5-4 Specify Required Redesign: Based on pilot test evaluation, specify redesign to alleviate problems found. Include in redesign recommended procedural changes that will further encourage and simplify the utilization of the models by weapon system planners.

Task 3: Develop Review Procedures

This task is concerned with the greater detail in identifying specific review items, setting up procedures, and specifying organizational entities responsible for enforcing the procedures. The HARDMAN Task 2

Figure N-6

Pilot Test and System Evaluation



report lays the groundwork for completion of this task, so that the establishment of review procedures can be accomplished early in the HARDMAN development, and then can be implemented with immediate benefit. Figure N-7 depicts the time phasing and level of effort required for completion of this task.

3-1 Assign Responsibilities for Review: Identify documents, issues subject to review by manpower/training analysts. Assign responsibility for conducting each review to the appropriate entity.

3-2 Develop Review Procedures: Develop procedures for reviewing documents/issues with emphasis on assessing completeness and quality and validity of analytical models used.

3-3 Prepare Reporting Procedures and Supporting Documentation: Develop procedures for capturing and reporting review events and actions. Specify supporting documentation required for conduct of reviews.

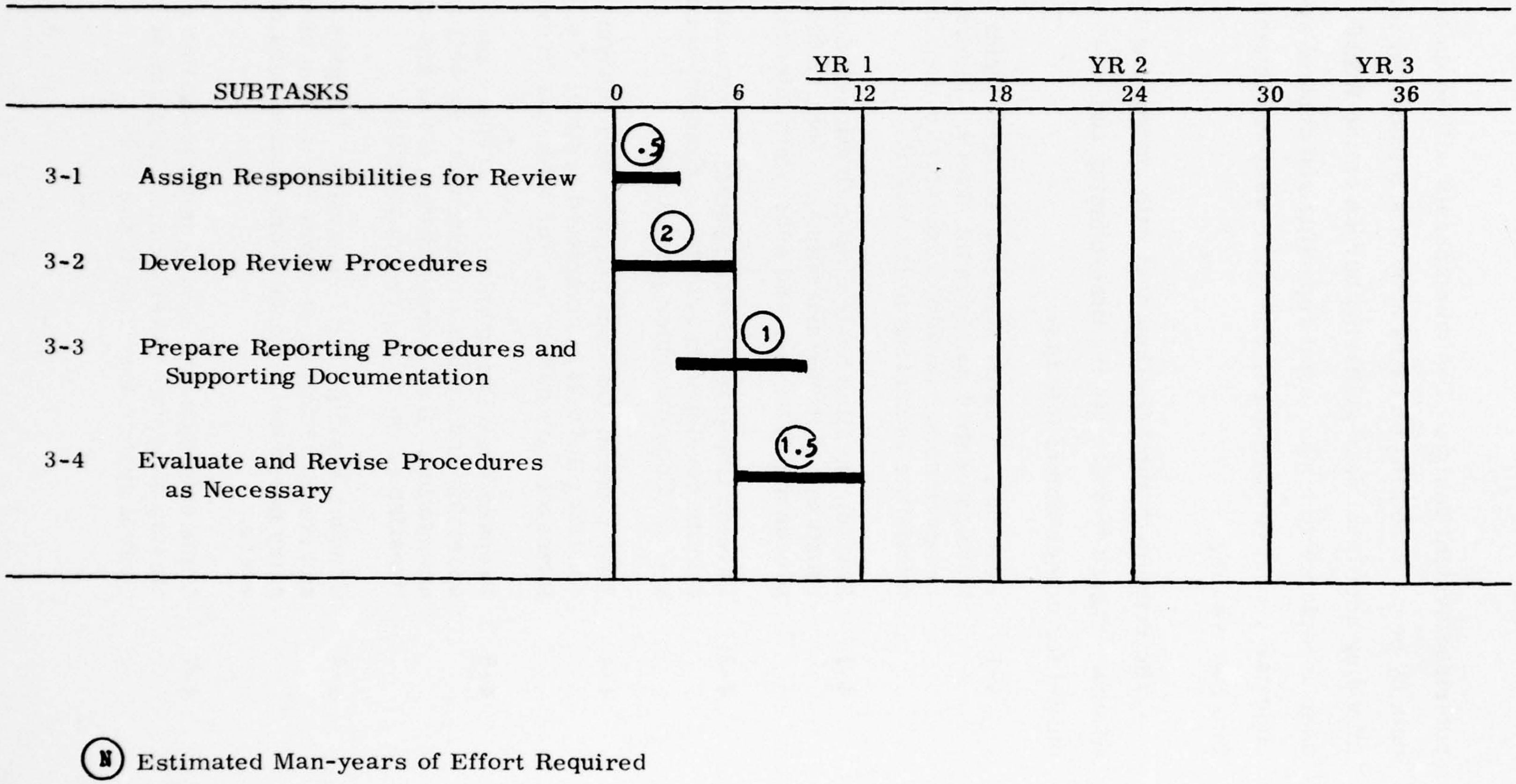
3-4 Evaluate and Revise Procedures as Necessary: Evaluate and redesign review procedures with respect to review deficiencies found in previous HARDMAN analysis and organizational turbulence caused by recommended organizational framework. Evaluate reporting procedures for their contribution to compliance with review procedures.

Task 4: Develop Reporting and Control System

Reporting and control will take the form of a management information system designed to 1) generate reports supporting decision-making in the WSAP and 2) to keep track of actions required to satisfy HARDMAN review procedures and data collection. The reporting and control system will accept input from the data bases used by the various analytical modules, adding milestone data to serve as a master tickler file, and other data for reporting purposes. The greatest effort will be required during the conceptual systems design (Subtask 4-1) since this will entail development of procedures and delineation of responsibilities as well as the com-

Figure N-7

Review Procedures



puterized system design. Design emphasis will be on capturing event data by perhaps routing an extra copy of a transmittal letter rather than imposing additional data-gathering burden on the WSAP. With increasing user acceptance to a successful reporting and control system, more budgetary, cost performance, and other weapon systems data can be phased into the system.

The remaining subtasks then deal with automating the conceptual design. Figure N-8 depicts the time-phasing and level of effort required for completion of this task.

4-1 Develop Conceptual Systems Design: Identify manpower/training control points in the WSAP. Determine reporting requirements. Develop conceptual system design which minimizes intrusions to the WSAP.

4-2 Develop Detailed System Specifications: Specify form and substance of inputs and outputs. Specify file structure, processing features, and subsystem interrelationships.

4-3 Develop Computer-Based System: Formulate detailed system development schedule. Complete program designs. Code computer programs.

4-4 Test System: Conduct program and subsystem testing, then conduct pilot test of completed system. Collect performance data during test for later use in evaluation.

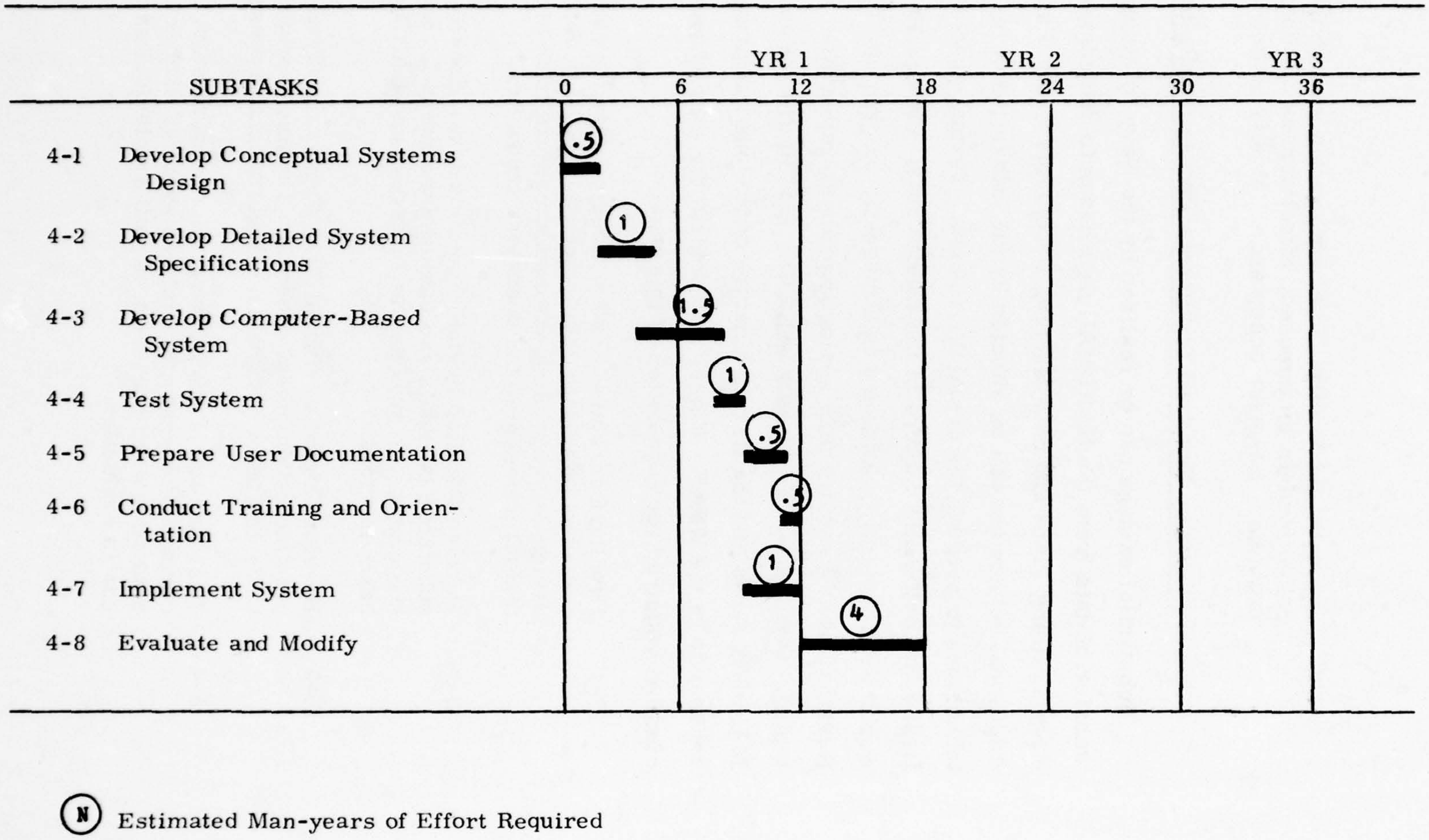
4-5 Prepare User Documentation: Prepare guide for systems operation and systems maintenance as well as user documentation. Incorporate system flows and clear delineation of reporting responsibilities.

4-6 Conduct Training and Orientation: Prepare training materials and conduct training sessions for system operators and data entry personnel. Conduct orientation sessions for system users.

4-7 Implement System: Modify implementation plan at conclusion of system development. Implement reporting and control system for ships in the WSAP.

Figure N-8

Reporting and Control System



4-8 Evaluate and Modify: Evaluate system with respect to data collection burden imposed, effectiveness of control, operating problems, and user acceptance. Modify as necessary.

Task 5: Develop Required Documents Processing System

Substantial savings can be realized by the Navy by automating the transfer of data from the HARDMAN data bases to documents such as Navy Training Plans and Ship Manning Documents which display the data. Additional economies can be effected by the utilization of textual processing techniques to produce the actual documents. Textual processing would first allow automatic capture of the needed data, and equally important would store the entire document in a magnetic medium so that successive iterations would require only keying in changes rather than lengthy retyping. Completion of this task will allow exploitation of existent HARDMAN data bases and the iterative nature of various manpower/training documents in the WSAP. Figure N-9 depicts the time phasing and level of effort required for completion of this task.

5-1 Develop Conceptual System Design: Identify candidate documents and associated data requirements. Develop conceptual system design encompassing automated capture of required data and textual processing for document production.

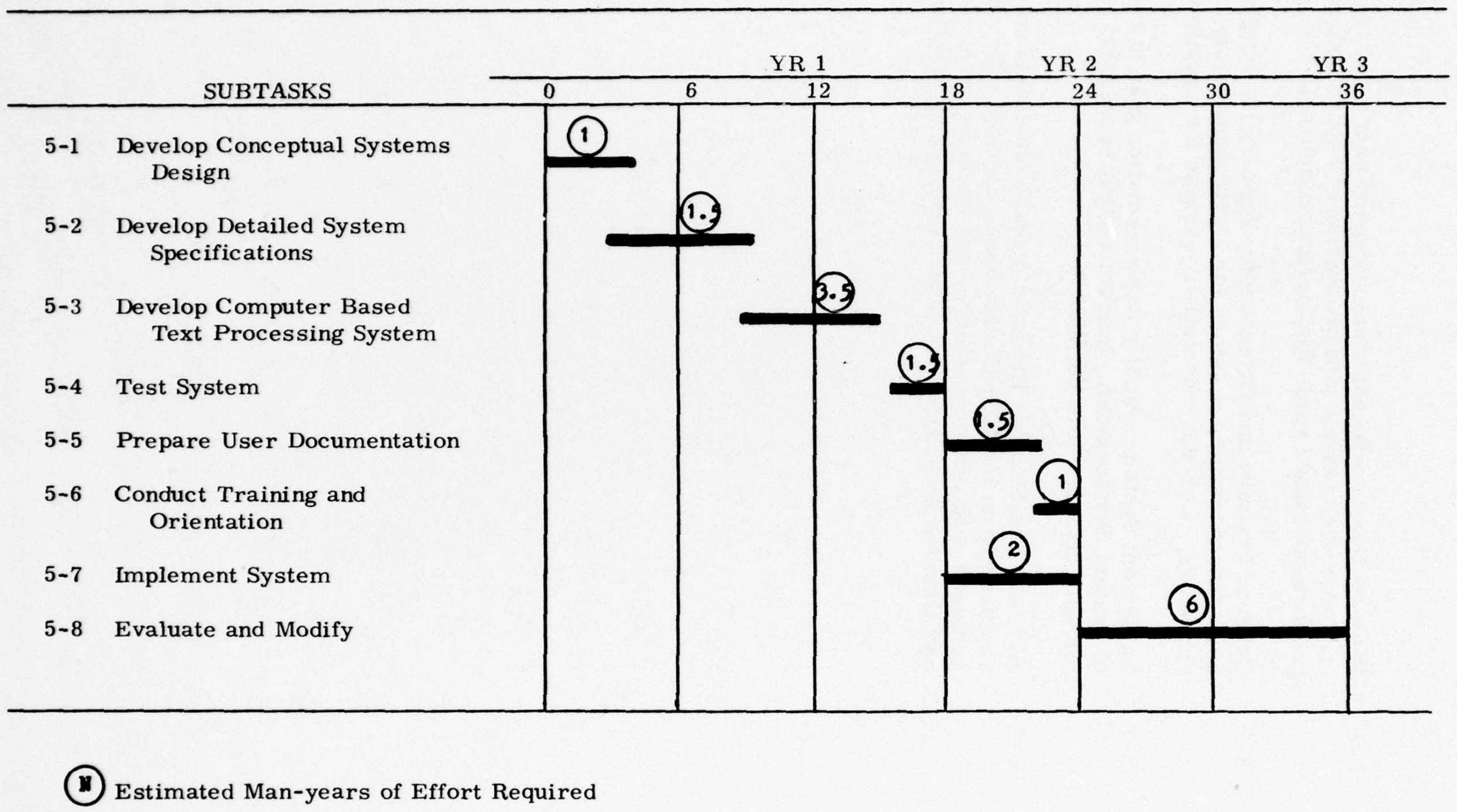
5-2 Develop Detailed System Specifications: Specify form and substance of inputs and outputs (documents). Specify file structure, text processing features, and HARDMAN data base interface.

5-3 Develop Computer-Based Text Processing System: Formulate detailed development schedule. Complete program designs. Code computer programs. Acquire text processing software.

5-4 Test System: Conduct program and subsystem testing, then conduct pilot test of completed system. Collect performance data on system operation as well as clerical savings for later use in evaluation.

Figure N-9

Required Documents Processing System



5-5 Prepare User Documentation: Prepare users manual for staff elements tasked with production of required documents. prepare operators guide for clerical personnel.

5-6 Conduct Training and Orientation: Prepare training materials and conduct training sessions for clerical operators and system operators. Conduct orientation sessions for system users.

5-7 Implement System: Modify implementation plan at conclusion of system development. Implement text processing system for ship documents in the WSAP.

5-8 Evaluate and Modify: Evaluate proportion of data automatically captured from HARDMAN data base, clerical efficiences achieved with text processing, user efficiencies achieved, and timeliness of document production. Modify as necessary.

APPENDIX O

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The HARDMAN study was conducted to analyze the current manpower and training requirements, reporting and review structure as it applies to the Weapon Systems Acquisition Process (WSAP) and to develop to the extent necessary a new manpower and training requirements, analysis and review process which could be integrated into the acquisition process. The study's principal objective was to: Insure explicit consideration of man-

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power/training resource requirements early in the WSAP.

This report presents the findings and recommendations of the HARDMAN Study. Procedures have been identified, along with analytical tools and supporting methodologies, which are complementary to the WSAP and which will ensure that manpower and training information is available prior to finalizing policy decisions on weapon procurements.