NAVAL SHIP PROCUREMENT PROCESS STUDY.

Final Report.

Assistant Secretary of the Navy
Manpower, Reserve Affairs and Logistics
DEPARTMENT OF THE NAVY
Washington, D.C.

July 1978

THE ASSISTANT SECRETARY OF THE NAVY
(MANPOWER, RESERVE AFFAIRS AND LOGISTICS)
WASHINGTON, D. C. 20360

17 July 1978

The Honorable W. Graham Claytor, Jr.
Secretary of the Navy
Washington, D.C. 20350

Dear Mr. Secretary:

I am pleased to forward the Navy Ship Procurement Process Study of July 1978 for your review and appropriate action. On behalf of the Department of the Navy, I wish to recognize that the concept of this Study originated in January 1977 with my predecessor on the Installations and Logistics side, then Assistant Secretary of the Navy, Dr. John J. Bennett. We are indebted to him for the basic structure of the Interim Report with which I became involved upon taking office in April 1977 and which was completed in August of that year.

The purpose of the Interim Report, as more fully explained in the Preface of this Final Report, was to bring together the problem areas which over the years had emerged between the Navy and the shipbuilding industry and which, in one degree or another, were relevant to the controversial shipbuilding claims filed against the Navy. In April 1977 these claims had reached the unprecedented figure of $2.7B, nearly $2.4B of which stemmed from disagreements with three major shipbuilders (Electric Boat, Ingalls and Newport News) originating from contracts for major combatant ships entered into prior to 1974.

The Interim Report was distributed to key shipbuilders and became the charter for individual interviews with top officials of ten major Companies from September to November 1977. In opening each of these interviews I stressed that:

- free and open discussion of the problem areas, their analysis and possible solution, was imperative;

- while specific discussion of the existing claims would, in the context of the interviews, be counterproductive and hence should be considered outside the agenda, a central purpose of the interviews was to draw from the troublesome experiences of the past, compelling lessons which the Navy and the shipbuilding industry would be strongly motivated to avoid in the future, to the maximum extent possible;

- the views expressed by both sides in the interviews would, to a significant extent, shape the structure and content of the Final Report.

This is not the place for a discussion of our efforts since October 1977 to negotiate solutions of the claims filed against the Navy by Litton/Ingalls ($1.088M), General Dynamics/Electric Boat ($544M) and Tenneco/Newport News ($742M) and, far more importantly, of the problems underlying those claims; nor is it the time to discuss the settlements reached in the Litton and General Dynamics situations in June of this year. It is highly relevant, however, for me to point out that as a result of my simultaneous participation in the negotiations and in the preparation of this Final Report, the crucial urgency and importance of the central objective of this Report -- maximum claims avoidance in the future -- became forcefully apparent.

It would be as misleading to view this Final Report as a panacea, as it would be to ignore the basic importance of observing the clear warnings which it contains and of implementing the corrective measures it proposes. Both the Navy and the shipbuilding industry should, as a vigorous determination for claims avoidance is more clearly defined and strengthened, remain in a state of intelligent alert, with open lines of communication as an essential and continuing element.

As the Interim Report of August 1977 was approaching completion, we were fortunate to persuade Professor Ralph C. Nash, Jr., distinguished authority in the field of government contracting, to assume executive direction of the Study Team's efforts, including the shipbuilder interviews to which I have earlier referred. He has conducted his task with a wisdom and objectivity which are reflected in the Final Report. I give similar recognition and thanks to the other members of the Study Team who are identified in the Preface. It has been a long, arduous task of one and a half years. Traversing the road of future implementation, one in which the tenacity and objectivity of the Navy and the shipbuilding industry will prove absolutely essential, will be many times longer.

While several members of the Naval Sea Systems Command have not only participated in the Study Team's efforts but otherwise been contemporaneously aware of and reviewed the contents of the Interim and Final Reports, and while the copies of the Final Report have been made available in advance to the Naval Material Command and to OPNAV, the official imprimatur of the Navy is limited to that of the Study Team and my own. The Final Report will be promptly submitted to the shipbuilders for their review and comments. The vital tasks of review, analysis, consensus and implementation lie ahead of us and must be achieved.

Sincerely,

E. Hidalgo

Edward Hidalgo

Enclosure

PREFACE

This document is the final report of the Naval Ship Procurement Process Study. The report, which was prepared by a study team under the chairmanship of the Honorable Edward Hidalgo, Assistant Secretary of the Navy for Manpower, Reserve Affairs, and Logistics, addresses the avoidance of claims against the Navy by private U.S. shipbuilders in future shipbuilding contracts. Its goal is to reexamine and validate current U.S. Navy ship acquisition policies and procedures and to offer conclusions regarding changes to selected policies with a view to maximum curtailment of future shipbuilder claims.

The study team began its work in January 1977 under the executive direction of Dr. John J. Bennett. By August of that year, the study team had prepared an Interim Report that consisted of 26 problem statements reflecting its perceptions of shipbuilder views and criticisms concerning Navy ship acquisition policies. These problem statements were based in part on the testimony of shipbuilding officials before the Congress from 1974 to 1977 and in part on material appearing in the 1974 report of the Shipbuilders Council of America Ad Hoc Committee, A Discussion of Navy – Shipbuilding Industry Business Relationships. The balance of each problem statement consisted of the study team's view of the Navy's measure of agreement or disagreement with the industry's perception of the problem; the study team's understanding of the Navy's policy, position, and/or practice; and Naval Sea Systems Command related initiatives that are under way or contemplated.

Upon publication of the Interim Report in August 1977, the executive direction of the study team was assumed by Professor Ralph C. Nash, Jr. The study team then contacted numerous officials within the Navy and the private shipbuilding community to obtain their views regarding Navy ship acquisition. As a first step, in order to obtain the firsthand views of the Navy personnel who are responsible for the administration of Navy shipbuilding contracts, study team visits were made to the SUPSHIPs offices at Pascagoula, Mississippi; Newport News, Virginia; and Bath, Maine. In addition, high officials of 11 private shipbuilders and of the Shipbuilders Council of America were interviewed in

Washington, D.C., from September to November 1977. The firms interviewed were Avondale Shipyards, Inc.; Bath Iron Works Corporation, a subsidiary of Congoleum Corporation; Bethlehem Steel Corporation; Electric Boat Division of General Dynamics Corporation; Ingalls Shipbuilding Division of Litton Industries, Inc.; Lockheed Shipbuilding and Construction Company, a subsidiary of Lockheed Aircraft Corporation; National Steel and Shipbuilding Company, an affiliate of Kaiser Industries Corporation and Morrison-Knudsen Company, Inc.; Newport News Shipbuilding & Dry Dock Company, a subsidiary of Tenneco, Inc.; Peterson Builders, Inc.; and Todd Shipyards Corporation.

Each of the 26 problem statements appearing in the Interim Report plus other issues that the shipbuilders and study team members considered worthy of review and discussion were addressed in the interviews. These interviews consisted of a series of frank and detailed discussions of the policies and practices relevant to the causes of shipbuilding claims, although the existing claims were expressly excluded from the agenda. Suggestions were freely exchanged concerning changes to these policies and practices which were calculated to minimize claims.

Upon completion of the interviews with the private shipbuilders, the study team interviewed a number of Navy personnel in the Washington, D.C., area, including managers of the Naval Material Command, the Naval Sea Systems Command, and the Naval Ship Engineering Center. These interviews provided a number of insights into the process of planning for the acquisition of Navy ships as well as the legal and business considerations that shape the overall Navy ship acquisition process.

In the course of preparing this final report, the study team assembled data on the ship acquisition process with the help of the Naval Material Command, the Naval Sea Systems Command, and the Shipbuilders Council of America. While this report documents the impact of this process on both the Navy and the shipbuilding industry, the major focus of the study was on the Navy's policies and procedures for acquiring major naval vessels. Such a focus is appropriate because of the Navy's dominant role in the formulation of policies on the acquisition of naval ships. Hence, most of the conclusions in the report address potential changes

by the Navy aimed toward reducing the risks of building naval ships and achieving a more appropriate balance of such risks. Close cooperation by the shipbuilders will obviously be necessary to carry out these changes and a reasonable measure of this cooperation is assumed by the study team.

One of the major difficulties which the study team encountered in conducting this effort was appraising the effectiveness of the numerous changes in ship acquisition practices that have been made by the Navy in the past few years. There is no doubt that these changes both reduce and redistribute shipbuilding risks to a major extent, but most of the changes are so new that conclusive results are not available for assessment. The study team has used its best judgment in evaluating these changes and in suggesting alterations that might lead to further improvement in the ship acquisition process. The study team's overall impression is that the Naval Sea Systems Command has made significant efforts in recent years to address some of its more difficult problems and to arrive at equitable solutions with various segments of the shipbuilding industry.

The study team believes that further efforts should be undertaken to formulate and institutionalize forward-looking policies governing the acquisition of naval ships. Since this study was primarily directed at claims avoidance, it concentrated heavily on the distribution of risk between the Navy and its shipbuilders that is inherent in the ship acquisition process. While some of the study team conclusions also address the reduction of such risks, much additional work needs to be done in this area. A study of risk reduction should include a full appraisal of the cost-reduction measures that could be applied to future naval ships as well as the process of acquiring them. Such a study should also logically include an evaluation of shipbuilder productivity and the ability of current corporate management to control and improve such productivity.

The study team is indebted to the many Navy and private shipbuilder personnel who gave their time, ideas, and assistance in preparing this report. Their professional competence combined with their obvious desire to see claims avoidance become a reality provided a strong stimulus to the study team's efforts.

A roster of the study team's participants at different stages of the one and one-half years of research and preparation of the August 1977 Interim Report and this final report is as follows:

Chairman

Hon. Edward Hidalgo

Executive Director -- Final Report

Prof. Ralph C. Nash, Jr.

Executive Director -- Interim Report

Dr. John J. Bennett

Drafting Committee

Captain Robert K. Reed, USN
Mr. Raymond F. Chiesa
Commander Hugh D. Campbell, JAGC, USN

Outside Consultants -- Harbridge House, Inc.
Rear Admiral Elmer T. Westfall, USN (Ret)
Mr. Harry B. Ellis, Jr.

Participants and Consultants

Rear Admiral Paul L. Foster, USN
Rear Admiral Edward J. Otth, Jr., USN
Rear Admiral Gerald J. Thompson, SC, USN
Rear Admiral Leroy E. Hopkins, USN (Ret)
Mr. Gerald J. McBride
Mr. John J. McDonnell
Captain William J. Ryan, SC, USN
Captain Ronald A. Jones, SC, USN
Mr. Robert H. Link
Mr. George J. Rabstejnek, Jr. (Harbridge House, Inc.)
Ms. Sandra A. Rubico (Harbridge House, Inc.)

Ralph C. Nash, Jr.

EXECUTIVE SUMMARY

In the past two decades, the Navy has undertaken an ambitious shipbuilding program. In the 1960s, this program was spread over approximately 20 private shipyards as well as naval shipyards. However, by the 1970s, with the increased acquisition of nuclear ships and the reduced number of ship types, only nine private shipyards were building naval vessels. Three of the nine shipyards – Electric Boat, Newport News, and Ingalls – were performing over three-quarters of the work.

During the latter period, the industry was plagued with inflationary cost increases, material shortages, and labor instability, and substantial problems were encountered with the specifications and drawings provided by the Navy. Working under fixed price incentive contracts with escalation clauses that did not fully compensate for inflationary costs, the major shipbuilders experienced large cost overruns which could not be settled with the Navy. The result was major claims totaling $2.7 billion by the end of 1977. Two of the most complex claims – one by Electric Boat ($544 million) and one by Ingalls ($1,088 million) – were resolved by settlement agreements signed on 9 and 20 June 1978, respectively.

Employment and Workloads

The shipbuilding companies have been plagued by unstable employment and, in the 1970s, the three major shipyards attempted to increase their total employment beyond optimum levels in order to perform the work under contract. The employment at the other private shipyards that are currently performing Navy work is at productive levels, but the projection of the future Navy and commercial programs indicates that there is insufficient work to support the nine shipyards currently building naval ships. The problem is further complicated by indications that three other qualified shipbuilders are interested in competing for future Navy ship contracts. Hence, it appears that unstable employment will be a continuing problem. In short, despite the fact that unstable workloads are a major cause of shipyard cost growth, the government has not been able to plan its naval shipbuilding program to minimize such instability.

A major initiative should be undertaken to establish agreed-upon "workload windows" with each shipyard in order to define the upper and lower limits of employment at which the shipyard can maintain productivity. The planning and execution of Navy programs by both the legislative and executive branches should be oriented toward keeping the shipyards that are participating in naval shipbuilding within these windows.

Design Packages

The Navy has encountered substantial difficulties in devising processes for ship design which permit the use of accepted acquisition techniques for the construction of naval ships. In earlier programs, shipbuilders were able to prepare realistic cost estimates of the construction effort on the basis of a broad-based contract design package – even though the detailed working drawings were not prepared until after contract award. In the current environment of the increasing complexity of ships, the uncertain productivity of the shipyards, and the unwillingness of vendors to quote firm prices, it is no longer possible to make such estimates. This problem is exacerbated by the reduced capability of the Navy to prepare contract design packages of sufficient accuracy to permit valid estimates. Revised acquisition techniques should be used to deal with this problem.

The Navy has pursued several encouraging strategies on recent programs. Prospective shipbuilders have participated in the preparation of the contract design package, and it is planned on two future programs to have the lead shipbuilder participate in the contract design as the first task on its contract. Lead shipbuilding contracts have been awarded on a cost plus incentive fee or cost plus award fee basis. In one program, follow shipbuilders have been given "validated drawings" with a guarantee of their accuracy and suitability. Land-based test sites and full-scale mock-ups are increasingly being used to check out the more complex features of the design prior to construction.

Continued efforts to devise acquisition strategies which recognize the inherent difficulties of the ship design process are required. In addition, the Navy should make a concerted effort to improve its in-house ship design capabilities.

Risk Allocation

The risks of building modern naval vessels have become so large that new acquisition strategies are called for to allocate such risks equitably to the contracting parties. Three types of risks must be addressed: Technical risk because of the complexity of ship design, schedule risk because of the four- to seven-year period needed to construct a ship, and cost risk because of the difficulties of predicting the costs of the multiple elements of the ship construction process. Since a lead ship of a new class is designed and built concurrently, the risks are too great to permit the use of a fixed-price type contract.

Cost plus incentive fee or award fee arrangements should be used to motivate the shipbuilder to perform well. Lead shipbuilders should be selected on the basis of all of the appropriate evaluation factors, including experience with similar ships, technical and design competence, understanding of program objectives and risks, management ability, shipyard capacity, and cost realism.

Follow ships present a much more difficult problem in devising acquisition strategies that will not only provide for balanced allocation of risk, but also motivate effective performance. Program considerations dictate that early follow ships trail the construction of the lead ship by no more than two years. As a result, they must be placed under contract two or more years before completion of lead ship design.

This situation suggests that contracts for such early follow ships should probably be awarded to the lead shipyard using cost-type transition contracts. Such contracts should be converted to fixed price incentive contracts as soon as the risks can be adequately defined and priced. In programs with a small total number of ships, the policy should normally dictate that all ships of the class will be constructed by the lead shipyard. In large programs or in situations where the lead shipbuilder is not performing well, follow ships should be bought from other shipyards. The initial contract with a follow shipyard should be either a fixed price incentive contract or a cost-type transition contract – depending on the development stage of the technical design package, the complexity of the ship, and the stability of the shipbuilder's projected workload at the time of award. The

selection of such follow shipbuilders should be based on the evaluation of all relevant factors in much the same fashion as proposed for the selection of lead shipbuilders.

The most effective motivation of good performance can be achieved by using fixed price incentive contracts as soon as the risks can be defined and priced. To permit maximum use of such contracts, contract clauses should be adopted which relieve the shipbuilders of the significant risks that are outside their control. These clauses should include economic price adjustment provisions that fully compensate shipbuilders for changes in direct and indirect labor rates, material prices, fringe benefit factors, and energy costs, as well as provisions relieving shipbuilders of the costs of events outside of their control or the costs of supervening sovereign acts. Fixed price incentive contract clauses should also be revised to strike a fair balance between the parties with regard to timely submission of notice of constructive changes and responsibility for defects in the technical documentation that is furnished to the shipbuilder by the Navy.

Management of the Shipbuilding Process

Management of the shipbuilding process has posed severe difficulties for the Navy. As the process of acquiring naval ships has become more complex, the Naval Sea Systems Command has faced reduced numbers of personnel and limitations on personnel grades. While project management staffs have increased modestly, the Naval Ship Engineering Center has declined in size. The overall organization is lacking a sufficient number of experienced, seasoned personnel.

The Naval Sea Systems Command should increase the capability of its functional organizations and contract for design services to facilitate better management. An effort should be undertaken to delegate more responsibility to the supervisor of shipbuilding organizations at the shipyards and to identify the contract administration functions that can be reduced or removed. Efforts should also be made to streamline and unify all of the management information systems that are used to monitor shipbuilder performance.

Change Management

Changes have presented serious problems in the naval ship acquisition process. For shipbuilding to proceed in an orderly way, changes must be controlled

and ordered promptly when needed. The primary way of controlling changes is improvement of the technical documentation that is furnished to the shipbuilder. The current acquisition strategies that are aimed at improving the contract design package will assist in achieving this goal.

A major effort should be made to achieve control over the numerous specifications which are referenced into the contract design package in order to assure that they are current and that project managers have some means of adopting only those requirements necessary for their programs.

Achieving timely processing and pricing of changes is a major challenge for the Navy and the shipbuilders. Techniques should be devised to process engineering change proposals more quickly so that changes can be issued earlier. More flexible means of issuing changes should also be adopted, including broader use of two-step changes and less-stringent controls on unilateral changes. Additional techniques to facilitate the early pricing of changes should be sought – particularly methods of reducing the administrative workload of the pricing process and means of pricing delay and disruption costs. Finally, a means of assuring early notification of constructive changes should be adopted to provide that the costs of such changes will not be reimbursed to the shipbuilder when it knows or should have known of the change and deprived the Navy of the opportunity to save the costs by failure of notice.

Recent Navy corrective measures in shipbuilding contracts, other practices being considered, and the initiatives discussed in this report will permit the Navy and its shipbuilders to devote their full attention to the difficult task of designing and constructing ships. These actions will entail a strengthening of the Navy's in-house technical and management capabilities and a refocusing of shipbuilder attention on the vital issue of shipyard productivity. They measurably improve future shipbuilding contracts and promote a pattern of contract formulation and management that is mutually beneficial to the Navy and the shipbuilding industry.

TABLE OF CONTENTS

Page

CHAPTER TWO. PLANNING

CHAPTER THREE. CONTRACTING POLICIES, CONTRACT TYPES, AND CLAUSES

Blank

LIST OF EXHIBITS

CHAPTER TWO. PLANNING

Page

CHAPTER THREE. CONTRACTING POLICIES, CONTRACT TYPES, AND CLAUSES

CHAPTER FOUR. MANAGEMENT OF SHIP CONSTRUCTION CONTRACTS

Page

CHAPTER FIVE. CHANGE MANAGEMENT

Chapter One. Introduction

CHAPTER ONE. INTRODUCTION

A. Historical Perspective

In undertaking a study of the ship acquisition process, it is well to remember that controversy concerning the acquisition of U.S. Navy ships has been with us since the early days of our nation. The first major ship acquisition program undertaken by the Federal Government was authorized by the U.S. Congress in 1794. The Naval Act of that year provided for the construction, equipping, and manning of six frigates, and a design contract was awarded on a sole-source basis to Philadelphia shipbuilder John Humphries.[1] Plans for the frigates were completed in 1796, and the lead frigate was awarded to Humphries' yard in Philadelphia. Follow ships were awarded to shipyards in New York, Boston, Portsmouth (New Hampshire), Baltimore, and Norfolk.

The shipbuilders experienced lengthy delays in getting started because of timber shortages and lack of other materials. During construction, numerous changes in specifications caused significant rip-out and rework. As a result of these delays and the disruption caused by the changes, shipbuilder costs rose far above original expectations. Drastic overruns were avoided only by a declaration of peace with Algiers, which caused all work to stop until Congress passed a supplemental act. This act reprogrammed the available funds by authorizing completion of only three ships – those in an advanced state of construction at Boston, Philadelphia, and Baltimore.

The first frigates were severely criticized by the Navy and the Congress. Their size and draft limited the number of ports they could use as bases or anchorages, and they required frequent and expensive repairs. Congressional critics voiced concern over the Navy's ship acquisition policies, and Benjamin Stoddert, first Secretary of the Navy, responded by indicating that he planned to change them.

---

[1] Shipbuilders in Maine, Massachusetts, and Virginia were upset by the circumstances surrounding this award. Since there was no formally established channel for protest, they wrote to their Congressmen about it.

Controversy concerning the acquisition of Navy ships has continued to the present day. In the early 1950s, the Navy began a major shipbuilding program to modernize its fleet of combatant ships. Initially, this new construction effort was split between the U.S. naval shipyards and private shipbuilders, but the focus gradually shifted toward reliance on private shipyards. By the early 1960s, the naval shipyards were building only a few auxiliaries, landing craft, and nuclear submarines. In 1967, the last new ship was assigned to a naval shipyard. Since that time, total reliance has been placed on private industry.

In conducting this long modernization effort, the Navy has employed a number of different acquisition policies to obtain ships from the private shipbuilders within its established time and cost estimates. Initially, the Navy allocated some of its larger combatant ships to selected shipbuilders in order to maintain a broad shipbuilding mobilization base. In most cases, fixed price contracts were employed for these acquisitions. By 1964, the policy had changed, and the Navy shifted to competitive procurement of many of the ships under formal advertising procedures. Later, in 1969 and 1970, two major shipbuilding programs were placed under contract using total package procurement procedures. Finally, in 1971, the Navy shifted to the use of competitive negotiation procedures, buying a single year's increment of ships in each acquisition. Beginning in the late 1960s, Navy personnel slowly became more involved in the day-to-day operations of the private shipbuilders – an acquisition policy that later became known as "engagement."

The Navy's fleet modernization efforts were complicated by the increasing sophistication of its ships. By 1970, virtually every ship being built incorporated newly developed state-of-the-art techniques in its electronics, propulsion, and weapons systems. At about the same time, a national commitment was made to obtain a 600-ship Navy, and a broader spectrum of Navy ship types began to be built. A new Presidentially supported commercial shipbuilding program also began in 1970, and some of the shipbuilders moved away from Navy ship construction into commercial work in the belief that such work would be more profitable.

The impact of this expanded commercial program combined with the larger Navy construction program resulted in increasing demands for skilled

manpower. However, shortly thereafter, material shortages began to occur, and the U.S. economy entered into an inflationary spiral that significantly increased shipbuilder prices for materials and labor. These factors, along with an apparent loss of productivity and continued technological and design changes to ships under construction, gave rise to a number of shipbuilder claims for price adjustments. By the spring of 1978, the value of outstanding claims by the shipbuilders against the Navy totaled $2.7 billion.[1]

The material presented in the balance of this chapter provides a factual basis for analyzing the strengths and weaknesses of the Navy's modern-day ship acquisition process. The chapter includes an analysis of the naval shipbuilding program and the industrial base on which it depends.

B. The Naval Shipbuilding Program

The naval shipbuilding program is one of the most complex enterprises ever undertaken in the United States. Through this program, the Navy acquires a wide variety of ships, ranging from huge nuclear aircraft carriers and complex submarines to small auxiliary and patrol craft.

1. Profile of the Naval Shipbuilding Program

During the 19-year period from fiscal year 1960 to 1978, with authorization from the Congress the Navy acquired 401 new ships. Private U.S. shipyards provided 359 of these ships, naval shipyards supplied 37 ships, and foreign shipyards in the United Kingdom built five ships. Exhibit I lists acquisitions by ship type.

---

[1] Agreements were reached in June 1978, settling more than $1.6 billion of these claims.

EXHIBIT I
U.S. NAVY NEW CONSTRUCTION AWARDS:
FISCAL YEAR 1960 - 1978*

Ship Type	Private Shipyards	Naval Shipyards	Foreign Shipyards	All Shipyards
Aircraft Carriers	5	-	-	5
Cruisers	13	3	-	16
Submarines	100	15	-	115
Destroyers	37	-	-	37
Frigates	90	-	-	90
Amphibious Ships	44	12	-	56
Auxiliaries	70	7	5	82
Total	359	37	5	401

*Excludes 113 patrol, landing, mine, riverine warfare, SEAL, and service craft that were also procured during this period.

Source: NAVSEA Ships Data File.

The total cost of these 401 ships, including the budget submitted for ships ordered in 1978, was over $42 billion. Exhibit II segregates the total cost of these new ship acquisitions by private and naval shipyards.[1] It should be noted that no ships have been ordered or funded for construction in naval shipyards since 1967.

Exhibit III breaks down the Navy's new ship construction awards to private U.S. shipyards during the 19-year period from 1960 to 1978 by ship type. As noted above, 359 ships were placed under contract with private U.S. shipyards. While 31 different hull types were built, more than 60 percent of the total orders fell into four categories: attack submarines (69 SSN), destroyers (31 DD and 6 DDG), fleet ballistic missile submarines (31 SSBN), and frigates (58 FF and 32 FFG).

Exhibit IV arrays the same data in terms of the private shipyards that received the awards. In all, 22 U.S. shipyards participated in these new ship construction efforts. It is noteworthy that 162 of the 359 ships, or 45 percent, were placed with just three of the private shipyards: The Electric Boat Division of General Dynamics Corporation; the Newport News Shipbuilding & Dry Dock Company, a subsidiary of Tenneco, Inc.; and the Ingalls Shipbuilding Division of Litton Industries, Inc.

Exhibit V presents the contract award values of these 359 privately built ships by fiscal year of contract placement and the individual shipyards. (Since this exhibit repeats the format of Exhibit IV, it is possible to determine the value of the awards each year to each shipyard by ship type.) The data exclude the cost of all government-furnished equipment (such as electronic, propulsion, and weapon systems), but include the cost of all contractor-furnished equipment and materials purchased by the shipyard.

---

[1] In 1977, the government changed its fiscal year period of 1 July to 30 June to 1 October to 30 September. The period from 1 July 1977 to 30 September 1977 was designated as the transition quarter or "FY7T." Exhibit II and most of the following exhibits that present fiscal year data include FY7T in fiscal year 1976.

EXHIBIT II
TOTAL OBLIGATIONAL AUTHORITY FOR ALL U.S. NAVY NEW CONSTRUCTION: FISCAL YEAR 1960 - 1978*
(Millions of Dollars)

Fiscal Year	Naval Shipyards	Private Shipyards	Total Naval and Private Shipyards	Private Shipyards Percent of Total
1960	$ 86	$ 430	$ 516	83%
1961	484	1,489	1,973	76
1962	772	1,589	2,361	67
1963	274	1,888	2,162	87
1964	322	1,373	1,695	81
1965	441	1,306	1,747	75
1966	255	1,390	1,645	85
1967	7	1,827	1,834	99
1968	-	511	511	100
1969	-	352	352	100
1970	-	1,901	1,901	100
1971	-	1,710	1,710	100
1972	-	1,998	1,998	100
1973	-	1,505	1,505	100
1974	-	3,588	3,588	100
1975	-	3,182	3,182	100
1976	-	3,889	3,889	100
1977	-	5,169	5,169	100
1978**	-	4,712	4,712	100
Total	$2,641	$39,809	$42,450	

*Data include RDT&E-funded new construction plus all craft. Data from 1960 to 1970 include outfitting and post-delivery expenses; data from 1970 to 1978 exclude these expenses.

**President's March 1978 budget submission to Congress for fiscal year 1978 to 1983.

Source: NAVSEA and the Shipbuilders Council of America, March 1978.

EXHIBIT III
U.S. NAVY NEW CONSTRUCTION AWARDS TO PRIVATE U.S. SHIPYARDS BY SHIP TYPE: FISCAL YEAR 1960 - 1978*

Ship Type	Current Symbol	Fiscal Year 1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978**	19-Year Total-	
Attack Aircraft Carrier	CVA		1		1																2	CVA
Aircraft Carrier (Nuclear)	CVN								1			1				1					3	CVN
Guided Missile Cruiser	CG		3	3																	6	CG
Guided Missile Cruiser (Nuclear)	CGN			1					1	1		1	1	1			1				7	CGN
Poseidon Submarine (Nuclear)	SSBN		7	7	5	5															24	SSBN
Trident Submarine (Nuclear)	SSBN															1	2	1	1	2	7	SSBN
Attack Submarine (Nuclear)	SSN	4	1	3	7	4	4	4	5	3	2	3	4	5	6	5	3	2	3	1	69	SSN
Destroyer	DD											3	6	7		7	7	*		1	31	DD
Guided Missile Destroyer	DDG	3	2																	1	6	DDG
Frigate	FF	2	2	3	5	10	16	10	10												58	FF
Guided Missile Frigate	FFG			3	3										1		3	6	8	8	32	FFG
Amphibious Command Ship	LCC							1													1	LCC
Amphibious Assault Ship (Gen'l Purpose)	LHA										1	2	2								5	LHA
Amphibious Cargo Ship	LKA						4	1													5	LKA
Amphibious Transport Dock	LPD				4	2	2														9	LPD
Amphibious Assault Ship	LPH				1			1													2	LPH
Dock Landing Ship	LSD						1	3	1												5	LSD
Tank Landing Ship	LST							6	11												17	LST
Destroyer Tender	AD																1	1	1		3	AD
Ammunition Ship	AE						2	2	2	2											8	AE
Combat Store Ship	AFS		1	1		1	2	1	1												7	AFS
Hydrofoil Research Ship	AGEH			1																	1	AGEH
Frigate Research Ship	AGFF		1																		1	AGFF
Oceanographic Research Ship	AGOS	2	1	2	2		2	2	1				2								14	AGOS
Surveying Ship	AGS			1	1	1	1		2												6	AGS
Oiler	AO																	2	1	2	5	AO
Fast Combat Support Ship	AOE				1																1	AOE
Replenishment Oiler	AOR						2	2	2					1							7	AOR
Submarine Tender	AS	1		1		1	1	1						1	1				1		8	AS
Submarine Rescue Ship	ASR								1	1											2	ASR
Fleet Ocean Tug	ATF																4			3	7	ATF
Total		12	19	26	30	25	37	34	38	7	3	10	15	15	8	14	21	12	15	18	359	

*Excludes patrol, landing, mine, riverine warfare, SEAL, and service craft.
**Some awards for 1978 are not yet determined.

Source: NAVSEA Ships Data File.

EXHIBIT IV
U.S. NAVY NEW CONSTRUCTION AWARDS TO PRIVATE U.S. SHIPYARDS: FISCAL YEAR 1960 - 1978*

Shipbuilder	Fiscal Year 1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	Total
Alabama Dry Dock & Shipbuilding Co.								1 ASR	1 ASR											2
American Ship Building Co.				1 AGS																1
Avondale Shipyards Inc.	2 FF		3 FF		3 FF	4 FF	10 FF	10 FF									2 AO	1 AO	2 AO	37
Bath Iron Works Corp., Subs. of Congoleum Corp.		3 CG 1 AGFF	2 CG	3 FFG										1 FFG		1 FFG	4 FFG	3 FFG	3 FFG	21
Bethlehem Steel Corp. (Sparrows Point)		2 FF					2 AE													4
Boland Marine & Manufacturing Co.			1 AGS																	1
Christy Corp.	1 AGOS	1 AGOS			1 AGS															3
Defoe Shipbuilding Co.				3 FF		1 AGS	2 AGOS	2 AGS												8
Electric Boat Div. of General Dynamics Corp.	3 SSN	4 SSBN	2 SSN 3 SSBN	2 SSN 3 SSBN	1 SSN 3 SSBN	2 SSN	4 SSN	3 SSN	2 SSN		1 SSN	2 SSN	4 SSN	6 SSN	5 SSN 1 SSBN**	2 SSBN**	1 SSBN**	1 SSBN**	2 SSBN**	57
Gibbs Shipyards Inc.	1 AGOJ																			1
Halter Marine Services, Inc.												2 AGOS								2
Ingalls Shipbuilding Div. of Litton Industries Inc.		1 SSN	1 SSN 1 AS	2 SSN 2 LPD 1 LPH	1 AS	1 LSD	1 LPH	2 SSN 2 AE	1 SSN 2 AE	1 LHA	2 LHA 3 DD	2 LHA 6 DD	7 DD		7 DD	7 DD				56
Lockheed Shipbuilding and Construction Co., Subs. of Lockheed Aircraft Corp.	3 DDG		1 AGEH 3 FFG	2 FF 2 LPD	1 FF 3 LPD	4 FF 2 LPD							1 AS	1 AS				1 AS		24
Marietta Manufacturing Co.			2 AGOS																	2
Marinette Marine Corp.				2 AGOS												4 ATF			3 ATF	9
National Steel and Shipbuilding Co., Affil. of Kaiser Industries Corp. & M. Tison-Knudsen Co. Inc.		1 AFS	1 AFS		1 AFS	2 AFS	1 AFS 6 LST	1 AFS 11 LST					1 AOR			1 AD	1 AD	1 AD		28
Newport News Shipbuilding & Dry Dock Co., Subs. of Tenneco Inc.	1 AS	1 CVA 2 SSBN	4 SSBN	2 SSN 2 SSBN 1 CVA	3 SSN 2 SSBN	2 SSN 4 LKA	1 LCC 6 LKA	1 CGN 1 CVN	1 CGN	2 SSN	2 SSN 1 CGN 1 CVN	2 SSN 1 CGN	1 SSN 1 CGN		1 CVN	3 SSN 1 CGN	2 SSN	3 SSN		51
New York Shipbuilding Corp.	1 SSN		1 CGN	1 AOE																3
Northwest Marine Iron Works						2 AGOS														2
Quincy Shipbuilding Div., General Dynamics Corp.						2 AOR 1 AS 2 AE	2 AOR 1 AS 3 LSD	2 AOR 1 LSD												14
Todd Shipyards Corp. - Seattle - San Pedro		2 DDG	1 CL		3 FF 3 FF	4 FF 4 FF		1 AGOS								1 FFG 1 FFG	FFG	2 FFG 3 FFG	2 FFG 3 FFG	15 17
Awards Undecided																			1 DDG-17 1 SSN 1 DD	3
Total Ships	12	19	26	18	25	37	34	38	7	1	10	15	15	8	14	21	12	13	16	359

*Excludes patrol, landing, mine, riverine warfare, SEAL, and service craft.
**Trident-class SSBN.

Source: NAVSEA Ships Data File.

EXHIBIT V
TOTAL CONTRACT VALUE OF U.S. NAVY NEW CONSTRUCTION AWARDS TO PRIVATE U.S. SHIPYARDS: FISCAL YEAR 1960 - 1978
(Millions of Dollars)

Shipbuilder	Fiscal Year																			Total
	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	
[illegible] Dry Dock & [illegible] Co.								$ 29.2	$ 29.6											$ 58.8
[illegible] Ship Building Co.				$ 6.9																6.9
[illegible]'s Shipyards Inc.	$ 17.2		$ 30.1		$ 44.9	$ 46.6	$150.1	166.8									$ 145.7	$ 72.9	$ 146.2	829.5
Bath Iron Works Corp., Sub. of Congoleum Corp.		$ 81.3	46.7	39.3										$ 242.6		$ 62.8	221.5	151.4	147.2	994.8
Bethlehem Steel Corp. (Sparrows Point)		25.7					100.2													125.9
Boland Marine & Manufacturing Co.			3.9																	3.9
Christy Corp.	2.5	2.6			5.7															10.6
Defoe Shipbuilding Co.				32.0		5.1	12.4	18.8												68.3
Electric Boat Div. of General Dynamics Corp.	135.6	181.4	93.0 154.3	85.9 146.2	52.5 124.6	65.2	133.2	133.1	175.1		$ 84.9	$ 184.9	$ 378.1	646.4	$ 579.0 479.0	802.1	418.3	438.9	1,490.3(e)*	6,960.8
Gibbs Shipyards Inc.	2.9																			2.9
Halter Marine Services Inc.												3.8								3.8
Ingalls Shipbuilding Div. of Litton Industries Inc.		54.1	55.6 29.3	126.1 61.7 34.8	39.2	24.1	43.3	94.5 67.4	46.5 48.5	$200.0	396.4 299.7	402.4 594.6	745.0		774.0	791.4				4,969.4
Lockheed Shipbuilding and Construction Co., Subs. of Lockheed Aircraft Corp.	50.6		35.9 37.5	24.5 67.6	15.8 95.4	66.1 65.8							137.1	123.0				178.8		878.1
Marietta Manufacturing Co.			5.9																	5.9
Marinette Marine Corp.				5.6												10.2		25.1		70.9
National Steel & Shipbuilding Co., Affil. of Kaiser Industries Corp. & Morrison-Knudsen Co. Inc.		18.9	17.1		20.3	46.9	25.1 111.2	28.1 207.4					73.1			179.0	139.6	189.0		1,076.6
Newport News Sh. building & Dry Dock Co., Sub. of Tenneco Inc.	35.9	175.4 129.1	170.7	77.2 103.1 228.8	102.7 100.9	69.2 93.7	55.1 25.2	111.7 414.7	136.3	104.5	190.5 208.6 616.2	126.3 170.6	130.7 167.5		1,329.5	473.4 142.5	309.1	559.0		6,606.2
New York Shipbuilding Corp.	65.7		61.5	53.6																160.8
Northwest Marine Iron Works						10.5														10.5
Quincy Shipbuilding Div., General Dynamics Corp.						59.5 41.3 51.1	57.9 38.2 49.2	68.2 25.7												411.6
Todd Shipyards Corp. - Seattle - San Pedro		36.0	29.1		79.2 33.7	78.9 72.9		15.4								54.9 59.7	93.5	101.1 154.0	97.2 146.2	460.6 608.0
Awards Undersided																			1,518.5(e)*	1,518.5(e)*
Total	$311.4	$704.3	$755.6	$1,102.1	$734.9	$798.8	$929.6	$1,381.3	$454.0	$312.5	$1,796.1	$1,489.6	$1,631.7	$1,012.0	$3,161.5	$2,444.9	$1,344.2	$1,870.2	$3,545.6(e)*	$25,879.5

(e) = estimate

Source: NAVSEA, Quarterly Report of Status of Shipbuilding and Conversion Contracts, Report 7303-4, Washington, D.C. (various issues)

The contract values of the 359 ships built by private shipyards during this 19-year period totaled nearly $26 billion. The three shipyards which were responsible for developing nearly half of the ships held 72 percent of the total contract value of these awards. Specifically, Electric Boat had contracts of $6,998 million, Newport News held contracts of $6,606 million, and Ingalls had contracts of $4,969 million.

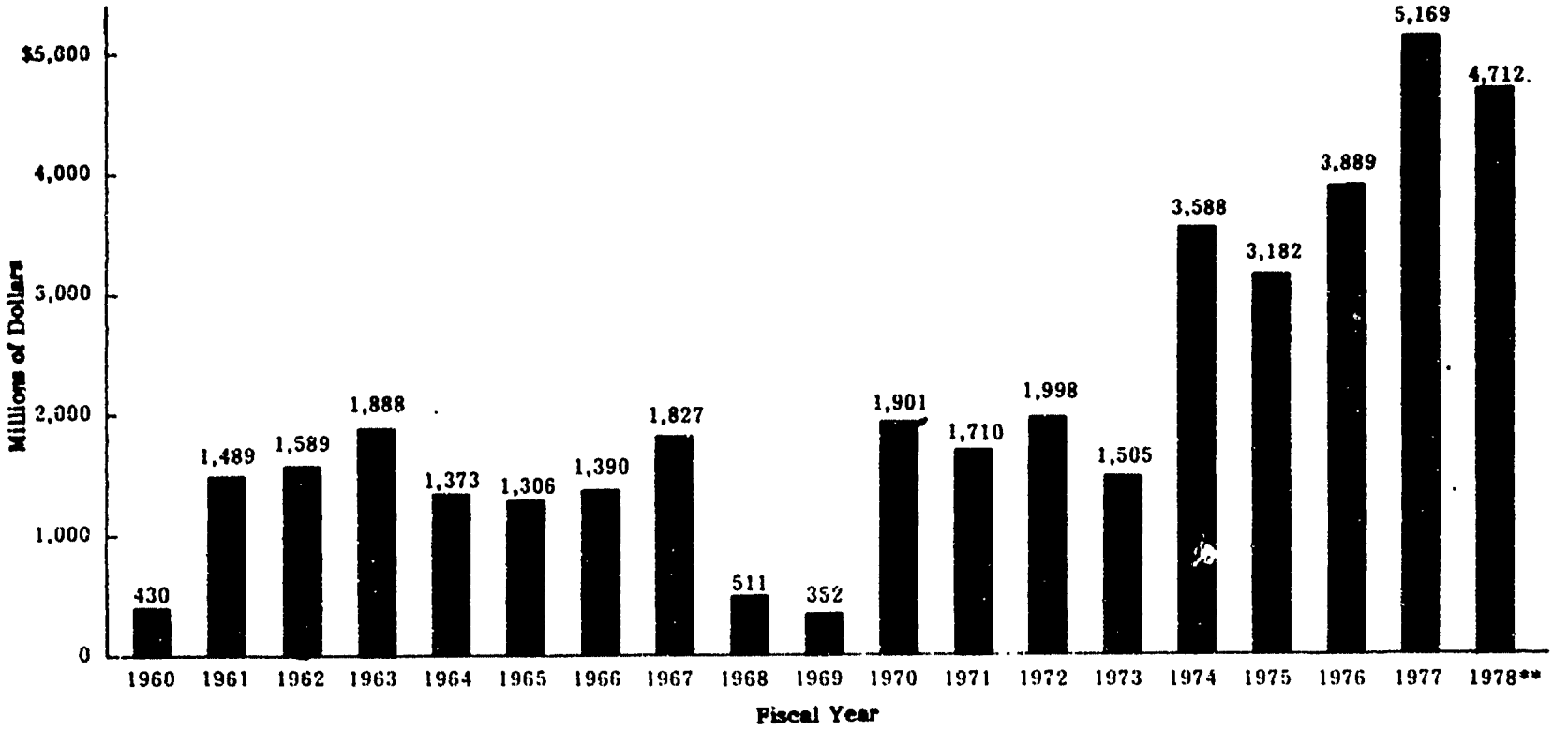
Using a bar chart format, Exhibit VI displays the total SCN (ship construction, Navy) appropriation for new ship construction in private U.S. shipyards during fiscal year 1960 to 1978.[1] As this exhibit indicates, total obligational authority (TOA) has varied significantly from one year to the next – from a low of $352 million in fiscal year 1969 to a high of nearly $5.2 billion in fiscal year 1977. These variations do not reflect expenditures during the same period, since TOA represents the appropriation of SCN funds. As illustrated by the bar chart presented in Exhibit VII, data on gross expenditures reflect a far smoother upward pattern.

While historical data are a valuable means of examining the Navy shipbuilding program, forecast information is equally important. Exhibit VIII indicates the projected U.S. Navy five-year shipbuilding program for fiscal year 1979 to 1983 as included in the President's budget submitted to the Congress in March 1978. As this exhibit reveals, it is planned that 70 new ships will be constructed during this period, ranging from an aircraft carrier and nuclear-powered submarines to oceanographic research vessels and cable repair ships. In addition, 13 ships currently in the fleet are to be modernized, including aircraft carriers, guided missile destroyers, and an auxiliary supply ship.

Exhibit IX translates these data into dollars. Over the next five years, plans call for more than $30 billion to be expended in this new construction and modernization program. Trident (SSBN) and attack submarines (SSN) account for

[1] These figures are not comparable to those presented in Exhibit V since the total SCN appropriations include government-furnished equipment.

EXHIBIT VI
TOTAL SCN APPROPRIATION FOR U.S. NAVY NEW CONSTRUCTION IN PRIVATE U.S. SHIPYARDS: FISCAL YEAR 1960 - 1978*

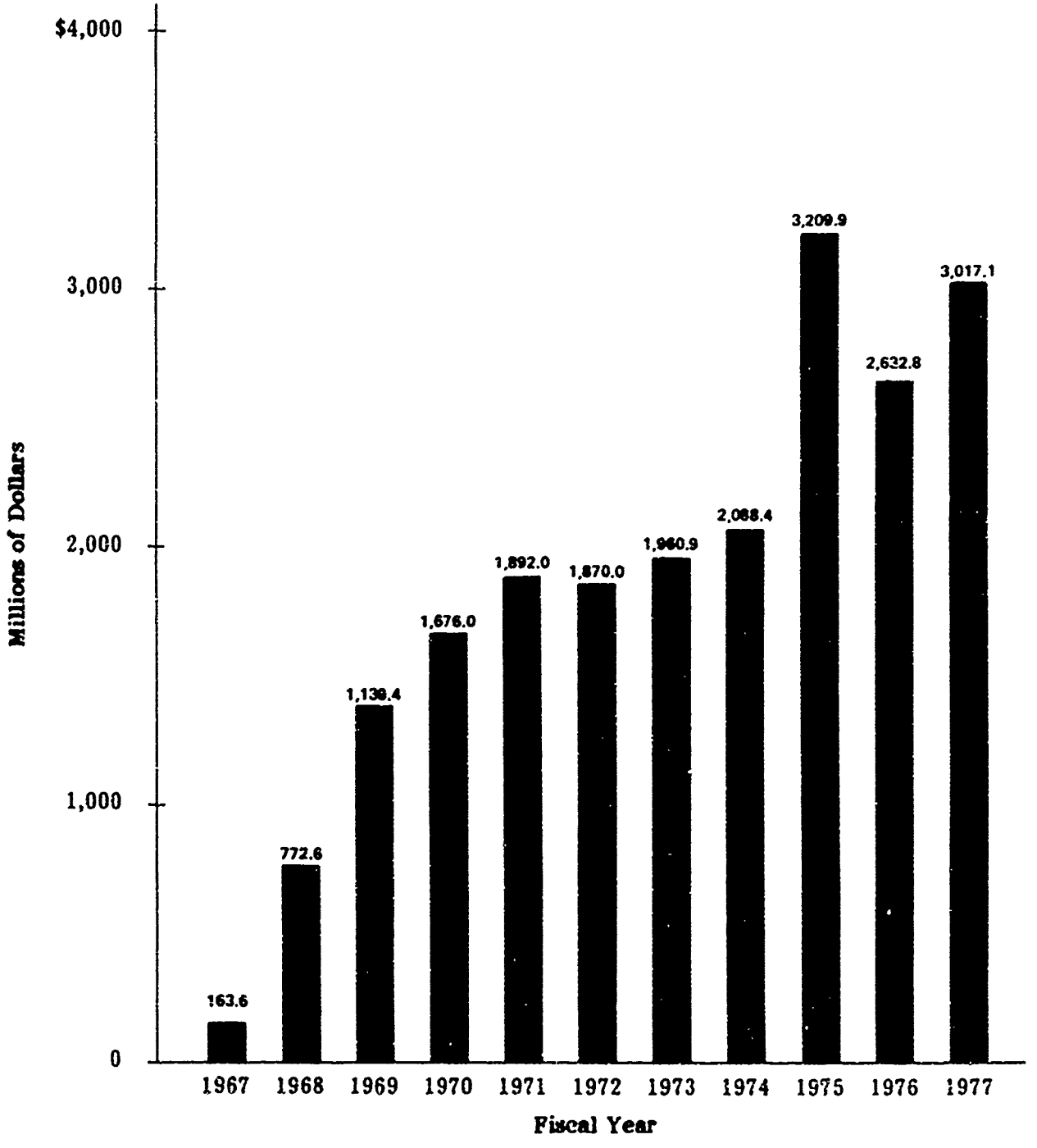


*Data include all RDT&E-funded new construction plus all craft. Data from 1960 to 1970 include all outfitting and post-delivery expenses; data from 1970 to 1978 exclude these expenses.

**President's March 1978 budget submission to Congress for fiscal year 1978 to 1983.

Source: NAVSEA and the Shipbuilders Council of America, March 1978.

EXHIBIT VII
GROSS EXPENDITURES FOR NEW SHIP CONSTRUCTION:
FISCAL YEAR 1967 - * 7*



*Data include expenditures for GFE. Data prior to fiscal year 1967 include expenditures for foreign military sales and are considered misleading; data for 1978 are incomplete.

Source: NAVSEA.

EXHIBIT VIII
U.S. NAVY FIVE-YEAR SHIPBUILDING PROGRAM
BY SHIP TYPE AND NUMBER OF HULLS: FISCAL YEAR 1979 - 1983*

Ship Type	Current Symbol	Fiscal Year					Five-Year Total
		1979	1980	1981	1982	1983	
New Construction							
Midsized, Conventional Aircraft Carrier	CVV		1				1
Trident Submarine (Nuclear)	SSBN	1	1	1	2	1	6
Attack Submarine (Nuclear)	SSN-688	1	1	1	1	1	5
Guided Missile Cruiser (Nuclear)	CGN-42					1	1
Guided Missile Destroyer	DDG-47		1	2	2	2	7
Dock Landing Ship	LSD-41			1		1	2
Guided Missile Frigate	FFG-7	8	5	5	5	3	26
Mine Countermeasures Ship	MCM		1		2	2	5
Destroyer Tender	AD	1					1
Oiler	AO			1			1
Oceanographic Research Vessel	AGOS	3	5	4			12
Cable Repairing Ship	ARC	1					1
Fleet Ocean Tug	ATF			2			2
Total New Construction		15	15	17	12	11	70
Modifications and Conversions							
Aircraft Carrier Ship Life Extension Program	CV-SLEP			1		1	2
Guided Missile Destroyer-Conversion	DDG-2		1	3	3	3	10
Auxiliary Supply Ship-Conversion	TAK			1			1
Total Modifications and Conversions			1	5	3	4	13
Total Five-Year Shipbuilding Program		15	16	22	15	15	83

*Program data exclude craft.

Source: President's March 1978 budget submission to Congress for fiscal year 1979 to 1983.

EXHIBIT IX
U.S. NAVY FIVE-YEAR SHIPBUILDING PROGRAM
BY SHIP TYPE AND DOLLARS: FISCAL YEAR 1979 - 1983*
(Millions of Dollars)

Ship Type	Current Symbol	Fiscal Year 1979	1980	1981	1982	1983	Five-Year Total
New Construction							
Midsized, Conventional Aircraft Carrier	CVV		$1,535.0				$ 1,535.0
Trident Submarine (Nuclear)	SSBN	$1,186.7	1,178.4	$1,393.7	$2,773.2	$1,626.7	8,158.7
Attack Submarine (Nuclear)	SSN-688	433.0	469.4	481.0	514.0	545.0	2,433.4
Guided Missile Cruiser (Nuclear)	CGN-42				209.0	1,328.4	1,537.4
Guided Missile Destroyer	DDG-47		766.7	1,480.4	1,557.8	1,586.3	5,391.2
Dock Landing Ship	LSD-41			371.0		343.1	714.1
Guided Missile Frigate	FFG-7	1,533.1	1,063.9	1,196.6	1,147.7	754.5	5,695.8
Mine Countermeasures Ship	MCM		117.9		228.7	205.6	552.2
Destroyer Tender	AD	318.0					318.0
Oiler	AO			202.0			202.0
Oceanographic Research Vessel	AGOS	98.0	151.0	126.0			375.0
Cable Repairing Ship	ARC	191.0					191.0
Fleet Ocean Tug	ATF			55.0			55.0
Total New Construction		$3,759.8	$5,273.3	$5,305.7	$6,430.4	$6,389.6	$27,158.8
Modifications and Conversions							
Aircraft Carrier Ship Life Extension Program	CV-SLEP	$ 32.2	$ 44.0	$ 479.8	$ 34.0	$ 530.0	$ 1,120.0
Guided Missile Destroyer-Conversion	DDG-2	151.0	348.4	540.5	440.2	319.1	1,799.2
Auxiliary Supply Ship-Conversion	TAK		5.4	44.7			50.1
Total Modifications and Conversions		$ 183.2	$ 397.8	$1,065.0	$ 474.2	$ 849.1	$ 2,969.3
Total Five-Year Shipbuilding Program		$3,943.0	$5,671.1	$6,370.7	$6,904.6	$7,238.7	$30,128.1

*Program data include long-lead-time items planned for advance procurement to be provided to the shipbuilders as GFE, and exclude small craft, outfitting, and post-delivery and cost-growth estimates.

Source: President's March 1978 budget submission to Congress for fiscal year 1978 to 1983.

roughly one-third of this total budget submission. Another third of the budget covers planned construction of 26 guided missile frigates and seven guided missile destroyers.

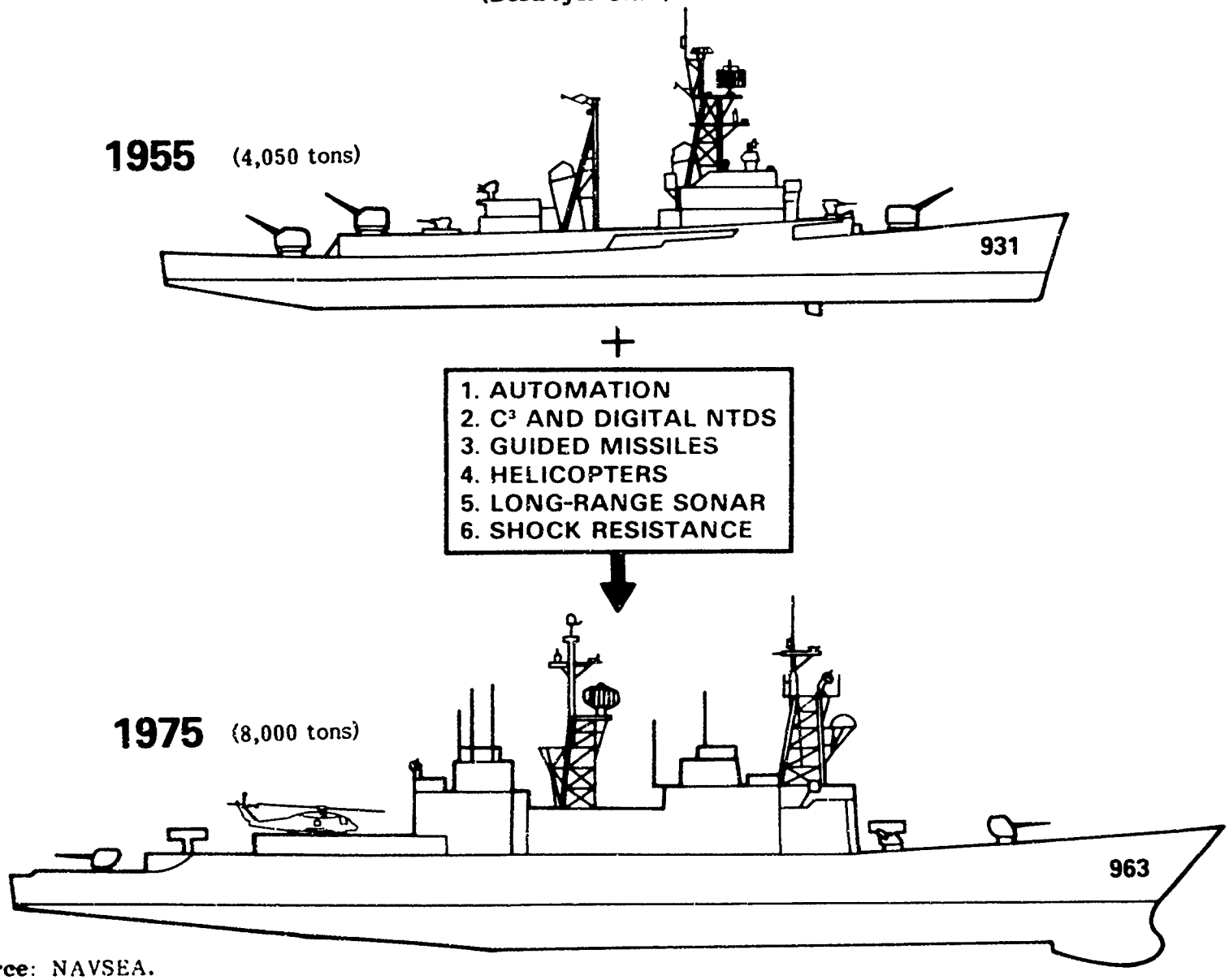
2. Complexity of Naval Ships

During the past two decades, advances in technology have expanded the capabilities and increased the complexity of naval combatant ships. For example, Exhibit X compares the Forest Sherman class destroyer (DD-931) which was built during the mid-1950s with the Spruance class (DD-963) which is under construction today. The control systems on the DD-963 have been centralized and automated to permit operation from the bridge, thereby reducing the personnel required for operation of the ship. Computer-aided navigation systems have been designed and installed. Propulsion engines have moved from basic boiler plants to gas turbines, and high-horsepower controllable-pitch propellers have been added. Other improvements include the installation of sound isolation material, high-shock resistance, a countermeasures system, helicopters, a long-range sonar capability, and missile and rocket weapon systems. In addition, pollution and habitability standards have been upgraded, and the electrical plant has been increased to provide for higher loads.

3. Length of Contract Performance

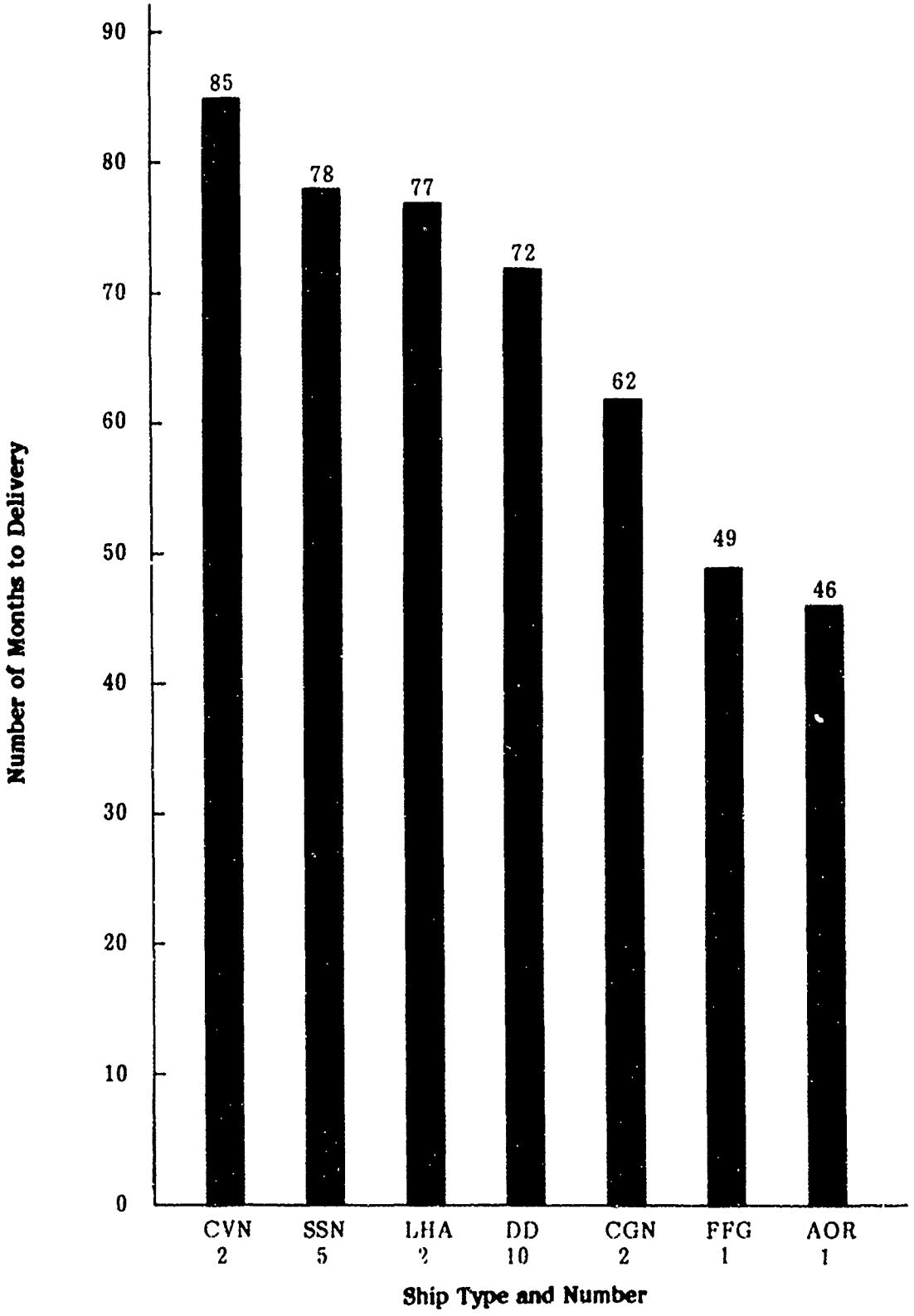
Exhibit XI presents information on 23 new ships ordered between fiscal year 1967 and 1973 and delivered during the three-year period between fiscal year 1975 and 1977. These 23 ships include seven different hull types. As the exhibit reveals, the longest contract performance period was for nuclear aircraft carriers (CVN), averaging slightly more than seven years for each of two ships. The five nuclear attack submarines (SSN) and two amphibious assault ships (LHA) were close behind, averaging six and one-half years of construction. Even auxiliaries necessitate long contract performance periods. For example, the AOR which was delivered in 1976 took nearly four years from contract award to commissioning. In short, the construction of major naval ships requires a period of from four to seven years after contract award – an unusually long period when the contracting parties must agree to firm prices for the ships at the time of the initial contract.

EXHIBIT X
GROWTH IN COMPLEXITY: 1955 - 1975
(Destroyer Class)



Source: NAVSEA.

EXHIBIT XI
U.S. NAVY NEW CONSTRUCTION SHIP DELIVERIES
(Ships Ordered in Fiscal Year 1967 to 1973 and Delivered in Fiscal Year 1975 to 1977)



Source: NAVSEA.

C. The Private Shipbuilding Industry

According to statistics compiled by the U.S. Department of Commerce, the U.S. shipbuilding and repair industry consists of 455 companies. The heart of the industry is composed of 164 private shipyards or repair yards. Thirty-seven of the private shipyards possess graving docks, marine railways, or shipways for constructing ships 400 feet or greater in length.[1] Eleven private shipyards are currently considered capable of handling major Navy new construction work, including combatants, landing craft, and auxiliary ships.[2] Three of the 11 shipyards are nuclear qualified. Two of the shipyards are currently engaged in both nuclear ship new construction and repair (Electric Boat and Newport News), and one is performing nuclear repair work only (Ingalls).

While these shipyards are relatively old, major capital investments have been made in several of them, and the industry as a whole has attempted to modernize its facilities when capital has been available. However, in recent years the industry has been characterized by low profits and a declining base of suppliers for marine products.

1. Industry Profile

Exhibit XII identifies the 11 major shipyards that are presently considered capable of constructing major naval ships. These shipyards account for 63 percent of the employment of the industry. This exhibit also shows the total value of the Navy new construction contracts that each of the 11 shipyards has received from 1973 through 1977. These data indicate that three of the 11 shipyards have become dominant, now accounting for more than three-quarters (77 percent) of the dollar value of the Navy's orders for new ships during this period. As shown in Exhibit V, above, the new ship awards during the 1960s were much more evenly

---

[1] Department of Commerce, Maritime Administration, Survey of U.S. Shipbuilding and Repair Facilities, 1977, Washington, D.C., December 1977.

[2] NAVSEA recently added Sun Shipbuilding and Dry Dock Company as a twelfth shipyard capable of performing Navy new construction work. Since all of the data for this study were assembled, no interview was conducted with this shipyard, and it is not referenced in the data contained in this study.

EXHIBIT XII
DOMINANCE OF THE ELEVEN MAJOR SHIPYARDS

Shipbuilders	Total Employment as of 1 February 1978			Dollar Value of U.S. Navy New Construction Contracts Placed (1973 - 1977)*		
	Number of Employees	Percent of Total	Cumulative Percent	Dollars (in Millions)	Percent of Total Dollars	
Eleven Major Shipyards						
Newport News	25,400	15%	15%	$ 2,853.8	28.2%	
Ingalls	24,700	15	30	1,565.4	15.5	77.0
Electric Boat	24,200	14	44	3,363.7	33.3	
Avondale	7,400	4	48	218.6	2.2	
National Steel	6,100	4	52	527.8	5.2	
Quincy	4,400	3	55	-	-	
Bath	4,000	2	57	678.3	6.7	
Lockheed	3,100	2	59	438.9	4.3	
Bethlehem	2,800	2	61	-	-	
Todd – Seattle	1,600	1	62	155.9	1.6	
Todd – San Pedro	1,500	1	63	306.2	3.0	
Total	105,200	63%	63%	$10,108.6	100.0%	
All Remaining Shipbuilders, Repair Yards, and Others	62,800	37%	100%	N/A	N/A	
Total: 455 Companies	168,000	100%	100%	N/A	N/A	

*Excludes awards for craft.

Source: Employment data from NAVSEA and Department of Commerce. Contract values data from NAVSEA, Quarterly Report of Status of Shipbuilding and Conversion Contracts.

spread among the various shipyards participating in the naval shipbuilding program. The current dominance is undoubtedly due to the fact that only two of the shipyards (Electric Boat and Newport News) are capable of building some of the major ships the Navy is now ordering – large nuclear-propelled submarines, carriers, and cruisers. The third shipyard (Ingalls) is the recipient of the two major total package procurements of 1969 and 1970.

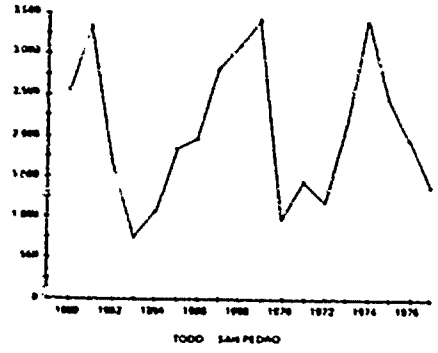
2. Stability of the Industry

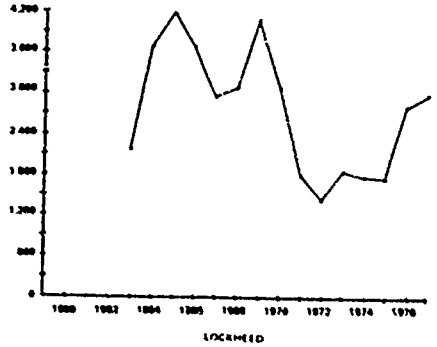
Exhibit XIII presents data on the employment levels at the 11 major shipyards from 1960 to 1977. There have been tremendous fluctuations in employment, with remarkably few level periods at any shipyard. Indeed, these data seem to indicate that the industry has been inherently unstable for the past two decades.

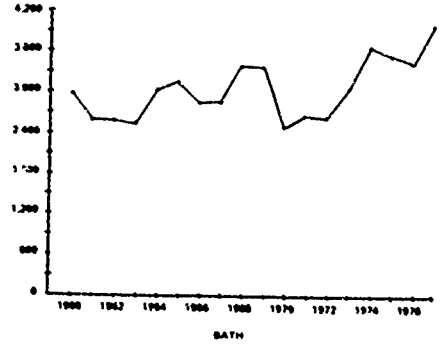
Exhibit XIV focuses on the employment levels of the 11 major shipyards for the recent past: 1973 through 1977. The information is broken down into Navy new construction, Navy repair work, private new construction, private repair work, non-ship work, and total direct and indirect employment. Significant fluctuations are also apparent during this period. For example, employment at Avondale fell 27 percent between 1973 and 1974, while employment at National Steel increased by nearly 25 percent during the same period. Electric Boat increased its work force by 80 percent between 1973 and 1976, while Todd – Seattle fluctuated significantly from one year to the next in each of the five years reported. Overall, employment in the 11 shipyards grew steadily every year until 1977 when it peaked at just over 106,000 employees. A decline in employment has since commenced, as shown in Exhibit XV.

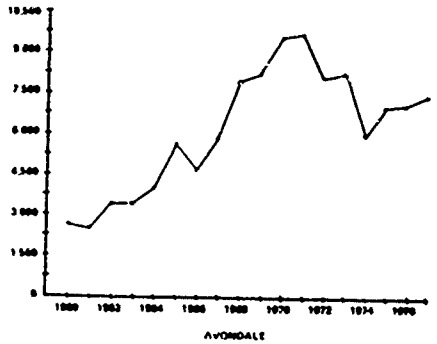
Navy new construction and conversion work as a percent of total direct employment has varied from a low of 55 percent in 1974 to a high of 62 percent in 1977. However, total Navy employment has been more stable. Typically, when Navy new construction and conversion work has decreased, Navy repair work has increased. Total Navy work as a percent of total direct employment has varied about 4 percentage points (between 66 percent and 70 percent) during the past three years and is a growing percentage of total work. On the average, Navy new construction work has employed about 44,000 people

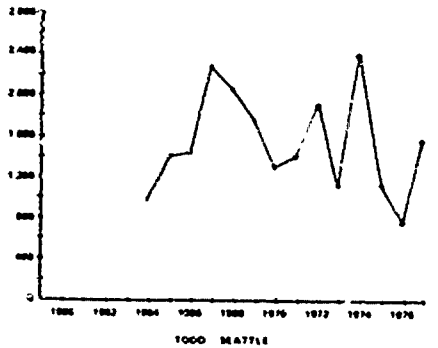
EXHIBIT XIII
EMPLOYMENT HISTORY AT THE ELEVEN MAJOR SHIPYARDS: 1960 - 1977

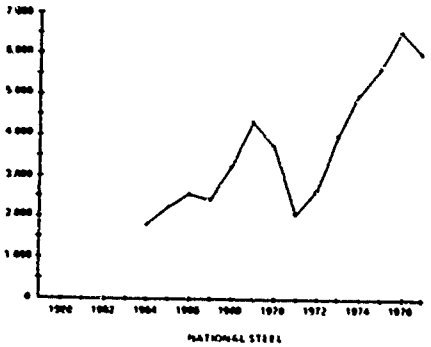


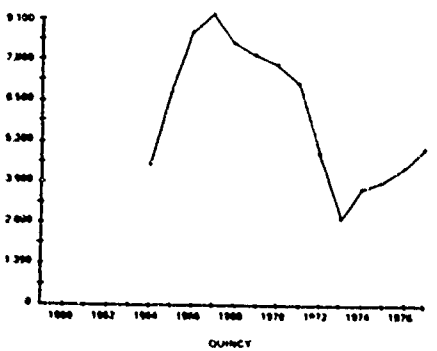


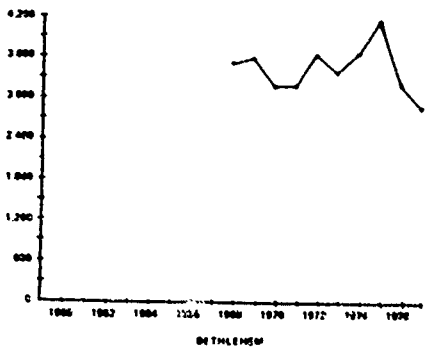


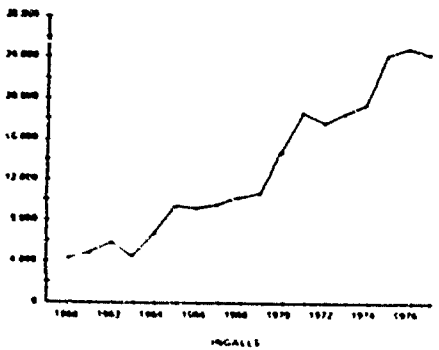


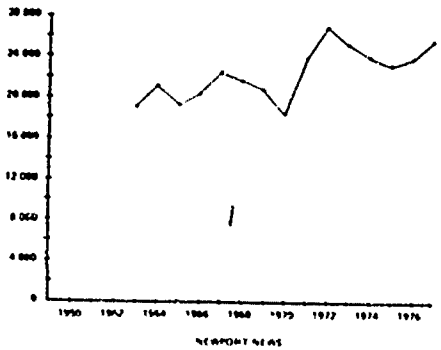


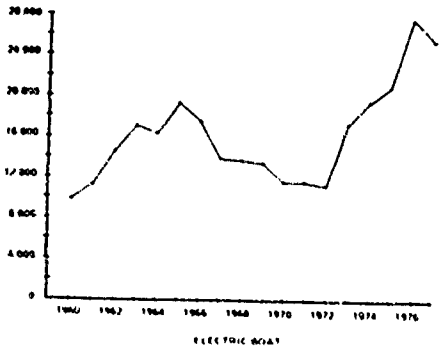












Source: NAVSEA.

EXHIBIT XIV
EMPLOYMENT LEVELS AT THE ELEVEN MAJOR SHIPYARDS: 1973 - 1977*

Year	Category	Avondale	Bath	Bethlehem	Electric Boat	Ingalls	Lockheed	National Steel	Newport News	Todd - Seattle	Todd - San Pedro	Quincy	All Shipbuilders Total Employees
1973	Navy New Construction/Conversion	809	914	-	5,600	12,278	1	165	19,625	-	-	416	39,806
	Navy Repair	-	-	-	1,787	1,646	-	544	135	257	84	198	4,551
	Private New Construction/Conversion	4,448	1,892	2,028	183	2,136	1,407	2,343	575	5	1,561	457	17,035
	Private Repair	1,950	184	168	236	-	281	61	1,675	960	65	77	5,657
	Non-Shipwork	-	-	-	-	-	-	-	-	-	-	-	-
	Total Direct Employment	7,207	2,990	2,196	7,806	16,060	1,689	3,113	22,010	1,122	1,710	1,148	67,051
	Indirect	955	52	1,212	7,531	2,166	196	877	3,000	-	414	1,580	18,793
	Total Employment	8,202	3,042	3,408	15,337	18,226	1,885	3,990	25,010	1,122	2,124	2,728	85,854
1974	Navy New Construction/Conversion	63	789	-	9,090	12,896	27	725	16,012	74	-	35	39,711
	Navy Repair	-	-	-	4,480	1,164	12	452	1,577	735	138	129	8,687
	Private New Construction Conversion	2,968	2,034	2,171	-	1	1,165	2,725	311	869	2,285	1,736	16,265
	Private Repair	1,943	-	82	-		253	63	1,346	109	189	-	3,985
	Non-Shipwork	37	284	-	640	-	201	204	744	395	-	225	2,730
	Total Direct Employment	5,011	3,107	2,253	14,210	14,061	1,658	4,169	19,990	2,182	2,612	2,125	71,378
	Indirect	967	538	1,422	5,396	5,344	142	816	3,845	216	518	1,666	20,870
	Total Employment	5,979	3,645	3,675	19,606	19,405	1,800	4,985	23,835	2,398	3,130	3,791	92,248
1975	Navy New Construction/Conversion	-	667		11,137	16,675	633	502	13,701	130	-	-	43,245
	Navy Repair	-		-	2,802	2,038	-	183	1,218	36	250	61	6,588
	Private New Construction/Conversion	4,424	1,667	2,665	-	-	590	3,689	1,168	565	1,505	2,665	19,018
	Private Repair	1,469	-	-		-	117	97	1,529	159	64	-	3,535
	Non-Shipwork	-	227	90	945	-	182	229	614	46	-	203	2,536
	Total Direct Employment	5,893	2,561	2,755	14,884	18,513	1,622	4,700	18,330	936	1,819	2,929	74,922
	Indirect	1,052	1,005	1,382	6,046	5,623	167	984	4,800	195	456	1,616	23,326
	Total Employment	6,945	3,566	4,137	20,930	24,136	1,789	5,684	23,130	1,131	2,275	4,545	98,248
1976	Navy New Construction/Conversion	-	990	241	15,775	17,044	1,953	292	11,505	126	46	-	47,962
	Navy Repair	-	596	-	2,864	2,215		504	936	29	534	55	7,733
	Private New Construction/Conversion	3,779	1,163	1,770	-		361	4,184	3,267	103	916	2,607	18,150
	Private Repair	2,016	-				192	133	1,784	322	85	122	4,654
	Non-Shipwork	-	246	119	720		148	209	600	7	-		2,049
	Total Direct Employment	5,795	2,995	2,130	19,359	19,259	2,654	5,312	18,042	587	1,581	2,784	80,548
	Indirect	1,181	445	1,104	8,231	5,456	203	1,196	5,638	196	364	1,551	25,565
	Total Employment	6,976	3,440	3,234	27,590	24,715	2,857	6,508	23,730	783	1,945	4,335	106,113
1977	Navy New Construction/Conversion	45	1,139	192	16,818	19,172	2,470	1,423	10,197	675	825	61	52,012
	Navy Repair		582		1,873	2,137	80	152	2,108	450	30		7,002
	Private New Construction/Conversion	4,283	1,112	1,466				2,288	1,331			3,064	17,544
	Private Repair	1,972					102	288	2,122	183	214		8,881
	Non-Shipwork		140	134	743		39	229	862	6		114	2,408
	Total Direct Employment	6,300	3,113	1,792	19,434	20,309	2,691	4,680	19,615	1,304	1,069	3,239	83,847
	Indirect	1,120	879	1,108	6,175	3,904	216	1,132	6,819	273	254	1,741	22,621
	Total Employment	7,420	3,992	2,900	25,609	24,213	2,907	6,012	26,434	1,577	1,323	4,981	106,468

*Data presented are for the month of December each year except for Ingalls in 1974 when October data are used.

Source: MARAD

EXHIBIT XV
1978 EMPLOYMENT VS. OPTIMUM MANNING
AT THE ELEVEN MAJOR SHIPYARDS

Shipyard	Total Employment (as of May 1978)	Optimum Manning Estimates (as of June 1978)	Percent Deviation
Avondale	5,900	7,200	+22.0%
Bath	4,500	4,000	-11.1
Bethlehem	3,200	4,000	+25.0
Electric Boat	23,300	25,000	+ 7.3
Ingalls	21,600	18,000	-16.7
Lockheed	2,900	3,000	+ 3.4
National Steel	5,400	7,000	+29.6
Newport News	25,000	25,000	--
Quincy	5,600	9,000	+60.7
Todd - Seattle	1,900	3,000	+57.9
Todd - San Pedro	2,400	4,500	+87.5
Total	101,700	109,700	+ 7.9%

Source: Optimum manning estimates were obtained from the shipyards listed by the Office of the Assistant Secretary of the Navy (MRA&L) in June 1978. Data were provided in response to the question: "Given your current facilities, what total manning level would you ideally choose for operating your shipyard with a continuous stable workload?"

annually for the past five years. The three largest shipyards (Electric Boat, Ingalls, and Newport News) account for approximately 93 percent of this employment.

As mentioned earlier, Exhibit XV compares May 1978 employment levels with "optimum" manning levels, as perceived by the 11 major shipyards. As this exhibit indicates, eight shipyards feel that they should increase employment to handle a stable workload with maximum efficiency, while two are already over the optimum manning level. One shipyard is currently at the optimum level. In combination, the shipyards see a need to increase their overall employment by almost 8 percent. These figures indicate that the gross amount of work currently under way in the industry is adequate to permit a high degree of productivity. However, the work is not spread evenly throughout the shipyards. For example, the three large shipyards combined are currently working at 103 percent of the optimum level, while the eight smaller yards combined are working at 76 percent of the optimum level.

3. Labor

In contrast to most other large-scale industrial enterprises, the shipbuilding industry is extremely labor intensive. Furthermore, it is highly dependent on a relatively large proportion of skilled craftsmen, such as welders, shipfitters, and electricians. Exhibit XVI shows the percentage of craft and other labor to total shipbuilding labor.

EXHIBIT XVI
SHIPBUILDING LABOR – ALL PRIVATE SHIPYARDS*

Craft Labor	52.6%
Laborer	4.6%
Semi-Skilled Labor	24.8%
White Collar Labor	18.0%

*Source: Martin, John C., The Labor Market of the United States Shipbuilding Industry, Doctoral dissertation, George Washington University, 1978.

Exhibit XVII compares the weekly earnings of production workers in the shipbuilding industry to those of workers in the contract construction industry. As this exhibit reveals, except for 1963, the earnings of shipbuilding workers have always lagged behind those of contract construction workers. Beginning in 1964, a trend of earnings increases commenced for both contract construction and shipbuilding workers. By 1974, contract construction workers were realizing $59 a week more than shipbuilding workers. The greatest percentage difference occurred in 1973, when contract construction workers earned nearly 25 percent more than shipbuilding workers. On balance, it appears that earnings in the shipbuilding industry tend to lag two to three years behind those in the contract construction industry.

Working conditions in the shipbuilding industry are far less desirable than those in many other manufacturing industries. Thus, working conditions may partially explain the extremely high turnover rates in this industry, as shown in Exhibit XVIII. During the interviews, some shipbuilders told the study team that their work forces are roughly composed of two groups: (i) a relatively stable cadre of skilled workers and (ii) a substantial number of less skilled employees who work on a highly irregular basis. Some individuals in the latter group may go through a "hire and quit" cycle two, three, or four times in the course of a single year.

These high turnover rates may also be caused by the fact that, in some of the shipyards, the work force has expanded beyond the available local labor pool. An additional factor affecting personnel stability is the need to maintain a balance between the skills profile necessary to accomplish the workload and the skills profile of the work force. Should an imbalance occur that cannot be corrected by internal management action (such as rescheduling work), it becomes necessary to hire and fire skilled workers. Such turbulence in this crucial manpower resource is even more damaging to shipyard productivity than turbulence among the less skilled employees.

Experience indicates that shipbuilding labor is not generally mobile. In a recent study conducted by a doctoral candidate at George Washington

EXHIBIT XVII
WEEKLY EARNINGS OF PRIVATE SHIPBUILDING VS. CONTRACT CONSTRUCTION PRODUCTION WORKERS

Year	Contract Construction	Private Shipbuilding	Differential: Contract Construction vs. Private Shipbuilding	
			Dollars	Percent
1960	$113.04	$110.43	$ 2.61	2.3%
1961	118.08	117.20	.88	0.8
1962	122.47	121.60	.87	0.7
1963	127.19	127.92	(.73)	(0.6)
1964	132.06	128.21	3.85	2.9
1965	138.38	127.98	10.40	7.5
1966	146.26	137.78	8.48	5.8
1967	154.95	139.32	15.63	10.1
1968	164.49	144.99	19.50	11.9
1969	181.54	155.07	26.47	14.6
1970	195.45	158.00	37.45	19.2
1971	211.67	162.74	48.93	23.1
1972	222.51	172.66	49.85	22.4
1973	235.69	178.41	57.28	24.3
1974	249.08	189.74	59.34	23.8
1975	265.35	217.09	48.26	18.2
1976	284.56	247.33	37.23	13.1

Source: Department of Labor, Bureau of Labor Statistics, Employment and Earnings, United States, 1909-1975, Bulletin 1312-10, Washington, D.C., 1976, and Employment and Earnings, Washington, D.C., March 1976 and March 1977.

EXHIBIT XVIII
MONTHLY LABOR TURNOVER RATES IN SELECTED INDUSTRIES: 1976

Industry	Rate of Change per 100 Employees per Month		
	Accessions	Separations	Turnover
Private Shipyards	6.7	6.3	13.0
Fabricated Metal Products	3.9	4.2	8.1
Primary Metals	3.0	2.9	5.9
Aircraft	1.4	1.7	3.1
Naval Shipyards	1.2	1.0	2.2

Source: Department of Labor, Bureau of Labor Statistics, Employment and Earnings, Washington, D.C., February 1978, and NAVSEA.

University,[1] it was found that only 9.1 percent of the 1965 work force at the private shipyards had moved to another state by 1970. During the interviews, shipbuilders indicated to the study team that employees who are separated seldom move to other locations where the industry is experiencing expansion. Often, skilled personnel will simply seek employment in other allied industries. As a result, the pool of skilled manpower available to each shipyard appears to be limited to those workers in its geographic area. Thus, shipbuilders are not generally able to expand their labor forces unless they undertake expensive training efforts.

4. Facilities

Shipbuilding requires a large fixed asset investment for each sales dollar. While much of this investment was made in earlier decades, several shipbuilders have made major capital investments in recent years. Thus, the private shipyards are currently a mixture of old facilities with some modern additions. Since 1970, the U.S. shipbuilding industry has invested approximately $1.3 billion in facilities modernization and capital improvements. Of this investment, $135 million was expended in fiscal year 1977. Plans for fiscal year 1978 call for investment of $167 million. Exhibit XIX shows the portion of this investment made by the 11 major shipyards. In this context, the total investment figures include improvements that are applicable to both commercial and Navy work. The exhibit also identifies the amount of investment estimated by the shipbuilders as applying specifically to Navy work.

The following examples are representative of the recent modernization programs that have been undertaken in the industry:[2]

---

[1] Martin, The Labor Market of the United States Shipbuilding Industry, pp. 1-27.

[2] Data on all shipyards except Electric Boat taken from Department of Commerce, Maritime Administration, MARAD '76, Annual Report of the Maritime Administration for Fiscal Year 1976 and the Transition Quarter Ending September 30, 1976, Washington, D.C., April 1977.

EXHIBIT XIX
TOTAL CAPITAL INVESTMENT OF THE ELEVEN MAJOR SHIPYARDS: 1970 - 1977
(Millions of Dollars)

Year	Total Investment	Estimated Investment Identified to Navy Work
1970	$ 105.2	$ 92.4
1971	84.3	55.5
1972	73.8	34.2
1973	111.8	19.4
1974	107.4	45.8
1975	134.7	73.5
1976	295.2	44.9
1977	90.4	30.3
Total	$1,002.8	$396.0

Source: Shipbuilders Council of America.

- Avondale. Completed a $42 million expansion program in 1975 centering around the construction of two new building ways on which two ships can be built simultaneously. The company has also added a 900- by 260-foot floating drydock.

- National Steel. Completed a $20 million expansion and modernization program in early 1976 which provides the capability to build ships as large as 190,000 deadweight tons. In its new building basin, National Steel can produce vessels 1,000 feet long and 170 feet wide. Previously, it was limited to building vessels 900 feet by 106 feet.

- Newport News. Expended approximately $210 million for a new commercial shipyard which was completed in 1976. The new facilities include the largest building basin in the United States, a steel preparation building, panel shop, subassembly areas, and a 900-ton Goliath crane.

- Electric Boat. Completed an approximately $150 million facilities improvement program. Improvements at the Groton site are principally in the land-level construction facility, and consist of an inshore and an outboard erection site and a 60,000-square foot pontoon graving dock and launcher. At Quonset Point, improvements were completed in late 1976 on buildings used for steel-processing and fabrication, housing various shops, and storing material.[1]

[1] Department of Defense, Coordinator of Shipbuilding, Conversion, and Repair, Annual Report on the Status of the Shipbuilding and Ship Repair Industry of the United States, 1976, Report Control Symbol DD-I&L(A) 1141, Washington, D.C., 26 April 1977.

- Quincy. Completed a $40 million modernization program in mid-1975. Two inclined shipways were converted to building basins to enable construction of LNGs (liquefied natural gas carriers) in series production. In addition, a 1,200-ton Goliath crane (the largest in the western hemisphere) was installed.

Most private U.S. shipyards are constrained by their facilities in terms of the programs that they can undertake. For example, on the one hand, only Electric Boat has the facilities needed to build a Trident SSBN, and only Newport News has the facilities to build a CVN. On the other hand, some shipyards (such as National Steel) are laid out in such a manner that only noncombatant ships can be built efficiently.

During the course of the interviews, nearly every shipbuilder pointed out that its facilities are very expensive and generally of long life. Therefore, a relatively long productive use for new facilities must be evident in order to justify their purchase.

5. The Supplier Base

Another dimension of the shipbuilding industry is the shrinking supplier base for marinized material. Exhibit XX presents some statistics on the material and equipment lead times experienced over the last 16 years by shipbuilders constructing Navy ships. While the list is merely a representative sample and lead times for some basic materials have recently improved, the overall trend of longer and longer lead times is apparent. During the interviews, a number of shipbuilders stated that there has been a slow but steady erosion in the number of marine suppliers. The shipbuilders and other knowledgeable observers of the marine supplier industry believe that this erosion will continue during the next decade unless the volume of Navy business increases and/or Navy acquisition procedures and technical and administrative requirements are relaxed.

6. Management

Management of a commercial shipyard is clearly a difficult and exacting task. Maintaining control of an operation involving thousands of people who are performing a broad spectrum of tasks and utilizing a multimillion-dollar facility complex is, alone, a challenging job for the managers in the larger

EXHIBIT XX
MATERIAL AND EQUIPMENT LEAD TIMES

	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Material Lead Time (Weeks)																
Aluminim Shapes Extruded Lg.	12	12	12	12	12	16	16	14	16	16	16	16	24	30	12	13
Aluminum Shapes, Structurals	-	-	-	-	-	-	14	14	14	14	14	14	20	26	12	13
Carbon Steel Plate (M)	8	8	8	10	10	10	10	10	10	10	8	8	12	20	12	12
Carbon Steel Structurals (M)	11	12	12	10	10	10	10	10	12	12	10	10	16	24	12	16
Alloy Stl. Shapes Structural (M)	12	12	12	12	12	12	12	13	13	13	12	13	24	34	24	24
Casting, Copper and Brass Lg.	4	6	6	6	10	12	16	16	16	16	16	16	18	24	20	16
Castings, Steel Alloy Lg.	8	8	12	20	20	20	24	30	40	40	40	30	36	70	52	36
Forgings, Steel Alloy Lg.	10	10	10	10	10	10	16	18	24	24	20	24	44	60	40	30
Equipment Lead Time (Months)																
Blowers, F.D. Turb./Driv.	14	14	14	14	14	16	16	16	16	16	16	16	17	18	18	18
Blowers, F.D. Motor/Driv.	-	-	-	10	10	12	12	12	10	10	10	10	11	14	14	14
Blowers, Main	14	14	13	13	14	14	14	15	15	15	14	14	14	15	18	17
Condensers, Main	11	11	11	11	11	12	12	14	14	14	14	14	14	15	15	15
Distilling Plants	11	11	11	11	11	13	13	13	13	13	13	12	13	13	15	14
Gears, Main Reduction	15	15	15	15	15	17	17	18	18	18	18	16	16	18	17	17
Generators, Stm. Turb.	13	13	13	13	12	14	16	17	17	17	17	18	18	20	19	19
S/S Switchboards	13	13	13	14	13	13	17	17	17	17	17	18	18	18	17	17

Source: NAVSEA.

shipyards. However, such managers must also press for productivity improvements and give time and attention to the acquisition of and preparation for additional business. The difficulties of managing a smaller shipyard are similar, but on a smaller scale.

The past decade has witnessed a substantial growth in the management tasks with which the shipbuilders of naval ships must cope. Examples of new or expanded requirements relating to national social goals include the Occupational Safety and Health Act, environmental protection, equal employment opportunity, and the Longshoremen's and Harbor Workers Act. Other management tasks derive from the steadily increasing complexity of the technology involved and the never-ending demands for information from diverse government agencies. Inevitably, the demands on management time, talent, and energy expand as shipbuilders respond and adjust to external requirements.

7. Productivity

In general, the shipbuilders interviewed indicated that industry productivity is stagnant at best. While no quantitative measure of productivity has been cited, some shipbuilders reported a steady decline in productivity.[1] In a recent survey of 14 industrial organizations, which included five U.S. private shipyards, several factors were found to have an impact on productivity:[2]

- Learning.
- Social legislation.
- Labor agreements.
- Stability of contractor operations and its close relationship with labor availability and turnover.
- Navy-controlled considerations, including plans and specifications, inspection, quality control, and contract administration.

---

[1] One shipbuilder estimated that the loss was at the rate of 1 to 2 percent per year.

[2] International Maritime Associates, Inc., A Study of Ship Cost Estimating in the Naval Sea Systems Command, Washington, D.C., October 1977.

The survey concluded that the negative portion of each of these factors (except for learning) has dominated over the past decade and that, as a result, shipyard productivity has seriously deteriorated. The study suggested that large numbers of changes, market fluctuations, labor turnover, social legislation, and technological complexity have also contributed to a decrease in productivity.

8. Profitability

Available statistics indicate that the shipbuilding industry has earned meager profits in recent years. In a widely publicized study, known as "Profit '76,"[1] the Department of Defense reported that the shipbuilding industry earned only 2.9 percent profit as a percentage of government sales and 3.5 percent profit on commercial sales compared with 4.7 percent and 6.7 percent, respectively, for all defense contractors. While this study indicated that the shipbuilding industry is the least profitable of all defense industries, it appears that the reported figures may have been overstated since they were based on the performance of only five companies during a five-year period.

A more recent study[2] based on a larger number of companies has developed the data set forth in Exhibit XXI. These data indicate that profit for the 11 major shipbuilding companies from 1967 through 1976 inclusive was less than 0.2 percent of sales. While the data in this study are not broken down by government and commercial sales, there is evidence that government sales generated losses for a number of the companies in the survey. This study also indicates that profits in prior decades were low – demonstrating the long-term difficulties that the industry has experienced.

As a result of the "Profit '76" study, the Department of Defense promulgated a new profit policy effective 1 October 1976. This policy altered the

---

[1] Department of Defense, Office of the Assistant Secretary of Defense (Installations and Logistics), Office of the Deputy Assistant Secretary of Defense (Procurement), Profit Study Group, Profit '76 Summary Report, Washington, D.C., December 1976.

[2] Office of Naval Research, The Profitability of the U.S. Shipbuilding Industry, 1947-1976, draft report, Washington, D.C., 16 May 1978.

EXHIBIT XXI
INDUSTRY SALES AND PROFIT DATA
(Millions of Dollars)

Date	Number of Firms	Sales (after Taxes)	Profit (after Taxes)	Average		Percent Profit		
				Net Worth	Fixed Assets (Net)	Sales	Net Worth	Fixed Assets (Net)
1947 to 1956 Inclusive	11*	$ 3,970.3	$154.0	$164.4	$ 55.5	3.9%	9.4%	27.8%
1957 to 1966 Inclusive	9**	6,821.4	154.3	226.5	109.1	2.3	6.8	14.2
1967 to 1976 Inclusive	11***	21,799.9	37.0 (est.)	N/A	N/A	.2	N/A	N/A

*Alabama, American (1950-1956), Avondale, Bath, Electric Boat (1947-1952), Ingalls, Maryland, National Steel, Newport News, New York, Todd.
**Alabama, American, Avondale, Bath, Ingalls, Maryland, Newport News, New York, Todd.
***Alabama, American, Avondale, Bath, Electric Boat, Ingalls, Lockheed, National Steel, Newport News, Sun, Todd.

Source: Office of Naval Research, The Profitability of the U.S. Shipbuilding Industry, 1947-1976.

profit calculation to give greater emphasis to fixed-asset investments and permitted the imputed cost of capital invested in fixed assets to be reimbursed as an allowable cost on defense contracts. During the interviews, the shipbuilders overwhelmingly characterized this new policy as inadequate to induce them to make fixed-asset investments. They also affirmed that the new policy might result in reduced profits for the shipbuilding industry in the long run.

D. Economic Conditions

Rising labor costs and increases in materials and equipment prices have all been blamed for low profits in the shipbuilding industry. It is clear that the shipbuilding industry has been seriously affected by the inflationary spiral. Exhibit XXII presents some statistics on rising prices as measured by the Consumer Price Index and NAVSEA's material index for steel vessel contracts. As this exhibit indicates, depending on the index used, general prices have increased 51 to 56 percent during the seven-year period from October 1970 to October 1977. The NAVSEA material index for steel vessel contracts surged 75 to 83 percent during the same period.

A less severe trend occurred in shipbuilding wages. From 1970 to 1974, weekly wages for shipbuilding workers increased by only 20.1 percent (see Exhibit XVII, above). A review of BLS wage data for the same period reveals that the increase for private nonagricultural payrolls combined was 27.4 percent.[1] The low rate of increase in shipbuilding wages is partially attributable to the growth of the total work force during that period. However, from 1974 to 1976 weekly shipbuilding wages increased by 30.3 percent as the industry caught up with the national trend. Increases from 1970 to 1976 averaged 47.6 percent for workers nationally and 56.5 percent for the shipbuilding industry.

---

[1] Department of Labor, Bureau of Labor Statistics, Employment and Earnings, Washington, D.C., February 1978. The private, nonagricultural payrolls cited include production and related workers in mining and manufacturing, construction workers in contract construction, and nonsupervisory workers in transportation and public utilities; wholesale and retail trade; finance, insurance, and real estate; and services.

EXHIBIT XXII
INCREASES IN PRICES: CONSUMER AND STEEL INDEXES

Consumer Price Index

	1957 - 1959 = 100		1967 = 100	
October 1970	N/A		118.1	
October 1971	142.4		122.4	
October 1972	147.1		126.6	
October 1973	158.8	51%	136.6	56%
October 1974	177.9	Increase	153.0	Increase
October 1975	191.4		164.6	
October 1976	201.5		173.3	
October 1977	214.6		184.5	

Material Index for NAVSEA Steel Vessel Contracts

	1957 - 1959 = 100		1967 = 100	
October 1970	N/A		115.2*	
October 1971	129.6		121.0	
October 1972	132.9		123.9	
October 1973	140.2	75%	130.7	83%
October 1974	188.7	Increase	175.9	Increase
October 1975	199.8		186.2	
October 1976	212.9		198.4	
October 1977	226.5		211.1	

*Figure for November 1970.

Source: Shipbuilders Council of America, March 1978.

E. The Ship Acquisition Process

1. Organization for Ship Acquisition

Once the Navy shipbuilding program has been approved by the Congress, the actual acquisition can begin. A number of Navy organizations play a part in acquiring its ships, including the Secretary of the Navy, the Chief of Naval Operations, and the Chief of Naval Material. The Assistant Secretary of the Navy for Manpower, Reserve Affairs, and Logistics is the shipbuilding acquisition executive.[1] A major responsibility for ship acquisition rests with the Commander, Naval Sea Systems Command. Exhibit XXIII presents a summary organization chart of NAVSEA. The ship acquisition project managers (SHAPMs), the Contracts Directorate (SEA-02), and the Naval Ship Engineering Center (NAVSEC) are assigned most of the responsibilities during the ship acquisition process, although the Nuclear Propulsion Directorate (SEA-08) and other NAVSEA codes also participate.

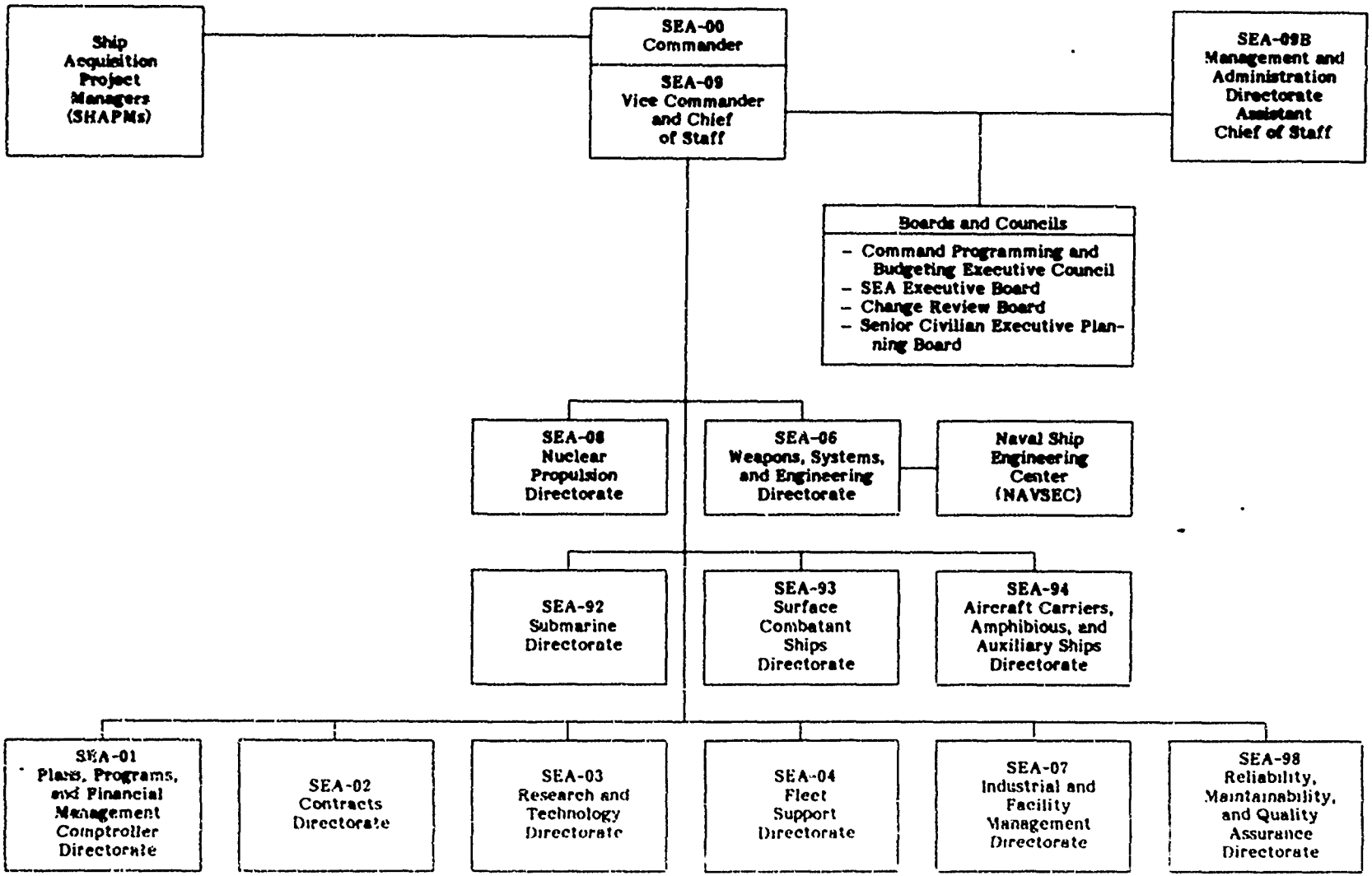
a. SHAPMs. Historically, NAVSEA has employed a matrix organization for ship acquisitions in which a small project organization headed by a ship acquisition project manager (SHAPM) coordinates and manages the efforts of the larger functional organizations that affect its projects. These functional organizations report directly to the Commander, NAVSEA, but customarily assign key participants to fulfill their responsibilities to the project.

Exhibit XXIV lists all of the current designated projects in NAVSEA, including the ship acquisition projects which are headed by SHAPMs. Each SHAPM office is tailored to the unique needs of the program it manages, and the size and shape of the organization varies as the program moves from conceptual design to construction. Some SHAPM offices have become institutionalized in order to oversee the procurement of successive programs of ships of the same type.

---

[1] This designation occurred in a memorandum of 28 July 1977 from the Secretary of the Navy to the Deputy Secretary of Defense. It will be further defined in SECNAV Instruction 5000.1 soon to be promulgated.

EXHIBIT XXIII
ORGANIZATION OF THE NAVAL SEA SYSTEMS COMMAND (NAVSEA)



Source: NAVSEA.

EXHIBIT XXIV
NAVSEA DESIGNATED PROJECTS

Submarine Projects
- PMS* 393 SSN
- PMS 395 Deep Submergence
- PMS 396 Trident

Escort Projects
- PMS 303 PHM
- PMS 376 Spanish Ship Support
- PMS 378 CGN-38
- PMS 389 DD-963/993 IIN
- PMS 399 FFG-7

Amphibious Auxiliary Projects
- PMS 300 Boats and Crafts
- PMS 307 Saudi Naval Expansion
- PMS 377 LHA/LSD-41
- PMS 383 Auxiliaries

Carrier Projects
- PMS 392 CVAN
- PMS 397 VSS

Systems Projects
- PMS 402 MK 48 Torpedo
- PMS 404 Anti-Ship Missile Defense
- PMS 405 High-Energy Laser
- PMS 406 Advanced Lightweight Torpedo
- PMS 407 Captor

Fleet Support Projects
- PMS 301 Steam Propulsion Plant Improvement
- PMS 306 Ship Support Improvement

Technology Projects
- PMS 304 Surface Effect Ship

AEGIS Shipbuilding
- PMS 400 DDG-47/CGN-42/AEGIS

*PMS = Project Manager, Sea.

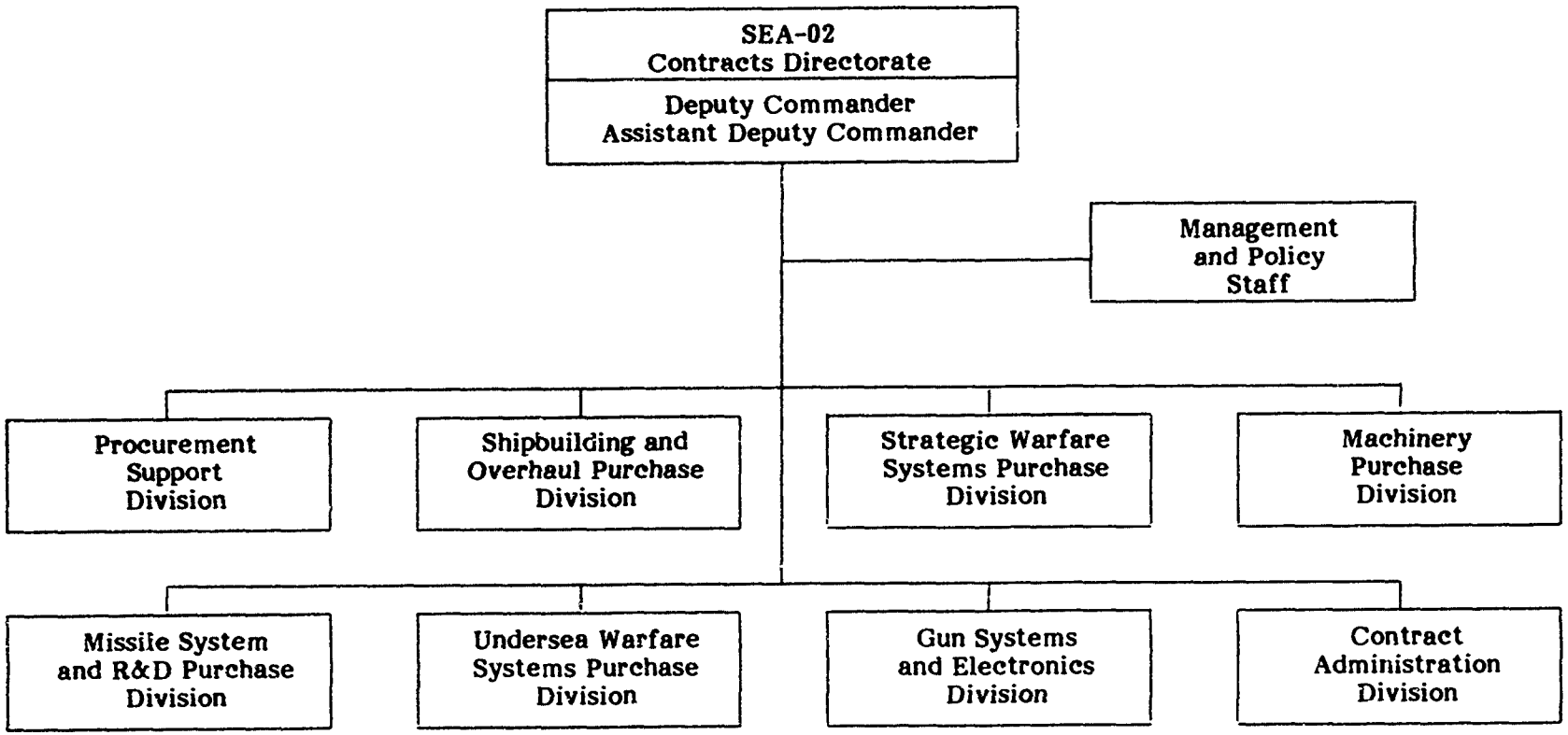
Source: NAVSEA.

As noted above, SHAPM staffs are relatively small, relying on support from NAVSEA and NAVSEC for such functions as technical advice, contracting, procurement of government-furnished equipment (GFE), and training. However, functions such as risk analysis, configuration management, and the development of integrated logistic support plans are now focused in the SHAPM. The SHAPM also exercises authority over a change control board, deciding the mandatory or desirable nature of proposed ship changes as well as the timing of their implementation. Through a system of ship project directives (SPDs), the SHAPM controls project funds and has the authority to manage the scheduling and the provision of the diverse services, materials, and data which are the Navy's responsibility in a shipbuilding contract. A number of these services, particularly the procurement of GFE and government-furnished information (GFI) are provided by participating managers (PARMs). The PARMs are normally given an in-house contract by the SHAPMs for the acquisition of various equipments (weapons systems, for example) plus their supporting data. They report to the SHAPMs, as outlined in the SPD, as well as to the head of their organizations. Shipbuilders appear to be relatively pleased with this organizational mode, which provides a focal point for them during the ship acquisition process.

b. Contracts Directorate. While SHAPMs have much of the internal Navy planning authority and responsibility, only procurement contracting officers (PCOs) of the NAVSEA Contracts Directorate have the authority to negotiate and enter into ship construction contracts. Exhibit XXV presents the organization chart of the NAVSEA Contracts Directorate. As this exhibit reveals, PCOs are organized by divisions, with the Shipbuilding and Overhaul Purchase Division shouldering the major responsibility for the placement of ship acquisition contracts. Separate branches within this division address submarine, surface and auxiliary, and small craft acquisitions.

Because of limited NAVSEA resources, individual PCOs may have responsibility for more than one ship program at the same time. In major ship acquisitions, the PCO typically has no other assigned program responsibilities. Nevertheless, the PCO remains in the SEA-02 organization and is not subject to direction from the SHAPM. By remaining organizationally apart from the SHAPM,

EXHIBIT XXV
ORGANIZATION OF THE NAVSEA CONTRACTS DIRECTORATE



Source: NAVSEA.

the PCO retains contract autonomy even though funds control is a SHAPM responsibility. In the interviews, a number of the shipbuilders commented that the Contracts Directorate is understaffed and, hence, unable to process procurements as quickly as is desirable.

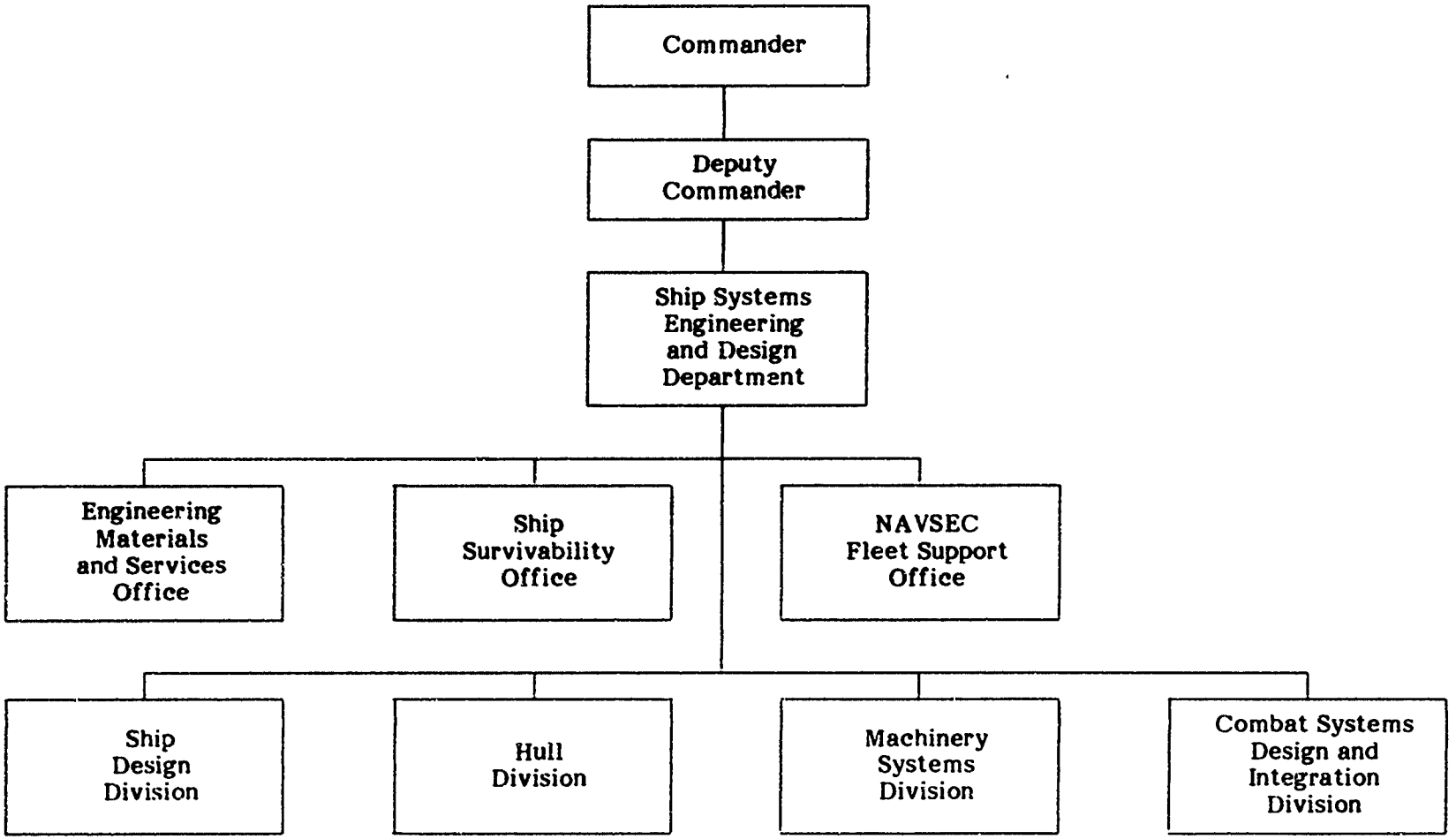
c. **NAVSEC.** Although NAVSEC is only one of many organizations participating in the ship acquisition process, it has a pivotal role as the developer of the contract design and specifications and the technical advisor on design changes and GFE and GFI.

A partial NAVSEC organization chart showing the portion dealing with ship acquisitions is presented in Exhibit XXVI. Ship design, through the contract design stage, is managed by the Ship Design Division located within the Ship Systems Engineering and Design Department. Each ship design project is headed by a design manager from that division. The design project manager is normally assisted by a small project staff made up of key personnel from the other functional divisions – hull, machinery systems, and combat systems. These people may be dedicated full time to the project, or they may be assigned to more than one project at a time. Customarily, they retain functional responsibilities within their parent organizations in addition to their project duties.

To perform the engineering and drafting efforts involved in developing a design, NAVSEC uses its in-house talent insofar as possible and supplements it with support from commercial naval architects, known as contract design agents. NAVSEC design support contracts are held by most of the major ship design firms in the country, which permits NAVSEC to augment its in-house capability with the manpower and engineering experience of a variety of design agents. These agents may be used in a dedicated mode, where one design agent supports a single ship design, or in a design task mode, where the resources of several design agents may be used for different aspects of a single ship design.

d. **SUPSHIPs.** The supervisors of shipbuilding (SUPSHIPs), field activities of NAVSEA, play a key role in Navy ship acquisitions. Most of the SUPSHIPs' efforts are undertaken after placement of the contract with the shipbuilder. (SUPSHIPs' responsibilities are discussed in Chapter Four, Management of Ship Construction Contracts.)

EXHIBIT XXVI
PARTIAL ORGANIZATION OF THE NAVAL SHIP ENGINEERING CENTER



Source: NAVSEA.

2. Acquisition Strategies

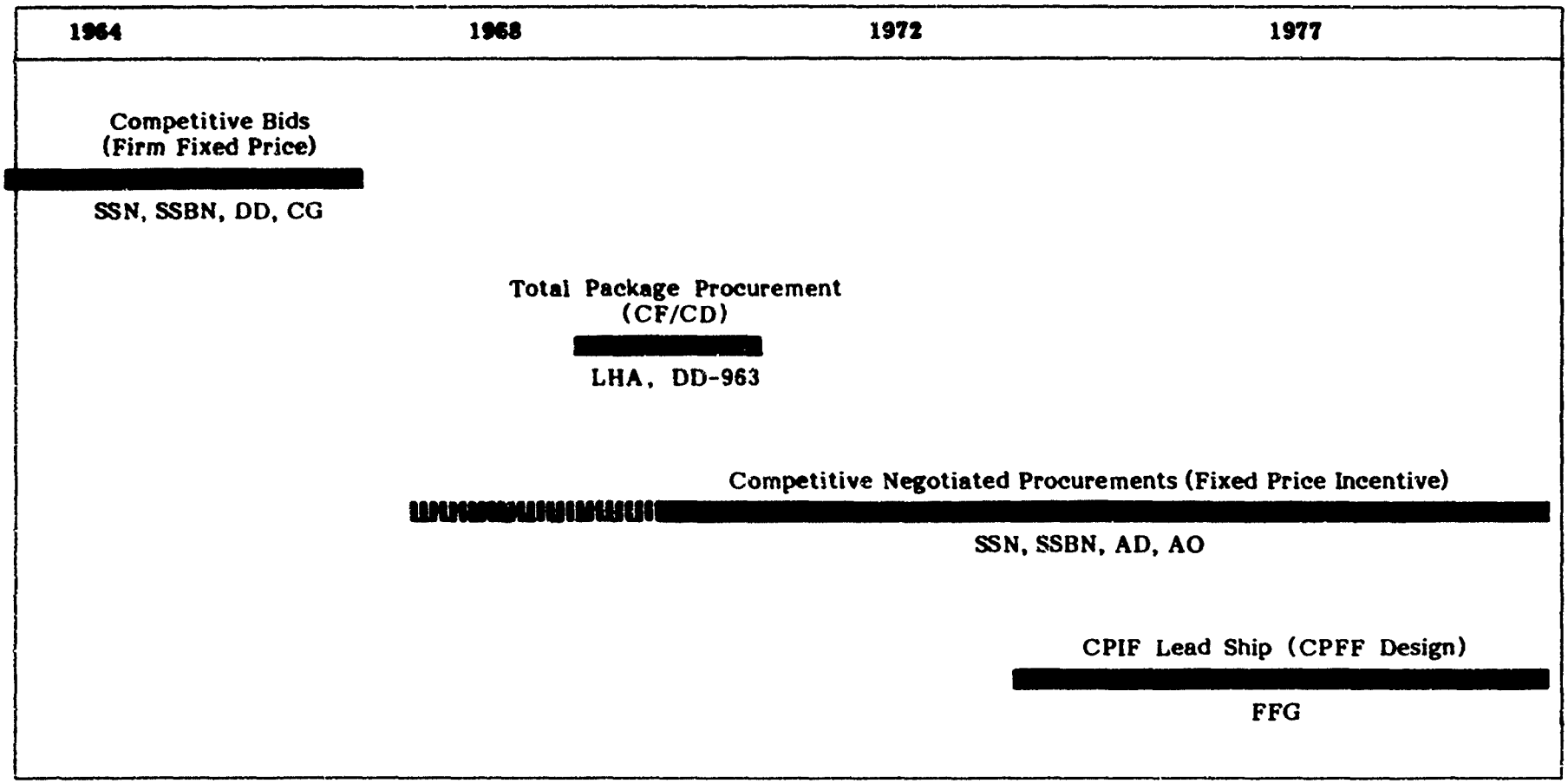
In the 1950s and the early 1960s, shipbuilding contracts were awarded primarily by allocation, with only limited use of competitive procedures in the usually accepted sense – that is, on the basis of price alone. At the time, this method of award was followed in part because national security policy required the preservation of the shipbuilding mobilization base.

Exhibit XXVII illustrates the evolution of the acquisition strategies that have been pursued by the Navy since 1964. When procurement policy changed with the acquisition of the DD-1052 class ships, conventional competitive bids were used in the selection of shipbuilding contractors, and most contracts were written as firm fixed price instruments. This shift in policy was in response to a general move toward fixed-price contracting which took place throughout the Department of Defense at that time.

In the late 1960s, the picture changed again. In 1967, for the first time the President determined that it was in the national interest to award all new construction to private shipyards. This decision began a pattern that has not changed to this date.

At approximately the same time, some ships were acquired under fixed price incentive contracts using competitive negotiation procedures. In 1969, a new ship – the amphibious assault ship (LHA) – was obtained by total package procurement (TPP) procedures. In 1970, a second major program – the DD-963 class destroyer – was awarded employing the same procedure. As applied to shipbuilding, TPP called for the Navy to provide a performance specification and for the shipbuilder to respond with a design that satisfied this specification. Little GFE was provided, and the Navy relied on the expertise and efficiency of the shipbuilder to produce a ship on time that met the performance specification. The total price of the program included the design and construction of all of the ships in the class, plus the cost of selected shipbuilder support services for an established period, the cost of guaranteeing design, and the cost of various on-board systems purchased by the shipbuilder. This policy assured the shipbuilder (Ingalls) of a sufficient program (five LHAs and, later, 30 DDs) to justify financing the construction of a new modern shipyard.

EXHIBIT XXVII
ACQUISITION STRATEGIES FOR U.S. NAVY SHIPS



Source: Sonenshein, N., RADM, USN(Ret.), editor, Global Marine Development, Inc., Defense Science Board Summer Study, 1977 Report of the Ship Acquisition Team of the Acquisition Cycle Task Force, Newport Beach, California, 26 August 1977.

Both the defense industry and the Department of Defense found that TPP acquisition policies created more problems then they resolved. For exam , the Air Force C5-A procurement became a problematic acquisition, and the LHA and DD-963 ships developed a number of difficulties – in part related to conflicts between the Navy and the shipbuilders concerning the scope of respective design responsibilities. The difficulties in the LHA program impacted so heavily on the shipbuilder that the problems in the overlapping DD-963 program may, in part, have their origins in the LHA program. By 1971, the Navy ship acquisition strategies had changed to buying only those ships in the current program year, with options to acquire additional hulls in the out years at a negotiated price. Fixed price incentive contracts were used, and source selection was based primarily on negotiated target prices, "tight" ceilings, and competition among shipbuilders to obtain realistic pricing.

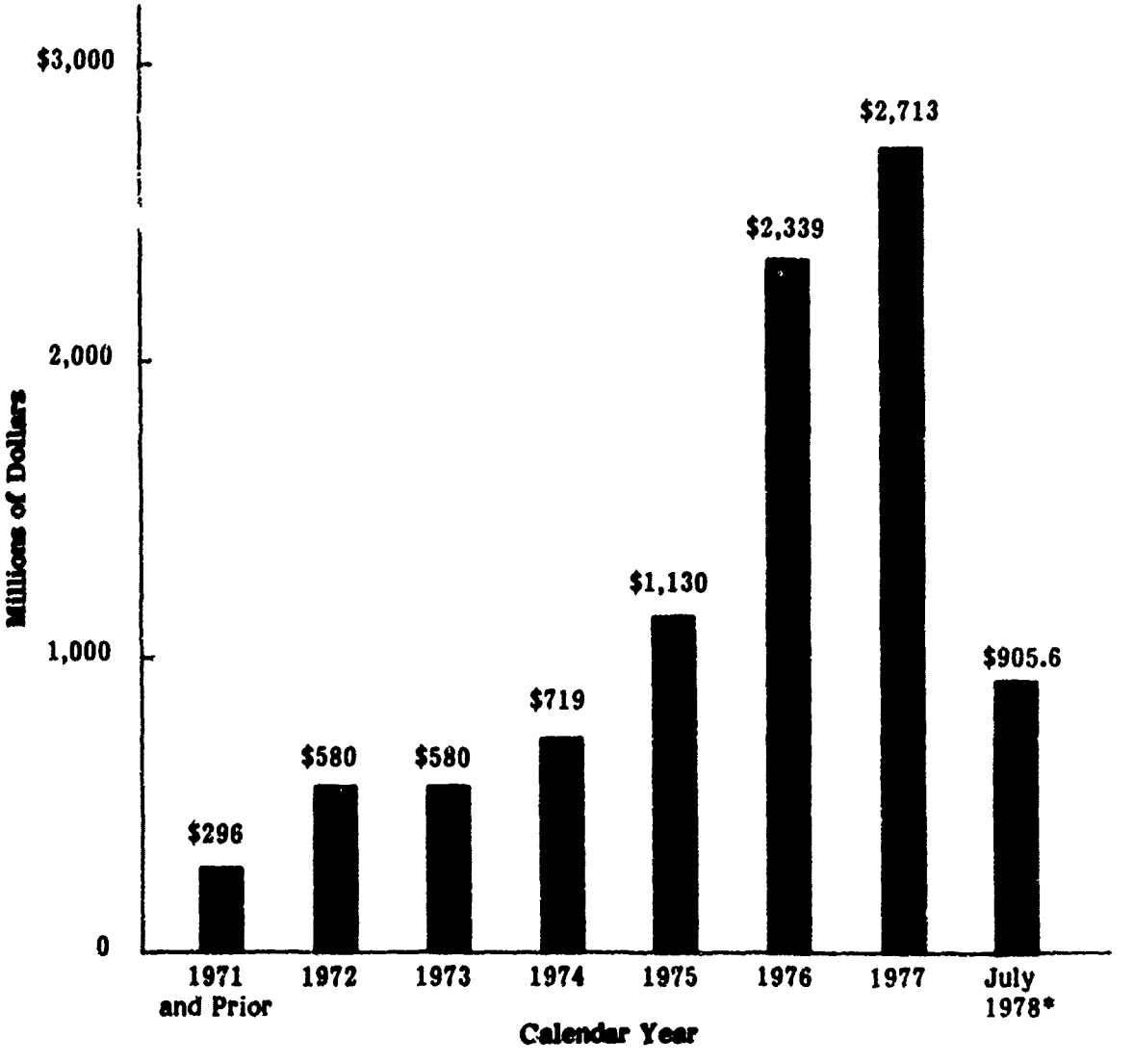
An additional change occurred in 1973 with the purchase of the lead ship in the guided missile frigate (FFG) program. This approach employed a cost plus incentive fee contract for the lead ship. After an interval of two years, to permit the design to stabilize, contracts were placed for follow ships employing fixed price incentive instruments. This acquisition strategy has continued to serve as a baseline for current acquisitions, with variations being made as appropriate for individual programs.

F. Claims

Exhibit XXVIII presents information on the cumulative value of outstanding NAVSEA claims at the end of each year. As this exhibit illustrates, claims were less than $300 million in 1971. However, shortly thereafter a trend began which saw the value of claims increasing each year to the point where, seven years later, claims reached $2.7 billion. A major reduction in outstanding claims was achieved in mid-1978 with the result that the current figure is under $1 billion.

Exhibit XXIX breaks down the dollar value of the claims in terms of the year of contract award and the current status of the claim. The contract which generated the largest claim was the LHA total package procurement awarded to Ingalls in 1969. Earlier contracts in the 1960s, which were awarded

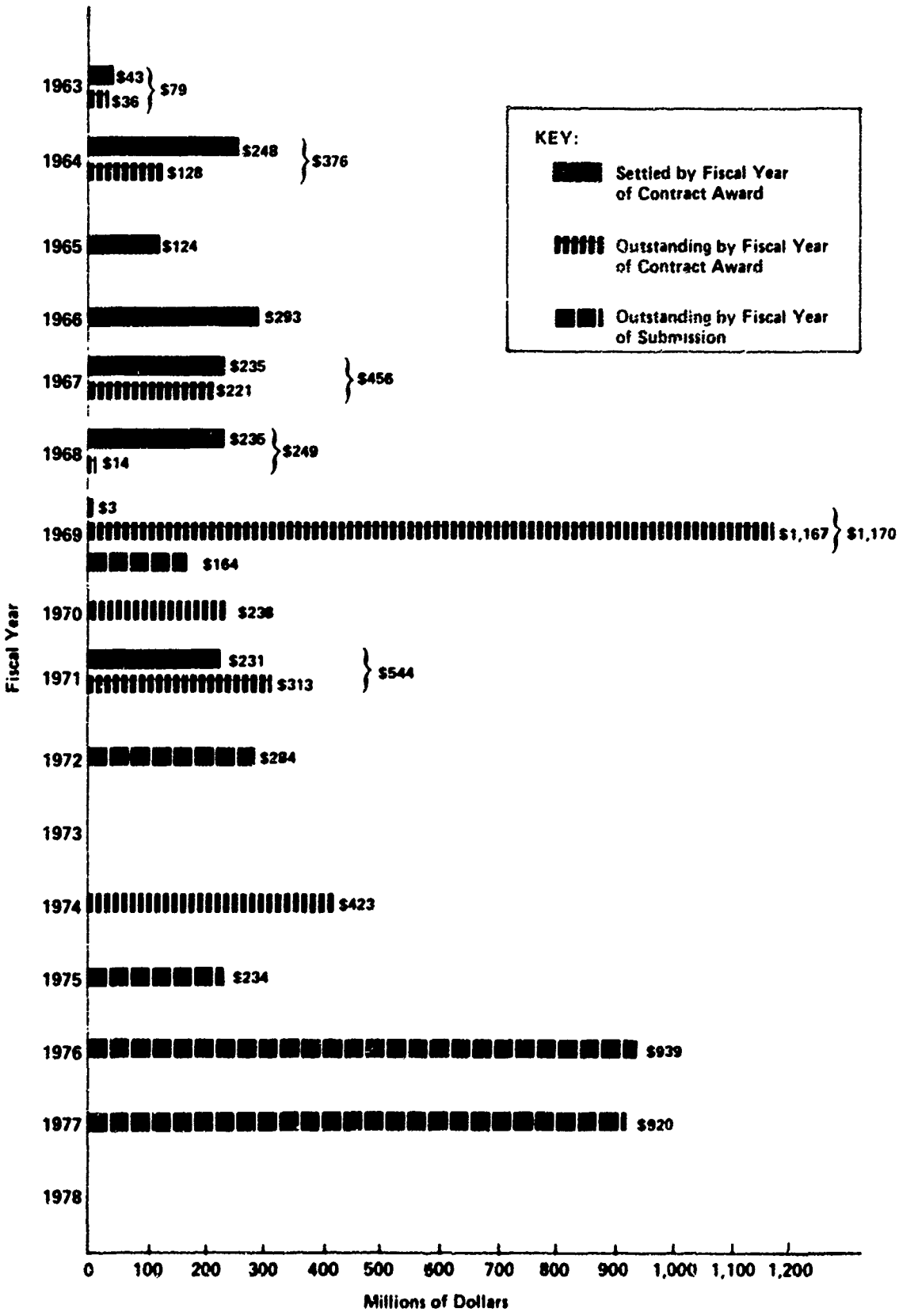
EXHIBIT XXVIII
OUTSTANDING MAJOR SHIPBUILDING CLAIMS –
CUMULATIVE NET VALUE AT END OF PERIOD



*Subject to congressional approval of settlements negotiated with General Dynamics/ Electric Boat and Litton Industries/Ingalls under Public Law 85-804.

Source: NAVSEA.

EXHIBIT XXIX
SETTLED VS. OUTSTANDING MAJOR SHIPBUILDING CLAIMS BY FISCAL YEAR OF CONTRACT AWARD AND SUBMISSION



Source: Headquarters, Naval Material Command, 5 April 1978.

through competitive bid procedures, also generated a significant dollar volume of claims. Since the Navy discontinued use of TPP procedures, the only contracts that have generated claims are the fixed price incentive contracts used for lead and early follow nuclear ships. These contracts were awarded before the completion of detailed design. More recent awards, employing a cost-type contract for the lead ship and allowing a time span of two years or so before follow ship awards, have not resulted in any claims to date. However, since shipbuilder claims tend to emerge approximately four years after an award, it is too early to state conclusively that these newer acquisition strategies will significantly reduce claims.

Exhibit XXIX also displays the currently outstanding claims by year of submission. The data indicate that approximately two-thirds of the outstanding claims were submitted in 1976 and 1977. Generally, there is a substantial lag between contract award and claim submission because of the length of time involved in the ship construction process.

G. Summary

The diversion of Navy and shipbuilder energies to the analysis and pursuit of claims became a significant factor in the Navy's management planning, organization, and budgeting for ship acquisitions, and has drained the valuable managerial time and attention of the Navy and the shipbuilders away from the problems attendant to construction of Navy ships. In addition, the public acrimony and disputes between the Navy and its shipbuilders raised serious questions about the credibility of both sides in the ship acquisition process.

The settlement agreements with General Dynamics/Electric Boat and with Litton Industries/Ingalls in June 1978 are major steps toward the re-establishment of normal business relations. The materials presented in the remaining four chapters of this report examine the crucial elements of these problems in detail and present the conclusions of the study team regarding changes to the ship acquisition process that will minimize the probability of claims in the future.

Chapter Two. Planning

CHAPTER TWO. PLANNING

A. Introduction

This chapter examines the impact of planning on the process of acquiring U.S. Navy ships. In this sense, planning encompasses determination of requirements for ship types and numbers, budgeting, scheduling, and assessment of industrial feasibility. Specifically, three areas of planning are reviewed: (i) the Navy's internal planning process for ship acquisitions, (ii) the salient characteristics of the private shipbuilding base, and (iii) the subcontractor base. As part of this review and analysis, needed changes to the planning process have been identified – changes designed to reduce the generation of claims under future ship construction contracts.

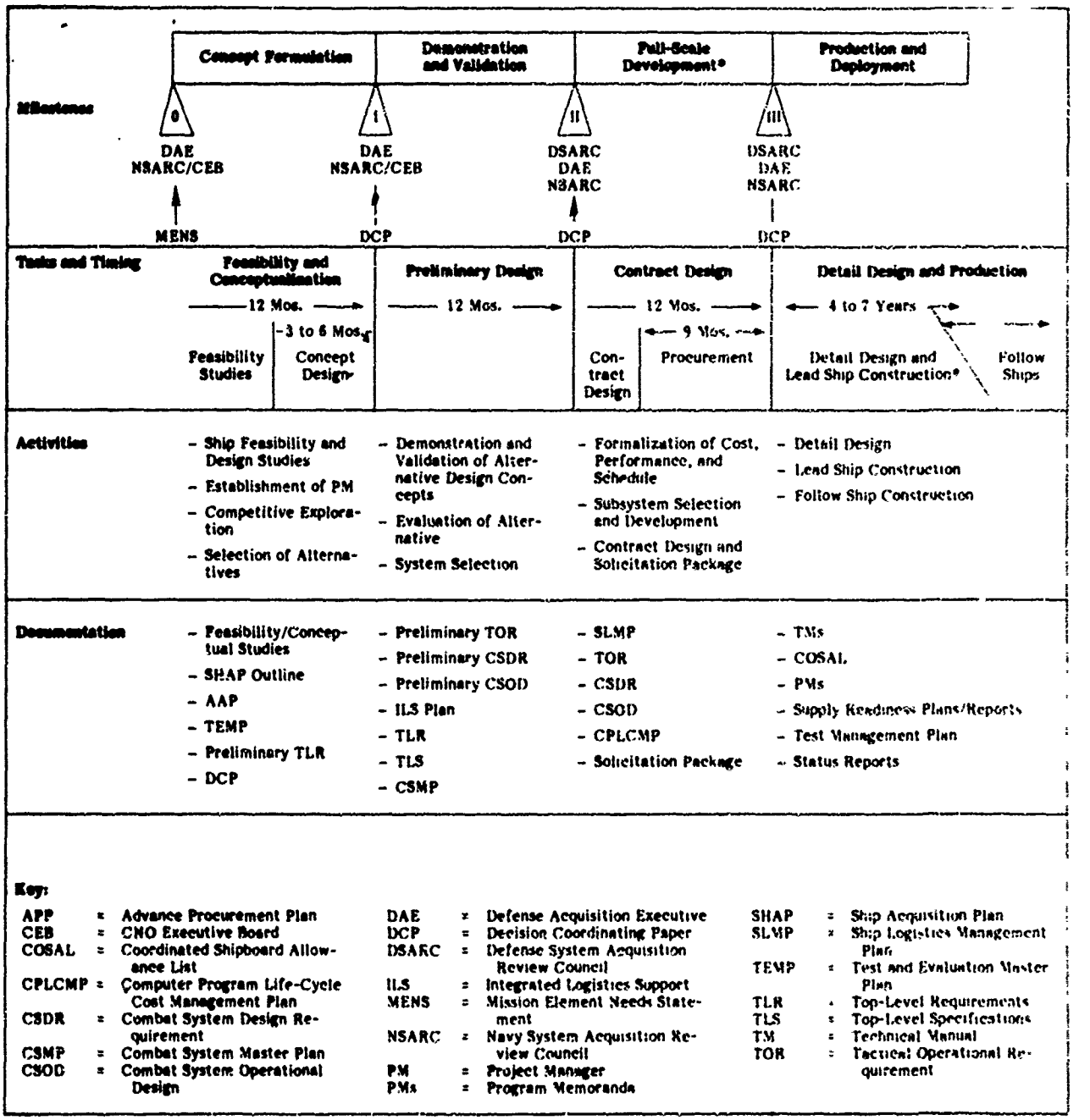
B. The Navy's Internal Planning Process

Exhibit XXX summarizes the Navy ship acquisition process, including all of the major tasks and internal approval requirements. This exhibit incorporates the current revisions of DOD Directives 5000.1 and 5000.2, the policy documents that support major DOD system acquisitions. It portrays a complex internal management process in which the Office of the Secretary of Defense (OSD) plays a critical role in monitoring each shipbuilding program. A more detailed examination of the naval ship acquisition process is presented in Appendix A to this report.

A number of recent studies and reports have addressed the internal approval and management processes followed in the Navy ship acquisition cycle.[1] Since this internal process does not appear to be directly related to shipbuilder claims, this report does not present any general conclusions in this regard. However, certain specific elements of internal Navy planning require further

[1] See Blue Ribbon Defense Panel, Report to the President and the Secretary of Defense on the Department of Defense, Washington, D.C., 1 July 1970; Office of the Secretary of the Navy, Report of the Navy Marine Corps Acquisition Review Committee, Washington, D.C., January 1975; and Sonenshein, Defense Science Board Summer Study.

EXHIBIT XXX
THE NAVY SHIP ACQUISITION PROCESS: MILESTONES, MAJOR TASKS, ACTIVITIES, AND DOCUMENTATION



*In some programs, DSARC-II has authorized design and construction of the lead ship.

examination, including the development of the Navy five-year shipbuilding plan, the design process, cost-estimating, and scheduling of ship construction efforts. Each of these subjects is discussed more fully below.

1. Developing the Five-Year Shipbuilding Plan

The U.S. Navy five-year shipbuilding program is the fundamental building block of the entire naval ship procurement process. It consists of the Navy's request to the Congress (as approved by the Secretary of Defense and the President) for the ships it believes it needs to accomplish its assigned missions. The program presented to the Congress each year covers a five-year period: the upcoming fiscal year plus the following four fiscal years. It includes a breakdown of the number of ships requested by ship type as well as the Navy's estimate of what these ships will cost, including all of the government-purchased equipment to be furnished to the shipbuilders. The five-year program is updated annually for presentation to the Congress as part of the President's budget submission. Exhibit XXXI summarizes the Navy five-year shipbuilding program for fiscal year 1979 to 1983 which was submitted to the Congress in March 1978.[1]

Three separate but related issues arise as the five-year shipbuilding plan develops: (i) the size and mix of the acquisition program, (ii) the financing of the program, and (iii) the planning required for program execution. Each of these issues is discussed below.

a. Program Size and Mix. The determination of the types of ships that the Navy needs and the numbers of ships of each type that should be built is a complex decision which involves relating overall Navy missions to the threats facing our nation. This element of early (and iterative) planning is addressed primarily by the Chief of Naval Operations and the Secretariat, with staff support from other segments of the Navy. The Office of the Secretary of Defense, the Office of Management and Budget, the National Security Council, and the President also participate extensively in the final decisions made in this process.

---

[1] This exhibit differs from Exhibits VIII and IX (Chapter One) in that it combines both the number of ships requested in the President's budget and their estimated cost.

EXHIBIT XXXI
U.S. NAVY FIVE-YEAR SHIPBUILDING PROGRAM
BY SHIP TYPE, NUMBER OF SHIPS, AND DOLLARS: FISCAL YEAR 1979 - 1983*
(Millions of Dollars)

Ship Type	Current Symbol	Fiscal Year 1979	1980	1981	1982	1983	Five-Year Total
New Construction							
Midsized, Conventional Aircraft Carrier	CVV		(1) $1,535.0				(1) $ 1,535.0
Trident Submarine (Nuclear)	SSBN	(1) $1,186.7	(1) 1,178.4	(1) $1,393.7	(2) $2,773.2	(1) $1,626.7	(6) 8,158.7
Attack Submarine (Nuclear)	SSN-688	(1) 433.0	(1) 460.4	(1) 481.0	(1) 514.0	(1) 545.0	(5) 2,433.4
Guided Missile Cruiser (Nuclear)	CGN-42				209.0	(1) 1,328.4	(1) 1,537.4
Guided Missile Destroyer	DDG-47		(1) 766.7	(2) 1,480.4	(2) 1,557.8	(2) 1,586.3	(7) 5,391.2
Dock Landing Ship	LSD-41			(1) 371.0		(1) 343.1	(2) 714.1
Guided Missile Frigate	FFG-7	(8) 1,533.1	(5) 1,063.9	(5) 1,196.0	(5) 1,147.7	(3) [illegible]	(26) 5,695.8
Mine Countermeasures Ship	MCM		(1) 117.9		(2) 228.7	(2) 205.6	(5) 552.2
Destroyer Tender	AD	(1) 318.0					(1) 318.0
Oiler	AO			(1) 202.0			(1) 202.0
Oceanographic Research Vessel	AGOS	(3) 98.0	(5) 151.0	(4) 126.0			(12) 375.0
Cable Repairing Ship	ARC	(1) 191.0					(1) 191.0
Fleet Ocean Tug	ATF			(2) 55.0			(2) 55.0
Total New Construction		(15) $3,759.8	(15) $5,273.3	(17) $5,305.7	(12) $6,430.4	(11) $6,389.6	(70) $27,158.8
Modifications and Conversions							
Aircraft Carrier Ship Life Extension Program	CV-SLEP	$ 32.2	$ 44.0	(1) $ 479.8	$ 34.0	(1) $ 530.0	(2) $ 1,120.0
Guided Missile Destroyer-Conversion	DDG-2	151.0	(1) 348.4	(3) 540.5	(3) 440.2	(3) 319.1	(10) 1,799.2
Auxiliary Supply Ship-Conversion	TAK		5.4	(1) 44.7			(1) 50.1
Total Modifications and Conversions		$ 183.2	(1) $ 397.8	(5) $1,065.0	(3) $ 474.2	(4) $ 849.1	(13) $ 2,969.3
Total Five-Year Shipbuilding Program		(15) $3,943.0	(16) $5,671.1	(22) $6,370.7	(15) $6,904.6	(15) $7,238.7	(83) $30,128.1

*Program data include long-lead-time items planned for advance procurement to be provided to the shipbuilders as GFE, and exclude small craft, outfitting, and post-delivery and cost-growth estimates.

Source: President's March 1978 budget submission to Congress for fiscal year 1978 to 1983.

Exhibit XXXII presents data on the size and mix of the Navy's fiscal year 1978 shipbuilding program as it appeared in each successive five-year defense program (FYDP) in which it was included.[1] As this exhibit illustrates, the fiscal year 1978 program, which was first addressed in the President's budget submission in 1973, was thoroughly restructured in every program year thereafter. For example, there were no SSBN submarines in the fiscal year 1978 program when it was originally conceived in 1973; five years later, the program had been altered to seek approval for two SSBNs. During the same period, the fiscal year 1978 program went from five SSNs planned in 1973 to one in 1978. Variations also occurred in major surface combatants, other surface ships, and auxiliaries.

During the interviews, the shipbuilders told the study team that the unpredictability in the planning process made it extremely difficult for shipyard management to undertake realistic long-range planning. The fluctuations in the shipbuilding program illustrated in Exhibit XXXII appear to be typical.

b. Program Financing. One of the fundamental issues underlying the total planning effort is the question of what resources will be made available to obtain the ships that the Navy believes it should acquire. Traditionally, the financial resources which are ultimately made available to the Navy seldom support the ship acquisition program it believes is necessary to ensure the security of the nation. This circumstance encourages vigorous debate within the Navy and among others associated with the program decisions. This debate and the inevitable mismatch between perceived needs and available resources often force complex trade-offs among ship types, delivery dates, and program priorities. As a result, the final Navy program represents a compromise among competing program sponsors and is usually a disappointment for many of the participants involved in its development.

---

[1] The five-year defense program includes the upcoming fiscal year plus the four following program years. The first FYDP in which the fiscal year 1978 program was addressed was prepared in 1973 and covered fiscal year 1974 to 1978.

EXHIBIT XXXII
SIZE AND MIX CHANGES IN U.S. NAVY FISCAL YEAR 1978 SHIPBUILDING PROGRAM

Five-Year Defense Program	Number of Ships by Class Planned for Fiscal Year 1978					
	SSBN	SSN	Major Surface Combatants (Non-Nuclear)	Surface Ships	Auxiliaries	Total
Fiscal Year 1974 - 1978	0	5	3	2	7	17
Fiscal Year 1975 - 1979	1	2	11	2	9	25
Fiscal Year 1976 - 1980	1	2	15	8	8	34
Fiscal Year 1977 - 1981	2	2	8	0	6	18
Fiscal Year 1978 - 1982	2	1	10	0	9	22
1978 Authorization	2	1	10	3	2	18

Source: President's annual budget submissions to Congress.

Debate and compromise continue as the Navy program moves through successive congressional reviews.[1] Since the Congress serves as the "court of last resort," a number of these positions and the arguments in their support are placed before the Congress – usually in response to a specific question or, on occasion, as a result of congressional invitations to various constituencies to appear and state their views. These views, which are often offered with strong congressional backing, may result in additional changes to the President's program. For example, the fiscal year 1978 budget which was submitted by President Ford requested two SSNs, whereas President Carter's submittal requested one. The House Armed Services Committee approved two of these ships; however, the Senate Armed Services Committee approved only one, and the latter position prevailed. Similarly, President Ford requested 11 FFGs, while President Carter requested nine; the Congress approved eight. Both President Ford and President Carter requested four fleet oilers, and the Congress approved two.

Another change to the fiscal year 1978 budget submittal occurred with respect to the DD-963 class. Neither President Ford nor President Carter requested funds for these ships. However, the Senate Armed Services Committee decided to include one ship of this class in the budget, and the Committee's position was approved by a House and Senate Conference in April 1977.

Exhibit XXXII, above, shows the changes made to the size and mix of the fiscal year 1978 program. Exhibit XXXIII summarizes the fiscal results of these changes from 1973 to 1978.

[1] At least four separate reviews of the Navy program are undertaken by the Congress: The Armed Services Committee and the Appropriations Committee of the House and the Armed Services and Appropriations Committees of the Senate review the program.

EXHIBIT XXXIII
EVOLUTION OF THE NAVY FISCAL YEAR 1978 SHIPBUILDING PROGRAM

FYDP Year	Dollars (in Millions)*
1973	$2,531
1974	4,476
1975	6,325
1976	4,260
1977	4,506
1978 (Authorization)	5,760

*The dollar data presented here are in fiscal year 1978 dollars, based on the average of the hull estimates appearing in President Carter's budget submission to the Congress in February 1977. The data exclude craft and cost-growth requests.

c. **Planning for Program Execution.** As the annual ship construction program is generated, the process includes a study of the ability of the shipbuilding industry to produce the ships appearing therein. A similar study is performed as each annual revision of the five-year program is made. NAVSEA undertakes these program execution studies for the Navy.

Each study involves several iterations of alternative shipyard workloads and identifies the changes that must be made to delivery dates and other parameters if the candidate program is to be executed. The data base which is utilized includes information on all of the current and projected Navy and commercial new construction and repair work in the shipyards under review as well as information on the past performance of each shipyard on similar ship work, the most efficient operating size for each shipyard, and the established (or estimated) capability and capacity of each shipyard to build the ships.[1] Capability

[1] NAVSEA defines "capacity" as the gross measurement of the manpower and facilities required to undertake the work of building its ships, and "capability" as the capacity plus the management and trade skills at the required competence level and mix to perform the required work.

determinations are strongly influenced by historical data because of the lack of precise data on the inventory of skills available to each shipbuilder. If a shipyard has built a specific ship type in the recent past, NAVSEA program execution studies categorize that shipyard as having "demonstrated capability" for that ship type. If a shipyard has not had recent experience with the ship type but a review indicates it has or can readily acquire the needed facilities and labor skills, NAVSEA categorizes that shipyard as one with "potential capability."

Exhibit XXXIV presents a NAVSEA program execution study that is based on the fiscal year 1979 to 1983 ship construction budget which the President submitted to the Congress in March 1978. As this exhibit reveals, NAVSEA's study found that five of the 11 major shipyards have demonstrated capabilities to construct much of the fiscal year 1979 to 1983 program. In more specific terms, the President's budget submission calls for 13 different ship types to be constructed plus three types of modifications/conversions to be undertaken. Five ship types (SSBN, SSN, CGN-42, CVV, and FFG) plus one conversion (CV-SLEP) account for 68 percent of the dollars requested of the Congress. As NAVSEA's study indicates, five shipbuilders have the demonstrated capability to build all of these ships.

The ability of a shipyard to grow to the size required in order to execute a portion of the planned shipbuilding program is determined by subjectively judging the growth potential of the labor pool in the shipbuilder's geographic area. This judgment takes into account other work that will compete in the market and the maximum assumed rate at which the shipyard can expand without a reduction in productivity or management control. Historically, the private shipyards have taken the position that they can manage and control needed growth.

2. Ship Design and Documentation

The advance of technology has made available weapons of rapidly improving capability. As a result, the complexity of Navy combatants has increased significantly. A warship is no longer a stable platform which is rapidly adaptable to various simple weapon installations. It is now necessary to integrate weapons systems, command and control systems, and reliability/maintainability

EXHIBIT XXXIV
NAVSEA PROGRAM EXECUTION STUDY
BY SHIP TYPE AND FIVE-YEAR PROGRAM VALUES: FISCAL YEAR 1979 - 1983*

Shipbuilders	Employment (as of 1 February 1978)	SSBN (Trident)	SSN	CGN-42	CVV	CV-SLEP	FFG	DDG-47
Avondale	7,400						□	
Bath	4,000						■	□
Bethlehem	2,800							
Electric Boat	24,200	■	■					
Ingalls	24,700		□		□		□	□
Lockheed	3,100						□	□
National Steel	6,100							
Newport News	25,400		■	■	■	■		
Quincy	4,400			□	□			□
Todd – Seattle	1,600						■	
Todd – San Pedro	1,500						■	
Annualized Values (Millions of Dollars)		$8,158.7	$2,433.4	$1,537.4	$1,535.0	$1,120.0	$5,696.8	$5,391.2
Percent of Dollars		27.1	8.1	5.1	5.1	3.7	18.9	17.9
Cumulative Percent		27.1	35.2	40.3	45.4	49.1	68.0	85.9

*Program data include long-lead-time items and exclude craft, outfitting, and post-delivery and cost-growth estimates.

Source: Capability data, NAVSEA. Dollar data taken from the President's March 1978 budget submission to Congress for fiscal year 1979 to 1983.

Key:
■ Demonstrated Capability
□ Potential Capability

considerations into the total ship design from its inception. This requirement has introduced a high order of difficulty into the technical aspects of ship design and documentation – a difficulty which is intensified by the overall complexity of a warship and its extremely high unit cost.

As revealed by Exhibit XXXV, the design of naval ships is an iterative process during which a number of plans, drawings, and specifications are generated. Once a requirement for a new ship has been recognized, feasibility studies are made to develop the gross physical characteristics of the design and to determine the best balance between cost and performance. The next step is a concept design which establishes the technical feasibility of the design and leads to draft top-level requirements. These top-level requirements establish ship performance requirements and cost constraints.

NAVSEA then prepares a preliminary design. This design stage, which lasts for approximately one year, entails selecting the ship subsystems, establishing the ship system requirements and characteristics, and providing a functional baseline. It is the basis for a Class "C" cost estimate.[1] This phase also generates the final top-level specifications which describe the performance expected of the ship and its equipment.

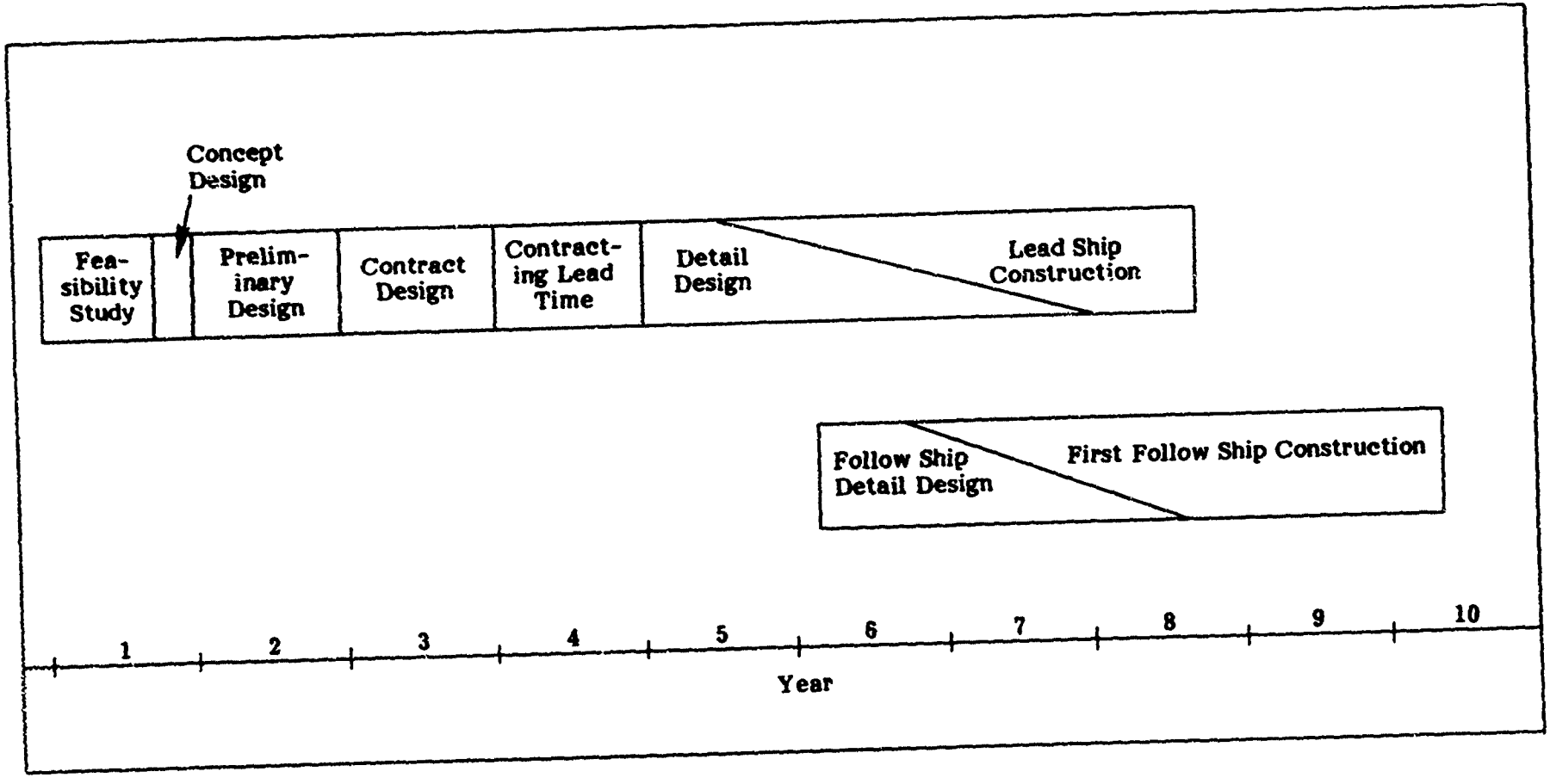
The preliminary design effort is followed by the development of a contract design – that is, a design that permits a shipbuilder to estimate the work required and to offer a proposal for construction of the ship. During this phase, the ship design is carried to another level of detail. Layouts of vital spaces in the ship are developed in detail, various subsystem configurations are defined, and several documents are prepared (among them the ship specifications, contract

---

[1]The NAVSEA cost estimate classification system may be summarized as follows:

- A Class "C" estimate is a budget quality estimate
- A Class "D" estimate is a feasibility estimate.
- A Class "E" estimate is a computer estimate based on parametric estimating techniques.
- A Class "F" estimate is a quick cost estimate based on a gross approximated design parameter.

EXHIBIT XXXV
DESIGN CYCLE FOR A TYPICAL NAVAL SHIP



Source: NAVSEC.

drawings, and test and evaluation plans). Beginning at this stage, a number of technical documents are employed, including general specifications for ships of the U.S. Navy, standard drawings, design data sheets, and various military and Federal specifications – both primary and subordinate specifications. This large volume of documentation is oriented toward standardizing equipment and assuring that the materials and processes used in constructing the ship meet established health, safety, reliability, and maintainability standards.

During contract design, documentation is prepared by the Naval Ship Engineering Center (NAVSEC) with the assistance of commercial design agents working under contract to the Navy. Historically, contract design has generally been accomplished without consultation with prospective shipbuilders. As a result, changes to the contract drawings are sometimes required to enable a shipbuilder to construct the ship in its unique facilities. More recently, however, NAVSEA has contracted with the prospective shipbuilders in the FFG-7 and DDG-47 acquisitions to participate in the contract design process. This practice produces a number of benefits that reduce the claims potential in the ship construction contracts which are subsequently awarded to participating shipbuilders. Such benefits include:

(i) Reduced potential for changes during the ship construction process.

(ii) Improved producibility of the ship.

(iii) Reduced risk in terms of the ship delivery schedule.

(iv) Reduced shipbuilder cost risk.

(v) More complete and timely ship construction support in such areas as government-furnished material and information.

In its most recent programs, the LSD-41 and MCM, NAVSEA is taking a further step toward involving shipbuilders in contract design. In these programs, the lead shipbuilder will be selected prior to the beginning of contract design and will participate in the contract design as the initial task of the contract. Under this process, the lead shipbuilder should be fully familiar with the contract design when detailed design commences.

Traditionally, the acquisition of the lead ship commences upon completion of contract design. However, since this process requires the preparation and promulgation of large amounts of procurement documentation, a significant contracting lead time is involved.

The final design stage is development of a detailed design. The purpose of this stage is to establish the final configuration of the ship, identify components, and produce detailed working drawings and bills of material.

The working drawings which are developed during the detailed design phase are usually produced by the shipbuilder selected to construct the lead ship – either as a part of the contract for the lead ship or under a separate contract. These working drawings may also be prepared by a naval architectural firm working under contract to the Navy or as a subcontractor hired by the shipbuilder. Since each shipyard has unique facilities, the working drawings will necessarily reflect the construction methodology that the lead shipbuilder will use to construct the ship. As the complexity of ships has grown, the Navy has adopted techniques to verify the lead ship design and the operability of its systems. Land-based test sites and full-scale mock-ups are utilized to accelerate this verification, and the Navy has carefully selected the interval between the lead and follow ships to provide for as much design assurance as feasible.

Whenever another shipbuilder contracts to construct a follow ship, changes to the working drawings are generally necessary, and it has been NAVSEA policy to allow such changes to be made. At the time when the cost estimate for the contract is prepared, the follow shipbuilder will only have the contract design package. Hence, as part of the contract, working drawings will have to be developed to reflect the shipbuilder's specific construction methodology. The working drawings used for construction of the lead ship are generally available to the follow shipbuilder.

Heretofore, follow shipbuilders have made substantial changes in these working drawings to permit the use of their own preferred construction methodology. One of the advantages of the recent NAVSEA practice of involving follow shipbuilders in the detail design process is the potential for reducing this engineering burden.

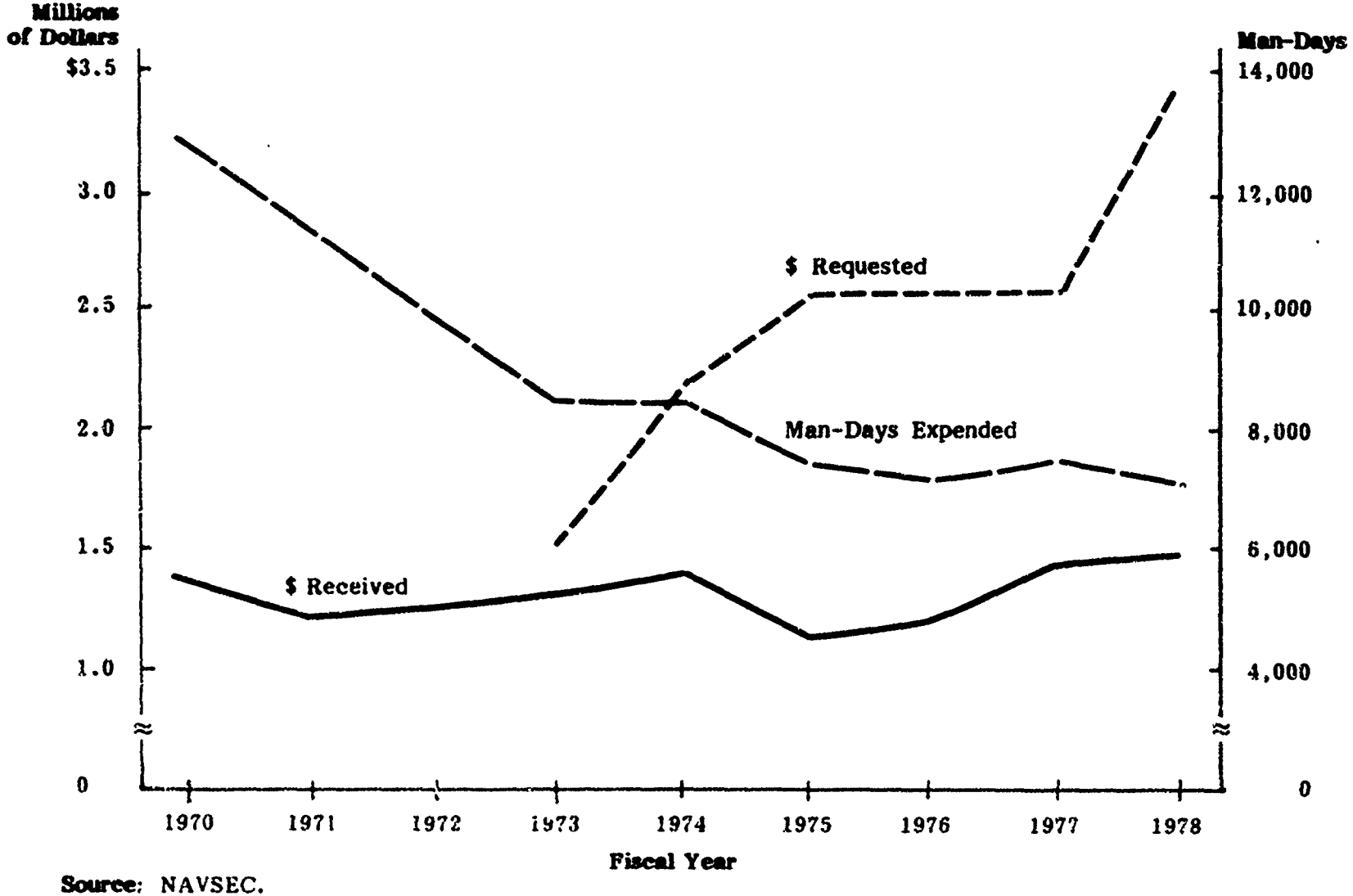
The problem of the follow shipbuilders is aggravated when there is a substantial lag between the construction of the prior ships of the class and the follow ship being acquired. Such follow ships are almost always modified by adopting current versions of the specifications in the contract design package. Usually, other modifications to the ship are also incorporated into the contract drawings. The task of discerning the differences between the follow ship being acquired and the prior ships of the class is immense, and the working drawings of the prior shipbuilder become less valuable as the length of construction lag increases.

The volume and complexity of the total design package for a combatant ship is staggering – particularly in terms of the number of Navy-controlled military and Federal specifications that apply to the ship, its equipment, and their interrelationship. Most of these specifications have been developed at different times and by a number of different organizations – both within and outside the Navy. Thus, as might be expected, conflicts may occur among some of these specifications. NAVSEC recently estimated that more than 40 percent of the 10,000 documents it controls have known, major defects. The problem is further compounded by the growing need to convert these documents to metric standards.

A lack of funding has been the major problem in preparing and maintaining adequate specifications. Exhibit XXXVI presents an eight-year history of the funds requested and received by NAVSEC for preparing and updating about 6,000 military and Federal specifications under its control. As the exhibit reveals, the funding received by NAVSEC during this period has been fairly constant – between $1.2 and $1.5 million annually. However, since the cost of a man-day of labor has increased during this period, the number of man-days that could be expended on this effort has fallen in each of these years – from a high of about 13,000 man-days in 1970 to about 7,000 man-days (projected) in 1978.

An inherent feature of the ship design process is a large number of drawing revisions. These revisions may involve correction of errors, clarification of directions to shipyard workers, changes to internal manufacturing processes, as well as actual changes in design. Exhibit XXXVII provides a recent NAVSEA

EXHIBIT XXXVI
NAVSEC MIL/FED SPECIFICATION FUNDING



Source: NAVSEC.

EXHIBIT XXXVII
NUMBER OF REVISIONS PER DRAWING*

Navy Ships	
Polaris SSBN	6
LHA	7
FFG	4
DDG	7
SSN-637	5
SSN-688	5
Commercial Ships	
Tanker (Class 1)	5.7
Tanker (Class 2)	6.7

*Based on the experience of the Navy and private customers for selected ships built in the last 20 years.

Source: NAVSEA.

sample of the number of revisions per drawing experienced by the Navy and private customers for selected ships built in the last 20 years. As this exhibit suggests, the number of revisions per detailed design drawing in U.S. shipbuilding has remained fairly constant for various procurements spanning many years.

As noted earlier, the Navy has introduced new design methods in the FFG-7 acquisition in an attempt to reduce the burden of this large number of drawing revisions. In this acquisition, the lead shipyard is required to produce "validated" drawings which are checked by both the lead shipyard and the Navy to assure that they reflect the lead ship as built. These drawings are furnished to the follow shipyard with a contractual guarantee that a ship built to these drawings will meet the contract specification. To date, the follow shipyard has been using the bulk of these drawings without redesign in the construction of the follow ship.

3. Ship Cost-Estimating

During the interviews, a number of shipbuilders stated that the inaccuracy of Navy-generated ship construction cost estimates contributes directly to claims. Some also stated that cost estimates have been deliberately manipulated to enhance the probability of program approval. Congressional sources also raise continuing questions about the quality of ship cost estimates.

The study team did not find data which permit definitive assessment of the cost-estimating process. Unfortunately, the large number of events which occur over the long period of ship construction allow for many interpretations of the accuracy of the original estimates. Perhaps the most complete data are presented in the selected acquisition report (SAR) which is submitted to the Congress on a quarterly basis, providing information on major weapons systems acquisitions and relating to operational and technical characteristics, schedule milestones, and cost experience. Exhibit XXXVIII presents a breakdown of the 31 March 1978 SAR for five major ship acquisition programs.

This exhibit divides the program cost growth into seven categories, permitting evaluation of the various reasons for variations from the original estimate. Most aspects of quantity changes, engineering changes, support changes, schedule changes, and sundry changes are not susceptible to estimation in the

EXHIBIT XXXVIII
COST GROWTH OF SELECTED SHIP PROGRAMS
(Millions of Dollars)

Program	Program Base Fiscal Year	Development Estimate	Program Cost Changes							Total Escalation	Current Estimate
			Quantity	Engineering	Support	Schedule	Economic	Estimating	Sundry		
CVN-68 Class	1968	$2,036.2	-	$ 116.7	$ 24.5	$ 84.0	$ 358.4	$ 30.2	$121.6	$ 649.9	$ 2,771.6
LHA	1969	1,380.3	-$436.9	43.8	50.4	39.4	73.3	10.5	397.7	422.1	1,558.5
DD-963	1970	2,581.2	315.2	35.0	33.2	-2.0	622.5	80.2	494.5	1,543.9	4,159.8
CGN-38 Class	1972	820.4	311.2	14.7	-	-	50.6	86.5	-	320.5	1,283.4
FFG-7	1973	3,244.5	298.4	1,037.3	126.2	1,585.2	2,053.6	1,779.6	-	5,670.9	10,124.8
										$8,607.3	$19,898.1

Program Cost Changes Categories

1. Quantity – changes including scope.
2. Engineering – changes altering the established physical or functional characteristics of a system.
3. Support – changes involving spare parts, ancillary equipment, warranty provisions, and governmentfurnished property and/or equipment.
4. Schedule – changes in delivery schedule, completion date, or some intermediate milestone of development, production, or construction.
5. Economic – changes that are influenced by one or more factors in the economy (such as inflation).
6. Estimating – corrections or other changes occurring since the initial or other baseline estimates for program or project costs were made.
7. Sundry – changes other than the above categories (such as environmental costs).

Source: Selected acquisition reports for CGN-38 class, CVN-68 class, DD-963 destroyer, general purpose amphibious assault ship (LHA), and guided missile frigate program, 31 March 1978, and General Accounting Office, Report to the Congress by the Comptroller General of the United States, Financial Status of Major Federal Acquisitions, PSAD-78-60, Washington, D.C., 20 January 1978.

original program estimate. However, to the extent that engineering changes or schedule changes are based on overly optimistic original estimates, cost growth in these areas can be attributed to inaccurate estimating. It can be argued that economic changes are predictable at the outset. However, this factor in the SAR indicates variations from the amount in the original estimate rather than the entire amount of the inflationary increases. In other words, estimating inaccuracies in this category reflect the inability to predict future inflation with precision. Accordingly, one can conclude that the major reflection of estimating errors in the SAR is found in the estimating category. This category represents the variations in prices from the original estimates and, as Exhibit XXXVIII shows, they are quite small.

Yet the figures are misleading in appraising the accuracy of ship construction contract estimates. First, the major program with significant estimating errors, the FFG-7, encountered a large proportion of the errors in the area of government-furnished material rather than in the estimate of the ship construction costs. Second, three of the other programs showing very small errors in estimating are the subject of major claims which are not reflected in the SAR statistics.

In summary, the available data will not yield an accurate appraisal of NAVSEA cost-estimating capabilities. During the interviews, the shipbuilders indicated a belief that NAVSEA personnel were competent and that the procedures followed were sound.

Exhibit XXXVIII does reveal one interesting phenomenon which is reflected in the total escalation category. This column breaks out the total dollars in the current program estimate that are attributable to inflationary factors in the economy from the date the ship construction contract was signed. It shows the inflationary impact on all of the other categories, including the development estimate, and indicates the amount added to the cost of the ship by inflation. It is clear from this computation that inflation has been a major problem in the ship acquisition process, exacerbating all of the other factors which contribute to cost growth.

NAVSEA cost-estimators have used standard factors to predict inflation in their original cost estimates. The factors that have been used in past years are displayed in Exhibit XXXIX. Up until fiscal year 1976, OSD developed forecasts of these factors and required that NAVSEA accept them; from fiscal year 1976 forward, NAVSEA derived the factors and OSD approved them. When these two sets of forecasts are compared to the actual figures, it appears the OSD seriously understated the inflationary pressures on labor and material for each of the four years for which it derived these data. Since OSD required NAVSEA to employ these factors in its shipbuilding programs during this period, these escalation inadequacies appear to be OSD's responsibility. For fiscal year 1976, the NAVSEA-derived labor forecast was low, although it came close on material (a forecast about 6 percent above actual). For the transition quarter, its labor forecast was slightly under, but its material forecast was high. Fiscal year 1977 data reveal that NAVSEA's forecasts for both labor and material were significantly higher than actual.

The planning process by which each annual ship construction program is created generates recurrent and urgent demands for a number of ship cost estimates. As the time nears when the program will be undertaken, a number of these estimates involve a program variation from a baseline ship which presents the estimator with significant difficulties. In such circumstances, the estimators do the best they can with the data they have and within the time allowed. It is no surprise that some of these estimates turn out to be inaccurate.

The NAVSEA estimating activity encompasses the most complex, largest dollar volume, and widest variety of cost-related functions of any of the other military departments, commands, or other government agencies. NAVSEA recognizes this activity as an important function which requires talented people, valid data, and workable procedures. In fact, NAVSEA management recently (February 1978) took a number of steps to strengthen its organization. Among other things, the Commander, NAVSEA, increased the number of billets in the Cost Estimating and Analysis Division from 25 to 62, and has accepted a number of recommendations from a recent detailed study of the cost-estimating function.[1]

---

[1] International Maritime Associates, A Study of Ship Acquisition Cost Estimating in the Naval Sea Systems Command.

EXHIBIT XXXIX
FORECAST VS. ACTUAL BLS SHIPBUILDING INDEXES USED FOR CALCULATING CONTRACT ESCALATION: FISCAL YEAR 1972 - 1978

	OSD Approved/OSD Derived								OSD Approved/ NAVSEA Derived				Actual	
	Fiscal Year 1972 Budget (as of August 1970)		Fiscal Year 1973 Budget (as of December 1971)		Fiscal Year 1974 Budget (as of December 1972)		Fiscal Year 1975 Budget (as of August 1973)		Fiscal Year 1976 Budget (as of August 1974)		Fiscal Year 1977 and Fiscal Year 1978 Budget (as of August 1975 - 1976)			
Fiscal Year	Labor %	Material %	Labor %	Material %	Labor %	Material %	Labor %	Material %	Labor %	Material %	Labor %	Material %	Labor %	Material %
1971	4.9	3.3											3.8	4.4
1972	4.5	2.2	4.5	2.8									5.2	4.3
1973	3.5	1.2	3.6	1.2	5.5	3.5							6.7	4.5
1974	3.5	1.2	3.5	1.2	5.0	3.5	5.0	3.5					8.8	22.7
1975	4.0	2.0	4.0	2.0	5.0	3.5	5.0	3.5	6.5	16.4			12.6	15.1
1976	5.0	2.2	5.0	3.0	5.0	3.5	5.0	3.5	7.7	15.3	12.9	10.1	5.4	7.5
TQ	-	-	-	-	-	-	-	-	-	-	1.9	3.7	2.2	.9
1977	4.19	2.2	5.0	3.0	5.0	3.5	5.0	3.5	7.3	14.6	8.4	12.0	5.4	6.4
1978	4.19	2.3	5.0	3.0	5.0	3.5	5.0	3.5	6.9	8.0	9.2	7.6		
1979							5.0	3.5	6.9	8.0	6.2	7.0		
1980											6.2	6.6		
1981											6.2	6.6		

Source: NAVSEA.

4. Establishing Ship Construction Schedules

The ship acquisition process is an extremely lengthy effort. Exhibit XL presents data on the time needed to acquire nine different types of ships. As the exhibit indicates, the actual timing ranges from a low of about four and one-half years (55 months) for a DDG-2 to eight and one-half years (102 months) for the DD-963 class. Moreover, the data reveal that about one-third of the total acquisition time was used prior to contract award – an indication of the time-consuming nature of the internal government decision process. The exhibit also shows that planned acquisition times are not met and that the actual times for these hulls have always been longer than planned times. Further, as we moved forward from 1955, both of the planned time spans – from concept definition to award and from award to delivery – have always increased. While some of these increases in planned times are a reflection of the increasing complexity of the ships themselves, they are also caused by the internal management process (as displayed on Exhibit XXX, above) which requires justification to an ever-increasing number of review and/or approval authorities.

The schedules for ship deliveries are introduced into the planning process in accordance with requirements for fleet readiness generated in the Office of the Chief of Naval Operations. In the early phases of annual program development, construction schedules are estimates based on prior experience with similar ships. Later, adjustments are made as the schedules are related to the more clearly perceived estimates of ship construction parameters. These schedules are based on two NAVSEA-generated data elements: (i) an estimate of the total man-days required to build the ship and (ii) a planned rate of labor application or manning per day.

A review of a number of completed and current shipbuilding programs that experienced schedule slippages indicates the Navy-projected rates of labor application were not achieved by the shipbuilders. In addition, the shipbuilders have experienced major difficulties in obtaining materials - particularly castings and forgings – as was shown in Exhibit XX (Chapter One). In recent years, the unpredictable nature of these items of contractor-furnished material and equipment have had a serious negative impact on schedules. In the face of these obstacles, it appears that Navy planners have been chronically optimistic.

EXHIBIT XL
PLANNED AND ACTUAL SCHEDULES FOR NINE SHIP HULLS
(Number of Months)

Ship Type	Award Year	From Concept Definition to Award			From Award to Delivery			Total Period		
		Planned	Actual	% Increase	Planned	Actual	% Increase	Planned	Actual	% Increase
Destroyer										
DDG-2	1955	12	15	25%	36	40	11%	48	55	15%
DD-963	1970	27	40	48	43	62	44	70	102	46
DDG-47*	1978	28	36	29	52	N/A	N/A	N/A	N/A	N/A
Frigate										
FF-1052	1964	16	21	31	36	56	56	52	77	46
FFG-7	1973	25	28	12	48	49	2	73	77	5
Submarine										
SSN-637	1961	(Originally Awarded as a Follow Ship)		N/A	40	60	50	40	60**	50
SSN-688	1971	17	28	65	50	68	36	67	96	43
AOR										
AOR-1	1965	26	26	-	34	47	38	60	73	22
AOR-7	1972	33	39	18	36	46	28	69	85	23

*Tentatively planned for 1978.
**Production only.

Source: Sonenshein, Defense Science Board Summer Study.

Until recently, the involvement of prospective shipbuilders at these early stages in the planning process has been somewhat limited. However, as noted above, prospective shipbuilders in the FFG and DDG-47 programs were placed on contract to work with NAVSEA during the contract design process. As a part of this effort, these shipbuilders thoroughly reviewed the proposed delivery schedules. The benefit of this increased shipbuilder participation is seen in the fact that the lead FFG was delivered to the Navy slightly ahead of the adjusted contract schedule.

During the interviews, the shipbuilders cited unrealistic schedules and the unwarranted diversion of management attention and shipbuilder resources in a vain attempt to meet them as important causes of inefficiencies in the ship construction process.

C. The Private Shipbuilding Base

In order to evaluate the effectiveness of the naval shipbuilding planning process, the private shipbuilding base must be closely examined. Elements of this examination include (i) the workload instability in selected shipyards, (ii) the projected Navy workload, (iii) commercial new construction and commercial and Navy overhaul and repair work, and (iv) shipbuilder productivity.

1. Workload Instability

As noted earlier, naval shipbuilding is concentrated in a small number of shipyards which include the giants of the industry as well as facilities of more modest size.[1] Exhibit XV (Chapter One) compares May 1978 total employment with shipbuilder-provided optimum manning estimates for the 11 major shipbuilders. Exhibit XLI displays information on the three shipyards where naval ship construction is primarily concentrated:

[1] See Exhibits III, IV, V, XII, and XIV (Chapter One).

EXHIBIT XLI
1978 EMPLOYMENT VS. OPTIMUM MANNING
AT THE THREE PRIMARY SHIPYARDS

Shipyard	Total Employment (as of May 1978)	Optimum Manning Estimates (as of June 1978)	Percent Deviation
Newport News	25,000	25,000	--
Ingalls	21,600	18,000	-16.7
Electric Boat	23,300	25,000	+ 7.3

As these data reveal, Ingalls indicated that it was overloaded with work and would be better served if it reduced its work force by nearly 17 percent. Newport News indicated that it was at the optimum manning level. Only Electric Boat felt that it could effectively employ more people.

While Newport News and Electric Boat are currently working at or close to optimum manning levels, their employment has not been stable in the recent past. As shown in Exhibit XIII (Chapter One), Newport News grew from 18,250 employees in 1970 to 25,010 in 1973 – a period when their shipyard facilities were significantly less extensive than now. Electric Boat experienced a similar rapid growth from 1972 to 1976, peaking at 27,590 employees – substantially above their optimum manning level. Hence, both of these shipyards experienced rapid growth and higher than optimum employment levels during the period when the major shipbuilding claims were generated.

Ingalls presents a somewhat different case. There, the rate of increase in employment was not as steep, although the shipyard peaked at 24,715 employees in 1976. This employment level was far above the optimum in a labor market that did not contain a sufficient number of skilled craftsmen to support such employment. One result was extremely high turnover rates.

In summary, these three shipyards have functioned in an unstable employment environment with excessive rates of growth and higher than optimum employment levels.

Eight smaller shipyards are currently capable of performing Navy new construction. Exhibit XLII indicates that these yards are working at substantial employment levels although they are not as fully occupied as the major yards.

EXHIBIT XLII
1978 EMPLOYMENT VS. OPTIMUM MANNING
AT THE EIGHT SMALLER SHIPYARDS

Shipyard	Total Employment (as of May 1978)	Optimum Manning Estimates (as of June 1978)	Percent Deviation
Avondale	5,900	7,200	+22.0%
Bath	4,500	4,000	-11.1
Bethlehem	3,200	4,000	+25.0
Lockheed	2,900	3,000	+ 3.4
National Steel	5,400	7,000	+29.6
Quincy	5,600	9,000	+60.7
Todd – Seattle	1,900	3,000	+57.9
Todd – San Pedro	2,400	4,500	+87.5

Exhibit XIII (Chapter One) shows that most of these shipyards have also experienced major fluctuations in employment levels in recent years. Hence, they have not only lacked employment stability, but generally need additional work to reach optimum manning levels.

2. Projected Navy New Construction Workload

Exhibit XLIII breaks the President's fiscal year 1979 to 1983 budget request for ship construction into two categories – (i) that portion assumed to be available for open competition among the shipyards and (ii) that portion assumed not to be available for such competition. As this exhibit indicates, in fiscal year 1979 the planned submarine programs will be undertaken by Electric Boat and Newport News;[1] the CV-SLEP program will be performed by Newport News if it is

[1] The study team assumed that the government will not expend additional funds simply to provide price competition to these two shipbuilders and that other shipbuilders will not make the necessary investment on their own.

EXHIBIT XLIII
U.S. NAVY FIVE-YEAR SHIPBUILDING PROGRAM BY SOURCE OF CONSTRUCTION – PREDETERMINED AND NOT PREDETERMINED: FISCAL YEAR 1979 - 1983
(Millions of Dollars)

Fiscal Year	President's Budget Request*	Source of Construction: Predetermined			Source of Construction: Not Predetermined		
		Ships	Dollar Value	Percent of Total	Ships	Dollar Value	Percent of Total
1979	$3,792.5	Trident, SSN, FFG-7, AD	$3,470.8	91.5%	AGOS, ARC, Service and Landing Craft	$321.7	8.5%
1980	5,671.1	Trident, SSN, CVV, FFG-7, AGOS, DDG-2 (C), DDG-47	5,509.8	97.2	MCM, Service and Landing Craft	161.3	2.8
1981	6,404.7	Trident, SSN, CV-SLEP, DDG-47, FFG-7, AGOS, DDG-2 (C)	5,427.7	85.0	LSD-41, AO, ATF, DDG-2 (C), TAK (C), Service and Landing Craft	977.0	15.0
1982	6,787.6	Trident, SSN, DDG-47, FFG-7, DDG-2 (C), MCM	6,661.6	98.0	Service and Landing Craft	126.0	2.0
1983	7,288.7	Trident, SSN, CV-SLEP, CGN-42, DDG-47, FFG-7, DDG-2 (C), LSD-41, MCM	7,238.7	99.0	Service and Landing Craft	50.0	1.0

*Program data exclude outfitting, post-delivery and cost-growth estimates, and advance planning and long-lead-time funding for modifications and conversions. For the purpose of this analysis, the study team assumed that one-half of the DDG-2 conversions would be placed with private shipyards in 1981.

Source: President's March 1978 budget submission to Congress for fiscal year 1979 to 1983.

assigned to the private sector. Hence, for all practical purposes the sources of construction for these programs are predetermined.

It is also assumed that sources for the FFG program are predetermined, since this program has been in the hands of Bath and Todd since 1975, and their prior experience makes them the logical sources for additional ships. The source for the AD, the fourth ship of its class, is also assumed to be predetermined. Based on these facts and assumptions, about 92 percent of the dollars in the SCN (Ship Construction, Navy) appropriation for fiscal year 1979 will probably be placed with sources that have already been determined.

During 1980, a similar situation will obtain, except that the MCM lead ship will be competed for, as will various service and landing craft. Beyond this, it is planned that the first DDG-2 conversion will be accomplished in the Philadelphia Naval Shipyard and, therefore, this ship is also in the predetermined category. In this year, about 97 percent of the SCN appropriation will be used for ships with predetermined sources.[1] In 1981, the major ships will be in the predetermined category, but competition will be conducted to identify the sources for the AO, ATF, the LSD-41 lead ship, TAK conversion, and one-half of the DDG-2 conversion.[2] In this year, 85 percent of the SCN appropriation will go to predetermined sources. By 1982, more than 98 percent of the dollars planned to be expended under the SCN appropriation will have been placed with predetermined sources.[3] These data are summarized in bar chart format in Exhibit XLIV.

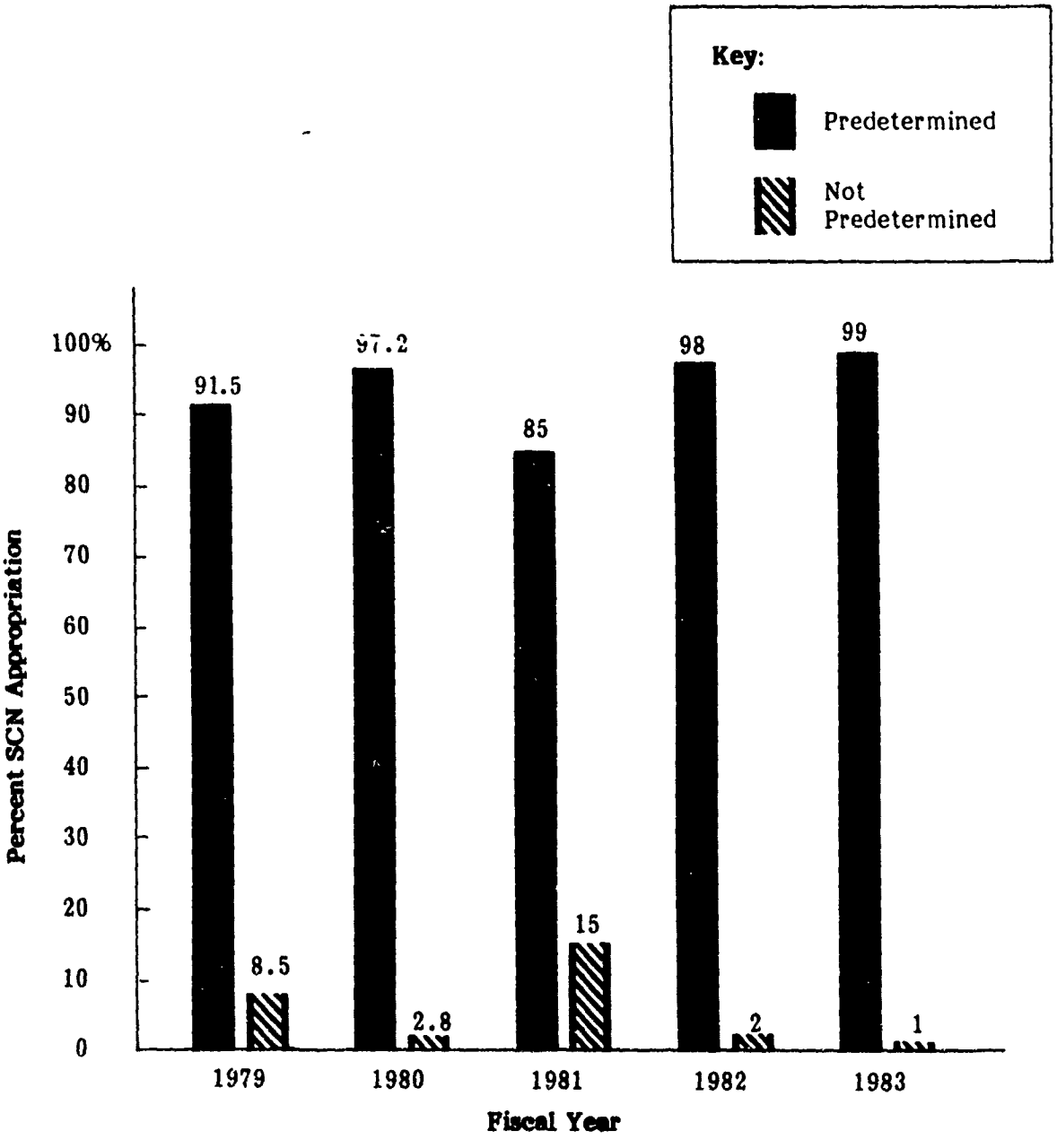
---

[1] Since the DDG-47 in this year is the first follow ship, it is assumed that it will be awarded to the lead shipyard.

[2] For the purpose of this analysis, the study team assumed that one-half of the DDG-2 conversions will be placed with private shipyards in 1981.

[3] Note that this analysis does not consider any new programs that might be included in subsequent FYDPs.

EXHIBIT XLIV
U.S. NAVY FIVE-YEAR SHIPBUILDING PROGRAM BY SOURCE OF CONSTRUCTION – PREDETERMINED AND NOT PREDETERMINED: FISCAL YEAR 1979 - 1983*



*Program data include long-lead-time items, and exclude outfitting and post-delivery and cost-growth estimates.

Source: President's March 1978 budget submission to Congress for fiscal year 1979 to 1983.

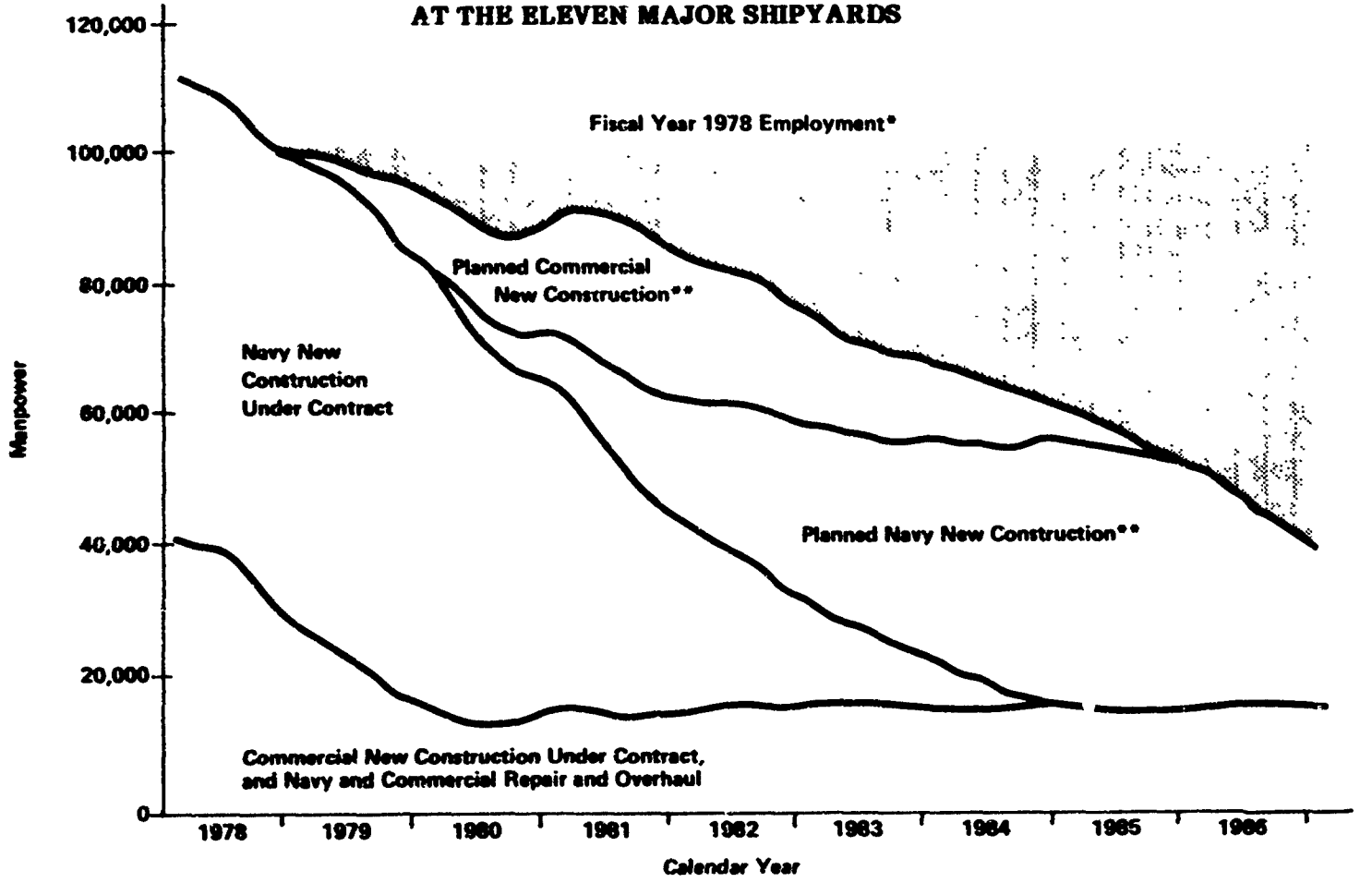
The problems of the shipbuilding community are brought into sharper focus in Exhibit XLV. This exhibit compares Navy and commercial new construction, repair, and overhaul work already awarded and projected to be awarded to the fiscal year 1978 employment in the 11 major private shipyards. As this exhibit indicates, a shortfall in workload is generated beginning in 1979 and continuing through the remainder of the period to 1986. Note that known and anticipated commercial work is included in the planned manpower requirements leading to this shortfall, although it can be assumed that some commercial contracts will be booked in later years to ameliorate slightly the shortfall after 1983.

Exhibit XLVI displays these data numerically and shows the number of employees who may have to be dropped from the private shipbuilding work force to adjust for the projected workload. This exhibit reveals that a 20 percent reduction in the overall work force is likely to occur by 1982, with further reductions to a total of about 52 percent by 1986.

While it is not possible to determine which of the 11 shipyards will be required to make the largest reductions in employment on the basis of these data, a partial answer is evident. Exhibit XXXIV, above, indicates that only two shipyards – Newport News and Electric Boat – have demonstrated capabilities to construct and convert five of the major combatant ship types: SSBN (Trident), SSN, CGN-42, CVV, and CV-SLEP. If it is assumed that the work available in the President's fiscal year 1979 to 1983 program for these five ship types is sufficient to keep these two shipyards occupied and that Newport News and Electric Boat are awarded this work, the balance of the program will be split among the nine remaining private yards. Exhibit XLVII summarizes the remaining program.

Exhibit XLVIII compares the available work force of these nine shipyards against this remaining Navy program, and illustrates the significant shortfalls that will occur. Specifically, employment in these yards will drop from 53,400 in early 1978 to 14,100 in 1986 if the Navy program remains as currently planned and no other new work is added. While it can be anticipated that the actual employment levels will be higher than 14,100 because of some additional commercial work, a large reduction in employment appears inevitable if the Navy program is not substantially enlarged.

EXHIBIT XLV
FISCAL YEAR 1978 MANPOWER VS. PROJECTED WORKLOAD AT THE ELEVEN MAJOR SHIPYARDS



*May 1978 total employment at the 11 major shipyards: Avondale, Bath, Bethlehem, Electric Boat, Ingalls, Lockheed, National Steel, Newport News, Quincy, Todd - Seattle, and Todd - San Pedro.
**Five-year projection plus unawarded fiscal year 1978 ships.

Source: NAVSEA.

EXHIBIT XLVI
REDUCTIONS IN MANPOWER RESULTING FROM PROJECTED WORKLOAD AT THE ELEVEN MAJOR SHIPYARDS
(Thousands of Employees)

Manpower Requirements	Fiscal Year								
	1978	1979	1980	1981	1982	1983	1984	1985	1986
Manpower Levels as of Fiscal Year 1978	102	102	102	102	102	102	102	102	102
Manpower Needed for:									
– Commercial New Construction Under Contract, and Navy and Commercial Repair and Overhaul	41	24	14	16	17	17	17	17	17
– Navy New Construction Under Contract	71	71	60	39	22	11	3	–	–
– Planned Navy New Construction	–	–	2	13	24	28	35	38	32
– Planned Commercial New Construction	–	5	14	24	19	16	11	2	–
Total Manpower Needed	112	100	90	92	82	72	66	57	49
Potential Excess Manpower	-10	+2	+12	+10	+20	+30	+36	+45	+53
Percent Manpower Reduction	+10%	-2%	-12%	-10%	-20%	-29%	-35%	-44%	-52%

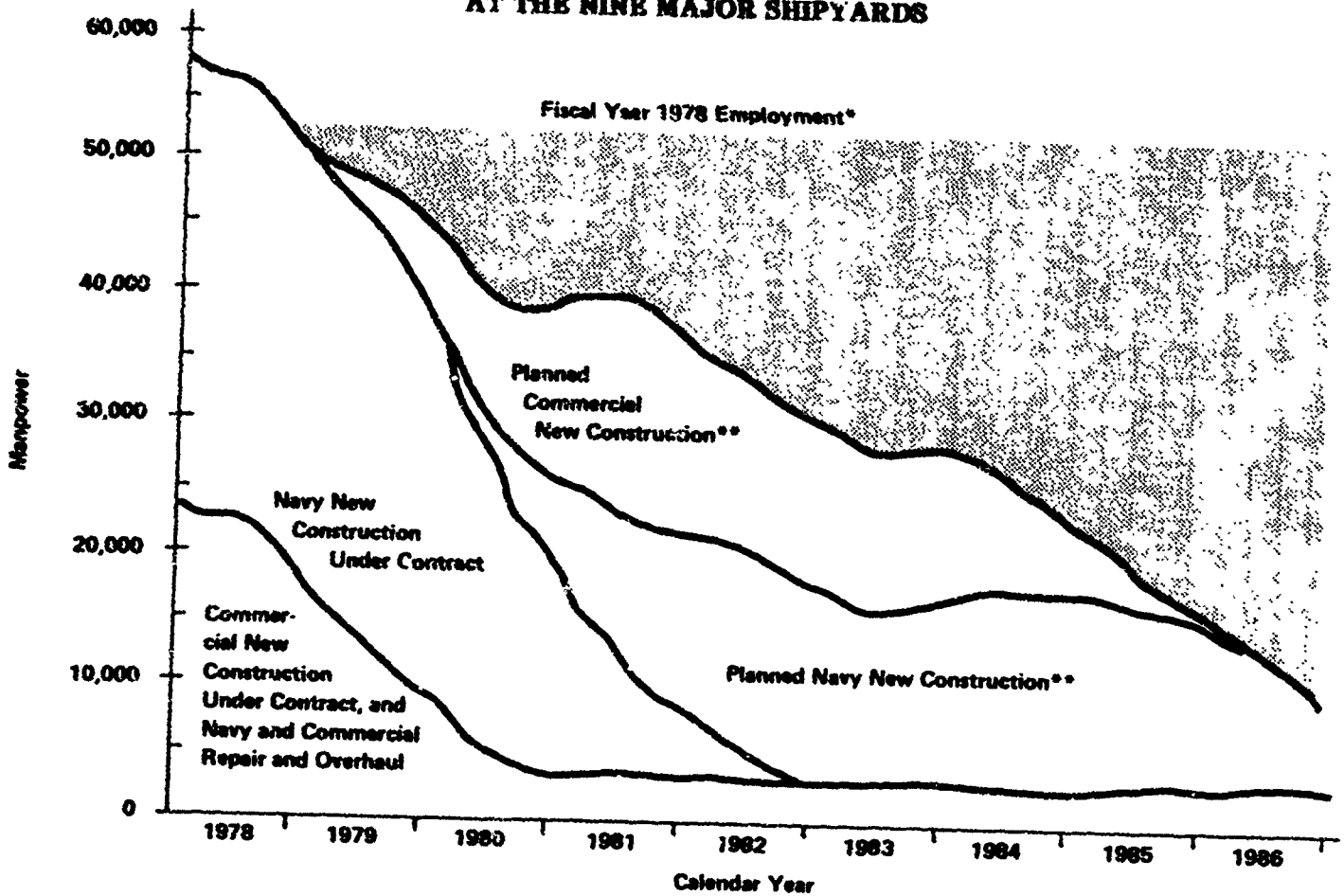
Source: NAVSEA.

EXHIBIT XLVII
REMAINING U.S. NAVY FIVE-YEAR SHIPBUILDING PROGRAM BY SHIP TYPE AND NUMBER OF SHIPS: FISCAL YEAR 1979-1983

Ship Type	Symbol	Number
New Construction		
Guided Missile Destroyer	DDG-47	7
Landing Ship Dock	LSD-41	2
Guided Missile Frigate	FFG-7	26
Mine Countermeasures Ship	MCM	5
Destroyer Tender	AD	1
Fleet Oiler	AO	1
Oceanographic Research Vessel	AGOS	12
Cable Repair Ship	ARC	1
Fleet Tug	ATF	2
Conversions		
Guided Missile Destroyer*	DDG-2	5

*The DDG-2 conversions total 10 ships. For the purpose of this analysis, the team assumed that one-half of these conversions will be undertaken in naval shipyards. Data are not available on the planned conversion of the one TAK.

EXHIBIT XLVIII
FISCAL YEAR 1978 MANPOWER VS. PROJECTED WORKLOAD AT THE NINE MAJOR SHIPYARDS



*February 1978 total employment at the nine major shipyards: Avondale, Bath, Bethlehem, Ingalls, Lockheed, National Steel, Quincy, Todd - Seattle, and Todd - San Pedro.
**Five-year projection plus unawarded fiscal year 1978 ships.

Source: NAVSEA.

If we assume that the FFG program will continue to be awarded to Bath and Todd (San Pedro and Seattle), the problems of insufficient Navy new construction become still more difficult to address. Exhibit XLIX presents a look at the results of this assumption. As the exhibit reveals, there is very little planned Navy new construction for placement in these shipyards. Six yards are available to split this limited amount of Navy new construction work. The shortfalls in work pictured here suggest that one or more private shipyards may go out of business unless other means of reducing the impact of these workload shortfalls can be found.

3. Commercial New Construction and Repair/ Navy Overhaul and Repair Work

Commercial new construction and repair work as well as Navy repair work can help to ease the bleak employment situation. However, as noted in Exhibit XLVI, above, beginning in 1981 both known commercial new construction and known and projected commercial and Navy overhauls will only employ about 16,000 to 17,000 people annually in the 11 major shipyards. In the decade ahead and even further into the future, it appears that there will be a paucity of commercial new construction – a lack of work which is likely to reduce the size of the industrial shipbuilding base even more. At the same time, this reduction will probably increase the cost of concurrent Navy new construction – particularly if the shipyards involved are not at the optimum size for efficient operation.

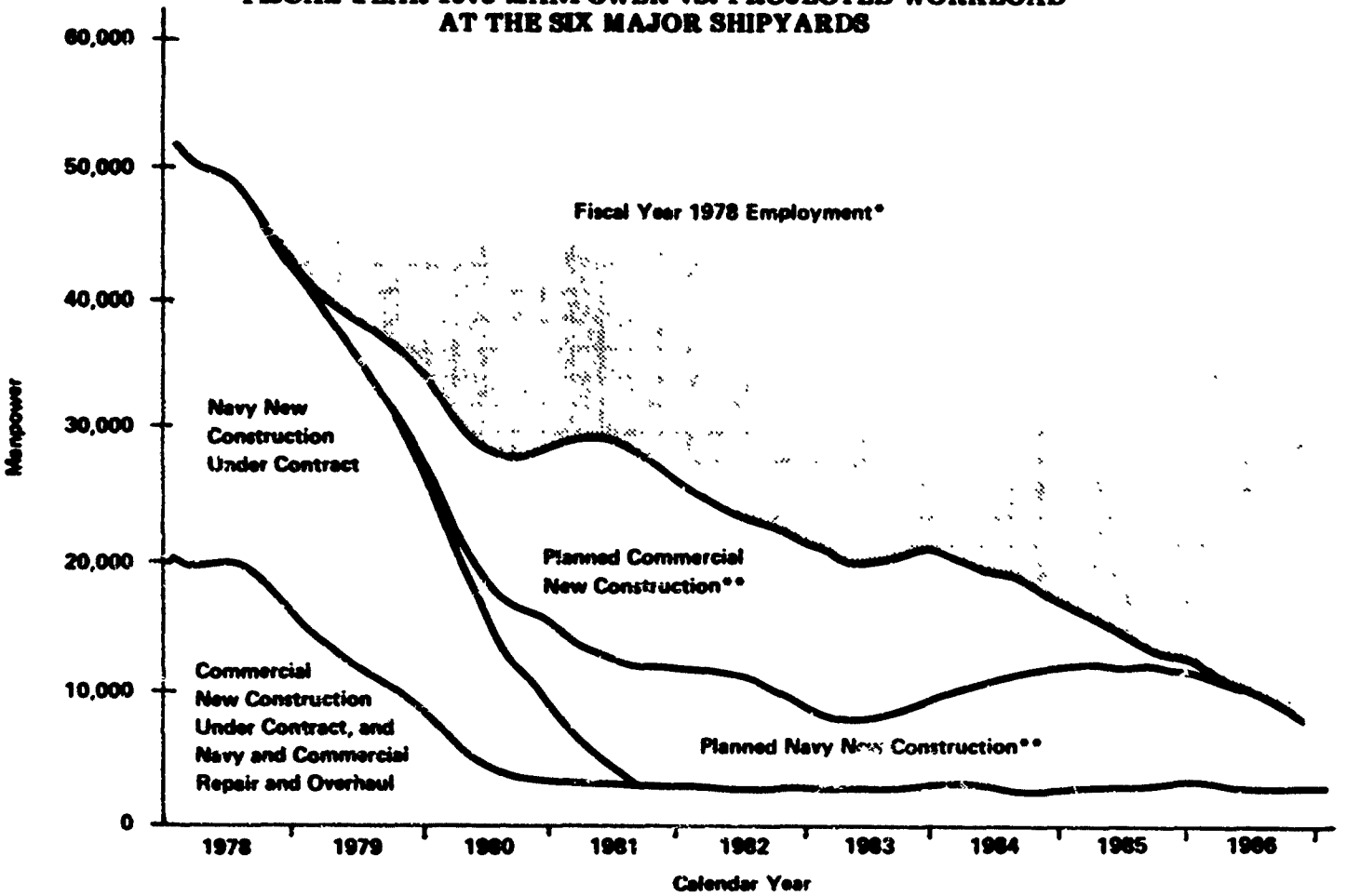
4. Shipyard Productivity

The apparent decline in shipyard productivity is discussed in Chapter One.[1] Several private shipbuilders expressed the view that productivity has become a serious problem in the industry. The large cost overruns which are at the root of the shipbuilder claims confirm – in a general way – that this is an accurate assessment. One of the difficulties that the study team encountered in attempting to address the issue of shipyard productivity was the lack of generally accepted measures of productivity and of specific related data on each shipyard. Yet

---

[1] See subsection C 7.

EXHIBIT XLIX
FISCAL YEAR 1978 MANPOWER VS. PROJECTED WORKLOAD AT THE SIX MAJOR SHIPYARDS



*February 1978 total manpower at the six major shipyards: Avondale, Bethlehem, Ingalls, Lockheed, National Steel, and Quincy.
**Five-year projection plus unawarded fiscal year 1978 ships.

Source: NAVSEA.

evidence of the problem surfaces in the subjective judgments of experienced, knowledgeable industry officials or is indirectly derived from industry data. For example, in several recent Navy programs the shipbuilders were unable to build the ships within the man-hours that they originally estimated based on their historical data concerning the man-hours required for similar work.

D. The Subcontractor Base

Another dimension of the shipbuilding problem is revealed by an examination of the subcontractor base. Exhibit XX (Chapter One) presented some statistics on the material and equipment lead times experienced by shipbuilders over the last 16 years. While the list is merely a representative sample, and lead times for some basic materials have recently improved, the overall trend to longer and longer lead times is apparent. At the same time, the number of subcontractors available to supply shipbuilders with the many manufactured materials and equipments required to build a ship is steadily shrinking. During the interviews, shipbuilders repeatedly emphasized that many vendor sources are drying up. One reason cited was the fact that Navy business is unique. The commercial marine market uses industrial components and equipments to a large extent, and the volume of Navy business is so small that it is not economical to many vendors to stay in the business. In addition, the technical requirements and documentation demanded for Navy work so far exceed those required for other business that some vendors simply drop many product lines. During the interviews, shipbuilders generally categorized the involvement of the Navy in their subcontracting as "overkill." Navy technical and documentation requirements work to reduce the number of sources, resulting in increased costs, and making ship construction schedules more dependent on the performance of fewer and fewer subcontractors. Many shipbuilders also believe that the Navy's involvement in shipbuilder subcontracting operations further escalates costs.

E. Discussion and Analysis

As shown in Exhibit XIII (Chapter One), the periodic workload fluctuations and rapid changes which have occurred in the private shipyards appear to be major underlying causes of the current shipbuilder claims. These factors have severely affected the companies' abilities to maintain or improve productivity and

have created difficulties in maintaining a healthy base of suppliers. However, if the workload at each private shipyard could be kept at a level that is within its facilities and manpower capabilities and yet high enough to absorb overhead efficiently, shipbuilders should be able to control the costs of construction and thereby permit accurate forward pricing. As a result, one of the major causes of claims would be eliminated. It follows that efforts to stabilize private shipyard workloads at efficient levels should be given high priority by both the Navy and its shipbuilders.

Four facets of this issue are considered below: (i) the potential for stabilization through internal Navy planning processes, (ii) the feasibility of establishing "workload windows" at each private shipyard, (iii) shipbuilder productivity, and (iv) the prospects for maintaining a healthy supplier base.

1. The Navy's Internal Planning Process

The internal planning undertaken by the Navy in the ship acquisition process has two major characteristics: (i) it produces unstable results as demonstrated by the fact that there are major alterations to the program from month to month and from year to year, and (ii) it involves a large number of decision-makers within the Navy, OSD, and the Congress. To a substantial extent, these characteristics are the result of the high visibility of the Navy's shipbuilding program. However, these factors make it very difficult for either the Navy or its private shipbuilders to do effective long-range planning. The volume of pending claims prior to June 1978 exacerbated this situation by focusing even more attention on the program. At the same time, this program instability is a contributing factor to these claims because it tends to prevent efforts to level the workloads at the private shipyards. The study team is firmly convinced that stabilizing the Navy shipbuilding program to achieve more level workloads at the private shipyards is the most effective single step that can be taken to avoid future claims.

a. The Five-Year Shipbuilding Plan. Review and approval of the Navy's five-year plan is a regular part of the budget cycle each year, and OSD and the Congress clearly play vital roles in the creation of this plan. However, in recent years their roles seem to have increased in importance – indicating a loss

of credibility with respect to the Navy's justification of its proposed program. This credibility might be significantly enhanced if the Navy would present detailed information concerning the impact that its program would have on the industrial base – the private shipbuilding industry. If the Navy presented accurate information on the projected workloads of each of the private shipyards and showed how its proposed program dovetailed into these projections, all of the reviewers would be aware of the stabilizing forces inherent in the program and, hence, would be more likely to accept it.

Such a procedure would require that greater emphasis be given to identifying the impact on the industrial base in the Navy's planning process and in the many tiers of review that precede final congressional approval of the program. While industrial base information has been considered, there appears to have been a tendency to make rather optimistic assumptions in assessing the information. Frequently, it is assumed that shipyards have growth potential and that current programs are performable within contract limits. However, experience has indicated that shipbuilders have often forecast their required manpower at levels below their true needs. For example, if more conservative assumptions were made and if it was agreed that there are strong reasons to keep private shipyards well within their range of efficient operating size, industrial base data would probably become a considerably more important factor in the long-range planning process. Some ships desired by the military planners might be deferred because of lack of shipyard capacity, but the actual impact on the fleet would probably be constructive since schedules would be more credible. Present Navy ship schedules slip substantially, as was illustrated in Exhibit XL.

The need for continuing awareness of industrial base data throughout the executive and legislative formulation of the Navy shipbuilding program is demonstrated by the major changes that have occurred in the 1979 program. While some of the decisions made have considered the impact on the industrial base, others appear to have the potential for prolonging the unstable employment characteristics of the shipyards. The study team believes a new philosophy must be created to counter this recurrent phenomenon.

b. Ship Design and Documentation. It is clear that shipbuilder claims can be reduced if the design process can be improved. The earlier in the acquisition process the Navy and its shipbuilders can arrive at a "clean" set of technical documentation, the fewer disruptions are likely to occur during the construction phase of the ship acquisition where change is so costly. Clean technical documentation may also enable shipbuilders to stay on their construction schedules since it appears that the inability to process working drawings has been one of the factors which has hampered the shipbuilders' ability to apply the construction manpower necessary to maintain their schedules.

The procedures followed in the FFG-7 and DDG-47 acquisitions appear to be solid steps that will improve the situation. In these programs, the prospective shipbuilders were awarded design support contracts to work with the Navy during contract design. This policy promotes shipbuilder participation in the design process to assure that construction methodology peculiarities are taken into account. It also serves to stimulate early resolution of design and specification errors. The validated drawing technique that was used on the FFG-7 acquisition also seems to have the potential for reducing drawing changes. While it is still too early to cite conclusive results from the FFG-7 program, there are indications of improvement in the quality of the drawings which had been validated against the lead ship. Participating in the contract design as the first task of a lead shipbuilder, which is planned for the LSD-41 and MCM acquisitions, is another technique which holds the promise for improvement in this area. NAVSEA should be encouraged to adopt these or other appropriate procedures to assure that shipbuilders are involved in contract design to a significant extent.

The Navy is also making greater use of land-based test sites and full-scale mock-ups to identify design problems before they might otherwise be encountered in the construction of the ship. This procedure permits design validation early enough to avoid a disruptive impact on the ship construction process. Selection of an appropriate interval between the lead and follow ships also provides the follow shipbuilder with more usable working drawings, and this serves to reduce the disruptive impact on the follow ship construction process.

Improvement of Navy-controlled specifications and drawings is one major aspect of ship design and documentation that has been severely neglected.

The shipbuilders were unanimous in the view that this documentation is currently obsolete and conflicting. Data from NAVSEC (see Exhibit XXXVI, above) confirm the lack of effort in this area, and it can be assumed that further deterioration will occur unless signficant additional resources are applied promptly. The study team believes that immediate action is called for in this area.

c. **Ship Cost Estimates.** While the study team concluded that the NAVSEA cost-estimators are professionally competent, Exhibit XXXVIII, above, indicates that the estimates themselves are not sufficiently accurate. Several factors come into play here. First, in recent years, the NAVSEA cost-estimating group has been too understaffed to handle the work assigned to them. Since NAVSEA has recently increased the size of the group substantially, this problem has been addressed. Second, the cost-estimators have had difficulty predicting the inflationary forces that will impact on shipbuilding. Prior to fiscal year 1976 the cost-estimators were required by OSD to use the factors shown on Exhibit XXXIX, which were grossly inaccurate. Since fiscal year 1976, they have used NAVSEA-derived factors which have been more accurate but which are still not satisfactory. However, this is a problem with which the best economists seem unable to cope, and it does not appear that NAVSEA can be expected to make significant improvements here. Third, the cost-estimators did not predict the loss of productivity of the shipyards which contributed to the current claims. There is no apparent cure for this problem other than to reestablish an environment in which the shipbuilders can control their productivity so that such an impact is again predictable..

A major cost-estimating problem could be avoided if the Navy would refrain from including ships in its budget submittals until Class "C" estimates have been made. There has been major congressional criticism of less accurate estimates with the result that Navy cost estimates have suffered some loss of credibility in Congress. Congressional committees have indicated that they do not want to approve the construction of ships before Class "C" estimates are available. Except for programs of great urgency (specifically identified as such), this practice should be followed strictly.

d. **Ship Construction Schedules.** Exhibit XL, above, indicates that schedule slippage is a major problem in the ship acquisition process. While some improvement can be anticipated if each shipyard is kept at a workload that is below its optimum manning level, there appears to be a bias toward optimism in establishing shipbuilding schedules. Recent efforts by NAVSEA to include prospective shipbuilders in the planning process in the FFG-7 and DDG-47 programs have apparently resulted in more realistic schedules, and this practice should be continued. It appears that shipbuilders are more likely to give a realistic assessment of the time required for a construction program prior to their actually competing for the work. In addition, the Navy should ensure all personnel understand that optimistic forecasts of ship construction schedules are highly undesirable.

It should be noted that this effort to begin each program based on a realistic schedule is critical to the success of a controlled workload policy. Since the man-days of effort estimated for each ship are spread over the time required to construct the ship, major variations in the schedule significantly alter the work done in any period of time. This, of course, impacts on workload planning. Establishing realistic schedules and meeting them would go a long way toward stabilizing workloads and thereby inhibiting the submission of claims.

2. **The "Workload Window"**

Almost all of the current shipbuilder claims have been generated by three shipyards – Electric Boat, Ingalls, and Newport News. All three yards have two things in common: (i) they are the three major private shipyards, and (ii) they have all been working close to or above their optimum manning levels, as illustrated in Exhibit XV (Chapter One). Since the estimated optimum manning levels shown in this exhibit seem optimistic, it is possible that these shipyards already exceed the upper limit of the range of efficient operating size. To avoid such a situation, the study team proposes the establishment of a "workload window" for each shipyard which would be used in all ship acquisition decisions relating to that shipyard. This workload window would be based on work force manning levels that would permit the shipyard to work at acceptable levels of efficiency.

a. Determination of Manning Levels. The optimum manning level figures set forth in Exhibit XV (Chapter One) were obtained by a survey of the companies which was conducted in 1978. These figures were based on current facilities and undoubtedly reflect a view of the likely mix of work in the near future as well as the local labor market. All of these variables are subject to change, with the result that optimum manning level figures will also change. As total employment figures, they are subject to inaccuracies with regard to the mix of trade as well as the varying numbers of support and managerial personnel available at any time. Since all of these variables will change regularly, total employment numbers can be used only in a gross sense to discuss the workload window concept. Nevertheless, they illustrate the basic thrust of this proposal.

Shipyard facilities and shipbuilding programs change rather slowly; and the shipbuilders generally agree that it is difficult to alter the available labor pool very quickly. Each shipyard is limited by some predominant factor – generally the large yards are labor constrained, while the small yards are facilities constrained. Hence, manning level estimates are relatively easy to arrive at and should not change radically from year to year. Indeed, there are strong reasons to avoid hasty changes, since past experience demonstrates that rapid expansion of the work force may be one of the prime causes of loss of control over productivity. Hence, one of the key elements of the workload window concept would be the ability to control changes in the work force.

It should be noted that the Navy played no role in determining the estimates presented in Exhibit XV (Chapter One) and thus might not agree with them. However, there is sufficient expertise in this area in NAVSEA to enable the Navy readily to generate manning level figures as required.

b. Feasibility of Workload Limitations. During the interviews, the shipbuilders all agreed that a stable work force is a major prerequisite for achieving maximum control and productivity. The first step toward achieving such stability would be to reach agreement with each shipbuilder concerning the workload window within which its shipyard would function most effectively. These figures should be arrived at on a regular basis without consideration of specific programs. At the outset, an annual determination would probably be

appropriate with adjustments whenever significant business or program changes occur. The study team anticipates that the shipbuilders would cooperate in the endeavor, since an early agreement with their major customer on their prospective business needs would be highly advantageous.

In establishing the workload window for succeeding years, it is essential to know the projected spread of work occurring under each current shipyard contract or each contract anticipated in the future. The sharing of such intelligence between the Navy and the shipbuilder is vital to this task, and it is here that the greatest difficulty can be anticipated. For adequate planning, all work – Navy new construction, commercial new construction, and overhaul and repair – would have to be included. In addition, a factor would have to be added for anticipated changes and delays to this work. While these matters contain the potential for considerable controversy, both NAVSEA and the shipbuilders regularly make such projections at the present time, and they have developed a substantial amount of expertise in this area. The key would be to avoid overly optimistic projections.

Once these projections have been agreed upon, both parties will know the amount of capacity available for future work and that should determine the eligibility of each shipbuilder for specific programs. The study team believes that the shipbuilders will abide by decisions restricting them from future programs that fall outside of their workload window since, in the long run, this proposed system will provide a much healthier shipbuilding environment. For example, Bath recently withdrew from the DDG-47 program because of forecasted excessive workload requirements, and Todd indicated in the interviews that it is not interested in additional Navy new construction work at the San Pedro and Seattle yards above the FFG-7 program.[1] The Navy must make it clear that the proposed system cannot guarantee shipbuilders that the Navy will provide sufficient work to keep them within the workload window. However, adherence to an upper manning

[1] During the interviews, the projected FFG-7 program called for the construction of eight ships per year. The President's most recent (March 1978) budget submission reduces this number to five ships per year.

level that is well within each shipyard's efficient operating size would tend to spread future work to some extent and would help to maintain the industrial base as well. It is also apparent that leveling or stabilizing the workload would provide a significant advantage to the taxpayer – it should result in more ships for the dollar.

The workload window concept will undoubtedly require refinement as it is adopted in actual practice. Our discussion has dealt only with total shipyard employment whereas, in reality, each shipyard must be concerned with a steady level of employment for each skilled craft and the proper number of managerial and support personnel to accommodate the specific mix of programs currently under way. A much more sophisticated analysis of current and future programs and a much greater effort in fitting future programs into the mix of work in the shipyard would be required to structure workload windows reflecting all of these variables. Varying the Navy overhaul and repair work will undoubtedly assist in producing adequate results in this regard. For example, in some cases, it may be prudent to assign Navy overhaul and repair work to a shipyard specifically for the purpose of maintaining stable employment in the outfitting crafts. The benefits of stable employment in the vital skilled crafts may justify such a policy.

c. Use of the Workload Window. Capacity and capability considerations are now included in the early stages of the development of the annual Navy shipbuilding program and the review of the five-year plan. However, the information used is not coordinated with the shipbuilders and is not as rigorously developed as contemplated here. Hence, adoption of this concept would provide considerably firmer data for use at the outset of program development and at all stages in the budget process. The same data should also be used each time a change to any part of the program is under consideration. The objective of such a process is to bias program development with hard information bearing on the capability of the industrial base and to assure that this information plays a significant role in the decision processes which occur during formulation of the shipbuilding program in both the executive and legislative branches.

Having adopted the workload window concept, the Navy would be encouraged to put together contract packages that fit the capacity of the eligible

shipbuilders. If it was projected that capacity was not available for a future ship, the Navy would be faced with the alternatives of developing an additional source or deferring acquisition to a later year. Of course, the system would be no better than the managers using it. If the projections were ignored or if the data were not kept current, overload situations would occur as they have in the past and loss of control over productivity could be anticipated.

It would also be necessary for each shipbuilder to undertake its commercial work in a way that would not violate the workload window. This would require not only early identification of commercial opportunities so that the data could be included in the determination of available capacity within the window, but also restraint in entering into commercial contracts which would necessitate effort above the shipyard's upper manning level. The study team stresses that shipbuilders must cooperate in this effort and believes that failure to do so should be a significant factor in future source decisions.

Assuming that the shipbuilders would abide by decisions limiting the volume of their work to the top of the window, the question of how to deal with shipyards falling below the lower level of the window remains. Presumably, this level would be the point at which the shipyard would no longer efficiently be able to absorb fixed costs, and it would vary from shipyard to shipyard. There should be no problem with shipbuilders competing for programs which would bring their total work above this level – even if they are below the level at the time of the competition. However, shipyards that are so far below the level that even winning a program would not bring them into a productive operating range would pose difficult problems. In such cases, the Navy would have to assess carefully the prices proposed to assure that they realistically reflect the prospective costs of performance, and instances might arise where a shipyard would be disqualified because of this factor. The procurement techniques available in this area are addressed more fully in Chapter Three.

d. **Impact of Commercial and Overhaul/Repair Work.** The entire thrust of the "workload window" concept is to enhance the probability that the shipyard involved during contract execution will have a good match between program, capacity, and capability, and that this stability will permit good

projections of performance and offer opportunities for productivity improvements. Yet, as demonstrated by Exhibits XLVI, XLVIII, and XLIX, above, there is insufficient new construction work to keep the shipyards within their respective windows. Since most of the shipyards involved (or likely to be involved) in naval new construction also construct ships for the commercial market and perform overhauls/repairs for both commercial and Navy ships, the most promising way to maintain a healthy industrial base in the immediate future is to provide additional amounts of such work.

Workload stability is a key factor in establishing an environment for naval ship construction that discourages the generation of claims in future naval ship construction programs. It argues strongly for a vigorous role on the part of the Navy in support of actions that will provide such stability. Thus, it is in the Navy's self-interest to give strong support to commercial shipbuilding programs as well as commercial ship repair work, and to adopt policies and practices in contracting for the overhaul and repair of naval ships that are responsive to the issue of maintaining a stable base for naval ship new construction.

3. Shipyard Productivity

Inherent in the workload window concept is the principle that, within a range of shipyard size and rate of growth, shipyard management can and will control worker productivity more effectively. Further, the workload window concept is based on the premise that a good match of workload to work force is an essential prerequisite for establishing shipyard operating stability. During the interviews, the shipbuilders vigorously endorsed the precept that operating stability is an essential factor in controlling and improving productivity. Thus, prudent application of the workload window concept and good shipyard productivity are inseparable parts of a large whole. The study team assumes that the shipbuilders will undertake the necessary management efforts to improve their control of productivity in conjunction with the Navy's effort to stabilize workloads.

There is currently no more important task for the shipbuilders than to take firm control over productivity and to assure that positive improvements are achieved. To the extent that actions of the government impede this effort, the

shipbuilders and the Navy must work together to remove the impediments or to find alternate means of dealing with the government actions. Many of the conclusions in this study are aimed at establishing a working environment between the Navy and its shipbuilders which will encourage shipbuilders to devote their attention to efforts to achieve productivity improvements.

In order to derive maximum benefit from improved industry performance, there is a real need for sharper tools and techniques to assess productivity than are now available. Subjective judgment of the productivity of shipyard work forces is simply not sufficient. New methods are required that will permit both the Navy and the shipbuilders to develop factual measures of worker output. The study team believes that the Navy and the shipbuilding and ship repair industry (including both private and public shipyards) should jointly develop reliable measures of overall shipyard productivity. Every effort should be made to identify the separate contributing elements as well as their impact on overall shipyard productivity. These elements include the blue collar work force, the white collar work force, facilities, and managerial expertise.

4. Supplier Base

The general consensus with regard to the supplier base available to shipbuilders is that it is too small and that it is shrinking. This seems to be the natural consequence of the business environment in which the subcontractors operate. One of the shipbuilders interviewed made this observation: ". . . the Navy must work with the shipbuilders to find means of accommodating the way subcontractors want to do business." The administrative and technical requirements imposed on subcontractors are viewed by many as burdensome beyond all legitimate needs. There appear to be two courses of action that could be followed to alleviate this situation: (i) reduction of paperwork requirements and (ii) use of commercial products.

a. Reduction of Paperwork Requirements. Many of the paperwork requirements imposed on the shipbuilders by the Navy are required of subcontractors as well. Some of these requirements are derived from regulations while others come from statutes. In totality, they seem overwhelming to subcontractors

who have little or infrequent government business. Indeed, it is believed that the Navy could increase the number of subcontractors participating in the shipbuilding effort by selectively waiving these requirements. In some cases, the Navy could probably obtain the necessary information by other means; in others, it might be possible to proceed without the information. There is some evidence that such steps are not taken at the present time because of administrative oversight rather than firm policy. The administration of subcontracts is conducted at the SUPSHIP level beginning with the prime contractor and the flowdown requirements of the prime contract – far below the policymaking level in the Navy. Thus, recognition that there are problems in this area and promulgation of a forthright policy that it is the desire of the Navy to increase participation at the subcontractor level – even if this requires relaxation of the paperwork requirements – could provide the necessary impetus to change the situation.

The shipbuilders can also take steps to alleviate this problem. During the interviews, some shipbuilders told the study team about special efforts they have undertaken to educate subcontractors on the administrative needs of the government. In view of the difficulties predicted for this area in the future, it appears that all of the shipbuilders must improve their performance in the subcontracting area. An aggressive program should be undertaken to ensure multiple sources for major components, and the Navy should be alerted to sole-source situations when they do occur.

b. Use of Commercial Products. Another means of increasing subcontractor participation is to find ways to make greater use of commercial products. For some ships, such as auxiliaries, it may be possible to use commercial systems without alteration. In other cases, the situation may be improved by writing the specifications to reflect commercial practices more closely. During the interviews, several shipbuilders recommended that the Navy streamline and update its technical specifications to the state of the art. Failing that, it was suggested that some way be found to benefit from the improvements available from commercial vendors whose products embody the state of the art even without a change in technical specifications (such as through a waiver procedure). The Navy might also rethink its ship design philosophy and practice with a view toward

embracing a design approach in which commercially available state-of-the-art components and equipments are accepted and used. Special treatment might be given to the interface between the ship and other systems and equipment as a means of allowing utilization of the commercial item without degradation of essential military and/or safety attributes. For example, required noise reduction features might be achieved by special foundations (the interface) rather than as an inherent aspect of the subcontractor-furnished equipment itself.

In view of the seriousness of the problems in this area, it seems that all of the approaches summarized above demand careful consideration. Clearly, the entire range of requirements (software and hardware) that adversely impact on the subcontractor base would benefit from innovative reexamination. There is need for a concerted effort by NAVSEA to find ways to increase subcontractor participation in the shipbuilding program.

Blank

F. Conclusions

The study team believes that a number of changes should be made to Navy and shipbuilder planning efforts. The team's conclusions are summarized below.

1. Workload Window

a. The Navy and each private shipbuilder involved should agree on a workload window for the period of planned naval new construction and should adopt procedures to keep this information current. To the extent feasible, this workload window should reflect the skilled crafts as well as the managerial and support personnel upon which the shipyard is dependent.

b. The Navy should incorporate workload window information into the planning process for its ship construction programs, require that each acquisition include written workload window analyses, and ensure that workload projections for ships under contract are regularly updated to reflect current estimates.

c. The Navy should thoroughly study its alternative sources of other work (overhaul, repair, and conversion) for private shipyards building naval ships, and should adopt policies and procedures that will support the assignment of such work to ensure the vitality and availability of the shipbuilders needed by the Navy to execute future naval ship construction programs.

d. The Navy should adopt acquisition procedures to ensure that contract awards will not require any shipbuilder to exceed its workload window.

2. Shipbuilding Documentation

The Navy should mount a vigorous and continuing effort to update and maintain the currency of all shipbuilding documentation. Additional funds should be made available to improve the technical documentation package for future ship construction contracts.

3. **Contract Design**

The Navy should continue to involve shipbuilders in contract design by appropriate methods such as giving them contracts to participate in the contract design effort.

4. **Cost Estimates**

The Navy should require Class "C" estimates for all ships for which appropriations are sought in its budget submissions to OSD, the President, and the Congress.

5. **Ship Delivery Schedules**

The Navy should refine the ship contract delivery schedule derived from the workload window analyses by consulting with potential shipbuilders during the contract design phase. Requests for Proposals should require that the shipbuilder's proposal include a preferred delivery schedule, with an appropriate explanation.

6. **Productivity**

a. The shipbuilders should take forceful management action to achieve better control over shipyard productivity and should aggressively report to the Navy any government actions which impede efforts to improve productivity.

b. The Navy and the shipbuilders should jointly develop reliable measures of shipyard productivity for both new construction and repair.

7. **Supplier Base**

The Navy should establish a shipbuilding industry/Navy effort to develop a program to better utilize commercially available equipments for naval ship construction.

Chapter Three. Contracting Policies Contract Types, and Clauses

CHAPTER THREE. CONTRACTING POLICIES, CONTRACT TYPES, AND CLAUSES

A. Introduction

This chapter considers the problems of risk allocation between the Navy and its private shipbuilders. Since shipbuilding is one of the longest, most complex construction processes in the world of government acquisitions, the determination of a balanced allocation of risk is of central importance in minimizing the probability that contract claims will occur.

This chapter examines three aspects of this matter: (i) the risks inherent in shipbuilding; (ii) the techniques that have been used to distribute these risks; and (iii) contracting policies, contract types, and contract clauses. The chapter also presents the study team's conclusions regarding those policies it believes should be employed in Navy shipbuilding contracts.

B. Risks in Shipbuilding

In recent years, most naval ships have grown dramatically in terms of size and complexity. A modern aircraft carrier is analogous to a small city in many respects – displacing more than 90,000 tons and accommodating a working force in excess of 5,000 men. The increase in size and complexity has necessitated a commensurately longer period of contract performance. Exhibit XI (Chapter One) indicates that the time from contract award to ship delivery can be as long as seven years and that four to six years of contract performance is commonplace. Clearly, shipbuilding is a high-risk enterprise, and risk allocation is of fundamental importance. However, risks must be identified before they can be allocated.

1. Technical Risk

Technical risk is encountered throughout the entire process of ship acquisition and is highly dependent on the degree to which the ship design or construction techniques extend the state of the art. A ship design which embodies an evolving engineering discipline, such as hydrofoil technology, is substantially more risky than one using conventional displacement hull and propulsion designs. As discussed in Chapter Two, even a new design for a conventional ship is riskier to the shipbuilder than a complex ship design which it has built before, since the

details of construction are customarily developed during a period which overlaps the building phase. Thus, if detail design development is late or is changed significantly, the shipbuilder's plans for ordering material and using facilities and manpower will be affected. Similarly, if a shipbuilder uses previously untried construction techniques or processes, the potential for unexpected problems is higher than with proven methods.

The construction of naval ships (particularly combatants) entails a greater degree of risk than the construction of commercial ships in that naval designs are generally based on higher performance requirements for such factors as speed, endurance, and resistance to damage. These features result in a more complex and more difficult-to-build ship, which is further complicated by weapons and communications systems and the large military crew that must be accommodated to operate them. In addition, because of the compactness of naval combatant designs, the consequences of a construction error or change can be substantially greater than in a commercial ship – particularly if the error requires rip-out and replacement of completed work

The continuing process of change in technical documentation also injects substantial technical risk into the ship acquisition process. In this regard, it is important to distinguish between technical changes and drawing revisions. The two are sometimes mistakenly combined in an attempt to simplify discussion. Technical changes occur only when a physical change to some part of the ship is required in order to meet Navy needs, whereas revisions occur whenever it is administratively necessary to alter some detail in the ship working drawings. Thus, drawing revisions represent an accounting practice for work authorization and control purposes; they include administrative changes as well as technical changes.

A single technical change may engender multiple drawing revisions; conversely, drawing revisions may be made which entail no technical change at all. The latter circumstance may come about when a drawing has been issued in an incomplete state to allow material to be ordered or to permit work to proceed on the completed portion. In this situation, a revision is later necessary to achieve the completed drawing. Alternatively, a drawing revision may be issued to

accommodate the unique construction requirements of a particular shipbuilder whose facilities or fabrication processes may differ from those of the lead shipbuilder, or to reflect a change required for the convenience of the shipbuilder that does not alter the Navy's specifications or design requirements.

Exhibit XXXVII (Chapter Two) indicated that drawing revisions are a way of life in ship construction – both for Navy combatants and commercial ships. This is true because of the traditional practice of concurrently designing and constructing ships. It is apparent that drawing revisions impose risk on the shipbuilder – particularly when they occur in such numbers that they complicate ship construction. In theory, technical changes do not impose significant risk on the shipbuilder because the Navy agrees to adjust the price equitably when it requires such changes. However, these changes may require rework, cause delay, or disrupt the existing plan for building the ship. The effect of these changes is more difficult to accommodate when the shipbuilder's ability to readjust the work force and schedules is limited. For a multiple ship contract, such changes may affect each ship differently. For example, rip-out and rework may be needed on a ship which is virtually completed, while relatively little effort may be required on a ship which is less complete. In many cases, the inability of the shipbuilder to trace the effect of such changes and to reach agreement with the Navy on their financial impact imposes a significant risk that the cost cannot be recovered from the Navy or that such recovery may be inordinately delayed.

The shipbuilders interviewed were virtually unanimous in the opinion that a more complete description of the Navy's requirements, together with fewer technical changes, would result in cost savings and would lessen the incidence of shipbuilder claims. Nevertheless, all of the shipbuilders agreed that the complexity of the ship design and construction process as well as its long construction period make it impractical to develop the detailed design completely prior to starting construction of the lead ship. The iterative process which ship design typifies will always require a significant degree of change with resulting technical risk.

2. Cost Risk

It is difficult to predict accurately the costs for ship construction. The long period of time involved precludes the availability of actual costs for many

years after a program has begun. Even after the actual costs of the lead ship are known, it is difficult to forecast accurately the costs of follow ships. Estimating tools that are used to predict improvement or learning in other industries often prove to be of less value in ship construction because of the small quantities of ships which are normally procured and the lack of opportunities for repetitive manufacturing operations. Difficulties in hiring and retaining requisite skilled manpower and the high turnover rates as presented in Exhibit XVIII (Chapter One) further complicate the task of estimating labor hours, since new and often unskilled employees are constantly being introduced into the construction operation.

Reliable estimates of the cost of material for ship construction are also difficult to develop. The relatively small quantities of specialized equipment being purchased from vendors have not provided a stable, profitable subcontractor base. As a result, competition is not always available to keep prices in line with predicted economic trends. Some suppliers of material sell only on the basis of posted prices at the time of delivery. Further, the significant amount of engineering performed on many components during ship construction increases the risk involved in estimating material costs.

Direct labor rates and overhead rates must also be forecast over a period of four to seven years in order to forward price a ship construction contract. As Exhibit XXXIX (Chapter Two) indicated, the Navy has been unable to predict labor rates and material prices accurately beyond a year or two. Thus, substantial cost risks are added to shipbuilding contracts. Overhead rates are also difficult to estimate accurately over such long periods of time. As Exhibit XIII (Chapter One) demonstrates, the workloads in shipyards tend to be erratic and difficult to predict and, consequently, the labor base for the computation of the overhead rate often is unstable. The costs in overhead pools also have become less predictable, since they are subject to the continuing impact of such factors as energy cost and energy shortages, OSHA legislation, and FICA adjustments.

3. Schedule Risk

Many of the factors that are responsible for technical and cost risk also contribute considerable schedule risk to ship construction efforts. The long

period of performance in Navy ship construction exposes the efforts of both the shipbuilders and the Navy to a wide range of potentially disruptive factors. Inefficiencies in shipbuilder operations can result in irretrievable schedule slippage because of the complex interdependence of the activities in the ship construction effort. Failure of a subcontractor to provide a critical item or service on time frequently affects schedule and cost performance. In many cases, the fact that a subcontractor must concurrently develop a new item for a ship is a major contributor to such schedule and cost risk.

Some data on schedule slippages for ships were presented earlier in Exhibit XL (Chapter Two). Excerpts from these data are summarized in Exhibit L.

EXHIBIT L
SCHEDULE SLIPPAGES OF EIGHT SHIP TYPES
FROM CONTRACT AWARD TO DELIVERY

Ship Type	Percent Schedule Slippage
Destroyers	
DDG-2	11
DD-963	44
Frigates	
FF-1052	56
FFG-7	2
Submarines	
SSN-637	50
SSN-688	36
AOR	
AOR-1	38
AOR-7	28

As noted by the shipbuilders during the interviews, the Navy often orders changes to a contract which may have an impact on the timing of performance that is difficult to predict. Labor strikes, energy shortages, and other

factors outside the shipbuilder's control can also have a profound effect on the schedule and are virtually impossible to anticipate over the long duration of a ship construction contract. As demonstrated in Exhibit XX (Chapter One), the unpredictability of material and equipment lead times is another factor that imposes schedule risk. While a delivery extension may be obtained through the Excusable Delay clause in Navy contracts, current fixed-price type contracts place the financial risk of such excusable delay on the shipbuilder. Moreover, delay in one ship construction contract may adversely affect other work in the shipyard.

C. Distribution of Risks

1. Difficulties in Identification of Risks

Applicable DOD directives[1] require that acquisition plans identify and accommodate uncertainty and risk. Specifically, when deciding on the type of contract to be employed, particular emphasis must be given to these issues.[2] However, such pronouncements do not ease the difficulty in identifying risks. The high degree of technical risk that is inherent in naval ship construction varies widely depending on the specific details of the acquisition. This uncertainty concerning the extent of risk depends in part on the size and complexity of the ship and in part on the previous experience (or lack of experience) of the shipbuilder. Frequently, contracts have been entered into for follow ships before the details of lead ship construction are available. Such a contracting environment is replete with variables and unknowns which even the most imaginative and sophisticated of contracting parties cannot anticipate – much less accurately forward price. Thus, in practice, the failure to identify risks is often more harmful to ship acquisitions than poor risk treatment. As discussed below, there are instances in which the variables of a particular acquisition defy risk identification, thereby creating risks which could not be projected by the parties involved.

---

[1] DOD Instruction 5000.1, 18 January 1977, para. IV.O., and DOD Instruction 5000.2, 18 January 1977, para. IV.F9.

[2] DOD Instruction 5000.2, 18 January 1977, para. IV.F9.

2. Methods for Distribution of Risks

Once risks have been satisfactorily identified to the maximum feasible extent, the shipbuilder and the Navy must decide how these risks are to be apportioned. Generally, risks fall into three categories: (i) those within the shipbuilder's control (for example, worker productivity); (ii) those within the Navy's control (for example, government-furnished property); and (iii) those beyond the control of either party (for example, inflation).

a. Risks Within Shipbuilder Control. With the exception of those few instances where a cost-type contract has been used because the overall risk was too great or uncertain to share, the general practice has been to fashion contracts so the shipbuilder bears the responsibility for those risks within its control; that is, the risks related to contractor-furnished material, the number of labor hours, and the level of overhead expenditures. The major vehicle for this risk apportionment has been the fixed price incentive contract which requires the shipbuilder to commit to a fixed-ceiling price and profit reductions above target cost. The contract clauses also play a vital role in this risk apportionment, as will be discussed later in this chapter.

b. Risks Within Navy Control. The government has usually structured its contracts so that it bears the risks within its control. However, there have been some instances where the Navy has attempted to shift responsibility to the shipbuilder for a risk that is usually thought to be within Navy control. Examples include the so-called J-22 clause, which attempted to limit the Navy's liability for late delivery of government-furnished equipment, and the various clauses which have stated that shipbuilders are not entitled to the costs of constructive changes that are incurred more than 20 days before such changes are identified and reported to the Navy.

Prime examples of the Navy's commitment to bear the cost of Navy-controlled risks are the Armed Services Procurement Regulation (ASPR) Changes clause, which gives the shipbuilder the right to an equitable adjustment when a Navy-ordered change adversely impacts on cost or schedule, and the Suspension of Work clause, which provides a price adjustment when the Navy orders work suspended or delays or interrupts the work and thus causes an increase in the cost of performing the contract.

e. Risks Beyond the Control of the Parties. Certain risks in shipbuilding are beyond the control of either party. While such risks may be relatively few in most government contracts, they can be substantial in lengthy and complex ship construction contracts. In practice, social and environmental legislation, natural calamities, inflation, and other similar factors have had a significant and unpredictable effect on the cost and time required to construct ships. The actions of the various agencies of the Federal Government – generally known as "sovereign acts" – are included in this category.

In the past, it has been Navy practice to allocate the cost impact of such risks to the shipbuilder – except for the risks associated with increases in wages or material prices which have been covered by economic price adjustment (EPA) or changes in cost-accounting standards. On occasion, other risks have been apportioned to the Navy on an ad hoc basis, depending on whether they have been foreseen, their anticipated extent and scope, and the bargaining positions of the parties. For example, for the last three years, Newport News has negotiated inclusion of a contract clause which shifts to the Navy the burden of payment for increases in the Federal Insurance Contribution Act (FICA) as voted by the Congress. Generally speaking, however, with the exception of EPA provisions, the Navy has not accepted clauses in its ship contracts which apportion to the Navy the costs of risks beyond the control of the parties.

Although a minority of shipbuilders felt otherwise, most of those interviewed indicated a preference for having the Navy bear all of the risks which are not under their control. A few shipbuilders argued that the Navy should absorb all contract risk through the use of cost-reimbursement contracts for all ship acquisition. Others would limit the use of cost-reimbursement contracts to major combatants.

D. Contracting Policies, Types, and Clauses

While the contractual instrument is the statement of risk allocation that is agreed to by the parties involved, the policies and procedures used in selecting sources and conducting negotiations play a major role in the actual allocation of risk as expressed in the contract. The selection of a contract type is a key factor which influences the adequacy of risk balance in the contract. If a

fixed price type contract is selected, contract clauses must be devised which specifically address each major area of risk to ensure that risk is equitably distributed among the parties. Each of these issues is examined more fully below.

1. Contracting Policies

Policies and procedures for selecting sources and conducting negotiations on shipbuilding contracts have evolved to the point where the practices that are considered most inequitable by the shipbuilding industry (such as formal advertising and total package procurement) have been abandoned in favor of less onerous acquisition techniques. Exhibit XXVII (Chapter One) illustrates the trend in acquisition strategies, indicating that the acquisition of naval ships by competitive negotiations has been the norm from the late 1960s to the present.

a. Lead Ships. The acquisition of the FFG in 1973 marked the introduction of new techniques for ship acquisition which were structured to overcome the problems of earlier acquisitions. Selection of a lead shipyard was accomplished after a competition which emphasized technical and management factors as selection criteria. Estimated cost was not a critical factor in the selection process.

The use of multiple evaluation factors permits an examination of the offeror's understanding of the ship and the program objectives and risks, technical competence, and management capabilities, as well as the offeror's resources that are available to accomplish the ship construction on time and at a profit. Typically, the evaluation factors are ranked in descending order of importance. For the FFG acquisition, the factors employed in order of importance were as follows:

- Approach to lead and follow ship production.
- Production experience.
- Approach to performing engineering and technical services in support of ship system design.

- Approach to achieving compliance with the criteria set forth in DOD Instruction 7000.2.[1]

Current Navy planning for the acquisition of lead ships such as the DDG-47, the LSD-41, and the MCM also includes multiple evaluation factors. When these ships are based on previously built hulls, such as the DDG-47, the evaluation criteria for selection of a shipbuilder emphasize this fact. The criteria for the selection of the DDG-47 shipbuilder in order of importance are as follows:

- Detail design and construction of the lead ship.
- Cost.
- DD-963 commonality.
- Lead yard services.
- Compliance with DOD Instruction 7000.2

In the case of the LSD-41 and the MCM, multiple evaluation factors will be used to reflect the fact that the lead shipbuilder will participate in the preparation of the contract design and then move directly on to preparation of working drawings. Because the selection of the lead shipbuilder on these ships will precede contract design, the evaluation factors will necessarily be somewhat different from those for the DDG-47. However, the principle of selecting the lead shipbuilder based on a full evaluation of all of the relevant factors will remain the same.

---

[1] Most major shipyards doing business with the Navy have brought their accounting systems into compliance with the standards of DOD Instruction 7000.2. That instruction provides criteria against which the Navy may validate a shipbuilder's cost/schedule control system. The required system calls for the logical breakdown of contract work into discrete work packages which include discrete start and stop dates and an allocation of labor and material resources in their support. The establishment of schedules for the performance of these work packages and their assignment to a cost account in the accounting system constitute an integration of work, budgets, and schedule which permits the creation of a performance measurement baseline.

b. **Follow Ships.** Problems are still being encountered in refining the Navy policies and procedures used for acquiring follow ships. Traditionally, any shipbuilder that has the capability and capacity to construct the ship has been permitted to make an offer. As a result, except for those follow ships of a type and size that can only be built in one or two private yards, follow ships have been acquired by unrestricted price competition. Recent contracts have contained a clause stating that "buy-in" prices may be grounds for rejection of a proposal, but no cases of such action have occurred.

These follow ship acquisitions have been based on a contract design package that contains the broad design of the ship, as described in Chapter Two. The competing shipbuilders have generally been given 120 days or more to submit proposals, including their firm estimates of target cost and ceiling price. In the interviews, some of the shipbuilders commented that it was very difficult to prepare accurate estimates under these conditions. They noted that the problem is greatly exacerbated when the follow ship is acquired several years later than the prior ships in the program – as was the situation in the recent AS and AD acquisitions. In such cases, the contract design package has been updated by the inclusion of the later versions of specifications and some drawing revisions. As a result, accurate subcontract prices are not obtainable from the prior subcontractors on the program without a thorough study of the necessity for redesigning their components. The shipbuilders emphasized to the study team that these modified follow ships present difficult cost-estimating problems because of the variations in the contract design package.

c. **Options.** The Navy has made frequent use of options as a method of contracting for follow ships. Exhibit LI provides data on this practice. In the late 1960s and early 1970s, it was common practice to include options for several years into the future in the form of multiyear acquisitions on such programs as the CVN and CGN. One ship, the CVN-70, was included in the contract in the form of an unpriced option. However, this practice was discontinued because of statutory restrictions on the use of multiyear contracts for major systems. In recent years, options have extended only one year beyond the basic contract, but have been used rather extensively. Several of the shipbuilders commented that options increased their risks and forced them to commit their facilities well into the future. Yet,

EXHIBIT LI
PROGRAMS CONTAINING OPTION SHIPS: FISCAL YEAR 1968 - 1977

Ship Type and Hull Number	Contract Number	Award Date*	Shipbuilder
AD-41	N00024-76-C-2002	12/15/75	National Steel
AD-42	N00024-76-C-2002	3/11/76 O	National Steel
AD-43	N00024-77-C-2031	9/30/77	National Steel
AO-177, 178	N00024-76-C-2080	8/09/76	Avondale
AO-179	N00024-76-C-2080	1/25/77 O	Avondale
CGN-36, 37	N00024-68-C-0355	6/13/68	Newport News
CGN-38, 39	N00024-70-C-0252	12/21/71	Newport News
CGN-40	N00024-70-C-0252	1/21/72 M	Newport News
CGN-41	N00024-70-C-0252	1/31/75 O	Newport News
CVN-68	N00024-67-C-0325	3/31/67	Newport News
CVN-69	N00024-67-C-0325	6/30/70 M	Newport News
CVN-70	N00024-67-C-0325	4/05/74 O	Newport News
FFG-7	N00024-74-C-0207	10/30/73	Bath
FFG-8, 11, 13, 15, 16	N00024-76-C-2001	2/27/76	Bath
FFG-9, 12, 14	N00024-76-C-2100	2/27/76	Todd - San Pedro
FFG-10, 17,** 18**	N00024-76-C-2101	2/27/76	Todd - Seattle
FFG-19, 23, 25	N00024-77-C-2082	2/28/77	Todd - San Pedro
FFG-20, 22	N00024-77-C-2081	2/28/77	Todd - Seattle
FFG-21, 24, 26	N00024-77-C-2080	2/28/77	Bath
FFG-27, 30, 33	N00024-77-C-2082	1/25/78 O	Todd - San Pedro
FFG-28, 31, 35**	N00024-77-C-2081	1/25/78 O	Todd - Seattle
FFG-29, 32, 34	N00024-77-C-2080	1/25/78 O	Bath
SSBN-726	N00024-75-C-2014	7/25/74	Electric Boat
SSBN-727, 728	N00024-75-C-2014	2/28/75 O	Electric Boat
SSBN-729	N00024-75-C-2014	2/20/76 O	Electric Boat
SSBN-730	By Supplemental Agreement to Basic Contract	6/06/77	Electric Boat
SSBN-731, 732		2/08/78 O	Electric Boat
SSN-678, 679, 680	N00024-68-C-0343	6/25/68	Electric Boat
SSN-684	N00024-68-C-0343	7/24/68 O	Electric Boat
SSN-688	N00024-70-C-0269	1/08/71	Newport News
SSN-689	N00024-71-C-0270	1/08/71	Newport News
SSN-690	N00024-71-C-0268	1/08/71	Electric Boat
SSN-691, 693	N00024-71-C-0270	2/02/71 M	Newport News
SSN-692, 694	N00024-71-C 0268	1/29/71 M	Electric Boat
SSN-695	N00024-71-C-0270	1/24/72 M	Newport News
SSN-696, 697, 698, 699	N00024-71-C-0268	1/24/72 M	Electric Boat
SSN-700-706	N00024-74-C-0206	10/31/73	Electric Boat
SSN-707-710	N00024-74-C-0206	12/10/73 O	Electric Boat
SSN-711-713	N00024-76-C-2031	8/01/75	Newport News
SSN-714, 715	N00024-76-C-2031	2/20/76 O	Newport News
SSN-716-718	N00024-77-C-2220	9/15/77	Newport News

* O = Option exercised.
M = Multiyear funding authorized.

**The FFG-17, FFG-18, and FFG-35 were ordered by the Royal Australian Navy.

the data indicate that the Navy has almost invariably exercised such options and, hence, it can be argued that the main impact on shipbuilders has been the pricing risk inherent in options.

2. Contract Types

The problem of selecting contract types for shipbuilding has been the subject of a number of recent analyses and reports. For example, the NMARC Report concluded that lead ships should be acquired on cost-type contracts and that fixed price incentive (FPI) contracts should be employed for follow ships.[1] The problem of initiating construction of the follow ship prior to completion of the lead ship was addressed but not resolved. More recently, the General Accounting Office (GAO) recommended that cost-type contracts be used sparingly in shipbuilding.[2] The GAO emphasized that exclusive use of cost-type contracts could force the government into absorbing the cost of the inefficient practices of the industry or the government – without surfacing the underlying causes.

The views of the shipbuilding industry on the selection of contract types were researched prior to the preparation of the Interim Report[3] and were further explored during the shipbuilder interviews. Statements released by shipbuilders and the congressional testimony of shipyard executives which was summarized in the Interim Report indicated that the entire industry advocated cost-type contracts for lead ships or for any ship requiring development work. Some shipbuilders were reported as suggesting that all shipbuilding should be performed on cost-type contracts.

---

[1] Office of the Secretary of the Navy, Report of the Navy Marine Corps Acquisition Review Committee, Volume II, pp. 62-63.

[2] General Accounting Office, Report to the Congress by the Comptroller General of the United States, Shipbuilder Claims – Problems and Solutions, Report Number PSAD-77-135, Washington, D.C., 9 August 1977, pp. 24-25.

[3] Study Team, The Naval Ship Procurement Process Study, Interim Report, Washington, D.C., August 1977.

During the interviews, it became clear that the industry does not present a unanimous position in this area. Some shipbuilders feel that fixed-price-type contracts are inappropriate for any ship construction effort because of the length of the production period (four to seven years) and that the inability to predict or provide for inflation makes accurate forward-pricing impossible. They also cite the complexity of Navy shipbuilding which was examined earlier in Exhibit X (Chapter One), indicating that it cannot be adequately addressed and defined in a fixed-price-type environment. Finally, in the opinion of these shipbuilders, the inevitability, magnitude, and frequency of changes disrupt construction and invalidate the fixed-price nature of this type of contract.

Other shipbuilders suggested that cost-type contracts were only necessary for lead ships and that the decisive factor in the selection of a contract type is the status of the design. Shipbuilders who are interested primarily in simpler ships considered FPI contracts appropriate in all cases, including the construction of the lead ship. A minority of the shipbuilders expressed the opinion that cost-type contracts are inconsistent with the effective management of a shipyard. These shipbuilders felt that such contracts would provide inadequate incentives to either management or workers to perform efficiently.

a. **Lead Ships.** With the exception of the Trident program, recent Navy planning for the acquisition of lead ships has called for the use of cost-type contracts. The FFG program is one example. The lead ship in this program was acquired by the use of a cost plus incentive fee contract. The DD-963 class destroyer being acquired for the Iranian government is a current example. The construction of this ship type will entail significant variations on the DD-963 hull. As of this writing, the Navy's current acquisition strategy for the DDG-47 lead ship calls for the use of a cost plus award fee contract.

b. **Follow Ships.** During the last 10 years, most follow ships have been acquired by FPI contracts. During the interviews, some shipbuilders stated that the use of such contracts for follow ships should not be considered until all of the design and construction problems are resolved in the lead ship. Others stated that actual cost data on a ship of the class were needed in each shipyard involved before using FPI contracts for follow ships in that shipyard. Lacking such actual

cost data, these shipbuilders stated that a cost-type contract should be used. A few shipbuilders stated that the use of FPI contracts on modified follow ships acquired after a significant production gap presented peculiar problems because of the difficulty of assessing the alterations that had occurred in the contract design package.

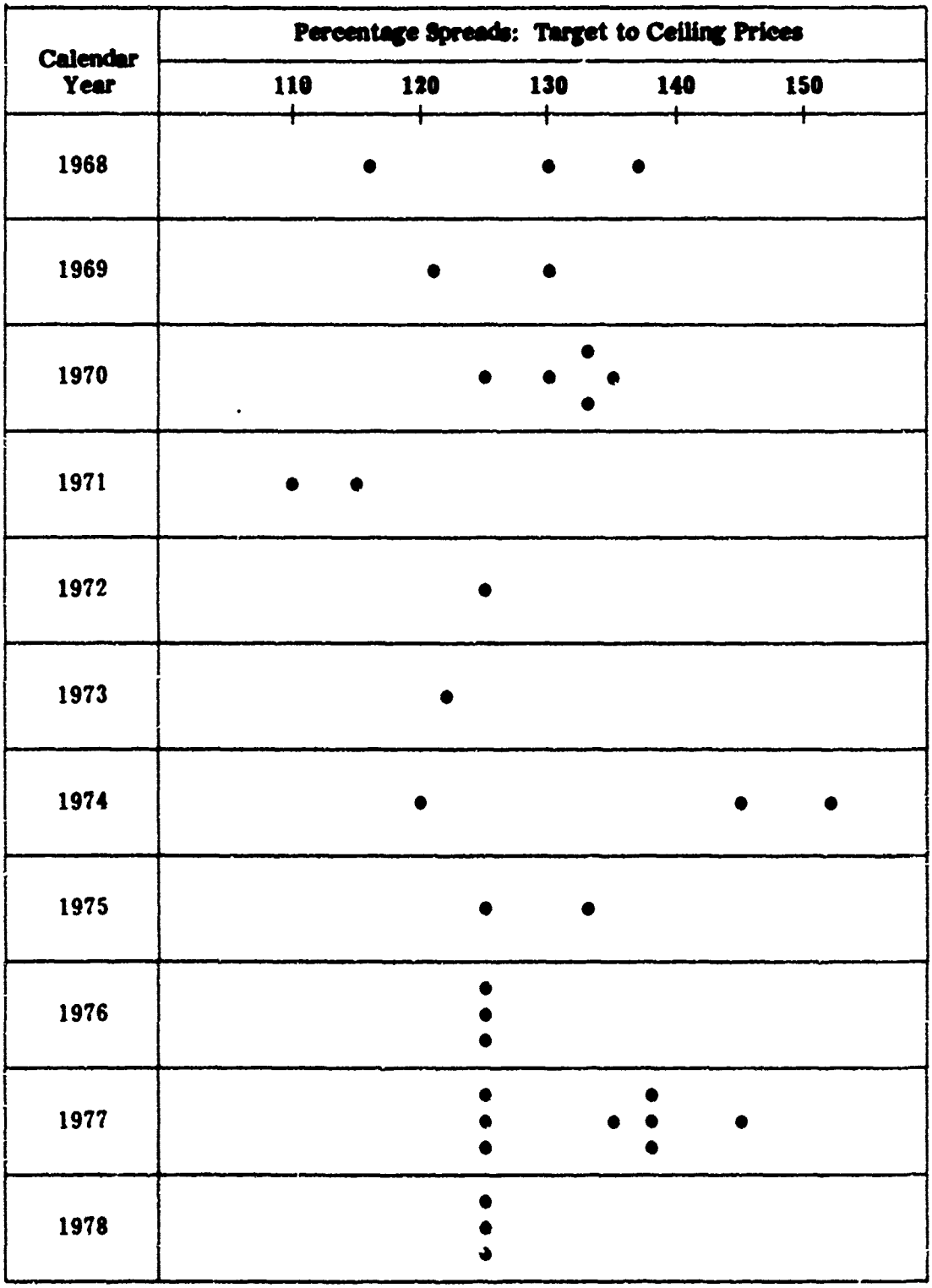
Fixed price incentive contracts have been employed for follow ships of the FFG-7 class in the lead shipyard and in two other follow shipyards. While these were the first ships of the class for each of the follow shipyards, a degree of risk balance was afforded by assuring that validated drawings would be provided by the lead shipyard and by providing for a period of more than two years between the beginning of work on the lead ship and the commencement of work in the follow shipyards. This period of time was used to address and resolve a number of the major technical problems in the construction of this ship type.

More recently, whenever FPI contracts have been considered appropriate, both the shipbuilders and the Navy have emphasized the need for a realistic spread between target cost and ceiling price. Exhibit LII shows the trend in target-to-ceiling spread between 1968 and 1978. This exhibit indicates that spreads prior to 1975 did not fall into a pattern, but rather ranged from a low of 110 percent to a high of 152 percent. Since 1976, however, all FPI contracts reflect a minimum spread of 125 percent, with the exceptions centering around 140 percent. For contracts where it is believed that cost, technical, and schedule risks are known and under control, the shipbuilders interviewed stated that a spread of 125 percent or more was reasonable.

Profits on FPI contracts are also an important issue to shipbuilders in view of the way in which they are affected by the Vinson-Trammell Act. The Vinson-Trammell Act, which applies in the absence of the Renegotiation Act that expired in 1976, places a limit on shipbuilding profits of 10 percent of the price or 11.1 percent of cost. Price is established on the basis of contract "receipts," as determined by the Internal Revenue Service.

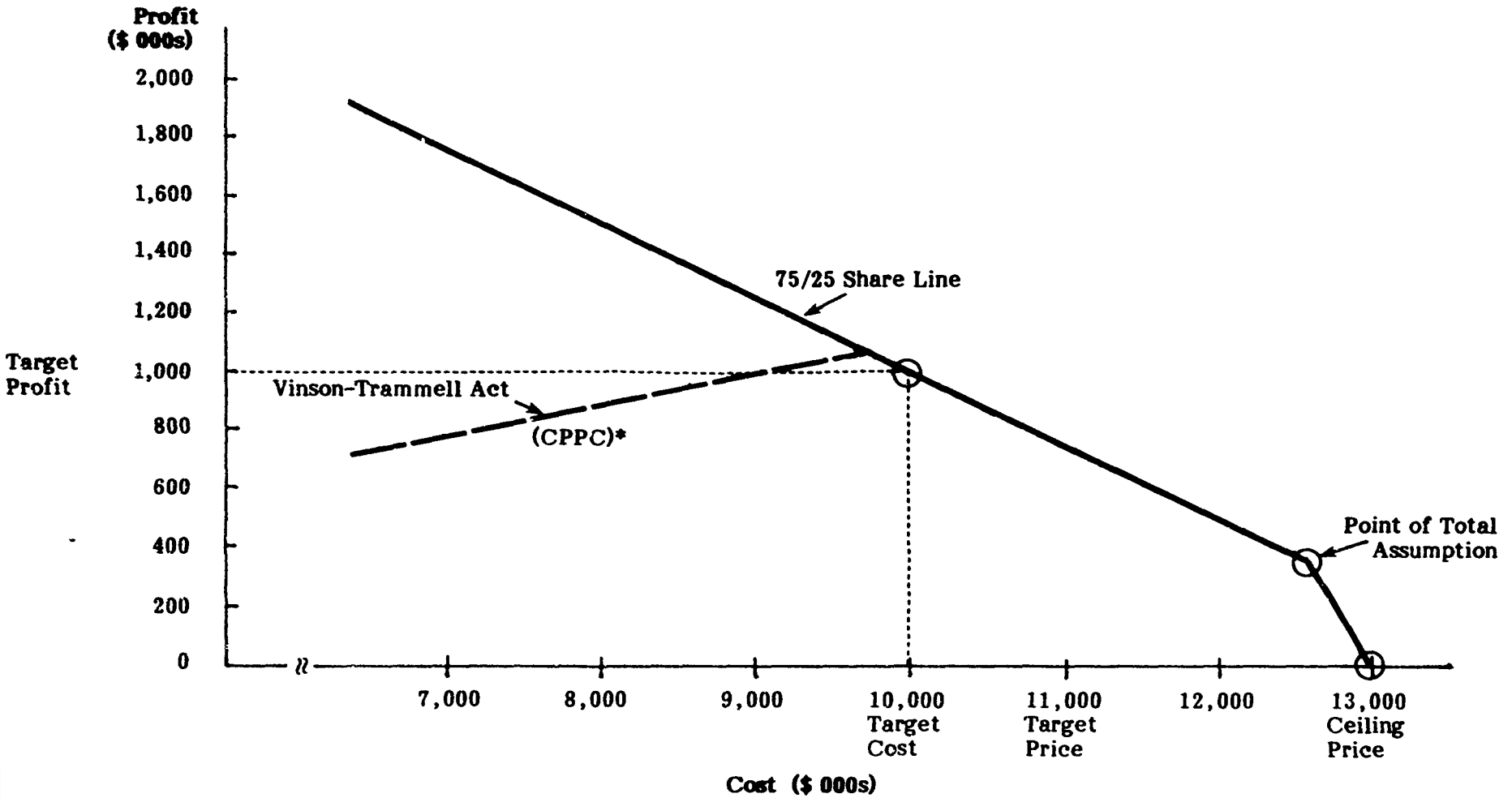
The effect of the Vinson-Trammell Act on profits under FPI contracts is shown in Exhibit LIII. This exhibit reveals that, if the target cost is underrun, there is a proportional reduction in shipbuilder profits. For example, with a target

EXHIBIT LII
CEILING PRICES ESTABLISHED FOR FIXED PRICE INCENTIVE CONTRACTS: 1968 - 1978



Source: NAVMAT.

EXHIBIT LIII
EFFECT OF VINSON-TRAMMELL ACT
ON PROFITS UNDER FIXED PRICE CONTRACTS



*Cost plus a percentage of cost.

cost of $10 million, a target profit of $1 million, and a 75/25 share line, the shipbuilder earns diminishing profits after an underrun of less than 3 percent of the target cost. Other assumptions employing different share lines, target costs, and target profits generate similar results.

The net effect of the Vinson-Trammell Act on cost underruns is that the Navy is forced into a cost plus a percentage of cost arrangement below target cost, and the shipbuilder is given a negative incentive to underrun the target. Further, the Vinson-Trammell Act is inconsistent with the feature of Defense Procurement Circular 76-3 which provides for increased profits to contractors assuming risks through fixed-price-type contracts.

3. Clauses

One of the means of allocating risk in fixed-price-type contracts is through contract clauses. By contrast, in cost-type contracts, the agreement of the Navy to reimburse costs fully tends to remove most risks from the shipbuilder. Thus, there is minimal need for clauses to allocate risks.

Contract clauses attempt to define and assign rights and responsibilities under the contract in advance, rather than leaving the rights of the parties to negotiation or judicial determination after an issue has developed. Once drafted, clauses tend to be used over and over again without change – in part to avoid time-consuming negotiation and drafting of new clauses each time a new contract is awarded. Some clauses are required to be in government contracts under the Armed Services Procurement Regulation (ASPR) and, therefore, become difficult to alter. Other ASPR clauses are used when the parties feel it appropriate to do so. The parties may also agree on any other contract-related matter and may include that agreement in the contract in the form of a clause – unless it is contrary to law or already covered in a mandatory ASPR clause.

Until the early 1970s, the clauses used in Navy shipbuilding contracts were generally noncontroversial. However, since that time, a number of newly drafted clauses – as well as some of those previously in existence – have become a source of acrimony and dispute. During the interviews, industry representatives voiced objection to a number of clauses, citing their feeling that they place unfair

risks and burdens on shipbuilders. However, the shipbuilders also expressed reservations about the introduction of new clauses in contracts, noting a preference for those previously used and already generally understood. The clauses the shipbuilders cite as the source of turbulence in Navy-shipbuilder relationships fall into six broad categories: (i) clauses dealing with risks that are beyond the control of both parties, (ii) clauses relating to delivery and acceptance of the ship as contracted, (iii) clauses relating to making progress payments, (iv) anti-claims clauses, (v) clauses relating to the provision of government-furnished material, and (vi) clauses defining the responsibility for drawings and other data.

Many of the controversial provisions of the various categories of clauses are no longer in use. However, most contracts contain one or more of these controversial clauses.[1] Each of these six groups of clauses is examined below.

a. Risks Beyond the Control of Both Parties. In fixed-price-type shipbuilding contracts, risks beyond the control of both parties have traditionally been allocated in a simple way – the shipbuilder assumed the cost risk of such events and the Navy agreed to give time extensions for such risks. The sole exception was the risk of inflation which the Navy agreed to bear under escalation clauses. This means of risk allocation worked reasonably well in Navy shipbuilding until the end of the 1960s. Prior to that time, most of the factors having a significant impact on the costs of performance were under the control of either the shipbuilder or the Navy. Under these circumstances, shipbuilders could and did agree to bear the risk of extra costs caused by outside events – without great concern that significant cost increases would occur. Even the relatively imprecise escalation clauses that were in use then were not seen as a problem when the economy was functioning at a constant and low annual inflation rate. However, in the last decade, the industry has been hit with a sequence of outside events which were not foreseen by either the Navy or its shipbuilders. As revealed by Exhibits XVII and

[1] Contract reformation under Public Law 85-804, incident to the settlement agreements with General Dynamics/Electric Boat and Litton/Ingalls, will significantly alter this situation if implemented after congressional review.

XXII (Chapter One), strong inflationary pressures occurred in the areas of shipbuilding labor and material. In addition, during this period, severe material shortages began to occur [see Exhibit XX (Chapter One)], the environmental concerns of the nation began to have an impact on shipbuilders, and equal employment opportunity goals became serious concerns. The 1973 oil embargo also had an impact on shipbuilding costs, increasing the cost of fuel and raising the specter of future fuel shortages.

Most industries pricing their products six months to one year ahead of the time of manufacture or sale could cope with these events without severe dislocations. But this sequence of economic events was catastrophic for an industry that had priced its work four to seven years ahead of performance.

It might have been possible to plan for known risks such as wage benefit changes and energy cost increases, but shipbuilders could only speculate upon unknown risks such as sovereign acts of the government. In 1975, the Navy addressed one aspect of this new risk picture by making substantial revisions to its escalation clauses. While there are a few instances where other clauses have been used in individual acquisitions to shift such risks to the Navy, no other clauses of this nature have been adopted for use in all shipbuilding contracts. As a result, most of these risks are still the responsibility of the shipbuilders in current Navy shipbuilding contracts.

b. Delivery and Acceptance of the Ship as Contracted. Two clauses in Navy shipbuilding contracts impact on the identification of discrepancies between the ship as contracted and the ship as built – the Delivery of Completed Vessel clause and the Nucleus Crew clause. Both clauses have been in use in shipbuilding contracts since 1969. The Delivery of Completed Vessel clause addresses the extensive testing and trials which ensure that a ship is ready for delivery, together with the shipbuilder's responsibility for various deficiencies noted during these trials.

The Nucleus Crew clause identifies the numbers of nucleus crew members who will arrive at the shipyard during the construction process as well as the time of their arrival. Nuclear ship contracts have also charged the nucleus crew with assisting the SUPSHIP in inspections of the propulsion plant.

During the interviews, it became clear that – with the exception of one shipbuilder – the industry does not object to either the Delivery of Completed Vessel or Nucleus Crew clauses. Rather, the industry objection is to the influx of naval representatives who had not previously been involved in contract administration and who now participate in the delivery process.

Navy concern over ship delivery and acceptance is not limited to these two clauses; Navy policy and practice relating to ship acceptance and delivery are also addressed in the Navy's Ship Acquisition Contract and Administration Manual (SACAM).[1] The issue of contract administration as it applies to deliveries and acceptance is addressed further in Chapter Four of this report.

c. **Progress Payments.** For many years prior to 1973, progress payments to Navy shipbuilders were based on the physical progress of ship construction. Payments were limited to 105 percent of the incurred costs with a retention of 5 percent of the price of the ship. In 1973 OSD raised a question about this clause and, in March 1973, the Secretary of the Navy promulgated a new policy which called for disbursement of progress payments at a percentage of contract costs incurred rather than based on physical progress.

The shipbuilding industry contended that this method of payment did not provide adequate working capital and that it aggravated their cash-flow problems. Before this clause could be introduced into a shipbuilding contract, the Secretary of the Navy reconsidered his actions and, in July 1975, a revised Progress Payments clause was issued which continued physical progress as the basis for making progress payments. The policy that was established in 1975 has remained in effect to this day. It requires that 10 percent of the contract price be withheld until the 50 percent completion point, limits payments to 100 percent of the allowable cost until the 50 percent completion point and to 105 percent thereafter, and provides for payment every two weeks.

---

[1] See Naval Sea Systems Command, Ship Acquisition Contract Administration Manual, Publication 0900-LP-079-6010, Washington, D.C., 1975, Chapter 20.

During the interviews, the shipbuilders told the study team that they were pleased with the return to physical progress as a basis for progress payments. However, they voiced some concern that the policy effectively precludes any payment of profit until 50 percent of completion. Their concern in this regard is based on their view that it is unfair to be forced to wait two to four years for profits to flow when Navy ship construction contracts take up all or nearly all of a shipyard's facilities.

Another problem with progress payments arises when a shipbuilder forecasts an overrun of the target cost because of claims based on unpriced actual or constructive changes emanating from the Navy. Since the shipbuilder has no voice in resetting the billing base in these circumstances, such changes can lead to an inability to bill costs and can result in a significant need for working capital to finance the job while price adjustments are being negotiated. If such changes mature into claims, this problem is greatly exacerbated.

d. **Anti-Claims Clauses.** In 1969, then Under Secretary of the Navy, John Warner, required a detailed survey of all Navy claims in excess of $1 million. This survey indicated that constructive changes were one of the principal causes of claims. Since constructive changes were not recognized in ASPR, no contractual tools existed to treat them. The fact that claims based on constructive changes were frequently submitted several years after the change had occurred was particularly troublesome.

A number of contract clauses were developed by the Navy to circumscribe the constructive change process. These clauses were designed to identify constructive changes early and to regulate their processing procedurally. This group of clauses was originally issued in 1970 in Navy Procurement Circular 15. Later, they were reissued with slight changes in Navy Procurement Circular 18. Today, the industry frequently refers to them as the "anti-claims" clauses.

During the interviews, shipbuilders often criticized four anti-claims clauses: (i) Changes, (ii) Change Order Estimates, (iii) Problem Identification Reports, and (iv) Equitable Adjustments: Waiver and Release of Claims.[1] The

---

[1] Three other anti-claims clauses appeared in Navy Procurement Circular 18: (i) Change Order Accounting, (ii) Time of Delivery, and (iii) Total System Responsibility. Neither of the first two clauses has been commented on critically by the

shipbuilders also criticized a fifth anti-claims-type provision which requires contractor affidavits and which came into use in 1975. Each of these is discussed more fully below.

(1) **Changes.** The Navy Procurement Circular 18 Changes clause not only provided the contracting officer with the traditional authority to order unilateral changes, but also required shipbuilders to give prompt notice of impending or newly discovered constructive changes as they occur. Most of the remainder of the clause set forth procedures for processing constructive changes. A shipbuilder was given 10 days to report a constructive change, and the contracting officer was required to respond within 10 days after having been put on notice. The shipbuilder then had 45 days from receipt of the contracting officer's response to assert any claim for adjustment. The clause provided that no equitable adjustment for a constructive change, other than one based on defective specifications, could contain any costs incurred more than 20 days prior to the date when written notice of the change was given to the Navy. During the interviews, the shipbuilders strongly objected to this 20-day notice provision for constructive changes, and commented that there is uncertainty as to establishing the starting date for the notification period.

Although one shipbuilding contract which was recently awarded incorporates the standard ASPR Changes and Notification of Changes clauses, a number of variations of the Navy Procurement Circular 18 clause continue to be used in shipbuilding contracts. These clauses contain differing time limits for shipbuilder notification of constructive changes. In fact, some do not contain the provision that limits shipbuilder recovery of costs to those incurred no more than 20 days prior to notification of a constructive change. The standard ASPR Changes and Notification of Changes clauses contain most of the substance of the

---

shipbuilders, although the Change Order Accounting clause appears in the ASPR. The Total System Responsibility clause is not examined in this report, since it applies only to total package procurement and has not been used in a shipbuilding contract since 1970. No plans exist for the use of this acquisition policy for Navy ships in the future.

Navy Procurement Circular 18 Changes clause – although the provision limiting shipbuilder recovery of costs incurred is absent, and most of the various time periods identified in the clause are open to negotiation.

(2) Change Order Estimates. The Navy Procurement Circular 18 clause dealing with engineering change proposals (ECPs) was entitled Change Order Estimates. It required that shipbuilders prepare and submit ECPs on their own initiative or at the direction of the Navy and stated that such proposals would remain irrevocable for 60 days. It further required that the cost estimate included in such ECPs contain full coverage of all the delay and disruption costs that the change would engender. The impact of this clause was to require the shipbuilder to foresee and contractually agree to the full costs of changes early in the performance process.

The successors to that clause in shipbuilding contracts are two elaborate clauses identified as the Configuration Control and Configuration Management clauses. These clauses provide the authority for the shipbuilder to submit an ECP proposal – normally within 45 days. Once the shipbuilder's ECP is submitted, it is irrevocable for 60 days. Upon receipt of the proposal, the contracting officer may (i) accept it and thereby create a bilateral agreement; (ii) request that the shipbuilder enter into a bilateral modification containing a maximum figure, with subsequent negotiations to finalize the price; (iii) commence negotiation of a bilateral agreement; or (iv) reject the proposal outright. These clauses provide that the estimated cost is conclusively presumed to include delay and disruption. However, both contain the added proviso: ". . . except as the parties may otherwise expressly agree in the aforesaid bilateral modification."

During the interviews, all of the shipbuilders complained that it took too long for the Navy to make decisions on ECPs. They also objected to the maximum price modifications that are called for by the clause. The portion of the clause that presumes the negotiated price of change to include all delay and disruption costs is equally bothersome to the shipbuilders. According to the shipbuilders, the problem is that it is frequently impossible to determine and quantify delay and disruption within the time constraints required by the clause.

(3) Problem Identification Reports. The Problem Identification Reports clause required that the shipbuilder report any contract performance problem other than a change which would be likely to result in a significant delay in delivery or a substantial claim. The clause contained a provision that precluded equitable adjustments for such "problems" from containing costs incurred more than 20 days prior to notice of the problem.

This clause, which was retitled Contract Problem Reports, is still being used in most Navy shipbuilding contracts – although the language has been modified significantly, and the clause no longer contains the penalty of loss of costs for failure to report a problem.

(4) Equitable Adjustments: Waiver and Release of Claims. The Navy Procurement Circular 18 Equitable Adjustments: Waiver and Release of Claims clause required that equitable adjustment submissions contain all of the cost elements of a change order, including delay and disruption costs. The shipbuilders objected to the use of the clause on the basis that they were sometimes required to price changes before they were aware of all of the cost ramifications.

(5) Claims Submission Affidavit. The requirement that an affidavit accompany the submissions of claims first appeared in Navy Procurement Directives in 1975.[1] The required affidavit generally provided for the shipbuilder to swear that the facts presented in its claim were current, complete, and accurate, and that the conclusions accurately reflected the damages it had suffered. However, although the affidavit was referenced in Navy Procurement Directives as an item that the Navy should require at the time of an initial claim submission, it was not included in contracts that were awarded prior to 1976, and the shipbuilders refused to include such an affidavit on claims that were submitted in connection with pre-1976 contracts. Recent contracts have included the Navy Procurement Directives affadavit as a provision in a Documentation of Request for Equitable Adjustment clause. During the interviews, the shipbuilders complained that they were unsure of the meaning of the affidavit and could not get clarification from the Navy. They attached considerable importance to reviewing the exact implications of such an affidavit.

---

[1] Navy Procurement Directive 1-401.55(c)(4)e.

e. **Government-Furnished Equipment (GFE).** Shipbuilders have frequently attributed significant problems – particularly delay and disruption – to the government's failure to deliver GFE in accordance with the contract schedule. A number of contract clauses have been drafted in an effort to deal with the problems of delay in GFE. The clauses are similar in most respects, with only a few significant variations. All of the clauses set forth the legal rights of the parties with regard to the GFE listed in the GFE contract schedule. The need to minimize delay when GFE is late is emphasized, and both parties are urged to do so. Another provision of the clause normally gives the government the option of forgoing furnishing an item of GFE, with a provision for an equitable adjustment. The major provision in the clause which has evoked comment from the shipbuilders is the requirement that all delivery dates for furnishing GFE be extended an equal amount of time with extension of the ship delivery date.

One clause which is occasionally used in Navy shipbuilding contracts, the J-22 clause, limits the government's liability for late delivery of GFE to any slippage in the vessel delivery date in excess of 180 days. During the interviews, several shipbuilders told the study team that the J-22 clause constituted a blatant attempt to shift responsibility from the Navy to the shipbuilders for delays in delivery of the ship caused by late GFE.

f. **Drawings and Other Data.** The last category of clauses to which the shipbuilding industry objects are those that address the rights, responsibilities, and liabilities of the parties relative to the contract design package contained in a lead ship construction contract and the working drawings that are made available to a follow shipbuilder. The contract design package and working drawings are discussed in detail in Chapter Two. The contract design package is prepared during the development of the contract design and is included in the Request for Proposals on which prospective shipbuilders will base their proposals. Among other documents, the package includes ship specifications, contract drawings, and contract guidance drawings. Because of their number and complexity, some deficiencies and inconsistencies in these documents are inevitable.

The Navy has generally assumed the responsibility for contract drawing and contract guidance drawing deficiencies and inconsistencies. The Contract Guidance Drawings clause provides the shipbuilder with the right to an equitable adjustment if a satisfactory ship design cannot be accomplished due to defects or impossibilities of performance resulting from these guidance drawings. The Configuration Control and Configuration Management clauses provide for an equitable adjustment for inadequacies in contract drawings.

Working drawings differ from contract guidance drawings and contract drawings in that they are far more detailed and are prepared after contract award for use in the construction of the lead ship. The Navy makes the lead shipbuilder's working drawings available to a follow shipbuilder for use in developing a detailed design that will reflect the follow shipbuilder's specific construction methodology.

Historically, a contract clause that is entitled Working Drawings and Other Data has defined the rights and responsibilities of the parties relative to working drawings. In nuclear ship construction contracts and other ship construction efforts where critical safety systems are installed, some of the working drawings must be followed without deviation – unless deviation or waiver is authorized by identified Navy officials. While the responsibility for these nondeviation working drawings is not spelled out in this clause, a provision does specify that all of the other working drawings are furnished on an "as is" basis. The government disclaims warranty or liability responsibility for such other drawings. In conventional ship contracts without nondeviation working drawings, the drawings have customarily been made available on the same "as is" basis. The Navy appears to assume that it is legally responsible for defects in nondeviation working drawings, but it has argued that it has no responsibility for defects in working drawings furnished on an "as is" basis.

More recently, a clause that is entitled Documentation Acquired by the Contractor has been used in a number of conventional follow shipbuilding contracts. A subparagraph of the clause entitled Validated Lead Yard Documentation warrants that, if the shipbuilder performs without departure from the documentation provided, the ship specifications requirements will be satisfied. Thus, if

the shipbuilder complies with the validated drawings and does not satisfactorily meet the ship's specifications, the shipbuilder is entitled to an equitable adjustment.

The Interim Report contains numerous complaints of inadequacies and conflicts in contract design packages and of inaccurate working drawings provided after follow ship contract award. Those complaints were reiterated by the shipbuilders during the interviews. The shipbuilders also voiced a general feeling that the problem is compounded by the Navy's use of contract clauses which attempt to shift responsibility for deficiencies from the Navy to the shipbuilder.

E. Discussion and Analysis

Experience has shown that no two Navy ship acquisitions are exactly the same. The process of selecting appropriate contract types and clauses for any one ship acquisition is influenced by a large number of factors, each of which may differ from one acquisition to another. Some of these factors include the number of ships that the Navy is acquiring in a particular class; the ship itself (lead or follow ship); the complexity of the ship in terms of mission and weapon systems; the propulsion system to be used – nuclear or conventional power; the current state of design for the ship; the availability of actual cost data from prior construction contracts for the same ship type; the number of shipbuilders capable of building the ship; the condition of the marketplace; and the relative bargaining power of the shipbuilder and the Navy. These and other similar considerations shape the ultimate acquisition package in terms of the various policies to be employed, the choice of contract type, and the selection and content of contract clauses.

Since a major share of the SCN appropriation is expended for combatants within various ship classes, the discussion presented here has been organized around lead and follow combatant ships of the same class. Because marketplace conditions have a significant impact on how lead and follow ships are acquired, consideration is given first to the marketplace factors that influence the actions of both the Navy and the shipbuilders. This discussion concludes with an examination of contract clauses.

1. Dynamics of the Marketplace

The projections of new Navy shipbuilding work over the next five years are presented in Exhibits XLIV through XLIX (Chapter Two). These exhibits indicate that there will not be enough work during this period to keep all of the major shipyards fully employed. Very few new programs are scheduled, and a number of the major shipyards have the capacity and capability to participate in them. The inevitable result will be extremely strong competition for each new buy. Unless the commercial market for shipbuilding improves significantly, these few Navy programs may be seen by several shipyards as the only means of keeping their operations afloat. Under similar circumstances in the past, the result has been cutthroat competition. There is little reason to believe that the shipbuilding industry will react differently during the 1980s.

The study team's appraisal of the lessons learned from analysis of the current claims situation is that, in the long run, the Navy suffers from unrealistically low prices. Shipbuilders facing loss contracts are likely to become sponsors of claims. Evidence of varying degrees of fault on the part of the Navy gives impetus to such claims, which might never have surfaced if the shipbuilders had been earning a profit on their contracts. A carefully defined policy must be developed to deal with competitive offers where prices appear to underestimate the anticipated costs of performance significantly.

2. Acquisition Strategies

This section addresses the business strategies and contract types that should be used in Navy ship acquisitions – both lead ship and follow ship. The material on follow ships is presented in three parts: (i) general comments, including remarks on the timing of follow ship acquisitions; (ii) construction of follow ships in the lead shipyard; and (iii) construction of follow ships in other shipyards.

a. Lead Ship Acquisition. As noted in Exhibit XXVII (Chapter One), FPI contracts were used for lead ship acquisition prior to 1973. The Navy's current FYDP (1979 to 1983) identifies as lead ships three ships that are to be acquired within the next five years: the DDG-47, the LSD-41, and the MCM. If recent Navy policy is followed (as typified by the FFG acquisition), each of these lead

ships will be procured competitively – with source selection based on a number of management and technical factors. Estimated cost will not be the most significant factor, and a cost-type contract will be utilized. At the present time, the Navy intends to use a cost plus award fee contract for the DDG-47. The incentive features of cost-type contracts for the LSD-41 and the MCM have not yet been definitized.

Such acquisition practices are a significant improvement over past procedures. Experience has conclusively demonstrated that the risks inherent in lead ship design and construction are normally far too great and uncertain to be covered in an FPI contract. Yet the Navy must be concerned with motivating the shipbuilder to perform to the best of its ability. Cost-type contracts that utilize incentive or award fees appear to be good means of accomplishing this goal. In addition, lead ship acquisition policy would benefit from more disciplined consideration of optimum manning levels among the shipyards competing for the lead ship. (This subject is addressed in Chapter Two.) More attention also should be given to the impact of the entire program (including follow ships) on the productivity of the shipyards involved.

It has been suggested that CPAF contracts will create difficulties for NAVSEA by greatly increasing the administrative burdens of the SHAPM. While this type of contract does add the major task of assessing shipbuilder performance for the purpose of making the periodic fee awards, it has a counter-balancing advantage in that it requires open and frequent communications between the parties. The study team also believes that the CPAF contract offers the potential for actually reducing the administrative workload during the early stages of detailed design before construction begins. This could be accomplished by permitting the shipbuilder to make alterations to the contract design package during this period without processing contract changes. The shipbuilder's performance in this regard could be considered one of the factors to be assessed in making the fee awards. Such a procedure would also speed the resolution of problems during the early stages of working drawing preparation.

The timing of the selection of the lead shipbuilder will also be an important consideration in future acquisitions. As discussed in Chapter Two, the Navy has gained major advantages by including the lead shipbuilder as a full-scale

participant in the contract design process. In order to do this, of course, the lead shipbuilder must be selected prior to contract design. The Navy is planning to make such early selections on both the LSD-41 and the MCM acquisitions, and the study team believes that this represents sound policy. The major factors that are involved in selection of the lead shipbuilder (experience with similar ships, technical and design competence, understanding of the program objectives and risks, management ability, and shipyard capacity) are as readily assessable before contract design as after that process. In cases where the Navy desires to maintain competition through the contract design phase, more than one shipbuilder could be selected to participate in contract design. Further, if a program contained sufficient quantities to justify multiple sources for follow ship construction, it would clearly be to the Navy's benefit to bring the follow shipbuilder into the design effort. This policy of early selection of the lead shipbuilder is fully consonant with the objectives of the study team in this area.

These source selection procedures greatly reduce the importance of each shipbuilder's projection of the cost of contract performance in the evaluation of proposals. However, the Navy can still evaluate the ability of a prospective lead shipbuilder to meet cost objectives based on future workload projections and current contract performance. The study team believes that this method of source evaluation is more realistic than looking at projections of costs many years into the future. It also believes that such an evaluation system will provide the proper inducement to both the Navy and prospective shipbuilders to appraise all of the multiple risks of lead ship design and construction honestly.

b. Follow Ships

(1) General. Over the past 10 years, when multiple sources have been available, virtually all of the follow ships have been acquired using FPI contracts that were awarded through price competition. Such competitions have generally required that shipbuilders estimate contract prices on the basis of contract design packages. A large commitment of technical and management personnel would be needed to arrive at a sound cost and schedule estimate. In almost all of these acquisitions, neither the time nor the financial resources have been available to permit the competing shipbuilders to make such an analysis.

Thus, cost estimates have reflected a significant amount of speculation rather than evaluation of specific work – a situation that has precluded full assessment of the multiple risks inherent in the program prior to fixed-price contracting. The lack of a firm understanding of the effort, combined with the shipbuilding industry's need for work, has frequently led to overly optimistic commitments by shipbuilders. In such circumstances, it has been difficult for the Navy to select follow shipbuilders on any basis other than price. Since the goal of the Navy should be to contract at realistic prices, this method of acquisition is seriously flawed. The Navy must pursue an acquisition strategy that avoids contracts at unreasonably low prices and it must recognize the pressures that are exerted upon shipbuilders to propose unrealistic prices in the face of severe competition.

The careful assessment of the optimum manning levels and rate of growth at the shipyards, as advocated in Chapter Two, may be of little significance if sources continue to be selected primarily on the basis of price. Pre-award surveys and other methods which are used to determine responsibility have not always provided the contracting officer with the tools needed to ensure that the follow ship contract is awarded at a realistic price to a shipbuilder who can deliver the ship within the optimum manning level and without exceeding its maximum acceptable rate of growth.

The timing of contracts for follow ships also presents a dilemma, with serious problems encountered at both extremes. A follow ship contract which is awarded soon after initiation of the effort on the lead ship may be burdened by unresolved technical problems and a disproportionate number of drawing changes. Such contracts are necessarily priced without the benefit of actual experience and, as a result, the target price may be inaccurate.

Theoretically, delaying the initiation of efforts under follow ship contracts until all of the technical problems on the lead ship have been resolved and until actual costs are known could present an opportunity for negotiation of an equitably priced and technically sound contract that offers optimum risk balance. However, a delay of four to six years may be required to achieve this optimum balance. Such a delay would be unacceptable on all counts – from the Navy's viewpoint and, for different reasons, from the shipbuilders' viewpoint as well. It

would also have a negative impact on the productivity of the shipbuilder since a production gap of that length in the shipyard would jeopardize learning. Further, the facilities dedicated to that ship would undoubtedly be used by the shipbuilder for other purposes and might not be available when needed for the follow ship construction. In addition, any special equipment that was developed solely for construction of that ship type might be discarded or might deteriorate from lack of use or maintenance. Thus, many costly one-of-a-kind items would have to be built again.

The subcontract base might also be eroded in a program marked by such a production gap. Subcontractors may change the design of their equipment during this time because of the demands of other customers and changes in competitive factors and in technology. For all of these reasons, the study team concludes that a delay of this magnitude prior to awarding follow ship contracts is not an economic or otherwise practical option.

(2) Follow Ships Constructed in a Lead Shipyard. The problems discussed above can be dealt with most successfully if follow ship construction is accomplished in the lead shipyard. Negotiation of a follow ship contract with only the lead shipyard would remove the potential for unrealistically low bids from less knowledgeable shipbuilders. It would also eliminate the problems of design interpretation which may be present when a follow shipyard is introduced into a class acquisition program. In addition, the technical and management effort which the Navy must put forth to administer a contract with a new follow shipyard, while still maintaining delivery schedules and minimizing claims potential, may simply not be practicable. Validated drawings offer some help in this regard, but as each new shipbuilder is added to the program the Navy and that shipbuilder are required to engage in continual problem-solving conferences and exchanges of data in order to eliminate technical engineering and design deficiencies. It is not possible to predict the costs of these services to the Navy and the shipbuilder with any precision. However, both parties agree that they are large.

Use of the lead shipyard for a follow ship also eliminates the changes to the overall contract data package and supporting working drawings that would be needed to accommodate the production methods and facilities of a new shipyard. A final advantage is the shorter time period that may be achieved between

the lead ship and the first follow ship. For all of these reasons, the study team concludes that early follow ships on new Navy programs and, conceivably, subsequent follow ships on programs with small numbers of ships per year should be constructed in the lead shipyard.

This procedure might be viewed by some as a serious restriction on competition which it might be argued would result in higher prices for naval vessels. However, the study team has found little evidence that competitively set prices have led to lower ultimate costs in recent years. Rather, it would appear that the major factors that have influenced costs are shipyard workloading and the adequacy of technical design, as discussed in Chapter Two. Hence, award of follow ships to the lead shipyard should generally minimize the cost of follow ships – as long as the lead shipyard is performing effectively on the design and construction of the lead ship and has the capacity to construct the follow ships maintaining a relatively level workload. Of course, if the lead shipyard encounters problems, the Navy should evaluate the possibility of transferring the program to another shipyard before awarding the lead shipyard the follow ship contract.

Construction of the first follow ship in the lead shipyard should be initiated under a cost-type transition contract. This technique has been used successfully in the acquisition of various major weapons systems, including ships. A cost-type transition contract requires that the shipbuilder perform the work and acquire material necessary to protect the desired delivery schedule. Work is initiated on a follow ship, while technical, cost, and schedule risk remain unresolved under the lead ship contract, without shifting these risks to the shipbuilder. As discussed earlier, such risks can be substantial. There is little to be gained by forcing the parties to estimate the costs of such risks in a speculative fashion in order to arrive at a fixed-price type of contract. The study team believes it to be a much sounder policy to delay firm pricing until the parties can adequately define and price the risks on the program.

The cost-type transition contract provides for the payment of costs plus a fee (fixed, incentive, or award) – depending on the risks that are still unresolved. Such a contract also includes a clause under which the parties agree to

negotiate a superseding definitive FPI contract upon resolution of the technical, cost, and schedule risks to the extent that type of contract is appropriate. The government's assumption of the cost risk should be reflected in a somewhat lower profit, as called for in the weighted guidelines evaluation of profit/fee for both the cost contract and the superseding FPI contract. The time of transition to an FPI contract will vary from program to program. However, in all instances, the study team recognizes that both parties must perform diligently to accomplish the transition expeditiously. The shipbuilder's major incentive to transition early is the higher target profit that can be negotiated thereby; the government's major incentive is the determination of a more definitive limit on the final cost of contract performance. To the extent that either party inordinately delays transitioning to an FPI contract, the work will be done on a cost-reimbursement basis with a commensurately lower fee than would have been earned for FPI work.

All of the follow ships in the lead shipyard that are put under contract after the actual costs for construction of the lead ship are available should be constructed under FPI contracts. As shown in Exhibit L, above, recent NAVSEA practice has been to contract for a significant number of follow ships in future years by means of options. This practice gives the Navy a firm ceiling price on which to base its budget planning. However, several shipbuilders commented adversely on the effects of options. During the interviews, they stated that options place dual risks on the shipbuilder: First, in a world of uniquely long-term contracts, the shipbuilder's overall risk is extended one more year. Second, the shipbuilder must reserve space in the shipyard for work which may never be ordered, thereby forgoing the opportunity to seek other work.

While the study team found that options have been exercised in most of the cases in which they were offered, there is no doubt that additional risk is allocated to the shipbuilder by their use. However, the use of options offers significant advantages to the Navy. Options permit shipbuilders to propose prices for larger numbers of ships with a greater incentive to seek methods of improving productivity. Options also reduce the administrative burden of acquiring ships each year. For these reasons, the study team believes that the use of options for one year beyond the current year is a sound acquisition strategy. When such options are used, the shipbuilder should be protected by a requirement that all changes to current ships be made simultaneously to option ships.

Another means of accomplishing these results would be to reinstitute the use of multiyear contracting in shipbuilding. The multiyear approach is very similar to the option approach in the rights it affords the Navy. However, it also gives the shipbuilder with the contract assurance that it will build the ship if it remains in the program. Since this is more equitable to the shipbuilder, the study team believes that the Navy should consider seeking congressional authority to use multiyear contracts.

(3) Follow Ships Constructed in Other Shipyards. There are several circumstances when the Navy might choose to employ one or more follow shipyards to obtain additional ships. For example, this would be necessary if the lead shipyard did not have the capacity to handle the entire program. It would also be required when geographic dispersion of ship construction was considered desirable. A third situation might occur when the annual number of ships in a program provided enough work so that two or more shipyards could construct ships efficiently.

This third case would constitute the ideal program, where competitive forces could be used in a healthy way to spur each shipyard on to achieve greater productivity. Annually, the Navy could reward the shipyard that had achieved the best productivity by awarding it the extra ship in that year's program. This form of competition will become increasingly more realistic as the shipbuilders improve their ability to provide the Navy with detailed return cost data as each ship is being constructed.

If the Navy decides to obtain additional ships from one or more follow shipyards for any one of these reasons, a close analysis of the acquisition should be made to assure the selection of the most appropriate type of contract. If the contract design package is technically sound and stable, if the ship is not unduly complex, and if the shipbuilder's projected workload is stable, a FPI contract should be used. If these conditions do not obtain, the first follow ship should be acquired under a cost-type transition contract, paralleling the practice employed in acquiring the first follow ship from the lead shipyard. Once the risks associated with construction of the first follow ship can be adequately defined and priced, all subsequent follow ships awarded to that shipyard should employ FPI contracts. In

the case of modified follow ships, where prior ships have been constructed but the contract design package has been significantly updated, the cost-type transition contract could be structured with greater precision. An initial design evaluation task could be awarded on a cost basis and the ship construction tasks could be contracted on an FPI basis. This approach would allow the follow shipbuilder to evaluate the impact of the revised contract design package fully at the beginning of the work, rewriting subcontract procurement specifications, and preparing working drawings for parts of the ship where major modifications had occurred. Upon completion of this work and before any construction work other than advance procurement of long-lead-time items, the parties would negotiate an FPI ship construction contract.

The follow shipbuilder should be selected through competitive procedures, with evaluation of cost, technical, and management factors. The weighting of these factors would be dependent on the nature of the program and the amount of information available to the prospective shipbuilders at the time of the competition. In a case where a FPI contract was appropriate, cost would clearly be assigned a greater weight than in an instance where a cost-reimbursement contract was used. However, in all cases, the technical and management factors should be given significant weight to ensure the selection of a shipbuilder with the competence to perform the program effectively.

The study team believes that these approaches to follow ship acquisition will reduce the cost, schedule, and technical risks associated with the acquisition of the first follow ship. However, these approaches may not fully inhibit the shipbuilder from offering a low "buy-in" price for that ship. Since buy-in prices are likely to generate claims for price adjustment in the course of contract performance, the Navy should adopt a number of techniques to ensure that follow ship contracts are not awarded at unrealistic prices.

One technique for dealing with this problem would be to indicate clearly in the Request for Proposals for follow ships from new shipyards that one of the evaluation factors is the validity of the cost estimate. When underestimates of costs are encountered, lower scores should be given to the proposal. In addition, the RFP should encourage the competing shipbuilders to analyze fully the

performance risks for which they are contractually responsible to ensure that their offers include sufficient cost to cover such risks.

Situations may arise when all other factors are roughly equivalent and estimated cost is the sole remaining criterion for source selection. In such cases, the Navy should vigorously follow its currently stated policy of challenging low cost estimates by asking for full justification during negotiations. If a shipbuilder cannot demonstrate that an estimate is a realistic appraisal of the anticipated performance costs, the Navy should estimate the potential loss and should consider whether the shipbuilder is financially responsible to perform at such a loss. If the shipbuilder's financial position is weak, its offer might well be rejected.

In either instance, if a shipbuilder is selected at a price below cost – whether a multiple-factor or a price-only source selection – that fact should be fully documented. Further, the shipbuilder should be required to acknowledge in writing that it has been informed of the Navy's views concerning the accuracy of its price. If the shipbuilder agrees that the price is at a buy-in level, that should also be documented in writing. Such steps should discourage a practice that has historically had direct and significant relevance to claims.

If these techniques do not adequately inhibit competing shipbuilders from submitting unreasonably low prices, the Navy should consider adopting a forthright policy stating that proposals containing buy-in prices will be rejected. While there are no legal principles at the present time that permit such a policy, the Navy's claims experience over the past decade has clearly demonstrated that such a policy would be of long-term benefit. The study team concludes that such a policy would be totally justified.

c. **Pricing.** A review of the President's Navy shipbuilding program, which was recently presented to the Congress together with the suggestions for the future acquisition strategies just discussed, indicates that to a significant extent future contract prices for ships will not be determined by price competition. This fact will place a premium on the pricing techniques that will be used by the Navy in the coming years. Several aspects of this process merit discussion.

(1) Negotiation Techniques. In negotiating the target costs on noncompetitive shipbuilding contracts, there has been a tendency on the part of Navy negotiators to strive for the lowest cost that is acceptable to the shipbuilder. In some instances, this practice has resulted in long and intense negotiations where the Navy has taken a rigid stance on its target-cost position. Occasionally, the result has been a target cost which does not reflect a sound estimate of actual costs. Budgetary constraints have played a role in these developments.

The study team believes there is a need to establish a policy whereby Navy negotiators must work toward achieving target costs in FPI contracts which are as accurate a reflection of the actual anticipated costs of performance as possible in the specific circumstances of each acquisition. Such a policy would require that the Navy evaluate the full risk involved in each acquisition and attempt to price such risk. For example, the engineering effort required by a follow shipbuilder would have to be estimated in terms of the level of detailed design that is necessary to provide full working drawings to the shipyard work force. Construction labor-hour estimates would have to be based on past experience at the lead shipyard as well as on information from past programs at the shipyard contracting for the follow ship acquisition. The keys to improvement in this area are the Navy's ability to make a cost estimate which reflects actual predicted costs and its willingness to use that cost estimate – even when it exceeds the funds budgeted for the ship.

(2) Targeting of Escalation. In establishing target costs, the problem of handling anticipated escalation has been particularly troublesome. In the past, the Navy has followed the practice of targeting at the labor rate and material cost levels that are current at the time the contract is signed, with all escalation to be paid separately during contract performance. While this should not affect the amount of compensation that is ultimately recovered by the shipbuilder, it does result in a contract target cost which significantly understates the anticipated costs of performance. It also obscures the negotiation of target profit, as discussed below.

The study team believes there are benefits to be derived from including the projected escalation in the contract target cost at the rate

anticipated at the time of the negotiation. The result would be a more accurate and realistic statement of the target cost and a better base for profit negotiation. Contract escalation procedures would be altered by this change in that they would be based on deviations from the projections agreed to in the targeting, rather than on deviations from base costs as in the present system. Hence, if the parties agreed to target at a 6 percent labor rate increase per year, escalation would result in an upward price adjustment to the extent the shipbuilder's escalated labor rates exceeded 6 percent and in a downward price adjustment to the extent they were less than 6 percent.

(3) Profit. In the interviews, the shipbuilders complained about inadequate profits. One cause of such inadequacy is found in the process that is used to negotiate target profits. The two major issues in this area are profit on escalation and application of the weighted guidelines formula to profit negotiation. The shipbuilders also identified a third problem in the profit area – the impact of the Vinson-Trammell Act on the profits that are ultimately earned by shipbuilders.

(a) Profit on Escalation. Although the Navy states that it takes into account escalation in establishing target profit, most shipbuilders are convinced that the Navy does not apply full "weighted guidelines" profit amounts to anticipated escalation costs. The parties negotiate target costs based on current costs, but do not negotiate anticipated escalation costs. Hence, there is no discussion of the total anticipated costs of performance for the purpose of establishing the target profit. By including escalation in target costs the parties will be able to negotiate directly the amount of profit that should be included in the target profit in order to cover anticipated escalation cost.

The practice of including anticipated escalation cost in target cost will not assure shipbuilders of full profit on escalation, since actual escalation may vary significantly from anticipated escalation. However, this practice will permit shipbuilders to negotiate anticipated escalation and to make a weighted guidelines profit calculation on the basis of this figure. In this way, profit negotiations will be brought openly into the bargaining process, thus assuring shipbuilders an opportunity to negotiate reasonable profit on projected escalation.

(b) Weighted Guidelines. In 1976, the DOD changed the ASPR to adjust the weighted guidelines profit negotiation procedure to include an element covering contractor investment in capital equipment in defense contract profits. The stated purpose of this regulatory change was to enhance the productivity of defense contractors by inducing them to invest in labor-saving equipment. During the interviews, the shipbuilders were unanimous in their view that this change was of little interest and would not motivate them to alter their policies concerning the acquisition of capital equipment. Most of the shipbuilders explained that they had reached this conclusion because of the poor outlook for future business in the industry. The study team concluded that, since the shipbuilding industry tends to be labor intensive, it is likely that the new weighted guidelines policy will not significantly increase shipbuilder profits over the next few years.

The study team believes that other techniques will have to be used if the Navy is interested in motivating shipbuilders to make investments in labor-saving equipment and to improve productivity. Some of the techniques that could be explored include (i) guaranteeing recoupment of the cost of equipment through special termination provisions, (ii) directly providing equipment to shipbuilders as government-owned facilities, or (iii) seeking special legal authority from the Congress to permit accelerated depreciation of such equipment on a selective basis. Since increased productivity would be the long-term benefit to the Navy, a thorough study of this problem is warranted.

(c) The Vinson-Trammell Act. Since the expiration of the Renegotiation Act in 1976, the shipbuilding industry has been functioning under the 10 percent profit limitation of the Vinson-Trammell Act. The anomalous impact of the Vinson-Trammell Act is depicted in Exhibit LIII, above, which demonstrates that the shipbuilder has no incentive to reduce costs after a modest underrun of target cost. Since the Navy will undoubtedly continue to used fixed-price-type contracts, there appears to be a need to amend the Vinson-Trammell Act to reflect modern contracting practices. A simple means of doing so would be to provide that the act not apply to earned profits on incentive contracts. Another alternative would be the repeal of the act. Either course of action would be satisfactory, since there is little need for such legislation in the current business

environment where the Navy obtains its prices by means of competition or through vigorous negotiation.

3. Clauses

In recent years, contract clauses in FPI contracts have posed difficult problems for the Navy and its shipbuilders. On the one hand, the Navy has attempted to include clauses that force the shipbuilders to disclose their claims early and to agree to price limitations on such claims. On the other hand, shipbuilders have argued for clauses which reduce the risks inherent in this type of contracting. The result has been constant tension between the parties involved, which has been reflected in long and involved negotiations of contract language or repeated questioning of the Navy's intent in its Requests for Proposals. While this interchange has slowed the acquisition process in many recent procurements, the parties to each contract have ultimately been able to reach accommodations and to proceed with the job of constructing ships.

In the course of their efforts, both the Navy and its shipbuilders appear to have learned that there is a middle ground in contract language which is suitable for this type of long-term, high-risk acquisition. However, the Navy has not defined this middle ground in terms of contract clauses. Each Request for Proposal contains different clauses, and a comparison of these clauses does not give the appearance of a coherent Navy policy toward the role of contract clauses in recognizing and accounting for the risks of Navy shipbuilding.

At this time, it would be appropriate for the Navy to adopt a uniform set of contract clauses that reflect the current norm in Navy shipbuilding. Such clauses should not be seen as an immutable package which would be imposed on each shipbuilder, but rather as a new baseline for ship acquisitions. This baseline should reflect a modern understanding of the risks inherent in the process of acquiring Navy ships and of the tendency for claims to flow from this process. Accordingly, the study team believes the clauses should reflect two assumptions:

(i) It is vital for the Navy to have up-to-date information on the progress of the shipbuilder and on the problems that are being encountered in performing the contract and for the Navy to provide the shipbuilder with fair compensation for extra work caused by government orders or actions.

(ii) The clauses should reflect a balance of risk which places most, if not all, of the risks outside of the control of the shipbuilder on the Navy, thereby permitting the shipbuilder to focus attention on managing those aspects of the work over which it has control.

This new baseline of contract language should be applied to all shipbuilders – regardless of their competitive position or bargaining power. One of the benefits of this course of action would be a reduction in the acrimony and disputes that have pervaded discussions of contract language in recent years. A discussion and analyses of the clauses to be included in this new baseline as well as their background and derivation are included in the remainder of this chapter under six major categories: (i) clauses dealing with risks that are beyond the control of both parties; (ii) clauses relating to delivery and acceptance of a ship as contracted; (iii) clauses relating to making progress payments; (iv) anti-claims clauses; (v) clauses relating to the provision of government-furnished property; and (vi) clauses defining the responsibility for contract drawings – sometimes referred to as disclaimer or impact clauses.

a. **Risks Beyond the Control of Both Parties.** The lack of government clauses dealing with most events that are outside the control of either the Navy or the shipbuilder places the cost risk for such events on the shipbuilder. The shipbuilder must therefore include price and schedule contingencies in the contract or run the risk of disastrous losses. Experience has proven that the latter alternative has been the most likely to occur. Huge speculative contingencies are unacceptable to the Navy and, if included, would move shipbuilder prices out of the competitive range or, in noncompetitive awards, out of the budget envelope. Consider the situation if all shipbuilders, in estimating the prices of their 1978 contracts, included a 10 percent contingency to cover a prospective oil embargo in the winter of 1980 and 1981. No funds are included in the budget for such costs, and there is no way to predict the occurrence of such an event. Yet all of the contracts entered into this year will be performed in that period and, if such an embargo were imposed, the shipbuilder would be liable for such costs under current standard contract clauses. It is apparent that there is a serious need to consider the inclusion of clauses covering such outside events in contracts that involve performance over long periods of time.

In dealing with this problem, the outside events can be broken down into two categories – the known and the unknown. Specific clauses can be designed to cover those events which have occurred in the past and which are expected to recur. Both parties can be protected by such clauses by giving the shipbuilder the right to a price adjustment if costs increase and giving the Navy the same right to a price adjustment if costs decrease. The Navy would also derive a major benefit from such a clause by assuring that all of the contingencies for such events are not included in the original target cost. Events in this category include labor escalation and material price inflation, changes in labor fringe benefits, and energy cost fluctuations.

Contractual coverage of unknown and unforeseen events poses a much more difficult problem. A general clause would be required to cover such events, and the language of a clause of this nature might be subject to strong opposition as being unduly prejudicial to the government. These issues are discussed below.

(1) Known Events: Economic Price Adjustments. For many years, the major known events in shipbuilding contracts – increases in labor rates and material prices – have been covered by special contract clauses dealing with economic price adjustments (EPA). These provisions call for contract price adjustments for increases in labor rates and material prices based on variations of the Bureau of Labor Statistics (BLS) indexes of the shipbuilding industry. Shipbuilders considered the EPA clauses that were contained in the Navy shipbuilding contracts awarded prior to 1975 as less than adequate during relatively stable economic periods. The clauses were thought to be wholly inadequate with the advent of the 1973 and 1974 double-digit inflation. The pre-1975 EPA clauses provided for price increases based on a predetermined expenditure profile of materials, labor, and overhead which was agreed to during negotiation of the contract. The effect was that no escalation was paid on costs after the contract delivery date or on costs over the target costs. In addition, these clauses required that changes be priced at projected labor and material rates, excluding them from escalation coverage. The BLS labor and material indexes used were the same as those currently in use. There was no provision for payment of profit on escalation.

In 1975, the Navy made substantial revisions to the EPA clauses used in shipbuilding contracts. The new clauses provide for the payment of escalation on monthly allowable incurred labor, material, and indirect costs – as long as the de-escalated costs do not exceed the ceiling. Provision is also made for the payment of escalation on costs incurred after contract delivery date and on change order costs. If work continues past the contract delivery date, EPA payments are ordinarily based on the BLS index as of either the contract delivery date or another identified date – the index is "capped." For instance, in two recent shipbuilding contracts – for 688 Class submarines and an AO – the index was capped 240 days after contract delivery. However, the 1975 Trident contract and all follow FFG contracts contain no cap on escalation.

During the interviews, all of the shipbuilders commented favorably on the 1975 EPA clause changes, agreeing that they were a substantial improvement over the clauses that had previously been used. However, most of those interviewed suggested that further refinement was needed. Several shipbuilders described the BLS material indexes that are used by the Navy as not being representative of the shipbuilding industry, and most of them were even more critical of the BLS index used for labor escalation. Finally, a small number of those interviewed expressed dissatisfaction with the Navy's policy on economic adjustment for overhead and the Navy's apparent nonpayment of profit on escalation. The study team's views on the various aspects of escalation policy are set forth in the following discussion.

(a) Compensation Adjustment for Materials. During the interviews, several of the shipbuilders stated that the BLS shipbuilding index for materials used by the Navy did not provide a material mix which reflected the actual material purchased by the shipbuilder. The problem is that the BLS shipbuilding material index is not tailored to naval ships. The ultimate objective of providing an adjustment for inflation in the cost of materials essential to contract performance – much the same as any other adjustment for inflation – is to compensate shipbuilders for the precise amount of the increase in material costs that is attributable to causes over which they have no control. Such a result is equitable and in the best interests of both parties, since it permits pricing without contingencies for unforeseeable inflationary prices. However, the obvious way of

attaining that result – payment of the actual inflationary costs incurred – has certain drawbacks. Managerial/administrative expertise in procuring materials which meet specifications at a reasonable cost is one part of shipbuilder performance for which the Navy contracts in entering into a ship construction contract. Since this element of material procurement is the responsibility of the shipbuilder, care must be exercised to avoid a situation where an economic adjustment for materials based on actual costs incurred might diminish the shipbuilder's incentive to strive for the best price.

By adopting the suggestions of the study team with regard to contracting strategies for future ship acquisitions, the inequities inherent in the BLS material index are reduced. The use of cost-reimbursement contracts for lead ships and cost-type transition contracts for early follow ships would provide shipbuilders with full coverage for all or most of the material price increases in such acquisitions. Thus, material escalation is only a problem when FPI contracts are used on follow ship acquisitions. Here the study team concludes that the Navy should continue to provide for material escalation based on the BLS index. However, two steps are called for to improve the situation. First, in an acquisition where the shipbuilder can show a substantial disparity between the existing index and the proposed shipbuilding program, the Navy should tailor a special composite index which more accurately reflects that program. Such an index could be made up of other BLS indexes which have been weighted to reflect the actual material content of the ship. Second, the Navy and the BLS should begin work on a new series of indexes for various types of ships that will reflect the material content of such ships more accurately than the current single index. It seems probable that separate indexes for submarines, surface combatant ships, and auxiliaries would provide the necessary precision to assure the Navy and its shipbuilders of fair results.

(b) **Compensation Adjustment for Direct Labor.** The BLS shipbuilding labor index which is used as a basis for paying escalation on direct labor rates was also criticized by the shipbuilders. Although the index represents a cross-section of wage rates for most of the major private shipbuilders, virtually all of the shipbuilders interviewed felt that it did not reflect their individual circumstances. Several said that, because of the large disparity in the size of

shipyard work forces, the index is controlled by a few large shipyards. However, the complaints of index disparity came from the large yards as well as from those with relatively small work forces. One shipbuilder pointed out that the timing of labor contract negotiations is crucial to the impact of the index. Another indicated that, when a shipyard experiences a reduction in its work force, overall wage rates rise faster than the index because of the tendency to retain the more experienced people. The reverse is true when work forces are increased.

The diversity in the size of the shipyard labor forces and the changes in employment levels are substantial and well documented. As revealed in Exhibit XIII (Chapter One), total employment at each of the 11 major shipyards performing Navy work has fluctuated sharply during the last 19 years, with remarkably few periods of level employment at any one shipyard. Combined national shipbuilding employment during the same period is far smoother, revealing a slow upward trend in employment from 1961 to 1977. Since the current labor index is a national one based on wages throughout the industry, the index is more of a gamble for the individual shipbuilder than a reliable method of paying for escalation on labor rates. During the interviews, the shipbuilders indicated that the only means of adapting to the index was to place a significant contingency in the target price so as to reflect anticipated underrecovery of labor escalation.

As previously noted, the purpose of an economic adjustment clause is to divorce escalation from shipbuilder risk. The obvious method of accomplishing that objective is to pay for actual escalation. When applied to labor, this technique does not necessarily have the same pitfalls that make it an undesirable alternative for protecting against inflation on materials. A shipbuilder has a compelling interest in holding labor costs down – to maximize profits in ongoing commercial contracts and to remain competitive on downstream commercial and naval acquisitions. Since a number of shipbuilding companies are already somewhat noncompetitive and since a limited amount of new construction business is on the horizon, it appears doubtful that the shipbuilders would unduly increase their employees' wage rates because of the Navy's EPA clauses. Accordingly, the study team believes that labor escalation should be based on actual labor rates rather than on a national index. This basis for economic adjustment is sanctioned

by the ASPR in supply and service contracts, and a clause is offered within the body of the regulation.[1]

(c) **Compensation Adjustment for Indirect Costs.** Based on the foregoing discussion and the fact that labor costs make up a large share of total indirect expenses, the study team believes that it is logical to continue to apply escalation to indirect costs. Deciding what portion of indirect expenses are subject to inflation is a more difficult problem. In the past, Navy contracts have provided for payment of escalation on 70 to 100 percent of indirect costs. While consistency in indirect cost escalation protection to shipyards should be attained, this does not necessarily require that the percentage of coverage on all contracts be the same. The amount of indirect costs that are subject to escalation will vary with the shipyard and ship type(s) under construction. Thus, it would not be effective to establish a standard percentage of overhead cost on which the overhead escalation would be computed for all shipbuilding contracts. The portion of overhead which is subject to escalation should be decided on an ad hoc basis – after the shipbuilder's overhead accounts are reviewed and the parties have agreed to a negotiated overhead pool. Fixed costs, such as depreciation, should be excluded from the pool.

Further refinement of the escalation on indirect costs can be achieved by segregating those indirect costs that can be directly escalated at actual escalation rates. At least three elements of indirect cost deserve attention here: (i) indirect labor costs, (ii) employee benefit costs, and (iii) energy costs. Each of these is discussed below.

(1) **Escalation of indirect labor.** Indirect labor, the largest single element of indirect costs, has been covered by the Navy's EPA clauses for many years. The basis for this escalation has been the BLS shipbuilding labor index. If the Navy changes its escalation of direct labor rates to actual cost escalation, it would appear logical to escalate indirect labor rates based on actual costs as well. There are two possible ways that this could be done. Indirect labor

---

[1] ASPR, 3-404.3.

rate escalation could be called for at the rate used for direct labor escalation or it could be based on the actual rates incurred for indirect labor. The former alternative has the advantage of simplicity, but it offers the shipbuilder an incentive to increase profits by denying its indirect work force salary increases at the rate given to the direct work force. The latter alternative has the advantage of accuracy, but in this case the shipbuilder may be motivated to grant the indirect work force unusually high salary increases. The Navy should adopt the alternative most appropriate to each shipbuilder considering its commercial sales, union agreements with both direct and indirect employees, and past record of wage increases.

(2) **Escalation of employee benefits.** In recent years, employee benefits have claimed an ever-increasing segment of the shipbuilder's labor dollar. Moreover, it has become commonplace for these benefits and their costs to the shipbuilder to rise significantly as a result of state or Federal legislation. In 1975, in negotiation with the Navy for SSN-688s, Newport News underscored the unpredictability of these costs and was successful in obtaining the Navy's agreement to reimburse increases separately. In the latest contract with Newport News, a clause provides for separate reimbursement for increases and decreases in the cost of FICA, workmen's compensation, unemployment compensation, and disability. The amount of the adjustment is determined by a formula that is keyed to actual changes in cost and limited only by ceiling costs. When the de-escalated base costs reach the ceiling, no further adjustment is paid.

The fluidity of employee benefits will no doubt continue in the future. For example, there is current discussion of legislation to decrease the FICA tax in the future. Thus, the study team recommends that such costs be treated independently in all future contracts. However, consistent with the policy advocated for determining escalation on labor, the study team concludes that payments should be based on the actual cost increases in employee benefits.

(3) **Escalation of energy costs.** Until recently, energy cost fluctuations were consistently treated as an element of overhead in the general economic price adjustment clauses in ship construction contracts.

However, soaring but unpredictable increases in energy costs caused Newport News to reexamine these costs and, during the negotiations noted above, the company was successful in getting the Navy to agree to pay its share of the increased energy costs.

Two recent Newport News contracts contain separate provisions for energy escalation, and the Navy has offered such a clause on the latest acquisition of SSN-688s. The provisions that are in use identify the various energy cost elements and provide for economic price adjustment for increases in the costs of coal, coke, electricity, and fuel oil. The BLS wholesale price index serves as the basis for measuring increases in coal and coke costs. Increases for electricity and fuel oil are based on the actual cost increases for these products. Experience with these energy provisions has been limited because of their comparative newness. However, during the interviews, several shipbuilders expressed general satisfaction with the Newport News approach. Since it appears that energy costs will form an ever-increasing element of ship construction expense, the study team concludes that separate provisions for energy escalation should be included in all future ship construction contracts. Where commodity indexes exist, increases in indirect cost payments should be based on them; otherwise, these increases should be based on the actual increases in energy costs.

(4) **Limitation on escalation payments.** In response to shipbuilder complaints, the Navy has selected varying limitations on escalation payments in recent years. The most frequently used recent provision calls for no further increase in the escalation of costs after 240 days beyond scheduled delivery. The justification for such a provision is that it provides motivation to the shipbuilder to deliver the ship within a reasonable time after contract delivery. While the study team agrees with the Navy that such motivation may be needed in these contracts, it does not believe that the EPA clause is the correct place to include such incentives. When the contract is agreed upon, neither party knows what rate of increase will be incurred in labor rates and material prices after the delivery date of the ship. Hence, neither party knows the dollar impact of this type of delivery incentive. However, experience has shown that if it is at a high level, such as in 1973 and 1974, the contractor will be seriously hurt by the loss of escalation payments. Thus, the study team concludes that such delivery incentives

should be removed from the EPA clause. Whenever the Navy believes that delivery incentives are necessary to motivate shipbuilder performance, they should be included in a special delivery incentive clause. Such a clause would contain fixed amounts of profit bonus or penalty which the shipbuilder would earn or incur for early or late delivery, respectively, in accordance with normal incentive contracting principles.

(2) **Unknown Events.** For major shipbuilding contracts when the duration of the contract and the dollar amount (in comparison with corporate assets) result in unusually large shipbuilder vulnerability, the risk of unknown or unforeseen events that are outside the control of either party should be conscientiously addressed during contract negotiations. When such risks are perceived to be significant, there are serious disadvantages in following the normal practice of making the shipbuilder solely responsible for the costs. If the shipbuilder is placed in a loss position, management attention will be diverted from the primary task of controlling shipyard productivity to the secondary job of processing claims. Several alternatives are available for coping with such risks, depending on the situation. The most ready alternative is the use of a cost-type contract. While several of the shipbuilders urged this approach, the study team concludes that it should be used only in limited cases. The reason for this conclusion is the fact that a cost-type contract relieves the shipbuilder not only of the risk of unforeseen events outside its control, but also of all controllable cost increases (such as productivity of the work force, efficient purchasing of materials, and overhead expenditures level).

A second alternative is to use a wide target-cost-to-ceiling-price spread in an FPI contract. A third option is selectively to remove some or all of these risks from the shipbuilder through an appropriate clause in the contract. For example, during the interviews a number of shipbuilders complained that their costs were increased by legislative programs which were enacted or implemented after contract award and with which they were required to comply. Two examples that were repeatedly cited were environmental and occupational safety and health legislation. To remove that risk from the shipbuilder in appropriate circumstances, a clause should be included in the contract giving the shipbuilder the right to an equitable adjustment for changes in Federal law which increase costs. A sample of such a clause is included in Exhibit LIV.

EXHIBIT LIV
PRICE ADJUSTMENTS FOR CHANGES IN FEDERAL LAW

(a) If at any time after _____ there is any change in applicable Federal laws that directly results in an increase or decrease in the contractor's cost under this contract, an adjustment therefor (excluding profit) shall be made in the contract price.

(b) For the purpose of this clause:

(i) Federal laws shall include the U.S. Constitution, Federal statutes, and regulations promulgated by Federal authorities.

(ii) A change in law shall be deemed to mean the amendment or repeal of an existing law or the enactment of a new law, but shall not include judicial interpretation of existing laws.

(iii) Existing laws shall be deemed to mean those laws that are in effect on _____.

(c) The adjustment made pursuant to (a), above, shall be limited to changes affecting the contractor's operations that cause an increase or decrease in the cost of performance of this contract, but shall not include changes that affect subcontractors – notwithstanding that the latter changes indirectly affect the contractor's costs.

(d) No adjustment shall be made for any individual change in law that increases or decreases the contractor's costs unless it results in an increase or decrease in cost in excess of $100,000.

(e) The contractor shall promptly notify the contracting officer of all matters pertaining to changes in Federal laws that reasonably may be expected to result in an adjustment under this clause.

(f) Requests for price adjustments hereunder shall be in accordance with Article _____ (Documentation of Requests for Equitable Adjustment).

On the same theme, in the interviews other shipbuilders described the various types of outside events that had impacted on their costs during performance. The most frequently mentioned events were foreign fuel embargoes, strikes, and unusual weather. Such risks as well as those that are contingent on sovereign acts could be removed from the shipbuilder if a broader clause were used to provide for equitable adjustments in the event that the shipbuilder encounters an excusable delay. A sample of such a clause is included in Exhibit LV.

The study team recognizes that such clauses are unprecedented in traditional government contracts and that they may therefore be considered unduly liberal in protecting the shipbuilder from risks. However, it must be remembered that they are suggested for use when the alternative would be a cost-reimbursement contract or an FPI contract with a high ceiling price. Such contracts indiscriminately relieve the shipbuilder of risks of all types – including those over which the shipbuilder should be expected to exercise control. The proposed clauses are intended to reduce the shipbuilder's risk in a much more discriminating manner. Thus, they further one of the major goals which the study team has identified as necessary to reduce claims in the future – that of refocusing the shipbuilder's attention on productivity and efficiency in the shipbuilding process.

b. **Delivery and Acceptance of the Ship as Contracted.** Two clauses in Navy shipbuilding contracts address the problem of identifying discrepancies between the ship as built and the ship as contracted – the Delivery of Completed Vessel clause and the Nucleus Crew clause. Both clauses have been in use in shipbuilding contracts since 1969.

The Delivery of Completed Vessel clause addresses the extensive testing and trials which ensure that a ship is ready for delivery as well as the shipbuilder's responsibility for various deficiencies noted during these trials. This clause requires that:

> *(a) vessel shall not be presented for acceptance trials until . . . (the) contractor has satisfactorily carried out those parts . . . for which . . . (it) is responsible . . . and contractor has corrected (certain) . . . contractor responsible deficiencies . . . (b) contractor shall*

EXHIBIT LV
PRICE ADJUSTMENTS FOR UNFORESEEABLE CAUSES BEYOND THE CONTROL OF THE CONTRACTOR

(a) A price adjustment (excluding profit) shall be made for any increase or decrease in the contractor's cost under this contract arising from causes beyond the control and without any fault or negligence of the contractor, including but not restricted to acts of God, acts of the public enemy, acts of the Federal Government in either its sovereign or contractual capacity, acts of another contractor in the performance of a contract with the Government, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, unusually severe weather, or delays of subcontractors or suppliers arising from unforeseeable causes beyond the control and without the fault or negligence of both the contractor and such subcontractors or suppliers.

(b) Any adjustment made pursuant to (a), above, shall be limited to causes beyond the control and without any fault or negligence of the contractor affecting the contractor's operations and causing an increase or decrease in the cost of performance of this contract.

(c) No adjustment shall be made for any individual unforeseeable event which increases or decreases the contractor's costs unless it results in an increase or decrease in cost in excess of $100,000.

(d) The contractor shall promptly notify the contracting officer of all matters that reasonably may be expected to result in a price adjustment under this clause.

(e) The extent of any price adjustment entitlement under this clause is dependent upon the contractor having acted with reasonable promptness and having used best efforts to mitigate any adverse impact on cost and delay and disruption of performance. If the performance failure could have been avoided by the contractor through reasonable effort and without undue risk, the contractor shall not be entitled to a price adjustment.

(f) Requests for price adjustment under this clause shall be in accordance with Article _____ (Documentation of Request for Equitable Adjustment).

make (an) interval available . . . between . . . trials and delivery . . . to correct contractor responsible deficiencies . . . necessary to avoid an adverse effect on the operational capability of the vessel . . . .

Other salient paragraphs of the clause require that the shipbuilder make the ship available to the Navy for inspection, tests, and trials to the extent necessary, providing only (as also set forth in the Inspection clause) that they will be performed so as not to delay the shipbuilder's work unduly. Finally, this clause limits the shipbuilder's responsibility prior to acceptance trials to "contractor responsible deficiencies" and between trials and delivery to "contractor responsible deficiencies . . . necessary to avoid an adverse effect on the operational capability of the vessel."

The Delivery of Completed Vessel clause is silent on the role of the Naval Board of Inspection and Survey (INSURV) in the ship delivery process, but acceptance trials are defined in a ship specification article. INSURV guidance is also contained in the Navy's Ship Acquisition Contract Administration Manual (SACAM).[1] The SACAM manual provides for acceptance trials to be witnessed by the INSURV, noting that the purpose of these trials is ". . . to determine whether the vessel is completed in accordance with the contract specifications and is operationally ready."[2] The SACAM manual also allocates the task of the final identification of all deficiencies to the INSURV, but adds the caveat that its classification of an item as a shipbuilder responsibility is not contractually binding.[3] However, in a later paragraph, the SACAM manual notes that acceptance of the ship and delivery are conditioned on the accomplishment of all of the deficiencies noted by INSURV – without regard to whether they are the contractor's responsibility.[4]

---

[1] SACAM, Chapter 20.

[2] Ibid., 20-2.2.3(a).

[3] Ibid., 20-2.2.2(r).

[4] Ibid., 20-2.2.3(u).

The Nucleus Crew clause addresses the status of those elements of the ship's crew that are scheduled to serve at the shipyard prior to completion of the ship. The number and date of arrival of a nucleus crew varies with the size and complexity of a ship and whether it is nuclear or conventionally powered. Nuclear ship contracts have also charged the nucleus crew with assisting the SUPSHIP in the inspections of the propulsion plant with the proviso that the ". . . contractor reserves the right to have the Supervisor review any discrepancies submitted by the nucleus crew to shipyard personnel." Neither ship contracts nor the SACAM prescribe a role for the nucleus crew in terms of identifying deficiencies in a ship under construction which must subsequently be corrected prior to delivery.

The study team believes the Delivery of Completed Vessel clause, as written, adequately defines the rights and responsibilities of the parties, limits the shipbuilder's responsibility to its contractual obligations, and is reasonably well understood by the shipbuilders. Similarly, the Nucleus Crew clause is clear, unequivocal and, taken alone, gives shipbuilders no particular discomfort. Accordingly, the study team does not believe that it is necessary to restructure either the Delivery of Completed Vessel clause or the Nucleus Crew clause. However, the shipbuilders do encounter a genuine problem when the INSURV and the nucleus crews – both nonparties to the contract – become involved in determining whether the shipbuilder is fulfilling its responsibilities under the contract. This problem is discussed more fully in Chapter Four.

e. **Progress Payments.** As noted earlier in this chapter, in 1975 the Navy shipbuilding Progress Payments clause was changed in several ways. Current Navy policy employs physical progress as the basis for computing shipbuilding progress payments, limiting payments to 100 percent of the allowable cost until 50 percent completion and to 105 percent of allowable cost thereafter. The policy also requires that 10 percent of contract price be withheld up to the 50 percent completion point. This policy differs from the standard ASPR policy, which currently grants progress payments at a rate of 80 percent of the incurred costs but pays full profit upon delivery of the completed items.

The use of the standard ASPR progress payments policy was proposed in 1973. However, this policy was never implemented because of extreme resistance by shipbuilders. During the interviews, the shipbuilders indicated that

the current policy was a substantial improvement over the policy proposed in 1973, but they also recommended that additional changes be made to it. The two most frequent objections were to the 10 percent withholding and the nonpayment of profit prior to 50 percent of completion. The shipbuilders maintained that they are forced to make long-term investments of working capital in the construction effort, because the progress payments are limited to 90 percent of the contract price prior to 50 percent completion. A minor objection was also voiced to the once-every-two-weeks frequency of payment.

The study team believes there are real differences between Navy ship acquisitions and other DOD acquisitions that argue strongly for a ship progress payments policy which differs from the standard ASPR policy. First, naval ships have a four- to seven-year construction period which makes it impractical to deny profit recovery until delivery, as required by the standard ASPR policy. Second, the shipbuilding industry currently has very low earnings as shown by Exhibit XXI (Chapter One). In this situation, the imposition of heavy investments of working capital which require the payment of interest would wipe out any remaining profit and would have serious detrimental effects on the viability of the industry. At present, the only possible way to adopt the ASPR policy would be to permit shipbuilders to increase their target profits by the amount of the interest payments. The net result of such a policy would be for the Navy to pay interest on borrowings at the shipbuilder's interest rate rather than at the lower government rate. The study team sees little advantage in such a change.

Similarly, the study team did not find any reasons to liberalize the current policy. This policy limits the shipbuilder to recovery of 90 percent of the contract price during the first 50 percent of completion. If a shipbuilder's profits are negotiated at 10 percent of the contract price and if the contract is performed at target cost, it seems clear that the shipbuilder will be required to provide little or no working capital to finance the construction of the ship[1] – although no profits will be collected for the first half of the contract

[1]This point is supported by Assistant Secretary of the Navy (Financial Management), Report of Task Group to Study Progress Payments, Washington, D.C., 1972.

period. Profits that are negotiated below 10 percent may require the shipbuilder to invest some working capital in the construction of the ship, while profits negotiated above 10 percent may result in some profits being generated prior to 50 percent of completion. Thus, in normal circumstances the shipbuilder should have little working capital invested in Navy contracts. Since current DOD policy calls for payment of the imputed cost of fixed assets as a cost of performance, the shipbuilder's total capital costs should be covered on a current basis. In this situation, the study team believes that the current 10 percent withholding until 50 percent of completion is a reasonable reconciliation of the needs of both the shipbuilders and the Navy and that this withholding should be maintained.

One problem in ship construction that can have an adverse impact on the shipbuilder's working capital and can require major investments in the construction of the ship occurs when a shipbuilder overruns the target cost. If an overrun is caused by shipbuilder inefficiency or poor productivity, these investments are the penalty that must be paid for such inadequacies. However, it is another matter if these overruns occur because of changes that are required by the Navy or government delays. Typically, the shipbuilder has no voice in resetting the billing base and, in such circumstances, significant working capital investments may be required for which the shipbuilder will not be paid until its claims are finally adjudicated. In such circumstances, the study team believes that timely provisional adjustments should be made to the progress payment billing base in order to permit payment of that part of those costs for which the Navy may be responsible.

A second objection of the shipbuilders to the current progress payment policy relates to the nonpayment of profit prior to 50 percent completion. Since this policy sometimes results in nonpayment of profit for two, three, or more years, shipbuilder concern is understandable. However, the study team believes the current policy is defensible as a reasonable exchange for not having to make heavy investments of working capital. Shipbuilders have learned to accommodate this characteristic of shipbuilding contracts. Moreover, the Navy has lessened the impact of the policy for multiship contracts by applying the 50 percent rule to each individual ship rather than the entire contract.

Finally, a few shipbuilders objected to the Navy's policy of making progress payments on a once-every-two-weeks basis, noting that this is not frequent enough. While there is a once-every-two-weeks policy, shipbuilders may request a change in the payment schedule. If investigation shows that more frequent payment is necessary, the Navy has accommodated the shipbuilder's need. The study team sees no need to alter this basic policy.

d. Anti-Claims Clauses. As noted earlier in this chapter, anti-claims clauses arose from the constructive change phenomenon and its serious impact on claims. Since the ASPR did not provide contractual methods for treating them, the Navy promulgated special clauses. Four anti-claims clauses which originated in Navy Procurement Circular 18 were criticized by the shipbuilders: (i) Changes, (ii) Change Order Estimates, (iii) Problem Identification Reports, and (iv) Equitable Adjustments: Waiver and Release of Claims. The shipbuilders also criticized a fifth clause, Documentation of Request for Equitable Adjustment (developed later), that requires submission of an affidavit with such claims.

(1) Changes. The Navy Procurement Circular 18 Changes clause required that the shipbuilder provide early notice of constructive changes and establish a definitive procedure for processing them. The key element in this clause was a provision calling for notice of constructive changes within 10 days of occurrence and exclusion of any costs incurred more than 20 days prior to the shipbuilder's notice of the constructive change to the government.

During the interviews, the shipbuilders voiced strong objection to several facets of the Navy Procurement Circular 18 Changes clause. Several complained that the 10-day reporting period did not provide adequate time to prepare the supporting material required to give the government notice. Further, they cited the vagueness of the clause in identifying the date which triggers the start of the notice period. Finally, that part of the clause which precludes the shipbuilder from claiming costs incurred more than 20 days prior to the notice to the government was viewed as a clear device to avoid payment of legitimate shipbuilder costs.

Variations of the Navy Procurement Circular 18 Changes clause are still being used in most shipbuilding contracts. One recent ship acquisition contract contains two ASPR clauses – Changes and Notification of Changes. Together, these two clauses provide all of the rights and protections of the Navy Procurement Circular 18 Changes clause except that the Notification of Changes clause does not provide for the exclusion of costs incurred more than 20 days prior to notice of a constructive change. Since these are standard ASPR clauses, the study team believes that they should be used in future shipbuilding contracts with the addition of a supplemental provision that denies the shipbuilder compensation for constructive changes where notice has not been given after the shipbuilder knew or should have known of the change and after the Navy has been deprived of the opportunity to resolve the problem. This additional provision is discussed more fully in Chapter Five.

(2) Change Order Estimates. The ASPR Engineering Change Proposal (ECP) clause, a brief two-paragraph clause, is not tailored to shipbuilding contracts. Thus, the Navy uses two more elaborate clauses for shipbuilding ECPs – the Configuration Control clause and the Configuration Management clause. As used in shipbuilding, these clauses identify a configuration control baseline and set forth the process for changing that baseline. The time limitation requires that the shipbuilder submit an ECP within 45 days and make its proposal irrevocable for 60 days.

During the interviews, the shipbuilders complained that it took too long for the Navy to make decisions on changes. They also objected to the pricing provisions in the clause. In their view, the government typically attempts to hold the shipbuilder to a tight maximum price, thereby subjecting it to undue risk. In addition, they stated that their pricing problem is further aggravated by a contract provision which states that "any and all delay and disruption costs" are to be considered part of the total price adjustment.

The study team believes that the issue of the timely processing of ECPs and the forward pricing of delay and disruption are closely related. Expeditious processing of ECPs and early pricing of delay and disruption are

vitally important objectives and should be achieved while the participants that prepared the proposal are still available and while the reasons for the ECP are still fresh in their minds. These issues are discussed in more detail in Chapter Five. The study team believes that the procedures for speeding up the change process and for pricing delay and disruption that are presented therein should be incorporated into the Configuration Management and Configuration Control clauses.

(3) Problem Identification Reports. The intent of the Problem Identification Reports clause (which is now entitled Contract Problem Reports) was to provide the Navy with information concerning problems which the shipbuilder knew or reasonably should have known would significantly alter the time of delivery or give rise to a substantial claim. During the interviews, the shipbuilders expressed dissatisfaction with the clause, particularly with respect to the time limitations for an equitable adjustment. The clause reads:

> *. . . the contractor shall not be entitled . . . to an equitable adjustment of the contract due to the incurrence of costs therefor more than 20 days before the contractor submits the required Problem Identification Report. Further, required Government actions performed prior to the date of a Problem Identification Report identifying such required Government actions shall be deemed to have been timely performed.*

The 20-day limitation was recently eliminated from this clause and, hence, will not be an irritant to the shipbuilders on future contracts. The study team believes that the current clause is satisfactory. However, since its value is limited in its present form, its future usefulness might be reconsidered.

(4) Equitable Adjustments: Waiver and Release of Claims. The Equitable Adjustments: Waiver and Release of Claims clause was initially included in Navy Procurement Circular 18. This clause evolved as a result of the continuing disagreement between the Navy and its shipbuilders concerning the scope and terms of the supplemental agreements that provide for equitable adjustments under the Changes clause. Once a change was equitably adjusted, the Navy desired that the settlement reached be total and final.

The clause was substantially modified for the latest acquisition of 688 class submarines as well as for the AO-180 acquisition. The modified clause

provides that any shipbuilder claims for equitable adjustment must include all types of adjustments – not just those that are limited to delay and disruption. In addition, the shipbuilder is no longer required to execute a release if the parties agree otherwise. Although the language of the modified clause is somewhat awkward, the legal effect appears to be that the shipbuilder must include all of the compensable elements of a change in one claim for equitable adjustment – unless the parties agree otherwise.

The shipbuilder's objection to this clause is that it is sometimes impossible to anticipate all of the cost ramifications of a change – particularly at the time the change is issued. The Navy has taken the position that it recognizes this problem and that it does not invoke the clause in those situations. The study team believes that the clausal requirement that all compensable elements be included in the claim is a good business practice and that the shipbuilders should not be entitled to a second or third attempt to adjust their claim. Nevertheless, the uniqueness of the shipbuilding situation where there is a propensity for unpredictable delay and disruption arising from changes must be taken into account. When those situations arise, the Navy must acknowledge them and postpone pricing of delay and disruption until a later date when their impact can be more accurately assessed. Accordingly, the study team concludes that the current clause should continue to be used, but that it should be invoked only in situations when the full effects of a change are known or can be projected with a reasonable degree of certainty.

(5) Claims Submission Affidavit. As previously noted, the affidavit required in several recent contracts to support any claims that are submitted in connection with those contracts first appeared in the Navy Procurement Directives in April of 1976. The principal provisions of the affidavit require that an authorized shipbuilding official swear that:

> *. . . to the best of my knowledge and belief: (i) the facts described in the claim are current, complete and accurate; and (ii) the conclusions in the claim accurately reflect the material damages or contract adjustment for which the Navy is allegedly liable.*

The Navy initiated the affidavit in an effort to require shipbuilders to submit a one-time, "total" claim in connection with the contract on which a claim was dependent. Claims filed by shipbuilders during the late 1960s and early 1970s had sometimes been modified by shipbuilders to reflect greater damages than originally enumerated and/or to espouse a different legal theory than originally argued. Yet the shipbuilders contended that they were frequently unaware of all the facts or of the extent of all the damages at the time of initial submission and that later modifications only constituted updatings as additional information became known. The shipbuilders also objected to what they perceived as the implied accusation in the requirement that they had not always been forthright in previous claim submissions.

The affidavit is somewhat similar to the certificate of current pricing that is required for certain pricing actions by Public Law 87-653. However, there are three major differences: (i) the affidavit is submitted at the time of claims submission, while the certificate is submitted at the completion of price negotiation; (ii) the affidavit must be signed by top management, while the certificate may be signed by lower level employees; and (iii) the affidavit states that the facts presented are current, complete, and accurate and that the conclusions accurately reflect actual damages, while the certificate contains only the statement that the facts are current, complete, and accurate. The study team believes that the affidavit can serve a constructive purpose in involving higher levels of shipbuilder management when the conditions causing major claims emerge, but that it should not be used for normal equitable adjustment proposals. It is possible that a special affidavit could be devised for all claims over a specified dollar amount, such as $1 million. However, even in such cases, the study team questions the practice of requiring a shipbuilder to swear to the accuracy of the conclusions in a claim. The enforcement of this requirement is doubtful, and it raises many legal issues during negotiations. It appears that the language regarding the accuracy of shipbuilder conclusions should be removed from the affidavit so that it only covers the facts included in the claim.

e. **Government-Furnished Equipment (GFE).** As mentioned earlier in this chapter, shipbuilders have frequently attributed significant problems – particularly delay and disruption – to the government's failure to deliver GFE in

accordance with the contract schedule. A number of provisions to the clause have been drafted in an effort to define the responsibilities of the parties relative to GFE. The need to minimize delay when GFE is late is emphasized, and both parties are urged to do so. Another provision normally gives the government the option to forgo furnishing an item of GFE, with provision for an equitable adjustment. Further, the clause states that, after being informed of the government exercise of the option, the shipbuilder will go forward with pre-installation preparation so that construction will continue without delay and disruption. The shipbuilder further agrees that no delay and disruption will result and that no claim will be filed as long as the option is exercised prior to the scheduled delivery date of the GFE. However, should the government later have a change of mind, the shipbuilder is entitled to a contract modification which takes into account increases in the cost and changes in the delivery date.

Most of the minimization of delay provisions also contain a paragraph which allows the government to slip GFE delivery if the ship's delivery date slips:

> *If the delivery date of any vessel is extended . . . the latest date by which the Government must deliver (GFE) shall be extended by an equal number of days . . . .*
>
> *The Government shall not for any reason be obligated to deliver government-furnished property earlier than . . . (the adjusted date) . . . .*

The provision giving the government the option of not furnishing GFE is not considered controversial -- if the shipbuilder takes the timely action required by the clause, no delay or disruption usually occurs. However, the interviews with the shipbuilders did reveal dissatisfaction with the provision that allows the government to slip delivery of GFE a number of days equal to any ship delivery slippage. The majority of the shipbuilders felt that there is not always a direct correlation between a delay in ship delivery and when the shipbuilder needs the GFE and that the provision can adversely affect efficient performance when a delay occurs. In most cases, there is no adverse effect because the Navy does not exercise its right to delay delivery of GFE. Rather, in several recent instances, the Navy has insisted that the shipbuilder take delivery of GFE well ahead of the need for it because of slippage in ship delivery schedules.

In its present form, the provision does not seem particularly to accommodate either the shipbuilder or the government. While an identifiable date for delivery should be programmed to facilitate planning, the shipbuilder may desire an earlier or later date when ship delay occurs and the government may be able to accommodate that date if it is given timely notification. The availability of storage facilities as well as construction progress may also be important considerations.

In summary, the current provision does not allow any flexibility except to the extent that the Navy chooses not to exercise its rights under the clause. The study team concludes that the provision should be modified to require the parties to negotiate new GFE delivery dates if the ship delivery date is extended for excusable delays. The goal of such negotiation should be to follow the course of action which would impose the least cost on the shipbuilder, and the clause could so provide.

A provision in one GFE clause, known as the J-22 clause, denies government liability for delivery slippages up to 180 days:

> *In the event that late delivery . . . (of GFE) causes a delay in the delivery of any vessel in excess of 180 days, any equitable adjustment . . . shall be limited to increased costs attributable to such portion of the delay as extends beyond the 180 day period.*

Although this provision has only been used on rare occasions, it has proven highly contentious. In effect, the shipbuilders have indicated that this clause constitutes nothing more than an attempt by the Navy to shift its responsibility to provide GFE in a timely manner to the shipbuilder – specifically, for the first six months of any delay in ship delivery. However, the Navy feels that the provision encourages early delivery. Since the clause is only used in noncompetitive contracts, the Navy believes that the shipbuilder should be able to price the delay in its bid. It is the study's team's conclusion that any attempt by the shipbuilder to price such a delay would be largely speculative, and it is unlikely that the Navy would allow such a 180-day contingency in the bid. Accordingly, it is the view of the study team that the provision serves no useful purpose and should not be used in future contracts.

f. **Drawings and Other Data.** Navy Requests for Proposals define the ship to be built through the contract design package, which includes contract guidance drawings, contract drawings, and ship specifications. The shipbuilder prepares working drawings from this package for use in actual ship construction, taking into consideration its facilities and construction methodologies. If follow ships are built, the government then makes the lead shipbuilder's working drawings available to the follow shipbuilder for use in developing a detailed design reflecting its specific facilities and construction methodologies.

During the interviews, the shipbuilders offered numerous complaints about inadequacies and conflicts in the contract design package and about inaccurate working drawings provided in follow ship construction. They also indicated that the problem is compounded by the Navy's use of contract clauses which attempt to shift the responsibility for the deficiencies in these drawings and other data to the shipbuilder.

(1) **Contract Guidance Drawings.** The Navy has acknowledged its responsibility for defects in contract guidance drawings in a specific contract clause:

> *. . . If, during design development, a satisfactory design does not result due to defects or impossibilities of performance in these guidance drawings and the contractor's . . . (costs are affected) an equitable adjustment . . . shall be made . . . .*

Thus, if a shipbuilder elects to follow the directions provided by the contract guidance drawings and a less than satisfactory design results because of defects in these drawings, the shipbuilder is entitled to an equitable adjustment.

(2) **Contract Drawings.** The Configuration Control and Configuration Management clauses provide for an equitable adjustment when changes are required in the contract baseline established by the contract drawings. This provision assures the shipbuilder that a price adjustment will be made if the contract drawings are defective.

(3) **Working Drawings.** Working drawings present the shipbuilder's actual detailed plans for construction of the ship. As noted earlier in this chapter, they are prepared by the lead shipbuilder after contract award. These

drawings provide the shipbuilder's work force with the detailed information that is necessary to convert the design and specifications into specific material-ordering information and work instructions. Contractual problems do not generally arise between the Navy and the lead shipbuilder regarding these drawings, since they are prepared by the lead shipbuilder for its own use and thus reflect its facilities, construction methods, and material selections. However, problems can arise with the lead ship working drawings when a follow shipbuilder uses them to construct a ship in its shipyard, using its facilities, its mix of labor skills, and its construction methods. Further, if the working drawings have not been revised to reflect the lead shipbuilder's experience in building the lead ship, the construction problems faced by the lead shipbuilder will surface again and will require resolution by the follow shipbuilder. To the extent that the follow shipbuilder elects to procure different contractor-furnished materials, the follow shipbuilder may encounter additional problems in attempting to use the lead ship working drawings.

Historically, the Navy has made the lead shipbuilder's working drawings available to the follow shipbuilder for only the cost of reproduction. The follow shipbuilder has the discretion of using or not using the drawings. This approach gives the follow shipbuilder the benefit of the lead shipbuilder's experience, but allows the follow shipbuilder to proceed in that manner best suited to its needs.

There are three groups of working drawings which present peculiar problems: (i) nondeviation working drawings, (ii) other working drawings, and (iii) validated working drawings. Each of these drawings is discussed below.

(a) **Nondeviation Working Drawings.** With the advent of nuclear power and the attendant safety considerations, it became necessary to require uniformity for certain Navy ship systems and equipments. This need for uniformity has ultimately affected a number of critical nuclear and nonnuclear systems and equipments for both nuclear submarines and nuclear surface ships. The requirement for uniformity led to the development of a subset of working drawings which the shipbuilder must follow without deviation. Unlike other working drawings, nondeviation working drawings are furnished to the shipbuilder and must be followed exactly unless deviations are approved by Headquarters, NAVSEA.

The nondeviation drawings for each system and piece of equipment so categorized are listed by specific title in the Working Drawings and Other Data clause. The clause does not address the responsibility for defects in these nondeviation materials which result in work that does not meet the ship specifications. However, the right to an equitable adjustment under the Changes clause is implicit in the nondeviation requirement, provided the shipbuilder fully documents its request for an adjustment and shows how the deficiency caused extra work. The study team is of the opinion that spelling out entitlement to an equitable adjustment in the clause would be a useful addition.

(b) **Other Working Drawings.** The Working Drawings and Other Data clause lists the nondeviation items. Following this list the clause states:

> (i) *In addition to the drawings, technical manuals, and other data provided under paragraphs (a) through (h) . . . (the nondeviation drawings) the Government will provide . . . other working drawings, manuals, other data . . . (as they) become available, for whatever use they may have to the contractor in the condition in which they are provided. The Government does not make any representations or warranties with respect to the timeliness of the preparation and availability of such drawings and data, their suitability for the purpose of this contract, the correctness and accuracy of any details, dimensions or other information appearing therein, nor that such drawings and data include all data necessary for construction of the vessel(s) under this contract, nor that they are suitable for the contractor's method(s) or technique(s) of construction, nor that they depict the most economical means for accomplishing the work, and the Government shall not be liable under this contract or otherwise on account of such drawings or data . . . .*

The "other" working drawings and data that are referenced in this subparagraph are those working drawings – other than nondeviation drawings – which are prepared by the lead shipbuilder and furnished to the follow shipbuilder, if desired.[1] This clause simply states that these materials are available to the shipbuilder for whatever use they may serve. It affirms that the Navy makes no representation whatsoever as to the accuracy, usefulness, and

[1] Another term which is occasionally used for these other working drawings and data is "non-nondeviation drawings and data."

suitability of the drawings and further disclaims all liability for any errors or inadequacies in them. The intent of the Navy is to make these other working drawings and data available to the follow shipbuilder on the premise that they may be helpful. The follow shipbuilder has total discretion concerning their use and flexibility to meet the specifications in the manner that is best suited to its particular construction methods and facilities.

Working drawings in conventional ship contracts (contracts which do not contain nondeviation drawings) have generally been made available on an "as is" basis in a manner similar to the "other" working drawings in nuclear ship contracts. While such contracts do not contain any clause that specifically disclaims government liability for errors or deficiencies in such drawings, the Configuration Control clause in such contracts suggests that result:

> *Working drawings . . . which are non-mandatory to the extent . . . the contractor may, but is not required to use . . . whether they are prepared or reviewed by the contractor under this or any other contract, or obtained from a body and [are not included in the configuration baseline].*

Under these circumstances, the Navy takes the position that it should not be held responsible for any shortcomings in the materials. However, since it has been the normal practice for the government to make the drawings available, the shipbuilder undoubtedly counts on using them when submitting a proposal and should be able to presume that they meet adequate standards of accuracy.

(e) Validated Drawings. Another recently developed clause injects the Navy into the working drawings cycle – between the lead and the follow shipbuilder. Once the lead shipbuilder has prepared its working drawings and has found them to be sufficient to its construction needs, the drawings are validated by the shipbuilder and the Navy. After an appropriate interval, the drawings are furnished to the follow shipbuilders. The validation effort addresses the correction of errors and other deficiencies in the lead shipyard's working drawings to assure that they accurately reflect the way the lead ship was actually constructed.

The rights and responsibilities of both parties for the validated drawings appear in the Documentation Acquired by the Contractor clause under the subheading of Validated Lead Yard Documentation. It provides:

(i) *Construction documentation (including working drawings . . .) will be validated by the Government. The Government warrants that work performed without departure from the validated documentation . . . will meet ship specification requirements . . . If, during construction an impossibility of performance arises due to defects in the validated documentation, or if the ship is faithfully constructed in accordance with the validated drawings and fails to meet the requirements of the ship specifications, and the contractor's (cost/time are affected) . . . an equitable adjustment . . . shall be made.*

Another subparagraph of this clause adds:

(iv) *It is conceivable that there may be latent deficiencies found in the lead ship that require revision to previously validated documentation . . . If the contractor determines that the work so required is in excess of his contractual requirements . . . he may submit a request for an equitable adjustment . . . .*

Validated drawings are of relatively recent origin, but early returns from both the shipbuilders and the Navy have been favorable. In concept, the use of validated drawings would appear to offer advantages to both parties. The standardization which the concept produces is particularly desirable to the Navy. The removal of the uncertainty that was previously attached to working drawings is beneficial from the shipbuilder's standpoint. The shipbuilder is fully protected if it performs consistent with the validated drawings. The study team concludes that, whenever a program contains sufficient ships to justify the expense of the validation effort, validated drawings should be used in follow ship construction in accordance with a clause that is similar to the one cited above.

In other instances, the study team believes that there is a better alternative than simply making the drawings available as is and denying government liability through a contract clause. It would be preferable to allow the follow shipbuilder to review and refine the working drawings under a cost-type transition contract. Such an arrangement would enable the shipbuilder to refine the drawings and to make significant engineering changes -- which usually come early in contract performance -- on a cost-reimbursable basis. After the shipbuilder has had an adequate opportunity to review and modify the drawings, the shipbuilder would agree to adopt the drawings as its own. At that point, the transition to a fixed-price-type contract would occur.

In the case of modified follow ships, where prior ships have been constructed but where the contract design package has been significantly updated, the cost-type transition contract could contain a drawing review and design evaluation as an initial cost-type task to be followed by construction of the follow ships on an FPI basis. If a cost-type transition contract is not used in such a follow contract, the study team believes that the Navy should adopt a procedure and contract language to provide for equitable adjustments when significant defects in the working drawings increase the follow shipbuilder's costs.

Blank

F. Conclusions

The study team believes that a number of changes should be made to current ship acquisition strategies, including contract types and contract clauses. The study team's conclusions in each of these areas are summarized below.

1. Acquisition Strategies

a. **For Lead Ships.** The Navy should employ cost-reimbursement contracts – cost plus incentive fee or cost plus award fee – for lead ship acquisitions. The selection of the shipbuilder should be based on all relevant factors, including the optimum manning levels (as discussed in Chapter Two). The projected cost of each competing shipbuilder should be considered, but greater weight should be given to other factors which demonstrate the competence of the shipbuilder to control costs and maintain productivity.

b. **For Follow Ships.**

- The Navy should ordinarily construct follow ships in the lead shipyard where lead shipyard capacity permits – unless the current performance of the lead shipyard falls below standard.
- The Navy should use a cost-type transition contract for the first follow ship in the lead shipyard and then shift to the use of FPI contracts for follow ships as soon as the risks can be adequately defined and priced.
- The Navy should use cost-type transition contracts for modified follow ships when the prior ships have been constructed but the contract design package has been significantly updated. The cost portion of this contract should only cover the initial design evaluation task.
- When it is desirable to obtain additional ships from one or more follow shipbuilders, the Navy should:

- Employ multiple evaluation factors in selecting the follow shipyard(s), with cost but one of several factors.
- Require shipbuilders to justify low cost estimates.
- Select a contract type that is appropriate to the risks inherent in the construction task. An FPI contract is appropriate if the contract design package is technically sound and stable, the ship is not complex, and the shipbuilder's project workload is stable. If these conditions do not obtain, a cost-type transition contract should be employed for the first ship in the follow shipyard, with a transition to an FPI contract as soon as the actual costs of constructing the first ship in the shipyard can reasonably be predicted.

- The Navy should use options in acquiring follow ships only for one year beyond the current year. Option prices should be revised simultaneously with all revisions to basic contract prices.
- The Navy should consider seeking congressional authority to use multiyear contracting for shipbuilding.

2. Negotiation Techniques

a. Navy negotiators should establish target costs for FPI contracts which are as accurate a reflection of the anticipated costs of performance as possible.

b. Target costs should include projected escalation at the rate anticipated at the time of negotiations, with upward and downward adjustments in escalation based on variations from the projected rates.

c. Profits should be established against the total anticipated costs of performance, including projected escalation.

d. The Vinson-Trammell Act should be amended to reflect modern contracting practices.

e. The Navy should study additional means of incentivizing shipbuilders to invest in labor-saving equipment.

3. **Contract Clauses**

A new baseline of standard contract clauses should be established for use in Navy shipbuilding contracts, incorporating the following principles:

a. **Known Risks Beyond the Control of Both Parties/ Economic Price Adjustments**

- Materials: Adjust on the basis of the Bureau of Labor Statistics (BLS) index. A more accurate index should be developed to reflect various categories of ships. If a substantial disparity exists between the BLS index and the proposed shipbuilding program, a special composite index should be negotiated.
- Direct Labor: Adjust on the basis of the actual labor rate.
- Indirect Costs: Adjust indirect labor on the basis of the fluctuations in either the actual direct or indirect labor rates as circumstances dictate. Separate adjustments should be made for employee benefits and energy costs.
- Time Limitation on Escalation: Remove time limitations from the Economic Price Adjustment clause and place any desired delivery incentive in a specially designed clause that states the specific dollar amount of such incentives.

b. **Unknown Risks Beyond the Control of Both Parties.** Relieve the shipbuilder of unknown risks through contract clauses in long-term, high-risk contracts, where cost-type contracts are not considered desirable.

c. **Delivery and Acceptance of the Ship.** Continue the use of the current Delivery of Completed Vessel and Nucleus Crew clauses.

d. **Progress Payments.** Continue to use the current Progress Payments clause. Provisionally adjust the progress payment billing base when target costs are overrun because of Navy-required changes. If the shipbuilder can justify the need for payments more frequently than every other week, the Navy should accommodate.

e. **Anti-Claims Clauses**

- **Changes.** Use the standard ASPR Changes and Notification of Changes clauses in all shipbuilding contracts. Add an additional provision denying the shipbuilder compensation for constructive changes where notice has not been given after the shipbuilder knew or should have known of the change, and denied the Navy the opportunity to resolve the problem.
- **Change Order Estimates.** Continue to use the Configuration Control or Configuration Management clauses.
- **Problem Identification Reports.** Reevaluate the utility of the Contract Problem Reports clause.
- **Equitable Adjustments: Waiver and Release of Claims.** Continue to use the Equitable Adjustments: Waiver and Release of Claims clause, but require fully priced adjustments only in those situations where all of the ramifications of a change can be predicted.
- **Claims Submission Affidavit.** Use this clause only for major claims, and limit the certification to statements of fact.

f. **Government-Furnished Material.** Make more flexible the provision which extends the delivery of GFE day for day if the ship delivery date is extended and discontinue the use of the J-22 clause.

g. **Drawings and Other Data.** Continue the use of the current clauses dealing with contract guidance drawings and contract drawings. For working drawings:

- Use validated drawings on follow ships where the program contains sufficient ships to justify the validation effort.
- State the shipbuilder's right to an equitable adjustment for defective nondeviation drawings.
- Discontinue the provision of other working drawings on an "as is" basis by including a cost-reimbursement segment in the contracts under which such drawings are available.

Blank

Chapter Four Management of Ship Construction Contracts

CHAPTER FOUR. MANAGEMENT OF SHIP CONSTRUCTION CONTRACTS

A. Introduction

This chapter addresses the management of Navy ship construction contracts – a process which begins with the award of a contract to a shipbuilder. It examines the problems that are created through the interactions between the government and the shipbuilder during the course of the contract and the extent to which these problems contribute to managerial frustration, cost increases, acrimony and disputes and, ultimately, to shipbuilder claims.

The opportunities for conflict and misunderstanding during the construction cycle are plentiful because of the complexity of naval ships, the process of ship design and construction, and the multiple administrative requirements that are necessary to manage this process. The need to clarify and resolve issues relating to the technical and business aspects of shipbuilding during the long construction period negates a hands-off approach by the Navy. For one thing, technological improvements generally occur during construction that require changes if the ship is to achieve optimum performance. In addition, the ship's specifications and drawings are never totally free of ambiguity or error. Further, the contract and its supporting specifications and drawings simply cannot anticipate precisely all of the questions that will arise in the execution of such a complex task.

Given this need for interchange of information, it is important to establish a climate that is favorable to full and free communication in both directions. However, such a climate can only come about where both parties trust and support one another. In the current atmosphere of multimillion-dollar claims, lawsuits, and ship delivery slippages extending years beyond contract delivery dates, the desired climate is obviously lacking with a number of the shipbuilders. Mutual fault-finding and suspicion distort even the simplest issues.

The interviews with the shipbuilders confirmed the fact that those who have filed major claims for price adjustments are most critical of the Navy's handling of contract management. These shipbuilders believe that certain actions

by the Navy in administering shipbuilding contracts constitute an unwarranted intrusion into corporate management. They also reported a steadily increasing burden of nonproductive administrative effort associated with contract performance which has resulted from acts of the Navy and other agencies of the Federal Government. In addition, these shipbuilders were highly critical of the Navy's insensitivity to the cost and schedule effects of these actions. They perceived a marked erosion of the Navy's capability in technical and contracting disciplines.

Clearly, Navy representatives have been concerned with the management practices of some shipbuilders. This type of contract management, which is often termed "engagement" by the industry, came about because Navy personnel detected a general deterioration of productivity in shipyards – particularly those undergoing major expansion efforts – and felt that shipyard managers were not dealing effectively with this problem. In the Navy's view, one aspect of this problem was the lack of good shipbuilder management information systems. This fault was seen as a contributing cause of poor management control which prevented shipbuilders from accurately assessing the effects of managerial actions or contract changes.

B. The Contract Management Environment

Construction of a Navy ship involves a large number of management tasks. Exhibit LVI sets forth a partial listing of the areas of contract management that require communication between the Navy and the shipbuilders after contract award. The list is divided into three broad areas of concern: technical management, business management, and administrative management. On the basis of this exhibit, it is clear that Navy involvement covers virtually the full spectrum of internal management. For example, in the technical area of specification interpretation and design approval, the Navy concerns itself with the shipbuilder's design capabilities. In the area of quality assurance, the Navy closely monitors the training and qualifications of the shipbuilder's work force. In the business area, the need to assess schedule feasibility and to mesh government support actions with the shipbuilder's schedules prompts the Navy to inquire into such internal management details as hiring and training plans, performance to internal schedules, and the application of resources. The same attention is given to equal employment opportunity progress in the area of administrative management.

EXHIBIT LVI
AREAS OF NAVY/SHIPBUILDER CONTRACT MANAGEMENT INVOLVEMENT

Technical Management	Business Management	Administrative Management
– Specification Interpretation – Design Approval – Process Qualification – Government-Furnished Data – Government-Furnished Material – Value Engineering – Deviation Approval – Quality Assurance – Testing and Trials – Product Acceptance	– Planning/Scheduling – Make/Buy Plans – Subcontract Review – Property Administration – Progress Measurement – Overtime Review – Subcontractor Performance – Productivity – Claims Avoidance – Change Management – Claims Administration – Insurance – Payments	– Equal Employment Opportunity – Material Management – Physical Security – Safety – Small Business Program – Radiological Controls – Nucleus Crew Management – Visitor Control – Public Information

Exhibit LVII sets forth a partial listing of the government agencies which deal directly with the shipbuilder during the course of ship construction, trials, and delivery. The need for interaction with most of these agencies is real and will continue, but the potential for uncoordinated actions that affect shipbuilder performance is clearly a problem.

1. The Navy Contract Management Organization

Exhibit LVII indicates that a number of Navy organizations influence the management of Navy ship construction contracts. However, the major responsibility for contract management rests with the Commander, NAVSEA.

In order to oversee all ship construction efforts, NAVSEA has established the ship acquisition project manager (SHAPM) as the coordinator of all Navy actions relating to a specific ship construction program and the supervisor of shipbuilding (SUPSHIP) as the focus of all actions dealing with a specific shipbuilder. Within this framework, other NAVSEA organizations interact with the shipbuilder in their respective functional areas. These include NAVSEC, the Contracts Directorate, and the participating managers (PARMs) responsible for providing government-furnished equipment.

A number of the policies by which the SHAPM exercises authority appear in various ship project directives (SPDs). The policies and procedures by which these other NAVSEA organizations administer shipbuilding contracts are set forth in the Ship Acquisition Contract Administration Manual (SACAM). In addition to specific guidance, the SACAM sets the tone for Navy shipbuilding contract administration. Active involvement with the shipbuilder is prescribed by the SACAM to assure that Navy interests are protected and that Navy decisions are made on the basis of full, factual knowledge of the circumstances.

Three of the NAVSEA elements that are concerned with the management of Navy ship construction contracts are discussed more fully below. They include the Command itself (that is, NAVSEA generally), NAVSEC, and the various SUPSHIP offices.

EXHIBIT LVII
GOVERNMENT ORGANIZATIONS INTERACTING DIRECTLY WITH U.S. NAVY SHIPBUILDERS

Office of the Secretary of the Navy

- Assistant Secretary of the Navy (Manpower, Reserve Affairs, and Logistics)
- Assistant Secretary of the Navy (Research, Engineering, and Systems)
- Assistant Secretary of the Navy (Financial Management)

Office of the Chief of Naval Operations

- Chief of Naval Material
  - Program Managers
  - Commander, Naval Sea Systems Command (NAVSEA)
    - -- Ship Acquisition Project Managers (SHAPMs)
    - -- Contracts Directorate (SEA-02)
    - -- Participating Managers (PARMs)
    - -- Nuclear Propulsion Directorate (SEA-08)
    - -- Supervisors of Shipbuilding (SUPSHIPs)
    - -- Naval Ship Engineering Center (NAVSEC)
- Fleet Commanders
  - Fleet Introduction Team
  - Nucleus Crew
- Board of Inspection and Survey (INSURV)

Other Federal Agencies

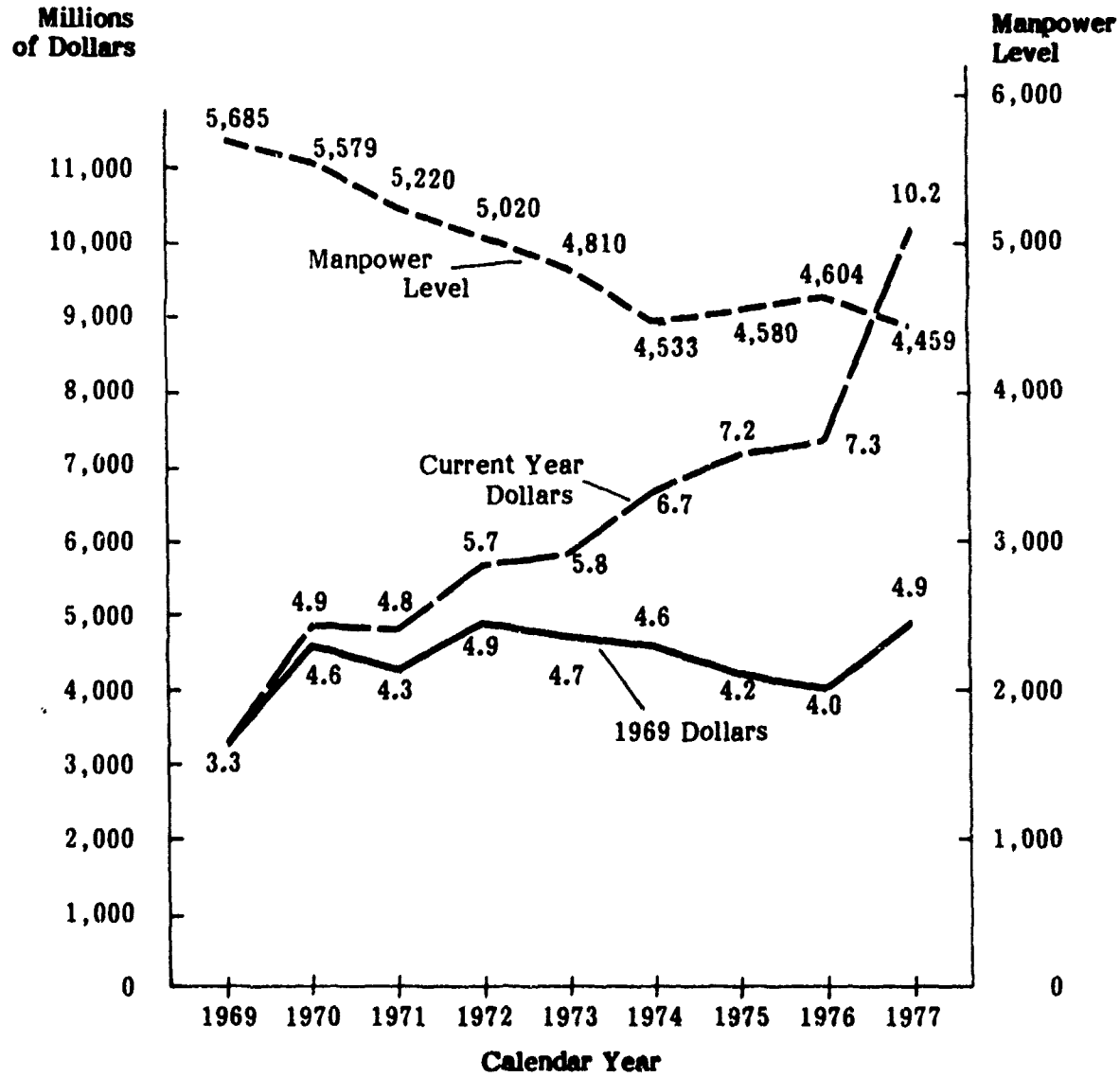
- The Congress
- Defense Contract Audit Agency (DCAA)
- Defense Contract Administration Service (DCAS)
- Department of Labor (DOL)
  - Occupational Safety and Health Administration
  - Office of Federal Contract Compliance
- Environmental Protection Agency (EPA)
- Government Accounting Office (GAO)
- Department of Commerce (DOC), Maritime Administration (MARAD)
- Department of Energy (DOE)

a. **NAVSEA.** Exhibit XXIII (Chapter One) displayed an organization chart of NAVSEA. A number of NAVSEA personnel, both within the Headquarters and in various field activities, have technical and contract management responsibilities during the ship construction cycle. However, in the course of the interviews, the shipbuilders were nearly unanimous in their opinion that NAVSEA's technical and contract management disciplines have been eroding for the past decade or more. Their views were generally qualified with an expression of confidence in the capabilities and excellence of individual NAVSEA employees, but they expressed the opinion that the ranks of experienced people are too thin to handle the workload. The shipbuilders also reported that decision-making authority in the field has been steadily circumscribed and supplanted by more centralized program direction from NAVSEA Headquarters. These trends manifested themselves to the shipbuilders in the form of the extended time necessary to obtain decisions of both a technical and business nature. Although the shipbuilders did not quantify the effect of this change, they declared that it added unnecessary cost through increased disruption of planned work.

Exhibit LVIII depicts the decline in the staffing levels at NAVSEA Headquarters during the period from 1969 to 1977. During this period, the Department of Defense as a whole underwent personnel reductions. Such reductions were levied on the services with relative uniformity in relation to their size. The reductions were distributed within the Navy, reducing strength across the whole organization – without reducing the number and type of functions to be performed. Under a Navy-wide policy during this period, personnel ceilings were lowered by means of hiring freezes rather than through reductions in force.

At the same time, Navy-wide reductions in the numbers of high-grade civilian employees were imposed. Grade-level goals have been approached through strict application of promotion restrictions in the high grades (GS-13 and above) and through more centralized control of the billet-grading process. These restrictions, coupled with the aforementioned personnel ceiling reductions, have greatly diminished the promotion opportunities for civilian employees of the Naval Material Command, including NAVSEA. The restrictions have had a serious impact on the command's ability to hire and retain high-quality personnel.

EXHIBIT LVIII
NAVSEA HEADQUARTERS END STRENGTH
AND DOLLARS EXPENDED: 1969 - 1977*



*Data include NAVSEC personnel.

Source: NAVSEA.

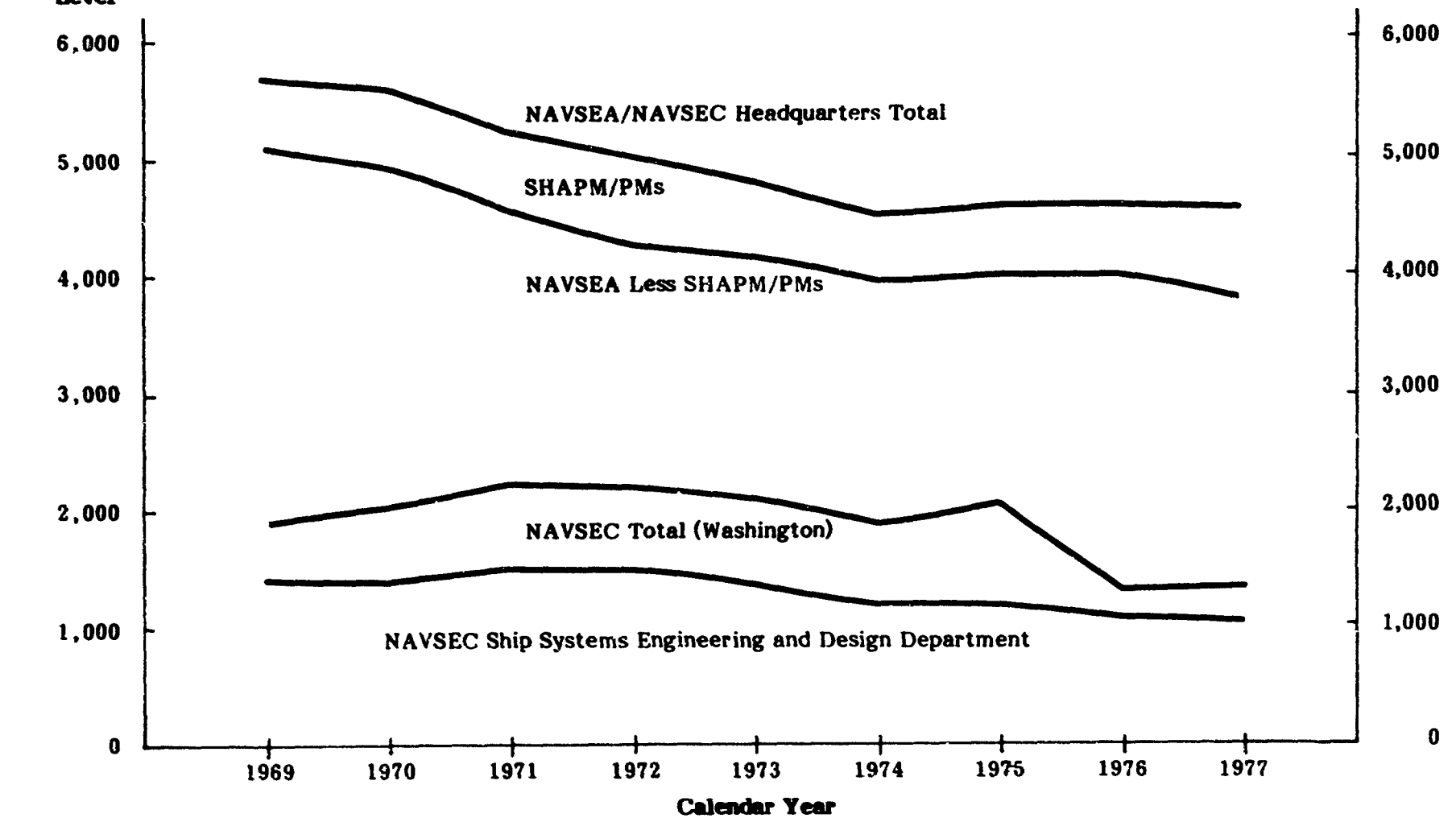
Exhibit LVIII also shows the increased dollars expended from 1969 to 1977 – a 42 percent increase in 1969 dollars. This is a measure of the added workload imposed on the command. This added burden on NAVSEA's management ability was exacerbated by two developments: the technical complexity of warships increased rapidly and increasing congressional and DOD interest in weapons system acquisition management imposed the need for stronger program management. Exhibit LIX shows the relative shifts of NAVSEA personnel resources during this period. Inevitably, people who were qualified to perform the project management tasks came out of the functional organizations. The NAVSEC engineering codes appear to have been most severely reduced.

The inability to hire for protracted periods has meant that the staff personnel structure has been shaped by the individual decisions to retire or transfer rather than by managerial plan. Skill imbalances have also resulted which have not been readily resolved. Management's ability to compensate by internal reassignment has been limited by the personnel resources on hand, which do not always match the needs that are generated by attrition.

During the interviews, the shipbuilders identified one specific aspect of this staffing dilemma which was highly visible. They noted that the contracting process had become laborious because of the overextension of the limited numbers of experienced contract specialists. The assignment of multiple programs to more experienced contracting personnel has meant they do not always devote the concentrated attention which is necessary to assure that contracting matters are promptly resolved on each program. These multiple assignments have been necessitated by the loss of experienced contract specialists to other government agencies with higher grades or greater opportunities for promotion.

b. NAVSEC. NAVSEC's responsibility is directed toward the development of the contract design of the ship which flows from the preliminary design that was prepared earlier. Thus, much of NAVSEC's effort is expended during the planning stages of the total acquisition cycle. However, at the same time, NAVSEC also performs a broad range of design services for the SHAPMs during construction of the ship, including providing advice on various design changes, reworking and updating needed specifications, reworking contract

EXHIBIT LIX
NAVSEA/NAVSEC STAFFING HISTORY: 1969 - 1977



Source: NAVSEA.

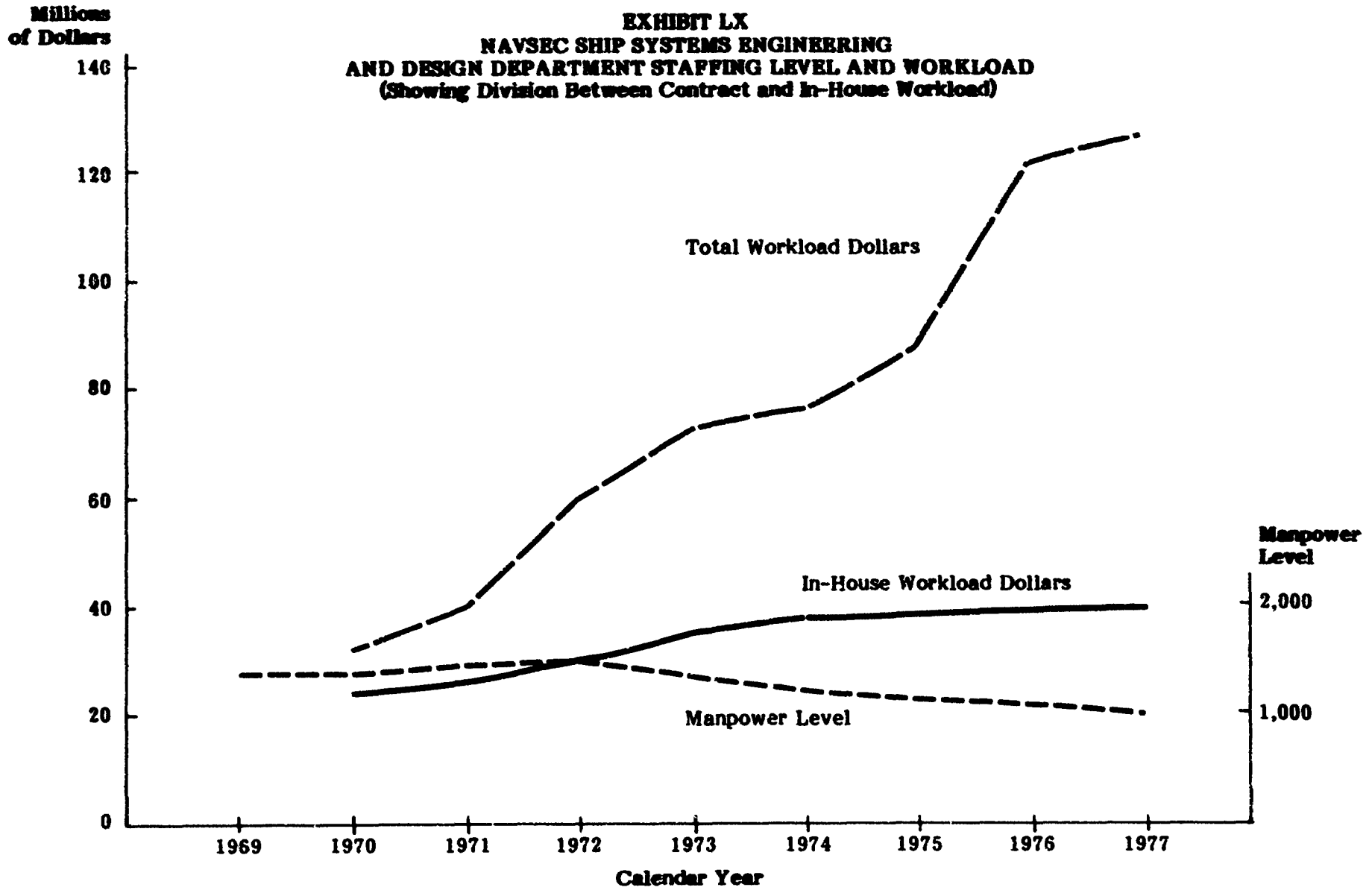
drawings, providing technical advice on construction and test problems, and providing advice and guidance on the government-furnished equipment and information used during construction. As part of these contract management efforts for the SHAPMs, NAVSEC employs a number of its engineers in the development of revised contract drawings and in changing and updating a large volume of ship and equipment specifications.

During the interviews, the shipbuilders (particularly those engaged in follow ship construction) commented unfavorably on the practice of modifying the specification for each new procurement to reflect updated specifications. They stated that this tendency to invoke the most current technical requirements created a high volume of change on follow ships, introduced added risk through the higher potential for conflicting specifications, and generally caused high shipbuilding cost without a commensurate gain in ship capability. The shipbuilders further indicated that it took an excessive amount of time to obtain drawing approvals and other associated technical decisions from NAVSEC. Finally, all of the shipbuilders voiced concern about the quality of NAVSEC-provided ship specifications and the frequency of conflict and obsolescence in equipment specifications.

Exhibit LIX, above, illustrates the decline in personnel strength at NAVSEC as a whole and in the NAVSEC Ship Systems Engineering and Design Department in particular. As this exhibit reveals, from fiscal year 1971 to 1977, the NAVSEC staff was reduced by 42 percent. In part, this reduction resulted from functional transfers to NAVSEA. However, the engineering force was reduced from 1,477 to 1,010 during this time – a 32 percent decline. As in the case of NAVSEA in general, the workload at NAVSEC grew substantially during this period. Exhibit LX shows the development of this increase.

In order to handle the greater workload with reduced numbers of people, NAVSEC has developed an increasing reliance on contract design agents. Whereas about 37 percent of its workload was contracted out in 1971, about 70 percent of its engineering effort was performed by commercial naval architect and engineering firms under contract in 1977. The personnel required for management of this large contract engineering effort (more than $90 million in 1977) have further diminished the NAVSEC resources that are available to perform engineering work in house.

EXHIBIT LX
NAVSEC SHIP SYSTEMS ENGINEERING
AND DESIGN DEPARTMENT STAFFING LEVEL AND WORKLOAD
(Showing Division Between Contract and In-House Workload)



Source: NAVSEA.

NAVSEC has also seen a reduction in the number of man-days expended in preparing and updating the 6,000 military specifications under its control. As Exhibit XXXVI (Chapter Two) reveals, the number of man-days expended on this effort has fallen from a high of 13,000 in 1970 to about 7,000 (projected) in 1978.

e. **SUPSHIPs.** As mentioned earlier in this chapter, the SHAPM serves as the coordinator for all of the actions which relate to a specific ship construction program, and the SUPSHIP is the focal point for all of the actions which deal with a specific shipbuilder. Exhibit LXI presents a list of SUPSHIP offices. These 16 SUPSHIP offices have been established for the purpose of field contract administration. They are located at the main shipyards that build Navy ships or in central locations. Four of these offices (Bath, Groton, Newport News, and Pascagoula) are virtually single shipbuilder offices, while the rest deal with more than one shipbuilder in the geographical area. Most SUPSHIP offices manage contracts with ship repair yards as well.

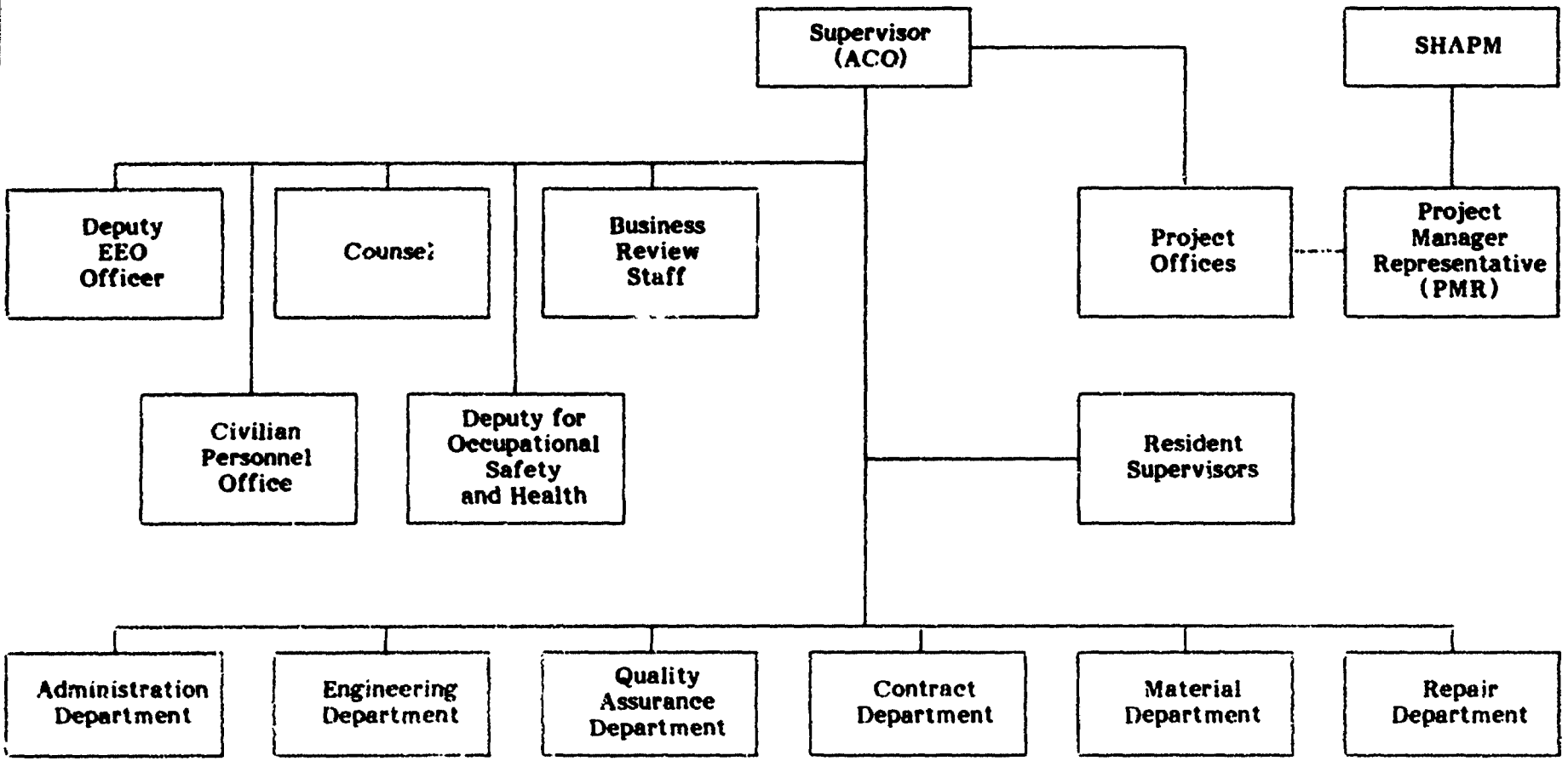
As the administrative contracting officer (ACO), the SUPSHIP is in daily contact with the shipbuilder on matters which cover the full spectrum of business and technical administration. A typical SUPSHIP organization diagram is depicted in Exhibit LXII. For major ship programs, SHAPMs have established field project manager representatives (PMRs) at the SUPSHIP offices to provide for project management oversight and rapid communications with NAVSEA Headquarters. Where a PMR has not been established, the SUPSHIP generally provides a project officer and staff to perform the same function. These staffs are small and they rely on the SUPSHIP functional organization for support and advice in such areas as quality assurance, technical approvals, and management of GFE.

The SUPSHIP's most visible role is that of observer and inspector of the shipbuilder. In addition, the SUPSHIP performs a number of vital functions in support of the shipbuilder's requirements, including coordination as required to assure that the Navy's contractual obligations are met, coordination of technical services from GFE vendors, material expediting, management of outfitting, and visitor clearance and control.

EXHIBIT LXI
SUPSHIP OFFICES

- Bath, Maine
- Boston, Massachusetts
- Brooklyn, New York
- Charleston, South Carolina
- Groton, Connecticut
- Jacksonville, Florida
- Long Beach, California
- Newport News, Virginia
- New Orleans, Louisiana
- Pascagoula, Mississippi
- Pearl Harbor, Hawaii
- Portsmouth, Virginia
- San Diego, California
- San Francisco, California
- Seattle, Washington
- Sturgeon Bay, Wisconsin

EXHIBIT LXII
TYPICAL SUPSHIP ORGANIZATION FOR NEW CONSTRUCTION



Source: NAVSEA.

While the concentration of authority in the SHAPM offices provides improved management capability within NAVSEA, it has also affected the authority of the SUPSHIP. The limits on the SUPSHIP's authority to act for the Commander, NAVSEA, are well defined in the SACAM. The relationship between the SUPSHIP and the SHAPM is further defined by Memoranda of Agreement and/or by ship project directives.

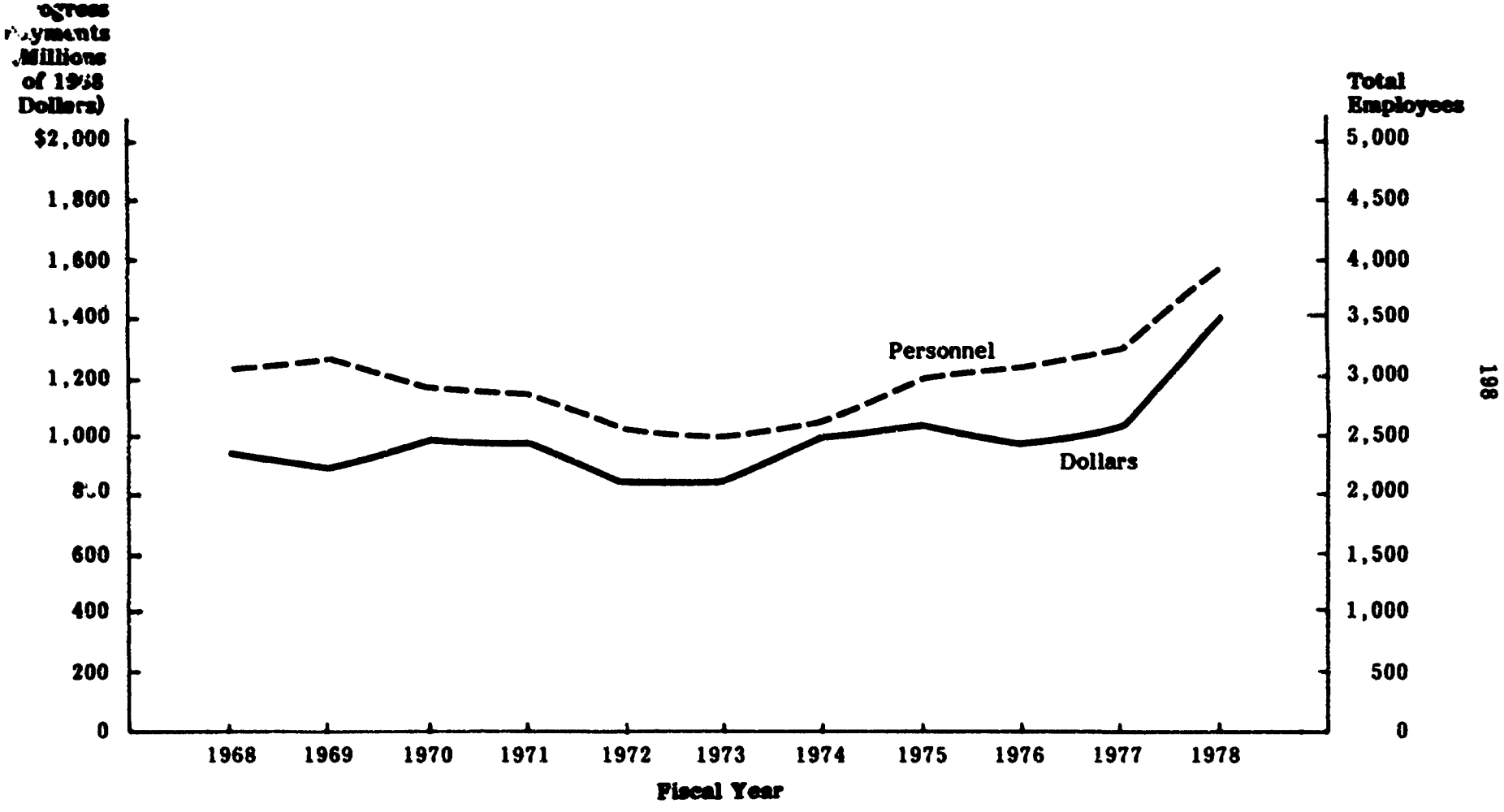
According to the shipbuilders, the SUPSHIPs are no longer making many of the type of significant decisions they made 10 years ago. Today, many technical and business matters which were formerly under local cognizance must be forwarded to the SHAPM for decision. Several shipbuilders expressed concern that a technical decision which a SUPSHIP must pass on to the SHAPM is then referred by the SHAPM to NAVSEC, where limited resources may cause an inordinate delay in the resolution of the problem. The lack of timely decision-making was cited as a major factor in delaying work.

The shipbuilders also pointed to the growth in the numbers of government personnel (including increases in the size of the SUPSHIP offices) as one of the reasons for the increases in their overhead costs. They informed the study team that they do not believe these additional personnel have either improved the quality of or reduced the costs of or the time required for ship construction.

(1) **SUPSHIP Staffing.** Exhibit LXIII displays the workload and work force history of the SUPSHIPs over the past 10 years. It shows that the size of the work force has varied from a low of about 2,600 people in fiscal year 1973 to a high of approximately 3,700 people projected to be on board at the end of fiscal year 1978 – an increase of about 42 percent over the period. This same exhibit reveals that progress payments as measured in constant 1968 dollars have varied from a low of about $850 million in fiscal year 1972 to a projected high of about $1,400 million in 1978. In summary, while the number of SUPSHIPs personnel increased about 42 percent during this period, progress payments increased by about 65 percent.

Progress payments have been considered a gauge of a shipbuilder's level of activity and, hence, a reasonable parameter against which to assess

EXHIBIT LXIII
SUPSHIP WORKLOAD VS. WORK FORCE: FISCAL YEAR 1968 - 1978*



*Dollar data are for new construction and conversion efforts; fiscal year 1978 data are projected.

Source: NAVSEA.

SUPSHIP manning needs. However, since some shipbuilders have in fact expended more than they have been paid in progress payments, the adequacy of this gauge merits further review.

(2) **Shift in the SUPSHIP's Role.** The role of the SUPSHIP has changed over this period to reflect an increasing awareness of the business aspects of the shipbuilder's operations and a diminished emphasis on the resident inspector role. This change is demonstrated by the inclusion of a business review staff in the SUPSHIP organization beginning in the early 1970s in response to the increasing use of cost-reimbursement and FPI contracts. Further, a deputy for occupational safety and health who is concerned with Navy personnel and safety conditions on board ships has been added. The lessened inspection role is reflected in a change from an Inspection Department to a Quality Assurance Department.

(3) **Inspection.** In recent years, the Navy has changed the process it uses to determine whether the technical requirements of a shipbuilding contract have been met. In the past, SUPSHIP personnel were used to perform detailed inspections of the ships as they were constructed. The process employed was that specified in MIL-I-45208A (known as "MIL-I"), which resulted in a constant and total involvement by the Navy in the day-to-day ship construction process. One consequence of MIL-I was that delays in construction which were brought about by SUPSHIP inspections were, in part, a Navy responsibility. Further, because the Navy had a competent inspection force on hand, there was a strong temptation for the shipbuilder to neglect the internal development of a comparable inspection capability.

Today a different process, as specified in MIL-Q-9858A (known as "MIL-Q"), is widely utilized. This approach requires that the shipbuilder develop an internal inspection capability and perform its own inspection. The SUPSHIP role is to conduct a continuing audit of the shipbuilder's internal inspection operation and to determine whether it meets the criteria set forth in MIL-Q. This change in SUPSHIP involvement in the ship construction process results in little, if any, delay in the ship construction cycle. In addition, the shipbuilder's internal competence to assess its own quality performance has been strengthened, thereby creating an environment which should lead to less rework, better schedule control, and lower ship construction costs.

The transition from MIL-I to MIL-Q has not been easy. One of the most significant problems has been the development of statistical quality assurance standards to suit the nonrepetitive nature of ship construction and component fabrication. During the course of the interviews, the shipbuilders told the study team that the SUPSHIPs continue to perform detailed inspections – even though they profess to have adopted an oversight role. Based on these discussions, it appears that this perception stems mainly from the turnover phase when the Navy takes custody of systems, components, or space. Uncompleted or defective work is catalogued during the process of ascertaining whether the component or system is in fact ready for turnover.

The problem of inspection at the time of system turnover is compounded by the fact that, before all work on a system is complete, it may be temporarily transferred for test or test support purposes and for operation by the Navy. The shipbuilders objected to the administrative efforts that are required to review what they consider to be premature reports of deficiency, while SUPSHIP personnel feel that failure to inspect and record these deficiencies could result in a later failure or imply acceptance of faulty or incomplete work. The issue is further complicated if Navy personnel list as deficiencies items which the shipbuilder believes meet the contract requirements.

(4) Subcontract Consent. Section 23 of the ASPR sets forth the requirements for review and approval of a shipbuilder's procurement system as well as for consent to subcontracts. It states the general policy that approval of the shipbuilder's procurement system will usually obviate the need for consent to individual subcontracts. Briefly, the regulation requires that a contractor procurement system review (CPSR) be performed when a shipbuilder's negotiated sales to the government are expected to exceed $5 million in a 12-month period. Section 23-200 of the ASPR requires that government consent be secured in advance of entering into specified subcontracts. The clause which is used in FPI contracts also provides that the need for prior approval of individual subcontracts is eliminated if a contractor's procurement system is approved – unless specific subcontracts are designated in the contract. Cost-type contracts provide for limited degrees of prior approval once the shipbuilder's procurement system is approved.

The SUPSHIP offices carry out the subcontract consent function. During the interviews, a number of the shipbuilders commented adversely on this function. The principal objection was that the Navy conducts the inspections and audits which lead to approval of the shipbuilder's subcontracting process, but still requires submission of subcontracts for consent. Some shipbuilders stated the approval process has been so slow at times that they have been forced to proceed in advance of consent – at the risk of reversal – in order to meet their material ordering schedules. Their perception was that subcontract consent represents an administrative burden of little benefit.

In the past year, the Navy has made some progress in this area. Two shipbuilders now have approved procurement systems, and a third has received conditional approval. Another shipbuilder's system is expected to be approved in September 1978. Although NAVSEA's earlier attitude appeared to be opposition to removing consent requirements once procurement system approval was granted, it is currently raising consent thresholds when systems are approved. However, as yet, no shipbuilder has been totally freed of subcontract consent requirements.

(5) **Surveillance.** Surveillance and auditing by the SUPSHIP in the areas of schedule compliance, labor productivity, and resource application have become more controversial in recent years as shipbuilders have experienced long schedule delays and cost overruns. The shipbuilders have viewed these activities as an attempt by the Navy to find and document shipbuilder problems in support of Navy defenses against claims. However, the Navy has viewed its actions as necessary in order to protect its interests in the cost-sharing provisions of FPI contracts. The Navy also believes that its surveillance activities are necessary in order to assess schedule realities and to make the best use of government resources (such as the nucleus crew support required for certain tests and government-furnished materials).

In some instances, the Navy's lack of confidence in shipbuilder management information systems has led to increased surveillance activities. In the Navy's view, the mutual inability of the Navy and its shipbuilders to discern incipient departures from plan, schedule slippages, and cost growth has largely been due to the unavailability of meaningful shipbuilder performance data. In

order to detect problems and correct them before they cause unavoidable delay and cost growth, the shipbuilder must monitor a variety of performance measures – cost and schedule performance being only the end result. Examples of the type of data which are needed include the shipbuilder's performance on its plans for material ordering and receipt, drawing issue, and manpower application. In addition, analysis of quality control information provides an early insight into productivity trends. Although cost and schedule performance may not provide the earliest notice of problems, it is a powerful tool for assessing the effectiveness of management control and for planning the future application of resources.

DOD Instruction 7000.2 sets forth standard cost/schedule control system criteria (C/SCSC), and provides for a work breakdown structure, the packaging of work, and the establishment of cost and schedule baselines for each work package. The performance data that are collected by this system show the budgeted and actual cost of the work scheduled and the work performed. Data can be accumulated at various levels of detail and can be analyzed to provide an objective assessment of performance to plan.

C/SCSC have been incorporated into a number of recent shipbuilding contracts. However, initially it was not accepted by most of the shipbuilders. The early difficulties stemmed from what shipbuilders felt was a rigid interpretation of the criteria by the Navy, which could force costly and unneeded changes in their work description and data collection and reporting procedures. In the course of the interviews, it became apparent that many of the early reservations about the cost/schedule control system have been resolved and that most shipbuilders consider adoption of the system to be beneficial.

At present, all but one of the 11 major shipbuilders are either validated or well on the way to validation under C/SCSC, and discussions with the last shipbuilder are continuing. Shipyards which are operating validated systems are reporting increased confidence in schedule and cost estimates and have documented numerous instances in which the analysis of the data provided by the system has permitted detection of incipient manpower, skill, or schedule problems early enough to prevent schedule delays and/or cost overruns. In some instances, review of the C/SCSC data by the SUPSHIP has been instrumental in problem detection and correction.

2. Non-NAVSEA Activities

In addition to NAVSEA and its subordinate activities, certain other activities of the Federal Government which also influence the management of shipbuilding contracts were cited in the shipbuilder interviews as having a significant, direct effect on Navy/shipbuilder relations and on shipbuilder costs. These include the Defense Contract Audit Agency (DCAA), the nucleus crew, and the Board of Inspection and Survey (INSURV). The impact that each of these activities has on the shipbuilding environment is discussed below.

A number of other government agencies were mentioned adversely during the interviews, including the Occupational Safety and Health Administration and the Environmental Protection Agency. Since the latter organizations exert their influence through law and regulation rather than as participants in contract management, they are treated separately in paragraph d, below.

a. Defense Contract Audit Agency. Most of the shipbuilders were highly critical of the DCAA. Their major concern was what they perceived as unwarranted DCAA involvement in their internal management – an involvement which they see as steadily increasing. They indicated that this intrusion into their management affairs often duplicated the activities of the SUPSHIP. Shipbuilder comments generally gave the impression that they were experiencing increased overhead costs in order to deal with these expanded DCAA interests.

Exhibit LXIV provides information on the number of DCAA personnel who are currently on site at the 11 major private shipyards. As this exhibit reveals, the number of auditors has doubled since 1969, with the largest increase occurring in 1974 when these staffs increased by about one-third. Since the DCAA's primary role is the audit of expended funds, one way of measuring the impact of these auditors on the shipbuilders is to compare the number of auditors with the dollar values of the contracts that are placed with these 11 shipyards. Exhibit XII (Chapter One) indicates that the dollar value of the new construction contracts that were placed with these shipyards has averaged $2,002 million annually for the past five years. Comparison of this information with the numbers of auditors as presented in Exhibit LXIV indicates that, on the average, each auditor examines $21 million in ship contract values annually.

EXHIBIT LXIV
SUMMARY OF DCAA RESIDENT AUDITOR STAFFING LEVELS AT THE ELEVEN MAJOR SHIPYARDS

Shipyard	30 June 1969	30 June 1970	30 June 1971	30 June 1972	30 June 1973	30 June 1974	30 June 1975	30 June 1976	30 June 1977	31 March 1978
Avondale	-	-	-	-	-	-	-	-	3	3
Bath	1	1	1	1	1	1	2	4	5	8
Bethlehem	-	-	-	-	-	-	-	-	-	-
Electric Boat	20	20	22	23	27	31	32	30	31	29
Ingalls	4	12	19	18	20	35	33	35	31	27
Lockheed	-	-	-	-	-	-	3	5	4	2
National Steel	1	1	1	1	1	4	3	3	3	3
Newport News	15	14	17	17	22	24	24	21	19	20
Quincy	-	-	-	-	-	-	-	-	-	-
Todd – Seattle	-	-	-	-	-	-	-	1	4	5
Todd – San Pedro	-	-	-	-	-	-	-	-	-	2
Total	41	48	60	60	71	95	97	99	100	99

The SACAM is explicit in assigning the full responsibility for contract administration to the SUPSHIP. The manual clearly also defines the advisory role of the DCAA. Navy Procurement Directive 1-408 specifies the relationship between the DCAA and the SUPSHIPs in more detail.

The functions performed by the DCAA include:

- Audit and review of shipbuilder accounts, internal control systems, and accounting and business practices.
- Determination of the allowability of costs on cost-type contracts.
- Advice to the procurement contracting officer (PCO) and the administrative contracting officer (ACO) concerning cost allowability on incentive contracts, the financial provisions of contracts, and the adequacy of shipbuilder accounting and financial management systems and estimating procedures.
- Assistance in surveys of procurement systems.
- Preparation of advisory audit reports incident to contract awards and changes.

The SUPSHIP relies on the DCAA for these advisory services, but does not supervise or oversee the DCAA staff.

A Memorandum of Understanding was executed by NAVMAT and DCAA in November 1974 that provides guidelines for the conduct of joint audits by the field audit offices of the DCAA and the Navy contract administration offices – naval plant representative offices (NAVPROs) and SUPSHIPs – as may be mutually agreed upon. The final responsibility for determining the allowability of the costs that are incurred remains with the PCO or ACO. Since the DCAA is not constrained by Navy Procurement Directives and since the Memorandum of Understanding only addresses joint audits, the DCAA continues to perform audits at its own initiative.

b. Nucleus Crew. In most cases, a nucleus crew arrives at the shipyard prior to completion of construction. The Nucleus Crew clause normally identifies the increments and times of nucleus crew arrival. The number and date of arrival of a nucleus crew vary with the size and complexity of a ship and whether it is nuclear or conventionally powered. Nuclear ship contracts typically also charge the nucleus crew with assisting the SUPSHIP in inspection of the propulsion plant, with the proviso that the shipbuilder reserves the right to have the SUPSHIP review any discrepancies submitted by the nucleus crew to shipyard personnel.

Neither the Navy's contracts with the shipbuilders nor the SACAM prescribe a role for the nucleus crew in identifying deficiencies in a ship under construction. Nevertheless, during the interviews the shipbuilders viewed the activities of the nucleus crew as unlicensed inspection of the ship and a cause of disruption and added cost.

The activities of the nucleus crew depend on the responsibilities that are assigned to them by the Navy. These responsibilities vary with ship types, being most intense in nuclear-powered ships. Customarily, on nonnuclear ships the nucleus crew is not given an active role in the process of ship construction and testing; rather, it is permitted access to the ship for the purpose of familiarization and training. However, the Navy nucleus crew is charged with the safe operation of the ship and its systems and, thus, must be assured that discrepancies are identified and evaluated before proceeding to testing or operation of the ship. In addition, as the ultimate custodians of the ship for the Navy the crew has an interest in assuring that all work is correct and complete before they take on the responsibility for its maintenance.

By far the greatest requirement for involvement of the nucleus crew arises in nuclear-powered ships because only the Navy crew is authorized to operate the reactor plant and propulsion systems. As a result, it becomes necessary for the crew to assume operational control of these and other supporting systems at various stages in the ship's construction cycle. This custody transfer may occur on a temporary basis before all shipbuilder work on a system is completed in order to permit preliminary testing. Permanent custody transfer is

normally effected prior to the sea trials, with provision made for regulated reentry by the shipbuilder into the transferred system should further work or repair be needed. Typically, ship construction contracts have not spelled out the rules by which these custody transfers occur.

As an element of the custody transfer, the nucleus crew in concert with the SUPSHIP will inspect the system and document any deficiencies and incomplete work. These discrepancies are then evaluated to determine whether any of them must be corrected before proceeding with the test or other evaluation for which the transfer is required. The conduct of this inspection is not distinctly identified in contracts, and this fact has contributed to the dissatisfaction expressed over nonuniform quality assurance actions.

Although there is a contractual requirement for formal definition of discrepancies by the SUPSHIP, in the interest of time and schedule it has been common practice for shipbuilders to discuss these problems directly with the nucleus crew. This shortcut, which may be beneficial overall, can also lead to instances where there is inadequate SUPSHIP screening of perceived discrepancies. These corrective actions by the shipbuilder may also entail changed work. Some shipbuilders voiced concern over the added administrative effort of reviewing discrepancy lists which have not been effectively screened by the SUPSHIP, indicating this practice necessitates that they review and defend against premature or inaccurate lists. In their view, their only alternative is to correct the discrepancies without question. However, this approach may result in work that is beyond the contract requirements or completion of work that may later need to be redone (such as final cleaning and painting).

c. Board of Inspection and Survey. The INSURV conducts preliminary acceptance trials prior to delivery of new ships as well as final acceptance trials after delivery but before expiration of the warranty period. In the case of nuclear-powered submarines, a combined acceptance trial is held before delivery, and an in-port material inspection is conducted in lieu of final acceptance trials.

The INSURV reports all deficiencies to the Chief of Naval Operations (CNO) – irrespective of their nature. For example, specification violations which are the responsibility of the shipbuilder are nonetheless reported to the CNO as

are recommendations for design changes which may not be required by the contract design package. Other government-responsible deficiencies are also reported, including shortages of spare parts for government-furnished equipment, missing technical manuals, and inability to comply with internal Navy directives which have no contractual stature. INSURV findings are categorized by their relative importance. Accordingly, some deficiencies may require immediate correction while others of lesser significance may be deferred to a post-delivery period such as the ship's first overhaul.

The INSURV was cited by several shipbuilders as a cause of disruptive changes late in the construction of the ship. Although the board's actions have no contractual standing, the shipbuilders believe that the INSURV's influence causes SHAPMs and SUPSHIPs to require work just before delivery which might otherwise be deferred or accomplished at another shipyard. In normal practice, there is a great deal of pressure on the shipbuilder to finish all work – including the correction of all shipbuilder-responsible deficiencies – during the last few weeks before delivery, and distinctions as to responsibility and priority often become blurred. It is a fact that, once a ship has been delivered, low-priority discrepancies may not be corrected for years since the operating schedule of the ship may preclude all but essential maintenance and repairs. Thus, to the ship's crew the INSURV represents the last opportunity to reinstate or upgrade to higher priority conditions which the SUPSHIP or the shipbuilder have not accepted as discrepancies.

The INSURV may also detect and report conditions that have not previously been recorded but that require correction, and may decree (to the Navy) that these conditions be corrected before the ship is delivered. While these conditions may or may not be the responsibility of the shipbuilder, it is often called upon to correct them if its skills or facilities are needed. Even though a contract change may be issued for these efforts, the imposition of unplanned work against an already full schedule can be costly and disruptive. In cases where the costs or delays are disproportionate to the value of the correction, waiver procedures are used by the Navy to defer the correction to a later date.

d. Acts of Other Government Activities. The Federal Government often attempts to achieve various social and economic goals by the enactment of legislation which has a direct impact on the acquisition process. Two areas where this is true are equal employment opportunity and small business programs. These programs (and others similar to them) establish a series of contract performance requirements which are not directly related to the ship being built. Typically, the shipbuilder is informed of the need for compliance with these programs in the RFP, and their effect on costs can be considered during proposal preparation.

Another recent series of Federal Government acts which are directed at the accomplishment of evolving national goals is far more difficult to address. Among other things, these acts have established the Occupational Safety and Health Administration (OSHA) and the Environmental Protection Agency (EPA).

Both OSHA and EPA set minimum standards of performance with which all U.S. industries must comply by certain dates that are identified by these agencies. These sovereign acts of the government apply to all contracts that are in existence at the established date and to all contracts negotiated after that date. The standards apply regardless of the cost to the shipbuilder (or other government contractor) – even though OSHA and EPA do not have privity of contract with the shipbuilder and even though the shipbuilder did not foresee their impact at the time of the contract negotiations. Historically, the Navy has routinely treated any costs resulting from these acts of other government agencies as risks that the shipbuilder must absorb.

The effects of these acts can be considerable and can significantly affect the shipbuilder's work methods and costs. During the interviews, one shipbuilder referred to a pending OSHA decision on allowable limits of exposure to nickel dust as having the potential for requiring some 12,000 employees to do their work wearing a self-contained breathing apparatus. Another shipbuilder told the study team of a prospective requirement to remove all personnel from the decks of the ship whenever a crane was working overhead. Both of these requirements would seriously reduce productivity – and neither were foreseeable requirements to the shipbuilder or the Navy at the time of contracting.

C. Discussion and Analysis

It is the view of the study team that none of the issues raised in the area of contract management are fundamental causes of shipbuilder claims. Rather, these issues are focal points of discontent and reflect a deterioration of communications which often occurs after claims have been filed (rather than before). It is clear that the climate of mutual trust and respect which once prevailed between the Navy and the shipbuilders has deteriorated to the point where suspicion, distrust, and doubt seriously affect the Navy's relationship with some shipbuilders.

It is apparent that any measures that are taken which will improve the contract management process will benefit both the Navy and the shipbuilders. There will always be a need for close mutual support and communication between the parties during the construction of naval ships since the contract and the specifications cannot be so perfectly contrived as to stand alone. The process can be facilitated if the parties approach the problems that arise by dealing with each other in an atmosphere of confidence and trust. Yet it appears that this area will continue to be fertile ground for charge and countercharge should a claim arise. Thus, the study team believes that one of the principal benefits that should be sought from improved contract management is closer teamwork and cooperation. The remainder of this chapter discusses changes in the Navy/shipbuilder contract management environment that the study team believes can bring about this result.

1. The Contract Management Environment

As noted earlier in this chapter, during the shipbuilder interviews it was suggested that the Navy's ship acquisition effort would improve considerably if the Navy would provide a definitive specification and allow the shipbuilder to construct the ship without Navy intervention. It is the view of the study team that there are real limits to the practicality of this approach. Because of the complexity of naval ships and the interdependence of Navy and shipbuilder procurement and support functions, it is simply not practical to eliminate Navy involvement. To be sure, there are shipbuilding programs where the need for involvement is minimal, those where involvement must be high, and a range in between. Navy involvement in contract administration can be limited where

relatively simple ships are built in accordance with commercial practice, little government-furnished material is provided, and no nucleus crew is needed. This is the case with such ships as fleet tugs and craft. However, Navy involvement must be high when the contract and its supporting specifications and drawings cannot completely describe the ship, when a need exists to integrate the efforts of many agencies of the government with the shipbuilders' schedules and needs, when the Navy crew must assume responsibility for test and operation of the ship or its systems before delivery, or when the Navy assumes a significant share of cost risk. This latter case is generally descriptive of combatant ships and, to a lesser extent, of auxiliaries.

The existence of the large omnibus claims, in which cause and effect relationships are difficult to demonstrate and which rely in part on the theory of constructive change, has also eroded the contract management environment. In seeking to protect the rights of their organizations, both the Navy and the shipbuilders have used reservations and disclaimers together with higher levels of administrative review for formal communications which otherwise might be more prompt and direct. In the study team's view, the Navy and its shipbuilders must seek ways at every level to restore and sustain an atmosphere of full and free communication of the information and decisions that are needed to conduct the intricate business of shipbuilding. Adherence to the present plan for cost-type contracts for lead ships and an ample interval between lead and follow ships will go a long way toward restoring this atmosphere. In addition, as a matter of high priority, a workable means should be sought by which the shipbuilders and the Navy can manage constructive changes. This subject is discussed in greater detail in Chapter Five.

a. NAVSEA Management

(1) **Headquarters Organization.** In view of its scarce personnel resources, the study team believes that NAVSEA has followed the most practical approach in keeping SHAPM staffs relatively small and in attempting to maintain common functional organizations. These common organizations have the advantage of promoting uniform implementation of business and technical policies among projects, providing flexibility of manpower allocation, and establishing a

stable organization for career development. However, the lack of identification to specific ship acquisition projects makes these organizations vulnerable to reduction when NAVSEA is faced with personnel or budgetary limitations. The history of personnel ceiling reductions over the past decade appears to demonstrate the difficulty involved in sustaining manpower which is not directly related to an identifiable project or program. The study team concludes that the current project management approach should be continued in NAVSEA, but that the functional organizations should be structured and staffed so that they will attract qualified personnel.

(2) NAVSEA and NAVSEC Staffing. NAVSEA's total involvement with the shipbuilders requires that its actions be technically sound, responsible in terms of schedule and cost impact, and undertaken in a timely manner. The ability of NAVSEA and of NAVSEC to meet these criteria has been damaged by the methods by which personnel ceiling reductions and grade-level controls have been administered. It seems that attrition rather than management judgment has been allowed to shape the organization. Further, it appears that unrealistically low grade levels and the inability to promote because of freezes are severely damaging NAVSEC's ability to perform its mission. The lack of sufficient experienced contracting personnel can also be traced to extremely low grade levels and poor promotion opportunities in the Contracts Directorate as compared with other agencies. Since a contract specialist who is assigned to a major ship acquisition program has one of the most difficult and challenging contractual assignments within the Federal Government, such positions should carry commensurately high grades.

The study team believes that NAVSEA cannot carry out effective programs for ship acquisition management with the major personnel constraints that are depicted in Exhibits LIX and LX, above. If NAVSEA is to be a true manager of its ship acquisition programs – that is, if it is to manage shipbuilding programs that are characterized by few claims and on-time ship deliveries, it needs to be able to hire and retain the right people for the job. The Navy should develop procedures for manpower ceiling controls and grade-level controls which will allow greater management judgment in adjusting to changes in manpower or grade-level authorizations.

(3) Management Style. The study team notes that the policies and procedures by which NAVSEA organizations administer shipbuilding contracts, as set forth in the SACAM, prescribe a bold and energetic approach in pursuit of the Navy's ship acquisition goals. The study team believes that the SACAM should be restudied with a view to examining the problems of contract management. Such a study should develop guidance which is more strongly oriented toward prompt solution of shipbuilding problems, thereby assuring that Navy and shipbuilder interests are mutually served.

Further, the study team notes that the management style of NAVSEA, particularly its policy of active contract management, requires substantial numbers of personnel. If NAVSEA concludes that it has insufficient personnel to carry out all of its ship acquisition responsibilities for reasons of national policy or other considerations, the study team believes that NAVSEA should identify lower priority functions and should seek approval for their elimination.

(4) NAVSEC Design Capability. Earlier in this chapter, it was indicated that a large volume of ship design services are now obtained from commercial design agents because of reductions in NAVSEC's on-board personnel. However, two major problems flow from the use of outside design resources: the need to monitor the work of these agents and the fragmentation of the design effort that is caused by assignment of subtasks to various design agents – rather than assignment of the total task to one agent.

The study team believes that the large volume of design services for which NAVSEC now contracts (representing 70 percent of all design dollars) reduces the quality of the ship design if these services are not adequately monitored and coordinated. To the extent that these services are fragmented by the assignment of various design subtasks to a number of different design agents, the study team believes that NAVSEC suffers deterioration of its ability to organize these products into a coherent whole. Accordingly, the study team believes that efforts to procure design services in these smaller packages should be supplemented with a practice of procuring a more coordinated design product from the contract design agents. In addition, the study team believes that the NAVSEC in-house engineering capability should be restored to its pre-1970 level.

This conclusion follows from the observation that NAVSEC's responsiveness has diminished, as reflected in the increasing time requirements for technical decisions and drawing approvals and the less-than-adequate specification control. If adequate technical strength is restored to NAVSEC, the specifications for which it is responsible should be kept more current and, at the same time, more considered judgment should be possible in tailoring them to the particular ship procurement under consideration. The study team believes that such improvements will decrease the potential for conflicting specifications and, in the long run, will permit the SHAPM to procure follow ships to the initial specification without the need to modify it for update purposes.

b. **SUPSHIPs.** The perception of several shipbuilders that decision authority has become more centralized in NAVSEA appears to be valid, but the study team believes this situation must be considered in light of the shipbuilding programs and the goal of contract management. Given the assigned role of the SUPSHIP as the focal point for all actions dealing with specific shipbuilders, NAVSEA Headquarters should delegate to the SUPSHIP the authority to make all of the necessary decisions at that level. While such delegation may be carried out effectively when one type of ship is being built in a single shipyard, it will be far more complicated when the same types of ships are being built in different shipyards. In these circumstances, the need for central control of the activities of these several shipyards is supplied by the SHAPM program management representatives (PMRs). The PMRs can apprise the SHAPM of the priority of the attention needed on matters which must be controlled in NAVSEA. Consideration should be given to limiting referrals to NAVSEA to only those matters which demand it and to stimulating as much delegation to the SUPSHIPs as is practical.

(1) **SUPSHIP Staffing.** The SUPSHIP staffing criteria, which were developed as a means of establishing the level of manpower required for the SUPSHIP offices, rely heavily on progress payments as a basis for assessing annual budget and manpower needs. However, the existence of the large shipbuilder claims, which indicate expenses in excess of progress payments, suggests the need for reassessment of these criteria. The SUPSHIPs who are involved with major claims have been required to shift their resources to assist in claims evaluation and to initiate more active problem identification and claims avoidance programs. It is difficult to relate these functions to the level of progress payments.

Over the past few years, personnel have been added to the SUPSHIP offices. Hence the shipbuilders' perception of an increased presence of SUPSHIP manpower in their shipyards is a fact. However, the study team believes the real issue is to determine the appropriate number and types of SUPSHIP personnel that should be stationed at the commercial shipyards given the dynamic nature of the contract management environment. Accordingly, a review of the SUPSHIP staffing criteria is in order.

(2) **Inspection.** The study team recognizes that the inspection role of the SUPSHIP is an essential element of shipbuilding contract management. The complex nature of the ship construction process precludes the use of full Navy inspection and testing to ascertain contract compliance. Further, it is sounder management to place the major responsibility for inspection on the shipbuilder, with surveillance of its effort being the primary task of the Navy. Such surveillance necessarily includes spot-checking the details of the work at a level dependent on the effectiveness of the shipbuilder's inspection system. These detailed spot checks, which are conducted in accordance with MIL-Q, are not believed to be a significant problem to the shipbuilders – although there may be lingering difficulties in making the transition from the previous type of government inspection to the present mode. The problem associated with the Navy inspections does not appear to relate to the SUPSHIP quality assurance function as much as to the process by which the Navy accepts systems for temporary or permanent operational control. This topic is considered further in the discussion of the nucleus crew issue.

(3) **Subcontract Consent.** The study team feels that NAVSEA and the shipbuilders should continue to pursue adoption of the DOD procedures with regard to subcontract procurement systems. This will require the cooperation of both parties in conducting systems reviews and upgrading systems until they are approved. Once a shipbuilder's procurement system has received Navy approval, the need for consent to individual subcontracts should be drastically curtailed. The goal should be to adopt fully the DOD procedure calling for no prior approval of subcontracts on FPI contracts (except in special cases as spelled out in the contract) and limited prior approval on cost reimbursement contracts. The DOD

procedure gives the government ample protection by providing for regular surveillance of the shipbuilder's procurement system and for full review every three years after the initial approval of the system.

(4) Surveillance. The study team believes that the SUPSHIP must be able to verify the validity of a shipbuilder's processes and supporting management data. To the extent that these processes and data are valid, Navy surveillance can be reduced to spot-checking. Where experience indicates that there is a departure from standards or defective data, the level of surveillance may need to be increased.

To this end, the study team feels that the provision of credible, reliable, and meaningful shipbuilder performance data to both parties will mean a common basis for understanding performance trends and a means for detecting and correcting the adverse effect of shipbuilder or government actions. Although the performance data to be analyzed are far broader than cost and schedule performance information, these are essential elements for which an accepted analytical method now exists. The Navy seems to recognize the need to permit each shipbuilder to adapt DOD Instruction 7000.2, Cost/Schedule Control System Criteria, to its own management scheme and data collection system. Under these circumstances, it would be beneficial to both parties to arrive at approved C/SCSC as quickly as possible.

2. Non-NAVSEA Activities

a. DCAA. The growth of the DCAA role in shipbuilding is useful in that it provides more timely audit services to the SUPSHIPs. The on-site presence of DCAA auditors is particularly helpful in view of the growing need for financial audits under cost reimbursement and incentive contracts. However, with respect to management or operational audits, the DCAA presence has been the focus of considerable controversy. The shipbuilders have complained of audits beyond the competence of the DCAA resident auditors. While the Memorandum of Understanding between NAVMAT and DCAA specifies the techniques to be used in making joint SUPSHIP and DCAA audits, it is silent on the management or operational audits that are made solely by the DCAA. The study team believes

that the memorandum should be clarified to require that all DCAA management or operational audits of shipbuilders be made jointly with the SUPSHIP to assure that Navy shipbuilding expertise is used in the evaluative process that is essential to such audits.

b. Nucleus Crew. The study team feels that the involvement of the nucleus crew is not a major issue in the management of ship construction contracts. While their influence may be real, their impact on claims and cost increases through extra-contractual actions is significant only if it is not well controlled. It is up to the shipbuilder and the SUPSHIP to do their jobs well to prevent these influences from being disruptive.

Improvements may be achieved by including more explicit descriptions in the contract or by specifying the required conditions of completion as prerequisites to custody transfer prior to specified key events such as dock trials, crew certifications, and sea trials. The difficulty in describing these conditions in sufficient detail to preclude disagreements is a principal cause of past problems. Due to the differences in ship equipments and systems, the study team does not believe that written descriptions will achieve permanent improvements. Nevertheless, given these inevitable differences and the fact that nucleus crew personnel seldom return for a second pre-commissioning assignment, it is important to establish standards of acceptability at a given shipyard. In this way the shipyard can plan in advance for turnover requirements and will be protected from idiosyncrasy. Conversely, the SUPSHIP can rely on the standards in order to resist the pressures for relaxation of scrutiny when schedules are compressed.

Controversies of this nature are not new to the shipbuilding business; they have traditionally been a part of the normal give-and-take of the business and have usually been settled in a routine manner. What has changed is the volume of such activities which has increased as the complexity of ships has required greater Navy involvement in the test and trial phases. There also appears to be a reluctance on the part of the shipbuilders to accept responsibility for corrections that they might not have contested at a more opportune time. Because of the large number of reported discrepancies and the frequent uncertainty as to responsibility, this is an area where there is high potential for the generation of

constructive changes. Requiring that all such discrepancy reports be processed as SUPSHIP quality deficiency reports (QDR) will screen out improper discrepancies and will assign responsibility more equitably. The penalty for this screening is the added time and cost burden of formal processing. Clearly, there is no substitute for balanced judgment in this area.

The study team concludes that it would be beneficial to define the specific events for which system or compartment turnover to the Navy is required and to provide for a standardized definition of the conditions to be met at those times. The process by which formal and informal notification of deficient conditions is made to the shipbuilder should also be reviewed to obtain the optimum flow of information.

c. The Board of Inspection and Survey. The naval INSURV plays a vital role in the ship acquisition process by ensuring that the Navy receives safe ships that meet mission requirements. Despite complaints that the INSURV causes late additions of work, the study team concludes that current procedures provide for handling this issue within the terms of the contract and that the disruptive effects of the INSURV may be overstated.

d. Acts of Other Government Activities. It is obviously impractical to exempt Navy ship acquisitions from the impact of the government's sovereign acts. However, some means should be developed within the framework of the contract to compensate shipbuilders for the resulting expenses. To this end, as noted in Chapter Three it is recommended that there be selective removal of unknown risks from the shipbuilder through an appropriate clause in the contract.

D. Conclusions

The study team believes that a number of changes should be made in the management and administration of Navy ship construction contracts. The study team's conclusions in each of these areas are summarized below.

1. Communications

The Navy and its shipbuilders must continuously seek ways to sustain an atmosphere of full and free communication.

2. Personnel

a. NAVSEA should continue to employ its current project management practices, but should identify and obtain the authority to implement procedures which will assure that its functional organizations attract personnel with the qualifications necessary to manage ship acquisitions.

b. Navy commands, such as NAVSEA, should be granted management flexibility to handle personnel ceiling reductions and grade-level controls more effectively. (Across-the-board freezes are destructive.)

c. NAVSEA should review the SUPSHIP staffing criteria to ascertain whether progress payments are a valid basis for determining personnel levels.

3. Environment

The SACAM should be reviewed to assure that it reflects guidance to ship contract administration personnel that is strongly oriented toward prompt problem-solving.

4. NAVSEC Design Capability

a. NAVSEC should contract for design work in larger, coherent packages in order to facilitate better design coordination.

b. The NAVSEC engineering capability should be restored to its pre-1970 level.

c. NAVSEA should adopt controls which preclude blanket invocation of updated specifications and allow the SHAPM selectivity in updating specifications only where necessary.

5. Procurement System Approval and Subcontract Consent

NAVSEA and the shipbuilders should continue to work toward full adoption of the DOD procedures for procurement system approval and subcontract consent.

6. Management Information Systems

NAVSEA and the shipbuilders should continue to improve their management information systems and should adopt cost/schedule control system criteria in accordance with DOD Instruction 7000.2.

7. DCAA Audits

NAVMAT and the DCAA should clarify their Memorandum of Understanding to provide that DCAA management and operational audits of shipbuilders be made by DCAA only on a joint basis with the cognizant SUPSHIP.

8. Nucleus Crew

NAVSEA should define the specific events that require system or compartment turnover to nucleus crews and should provide a standardized definition of the conditions to be met at those times.

Chapter Five. Change Management

CHAPTER FIVE. CHANGE MANAGEMENT

A. Background

Change is inevitable during ship construction. The acquisition of ships is conducted in an environment of rapidly advancing technology and changing needs and requirements. The contracts span a number of years and are frequently based on government needs that are defined a substantial time before the contract is awarded. Thus, occasions arise during performance when it is in the government's interest to change the specifications or the methods of performance.

The design process for naval ships, as described in Chapter Two, also leads to the generation of substantial numbers of changes. Ship design has tended to be iterative and evolutionary to the extent that even designs of later year follow ships contain new elements which require interpretation during contract performance. The Changes clause allows the parties a ready means of addressing such issues. It also provides shipbuilders with a simple means of proposing desirable changes since the contracting officer can readily adopt them by issuance of a change order.

The change process in Navy shipbuilding has its own terminology and procedures. Appendix B presents a discussion and explanation of the change lexicon, plus a number of detailed comments on the overall change process.

1. The Changes Clause

Over the past decade, shipbuilding contracts have contained several different Changes clauses. However, one uniform provision of all of these clauses is the unilateral right of the Navy to order changes. The standard language stating this right is found in the ASPR Changes clause for supply contracts as follows:

> *The Contracting Officer may at any time, by a written order and without notice to the sureties, make changes, within the general scope of this contract, in any one or more of the following: (i) Drawings, designs, or specifications, where the supplies to be furnished are to be specially manufactured for the Government in accordance therewith; (ii) method of shipment or packing; and (iii) place of delivery.*

The clause imposes certain limitations on the changes which may be ordered. The first limitation is that any change must be "within the general scope" of the contract. This means that in ordering changes the contracting officer must stay within the broad parameters which are descriptive of the function of the product being procured. This limitation protects the shipbuilder in that it cannot be required to do work that is not a reasonable and appropriate part of the product being acquired. However, the limitation also protects the Navy since it prevents contracting for unrelated work which should be acquired as a new procurement. Another uniform portion of the clauses requires that the shipbuilder continue performance of the contract as changed – even though the parties cannot resolve disputes as to changes.

The clauses also give the shipbuilder the right to an equitable adjustment when a change is ordered. The ASPR clause states this right as follows:

> *If any such change causes an increase or decrease in the cost of, or the time required for the performance of any part of the work under this contract, whether changed or not changed by any such order, an equitable adjustment shall be made in the contract price or delivery schedule, or both, and the contract shall be modified in writing accordingly.*

This provision is intended to assure the shipbuilder that the cost and schedule consequences of an ordered change will be recognized by the government and that the contract will be modified, in writing, as necessary to reflect the increased cost to the shipbuilder as well as any necessary schedule delays resulting from the change. The clauses also provide that, if the parties fail to agree to an equitable adjustment, the shipbuilder is afforded the right to appeal under the Disputes clause.

The ASPR Changes clause is limited in its language to those changes which are ordered in writing. Hence, in the late 1960s, when shipbuilders began to submit requests for substantial equitable adjustments that were based on shipbuilder-perceived changes which were not ordered in writing – so-called "constructive changes," Navy shipbuilding contracts did not contain procedures for dealing with these changes. To remedy this defect, the Navy drastically altered its Changes clauses in shipbuilding contracts to provide for the identification and

treatment of constructive changes. Subsequently, the ASPR made provision for constructive changes in a clause entitled Notification of Changes.

The clauses require that any shipbuilder claim for adjustment must be asserted within a definitive time period from the date of receipt of a change order. This time period has generally been negotiable, and many shipbuilding contracts specify a 45- or 60-day period. In addition, at the discretion of the contracting officer, such claims may be acted upon at any time prior to final payment under the contract.

2. The Change Process in Shipbuilding

Since the term "change" has come to have a number of meanings, it is important to distinguish between the two major types of changes. In this discussion, the term "directed change" will be used to characterize those formal, deliberate changes which have been ordered in writing by the contracting officer, while the term "constructive change" will be used to describe those changes which have originated apart from such directed actions. This latter category includes changes resulting from shipbuilder responses to communications or from acts or omissions of government personnel. It should be noted that, when the Navy agrees a constructive change has in fact occurred, it will issue a directed change formalizing that fact.

a. Directed Changes. The most visible type of change that occurs in naval shipbuilding is the directed change. While the suggestion for such a change may come initially from the shipbuilder or the design agent, these changes do not take effect until they are ordered by the Navy. There is no dispute as to whether they constitute changes, but there may be a dispute over the equitable adjustment to which the shipbuilder is entitled as a result of such a change.

Directed changes may take the form of a bilateral modification to the contract or they may be directed unilaterally by the Navy. A bilateral contract modification occurs when the Navy and the shipbuilder mutually agree on the scope and price of a change. Bilateral modifications may take the form of fully priced supplemental agreements that include a release of future claims; they may contain provisions that make them maximum-priced; or they may be partially priced, with a reservation that some element of the equitable adjustment (such as

delay and disruption) is to be resolved at a later date. It is Navy policy to seek bilateral agreements with shipbuilders on changes together with full advance pricing before entering into a change. The Changes clause also permits directed changes to be ordered unilaterally; however, there are policy restrictions on such orders.

(1) **Control Procedures.** Excessive use of directed changes can greatly increase the price of the ship to the Navy as well as delay its delivery. Directed changes may also have serious and adverse effects on shipbuilders in that they may disrupt work on other contracts or projects which require the effort of the skilled manpower and facilities that must be used to execute the changes. There are various controls within the DOD and the Navy that are designed to minimize such effects. These controls, which have been implemented by NAVSEA in the Ship Acquisition Contract Administration Manual (SACAM), require that there be a compelling reason to justify the implementation of a directed change.[1] Such reasons are limited to correcting deficiencies or errors in design, meeting operational requirements, providing for the safety of personnel and equipment, or realizing cost savings to the government. Normally, changes that can be prudently implemented after delivery of the ship are not issued during the construction cycle.

Directed changes are controlled by (i) documentation requirements through the preparation of engineering change proposals (ECPs) and (ii) a change control board (CCB) which is established by each ship acquisition project manager (SHAPM) to review all of the significant ECPs to determine whether they should be authorized for implementation during construction. ECPs are prepared by the shipbuilder to document the change and the full effect that it is expected to have on the shipbuilding program. ECPs are required for all changes that alter the configuration of those parts of the ship that have been designated for configuration control by inclusion by the SHAPM in the configuration baseline of the ship. When such a configuration baseline is established, it effectively standardizes all of the subsequent ships in the class to that configuration – unless

---

[1] SACAM, 12-2.

changes are approved permitting deviation from the baseline. Since the shipbuilder inevitably encounters purchased items or construction methods on the baseline which it cannot practically include in the ship, the volume of changes increases as more parts of a ship are included in the configuration baseline. The most common occurrence of this type is when a purchased item is no longer being manufactured in a configuration that is identical to what was specified on the baseline.

NAVSEA follows the guidance of MIL-STD-480 in specifying the substantial amount of detailed information which the shipbuilder must include in the ECP. During the interviews, it was stated that the need to provide this information imposes a large burden on a shipbuilder when a detailed analysis of all of the characteristics of the ship has not been made. For example, ECPs must document the impact of a proposed change on lifetime operation and maintenance costs as well as the immediate effects on the shipbuilding contract. This information is not readily available to many follow shipbuilders.

When an ECP has been submitted by a shipbuilder, it is reviewed by a CCB if it has a significant impact on the shipbuilding program. The CCB is composed of members from various disciplines and is responsible for evaluating the change in terms of its cost, performance, and delivery impact on the ship as well as for determining the production and logistics support that will be required thereafter. SHAPMs have limited change approval authority and must obtain approval from higher authority for changes beyond their established approval levels.

Generally, the greater the technical, cost, and/or schedule impact of a change, the higher the required organizational level of approval. For example, changes which affect the military characteristics of the ship can only be issued with the approval of the Chief of Naval Operations. After appropriate approval, the SHAPM is responsible for implementation of the change via an administrative document known as a headquarters modification requisition (HMR) which is forwarded to the SUPSHIP. The HMR authorizes the SUPSHIP to contract for the change with the shipbuilder and frequently contains limitations on the dollar amount and method of ordering the change. In short, changes to shipbuilding contracts are not issued unless they are processed through a well-disciplined

configuration control system. One adverse impact of this system is that changes are issued at a slow pace. The shipbuilders commented during the interviews that this presented a significant problem. A review of one major program indicated that it takes from four to seven and one-half months to issue a change after an ECP has been received from the shipbuilder.

An example of a directed change would be one ordered by the Navy as a result of operational experience to improve a certain aspect of a hydraulic system. Another would be a change directed by the Navy to provide protective shields over certain equipments that had not been identified as safety hazards during the design process.

During hearings before the Seapower Subcommittee, industry representatives expressed their disenchantment with having to perform changed work. Nevertheless, during the interviews, virtually all of the industry representatives agreed that the Navy has a legitimate need to issue changes after contracting. However, they were also unanimous in emphasizing the need for "tight" Navy management of changes – to minimize them, to defer unnecessary changes for backfit, and to implement necessary changes as early in the construction process as possible. Indeed, many of the shipbuilders felt strongly that the timing of changes presents an overall opportunity for cost reduction in shipbuilding.

(2) Number of Directed Changes. The Interim Report referenced shipbuilder statements to Congress concerning the alleged high volume of directed changes on shipbuilding contracts. However, data reviewed by the study team indicate that adjustments to a contract as a result of ordered changes represent a relatively small percentage of the contract value. Exhibit LXV presents the number and dollar value of all of the changes that were issued for six recently delivered Navy ships and indicates the percentage of contract price that is represented by these changes. As these data reveal, the total number of changes that are issued against a ship construction contract varies with the complexity of the ship. For example, the nuclear aircraft carrier Eisenhower (CVN-69) had 1,753 changes issued, whereas a less complex ship such as the replenishment oiler

EXHIBIT LXV
COMPARISON OF CHANGES TO ORIGINAL CONTRACT PRICES*

Ship Type	Number of Contract Modifications Issued**	Value of Ship Changes (Millions of Dollars)	Percentage Value of Ship Change to Original Contract Price
CVN-69	1,753	$17.7	5.9%
SSN-690	498	3.9	6.3
LHA-2	430	10.4	6.5
AOR-7	238	4.9	1.0
CGN-38	1,021	9.7	8.8
CGN-39	1,007	4.7	5.0
Average Value of Changes to Original Contract Price: 6.5%			

*Data are based on delivered ships. In some cases, the data may not include all changes because some may be unadjudicated while others may be involved in claims.

**Includes a few contract amendments (such as escalation payments, correction of defects, and so on) which implement actions under clauses of the contract other than the Changes clause. These amendments do not significantly affect the conclusions on the volume of change activity.

Source: Compiled by NAVMAT from data obtained from NAVSEA SHAPMs and SUPSHIPs.

Roanoke (AOR-7) had 238 changes issued. In the case of the nuclear aircraft carrier, directed changes made up only 5.9 percent of the contract price, while changes for the oiler represented only one percent of the contract price. The average percentage value of changes to the original contract price for the ships listed was 6.5 percent.

b. Constructive Changes. A constructive change is defined as a course of conduct (which may include actions, inactions, and written or oral communications) by the contracting officer or an authorized representative that causes the shipbuilder to perform additional or different work than what is required by the contract terms. Under law, constructive changes are construed to have the same force and effect as directed changes that are issued by a contracting officer under the Changes clause.

(1) Categories of Constructive Changes. There are three broad categories of constructive changes: (i) defective or ambiguous drawings and specifications, (ii) communications and interpretations during the ship construction cycle, and (iii) failure of the government to meet its contractual obligations.

(a) Defective and Ambiguous Drawings and Specifications. The need for the first type of constructive change results from errors, ambiguities, or defects in the drawings and specifications furnished to the shipbuilder.[1] Such changes can occur in the lead ship contract when the contract design package contains errors or is misleading. For example, a constructive change may be required if the contract design package will not permit the use of an accepted construction methodology which the shipbuilder would normally plan to use, but the prohibition is not clearly stated and is only discovered in the

[1] A discussion of the various forms this information takes and the way it is created during the conceptual, preliminary, contract, and detail design phases of the ship acquisition process is presented in Chapter Two.

process of developing the detail design. Similarly, a constructive change might occur if a contract design package reflects three boilers of a certain size and capacity located within an identified boiler room, but the shipbuilder discovers during detail design that space constraints make it physically impossible to install the boilers without modification to the structural details specified within the contract design.

Constructive changes involving defective drawings and specifications also occur when inaccurate working drawings are furnished to follow shipbuilders. Such inaccuracies can easily occur because working drawings are frequently modified during construction of the lead ship. The bulk of these revisions record a wide variety of actions and decisions, such as correction of errors, clarification of data, and improvements in manufacturing processes. Inaccuracies also occur because the working drawings produced through this revision process do not accurately reflect the way the lead ship was built.

If defective working drawings which have been furnished by the Navy are unknowingly used by the follow shipbuilder and if they result in work that must subsequently be corrected, a constructive change may exist. This would be the case if the shipbuilder could prove that the Navy knew of the defective drawings, insisted on their use by the follow shipbuilder, or was otherwise responsible for multiple defects that caused serious loss to the shipbuilder. Another example would be when working drawings that were furnished to the follow shipbuilder were obsolete because the Navy failed to communicate to the follow shipbuilder corrections to the drawings that had been made by the lead shipbuilder.

(b) Communications and Interpretations. The second general category of constructive changes are those resulting from communications during contract performance. As discussed in Chapter Four, there is necessarily a large amount of written and oral communication between the Navy and its shipbuilders during ship construction. However, this situation creates the risk that Navy officials will inadvertently order changes in the work. In such situations, considerable controversy can arise over what was said and whether the communications actually constituted an order for changed work. An example would be a case where the follow shipbuilder installed the anchor windlass piping

in accordance with lead shipyard drawings. Subsequently, a Navy inspector erroneously determined that the installation would have to be removed and reinstalled because it was not in conformance with ship specifications. The shipbuilder complied with the Navy inspector's determinations. The actions of the Navy inspector constituted a constructive change for which the shipbuilder was entitled to compensation.

In another situation, the ship specifications noted that "butterfly type valves in accordance with MIL SPEC MIL-V-22133 may be used in lieu of gate valves where applicable." Since butterfly valves are less expensive and since there was no other provision in the contract restricting the substituted use of the butterfly valves, the shipbuilder informed the appropriate Navy official of its intention to use butterfly valves in lieu of gate valves. The Navy official disagreed with the shipbuilder and required the use of the more costly gate valves. Subsequently, it was determined that butterfly-type valves were applicable. The Navy official's action constituted a constructive change.

(c) Failure of the Government to Meet Its Contractual Obligations. The third category of constructive changes are those resulting from failure by the Navy to perform its contractual obligations. As discussed in Chapter Four, there are numerous interactions between the shipbuilder and the Navy during contract performance with the opportunity for inaction by Navy personnel when the shipbuilder needs positive communications to permit it to proceed with the work. To the extent that the contract provisions or good business practice call for action by the Navy, a constructive change may result if the Navy fails to act. One example would be the failure of the SUPSHIP to give subcontract approval in a timely manner. Another example would be the failure of the SHAPM to resolve a technical problem growing out of government-furnished equipment.

(2) Numbers of Constructive Changes. The study team was unable to quantify the number of constructive changes that occur on shipbuilding contracts. However, during the interviews, the shipbuilders stated that such changes happen regularly as a result of defects in the design package and the substantial amount of communication that occurs on a daily basis during ship construction. It is also clear that shipbuilder claims for additional compensation

have been based to a large extent on the presence of a large volume of constructive changes. In an examination of 50 shipbuilding contracts for the period from 1968 to 1975, NAVSEA categorized claims on the basis of their causes. This analysis found that defective specifications and plans, excessive quality assurance and inspection requirements, late and defective government-furnished equipment and information, and defective lead yard working drawings accounted for 61 percent of the causes of claims, as indicated by the shipbuilders filing these claims.

(3) Constructive Change Control Efforts. Efforts are currently under way in NAVSEA to control the volume of constructive changes. The principal initiative is through the use of the contract clauses – particularly the Changes clause as it appeared in Navy Procurement Circular 18 and the more recent ASPR Notification of Changes clause. The Navy Procurement Circular 18 Changes clause was developed by the Navy in response to an increasing volume of constructive changes and claims that were based on such changes. The clause required that the shipbuilders promptly notify the Navy of any "written or oral communication . . . or any other act or omission of the Government" which the shipbuilder regarded as a change. It was envisioned that the clause would reduce claims and facilitate contract administration by providing the Navy with early warning of shipbuilder-perceived problems which could be obviated or acknowledged and priced in a timely fashion.

During the interviews, the shipbuilders voiced objection to several facets of the Navy Procurement Circular 18 clause. Several complained that the 10-day reporting period did not provide adequate time for them to prepare and accumulate the supportive material required when putting the government on notice. In addition, the shipbuilders cited the vagueness of the clause in identifying the beginning of the notice period. Finally, the shipbuilders objected to that part of the clause which precluded them from recovering costs that they incurred in connection with a constructive change more than 20 days prior to the time the government was put on notice of the perceived change. They stated that this provision was an attempt by the Navy to avoid payment of the legitimate costs for which the shipbuilder should be reimbursed.

The ASPR Notification of Changes clause was developed, in part, as a response to the shipbuilders' objection to the Navy Procurement Circular 18 clause. While the intent of the clause remains the same – to ensure that the Navy is promptly notified of government conduct which the shipbuilder regards as a change (including actions, inactions, and written or oral communications) – the clause contains several significant modifications to the Navy Procurement Circular 18 clause.

Exhibit LXVI presents a comparative summary of these two clauses. As the exhibit reveals, the ASPR Notification of Changes clause changed the time for putting the Navy on notice from a 10-day period to a period to be negotiated. In practice, the time period negotiated has frequently been 30 days. The ASPR clause also attempts to clear up the lack of specificity in the Navy Procurement Circular 18 clause as to what triggers the commencement of the notice period. The ASPR clause specifies the date that starts the notice period as the date that the contractor identifies any government action, inaction, written or oral communication which the contractor regards as a change to the contract terms and conditions. However, the question still remains as to which shipbuilder officials/employees constitute the "contractor" whose identification of "government conduct" starts the notice period.

Another significant deviation from the Navy Procurement Circular 18 Changes clause is deletion of the provision that precludes a claim for costs incurred more than 20 days prior to providing notice. The provision of the ASPR clause gives the shipbuilder the right to an equitable adjustment if the government confirms the change, adding the caveat that any such adjustment "shall not include increased costs . . . resulting from the contractor's failure to provide notice . . . (as required by the clause)."

In a further effort to control constructive changes, a recent NAVSEA initiative placed 15 additional personnel in five SUPSHIP offices for the purpose of aiding in the monitoring of changes – particularly constructive changes.

c. Methods of Ordering Changes

(1) Directed Changes. Directed or formal changes may be ordered in the form of a bilateral modification or by a unilateral change order.

EXHIBIT LXVI
CONTRACT CLAUSES DIRECTED TOWARD CONTROLLING CONSTRUCTIVE CHANGES

Contract Provision	Navy Procurement Circular 18 Changes Clause*	ASPR Notification of Changes Clause
– Authority for Ordering Changes	Unilateral authority for Navy.	Covered by ASPR Changes clause.
– Notification Request	Written notification to the contracting officer.	Written notification to the contracting officer or administrative contracting officer.
– Start Date for Notification	Vague.	Date the shipbuilder identifies the constructive change.
– Identity of Contractor Personnel that Identify Government Actions Triggering the Notification Requirement	Silent.	Silent.
– Time Period for Notification	10 days from an unidentified date.	Time period negotiated from date the shipbuilder identifies change.
– Government Time to Respond	10 days from contractor notification.	Time period negotiated from date of shipbuilder notification.
– Cutoff Date on Recoverable Costs	Limited to costs incurred no more than 20 days prior to the start date for notification (except for errors in drawings, designs, or specifications).	No cutoff date established.
– Shipbuilder Rights	Permits requests for equitable adjustments subject to other provisions of the clause.	Same.
– Time Period for Submittal of a Request for Equitable Adjustment	30 days from time of Navy response.	Covered by ASPR Changes clause.
– Navy Rights	Obtain early shipbuilder notification and decision on perceived constructive changes.	Same, but no limitations on recovery tied to date of notification.

*The Navy Procurement Circular 18 Changes clause addresses directed changes as well as constructive changes.

When the parties agree to a bilateral modification that incorporates a change into the contract, this agreement may be fully priced or subject to later pricing action. Fully priced bilateral modifications cover all of the effects of a change with respect to price and/or delivery dates. Bilateral modifications which are not fully priced can be of various types: they may include a maximum price, they may be partially priced, or pricing may be deferred until some condition that is specified in the modification has been met.

Changes that are issued by the change order route are unilateral rather than bilateral actions. They are followed by negotiation of an equitable adjustment in price and/or time of delivery. Navy policy has greatly restricted this method of ordering changes. The current policy is based on guidance from the Office of the Secretary of Defense. DOD Directive 5000.1 states:

> *Changes shall be limited to those that are necessary or offer significant benefit to the DOD. Where changes are necessary, they shall be contractually priced or subject to an established ceiling before authorization, except in patently impractical cases.*

ASPR 26-101 states:

> *The price of [a] contract modification (this term includes changes) shall be negotiated prior to (its) execution if this can be done without adversely affecting the interests of the Government. This includes changes which could be issued unilaterally pursuant to the contract.*

Further, ASPR provides that "if a significant cost increase could result from a modification and time does not permit negotiation of a price, at least a maximum price shall be negotiated unless to do so would be clearly impracticable."

These policy statements have been implemented by Navy Procurement Directive 26-101 which requires that contract modifications made to fixed-price-type contracts must be fully priced at the time of issuance, wherever possible. Directed changes are generally initiated by an engineering change proposal (ECP) or a non-engineering change proposal (NECP), which may be suggested by the Navy, the shipbuilder, or associated vendors. Approved ECPs and NECPs are authorized either by a headquarters modification request (HMR) or a field modification request (FMR). The SUPSHIP is authorized to approve ECPs and NECPs

which do not exceed $10,000 per ship or $150,000 per contract in estimated gross price effect – provided the nature of the change does not require higher level approval. Higher level approval is required for changes which have a significant effect on the operating characteristics, arrangements, or capabilities of the ship; changes which affect delivery dates; or changes which adversely affect life-cycle logistic considerations.

The SACAM reflects the policies that were implemented by Navy Procurement Directive 26-101 authorizing the SUPSHIP to negotiate contract changes with the shipbuilder for approved HMRs and FMRs within the dollar limitations and method of ordering set forth in the HMR. In the event that a fully priced bilateral agreement cannot be achieved, issuance of various partially priced agreements is authorized.[1] If a unilateral change order is considered necessary, the SUPSHIP is authorized to issue one. However, the change order cannot exceed the value of $50,000 per ship unless the approval of higher authority is obtained. Approval of unilateral change orders exceeding $50,000 is reserved to the Chief of Naval Material. For unilateral changes of less than $50,000 per ship, the SUPSHIP must personally approve the change before it can be issued.

In issuing a unilateral change order, the Navy encounters certain risks which must be weighed against the probable benefits. The principal risk is the uncertainty of the cost and schedule effects. There is the potential that even a relatively minor change may have unforeseeable disruptive effects and that its cost could far exceed its value. However, deferral of a change may result in higher costs to the Navy if the change is more difficult to make at a later time. The decision for such a change order is judgmental, based on the best estimates of probable impact and on the urgency for accomplishment. The benefits of issuing a unilateral change are most apparent when it can be determined that a change is clearly essential to completion and delivery of the ship.

---

[1] See SACAM, 13-3, 13-4.

Since there are numerous instances when the Navy and a shipbuilder cannot agree on all of the elements of the equitable adjustment before a change order is issued, other techniques have been used to accommodate the restrictions on issuance of unpriced, unilateral change orders. The most frequent technique is the maximum-priced modification mentioned earlier. This bilateral contract modification authorizes the shipbuilder to proceed with the revised work, setting a maximum price for a subsequent final price adjustment. In some cases, shipbuilders have refused to agree to such modifications because they cannot accurately predict the full impact of the change, and the Navy will not agree to a maximum price containing the large contingencies the shipbuilder considers necessary.

Another technique for avoiding the use of unilateral change orders has been the pricing of the "hard core" costs of the change, with reservation of the delay and disruption costs for later agreement. The policy of reserving delay and disruption costs for future pricing has been used sparingly because Navy Procurement Directive 26-101 states that changes should be fully priced at the time of issuance. Recently, Navy Procurement Directive 26-206.2 has been issued, permitting this practice in exceptional cases where delay and disruption costs are known to exist but cannot be currently resolved. No data are available on the number of instances where this exception has been used.

A majority of the shipbuilders posed no objection to the use of unilateral change orders to achieve timely issuance of changes. The shipbuilders generally stated that maximum-priced modifications were a one-sided way of ordering changes; several shipbuilders stated that they would not agree to such an arrangement on significant change orders.

The results of these policies are summarized in Exhibit LXVII. As this exhibit indicates, the Navy has processed 12,799 changes during the nine quarters from January 1976 to March 1978 for a total dollar value of approximately $370 million. Sixty-three percent of these changes were fully priced bilateral modifications while only 3 percent were maximum-priced modifications. Dollar data are more revealing than the number of changes. As the second column of Exhibit LXVII shows, 28 percent of the dollar value of these changes were for maximum-priced modifications – a group that accounts for less than 3 percent of

EXHIBIT LXVII
TOTAL CHANGE ORDERS – NUMBER AND DOLLAR VALUE: JANUARY 1976 - MARCH 1978
(Thousands of Dollars)

Types of Changes	Numbers of Changes		Dollar Value of Changes		Average Value of a Change
	Number	Percent	Dollars	Percent	
Fully Priced Bilateral Modifications	8,098	63%	$150,954	41%	$ 18.6
Maximum-Priced Bilateral Modifications	306	3	104,548	28	341.7
Unilateral Change Orders	4,395	34	115,219	31	26.2
Total	12,799	100%	$370,721	100%	$ 29.0

Source: NAVMAT.

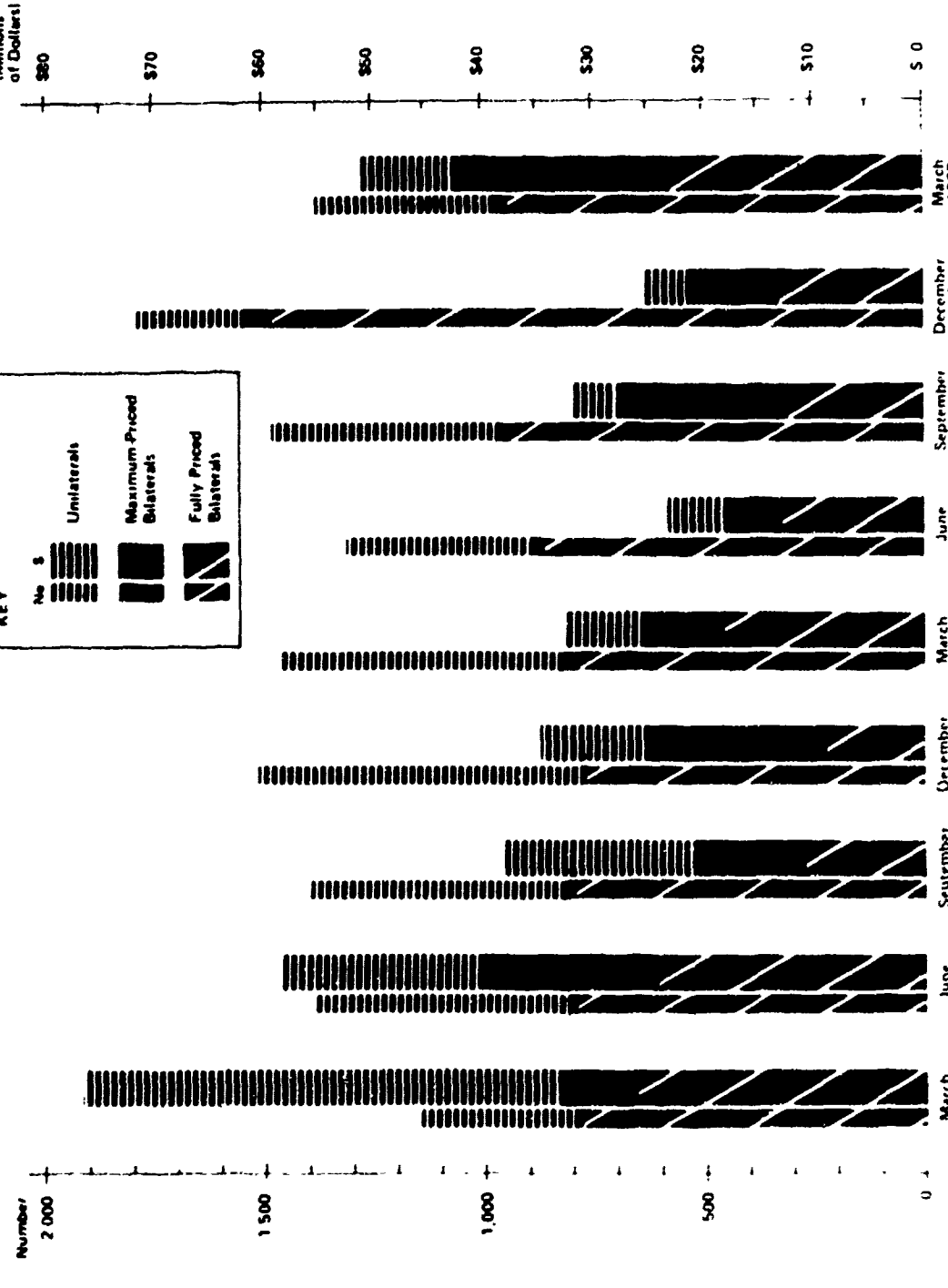
all of the changes that were processed during this period. The third column of this exhibit provides the average dollar value of the changes ordered by each of these methods and reveals that maximum-priced bilateral modifications are many times larger than either fully priced bilateral modifications or unilateral change orders.

Exhibit LXVIII breaks down the same data by quarters to reveal the trends in the changes that have been processed by the Navy. As this exhibit reveals, the total number of fully priced, maximum-priced, and unilateral change orders has generally been growing slowly over eight of the past nine quarters, while the dollar value of changes has generally been declining.[1] An examination of the portion of the exhibit displaying fully priced bilateral modifications indicates that the Navy has been successful in obtaining increasing numbers of this type of change in its negotiations with the shipbuilders. The exhibit also shows that maximum-priced bilateral modifications are used infrequently but normally cover large changes. This apparently indicates that some shipbuilders accept maximum-priced bilateral modifications as a means of obtaining progress payments which would not normally be given if a unilateral change order was issued. Exhibits LXVII and LXVIII show that the Navy issued a substantial number of unilateral change orders despite the policy statements discouraging their use. However, in almost all cases, the changes were for less than $50,000 and, thus, did not require NAVMAT approval.

(2) Constructive Changes. By their nature, constructive changes are initially identified by the shipbuilder and presented to the Navy as a request for additional compensation. If the Navy agrees that a change has occurred and that the Navy is responsible for the change, it is treated as a directed change and is ordered by one of the methods previously discussed. Shipbuilder-alleged constructive changes which the Navy feels do not meet those

[1] The dollar data presented in this exhibit are "gross" dollars, that is, they indicate the sum of the value of all of the changes that both add to and subtract from the cost of the ships.

EXHIBIT LXVIII
NUMBER AND VALUE OF FULLY PRICED, MAXIMUM-PRICED, AND UNILATERAL CHANGE ORDERS BY QUARTER



Source: NAVMAT.

tests or have not been asserted in a timely manner are denied by the Navy. Frequently, these constructive changes are reasserted as claims if the shipbuilder feels it has incurred additional costs.

3. Pricing Equitable Adjustments

As discussed above, Navy policy requires that contract modifications to fixed-price-type contracts be fully priced at the time of issuance wherever possible. One effect of this policy is to retard the speed with which essential changes are processed by the Navy – and to confront shipbuilders with a dilemma. If the shipbuilder continues the work in an area which is to be changed while a bilateral modification is being negotiated, the result is increased costs and greater disruption once the change is authorized. If the shipbuilder stops work in the area to be changed or proceeds with the change in advance of authorization, it may bear the cost of delay or of financing the changed work for an indeterminate period of time. However, if the Navy authorizes changed work without the agreement of the shipbuilder as to cost and schedule effects, it may unknowingly incur costs or schedule delay it is unwilling to accept. If the Navy defers authorization pending the negotiation of a bilateral agreement, it may incur greater cost and schedule impact than if it had ordered the change. The problem faced by the Navy is the identification of those essential changes which warrant the added risk of unilateral direction.

Both Navy and shipbuilder personnel agree that pricing a directed change order[1] – that is, determining the equitable adjustment to be made to the contract price as a result of a change – is a difficult and time-consuming effort. Difficulties arise in part because (i) the change can affect both completed work and work that will not be accomplished for some time to come; (ii) the change may require that the shipbuilder accelerate work on some tasks while slowing the pace on others; and (iii) the change may occasionally affect other work in the shipyard. This section on pricing equitable adjustments examines these problems.

---

[1] Only directed changes are susceptible to an equitable price adjustment. Once constructive changes are accepted by the Navy, they become directed changes.

a. **Timing.** Exhibit LXIX presents information on the aging of undefinitized directed changes for the nine quarters from January 1976 through March 1978. These data include maximum-priced bilateral modifications and unilateral change orders from the time they were issued to the time the equitable adjustment was agreed upon and incorporated into the contract. As this exhibit indicates, 44 percent of the undefinitized changes are more than a year old. The same changes are valued at approximately $418 million or 46 percent of the dollar value of all of the undefinitized changes.

Exhibit LXX presents the same data by quarters and reveals trends in the directed changes that have yet to be definitized. The number and cost of undefinitized changes appears to be declining, with the exception of the last two quarters. It is apparent from the data presented in Exhibits LXIX and LXX that the pricing of equitable adjustment is a lengthy process.

These exhibits do not cover changes that are fully priced upon issuance. However, in the interviews the shipbuilders indicated that in many cases there is also a time-consuming process which occurs in pricing these changes. Many proposed changes require detailed engineering analysis as well as careful estimating efforts by the shipbuilder and detailed analysis by the SUPSHIP staff. Subsequent negotiation may also be time-consuming.

When changes exceed $100,000, the pricing process becomes even more involved. In this case, the shipbuilder must meet the statutory requirement for the submission of cost and pricing data that are "current, complete, and accurate,"[1] and such data must be evaluated by SUPSHIP personnel. In addition, prenegotiation audits by the DCAA are frequently obtained to verify such data, although these audits are only required for changes over $250,000.[2] These steps add significant time to the pricing process.

---

[1] As required by Public Law 87-653.

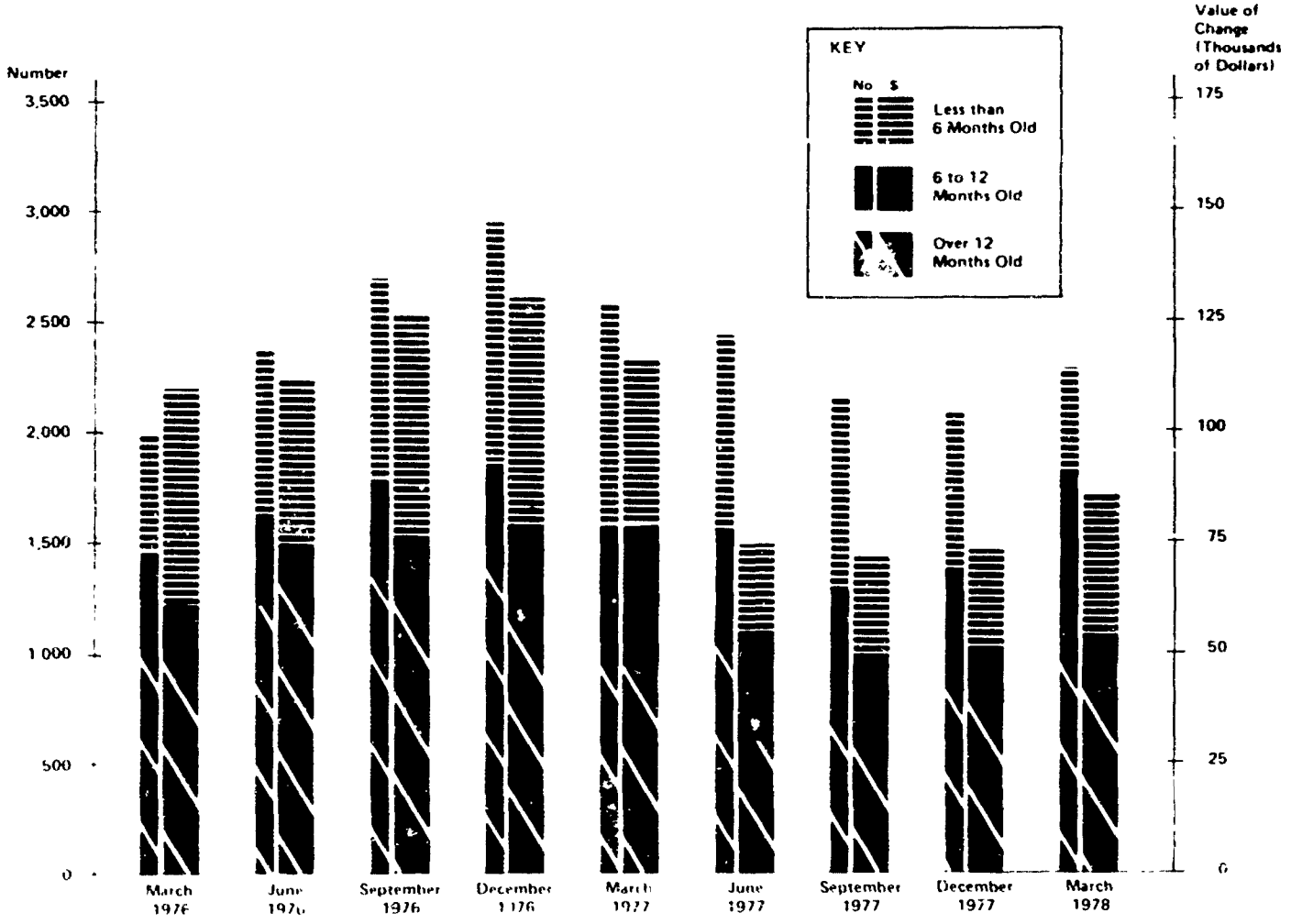
[2] ASPR, 3-801.

EXHIBIT LXIX
BACKLOG AND AGING OF UNDEFINITIZED DIRECTED CHANGES: JANUARY 1976 - MARCH 1978
(Thousands of Dollars)

Age	Numbers of Changes		Dollar Value of Changes		Average Value of a Change
	Number	Percent	Dollars	Percent	
Less than 6 Months Old	7,332	34%	$325,880	36%	$44.4
6 to 12 Months Old	4,731	22	157,714	18	33.3
Over 12 Months Old	9,385	44	418,180	46	44.5
Total	21,448	100%	$901,774	100%	$42.0

Source: NAVMAT.

EXHIBIT LXX
BACKLOG AND AGING OF UNDEFINITIZED DIRECTED CHANGES: JANUARY 1976 - MARCH 1978



Source: NAVMAT.

b. Cost Elements. Several cost elements are of concern in determining the ultimate price of a change: (i) the hard-core costs of the change; (ii) the cost of delay, acceleration, and disruption that is associated with the change; (iii) the cost of the cumulative impact of the change; and (iv) the cost incurred on other contracts in the shipyard because of the effect of the change on the shipbuilder's resources – that is, cross-contract impact costs.

(1) Hard-Core Costs. These costs consist of the net costs of labor and materials for added new work, rip-out and rework, and deleted work as well as labor premiums and overhead on these costs. Added new work is work that was not required by the contract before the change but was substituted or added by the change. Rip-out and rework is completed, unchanged work requiring removal and/or restoration incident to the change. Deleted work is unaccomplished work that was required by the contract before the change but has been deleted by the change. Historically, the shipbuilders and the Navy have not found it difficult to agree on the hard-core costs of a change.

(2) Delay and Disruption Costs. These costs consist of the additional costs of unchanged work resulting from the change. The pricing of delay and disruption costs has been a major impediment to the settlement of Navy shipbuilding claims. Almost all of the claims have included large amounts to cover these factors, and the Navy has been reluctant to pay such amounts without clear proof of Navy responsibility. In the interviews, the shipbuilders indicated that they considered the Navy's position on this matter to be one of the major causes of the claims problem.

(a) Delay. If a change delays any aspect of the work and causes additional cost, the shipbuilder is entitled to such costs as part of the equitable adjustment. In cases where one or more changes cause slippage in the contract delivery schedule, the shipbuilder's delay costs greatly increase in magnitude because the entire management and support work force will remain on the contract longer than originally estimated.[1] Delays occur in many aspects of

[1] Major shipbuilding claims have included delay costs originating in government actions other than changes. Since these claims are based on other clauses such as the Suspension of Work or Government-Furnished Property clauses, they are not addressed in detail here.

the work throughout contract performance, and the Navy takes a narrow view of its responsibility for such delays. The Navy maintains that it is not liable for the cost of the delays when the shipbuilder was concurrently delayed by its own actions or by excusable delays.

(b) **Acceleration Costs.** These costs occur when the shipbuilder is entitled to an extension of its established delivery schedule because of excusable delays (including delays caused by government actions or inactions), but the Navy still requires that the original delivery schedule be met. In such a situation, the shipbuilder may assert that the schedule has been accelerated.[1] The shipbuilder may recover the cost of making up the time to which it was entitled, including the cost of labor premiums and the cost of inefficiency or loss of productivity.

(c) **Disruption Costs.** These are costs that were incurred because of Navy-induced inefficiencies in the nonchanged work – that is, work that was not added, deleted, revised, or modified as a necessary requisite to accomplishment of the work set forth in the hard-core categories of the change. In other words, disruption is a loss of efficiency, requiring the shipbuilder to expend more labor to accomplish unchanged work than had previously been planned. Disruption costs are difficult to trace to specific changes, and this difficulty has proved to be a major impediment to the pricing of claims since the Navy has required detailed proof of the relationship between such costs and specific changes.

(3) **Cumulative Effect Costs.** These are costs that arise because of the cumulative inefficiencies resulting from a multiplicity of changes to a shipbuilding contract. Since such costs are not directly related to specific changes, they are difficult to prove and have been frequently denied by the Navy. Several of the major claims contain substantial amounts of costs in this category.

---

[1] See SACAM, paragraph 18-2.2.4.

(4) Cross-Contract Impact Costs. According to the evolving cross-contract theory, the impact of changes under one contract may increase or decrease the cost of performing work on other contracts in the shipyard. For example, there might be two Navy contracts at the same shipyard which overlap for some part of the same time period. Because of changes on the first contract, the shipbuilder's ability to perform on the second one could be affected. A similar situation would arise if a subsequent ship was scheduled to be built on a building way which is occupied by a delayed ship. The term "synergistic effect" is occasionally employed to define the cross-contract impacts that affect more than one of the shipbuilder's customers.

The Navy has not yet recognized its liability under this theory. Two cases are currently in litigation which rely on this theory to some extent for recovery against the Navy. In one case, the Armed Services Board of Contract Appeals (ASBCA) denied recovery to the shipbuilder, and the case is on appeal to the Court of Claims. In another case, the ASBCA has granted relief to a shipbuilder on a cross-contract impact claim for the increased costs on other Navy and commercial contracts.

c. Pricing Methods. NAVSEA provides detailed guidance on the pricing of equitable adjustments in the SACAM.[1] The SACAM requires that the administrative contracting officer (ACO) use a team concept in negotiating equitable adjustments. In this way, the ACO may take advantage of the advice of Navy specialists in the areas of contracting, finance, law, audit, engineering, and price analysis. Procedures call for the submission of detailed information by the shipbuilder in an ECP, including a comprehensive statement of the work (work scope); subsequent submission of detailed cost estimates on various DD-633 forms by the shipbuilder; and preparation of a technical advisory report (TAR) that reflects the Navy analyst's judgment of the reasonableness of the man-hours and material estimates contained in the ECP. In addition, for ECPs in excess of

[1] In particular, SACAM, 13-3, "Adjudication and Execution of Contract Modifications by ACOs."

$100,000, the shipbuilder is required to submit full cost or pricing data in support of its cost estimate, and an audit evaluation of the proposal is generally performed by the DCAA. Having assembled these various elements of information, the SUPSHIP is prepared to begin the negotiations leading to pricing of the directed change order.

During the interviews, a number of the shipbuilders told the study team that their first concern when handed a directed change by the Navy is not its basic cost; rather, they look at the content of the work to determine how they might best accomplish it. The change could raise such issues as the design effort needed; the availability of material, special facilities, and manpower; the point in time when the change should best be introduced, including problems related to near-term planning requirements, procurement actions, and scheduling issues; the relationship of the change to others already in hand as well as those that may be added; and the effect of the change on such issues as productivity, work force utilization, and ship delivery.

Given these problems, the shipbuilders expressed a clear reluctance to pre-price changes. A number of them pointed out that the Changes clause of the contract entitles them to a fair and equitable adjustment in price and delivery schedule as a consequence of a change. In accepting changes, they want to minimize risk, not increase it. To them that means recovering all of their costs – not just estimating them.

According to the interview comments, the pre-pricing problem largely centers on determining the cost of delay and disruption associated with the change. The shipbuilders take the position that there are no precise estimating techniques available to predict the cumulative amount of delay and disruption that will be caused by changes. They were equally positive in stating that delay and disruption exist and are manifested in increased costs – although their overall extent cannot be predicted before the fact nor separately audited after the fact.[1]

---

[1] The SACAM supports this latter point in 13-3.18.11(b) which states: ". . . In evaluating the claim for disruption the negotiating team must recognize that it is not susceptible to an accounting and audit determination."

In some instances, the Navy has issued changes pricing the "hard-core" costs and reserving the pricing of delay and disruption costs. However, the general policy is to avoid partially priced changes.

NAVSEA has recently initiated a series of studies, with the objective of resolving the problems of pricing delay and disruption that are caused by changes. These studies include the development of a general-purpose simulator for system and network analysis of the delay and disruption; an investigation into the feasibility of an analytical tool for determining the pricing of delay and disruption proposals; the development of a series of guidelines and weighting factors that address local and cumulative disruption for engineering and production efforts across the total ship construction cycle; and a formula approach that yields a disruption factor to calculate the total costs of a change including disruption and acceleration, together with provision for partial payment on the change if the shipbuilder refuses the Navy offer based on the formula.

B. Discussion and Analysis

1. Directed Changes

a. Recognition of Need. There is no dispute between the Navy and the shipbuilders concerning the need to make directed changes after contract award and the right of the Navy to order them. Given the long and involved construction cycle, the inability of the various principals involved in the planning, design, and drawing processes to define precisely a complex naval vessel and its components is a postulate of naval shipbuilding. In order to ensure that current ships incorporate the most recent technological advances and the sophistication that is essential to meeting the threat of potential enemy fleets, the ability to modify the contract through the change process – unilaterally if necessary – is a fundamental need.

b. Reducing the Number of Changes. While it is acknowledged that changes will continue to occur in shipbuilding contracts, it does not follow that the number of changes cannot be controlled or that their adverse effect on shipbuilder performance cannot be substantially reduced. The data in Exhibits LXVII through LXIX show that the total number of changes has been relatively stable over the past nine quarters, but that the dollar impact has grown. Hence, it would appear that there is a need for continued efforts to control such changes.

The study team believes the current system of controls over directed changes, including the documentation required in support of ECPs and the operation of CCBs in all of the SHAPM offices, provides a well-disciplined means of change control. These controls appear adequate to limit the directed changes resulting from new technology or suggested improvements to ships. However, they do not provide a mechanism for controlling the changes that result from errors or omissions in the ship specifications and drawings. It is in this area that the study team believes additional efforts should be made to reduce the number of changes.

In the past, contract design packages that were prepared by the Navy have usually served as the basis for obtaining shipbuilder proposals to construct ships. These contract design packages have varied in quality with the result that, on some programs with lesser quality design packages, many changes have been necessary to permit the shipbuilder to construct the ship. NAVSEA has recognized this problem and has taken several steps to overcome it.

The study team believes that the most promising technique being used is the involvement of shipbuilders in the contract design process, as discussed in Chapter Two. The use of design support contracts with prospective shipbuilders in the FFG-7 and DDG-47 programs was an initial step in this direction. The planned selection of the lead shipbuilder for the LSD-41 and MCM programs prior to contract design is a further move toward the goal of improving the contract design package. In these latter programs, early selection should enable the shipbuilder to become fully aware of the content of the contract design package prior to preparation of the detailed design. The study team feels this technique gives the best assurance of minimal defects in the contract design package. However, two reservations must be noted.

First, in order for this technique to provide substantially better contract design packages, the shipbuilder must be able to supply sufficient quantities of competent engineering manpower. If that objective is to be achieved, increased funding for this effort will be necessary. Second, as discussed in Chapter Four, the multitude of specifications that are controlled by NAVSEA and referenced in the contract design package should be brought under control. Such an action will necessitate a substantially greater effort on the part of NAVSEC as

well as the development of some technique which the SHAPMs can use to determine systematically which specification revisions are applicable to their programs. This problem is particularly difficult to resolve when a modified follow ship is being acquired, but it is a recurrent issue in all programs whenever additional ships are being obtained. The study team considers this an area where NAVSEA should undertake a major initiative in order to improve the present system.

In situations where follow shipbuilders are expected to build ships using working drawings that have been prepared by a lead shipbuilder, large numbers of changes have also been generated. The use of cost-type transition contracts for the first follow ship and the use of validated working drawings will certainly reduce claims in this area by permitting the follow shipbuilder to recover extra costs flowing from defective working drawings. Reduction of the number of defects is dependent on the validation process which is used to ensure that the working drawings actually represent the work done on the lead ship. It is too early to make final judgments on the effectiveness of the procedures used in the FFG-7 program, but the study team believes that NAVSEA is following a sound course of action in this validation effort.

At some point, the cost of validation will undoubtedly exceed the cost of changes when drawings are not validated, and the study team feels that NAVSEA should carefully monitor future validation efforts to determine where the balance falls in this area. One option worth considering is whether personnel of the follow shipbuilder could be more heavily involved in the validation effort. Currently, there are usually small technical liaison teams from the follow shipbuilder at the lead shipyard. An increase in their size could pay dividends in terms of improved and early communication of engineering problems.

c. **Preparing and Processing ECPs.** While MIL-STD-480 contains sound guidance on the need to obtain complete information on a proposed change before it is implemented, it requires the generation of large amounts of information at substantial cost. When large numbers of ECPs are prepared and processed, the management burden is difficult to handle without delay in the implementation of those changes which are necessary. The study team believes that there is a need for a thorough review of the ECP process to reduce these burdens to a minimum.

Several items should be addressed in this review. First, NAVSEA should consider whether too much is being included in the configuration baseline of the ship and whether configuration baselines are being established too early in the design process. To the extent that flexibility can be given to the shipbuilder by not establishing firm baselines, the number of ECPs can be reduced and the management burdens can be lessened. Of course, parts of the ship which must be standardized and controlled for safety or operational reasons should continue to be subject to configuration control. However, it appears that a reexamination of this issue on each ship program would reveal areas where less stringent configuration control would yield significant benefits in terms of reducing the number of changes and the management burden of processing ECPs.

A second area of review is the level of detail that is included in the ECP. NAVSEA should review its use of the MIL-STD-480 procedures to determine whether all of the information called for is needed as frequently as it is supplied and whether the shipbuilder is the most effective source of the information. To the extent that the cost of preparing ECPs can be reduced, the process can be streamlined to the benefit of both the Navy and the shipbuilders. The study team believes that a thorough review of the ECP process would disclose methods of preparing and processing ECPs that would significantly reduce the burdens of the current process.

d. **Methods of Ordering Changes.** The shipbuilders were unanimous in the view that the earlier a change is issued, the smaller its impact on performance, cost, and schedule. If the impact of changes is to be minimized, the study team feels the earliest possible issuance of the change must become the standard Navy policy – once it has been decided that the change is essential. Early issuance of changes will provide the shipbuilder with the maximum flexibility to implement the change and to select the time when the change can be introduced so as to have the least impact on the remaining work.

Bilateral agreement on pricing is a worthwhile objective, but not at the expense of a significant delay and/or interference with work. The current Navy policy against unilateral changes seems to be working against the objective of early ordering of changes. While a significant volume of unilateral change

orders has been issued by the SUPSHIPs over the past few years, few have been issued over the $50,000 figure because of the current policy requiring prior approval at that level by the Chief of Naval Material. The Navy has employed a number of techniques to allow the early ordering of changes, including the use of maximum-priced modifications and the pricing of hard-core costs with a reservation for delay and disruption. However, these alternatives are not wholly acceptable for either the Navy or the shipbuilders. Accordingly, the study team believes that additional methods of ordering changes should be developed. Specifically, the study team suggests that the following alternatives should be used in ordering directed changes:

(i) Bilateral Modification

- Fully priced bilateral modifications should continue to be pursued when a change is well defined and can be realistically priced and when the initiation of the change can be delayed without adverse economic or technical impact.

- If it is apparent that the parties cannot consummate a fully priced bilateral agreement and if significant design work is involved, a bilateral modification should be negotiated for the engineering effort that is necessary to define the change to the point where a valid cost estimate can be made. If there is an urgent need for the change, adequate funds should be included to permit the advanced purchase of long-lead-time components or the early initiation of fabrication work in the shipyard. When the task is adequately defined, a second change should be negotiated to authorize implementation of the change into the ship construction process. In instances where it would be costly to proceed with the original work, a ship construction change could be ordered unilaterally -- concurrently with the design change. These procedures are not new; similar approaches have been used in prior ship construction contracts.

- The current practice of issuing bilateral modifications with maximum prices should be followed only when such modifications do not impose a significant risk of loss on the shipbuilder. The Navy has adopted this policy as a means of complying with DOD policy when it is impractical to price changes fully. However, the maximum-price modification can be unfair to the shipbuilder or may unnecessarily obligate Navy funds. If the maximum prices are set at levels which are sufficient to assure the shipbuilder that the final prices will be equitable, these modifications will frequently contain large contingencies. Yet, if the Navy insists on using a shipbuilder's original cost estimate as a basis for maximum price in order to protect the government from erroneously low estimates, some of the modifications may deny the shipbuilder recovery of the costs of the changed work. In these circumstances, the study team believes that maximum-priced modifications should only be used when time does not permit full pricing, but when the work scope is sufficiently definite and the impact of the change is sufficiently clear that there is virtually no risk the shipbuilder will suffer a loss on the changed work, and adequate funds will be available to cover the contingent risks.

(ii) Unilateral Change Orders

- Navy policy should be altered to permit freer use of unilateral change orders when the necessity of the change is clear and the parties cannot reach bilateral agreement through any of the recommended methods noted above. The use of unilateral changes imposes the risk on the Navy that the ultimate price will exceed the obligated funds and that unforeseen schedule delays may occur. However, there are times when the risks of delay through failure to issue a change promptly outweigh these considerations. As

previously noted, unilateral change orders that are expected to exceed $50,000 currently require approval by the Chief of Naval Material. The study team believes that bilateral modification should continue to be encouraged, but that Chief of Naval Material approval of unilateral change orders should be required only when subsequent business clearance approval is required. This approach would limit the involvement of the office to major changes and would reflect a Navy policy that unilateral changes are a proper method of contracting when circumstances so dictate. To ensure that the authority is not abused and that unilateral changes are promptly definitized and priced, the Chief of Naval Material should continue to monitor outstanding changes through the quarterly reports that must be submitted by the heads of procuring activities. The study team believes that each SHAPM should have the authority to agree with the cognizant SUPSHIP with respect to any limitations on the authority to issue unilateral change orders, keeping in mind the goal discussed in Chapter Four of delegating as much authority as feasible to SUPSHIPs.

In addition to the foregoing, the study team feels that Navy policy regarding early issuance of changes must be consistently emphasized to contract administration officials and must be strictly adhered to by the CCBs. At the same time, emphasis should be placed on saving nonessential changes for post-delivery implementation. When deferral past delivery is not feasible, the required changes should not be saved by the SHAPM or the SUPSHIP and initiated in "bundles" – even though this approach may save the Navy administrative time and effort. Using a bundle approach increases the overall cost of the ship because late receipt of changes by the shipbuilder inhibits its ability to address them individually and systematically. However, it is recognized that the "essentiality" determination is frequently not an easy one and that in some instances substantial delay may be unavoidably incurred in reaching the decision that a change is essential. As part of

the effort to obtain early issuance or deferral of nonessential change orders, the SACAM guidelines should be reviewed with the aim of streamlining the ordering process.

e. **SUPSHIP Authority to Order Changes.** While the SACAM contains useful and necessary guidance on the types of ECPs that must be referred to a SHAPM by SUPSHIPs, it also contains an arbitrary $10,000 per ship limitation on direct SUPSHIP action on an ECP. This limitation appears too restrictive in terms of current prices. In this area, the study team believes that the general conclusion in Chapter Four – that more authority should be delegated to SUPSHIPs – should be implemented by substantially raising the limit or by deleting this restriction. A more appropriate policy would permit the SUPSHIPs to act on an ECP as long as it was not in one of the specified categories requiring approval of higher authority and as long as it fell within the funds made available to the SUPSHIP by the SHAPM for this purpose.

2. Constructive Changes

a. **Recognition of the Need.** As indicated earlier in this chapter, constructive changes result from defective or ambiguous drawings and specifications, from communications and interpretations between government and shipbuilder personnel during the ship construction cycle, and from failure of the Navy to carry out its contractual obligations. The processes of interpretation and communication are vital parts of a shipbuilding program – without them, the Navy surely would not be able to acquire a ship that meets its needs. The final integration of engineering efforts by the ship designer and the shipbuilder as well as the suppliers of government-furnished materials and information can only take place during construction. Given the fact that ship specifications and drawings will never completely define the construction process, the study team feels that the use of skilled Navy personnel to interact with the shipbuilder during the ship construction cycle permits the Navy to obtain the ship it needs at the lowest cost and in a timely manner.

One means of reducing the number of constructive changes would be for the Navy to manage its contracts with great care, taking all possible steps to carry out its obligations. SHAPM and SUPSHIP personnel should be indoctrinated

with the importance of giving the shipbuilder timely answers to inquiries and taking administrative action promptly in accordance with the contract terms.

Historically, a major problem with constructive changes has been the fact that the Navy has not always been informed about them until substantial additional costs have been incurred. Some shipbuilders have built their claims for price increases on these changes. Even though the Navy uses its best efforts to identify problems by increased communication and more effective interpretation of drawings and specifications, the study team believes some constructive changes will continue to be identified by shipbuilders too late in the construction cycle, and it is probable that these changes will be used by some shipbuilders to generate claims for additional compensation. Only improved communications between the Navy and its shipbuilders during construction can reduce such occurrences to a manageable level.

b. Control Procedures. The major Navy control over constructive changes has thus far been undertaken by contract clauses. As discussed earlier in this chapter, the two clauses used for this purpose have been the Navy Procurement Circular 18 Changes clause and the ASPR Notification of Changes clause. Exhibit LXVI, above, presents a comparison of these two clauses.

During the interviews, the shipbuilders voiced strenuous objection to several facets of the Navy Procurement Circular 18 clause. Several complained that the 10-day reporting period did not provide adequate time to identify constructive changes or to accumulate and prepare the supporting material required when putting the government on notice. The brevity of the period for reporting was aggravated by the vagueness of the clause in identifying the inception of the period. Finally, that part of the clause which precluded the shipbuilder from claiming the costs incurred in connection with a constructive change more than 20 days prior to the point when the government was put on notice of the perceived change was viewed by the shipbuilders as an attempt to avoid legitimate costs for which the shipbuilder should be reimbursed.

The study team believes the early notice requirement of the clause was intended to serve a valid end, enabling the parties to reach timely decisions on the desirability of the change and to definitize the costs at a time when

memories were fresh and the impact of the change could be monitored. However, in many instances, 10 days has proven too little time for the shipbuilder to identify the event which constituted a potential constructive change. In addition, it is difficult to define a precise time as the starting point for the 10-day period. Further, it is clear that the provision precluding a shipbuilder from recovering costs incurred more than 20 days prior to the government being put on notice of a perceived constructive change has become a source of acrimony between the Navy and the shipbuilders.

The study team feels that the 20-day time limitation has little relevance to the costs incurred as the result of a change and that the Navy's use of this provision appears arbitrary. However, shipbuilders should not be permitted intentionally to withhold information of a constructive change from the Navy and thereby deprive the Navy of the opportunity to solve the problem. The study team concludes that the ASPR Notification of Changes clause should be used in conjunction with the ASPR Changes clause in future ship construction contracts in place of the Navy Procurement Circular 18 Changes clause. The Notification of Changes clause allows the parties to negotiate the time limitations relating to processing of constructive changes and identifies the inception date of the shipbuilder notification period as the date when the shipbuilder identifies a constructive change as such. An additional provision should be developed stating that the shipbuilder would receive no compensation for costs incurred with respect to constructive changes where failure of notice after the shipbuilder knew or should have known of the problem deprived the Navy of the opportunity to resolve the problem and to save such costs. Such a provision would reflect the current state of the law as stated by the Armed Services Board of Contract Appeals (ASBCA).

Earlier in this chapter, reference was made to a Navy initiative which placed additional personnel in SUPSHIPs offices for the purpose of aiding in the monitoring of changes – particularly constructive changes. The study team believes that the identification of constructive changes is a major responsibility of the entire SUPSHIP and SHAPM organizations and that any attempt to place responsibility for this effort in a team or group of persons within these offices is a move in the wrong direction. The thrust of the Navy should be to stimulate the

discovery of problems promptly and to seek timely solutions. Additional training of SUPSHIP and SHAPM personnel in contract administration issues may be needed. As part of this effort, the study team feels the Navy should provide readily available legal support to the SUPSHIPs to interact with Navy personnel regarding changes and to lead them to a better understanding of their roles and responsibilities as Navy representatives.

With regard to nucleus crew inspections, the study team believes that the resolution of ship's force deficiency reports – especially those which are not supported by contractual specifications – should be made by the SUPSHIP. Close coordination is required in the SUPSHIP offices to ensure that all of the ship's force deficiency reports are pre-screened by a SUPSHIP representative so as to ascertain which deficiencies are the responsibility of the shipbuilder under the contract. In cases where the deficiency report is not supported by contract requirements, the SUPSHIP should coordinate the action that is necessary to ensure prompt resolution. Careful management of ship's force deficiencies would improve the relationship between the parties, and would also minimize unnecessary impacts on the shipbuilder.

3. Pricing Equitable Adjustments

Expeditious decisions on changes and early agreement on price are in the best interests of all parties to the contract. Unfortunately, current procedures and policies do not always yield this result. Realistic pre-pricing of changes is frequently difficult to attain. Probably the most important single impediment is the difficulty of laying out a reasonably definitive work scope for a change. It is difficult to determine the work scope without essential technical details, and preparation of the necessary drawings, specifications, calculations, and material estimates takes time. As part of the problem, the shipbuilder must also decide on the point in the construction cycle when the change will be implemented – a time which is dependent on the multitude of variables that determine the planning of work in the shipyard. When shipbuilders are working at peak levels or suffering productivity losses, they are reluctant to agree to fully priced changes – particularly delay and disruption costs. Since the current Navy policy is to avoid partially priced changes, the result has been a backlog of pending changes in

several programs. To the extent that these changes would produce an improved ship at lower cost, the Navy is injured by this deferral in the ordering of changes. The study team considers it essential that the Navy devise a means of expediting the pricing of changes to reduce the number of outstanding unpriced changes and to permit the issuance of more fully priced bilateral modifications.

One action that should be considered is the use of contract clauses which would obligate both the Navy and its shipbuilders to accept changes with a cost impact below a specified dollar amount – perhaps $10,000 per ship – at no change in the contract price. Such contract clauses have been successfully used by a number of procuring activities as a means of reducing the administrative burden of numerous smaller changes. Under such a provision, the shipbuilder would forgo the upward adjustment to target cost, target profit, and ceiling price for such changes, and the Navy would forgo downward adjustments for changes which lowered costs. ECPs for such changes would still have to be processed, but the administrative work of pricing such changes would be eliminated.

Another procedure which has been suggested by the study team is the statistical pricing approach. The Navy has used such an approach on aerospace contracts, and it appears usable on shipbuilding contracts. Basically, this approach entails an agreement of the parties to collect groups of proposals under a specified dollar size – perhaps $100,000 – and to negotiate a randomly selected sample of the proposals. Once agreement is reached on the sample proposals, the percentage reduction which has been negotiated is applied to the balance of the proposals in the group. The result is a substantial reduction in the Navy workload.

It is also clear to the study team that the pricing of changes would be expedited if the difficult issue of delay and disruption costs could be addressed more effectively. One step in this direction would be the promulgation of better guidance on the current legal rules relating to such costs. While it is recognized that definitive legal decisions are not available on all aspects of these cost elements, there is a growing body of law dealing with these issues. For example, the ASBCA and the courts usually find some means of apportioning the costs of concurrent delays based on an assessment of the impact of the specific delays. Similarly, the issue of the degree of proof required for delay and disruption costs

has been addressed, and it is clear that direct tracing of delay and disruption costs to specific changes is not generally required. The case law on cumulative effect and cross-contract impact costs also is developed well enough to provide the basis for guidance to Navy negotiators on the techniques to be used in dealing with such costs.

Another method of dealing with delay and disruption costs would be to devise formula techniques for pricing them. The studies of the pricing of delay and disruption which NAVSEA has initiated are a useful first step. It would appear that both the Navy and the shipbuilders could agree to the application of such a formula approach if the hard-core costs are within a pre-agreed dollar range and if there are no abnormal workload problems at the shipyard. It is likely that the formula would be based on percentages of the hard-core costs for each change. The goal of this formula approach would be to permit the use of fully priced bilateral modifications for virtually all of the smaller changes. This approach would allow the SUPSHIPs to concentrate their efforts on major changes and would mean that smaller changes could be ordered in a more timely fashion.

The study team also believes that NAVSEA should experiment with block-pricing of delay and disruption at selected shipyards that are not in a peak load status. Such a technique would separate delay and disruption costs from hard-core costs, with agreement to price the total delay and disruption quarterly or semiannually. This approach would recognize the fact that delay and disruption generally result from the cumulative effect of both actions by shipbuilder management and Navy-responsible changes – factors which can be more readily evaluated over a period of time.

C. Conclusions

The study team believes that a number of actions should be initiated to improve the management of changes. The study team's conclusions are summarized below.

1. Minimization of Changes

NAVSEA should mount a continuing effort to control the number of changes that are ordered on ship construction contracts. In order to reduce the number of changes related to ship specifications and drawings, NAVSEA should expand its efforts to involve shipbuilders early in the contract design process. NAVSEA should emphasize to all concerned the value of deferring nonessential changes for post-delivery implementation.

2. Engineering Change Proposals

NAVSEA should thoroughly review the ECP process to find ways to reduce the burden of this process on both the shipbuilders and the Navy. Suggested actions include:

a. Reduce the coverage of the configuration baseline to the essential aspects of the ship.

b. Delay the establishment of the configuration baseline until later in the ship design process.

c. Reduce the amount of detailed information that is required in ECPs.

d. Remove the ECP information provision requirements from shipbuilders where the information is not readily available.

3. Method of Ordering Changes

NAVSEA should order changes using the following alternatives and based on a management judgment as to which course of action will achieve the most timely issuance of changes:

a. Use fully priced bilateral modifications as the primary means of ordering changes when a change is well defined and can be realistically priced.

b. Negotiate a bilateral modification for the necessary engineering effort if fully priced bilateral modifications cannot be obtained and substantial design work is involved. When the task is adequately defined, a second bilateral modification should be negotiated to authorize the implementation of the change into the ship construction process. In instances where it would be costly to proceed with the original work, the ship construction change could be ordered unilaterally, concurrent with the design change.

c. Issue bilateral modifications with maximum prices only when such modifications do not impose a significant risk of loss on the shipbuilder.

d. Permit freer use of unilateral change orders when the parties cannot agree to a bilateral modification. The requirement for approval of unilateral change orders by the Chief of Naval Material should only be required when business clearance approval is necessary. The SHAPM and the cognizant SUPSHIP should agree concerning any limitations on the authority to issue unilateral change orders, keeping in mind the advantages of delegating responsibility to SUPSHIPs, as discussed in Chapter Four.

4. SUPSHIP ECP Authority

The SACAM should be revised to delete the $10,000 per ship limitation on the SUPSHIP's authority to act on ECPs.

5. Clauses

The ASPR Changes and Notification of Changes clauses should be used in future ship construction contracts in place of the Navy Procurement Circular 18 Changes clause. An additional provision should deny to shipbuilders any recovery for costs incurred where failure of notice after the shipbuilder knew or should have known of the problem

deprived the Navy of the opportunity to solve the problem and to save the costs.

6. **Constructive Changes**

   a. Identification of constructive changes is a responsibility of the entire SUPSHIP organization and should not be placed with a team or a selected group of people within that office. Additional training should be provided to SUPSHIPs to aid in this process. Readily available legal support should be provided to the SUPSHIP staff.

   b. Efforts should be undertaken to assure that SHAPM and SUPSHIP personnel are fully aware of their contractual obligations and of the need to avoid creating constructive changes by meticuously adhering to contract terms.

7. **Nucleus Crew Deficiency Reports**

   Nucleus crew deficiency reports should also be prescreened by the SUPSHIP prior to presentation to the shipbuilder.

8. **Change Pricing**

   NAVSEA should implement methods for expediting the change-pricing process. Suggested techniques include:

   a. Use a contract clause which would obligate both parties to accept changes under a specified dollar value at no increase in contract price.

   b. Use of a statistical pricing approach for changes under a specified dollar value, providing that groups of changes will be priced on the basis of the results derived from pricing a random sample of the changes.

   c. Provide more detailed guidance to NAVSEA contracting personnel concerning the current legal interpretations of shipbuilder entitlement to delay and disruption costs.

d. Continue the work aimed at devising a formula method for pricing delay and disruption costs.

e. Experiment with techniques for pricing delay and disruption on a quarterly or semiannual basis rather than as an element of individual changes.

Appendixes

APPENDIX A
THE NAVY SHIP ACQUISITION PROCESS

TABLE OF CONTENTS

LIST OF EXHIBITS

I. INTRODUCTION

A. Objective

This appendix contains information which explains the various elements of the naval ship acquisition process in relation to the internal approval cycle within the Department of Defense, as displayed in Exhibit A-1.[1] This information reflects a review of the Department of Defense (DOD), Secretary of the Navy (SECNAV), Office of the Chief of Naval Operations (OPNAV), Naval Material Command (NAVMAT), and Naval Sea Systems Command (NAVSEA) directives, instructions, and other documentation that govern major system acquisition policies and the application of these policies in the ship acquisition process. Since major changes have recently been made to these regulations, it is not possible to predict precisely how they will be applied to future ship acquisitions. Hence, the material displayed here must be accepted as an informal interpretation of the current process.

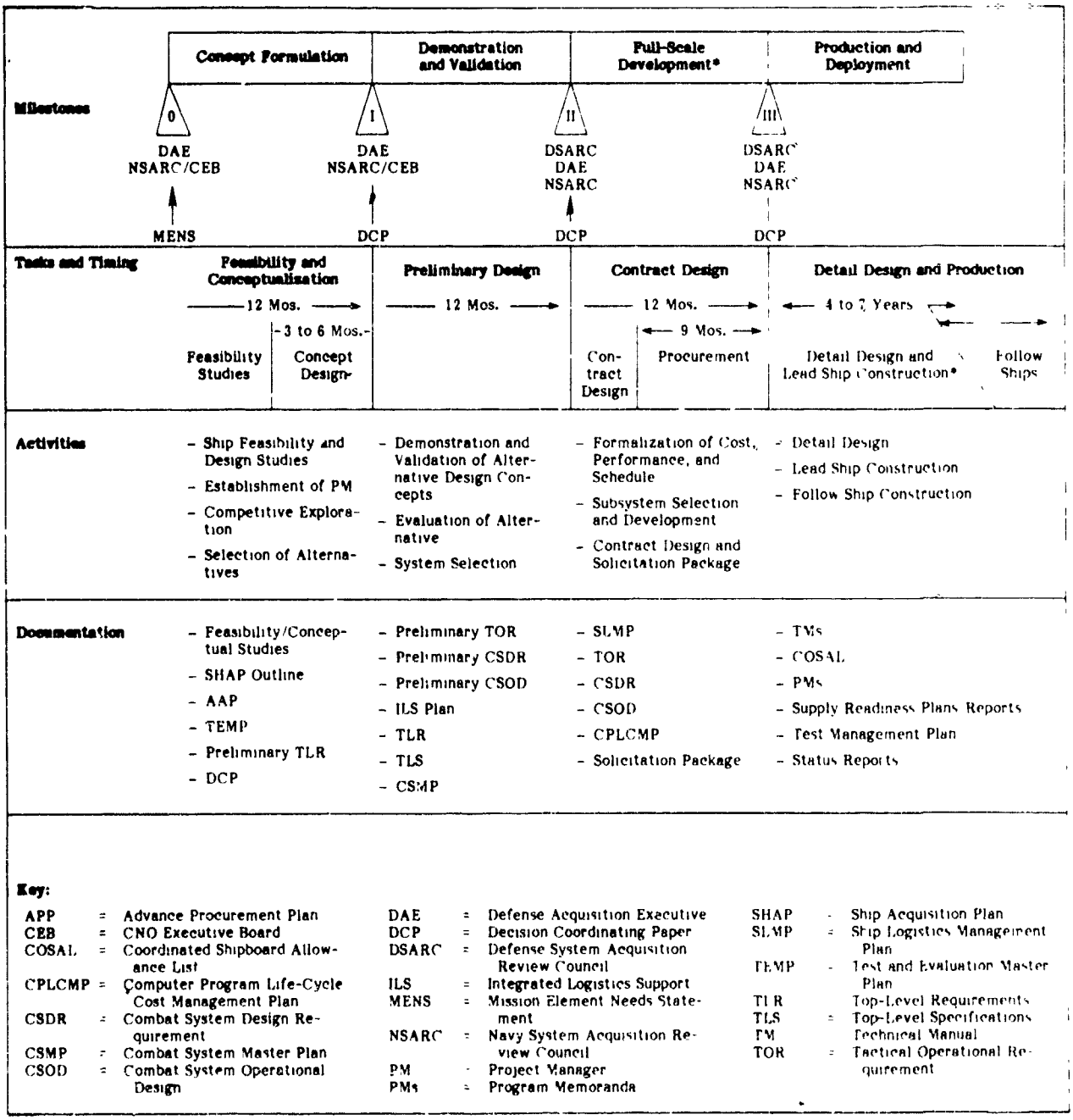
B. Organization

The following sections of this appendix present exhibits which set forth the detailed elements of the ship acquisition process and examine the FFG program as an example of some of the revisions to the process which have been initiated within the Navy. A list of the source documents that were used in preparing this material is included as an attachment.

---

[1] This exhibit also appears as Exhibit XXX (Chapter Two) in the body of this report.

EXHIBIT A-1
THE NAVY SHIP ACQUISITION PROCESS: MILESTONES, MAJOR TASKS, ACTIVITIES, AND DOCUMENTATION



Key:

APP	=	Advance Procurement Plan	DAE	=	Defense Acquisition Executive	SHAP	= Ship Acquisition Plan
CEB	=	CNO Executive Board	DCP	=	Decision Coordinating Paper	SLMP	= Ship Logistics Management Plan
COSAL	=	Coordinated Shipboard Allowance List	DSARC	=	Defense System Acquisition Review Council	TEMP	= Test and Evaluation Master Plan
CPLCMP	=	Computer Program Life-Cycle Cost Management Plan	ILS	=	Integrated Logistics Support	TLR	Top-Level Requirements
CSDR	=	Combat System Design Requirement	MENS	=	Mission Element Needs Statement	TLS	= Top-Level Specifications
CSMP	=	Combat System Master Plan	NSARC	=	Navy System Acquisition Review Council	TM	Technical Manual
CSOD	=	Combat System Operational Design	PM	=	Project Manager	TOR	= Tactical Operational Requirement
			PMs	=	Program Memoranda		

*In some programs, DSARC-II has authorized design and construction of the lead ship.

II. SHIP ACQUISITION PROCESS OVERVIEW

A. Background

In January 1977, the Secretary of Defense (SECDEF) issued new versions of DOD Directives 5000.1 and 5000.2, the policy documents that are fundamental to the process of major system acquisition. These top-level documents, which now reflect the guidance of higher authority as promulgated in Office of Management and Budget (OMB) Circular A-109 (April 1976), contain changes primarily in the following areas:

- Addition of a SECDEF decision point, Milestone 0, for approval of mission need and creation of a mission element needs statement (MENS) to support this decision point.
- Limitation of the number of SECDEF decision points to the four key milestones for those programs that are executed within agreed-to bounds.
- Strengthening of program manager authority through emphasis on line authority, responsibility, and accountability.
- Establishment of service [Navy] systems acquisition review councils (NSARCs).
- Simplification of decision coordinating paper (DCP) processing, with greater responsibility at the service level.
- Elimination of defense system acquisition review council (DSARC) reviews for certain classes of programs at Milestone I.
- Provision for waiver of DSARC reviews at other milestone decision points.

Revisions to SECNAV, OPNAV, NAVMAT, and NAVSEA directives incorporating the changes in the January 1977 DOD directives have not yet been issued. However, in the development of this discussion, it was assumed that such revisions will reflect DOD policy and procedures. The impact that these revisions will have on previous agreements between the Director of Defense Research and

Engineering and the Assistant Secretary of the Navy for Research and Development is not known.

B. Ship Acquisition Process

The exhibits which follow present the detailed elements of the ship acquisition process as displayed in Exhibit A-1 and discussed in the text of the report. Exhibit A-2 describes the program initiation phase. Exhibit A-3 shows the tasks during the basic phases in a major system acquisition. This phaseology is then used as a base to highlight the major SECDEF and DSARC decision points and the review/decision process in Exhibits A-4 and A-5. Exhibits A-6 and A-7 describe the technical phaseology and documentation and phase documentation.

EXHIBIT A-2
PROGRAM INITIATION:
MISSION ELEMENT NEEDS STATEMENT (MENS)* PROCESS

MENS Preparation	DAE Review	SECDEF Decision (Milestone 0)
• Identification of valid mission element need by any activity. • Formalization into MENS. – Mission area. – Projected threat. – Existing capabilities. – Known constraints. – Program plan for exploration. • Review by Navy System Acquisition Review Council (NSARC) or CNO Executive Board (CEB). • Submittal to DOD.**	• Distribution by defense acquisition executive (DAE) to OSD/OJCS staffs for review/comment. • Preparation of position paper by DAE. • Submission of package to SECDEF. – MENS. – DAE position paper. – OSD/OJCS comments. – Proposed action memo.	• Review and decision by SECDEF. • Signing of proposed action memo by SECDEF authorizing program initiation. • Issuance of papers for establishment of program manager and commencement of initial program activities.

*The MENS is essentially equivalent to the pre-January 1977 operational requirement (OR) and development proposal (DP).

**Prior to January 1977, DOD approval was not required to commence feasibility and conceptualization studies.

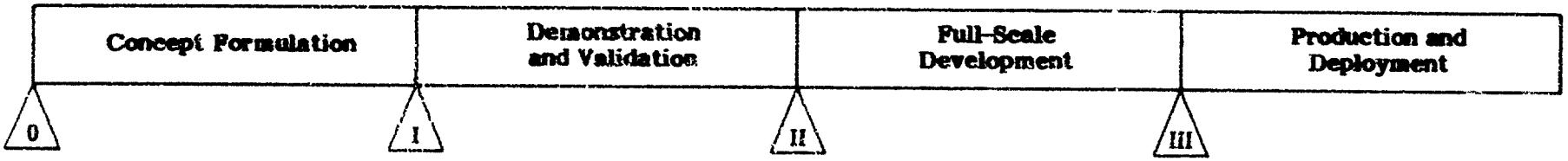
EXHIBIT A-3
TASKS DURING BASIC PHASES IN MAJOR SYSTEM ACQUISITION

Concept Formulation	Demonstration and Validation	Full-Scale Development	Production and Deployment
• Establishment of program coordinator (OPNAV) and program manager (NAVSEA).	• Demonstration and validation of one or more selected alternative design concepts.	• Formalization of cost, performance, and schedule estimates.	• Detail design preparation.*
• Development of acquisition strategy.	• Competitive prototype demonstration of system or critical subsystems.	• Subsystem selection and development.	• Lead ship construction.*
• Participation by competent industry and educational institutions in competitive exploration of alternative system concepts to meet approved need.	• Evaluation of demonstrated alternatives.	• Development of contract design and solicitation package for lead ship.	• Outfitting, delivery, shakedown, and post-shakedown availability (PSA).
• Development of top-level requirements (TLR).	• Selection of system concept for full-scale engineering development.	• Finalization of combat system requirements and specifications.	• SHAPM to ship logistic manager (SLM) turnover.
• Selection of alternatives warranting system demonstration and further development.	• Development of top-level specifications (TLS).	• Detail design preparation.*	• Follow ship construction.
		• Lead ship construction.	

5 Years

*It is not clear whether the lead ship design and construction is approved by DSARC II or DSARC III.

EXHIBIT A-4
MAJOR SECDEF AND DEFENSE SYSTEM ACQUISITION REVIEW COUNCIL (DSARC) DECISION POINTS



Concept Formulation

- DSARC review not required.
- SECDEF approval obtained through defense acquisition executive (DAE) using mission element needs statement (MENS).*
- Approval results in establishment of program manager and exploration of alternative system concepts.

Demonstration and Validation

- DSARC review required only for specific categories of acquisition (nuclear; strategic; joint service; multinational; intelligence; command, control, and logistics).
- SECDEF approval obtained via DAE using decision coordinating paper (DCP).
- Authorized demonstration and validation of selected alternative systems.

Full-Scale Development

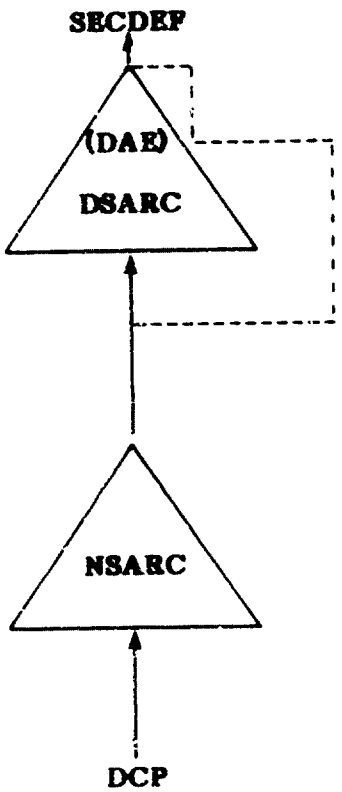
- DSARC review required.
- Vehicle is DCP.
- Authorizes:
  - Program continuation.
  - Full-scale development.
  - Long-lead-time material procurement.
  - Limited production activity necessary for operational test and evaluation (T&E).

Production and Deployment

- DSARC review required.
- Vehicle is DCP.
- Authorizes ship production and deployment.
- May be followed by a Decision Point III-A for follow ship production and deployment.

*SECDEF approval was not required prior to January 1977.

EXHIBIT A-5
REVIEW/DECISION PROCESS



SECDEF Review/Approval

- Draft "for comment" DCP submitted to DAE for OSD/OJCS review/comment.
- Comments returned to SECNAV who addresses OSD/OJCS/DAE issues.
- "For coordination" DCP submitted to DAE and DSARC members.
- DSARC review (DAE in case of milestones ⓪ and ①).
- Two reviews by NSARC.
- NSARC (or DNSARC) is composed of:
  - Assistant Secretary of the Navy (ASN) – cognizant.
  - Director, Research and Development, Test, and Engineering (DIR RDT&E).
  - Commander, Operational Test and Evaluation Forces (COMOPTEVFOR).
  - Office of the Assistant Secretary of the Navy (Financial Management) [OASN (FM)].
- Presentation by OPNAV program coordinator and NAVSEA program manager.
- Decision coordinating paper prepared/updated by program manager (NAVSEA) and program coordinator (OPNAV). Content specified in DOD DIR 5000.2.

EXHIBIT A-6
TECHNICAL PHASEOLOGY AND DOCUMENTATION

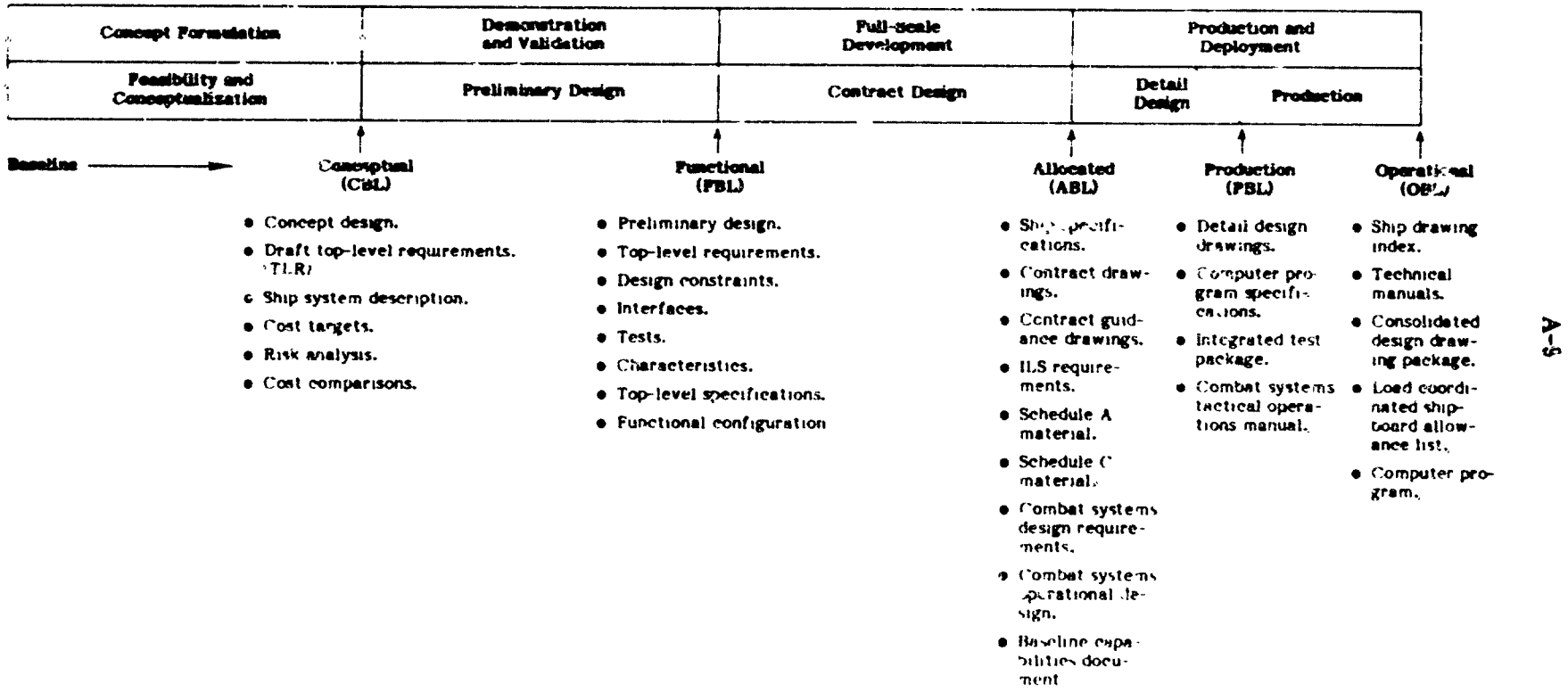


EXHIBIT A-7
PHASE DOCUMENTATION

Concept Formulation	Demonstration and Validation	Full-Scale Development	Production and Deployment
• Mission element needs statement. • Feasibility studies. • Conceptual studies. • Ship acquisition plan. • Advance procurement plan. • Test and evaluation master plan. • Preliminary top-level requirements. • Decision coordinating paper.	• Preliminary tactical operations requirements. • Preliminary combat system (CS) design requirements. • Preliminary CS operational design. • Integrated logistic support plan. • Top-level requirements. • Test and evaluation master plan update. • Top-level specifications. • Ship acquisition plan update. • CS master plan. • Decision coordinating paper.	• Ship logistic management plan. • Tactical operations requirements. • CS design requirements. • CS operational design. • Test and evaluation master plan update. • Ship acquisition plan update. • First ship specifications. • Solicitation package. • Decision coordinating paper. • Computer program life-cycle management plan. • Computer program allocated baseline.	• Test management plan. • Supply readiness milestone plan. • Ship maintenance plan. • Coordinated shipboard allowance list. • Technical manuals. • Project manager SEA. • Fitting-out plan. • Trial agendas. • Inspection and survey report.

III. FFG PROCUREMENT

A. Background

The FFG program was the first "design to a price" ship acquisition program advanced by the Navy. The success of the program has been attributed to a number of factors, including the following which were cited in the 1975 NMARC Report:[1]

- The development of more comprehensive contract plans and specifications reduced the risk to the lead shipbuilder in developing a responsive design.
- Participation by two shipbuilders and design agents early in the ship system design phase assured increased design producibility and responsiveness to program requirements.
- The use of a cost plus incentive fee contract for the lead ship reduced the risk to the lead shipbuilder.
- The Navy's warranting of validated working drawings for follow ships significantly reduced the risk to the follow shipbuilders.

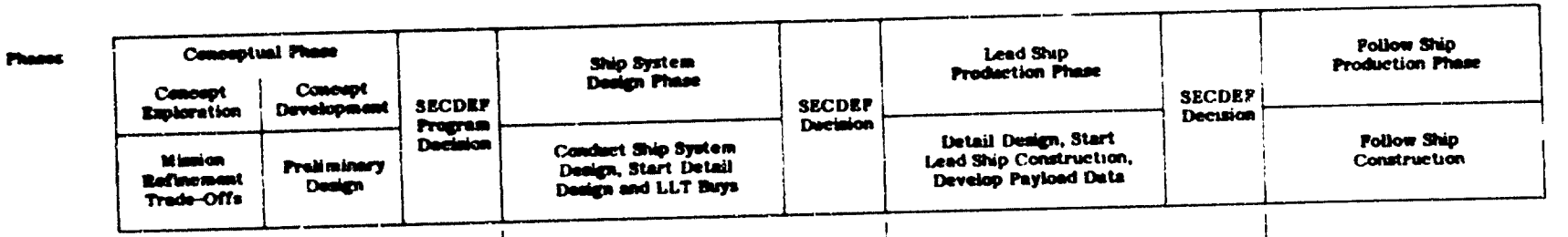
B. Acquisition Phases

Exhibit A-8 illustrates the FFG acquisition phases as they appeared in the Request for Proposal for contract design. The conceptual phase was primarily a Navy effort; the contract design phase combined Navy and shipbuilding industry participation; and the production phases were fundamentally an industry effort. The Navy controlled the technical development throughout the acquisition and was responsible for the basic ship system design. The contract design phase extended beyond the award of the lead ship production contract and continued until delineation of the follow ship allocated baseline.

---

[1] Office of the Secretary of the Navy, Report of the Navy Marine Corps Acquisition Review Committee, Washington, D.C., January 1975.

EXHIBIT A-8
FFG ACQUISITION PHASES



Baseline Content

- Need or requirement.
- Mission and threat description.
- Selected procurement concept.
- Ship and subsystem performance requirements.

- Selected configuration(s).
- General arrangements and line drawings.
- Performance capabilities.
- Estimated total program costs.

- Refined drawings on the arrangements, lines and mid-shipsection, hull, electrical, electronic, machinery.
- Ship and subsystem specifications.
- GFE/GFI list.
- All program plans.

- Partial detail design.
- Updated specifications.

Major End Products

- Concept exploration report.

- APP, SSD, DCP, ship system design RFP.

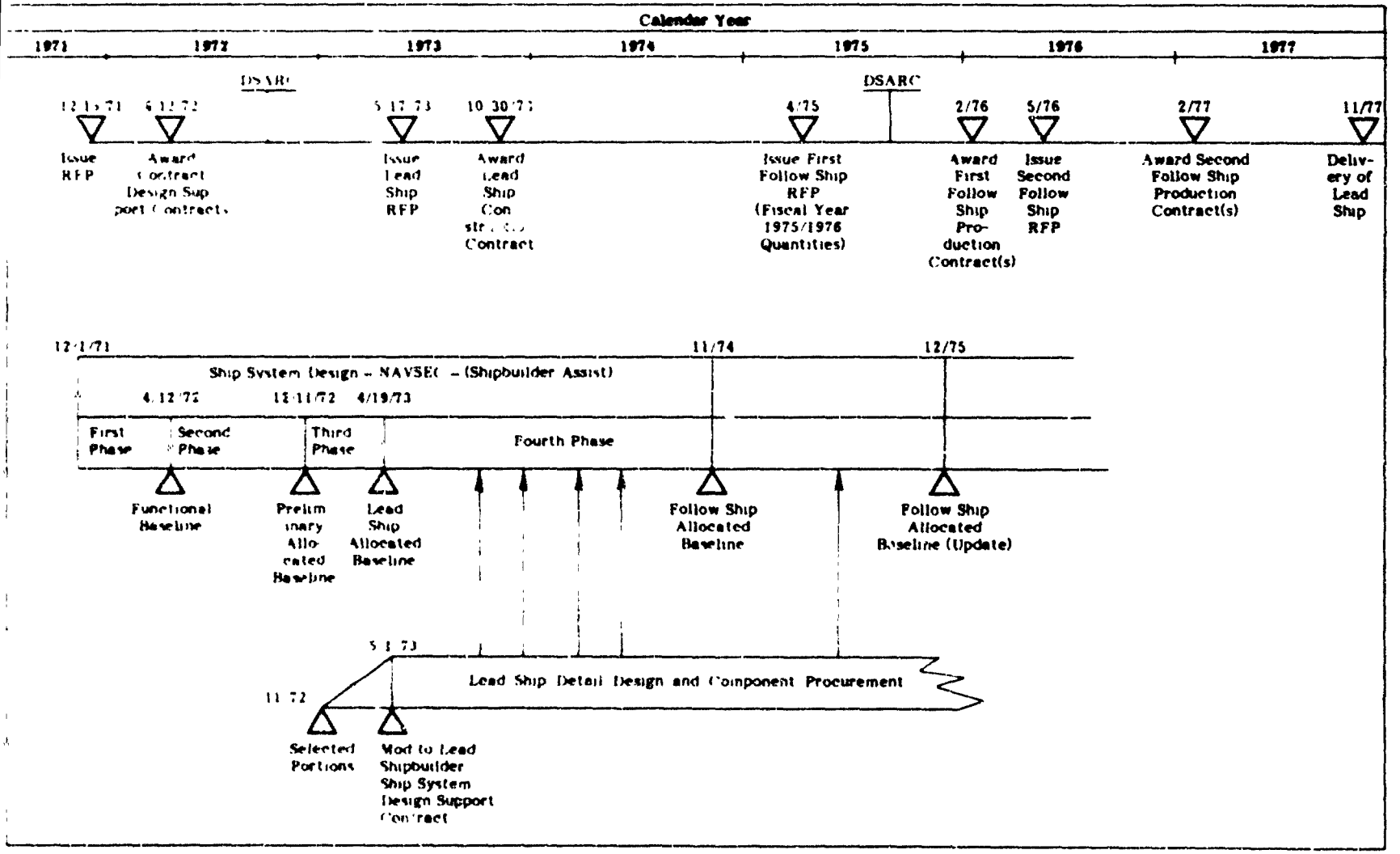
- Lead ship design package, SAP.

- Follow ship design package for RFP.

C. Procurement Plan

Two shipbuilders (Bath and Todd) were selected to participate with NAVSEC in contract design. Contracts were awarded during the second stage of contract design, and the two shipbuilders worked with NAVSEC in completing preparation of the preliminary allocated baseline. They became thoroughly familiar with the ship design and with the rationale governing all of the major technical decisions, and were responsible for injecting producibility considerations into the contract design process. Exhibit A-9 depicts the FFG procurement plan through November 1977.

EXHIBIT A-9
FFG PROCUREMENT PLAN



ATTACHMENT
SOURCE DOCUMENT LIST

Department of Defense, Directive 5000.1, "Major System Acquisitions," 18 January 1977.

Department of Defense, Directive 5000.2, "Major System Acquisition Process," 18 January 1977.

Department of Defense, Directive 5000.30, "Defense Acquisition Executive," 20 August 1976.

Director of Defense Research and Engineering and Assistant Secretary of the Navy for Research and Development, Agreement Concerning Implementation of DOD Directive 5000.1 for Ship Programs, 11 August 1975.

Naval Material Command, Instruction 5000.23, "Defense Systems Acquisition Review Council (DSARC)," 20 March 1975.

Naval Sea Systems Command, Instruction 9060.4, "Ship Acquisition Process," 29 March 1976.

Naval Sea Systems Command, "Ship Acquisition Reef Points," September 1976.

Naval Ship System Command, PMS 399, Request for Proposals for PF Program (now FFG Program) Ship System Design (SSD) Phase, Section A – Program Summary, December 1971.

Office of Federal Procurement Policy, Pamphlet No. 1, "Major System Acquisitions: A Discussion of the Application of OMB Circular A-109," August 1976.

Office of the Chief of Naval Operations, Instruction 5000.46, "Preparation and Processing of Decision Coordinating Papers (DCPs), Program Memoranda (PMs), and Navy Decision Coordinating Papers (NDCPs)," 22 April 1976.

Office of the Secretary of the Navy, Report of the Navy Marine Corps Acquisition Review Committee, Washington, D.C., January 1975.

Secretary of the Navy, Instruction 5000.1, through Ch. 3, "System Acquisition in the Department of the Navy," 14 May 1976.

Secretary of the Navy, Instruction 5200.30, "Management of Decision Coordinating Papers (DCPs) and Program Memoranda (PMs) within the Department of the Navy (DN)," 27 August 1975.

Secretary of the Navy, Instruction 5420.172B, "Establishment of the Department of the Navy Systems Acquisition Review Council (DNSARC)," 18 May 1976.

APPENDIX B
THE CHANGE LEXICON

TABLE OF CONTENTS

LIST OF EXHIBITS

A. Terms

The basic change terminology which is used in shipbuilding contracts is defined as follows:

Administrative Change

An administrative change is a modification that is primarily administrative in nature and does not alter the essential agreement between the parties. Such a change may be issued by a contracting officer without consideration to the Navy and without the shipbuilder's acceptance thereof. It is ordinarily a form of directed change. Representative examples of this type of modification include:

- Revision of accounting data.
- Correction of obvious typographical errors, such as misplaced decimal points or erroneous extensions in contract price.

Bilateral Contract Modification

A bilateral contract modification, which is sometimes called a supplemental agreement, incorporates a change into a contract as agreed to by both parties. Bilateral contract modifications may be fully priced or partially priced.

Change Control Board

The decision on whether to issue an engineering change proposal (ECP) is made by a change control board (CCB). This board serves a dual purpose:

- It brings all of the responsible people in the Navy together to assure that there is a full review of the merits of the proposed change.
- It expedites the decision by bringing all of the decision-makers together into a single conference.

Change Order

A change order is a directed change that is issued unilaterally pursuant to the Changes clause and the

contract. The Armed Services Procurement Regulation Changes clause or a variation of the Navy Procurement Circular 18 Changes clause is used in shipbuilding contracts.

In addition to the unilateral change order authority which the clause gives to the Navy, the clause provides the shipbuilder with the right to an equitable adjustment in the contract price and/or delivery schedule if the change results in additional costs or delays delivery. Present Navy policy discourages the use of unilateral change orders. This policy limits their use to those cases when it is not possible to reach agreement with the shipbuilder concerning the impact of the change on the contract price and/or delivery date before the change must be implemented.

Constructive Change

A constructive change is any communication other than a directed change (including any order, direction, instruction, interpretation, or determination) that is received by the contractor from a representative of the government or an act or omission of the government that has the effect of requiring the contractor to do work which is different from or in addition to the prescribed contract terms. A constructive change becomes a directed change if it is recognized by the Navy.

Deviation

A deviation is the simplest kind of nonconformance with contract specifications, drawings, or other documents. Deviations are designated as (i) critical, (ii) major, or (iii) minor. Shipbuilder requests for deviations are reviewed by the cognizant supervisor of shipbuilding (SUPSHIP). If the SUPSHIP believes that the deviation should be incorporated in the requirements for future contracts, the contractor is required to submit an ECP.

Directed Change

A directed change is any accepted formal change (other than a constructive change) that is proposed by the shipbuilder or originated by the Navy. A directed change may result in a unilateral change order or a bilateral contract modification.

Engineering Change Proposal

An ECP, which is submitted pursuant to MIL-STD-480, is a document that addresses changes in the configuration of an item or in the detailed specifications for the construction of a ship. It both proposes an engineering change and includes the documentation by which the change is described. ECPs are characterized as essential or optional. Essential ECPs respond to urgent operational requirements and must be accomplished prior to the delivery of the ship. Optional ECPs do not have to be accomplished before delivery of the ship. ECPs may be originated by either the shipbuilder or the Navy.

ECP Approval Procedure

The draft NAVSEA Configuration Management and Change Control Manual establishes four levels of approval for ECPs: (i) Office of the Chief of Naval Operations (OPNAV), (ii) Naval Sea Systems Command (NAVSEA), (iii) Ship Acquisition Project Managers (SHAPMs), and (iv) SUPSHIPs. The greater the technical, cost, and/or schedule impact of a proposed change, the higher the required organizational level of approval. If an ECP proposes a change in military characteristics, it can be approved only by OPNAV.

Headquarters Modification Requisition/ Field Modification Requisition

A headquarters modification requisition (HMR) and a field modification requisition (FMR) are administrative documents that are used to control changes to ship construction contracts. An HMR is an authorization from a SHAPM to a SUPSHIP administrative contracting officer (ACO) to modify a contract as stated. An HMR package consists of

the HMR, ECP, or nonengineering change proposal (NECP) as well as applicable drawings and substitute specification pages. An FMR is a document that is prepared by a SUPSHIP authorizing the ACO to modify a contract as stated in the FMR.

Nonengineering Change Proposal — An NECP is a request proposing a change that does not impact on the configuration of an item, but does affect the cost, delivery, and scope of work. The criteria for determining whether an NECP is essential or optional are the same as for an ECP.

Waiver — A waiver is a contractor request for nonconformance in a configuration item that departs from the specified requirements, but that is nevertheless suitable for use in its existing form. Shipbuilder requests for waivers are processed in the same manner as deviations.

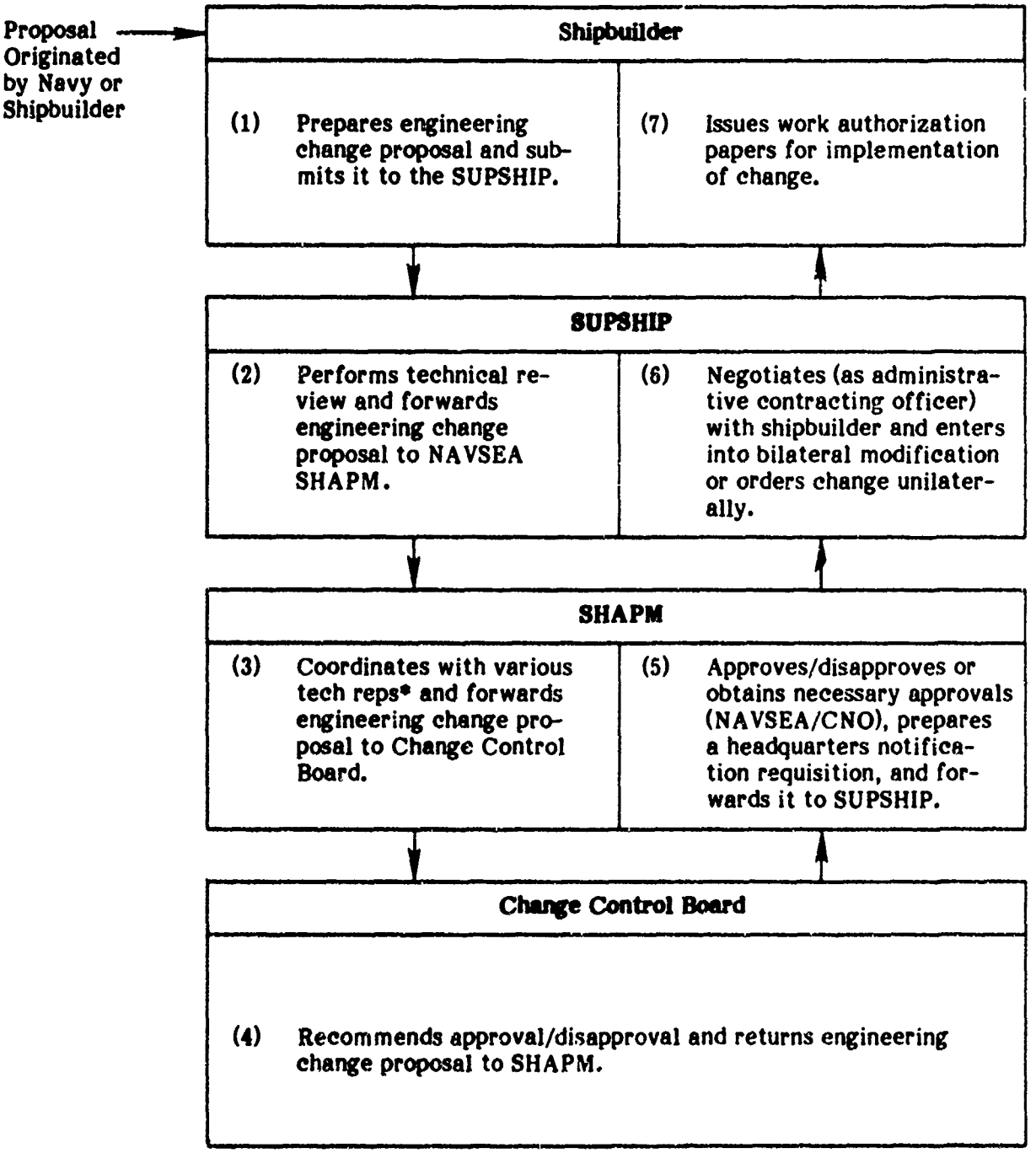
B. ECP Procedures

Exhibit B provides an overview of the ECP process. The various steps in this process are defined below:

(1) Shipbuilder — The shipbuilder (or design agent) prepares an ECP package which consists of all of the associated technical, schedule, and cost information, and submits this information to the local SUPSHIP.

(2) SUPSHIP — In the SUPSHIP organization, the ECP is reviewed from a technical standpoint by the program manager's representative (PMR) as an on-site representative of the SHAPM. The PMR may task other departments within the SUPSHIP in order to make an appropriate recommendation on the ECP. When this review is completed, the ECP is forwarded to the SUPSHIP ACO who forwards the entire package either to the SHAPM or to the SUPSHIP CCB – depending on the level of authorization required.

EXHIBIT B
THE ENGINEERING CHANGE PROPOSAL PROCESS



*NAVSEC, other Navy/DOD offices, other SUPSHIPs, and the follow shipbuilder.

(3) **SHAPM** — The SHAPM reviews the proposed ECP, coordinates with other technical organizations such as the Naval Ship Engineering Center (NAVSEC), the Navy laboratories, and other project managers who may have overlapping responsibilities (such as for weapon systems that are to be installed in the ship). When this coordination is accomplished, the SHAPM submits the package with the information obtained from other affected organizations to the CCB for action.

(4) **Change Control Board** — The membership of the CCB is convened to review, discuss, and act on the ECP. Usually, the deputy SHAPM for the program is also the chairman of the CCB and can provide the relevant data that the other members of the CCB who are acting on the ECP may need. The CCB recommends approval or disapproval of the ECP and forwards it to the cognizant SHAPM.

(5) **SHAPM** — If the ECP is approved, the SHAPM then determines what additional approvals are necessary. Depending on the complexity of the ECP, the approval of the Chief of Naval Operations, Commander of NAVSEA, or the SHAPM may be required. Once these approvals are obtained, the SHAPM prepares an HMR with all of the requisite technical data, and forwards it to the SUPSHIP. The HMR usually contains instructions on the method for ordering the change.

(6) **SUPSHIP** — The SUPSHIP ACO negotiates with the shipbuilder for the approved ECP. If the negotiations are successful, a bilateral modification is entered into between the shipbuilder and the SUPSHIP ACO. The ACO then makes appropriate distribution of the modification to all of the affected organizations of the program, including the Navy Finance Office. If the parties cannot agree to a bilateral modification, the SUPSHIP may order a unilateral change within the established limits of authority or may request the approval from higher authority to order such a change.

(7) **Shipbuilder** Upon receiving a copy of the executed bilateral modification or change order, the shipbuilder issues work authorization papers to the design, engineering, and/or shipyard departments for implementation of the change on the ship.

The process described above represents the typical handling of an ECP. However, there are variations to this cycle when the ECP is originated by the Navy or when the design agent only submits a preliminary ECP. In addition, when there are follow yards involved, the SHAPM issues an HMR to the cognizant SUPSHIP to contract for the work with the follow yards for all of the other ships of the class that are under construction.

APPENDIX C
REFERENCE BIBLIOGRAPHY

Assistant Secretary of the Navy (Financial Management), Report of Task Group to Study Progress Payments, Washington, D.C., 1972.

Blue Ribbon Defense Panel, Report to the President and the Secretary of Defense on the Department of Defense, Washington, D.C., 1 July 1970.

Department of Commerce, Maritime Administration, MARAD '76, Annual Report of the Maritime Administration for Fiscal Year 1976 and the Transition Quarter Ending September 30, 1976, Washington, D.C., April 1977.

Department of Commerce, Maritime Administration, Survey of U.S. Shipbuilding and Repair Facilities, 1977, Washington, D.C., December 1977.

Department of Defense, Armed Services Procurement Regulation, Washington, D.C., 1976.

Department of Defense, Coordinator of Shipbuilding, Conversion, and Repair, Annual Report on the Status of the Shipbuilding and Ship Repair Industry of the United States, 1976, Report Control Symbol DD-I&L(A)1141, Washington, D.C., 26 April 1977.

Department of Defense, Office of the Assistant Secretary of Defense (Installations and Logistics), Office of the Deputy Assistant Secretary of Defense (Procurement), Profit Study Group, Profit '76 Summary Report, Washington, D.C., December 1976.

Department of Labor, Bureau of Labor Statistics, Employment and Earnings, Washington, D.C., March 1976, March 1977, and February 1978.

Department of Labor, Bureau of Labor Statistics, Employment and Earnings, United States, 1909 - 1975, Bulletin 1312-10, Washington, D.C., 1976.

General Accounting Office, Report to the Congress by the Comptroller General of the United States, Financial Status of Major Federal Acquisitions September 30, 1977, Report Number PSAD-78-60, Washington, D.C., 20 January 1978.

General Accounting Office, Report to the Congress by the Comptroller General of the United States, Shipbuilder Claims - Problems and Solutions, Report Number PSAD-77-135, Washington, D.C., 9 August 1977.

General Accounting Office, Report to the Congress by the Comptroller General of the United States, Status of Shipbuilder Claims for Price Increases, Report Number PSAD-76-24, Washington, D.C., 5 November 1975.

International Maritime Associates, Inc., A Study of Ship Cost Estimating in the Naval Sea Systems Command, Washington, D.C., October 1977.

Martin, John C., The Labor Market of the United States Shipbuilding Industry, Doctoral dissertation, George Washington University, 1978.

Naval Sea Systems Command, Quarterly Report of Status of Shipbuilding and Conversion Contracts, Report 7303/4, Washington, D.C. (various issues).

Naval Sea Systems Command, Ship Acquisition Contract Administration Manual, Publication 0900-LP-079-6010, Washington, D.C., 1975.

Office of Naval Research, The Profitability of the U.S. Shipbuilding Industry, 1947 - 1976, draft report, Washington, D.C., 16 May 1978.

Office of the Secretary of the Navy, Report of the Navy Marine Corps Acquisition Review Committee, Washington, D.C., January 1975.

Shipbuilders Council of America, Shipyard Weekly, Washington, D.C. (various issues).

Shipbuilders Council of America, Statistical Quarterly, Washington, D.C. (various issues).

Sonenshein, N., RADM, USN (Ret.), editor, Global Marine Development, Inc., Defense Science Board Summer Study, 1977 Report of the Ship Acquisition Team of the Acquisition Cycle Task Force, Newport Beach, California, 26 August 1977.

Study Team, The Naval Ship Procurement Process Study, Interim Report, Washington, D.C., August 1977.