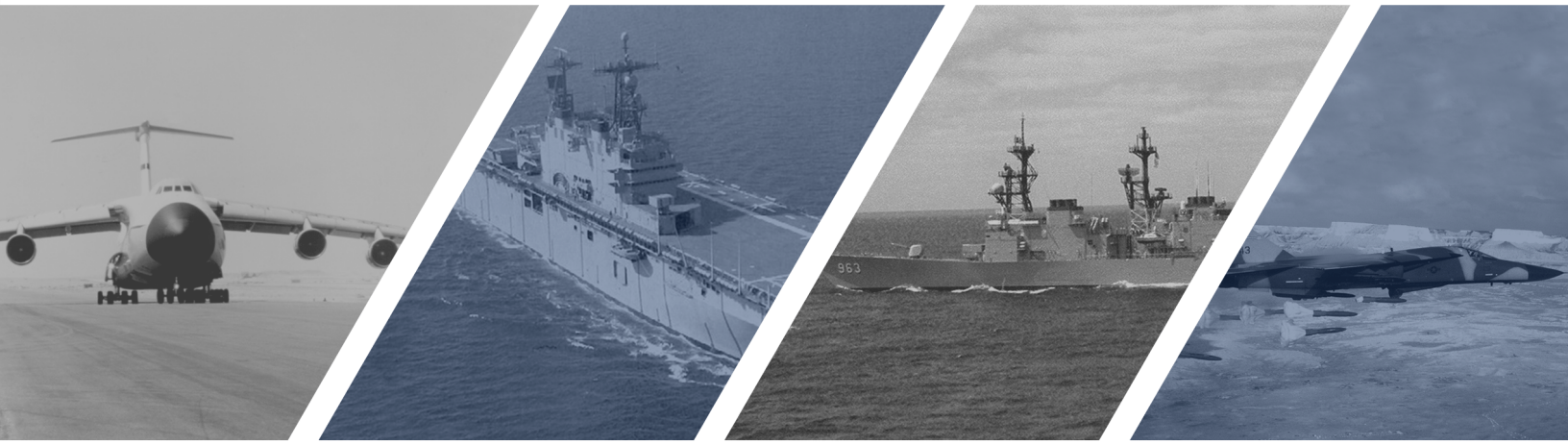
RISK AND FOCUS IN DEFENSE SYSTEMS ACQUISITION

A Story of Best Business Practices and Total Package Procurement



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ABSTRACT

At the turn of a new century, the acquisition of major weapon systems was changing to align with a "Revolution in Business Affairs" in the Department of Defense (DoD). This revolution advocated shifting more risk and responsibility for systems from government to private industry. Industry was being asked to synthesize and engineer up-front requirements, as well as to support systems once they were in service. This was sometimes called "Full-Service Contracting" and was an expansion of industry's more traditional development and production role. Fixed-price contracting for development was also being encouraged to attract commercial bidders. All of this was being promoted as a way of reducing cost. But, was this truly a revolution? Some of these reforms recalled an earlier upheaval in business affairs in the 1960s when the relatively new DoD embarked on another ambitious crusade to revise the way weapons are acquired, again to control costs. Central to that movement was a strategy called *Total Package Procurement* (*TPP*), which had some of the same elements seen in the mid-1990s and early 2000s. Three programs that used *TPP*—the C-5A aircraft and the LHA-1 and DD963 class ships; a program that was stimulated by the same business model—the F-111 aircraft; and an effort from the period that did not use *TPP*—the CGN-36/38 class ships—are discussed in detail, highlighting events and lessons that may be applicable still today. In addition, the history and times that led to *TPP* are explored for a fundamental understanding of why such business reforms continue to occur and often fall short.

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PREFACE

This publication is the final version of "Risk and Focus in Defense Systems Acquisition—a Story of Best Business Practices and Total Package Procurement." It was originally the result of a study tasked to Strategic Insight Ltd. by the Naval Surface Warfare Center (NSWC), Dahlgren, VA, in 1997. At that time, the Navy was trying to initiate a new major combatant ship construction program, then known as Surface Combatant-21 (SC-21). The ship was following very closely on another on-going attempt at a major ship construction program known as "Arsenal Ship," proponents of which had attempted to use a novel acquisition strategy managed through the Defense Advanced Research Project Agency (DARPA). This program ultimately failed, but at the time of the tasking, the Navy was debating whether the Arsenal Ship acquisition strategy, among others, should be followed for SC-21.

A draft proposal was put forward by the SC-21 program office, and a group of senior advisors, or "graybeards," were brought together at Dahlgren to review it. None of this report's authors attended the meeting, and a complete disclosure of the review was never made to them. However, at some point in the discussion, one of the graybeards commented "You are just doing Total Package Procurement all over again." The discussion, at least for a moment, came to a standstill, as no one else present besides the graybeards had ever heard of "Total Package Procurement" and had no idea what the speaker was talking about – though it was clearly a negative comment.

Following the meeting, the senior leader for these activities at NSWC Dahlgren contacted Strategic Insight and asked the company to assemble a team and report back on: "What was Total Package Procurement?", "How was it used in the Navy?", and "What was the Outcome?" The team included Mr. Dan Shields of KPMG/Peat Marwick, a retired comptroller from NSWC Dahlgren, Captain (USN) Larry Sharp of Strategic Insight, a retired Navy Engineering Duty Officer with a background in ship operation, shipbuilding and ship maintenance and support, and various other support staff. The team was led by Mr. Bob Gray, a former member of the AEGIS Program, who had worked at the Naval Weapons Laboratory and the Naval Surface Weapons Center (the predecessor organizations to NSWC Dahlgren) as a scientist/engineer prior to joining AEGIS. The team's approach is described in detail in this report; but, in short, it included interviews, an extensive literature search, a review of previous studies, and a dedicated war room to initiate the study and pull together its findings. The war room allowed study members to divide the work up while following a common, coherent approach. It also allowed the study sponsors to review the work as it evolved and to be briefed at their convenience.

The work was completed in less than a year. The final war room product, which was the principal mechanism for reporting the findings, was briefed to the sponsors, as well as other senior officials connected to the SC-21 effort; and, a very early version of this report was submitted to complete the contract. In 1998, the American Society of Naval Engineers (ASNE), requested that the report be presented as a "paper" at its "Engineering the Total Ship Symposium" to be held 13-15 May 1998. The original report was reduced in length and edited to meet ASNE publication requirements by Bob Gray and Ken McCollum, an excellent writer and retired Navy civilian from NSWC Dahlgren. The resulting 20-page paper was presented by them at the symposium's open forum and subsequently published as one of the symposium's products. The NSWC Dahlgren leader who had originally asked for the study also gave Strategic Insight permission to publish the report under its own logo.

Over the next few years, Strategic Insight periodically updated and polished the report, particularly as policies and events in DoD acquisition and Navy shipbuilding changed. Captain Sharp and Bob Gray spent one month refining the report, primarily adding contextual information, increasing the level of detail (including conducting a thorough audit of the financial information), and expanding the use and number of references. Sections comparing Total Package Procurement outcomes to the "lessons learned" on the Arsenal Ship were also added.

By 2002, the report was substantially of the length, form and substance it is today. In 2005, at the

beginning of the Chief of Naval Operations (CNO)-sponsored Surface Warfare Combatant Study for the 21st Century (SWCS-21), the report was distributed as background information to study members. It was also reviewed and commented on by the SWCS-21 Steering Board, composed of retired senior naval officers and civilians – many of whom had been active during the days of *TPP*. In particular, RADM Myron Ricketts, USN (Ret.), former head of the Ship Design and Engineering Directorate at the Naval Sea Systems Command, conducted an intense review, and much of his critique was incorporated.

After the SWCS-21 study ended in 2009, a few Navy organizations requested informal copies of the report and distributed it to their members. An unpublished version, dated 2002, was referenced in a report entitled "Navy and Defense Reform", published by the Navy History and Heritage Command in about 2012.*

This report is dated 2002, by which time substantive additions to the original report and attempts to keep it current and abreast of outside activities ended, even though editing continued periodically as discussed above. It is being published now in 2020 because Strategic Insight believes it provides timeless counsel to those who will build our future ships and weapons. While "Total Package Procurement" as a term has not been used since its failure in the 1960s and 1970s, the mindset and philosophy which conceived it are not likely to ever die. Thus, the company believes this updated report needs a more formal and more extensive distribution than has yet been made. It is being published to aid the efforts of today's and tomorrow's acquisition professionals – especially those in the Navy.

* *Navy and Defense Reform*: *A Short History and Reference Chronology*, by Justin L. C. Eldridge, Dr. Ryan Peeks, and Dr. Greg Bereiter. Navy History and Heritage Command, ca 2012.

"…A PAGE OF HISTORY IS WORTH A VOLUME OF LOGIC."

OLIVER WENDELL HOLMES, JR.

PREAMBLE
BASELINING THE STUDY

In 1997, this study was initiated to examine the Department of Defense's (DoD's) experience with Total Package Procurement (*TPP*), with particular emphasis on shipbuilding. At that time, the Navy was developing concepts in "Total Ship Engineering" and was concerned not to repeat past mistakes. This report documents the findings of that study and seeks to understand how the forces related to acquisition, in both their global and parochial aspects, impact the nation's ability to create high risk, complex systems, particularly warships.

The study team was led by professionals from Strategic Insight, Ltd. The team reviewed pertinent history from the 1800s to today to understand the context of *TPP* and what came afterwards. The study focused on Air Force aircraft programs, where *TPP* originated, and on Navy warships, which were the primary concerns of the study sponsors. The approach included:

a. Interviews with people who lived through the 1960s, 1970s, and *TPP*. All of these people were in some way connected to shipbuilding and included both public and private officials—engineers, program managers, lawyers, contracting officials, industry leaders, naval officers, program sponsors, and shipbuilders.

b. A broad-based literature search that included materials contemporary to the *TPP* era as well as before and after. The literature fell into numerous categories: (1) studies that examined the potential and actual effects of *TPP* on specific topics such as innovation, government oversight, and contract provisions, (2) studies that looked across many programs to examine acquisition trends, (3) papers written as part of graduate programs, (4) program office lessons learned, (5) textbooks from courses on Federal Procurement, (6) books on the specific programs involved, and (7) memoirs. All of these had different perspectives and tended to balance each other in their outlook. Many of the studies were based on significant primary sources of their own. Thus, in effect, the actual sources of this paper were many more than are acknowledged within.

c. A war room approach to synthesize the findings of the study and to help coordinate the principals, many of whom were working part time and had specific areas of expertise. This war room was also used to periodically brief the emerging results to the study sponsors and other interested parties.

Early in the study, it was clear that the study principals did not have the same backgrounds and did not review the literature or listen to the interviews from the same perspective or understanding. While this was good in some respects, when the job was split among individual researchers, key points and trends were sometimes lost. To remedy that situation, the team developed a primer, or set of four fundamentals, which it felt should be understood by any acquisition professional today. This primer became a baseline departure point for the team in trying to understand the period of the 1960s and the evolution of defense acquisition in general. It became clear that this primer was not only useful in conducting the research, but would be valuable in helping the reader of this report. Thus, those four fundamentals are presented and explained below, in advance of the body of the report, to help readers understand some of the intricacies of the forces at play in the programs reviewed:

- **First, any student of defense acquisition today must understand that the Federal Government procures many different products across its numerous agencies.** These products can range from already available commodities such as pencils and paper, to complex systems not yet invented or perhaps not achievable any time soon, such as a manned spacecraft for flying to Mars. The risk and cost of acquiring these items vary widely.

  For example, if a federal agency wants to *buy* a chair, it can send an agent to a local store and buy it just like any citizen would do. There is some risk that this will not yield the chair wanted or needed, depending on the person sent but that risk is small and somewhat reversible. On the other hand, the agency could *order* a different chair from what the store stocks. Now the risk to success increases. Factors not involved in buying come to bear—the company receiving the order may go out of business or the chair may be damaged in transit. Protection against the risks of ordering, therefore, is more complex than for buying. Of course, the government may require a unique chair made of space age materials currently not on the market that can neither be bought nor ordered. It may have to

be *designed and built* or *developed and produced* from scratch. Here again, the risks of not getting the desired chair go up considerably, and ever-greater factors come into play.

Risk becomes more complex very quickly, when one considers that the DoD develops and produces systems, such as missiles and aircraft carriers, that do not heretofore exist and are much more complicated than space age chairs. One person interviewed for our study stated, "To me, a major combatant warship is one of the most complex undertakings of man. It is as complicated as sending a man to the moon."[1] Another source concurred, proclaiming that "shipbuilding is the longest, most complex process in the spectrum of government acquisitions."[2] The mega-systems the Defense Department is envisioning today, in which ships are considered only parts or nodes, have introduced yet another level of risk to an already complex endeavor.

Such procurement extremes (from buying or ordering to designing and building or developing and producing) and the products they seek, from commodities to mega systems, are simply not understood and are often melded together by the public and even our appointed officials. In his 1994 memorandum on acquisition reform, former Secretary of Defense William Perry cited anecdotal "horror" stories on commodities such as radios, aspirin, spare parts, semiconductors, and even ant bait[3] and extrapolated them in eight pages to the flaws in the "acquisition process as a whole (with emphasis on major systems acquisition)."[4] This was a dramatic leap of faith. Unfortunately, the risks associated with these various forms of acquisition are seriously different, and the methods, processes, people, expertise, and lessons learned are not often interchangeable.

- **A second required fundamental involves understanding the forms of contracts available today for federal procurement and the mechanics associated with each.** As stated in the Federal Acquisition Regulations (FAR), the preferred contract form for all federal procurements is *firm fixed price (FFP)*. This is reasonable, because most federal purchases are of the commodity *buy* and *order* variety. Therefore, the inertia in procurement is always toward *fixed price*. An exception must be granted if one wants to use any other contract form. One justification for an exception is the degree of risk involved in the effort to be contracted (such as the degree of risk that goes with the development of a complex system).

Moreover, as any "Contracts 101" course teaches, the assumption of risk follows the contract form, shown in **Figure 1**. This illustration divides government and contractor risk based on the assessed risk of delivering the desired product (left side) and the selected contract forms (across bottom). In theory, in a *firm-fixed-price* arrangement, the contractor assumes all the risk for delivering the product, no matter what its actual cost. However, in a *cost-plus* contract, the contractor is not responsible for delivering a product, but only for giving its best effort to the extent it is paid; the government assumes the risk of actual delivery. Other contract forms fall in between, and risk is shared according to the terms of the contract.

Besides the manner in which it deals in risk, each contract form also has different mechanics and provisions associated with it. For example, *fixed-price incentive* (*FPI*) contracts have devices such as target price, ceiling price and share-lines that make them work. *Cost-plus-award-fee* contracts have award fee pools and award fee reviews. Such provisions are too numerous to be covered here, but the team had to be sensitive to these details. In particular, the team had to be knowledgeable about an *FPI* contract, since

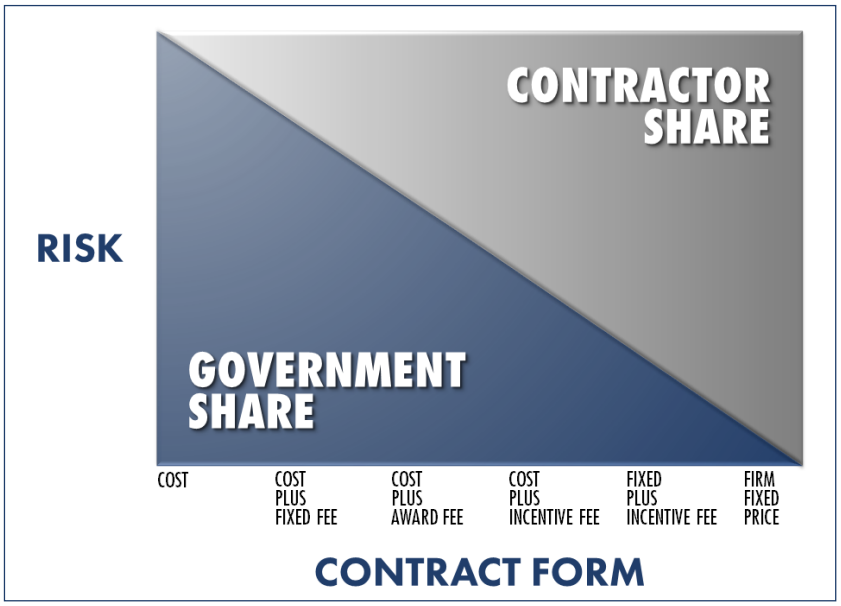


FIGURE 1. Risk Assignment versus Contract Form

this was the preferred contract form for *TPP*. Some of the source materials, for example, continuously mixed up target and ceiling prices when recounting the costs associated with the programs studied and this had to be sorted out. In fact, the term "overrun" is a technical term attached to an *FPI* contract that, when used in a public forum, took on much larger and more negative connotations. A more extensive explanation of an *FPI* contract is included in **Appendix A**.

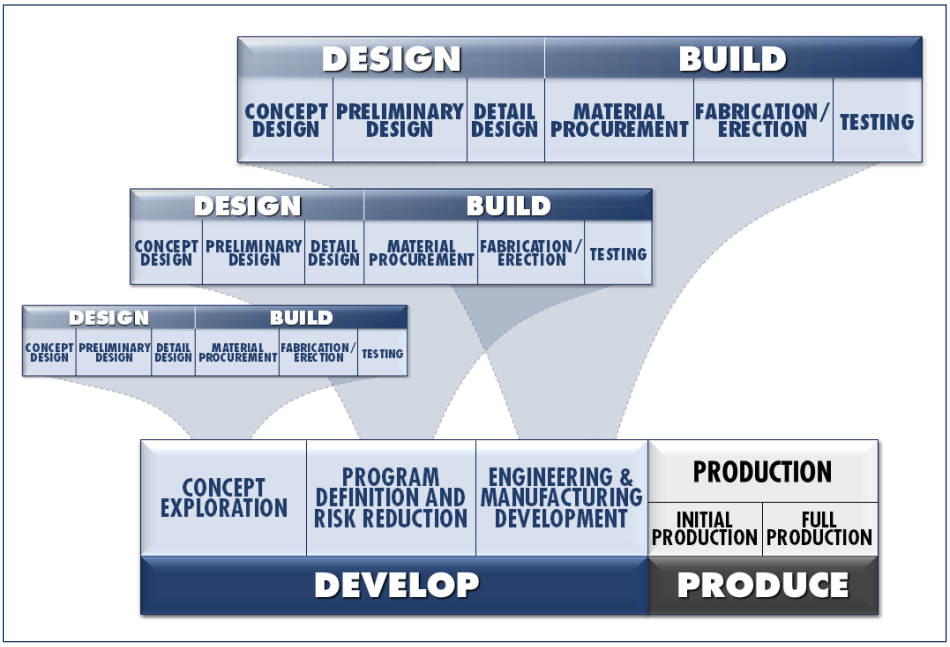


FIGURE 2. Design and Build vs. Develop and Produce

- **A third fundamental, particularly in shipbuilding, involves understanding the elementary differences between "production" and "construction."** The concept of production and assembly lines began with the industrial revolution in the early 1800s. The challenge was to break a job down into ever-smaller pieces so that an unskilled person on a line could become very proficient by repeating the job over and over—putting tops on bottles, for example. Construction, on the other hand, is much older, stretching back to before the Egyptian pyramids. It gains its efficiency by rotating skilled trades, such as concrete crews, pipefitters, and sheet metal workers, through construction sites—for example, to lay all the concrete or to install all the pipes in the proper order. In production, the job flows by the people; in construction, the people go through the job. Across the years, these two methods of building have influenced each other. In World War II, Henry Kaiser brought mass production techniques to the construction of Liberty ships. Today, prefabrication techniques are used extensively in home construction. However, there are limits. No one has yet discovered how to construct a complete Empire State Building on a production line, and thus turn it into a "commodity."

  Generally, when constructing the first of anything that is "one of a kind" and complex like a ship or a bridge, one cannot be totally certain it will work as a "system" until it is completed. The paradigm for this lack of certainty and the attendant risk is the Tacoma Narrows Bridge, a construction enterprise that collapsed while in use just four months after it was completed. In fact, it may take years before one knows for sure whether a bridge or dam works. The Brooklyn Bridge, for example, took 18 years and the best architect of the day to build (and there was still the uncertainty of the Manhattan tower resting on sand, as well as inferior cables). Shipbuilding includes all the risks associated with such construction, and ***warship*** building includes all the risks associated with construction and production. Thus, to reduce risk in warship building in the past, the Navy has sometimes postulated that all of a ship's critical weapons and systems should be in production before detail design of the ship begins. However, this is almost never possible. From time to time, the Navy has also explored developing and constructing the first ship of a class using research and development techniques and dollars before proceeding to serial construction just as is done in weapons procurement. This, because of the long build period for a ship matched against the short two-year authorization period of the RDT&E account, among other factors, has also rarely worked.

- **A fourth fundamental, and related to the third, involves the difference between *develop and produce* and *design and build*.** Generally, weapons are *developed and produced* while dams, bridges, and ships are *designed and built* or constructed. One relationship between the two methods is shown in **Figure 2**. Simply put, during development, if prototypes are built, one should "design and build" enough of a system to mitigate the

risks at ever greater levels during each phase of the development process. This relationship does not usually apply in shipbuilding because building any significant full-ship prototype is usually impractical. Thus, warships are designed and built once although designs can be modified to some extent in succeeding ships of a class. The design of weapons, on the other hand, is usually much more iterative over a longer period of time than the design of warships, so more risk can be accepted at the onset.

Another important difference between these two processes is the language involved—"concept exploration," "program definition and risk reduction," for example, as opposed to "concept design," "preliminary design." While weapons professionals are very familiar with both languages, shipbuilders are usually more conversant in the second. More importantly, it has always been difficult using the language of development to determine when the acquisition of a ship begins and how to address the overall risk in attaining its capability. If a warship begins when the first weapon for the ship is conceived, then development to remove the risk in all her weapons could take decades. Some ships today still carry systems that have their roots before World War II. This understanding may seem trivial, but it was required when the study team reviewed the literature. Much of the data in those sources was standardized to fit an "all forms of procurement are the same" mentality. One such source, for example, was the Selected Acquisition Report (SAR). SARs have been required of all major acquisition programs since the 1960s. These reports apply a standard nomenclature across all weapons acquisition programs, and the language used is that of development (since development programs constitute the majority of systems acquisitions). It was obvious that individual ship programs had difficulty in fitting this terminology to their planning and historical data. For example, in the DD-963 Program, development was interpreted to be lead ship construction, and production was follow-ship construction.[5] Other shipbuilding programs made different translations; for example, splitting development between contract design and detail design.

As stated earlier, the study team had to be alert to these fundamentals. However, as the study unfolded, it became clear that most of these modern-day fundamentals had not always been so and, in fact, reflected a long evolution that dated back to the nation's beginnings. Embedded within that evolution were a number of conflicting currents and tides:

- The exponential change in technology and its ever-more complex application into weapons systems.
- The use of that same technology to create the production/assembly line and to fuel the growth of American industry for commercial purposes, create commodities, establish a "supply and demand" culture, and eventually invent the modern corporation.
- The evolution of some corporations into a full-time defense role and the increasing appearance of industry leaders as political appointees.
- The changing role of in-house government talent and infrastructure.
- The expansions and contractions of the defense establishment before and after every war.
- The creation, formalization, and standardization of Federal acquisition and procurement.
- The often ambivalent relationship the American people have with their government, especially with their defense establishment.

These currents and tides came together to form a great tidal wave right in the middle of the 20th century, in World War II, when the coming of complex systems such as radars, missiles, and atomic weapons coincided with the greatest production explosion of weapon commodities in the history of the world. Massive government and private industrial capabilities were required. However, the natural competition between these currents and tides brought monumental problems to the post-war defense establishment. In the 1960s, *TPP,* as part of a larger set of business practices, attempted to re-synthesize these competing currents and tides in a great experiment that ultimately failed.

CHAPTER 1
INTRODUCTION

The 21st Century is upon us, and a century of massive progress has come to a close. A case can be made that the 20th Century, in terms of technologies that increased human capabilities, advanced further and faster than all previous centuries combined. At its center was the United States. To many living today, it is unimaginable that in 1900 there were practically no automobiles, phones, electrical appliances or lighting, and refrigeration. There were no airplanes, no radios or TVs, and no digital computers. Nor was there any of the infrastructure that accompanied them—paved roads and an interstate highway system; airports and a national air traffic control system; electrical generation, transmission, and distribution systems, as well as the industrial base, production lines, universities, and engineering organizations that fueled this progress. People over 80 today lived through this sea-change and can remember dirt roads, ice wagons, and outhouses. They also remember the first flight across the Atlantic, the dropping of the atomic bomb, landing on the moon, and a computer in every home.

TWO CONFLICTING REVOLUTIONS

Much of this progress was stimulated by military necessity, and much of the resulting technology, in turn, impacted weapons. In the 1800s, hi-tech weapons to the Army were rifled artillery, mobile cannon, and machine guns. Horses, not tanks, and balloons, not airplanes, were key elements of the battlefield. During the Civil War, the Navy introduced ironclad ships and submarines. In the last half of the 19th century, the Navy developed the first weapon "systems"—first the *Monitor* and later the steam-powered steel battleships armed with breech-loading rifled cannon that became known as the "Great White Fleet."[6] In these ships (or systems), "for the first time, all components were tailored to achieve the optimum performance in terms of the system's stated mission."[7] The 20th Century saw an explosion of such "systems" and, in the latter quarter of the century, the coming of "mega systems," or "systems of systems." Such systems became more and more automated and were the handiwork of the *weapons system engineer*.

Just as dramatic as the 20th Century's revolution in weapons technology was its revolution in the way weapons are produced. In the early 1800s, the weapon of choice was a rifle, elegantly handcrafted one at a time by a master gunsmith. The industrial revolution in the 1820-30s introduced machine technology to the manufacturing process, and weapons could be more precisely duplicated. The 20th Century, on the other hand, was about high-tech mass production—moving assembly lines, robotics, and computer-aided manufacturing, to name a few of the breakthroughs that have enabled the production of extremely large quantities at relatively low costs. Standardization and simplification were demanded to achieve the maximum benefits of production. Thus, the aspect of a weapon as a low-cost commodity emerged to challenge its aspect as a sophisticated system. The production engineer became almost as important as the weapons system engineer. This industrial revolution migrated from military products to commercial items and affected the nature of commercial business and business practices. It radically changed the nature of supply and demand, created fixed-pricing strategies in department stores, amassed huge amounts of capital in private hands, and established the large corporation. A new power emerged—the businessman. His culture and approach to problem-solving was grounded in the production line, and its use for commercial purposes.

IMPACT ON ACQUISITION

This core conflict between the ever-more complex weapons capabilities needed to fight wars and the standardization and simplification required for inexpensive, efficient production is not well understood. Its impact on Federal procurement practices, contracting, and acquisition strategies is understood even less, even to acquisition professionals and policy makers. Particularly since World War II, there has been a cascade of reorganizations and reform movements within the military acquisition establishment that reflects this conflict. Every new administration seems to bring its own reset; from the Johnson Administration's "War on Waste," or "W.O.W.", to the Reagan Administration's "Waste, Fraud and Abuse," or "WFA,"

campaign; from "System Management" in the 1960s to "Total Quality Management" in the 1990s; from Frank Carlucci's "32 Initiatives" in the 1980s to Albert Gore's "Reinventing Government," to today's "Revolution in Business Affairs," it never seems to end. Just why is this going on? While some of it certainly is politically motivated, and only that, much of it is being driven by the two conflicting revolutions and our inability to agree on how to balance them.

TODAY'S EXAMPLE

A new Acquisition Reform movement is once again a major force in the Defense Department of the latter 1990s and early 2000s. First announced by then Secretary of Defense William J. Perry in his memorandum of 15 March 1994 and spelled out in his paper, "Acquisition Reform—a Mandate for Change," this movement is focused on "saving the tax payer money; reinventing government; strengthening our military; and improving our economy."[8] The Secretary broadly concluded that "the world in which DoD must operate has changed beyond the limits of the existing acquisition system's ability to adjust or evolve—it must be totally re-engineered."[9] Driving this need for change, according to Perry, was a "radically changing threat, substantially declining defense budgets, and rapidly changing technology."[10] Subsequent administrations and Defense Secretaries have not significantly altered the course set by Secretary Perry.

A major imperative in this movement is the mandate to reduce acquisition costs by adopting the "business practices of world class suppliers."[11] While the movement, sometimes called a "Revolution in Business Affairs," began in the early 1990s, it has continued through two administrations, and its belief structure is held by influential leaders in both political parties and in both the Legislative and Executive branches of the Government. Dual-use technology, use of performance specifications for contracting, cradle-to-grave service, full-service contracting, self-governing industry, and "You build it, I'll buy it" are just some of the initiatives that have been proposed to implement a more business-oriented approach. Many of these new initiatives are copying the practices of contemporary commercial production companies and computer firms.

These reform initiatives are today impacting the Navy's new ship programs. LPD17, Arsenal Ship, DD-21, and now DD(X) have all been pressured by the Department of Defense (DoD) to adopt reform practices as part of their procurement strategies. Arsenal Ship, in particular, has been called a trailblazer of the new methods and, although cancelled, has been deemed a "success" in an extensive volume of lessons learned. DD-21 and DD(X) followed closely behind.

To old-timers, many of these reforms recall an earlier influx of "best business practices" into the DoD. In the 1960s, the country was coming out of a defense downsizing following the Korean War. At the same time, a revolution in military systems was occurring with the advent of missiles, radars, and nuclear power. On the other hand, automobiles, not weapons, were the best business commodities of the day, and the automobile companies were setting the pace in production technologies and methods. Like today, certain business practices were applied across all Defense programs and industries. Weapons System and Ship Acquisition Management were forced into congruence with a business concept known as *Total Package Procurement* promising salutary results. Unfortunately, *TPP* dead-ended in the 1970s with disastrous press and unacceptable results.

CHAPTER 2
WHAT CAME BEFORE

THE EARLY YEARS

The history of defense procurement dates back to the Revolutionary War. Then military procurements were split almost equally into weapons of war and military provisions, such as food and clothing. Throughout its first 125 years, military acquisition tended to be driven by periods of peace and periods of war. During peacetime, there was much political bickering over such topics as whether there should be a standing army, ways to prevent profiteering at the hands of unscrupulous contractors and politicians, and how to structure the contracting process. Periods of war, on the other hand, were driven by the need to mobilize, get weapons and provisions to the field quickly, and circumvent tedious contracting procedures. These early years also saw the coming of the industrial revolution and major advances such as steam powered ships, steel armor plating for protection, and mass-produced rifles.

Since private companies often turned to other ventures during peacetime and did not have the needed professional know-how to deal in the complexities of weapons nor the financial capital to handle the risks, the country invested in government-owned arsenals and shipyards to protect its ability to mobilize when needed. The Navy had to cultivate naval architects and create a special corps for Ship Constructors much like the Army's Corps of Engineers. Two distinct cabinet positions—the War Department and the Navy Department—managed weapons procurement and different rules, regulations, and appropriation bills were applied to each. Numerous other agencies and departments were also involved, especially in obtaining provisions. All had their own rules and regulations.

Toward the end of the 19th and beginning of the 20th Century, weaponry began to advance much more rapidly than before. The Spanish American War was influenced by armored steel, steam-powered battleships mounting breech-loading rifled cannon. These ships, part of "The Great White Fleet," were first built with great difficulty, long schedule slips, and huge cost increases. They dominated the Navy's procurement process,[12] and "the Navy became the first service to require products more sophisticated than those normally produced by industry."[13] At the same time, industrial growth, fueled by the mass production needs of both the Civil War and the Spanish American War and the consumer needs of the rapidly increasing American population, gave rise to the modern corporation, which for the first time placed major sources of capital in private hands. Over time, corporations and capitalists began to deal with the Federal Government as equals.[14] For instance, the Navy had a major conflict with the steel industry when steel officials would not commit to building an armor plate factory. To entice them, the Navy had to cut some generous deals. An armor plate procurement scandal resulted that fueled "the public's and Congress's impression that contractors could not be trusted."[15] As mobilization for World War I began, there were national debates over how to organize for it. Some wanted to take the "profit out of war," place all munitions production in public hands, and nationalize the munitions industry.[16]

WORLD WAR I AND AFTER

World War I witnessed the introduction of radios, tanks, and airplanes. However, while there were some successes in radios, most of the American industrial base, both public and private, was unable to mobilize fast enough to have any significant influence on the war. Only 248 American-built airplanes flew at the front out of a planned 50,000,[17] and no American-made tanks saw combat.[18] Guns, howitzers, automatic rifles, hand grenades, artillery shells, and mortars were all bought from the French.[19] Moreover, for most of the war, American troops were outfitted and armed by the allies.[20] The U.S. equipped less than half its fighting troops.[21] The Navy, having contracted out most of its shipbuilding since the 1880s, saw its own shipyards unprepared for the buildup.[22] New private yards had to be built.[23] There were "start-up" problems in abundance as assembly lines with interchangeable parts[24] were applied across a range of military items from firing mechanisms to ships. This inability to mobilize quickly and turn out quantities made a lasting impression on the military and some political leaders of that day.

Just as in the country's first century, military procurement was driven by cyclical peacetime and wartime concerns. Before and after World War I, policymaking emphasized competitive bidding; and, over time, the *fixed price*

contract became the preferred form. Contract names were often different from today's vernacular; however, in most cases, the types were the same. Much work was done every year in the Congress to deal with the various federal agencies that dealt in military procurement. Ultimately, the three key ones were the War Department, Navy Department, and the various predecessors to the General Services Administration (GSA). However, there were numerous divisions and agencies in each, all of which did business somewhat differently. In 1912, the Budget and Accounting Act created the Bureau of the Budget and the General Accounting Office (GAO).[25] Both were later to play a significant role in standardizing procurement across agencies. During World War I, most competitive contracting rules were again thrown away in the name of expediency. Contracts were allocated and negotiated. In fact, Congress allowed the President and heads of the government departments to make broad exceptions to advertising and competitive bidding regulations in the name of mobilization.[26] About 400 different contract forms, many of the cost type variety, were used; but few had been formulated to meet the needs of modern warfare.[27]

Following World War I, the nation and the Congress entered a long period of wrangling over the proprieties of *private* arms manufacture. Many citizens blamed the major corporations and financiers for getting the country into the war in the first place, and the term "merchants of death" was applied liberally to private arms manufacturers.[28] There were serious allegations of theft, profiteering, and unacceptable costs; and, there were efforts by the government to recoup "excess profits" from the arms contractors. In 1934, the Vinson-Trammel Act limited the profits on ships and naval aircraft to 10%,[29] and later the Nye Committee discussed limitations as low as 3%.[30]

One continuing debate, before and after the war, was whether the Army's Arsenal System should be modified to build tanks and airplanes; and, private manufacturers taken out of the picture entirely. One problem was that airplane technology was changing rapidly. Airplane manufacturing was almost a cottage industry with only 49 aircraft being produced in 1914. However, the numerous small companies involved were creating advances at a then dizzying pace.[31] It was not unusual for the Army to request funds from the Congress to buy a certain number of planes and by the time the money was appropriated, the number of planes was no longer affordable since they had grown both in capability and price. Thus, while some arsenals were upgraded to produce tanks, they were never modified for airplanes. The Navy, on the other hand, did build a naval aircraft factory on a forty-acre tract in the Philadelphia Naval Yard and began to assemble some airplanes during World War I.[32]

There was a similar debate over where to build ships. As naval shipbuilding decreased, the Navy wanted its own yards to educate its officers and recognized that public yards could exist without shipbuilding but private yards could not.[33] In the 1920s, the Navy built battleships, carriers and submarines to the limits of its own yards and contracted other ships, such as cruisers and destroyers.[34] All ships, no matter where they were built, were designed by architects from the Bureau of Construction and Repair (and, after 1940, the Bureau of Ships). Naval architects were so scarce that the Navy had to husband and develop its own. The Navy also tended to build its ordnance items inside its own activities under the direction of the Bureau of Ordnance. In some cases, these practices drove private shipyards and ordnance concerns out of business[35]—an outcome naval officers were willing to accept. As shipbuilding accelerated in the 1930s, more contracting was done.[36]

The Army, unlike the Navy, decided not to manufacture its own material to the exclusion of private manufacturers.[37] As early as 1915, it decided to operate its own plants only to establish standards, understand production costs, ensure quality, and qualify its officers as experts in production.[38] It is worth observing that the Navy's approach was being driven by the complexity of its ships as systems, while the Army was more concerned with the production of the commodities to outfit its fighting men.

WORLD WAR II

World War II interrupted these activities and debates. It is perhaps the defining moment of American industry and certainly of the production line. Private industry went from being "merchants of death" to the "arsenal of democracy."[39] Within three years of entering the war, the country was out-producing all other combatant countries combined.[40] The U.S. produced 300,000 airplanes[41] and over 6,000 ships in the largest industrial buildup in history. Between July 1940 and June 1945, the Navy added 10 battleships, 19 aircraft carriers, 110 escort carriers, 45 light and heavy cruisers, 358 destroyers, 504 destroyer escorts, 211 submarines, and 82,028 landing craft, not counting allied shipping and numerous auxiliary and cargo ships, including the famous Liberty ships. By

1942, shipyards employed more workers than any other war industry.[42] The Army's contracting effort was even greater than the Navy's. The Army became the greatest single agency *purchasing* operation in the country's history.[43] It spent $117 billion for goods between 1940 and 1945. There was also great activity in the Army's arsenals, which produced one-fourth of the tanks and tripled their output in rifles per day.[44] Both the Navy and the Army were thirsty for airplanes, and by 1944 airplane manufacturing had overtaken shipbuilding as the nation's largest industry.[45]

The buildup actually began before Pearl Harbor. Veterans of World War I under President Franklin Roosevelt's lead began planning and building new major ship classes, airplanes and tanks starting first within its in-house, government-owned base. In the case of shipbuilding, all the classes of major combatants that subsequently influenced the war were designed and first laid down before America entered the war. As early as 1936, Congress had also begun addressing its aging merchant fleet with a crash program to build 500 new ships over ten years.[46] As war came, more funds were appropriated for ship construction. By December 1941, 340 ships were in the fleet and 344 more were under construction.[47] The Japanese, in particular, were to feel the brunt of this buildup in the Pacific.

Unlike major combatant ships, some new tanks and airplanes were designed after the war began as the country raced to keep up with the Germans. Radar, often using British designs, was introduced both on land and in ships. Some of these new developments were deployed with serious flaws. Of course, the most revolutionary technology developed was the atomic bomb, where custom-built prototypes designed and built by a government laboratory of world-renowned physicists, not by production lines of unskilled workers, were ultimately used in combat.

A major influence on wartime production was the commercial automotive industry and its production line expertise. Automotive leaders were persuaded to erect tank production lines out of whole cloth and productionize airplane designs so that bombers that once took one day to build could be built in an hour.[48] Similar innovations were made in shipbuilding by Henry Kaiser, who used modern production techniques to build Liberty ships, one of which set a construction record by being assembled in four days.[49] General Motors was the largest single defense contractor, and by 1945 car companies were responsible for 20% of the entire wartime output.[50] In fact, the modern airplane industry owes much of its existence to the World War II efforts of the automotive industry. The airplane industry had to be converted from job shops to assembly lines, and this was more difficult than in the automotive industry because the items were more complex.[51] During the war, the airplane's relatively simple parts were replaced by electrical, fuel, hydraulic, heating, and weapons systems.[52] Tensions arose between old-line aircraft companies who saw themselves as "watch-makers" and automotive companies who were struggling to break the jobs down so unskilled people could do them and massive amounts of manpower could be put to use. The war amalgamated the two groups.[53]

War planners knew that they would need some type of cost contracts for novel and complex projects that could not be fairly priced in advance.[54] Hardly a single item entering the inventory was anything like, in its final form, what had been originally contemplated.[55] In fact, the war effort would not have succeeded so well without the cost contract.[56] However, unlike World War I, where contracting methods rarely kept up with the problem, innovative contracting strategies did emerge. The *cost-plus-"evaluated-fee"* contract was created by the War Department, and fees varied depending on the quality of the contractor's performance.[57] Eventually, in the 1960s, NASA would develop this form more fully into the *cost-plus-award-fee* (*CPAF*) contract. The Navy created the *fixed-price-incentive* (*FPI*) contract and attempted throughout the war to convert its existing *cost-plus-fixed-fee* (*CPFF*) contracts to *FPI*.[58] It used this *FPI* form after 1943 on large, complex items, such as ships.[59] Navy Under Secretary Forrestal believed, "This kind of contract gives a company a definite incentive to cut its costs. In fact, the heart of the contract is the conviction that American business can perform miracles of low-cost production if it is given a profit incentive for doing so." [60]

The emphasis on cost contracting increased the drive to standardize and define "allowable costs." In 1942, the War and Navy Departments jointly issued the first formal cost principles to ensure that contractor extravagances were not charged to the government.[61] Called the "Green Book," the pamphlet was entitled "Explanations of Principles for Determination of Costs Under Government Contracts." Another movement in cost control was the attempt to excise high profits. In 1942, the Renegotiation Act allowed government agencies to renegotiate the price on any contract that accrued excess profits.[62]

DEMOBILIZATION TO KOREA AND THE COLD WAR

When World War II was won, the country began an unprecedented demobilization. The size of the demobilization, however, was gauged by the size of the original buildup. In fact, for the first time in its history, the country turned away from its "feast-to-famine" demobilization routine.[63] For example, it retained a large portion of its standing army and continued developing weapons of massive destruction. Nevertheless, numerous plants and equipment were sold to private industry, brand new ships were decommissioned, and bases were closed with little advance notice. The aircraft industry was especially hard hit, sinking from first to 44th among American industries.[64]

In 1947, the Congress created a new service, the Air Force, from the Army's Air Corps. In addition, Congress created the Department of Defense (DoD) and removed the old War and Navy Departments as Cabinet members after more than 150 years in those positions. It also began to "modernize" contracting processes.[65] The Armed Services Procurement Act of 1947 standardized purchasing methods across all three services and facilitated cross-service procurements. As a follow-on to this act, the services jointly issued the Armed Services Procurement Regulation, for years known as "ASPR," which became the official bible for defense contracting over the next 30 years.[66] The first ASPR was only 300 pages long and was often supplemented by the services.[67] In 1949, the General Services Administration (GSA) was also created to oversee most non-weapons procurement.

Amidst all these changes, the North Koreans invaded South Korea in June 1950. The country remobilized, tripling its defense budgets and activating plants and machinery from its stockpiles. By the time this new war ended, the aircraft industry had regained its World War II status as the largest American industry.[68] Much of the war, however, was fought with World War II weapons and designs, and a full-scale mobilization was not needed. The deployment of the jet plane was one exception.

While the demobilization after Korea was extreme by today's standards, it was not the massive demobilization that had followed the Civil War and the World Wars. In fact, Korea intensified the transition to the Cold War and the indefinite maintenance of large armed forces and a military-industrial complex, both publicly and privately owned. Defense remained a full-time business to some very sizable American corporations. The Cold War was to be a long war, absolutely unique in our history. It was a war that had some of the aspects of previous wars—mobilization, arms races, and a large dedicated industrial base. However, it also exhibited some of the aspects of peacetime—a preoccupation with costs, proper contract forms, and maintaining competition among contractors, as opposed to the allocations that usually came with war.

THE 1950s

Crystallizing the new Cold War were two historic events: Russia's explosion of an atomic bomb in 1949, and its launch of Sputnik in 1957. Soon the U.S. perceived that a "missile gap" existed. This belief called for a race to deploy superior technology. For the first time since World War II, sizable monies were spent on new weapons and technologies. Transistors and numerically controlled machine tools came into common use. New radars and communications systems developments began. However, the major advances that drove the nation's attention were ballistic missiles, the space race, jet airplanes, and atomic power. Growing pressures from these advances impacted both the shipbuilding and the aircraft, now aerospace, industries, as well as the Navy and the newly created Air Force. A race was on, and, just as in wartime, schedule, not cost, was the overwhelming concern.

By the mid-1950s, the aircraft industry had segregated—one side dedicated to military matters and concentrating on missiles, and the other still developing both commercial and military airplanes. The new autonomous Air Force began with no significant in-house infrastructure. It still lacked an arsenal system for aircraft, so it relied almost totally on industry and universities for development and production. Technical management and integration was done by major contractors.[69] In fact, Harvard Business School experts helped install needed management controls for the service soon after it was founded.[70]

The Navy Department, on the other hand, had a great deal of in-house expertise and infrastructure integrated around the building of complex warships. For major combatants, public shipyards often built at least the first ship of a class with designs from civilian Navy designers. Ships were allocated to private shipyards on the basis of the individual yard's capabilities and its backlog of on-going work. This practice continued until 1964; however, there was, to a degree, competition for contracts.[71] Weapons, principally guns, were engineered and

manufactured by the Naval Gun Factory in Washington, D.C. Private companies were used to supplement this capability under the control of a 100-year-old "Bureau" system that was centrally located in Washington, D.C. The Navy also still retained a limited aircraft production capability in Philadelphia. Neither the Navy nor the Air Force had an arsenal for missiles, and modern arsenals called Government owned - Contractor operated plants or "Go-Cos" were soon created to manufacture them.

The 1950s and the arms race with an industrialized enemy affected all three services. Technology proved balky and costs soared. A Brookings Institution study found that virtually all large military contracts in this period exceeded their original cost estimates by 300 to 700 percent.[72] The Navy initiated several ship classes—*Enterprise, Long Beach,* and *Bainbridge*—which turned out to be "single ship" classes. Developments in nuclear propulsion, radars, and missiles did not match the ship construction process, and Congress would not approve follow-on ships.[73] Thus, conversion of ships in service emerged as the only alternative to sustaining a fleet with adequate numbers.

USS Long Beach was a good example of the difficulties encountered. The first nuclear propelled cruiser, she mounted the first phased-array radars, SPS-32 and SPS-33, as well as new *Terrier* and *Talos* missiles and was the first cruiser to be built in modern times without guns. She was built by Bethlehem Steel at its Fore River Shipyard in Quincy, Massachusetts, at the same time that *Bainbridge* and three other warships were being built in that yard. All carried *Terrier* missiles, but none of the installations was identical.[74] A large portion of *Long Beach's* gear was still developmental, and this developmental character was present, to some degree, across "the whole spectrum of weapon, fire control, sonar, radar, and communication systems."[75] The shipbuilding effort was also impeded by strikes that caused at least one of the other ships to be moved to the Boston Navy Yard for completion. A great deal of attention was paid to the successful installation and testing of *Long Beach's* nuclear power plant; however, her weaponry was much less successful. It was not unusual to have 50 technicians deployed in the ship after she was commissioned to make both her missiles and radars work. Costs grew to the discredit of both the Navy and Bethlehem Steel. In fact, Bethlehem Steel never built another major warship at Quincy. The yard was soon sold to an aerospace corporation, General Dynamics, which downsized the operation considerably.

The Air Force was hit just as hard. One of the programs often cited as representative of the Air Force's problems in the 1950s was the B-47 Stratojet. Actually, the B-47 was first proposed in 1944 to the Army Air Forces by Boeing as a straight-wing bomber with engines enclosed in the fuselage. Development was delayed by the end of the war, which provided the opportunity to use captured German swept-wing design data. A swept-wing prototype development with engines below the wings began in 1946. The program went through numerous changes and version upgrades over the next 11 years, and by the time the last B-47E was delivered in 1957, 2,041 Stratojets had been built, the largest number of any bomber never involved in a war. These airplanes, in one critic's view, highlighted the failings of an acquisition process with no real centralized control over the entire system.[76] Like other Air Force programs of the era, the B-47 suffered performance problems, cost increases, and serious schedule delays. Reliability, in particular, became a significant issue.[77] Six principal causes were given by various studies to explain the new service's difficulties:

- **Its Management Approach was splintered.** In the early 1950s, the Air Force was continuing a functional management approach to its programs that originated in the 1920s with the Army Air Corps at its Materiel Division in Dayton, Ohio. This approach delegated responsibility and funding for armament, power plant, production engineering, and electronics to different groups[78] and used a "project engineer" concept to follow the design and manufacturing of each new piece of equipment.[79] In addition, two separate divisions, and later two separate commands, controlled engineering and production, and each had its own project offices. The engineering project offices were organized around aircraft types (bombers, fighters), while the production project offices were organized around the contractor supplying the equipment.[80] These offices were autonomous organizationally, physically, and fiscally. This arrangement worked during World War II except in the case of the B-29, where one officer had to be put in charge of all development and production to make the project work. However, the B-29 was an exception and the splintered approach continued into the 1950s. The approach began to come apart again for ballistic missiles and jet airplanes, like the B-47, where the components had to function more in unison.
- **Programs were funded annually using single-year appropriations, and contracts were limited to one year.**[81] Only the quantities authorized by the current fiscal year appropriation could be procured.[82] This reduced efficient planning and execution of programs

and increased administrative costs.[83] Programs were planned according to an annual budget; and, if this budget did not prove to be large enough to handle the quantities or work planned for that year, the program had to be re-planned and work reprioritized. The impact of this re-planning rippled into the next year and so on.

- **Poor Initial Definition of Projects was believed by some observers to be the cause of most cost escalation.** This was attributed to (a) lack of appreciation of the needs of the operational forces, (b) lack of understanding of the scope of the development task, and (c) failure to make realistic appraisals of technological difficulties.[84]
- **Concurrency was costly.**[85] "Concurrency" was an acquisition technique that flourished during World War II, Korea, and the 1950s. It accepted significantly greater overlaps in development, production, and in-service support to shorten schedules than with more serial or incremental approaches **(Figure 3)**. The advantage of concurrency was that it led to operational readiness in a shorter time but often at a higher risk of rework and increased costs. Such costs tended to accelerate with the novelty of the technology being developed.
- **Contract Forms and Incentives were considered flawed** by some. A lot of blame was laid on *cost* contracting. As has been described, cost contracts had exploded in World War II. There had been another four-fold increase in *cost-plus-incentive-fee* contracting in the 1950s.[86] Many of these contracts exceeded their original estimates and were blamed for not providing enough incentive for contractors to control costs. Moreover, when *fixed-price-incentive* contracts were used, the most critical flaw in maintaining a target price was the inability to control contract changes along with the renegotiations and added costs they brought with them.[87]

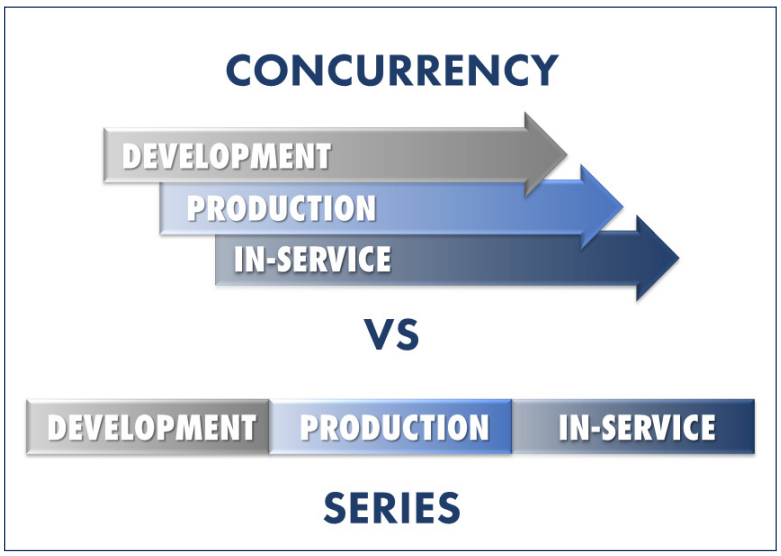


FIGURE 3. Concurrency vs. Series as Acquisition Techniques

FIGURE 4. Contracting Process in the 1950s as Seen by Critics

- **The Contractor Selection Process being used was criticized** for allowing a contractor to underbid, or "buy in," to win a development contract, about 20 percent of the total effort,[88] and then to recoup losses, or "get well," in production.[89] The selection process **(Figure 4)** was portrayed as (a) choose a contractor on scanty data and experimentation, (b) redefine the concept more thoroughly in the early stages of development, and (c) create a partnership between the government and a single-source contractor.[90] This process was seen as faulty because it removed the pressures of competition during production and opened the government up to price gouging. It was called "iceberg" procurement by various political appointees because only the up-front costs of the program were visible.[91] Moreover, these up-front development costs were being obscured by low bids that also contained misleading performance and schedule estimates. These, in turn, provided the basis upon which DoD decided to embark on programs that eventually yielded higher than expected costs and less than promised performance.[92]

CHAPTER 3
BEST BUSINESS PRACTICES COME TO DEFENSE

The 1960s brought a Kennedy Administration dedicated to "rational" government. The "Best and the Brightest" came to a Defense Department recently empowered, in the 1958 Defense Reorganization Act, to take control of funds for major weapons programs from the Services. In January 1961, Robert McNamara, the first non-Ford family member to be president of Ford Motor Company, became Secretary of Defense. He came with a mission to reform military acquisition, still done somewhat uniquely by each of the Services, and to teach the military the business methods that were perceived to have worked in one of the top commercial businesses of the day—automobiles. He was the second Secretary of Defense from the automotive industry and had been a statistical control expert for the Army in World War II, troubleshooting glitches in production and logistics during the war, while creating voluminous data-gathering systems. He had also taught at the Harvard Business School after the war. "Commonality and simplicity," as ingredients of efficiency, were two of his business hallmarks,[93] and he immediately shifted the department's focus from developing multiple, different systems to a least-cost production approach. In addition, he changed the procurement emphasis from *cost-reimbursement* to *fixed-price* contracts.[94]

McNamara believed deeply in the power of analysis, logic, and statistics to lead to good decision-making[95] and to control outcomes. This reflected his lineage from the school of statistics-based management that began in the early 1900s to run mass production enterprises.[96] This school, pioneered by DuPont and General Motors, promoted the use of financial data to make forecasts and then to measure performance against those forecasts.[97] During World War II, McNamara had seen this approach in action when analysis and statistics had been used to forecast the need to start phasing down aircraft production, fully a year before the war was won.[98] To implement his beliefs, he brought with him a team of like-minded individuals, including the new Secretary of the Air Force, Eugene Zuckert, a former colleague at the Harvard Business School.

In McNamara's organizations, power was always concentrated at the top because only top managers had enough information to make decisions.[99] He soon centralized major system acquisition under himself and cancelled numerous aircraft and shipbuilding programs. He was a zealous planner and assumed that a properly controlled program would proceed smoothly. Numbers told everything. Measurable inputs could turn directly and efficiently into measurable outputs when the proper data was monitored and "controls" established. Many of DoD's current mechanisms for forecasting, planning, and control—PPBS, the FYDP, SARs*—were created under McNamara. On his watch, ASPR grew significantly in size, and both the Defense Contract Administrative Services (DCAS) and Defense Contract Audit Administration (DCAA) were created. He also empowered systems analysts under a new Assistant Secretary, Alain Enthoven, to scrutinize operational needs for weapons across the services. Cost-effectiveness analysis, cost-performance reporting, and management information systems came into vogue.

F-111 AARDVARK PROGRAM

McNamara was barely three weeks in office when he got the opportunity to demonstrate how "commonality and simplicity" could be used to save money in acquisition. He received a briefing on the Air Force's Tactical Fighter Experimental (TFX) airplane. The root concept for the TFX was produced as early as 1958 by John Stack, a legendary aerodynamicist and pioneer in supersonic flight. Stack's design was seen by the Chief of the Air Force Tactical Air Command, who liked the concept and issued a formal requirement for TFX two years later. The aircraft was to be a new swing-wing design, weigh 63,000 pounds, measure 82.5 feet in length, be capable of flying 4000 miles subsonically, and be able to make a 200-mile dash on the deck at Mach 1.2 carrying 8000 pounds of bombs.[100] At about the same time, McNamara was also briefed on the Navy's plans to protect the fleet with a new fighter, *Missileer*. *Missileer* was to weigh less than 50,000 pounds so it could take off from an aircraft carrier,

* PPBS = Planning, Programming and Budgeting System, FYDP = Five Year Defense Plan, SAR = Selected Acquisition Report

dash to a station in the sky and loiter for hours while its 5-foot-diameter nose radar detected enemy aircraft at great ranges and guided long-range *Eagle* missiles to their targets.[101] From these two efforts, McNamara saw an opportunity to combine air superiority, deep interdiction strikes with nuclear weapons, and fleet air defense into a single airplane.

In February 1961, McNamara directed the Services to write a coordinated Specific Operational Requirement based on Stack's design. He also ordered Department of Defense Research and Engineering (DDR&E) Chief, Herbert F. York, to establish specifications to absorb Army and Marine Corps close air support requirements and thus create a tri-service plane.[102] A study conducted by DDR&E recommended against this, separating out Army and Marine needs. McNamara accepted this recommendation, which resulted in two planes instead of one. The second, or close air support aircraft, known as VAX, eventually led to the development of the A7. McNamara now began to focus on the common Navy/Air Force fighter, TFX.

By August 1961, the Secretaries of the Navy and Air Force, backed by their technical staffs, told McNamara that a joint plane was not technically feasible unless requirements were relaxed. He, on the other hand, believed that almost anything was possible technically; and, that a joint plane could be built because of advances in technology. He felt that the Services' attitudes were based on years of going their separate ways. He also continued to get advice that the job was feasible from DDR&E Chief York and his successor Harold Brown, both nuclear physicists. Brown even dictated the requirements for the joint fighter.[103]

In September 1961, McNamara signed the requirement and put the Air Force in charge. Rationality and efficiency were supposed to triumph over the contradictions.[104] The aircraft's radar would be three feet wide instead of the five feet the Navy wanted, and the plane itself would weigh 60,000 pounds like the TFX design, not the 50,000 in the Navy's. Minor modifications were to be made to make a Navy version, which would be smaller and lighter but more costly. This was somewhat odd because in those days, smaller and lighter usually meant a lower price. It was deliberately left up to industry to resolve such dilemmas and make the long, heavy "arrow" and the short, fat-nosed aircraft into one.[105]

McNamara gave the two Services a month to prepare design specifications and a Request For Proposal (RFP). These usually took three months, but the new leadership felt it could cut through the normal process and take less time than usual.[106] Six companies submitted plans in December 1961. Following Air Force contract-selection procedures, the plans were evaluated by a group of 225 experts, mainly from the Air Force, with some Navy professionals assigned. The evaluators decided that none of the bids were satisfactory, but recommended that the two top contenders, Boeing and General Dynamics, be given 90-day study contracts to resubmit plans. McNamara told President Kennedy that the final decision would be discussed with the President before contract award. When the two companies resubmitted their plans in April 1962, both designs were deemed to have gotten worse. However, the selection committee preferred Boeing's design. The Navy said neither design was acceptable, and the Chief of Naval Operations, Admiral George Anderson, asked, to no avail, that the project be abandoned.[107]

The two companies were given just three more weeks to correct deficiencies and meet Navy requirements. Navy expert George Spangenberg was to say later that the two contractors knew that the task was almost impossible, but each thought the requirements would be bent to fit the hardware after contract award.[108] Both companies were under great pressure, needing the business, since McNamara had recently cancelled some of their previous bomber contracts. Boeing now presented a wholly new plane; some called it an "inspired answer," which they had worked on for some time.[109] General Dynamics offered six alternative designs.

In June 1962, the source selection again favored Boeing. Now the Service Secretaries, who were designated, under the 1958 DoD Reorganization Act, as agents of the Secretary of Defense, weighed in. Air Force Secretary Eugene M. Zuckert was aware that the Air Force wanted to push the technological edge. Fred Korth, a Fort Worth banker, having just recently replaced Texan John Connally as the Navy Secretary, had not yet been deeply involved. Both recommended a fourth round of competition to achieve a common airplane and "two for the price of one."[110]

This time, the Air Force Project Manager, Colonel Charles Gayle, was allowed to help both design teams while not revealing the opposing designs to

the competing teams. General Dynamics produced a design that had 84 percent of its parts in common between the two Service versions. Boeing refined its third-round design and made sweeping performance promises while estimating a low cost, much lower than General Dynamics, whose design had less technology thrust.[111] Both designs were found acceptable, and Colonel Gayle made his non-preferential presentation up the line.

The Source Selection Board, the Air Force Logistics Command, Tactical Air Command, Air Force Systems Command, Air Force Council, Air Force Chief of Staff, and the Chief of Naval Operations all voted for Boeing's design.[112] Secretary Zuckert, however, found it more appealing that General Dynamics' design had more common parts, felt its higher cost was more realistic, and that it was more conservative technologically.[113] It was more responsive to the new way of doing business.[114] Overruling the source selection advisers, he recommended General Dynamics as more responsive to the new business approach. Navy Secretary Korth agreed. In November 1962, Zuckert, Korth, and McNamara signed a memorandum justifying the award to General Dynamics, whose assembly plant was in Fort Worth, Texas.[115] A go-ahead letter contract signed by McNamara's Deputy was given to General Dynamics for 23 developmental aircraft, 18 Air Force and 5 Navy, on 21 December 1962. General Dynamics subcontracted the Navy version, the F-111B, to Grumman. The formal development contract was not signed until May 1964;[116] and, for this groundbreaking, dual-service aircraft that the Navy felt was an impossibility, the contract was *fixed-price*—a feature that was to be dominant in subsequent *Total Package Procurement* efforts.

The news broke. Both Boeing and the Services were astounded since Boeing had won every round of competition. The Boeing design had 75 percent common parts (versus 84 per cent for General Dynamics) and was a more mature design.[117] Boeing's engineering team was revered for its capability, and if anyone could have built this impossible plane, it was probably Boeing.[118] Senator Henry M. Jackson from the State of Washington, where Boeing was headquartered, met with McNamara about the award and was treated quite rudely. McNamara insisted that Boeing did not understand what he wanted.[119] Offended, Jackson played his hand as a member of the Government Operations Committee of the Senate, whose chairman, John L. McClellan of Arkansas, was also chairman of the Permanent Subcommittee on Investigations. Something smelled about the choice, and both Jackson and McClellan were determined to find out what was wrong. Hearings were held. When the smoke cleared, however, McClellan had found no hard evidence of political corruption. When asked by the Government Accounting Office for the figures that he based his decision on, McNamara said they were all in his head.[120]

While no smoking gun was unearthed, the appearance of politics was pervasive. First, John Kennedy carried Illinois in his close 1960 campaign with the help of Chicago Mayor Richard Daley's political machine. Daley, in turn, was supported by the enormously wealthy Crown family of Chicago, the major shareholder in General Dynamics. Lyndon Johnson, Vice President and former Texas senator, had helped John Kennedy carry the South and was in favor of General Dynamics. Kennedy's first Secretary of the Navy was John Connally who by then Governor of Texas, where the General Dynamics plant involved was located.[121] Current Navy Secretary Korth had been president of a Fort Worth bank that had loaned $400,000 to that plant. Moreover, McNamara's assistant, Roswell Gilpatric, had billed $110,000 in legal fees to General Dynamics through his former law firm, Cravath, Swaine and Moore, before coming to Washington in 1961.[122] Most agreed that Gilpatric was not guilty of conflict of interest.[123] However, Attorney General Robert Kennedy expressed displeasure with his evasiveness on this subject before the McClellan Subcommittee, and Gilpatric was forced to resign.[124] The Subcommittee also found that Korth, while Secretary of the Navy, had entertained Fort Worth business associates aboard the Presidential yacht *Sequoia*. The Justice Department cleared Korth of wrongful doing, but Robert Kennedy thought his resignation was also appropriate, and Korth too resigned.[125]

After all the dust settled, however, McClellan's investigation had not succeeded in refuting McNamara's main argument that General Dynamics had responded to his new business philosophy while Boeing had not.[126] It is possible that McNamara and Zuckert favored General Dynamics just as they said: they wanted to impose their initiatives for commonality and cost-realism no matter how much

Photo courtesy of US Air Force

FIGURE 5. F-111 Aardvark

the Services balked.[127] TFX now officially became the F-111A for the Air Force **(Figure 5)** and F-111B for the Navy. Since the 1947 National Security Act allowed the Secretary of Defense to withhold the disbursement of funds for research and development efforts, even after Congressional approval, the F-111 program was now, *de facto*, in the hands of Robert McNamara.[128]

Development got underway and problems began to surface immediately. The General Dynamics model of the airplane was tested by NASA in a wind tunnel at Langley Field, Virginia, and could satisfy only half the requirements for maneuverability. Moreover, in December 1963, just after the McClellan hearings, General Dynamics announced that the weight of the Navy F-111B had increased by 5000 pounds.[129] In fact, the weight had been going up all along, but General Dynamics did not want to reveal it during the Senate hearings. This created immense problems for carrier operations, and the Navy again recommended cancelling its version.

Grumman, on its own, even recommended switching to a new, strictly Navy design which would later turn out to be the F-14. Even though McNamara rejected the proposal, it caused strife within the General Dynamics/Grumman team. The supposedly simple, common weapon system made for low-cost production was turning into a state-of-the-art, Mach 2 fighter-bomber with many complex features.

The first developmental F-111A flew in Forth Worth in December 1964. The first Grumman F-111B test flight was six months later in May 1965. Weight of the F-111A had now increased from about 62,775 pounds in 1962 to about 77,550 pounds in 1965. Performance suffered from high drag and lack of power. In fact, the aircraft was so underpowered that its range was greatly reduced, and engine stalls occurred frequently, posing safety problems. Weight-reduction measures had little effect. Testing soon uncovered other problems in both versions, but McNamara had already declared that the F-111 was exceeding expectations. In April 1965, he ordered immediate production of the Air Force version with a letter contract for 431 aircraft; and, in December 1965, he announced yet a third version to replace the B52 bombers.[130]

McNamara was determined to make "his plane" work; and, beginning in August 1966, he launched the ultimate phase of his efforts, "Project Icarus." With this management initiative, he convened regular Saturday morning meetings in his office with the heads of General Dynamics, Grumman, Pratt & Whitney (the propulsion system contractor), the Secretaries of the Air Force and Navy and the head of DDR&E. These were nuts and bolts meetings to solve technical problems that had not been solved by lower-level technical people. McNamara seemed to believe that the presidents could do what others could not. He would spread plans on his office floor, often crawling around with a pencil, marking drawings to indicate how the plane could be made to work. The corporate officials, businessmen like McNamara and not engineers, looked on and tried to offer suggestions.[131]

Initial operational capability (IOC) was October 1967. In March 1968, six F-111As arrived in Thailand to conduct strikes against North Vietnam. By late April, while flying numerous night missions, three aircraft were lost. It turned out that the losses were not from enemy action but were caused by structural defects in the wing and tail.[132] Operations were halted for a brief period to investigate the losses and to make necessary modifications. These losses caused a storm of controversy, with Senator William

Proxmire of Wisconsin denouncing the aircraft as unsafe and defective. The airplane became known as "McNamara's Flying Edsel" and was accused of being a "technological gold mine for the Reds."[133]

After the planes returned to the air, the crashes continued. By December 1969, fifteen aircraft had been lost, some due to enemy fire, but most due to malfunctions. Serious doubts surfaced about the plane's structure, causing the entire force to be grounded until the end of July 1970.[134] Each aircraft had to be checked and repaired. After modifications were made, two squadrons again deployed to Thailand in September 1972. Malfunctions continued on a regular basis, and planes continued to be lost (of the F-111As that redeployed, only six were lost in action).[135] The Air Force suspected mechanical problems but had no real idea why the planes were lost because they flew alone and out of radio contact.[136] After a prolonged period in which numerous problems had to be fixed, the F-111 turned out to be one of the most effective all-weather interdiction aircraft in the world. The planes flew over 4000 combat missions in Viet Nam with excellent success rates before the cease-fire in February 1973. They flew in all weather conditions, which sometimes grounded other aircraft. Ultimately, the F-111 compiled a fairly good safety record.[137]

The F-111 saga began in McNamara's first few weeks in office and dragged on for his full seven-year tenure. It gave him a terrible reputation for promoting civilian interference in military programs. Common, multi-service aircraft programs that have worked since, such as the F-4 Phantom, were less complex than the F-111 and were usually developed by one Service first before being adapted for a second. McNamara, however, was trying to make a point on "efficiency" and picked a tough, "high-tech" candidate to force his philosophy of procurement on the Service. The Air Force's requirement for a 200-mile dash on deck proved to be an impossible stumbling block to providing an adequate design that the Navy could use to loiter in the air.

Not only was the performance and safety of the F-111A suspect for years, but the unit cost rose from an estimated $3.9 million to $15 million, a 385 percent increase. The last of 158 F-111As was delivered in August 1969. This included 17 of the original 18 RDT&E prototypes ordered in December 1962. The 18th was used as the test prototype for the FB111A bomber program.[138] Ultimately, only 562 flight-worthy planes in seven different F-111 variants were completed,[139] compared with the roughly 2400 planes originally planned.[140]

In 1968, McNamara was succeeded by Clark Clifford, who killed the Navy's F-111B one month after taking office.[141] As a model of business efficiency or performance, the F-111 had not succeeded.

CHAPTER 4
THE AIR FORCE INVENTS TOTAL PACKAGE PROCUREMENT

Some years before McNamara began imposing his will on weapons acquisition and providing "hands on" guidance to the F-111 Program, the Air Force began addressing its own problems from the late 1940s and 50s. First, it attacked its splintered management approach and, in the mid-50s, introduced the "Weapons Systems Management Doctrine" **(Figure 6)**.

This doctrine put one office, known as a Weapon System Program Office or WSPO, in charge of all functional elements of a system, from design to test—even today a true "systems" approach. New theories of "system engineering management" were also proposed to meet the challenge. While these changes created and centralized a system focus, responsibilities for development and production remained under two separate commands. This created parallel reporting channels for a WSPO and made the concept "tricky to implement."[142] This separation continued into the 60s, even after WSPOs were renamed System Project Offices, or SPOs, in recognition of the growing importance of command, control, communications, and surveillance technology.[143]

The Air Force's "system management" concept had actually started in the 1950s as an exceptional approach to acquiring ballistic missiles. When the Service first tried to build upon German World War II ballistic missile developments, it found that airframe, propulsion, guidance, stability and control, warhead, launch, support and test equipment had to proceed in an integrated fashion. A similarly integrated approach was soon needed for jet airplanes. Government professionals at Dayton did not have the expertise to integrate such efforts, so the Air Force offered the job to industry as a "package."[144] Thus began the assignment of system engineering responsibilities to a single prime contractor. The principal engineering duty of the project office now was to monitor the contractor,[145] and some argue that "this is where the Air Force began to manage paper and procedures" rather than directly control the engineering needed to convert ideas into effective weapons.[146] Certainly, this level of management abstraction was a turning point in the Air Force's approach to system acquisition.[147] As a result, the Service began developing officers with more experience in procurement than in engineering and increased the use of *fixed-price-incentive* contracts.

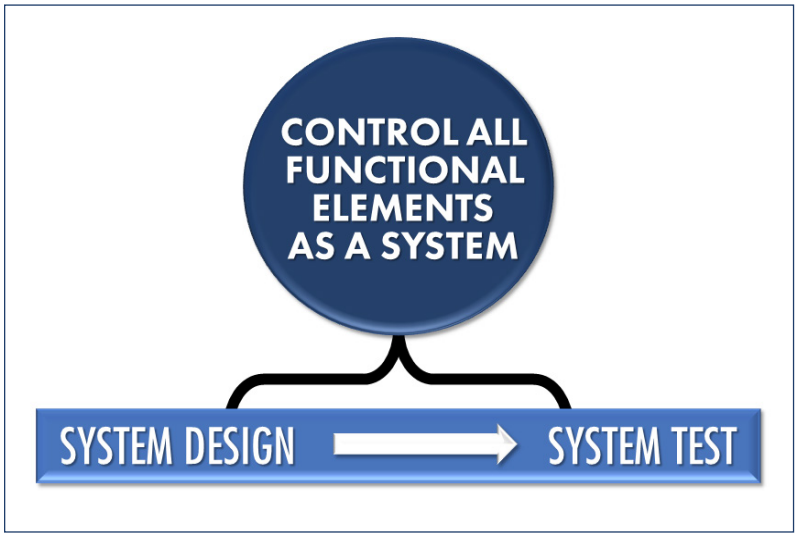


FIGURE 6. Weapons Systems Management Doctrine

The next step was to marry the program planning and financing functions into the "package" so it could all be adjudicated at once by the upper echelons of command. However, despite marrying all elements of a system into one package and efforts to streamline financial decision-making as the package moved from research to development to production to operations, authority was still under separate commands.[148] Transition of responsibility, especially from development to production, remained awkward. Empanelled in 1959 and 1960, the Weapon System Management Group recommended moving all development and production under one program director.[149] This recommendation met great resistance and was not invoked.

In 1961, McNamara offered all future military space programs to the Air Force, a decision that had been pending since the end of World War II. He made this offer in the form of a bribe to coax the Air Force to reform its organization.[150] The Air Force accepted the changes. It finally reorganized and put all development and production under one command, the new Air Force Systems Command (AFSC), and all logistics, supply and maintenance under the Air Force Logistics Command (AFLC). Now the only

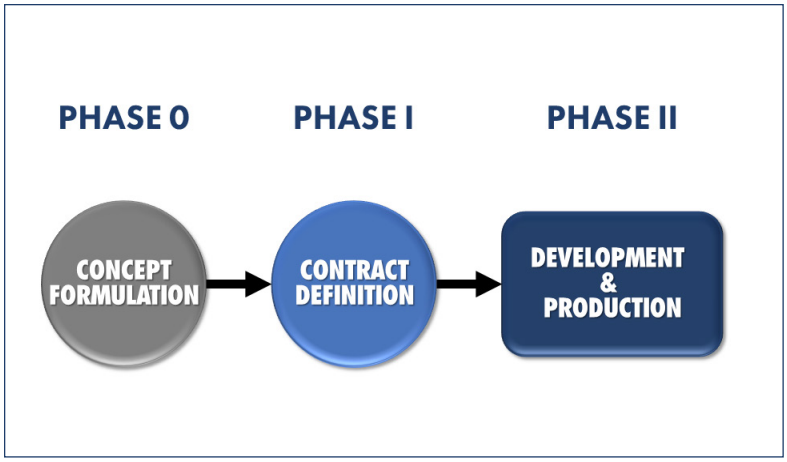


FIGURE 7. Acquisition Process in the Early 1960s

remaining transition for the package was between these two commands.

The Air Force also set out to bolster the initial definition of its programs. New acquisition procedures, which required updating the Air Force 375 series guidelines, were initiated. The Service created distinct "Concept Formulation" and "Contract Definition" phases, Phases 0 and I, respectively, to precede the Phase II development and production **(Figure 7)**. McNamara seized upon this work, and in DoD Directive 3200.9, issued in 1964, he directed that Concept Formulation/ Contract Definition be performed by all the Services for all weapons systems prior to full-scale development.

The purpose of Concept Formulation was to determine the need for a system and its technical feasibility through extensive analysis. An analysis of the force structure requirements was also to be done to determine the "optimum" quantities needed.[151] At the end of this phase, a *performance specification* or performance requirement was to be issued and a Contract Definition Phase begun with a number of contractors competing to be selected for the development and production phases. According to DoD Directive 3200.9, the ultimate goal of Contract Definition was "the establishment of achievable performance specifications, backed by a firm fixed price or fully structured incentive proposal of engineering development."[152] Technical, cost, schedule, and management aspects of system development were to be examined on a total cost basis.[153] To accomplish this, Contract Definition was to consist of numerous sub-phases **(Figure 8)** in which competing contractor teams submitted ever-more definitive designs and plans. As this process moved forward, the number of competing teams was to be pared down until one winner survived.

This left one issue—the scope of the contract to be let. Initially, it was for development only. However, pushing its Weapons Systems Management Doctrine two steps further, the Air Force ultimately proposed "total" package procurement including both production and elements of in-service support in the contract. This concept was formally led by then Assistant Secretary of the Air Force Robert H. Charles and introduced by him at an Air Force Logistics Command/Industry management conference on 25 June 1964.[155] Prior to his appointment in the Air Force, Charles had been with McDonnell Aircraft for 19 years, achieving the second highest position in that corporation. He was concerned with the lack of competition for development and logistics support in major weapon systems and advocated up-front competition for the entire program with suitable controls in place to solidify the benefits of that competition. He believed that a competitive atmosphere supported by appropriate incentives would solve many of the problems that previously existed in weapons acquisition.[156]

In subsequent Air Force documents, *Total Package Procurement (TPP)* was defined as "all anticipated development, production, and as much support as is feasible of a system throughout its anticipated life is to be procured as one total package and incorporated into one contract containing price and performance commitments at the outset of the acquisition phase of a system procurement."[157] In ASPR, *TPP* was described as

CONCEPT FORMULATION PHASE 0	CONTRACT DEFINITION PHASE I			DEVELOPMENT/ PRODUCTION PHASE II
Parametric Studies	Phase IA	Phase IB	Phase IC	Production
	Selection of competing contractor period	Contractor proposal preparation period	Selection of development contractor period	Development

FIGURE 8. Details of the Acquisition Process in the 1960s[154]

"a method of procuring at the outset of the acquisition phase under a single contract containing price, performance and schedule commitments, the maximum practical amount of design, development, production and support needed to introduce and sustain a system or component in the inventory."[158]

According to the Institute for Defense Analyses in a 1972 report, "The purpose of the *TPP* contract, generally of a *fixed-price-incentive* type, was to offer the Government the opportunity to shift the major risk and major program management responsibility to contractors."[159] To achieve this shift of risk, all *TPP* contracts had to be a version of *fixed-price*, generally *fixed-price-incentive* (*FPI*) for development with *fixed-price* options for production. The exact form of the *fixed-price* contract was to be determined on a case-by-case basis depending on the risk inherent in the program.[160] In establishing production options, different quantity bid-increments were sometimes to be used within each option, and the government was liable for termination costs if it contracted for certain quantities and later reduced them.[161]

The initiative was designed principally to restrain costs and was expected to cure a host of ills by:

- Tightening design and configuration discipline and forcing the government to be more specific in defining its requirements
- Limiting or eliminating buy-in, since the contractor now would have to live with its own designs in production
- Motivating economical production and enforcing design discipline
- Encouraging subcontracts with the most efficient suppliers (thus *TPP* would be flowed down)
- Obtaining long-term commitments leading to program stability
- Encouraging efficiency through competition[162]

It also allowed the government to select contractors based on "binding *commitments* to performance and price of operational equipment, rather than mere *estimates*."[163]

In practice, *TPP* was treated as a combination of (a) a Contract Definition Phase, (b) bundle bidding, and (c) contract terms and conditions to inhibit changes. Changes could not be tolerated on either side, because this would open the contract to renegotiation and, thus, greater costs. In many cases, guarantees of operating costs were required.[164] In private industry, such contracts are often called "turn-key."

Since, in most weapon systems, performance alone is more important than price alone, the two had to be related. This was to be done by basing contract awards on the "cost-effectiveness" of the anticipated system quantity in the operational environment over its "first-line utilization" period.[165] Awards did not have to be made to the low bidder as is common in traditional *fixed-price* contracts.

Total Package Procurement was a **system approach** designed to obtain, among other things, the cost advantages of efficient production. An historian might see it as a major synthesis of conflicting, century-old currents and tides. The complexity of a system was to be integrated with the demands of production. The contractor was to be responsible for overall system performance extending from acquisition into the operating life of the system. Concurrency, one of the supposed ills of the 1950s, was still in vogue and could be used by the contractor at its own risk. Thus, the Contract Definition Phase took on even more importance. In fact, Secretary Charles believed that any system that went through Contract Definition was a candidate for *TPP*.[166]

For *TPP* to work, the government had to disengage from the contractor. Whereas in a cost contract, government was the senior partner with the contractor, in a *TPP fixed-price-incentive* contract there was no need for a partnership, since there were firm commitments for price, performance, and delivery.[167] "Interfaces," as they were called, were to be avoided if possible. Thus, a "contractor-furnished" versus a "government-furnished" equipment approach was generally to be taken. In all these aspects, the government could take a "hands-off" approach and "hold the contractor's feet to the fire." However, a policy of complete DoD disengagement, coupled with the possibility that a contractor might fail to perform, could prove to be both wasteful and a threat to national security. Therefore, sufficient program visibility had to be maintained to permit prompt action if controls were called for.[168] Gaining this visibility came to depend on large management information systems wherein the contractor reduced all program status and problems to dollar terms and reported this information regularly to the government.

A great deal of analysis was spent in those days studying *TPP*, much of it by the Logistics Management Institute. Contract types and provisions, appropriate level of government involvement, impact on technical innovation, flow down to subcontractors, consumption of limited technical talent, and impact on other programs were just a few of the topics. Early on, it was recognized that *TPP* increased the contractor's risk in at least two primary ways: (1) fixed price production contracts were established without the experience of full-scale development, and (2) long term, fixed ceiling prices were set that could be subjected to economic fluctuations outside the contractor's control.[169] To mitigate the first, proponents believed the ceiling price and incentive share could be set high enough to encourage efficiency without imposing undue risk. To guard against the second, the contract had to contain clauses to permit cost and price adjustments for economic escalation in accordance with Bureau of Labor Statistics.[170]

Photo courtesy of US Air Force

FIGURE 9. C-5A Galaxy

The concept evolved over the first years of McNamara's tour, and it fit very well with his business philosophy. Some elements of it were used in the F-111 program very early on. That project, however, could not be made completely *TPP* because the full concept was still being worked out, and it depended on the ability to contract quantities over more than one year, which Congress would not at first allow. In 1963, McNamara succeeded in getting Congress to approve "multi-year procurement," which allowed contracts to extend up to five years.[171] By 1964, he had decreed in DoD Directive 3200.9 that all new weapons programs would use *TPP* .

C-5A GALAXY PROGRAM

The first program to be designated for *TPP* and the first to go through a comprehensive Contract Definition Phase[172] was the C-5A *Galaxy* heavy logistics transport aircraft or cargo plane (**Figure 9)**. It was to be the world's first jumbo transport.

During the 1950s and the Eisenhower years, national security strategy was dominated by a concept called "Massive Retaliation." This concept called for large nuclear strikes in reaction to aggression against the U.S. The Kennedy Administration rejected this approach and began to pursue a strategy called "Flexible Response." This concept called for the country to respond quickly and proportionally from the continental U.S. to brush-fire wars and other strategic threats abroad. The idea was to give the U.S. great mobility and a "remote presence" anywhere in the world.[173] Among other initiatives, the President asked McNamara to increase military airlift capability to "better assure the ability of our conventional forces to respond, with discrimination and speed, to any problem at any spot on the globe at any moment's notice. In particular it will enable us to meet any deliberate effort to avoid or divert our forces by starting limited wars in widely scattered parts of the globe."[174]

This requirement called for both the Air Force and the Army to be involved, as it was Army divisions, weapons, equipment, and supplies that had to be airlifted. As one DoD official noted, "This will mean an Army division in Kansas is just as much on the front lines as one in Germany."[175] To meet the requirement, bigger and faster transport planes were needed.[176] In addition, the planes had to operate in forward battle zones on primitive landing strips, sometimes within reach of enemy fire, just as was soon to happen in Viet Nam. Thus, they had to be able to stop, unload, and load quickly.[177]

In October 1961, Air Force Headquarters issued a Qualitative Operational Requirement (QOR) to the Military Air Transport Service (MATS) to replace the Douglas C133 *Cargomaster*. MATS amplified the QOR to require a multipurpose, long endurance aircraft

capable of carrying 100,000 pounds of outsized cargo at a speed near Mach 0.8.[178] The Air Force projected a "conservative" need for 167 aircraft, and appropriate planning documents were initiated. As the concept of the plane, designated CX-X, evolved, it was to be capable of flying 10,000 nautical miles without refueling and would use laminar flow control techniques and regenerative high bypass turbofan engines.[179] In June 1963, a Specific Operational Requirement (SOR) was prepared for a Heavy Logistics Aircraft Support System that would be operational through the 1968-1980 timeframe.[180]

In November 1963, General Bernard Schriever, Commander of the new Air Force Systems Command (AFSC), responded to the operational requirements. He recommended a development program that would achieve first flight by mid-1969 and Initial Operational Capability (IOC) by late 1971[181] (with IOC defined to be the fielding of the 16th aircraft).[182] Propulsion technology was expected to be the "pacing element."[183] Funds were requested to finance parametric propulsion and airframe studies starting in early 1964 as part of the new Phase 0, Concept Formulation. These studies were to be conducted by the companies that would eventually compete for the system. In December, a SPO was set up in the Aeronautical Systems Division (ASD) of AFSC. It was staffed with two military officers and three civilians,[184] none of whom had any experience with the new *TPP* concept then being developed by Assistant Secretary Charles. It would not be formally presented to them until the next year.

MATS addressed General Schriever's proposal and stated that an earlier IOC of 1969 as opposed to 1971, was absolutely essential.[185] In the ensuing debate, Schriever held out for an IOC in 1971-72 while others pushed for 1969.[186] McNamara resolved the matter in May 1964 when he declared that failure to meet 1969 would "jeopardize the program."[187] In fact, an alternative that provided the required airlift with more squadrons of C-141 planes, then in production, came to the fore and, for a time, received priority. Such alternatives were to remain a threat to the program for some years to come.

In early 1964, the plane was re-designated CX-HLS (Experimental Cargo-Heavy Logistics Support), and AFSC started trying to compress the schedule by increasing development spending and reducing propulsion performance requirements.[188] Meanwhile, the SPO received airframe study proposals from Boeing, Douglas, General Dynamics, Lockheed, and Martin-Marietta and engine study proposals from General Electric, Curtiss-Wright, and Pratt & Whitney. As a result, parametric study contracts were issued to all but General Dynamics, Martin-Marietta and Curtiss-Wright. These studies were to proceed in parallel with other Phase 0 Concept Formulation work and culminate in a competitive Contract Definition Phase beginning January 1, 1965.[189] The schedule was so tight that the ASD Assistant for Management advised the ASD Council that it was unwise to experiment with *TPP*.[190] Nevertheless, Assistant Secretary Charles met with the SPO to discuss its implementation.

Concept Formulation involved four formidable tasks—parametric analyses, design analysis, system performance analysis, and program planning.[191] As these proceeded, a larger cargo compartment of 2400 square feet was found to be more cost effective than the 1750 square foot compartment considered in the Specified Operational Requirements (SOR). A larger plane was emerging. In addition, a new high bypass ratio engine, capable of delivering 40,000 pounds of thrust, was found to be preferable to a cluster arrangement of conventional engines. These new engines were still considered to be the "most uncertain factor" in the program.[192] In August 1964, General Electric and Pratt & Whitney were awarded advanced development contracts for propulsion components to reduce the risk. Two months later, in October 1964, the study results and a Preliminary Technical Development Plan (PTDP) were briefed to Air Force Headquarters. The PTDP included the first total program cost estimate of $3.1 billion for 120 aircraft.[193] With the submission of the PTDP, Concept Formulation was completed.

In a November 1964 letter to McNamara, Secretary Zuckert proposed the application of *TPP* to the CX-HLS. His letter stated that *TPP* required at least two basic conditions. First, performance requirements had to be defined in detail with a high degree of accuracy; and, second, the major technologies to do the job had to be "in hand."[194] Regarding the airframe, he stated, "there is no large advance in the current state-of-the-art, and the technological building blocks are in hand."[195] He further pointed out that, before development would begin, the program would have already gone through Concept Formulation with its parametric studies and would go through Contract Definition as well. All these, in his mind, made the program viable for *TPP*.

In December 1964, the CX-HLS was re-designated the C-5A. Contract Definition Phase 1A began with the release of a 1287-page draft RFP to the three airframe

developers and the initiation of a parallel process to select an engine contractor. Accompanying each draft RFP was a personal letter from Charles emphasizing how C-5A was a bold step in evolving the new method of procurement.[196] For the first time, as prescribed by *TPP,* a model contract covering the entire program from development to in-service support was included with the RFP.[197] This model contract and the draft RFP as a whole could be modified as a result of work to be done in Phase 1B of Contract Definition. As finalized, these would form the basis for the contractors' proposals that would be evaluated in Phase 1C. As part of their proposals, each contractor was to present a revised model contract, signed and ready for Air Force acceptance. Eventually, the final award would be made to the contractor whose proposals yielded the most cost-effective program over a 10-year period.

The SPO was immediately flooded with questions from potential bidders regarding the complex RFP and how the new procurement process fit with the Air Force's evolving 375 series instructions on procurement management.[198] Many of these 375 guidelines were still in revision or in coordination draft.[199] Few of the questions, however, impacted the immediate need to begin Contract Definition Phase 1B; so on 31 December 1964 the Air Force awarded all five companies Contract Definition contracts.

Phase 1B of Contract Definition provided for system studies to determine the cost effectiveness of various combinations of weapons systems and configurations. The competitors were to produce proposals that included contract designs that would form the basis for the eventual contract. The companies were also funded for advanced development studies to determine the feasibility of "employing various concepts in the production of operational hardware."[200] In addition, they used their own funds to increase their chances of winning. Eventually, each airframe contractor spent $8 to $15 million over and above the $7 million provided by the Air Force.[201] Some of this investment was stimulated by the contractors' belief that the winning design would get a huge leg up in developing a new commercial transport.[202]

The SOR was revised in January 1965 to include the final results of Concept Formulation and provide an updated baseline for Phase 1B. Although the technical objectives in the SOR were fairly clear, questions continued to inundate the SPO regarding systems analysis, the *TPP* concept, and cost proposal preparation. Many briefings were held with bidders, and more than 750 questions were answered, some of which caused changes in the RFP.[203] Changes in the technical objectives also occurred, and a jumbo aircraft began to emerge as the most cost-effective alternative. An RFP revision again increased the floor area, this time to 2700 square feet. In all, there were 294 changes made to the RFP during Phase 1B with little adjustment to schedule,[204] which was still very tight.

Another cause of RFP changes was a debate over how to fund the new multi-year contracts that Congress allowed in 1963. DoD Directive 7200.4 essentially limited funding of multi-year programs to fiscal year increments. When the RFP was first drafted, it was assumed that the *TPP* concept would remove this limitation. However, McNamara would not approve such a deviation and stipulated that 7200.4 would be followed completely.[205] This forced many RFP work package statements to be reorganized and caused the SPO to concentrate on adherence to an annual budget throughout the program.

In February 1965, McNamara officially approved *TPP* for the C-5A, the first program to be so designated. The cost estimates worked out by the Air Force and supported by McNamara were between $3.2 and $3.4 billion for 115 C-5As, which included five test aircraft.[206] These estimates also included the engines, spares, and test equipment, as well as some other costs that would not be paid to the prime contractors but to other agents working on the program.

During Phase 1B, the Air Force continued to try to accelerate the schedule. The SPO suggested an early selection of the engine contractor to simplify the air frame process, but this was discarded as limiting the cost effectiveness trade-offs.[207] Ultimately, each of the three airframe contractors had to make proposals for two different engines and three different cost-sharing formulas—six proposals for each contractor, 18 proposals in all. The schedule called for firm proposals by 1 April and contract award by 1 August 1965. Despite pressure from Charles to speed up, the contractors did not deliver their designs and proposals until the end of April 1965. Phase 1B was complete and Phase 1C, the Evaluation and Selection Phase, began.

Early on, in preparing for Phase 1C, the Air Force had independently estimated that the cost for 115 airframes would be between $2.1 and 2.4 billion, or two-thirds the overall estimate for the plane. This was based on an airplane with final gross weight of 664,000 pounds,

5600 square feet of wing area, and cargo floor space of 2494 square feet.[208] During Phase 1B, all of these numbers had increased. As Phase 1C began, a system source selection board was established and supported by an evaluation group of about 500 people. Over seven days in late April 1965, 35 tons of proposals were delivered to Wright-Patterson Air Force Base.[209] The page count for the technical/management areas alone approached 50,000. The sheer mass of data led to approximately 600 negotiated changes to the contractors' proposals.[210] Over 60 percent of this huge volume of data covered aerospace ground equipment, which represented less than 5 percent of the contract cost.[211] This may have been due, as some believed, to a flawed RFP,[212] but ground equipment also may have been the best understood part of the plane. An attempt was also made to evaluate 10-year operating costs, even though the Air Force had no historical records to support this evaluation.[213]

Meanwhile, another (unsolicited) bid was submitted. Henry Irwin of Irwin and Associates proposed that the C-5A be a gas-filled dirigible similar to the Zeppelins. He claimed access to plans and drawings from Germany and to a retired Navy Admiral with dirigible experience. His formal proposal was spelled out in 100 hand-written pages, because he had no typist cleared for secret material. Irwin's proposal met or beat several C-5A performance requirements, and he asserted that his craft's lack of speed would be offset by its capability to carry 400,000 pounds of cargo. Its vertical takeoff and landing capabilities exceeded requirements, but its maneuverability in crosswinds was limited. The proposal had to be reviewed by the SPO, but it was "summarily rejected as nonresponsive."[214]

In July 1965, the engine selection board briefed the Air Council, Air Force Chief of Staff, and the Secretary of the Air Force. The General Electric engine was judged superior with its higher bypass ratio, and an 85/15 *flexible-cost-sharing* contract was signed with GE to equip the first 58 planes at a target price of $459 million.[215]

Choosing the airplane contractor was a more difficult matter, as the bidders' technical scores were very close. Although Boeing's cost was higher, the Selection Board unanimously recommended its design over the other two proposals as being aerodynamically more effective while meeting all RFP requirements, thereby offering the least risk in terms of cost, performance, and schedule.[216] In September 1965, the selection board results were discussed with each contractor. Boeing was told that its cost was too high, Lockheed was informed that its design could not meet takeoff and landing requirements, and Douglas was told that it did not meet most of the RFP requirements.[217]

Three days later, the contractors resubmitted their proposals. Boeing did little but lower its cost by $100 million. Lockheed substantially redesigned its aircraft increasing the wing area by 600 square feet, employing a different flap arrangement, and making improvements in engine inlet and thrust reverser design. Douglas also made extensive changes but was still deemed insufficient. The Selection Board again unanimously favored Boeing's design, stating that Lockheed's changes added "grave" schedule risks and the possibility of increased costs. This was despite the fact that Boeing was pricier—its target price was equal to Lockheed's ceiling price.[218]

The Selection Board's assessment was forwarded to Secretary Zuckert, who sought advice from other sources. He established a special scrub team of about twenty senior officers who re-characterized the Lockheed proposal as having "some risk" as opposed to "grave risk" and recommended the selection of Lockheed, based on its lower price. The Commanders of AFSC and AFLC each recommended Boeing based on risk and design superiority. The Commander of MATS and the Air Council came down on the side of Lockheed based on cost savings.[219] As one journalist later observed:

> The thirty-five tons of paper, the hundreds of thousands of man-hours, and the mountains of computer printouts had defined the problem far better than ever before, but they had not solved it. The gap that remained could be bridged only by a human judgment and the experts as usual were divided.[220]

Lockheed's plant in Marietta, Georgia, needed business and was in danger of closing without the C-5A. Boeing, on the other hand, had a backlog of commercial contracts. After the first round, word got out that Boeing might win.[221] Lockheed sprang into action, enlisting the aid of Senator Richard Russell, Georgia's powerful chairman of the Senate Armed Service Committee. Some serious "arm-twisting" seems to have ensued. In fact, Marietta's mayor would later say, "Without Russell, we wouldn't have gotten the contract."[222] The on-going F-111 cost fiasco also made officials shy away from recommending any more spending than absolutely necessary.[223]

With Lockheed as the low bidder, Secretary Zuckert concluded that "the selection of the Lockheed proposal is in the best interest of the Government."[224] On 30 September 1965, DoD announced that Lockheed would build the C5A under a *flexible-incentive* contract. Shortly after losing its bid for the C-5A, Boeing modified its design to carry people instead of cargo, took it to the commercial marketplace, and turned it into the Boeing 747, the first jumbo passenger plane. By April 1966, it had sold 25 planes to Pan American World Airways. Douglas, on the other hand, could not survive the loss and was absorbed by the McDonnell Corporation.[225]

The performance characteristics of the C-5A that were contracted with Lockheed called for a very large plane that could haul 100,000 pounds over 5,500 nautical miles as part of its basic mission but could expand that load to 265,000 pounds over 2,700 nautical miles for an emergency mission. Its take-off distance at 89.5 degrees F was to be 7,500 feet, and its landing distance a very challenging 3,900 feet[226]—both designed for primitive landing strips in tropical countries. The empty weight of the plane was to be 318,500 pounds. This was 16,000 pounds more than in Lockheed's original proposal in April 1965 and was the first order result of the last- minute design changes that the company made to make its proposal more competitive.[227]

The contract was to include five development aircraft and 53 planes in the first production increment, called "Run A." The five development planes were ultimately to be reworked and delivered as operational aircraft. There was an option for "not to exceed" 57 more aircraft in the next production increment, called "Run B," for a total of 115 airplanes, and an unpriced second option "not to exceed" 85 more aircraft in a "Run C," which, if exercised, would complete 200 aircraft. However, all top-level plans for the C-5A were based on a force of 6 squadrons or 120 planes.[228] The scope of the contract also included flight and ground test programs, crew and maintenance programs for the six squadrons, ground support equipment, and spare parts.[229]

Overall, the contract was extendable out to eight years.[230] The *flexible-incentive* contract that was championed by Charles was a version of *FPI*. It gave the contractor the option to adjust the cost sharing ratios within prescribed limits based on its assessment of risk at certain times during the program.[231] The initial share ratio was 85/15, and the provisions were very complex. However, the government also had an option, until January 1966, to convert the contract to a straight *FPI* in return for an increase of about 3% in the target and ceiling prices.[232]

While Lockheed had been selected and had signed a contract as part of its proposal, there were still some remaining disagreements:

1. Lockheed wanted to shift the IOC date (delivery of the 16th aircraft) of December 1969 to compensate for the two-month slip in contract award from 1 August to 30 September. The Air Force still considered the IOC essential and felt it was legally entitled to demand delivery on the contracted schedule.[233]

2. While the requirements of the RFP had been for a plane to carry an emergency load of 265,000 pounds over 2500 nautical miles, Lockheed's proposal had claimed that its plane would achieve 2700 nautical miles. Lockheed wanted now to contract to the RFP baseline, but the Air Force intended to hold the company to its proposal.[234]

3. Under the "total system integration responsibility" clause, Lockheed had to accept this responsibility even though the engine was to be furnished by the Air Force after it was produced by General Electric. The company now wanted to change some of the performance specifications on the engine, but General Electric was reluctant to change. Thus, Lockheed resisted accepting total system responsibility. The Air Force insisted on Lockheed's "unequivocal concurrence" with the design and performance of the engine as included in the RFP.[235]

These issues were debated for two months. All were settled in favor of the Air Force's positions. On 17 December 1965, the air frame contract was finalized with an effective date of 1 October 1965.[236] Two weeks later, the Air Force elected to execute its option to change from the *flexible-incentive* form to the simpler *fixed-price-incentive* arrangement. The new share line would be 50/50 below target cost and 70/30 above target. After all was said and done, the basic contract values for the development phase plus production Runs A and B were

Target Cost	*$1768 million*
Target Price	*$1945 million*
Ceiling Price	*$2299 million*[237]

These numbers were to be used by the SPO in tracking the contract for some time, even though

only an R&D and Run A contract had been actually executed. The target price was just over half as much as the Air Force had worked out with McNamara in 1965 for 115 aircraft.[238] The development plus Run A numbers were

Target Cost	*$1292 million*
Target Price	*$1420 million*[239]
Ceiling Price	*$2299 million*

In addition, there was a performance incentive that rewarded up to $22.5 million for meeting certain payload, weight, range and speed goals. The schedule had the first Run A C5A being delivered in June 1969, the 16th (IOC) in December 1969,[240] and the last Run A plane in January 1971.

The first plane in Run B, if that option were exercised, was also to be delivered in January 1971.[241] Included in the contract was a very complex "repricing" clause that provided a formula for exercising this option without reverting to sole source negotiations.[242] This formula related Run B prices to actual Run A costs. It attempted to protect the Air Force against excessive profits in the next buy option if there were large reductions in Run A costs and also to preclude catastrophic losses to Lockheed if unknown problems occurred over the long life of the contract.[243] One problem with the option was that, in order to keep the production line going, it had to be exercised in January 1969, two years before the delivery of all the Run A planes and before the actual total cost of Run A would be known. As the SPO noted three years later when the program was in trouble:

> "It is definitely in Lockheed's favor to keep us in the dark on the cost of Run A since the Run B target cost and ceiling price will be a factor of Run A cost. Once the Run B option is exercised, the Government is obligated to the combined ceilings of RDT&E and Production Runs A and B."[244]

Another problem with the repricing formula was that it did not describe what was to be done if economic conditions changed dramatically.[245] This clause was to become the source of great controversy as the program proceeded.

All in all, the first increment of the contract spanned six years into 1971. It presumed to be very complete in its scope to solidify the price gains from the design competition. Thus, it was extremely complex both in terms of its pricing and performance incentives. Secretary Charles himself had gotten intimately involved in preparing clauses to prevent the most common abuses perceived in defense contracting.[246] These included imposing late delivery penalties of $12,000 a day for each of the first 16 planes up to a maximum total penalty of $11 million, restricting contractor profits on any changes it proposed, and a correction of deficiencies clause, among others. All were intricately written. Fourteen pages were devoted to performance guarantees including:

- During flight tests, the plane was to demonstrate a reliability of 85% for the overall aircraft with no more than 15% subsystem failures on three airplanes during 1,080 hours of flight. If these parameters were not met, the Air Force could reject the aircraft and return it for repair or reengineering at no cost.
- Two years after becoming operational, 90% of all C5-As on a 10-hour mission had to reach their destination without a major subsystem failure. In addition, only 8% could not be delayed more than 15 minutes for mechanical reasons.[247]

Charles observed that it was "probably the toughest contract for a major defense system ever entered into by the Pentagon."[248] However, despite all the clauses and precautions, there were still suspicions that Lockheed had intentionally "underbid" counting on design changes and the repricing formula to make its gamble successful.[249] While Lockheed officials denied this allegation throughout the program, Charles was to say later,

> "They may have believed we wouldn't hold them to the contract. And there would be some merit in such belief. After all, we hadn't in the past."[250]

The program was underway. The first problem was to deal with the weight growth that had begun during Contract Definition and continued as the design matured. However, another problem emerged very quickly — excessive drag. Just after contract award, wind tunnel tests on a C-5A model showed that drag was significantly over target. Some of the changes made to correct this problem again added to the weight.[251] These weight and drag problems

not only affected cost, but also reduced the ability of the design to carry the large payloads desired and to make the short takeoffs and landings required.[252] Within nine months of contract award, Lockheed began to propose weight reduction changes to the contract. Some of these were significant, such as deletion of in-flight fueling and wing anti-icing capabilities.[253] The schedule for release of production drawings got tighter.[254]

A number of economic problems also began to impact the program. The buyer's market that existed at program onset was rapidly turning into a seller's market due to commercial demand in the aviation industry and the war in Vietnam.[255] Materials increased by 4 percent per pound.[256] Lockheed had predicated its bid on a healthy reserve of engineers and had actually cut its subcontractor estimates by 10% in its final bid, betting on a paucity of business in the industry. Neither materialized. Subcontractor costs actually came in at 5% above the original proposals. In addition, a serious shortage of in-house engineering talent forced dramatic increases in overtime.[257] Soon Lockheed was shopping everywhere for engineers. It went to companies throughout the country and even contracted with a British firm for help.[258] At one time, about 850 British engineers were employed on the C-5A, which caused liaison problems and introduced difficulties stemming from differing design techniques.[259] Such initiatives were taken to save schedule and avoid the huge penalties of late delivery;[260] however, at the same time, they increased the cost of development. Above all, inflation was beginning to grow at a rate that impacted wages and rates.[261] By late 1966, Lockheed admitted to a "projected" overrun of $58 million above *target cost*. About $20 million of this was attributed to abnormal economic escalation.[262] These increases reduced the company's anticipated profit from 10% to 8%.[263]

Both Lockheed and the SPO continued to work the weight problem. While the SPO did not fully accept Lockheed's recommendations, it proposed other changes. After months back and forth, reductions totaling 5,500 pounds were approved. None of these changes were supposed to affect contract price or guaranteed weight.[264] In return, Lockheed agreed to increase its efforts to test and track fatigue and extended its commitment to correct deficiencies.[265] By the fall of 1966, experts were beginning to debate the application of wind tunnel test data taken on small-scale replicas. This was the first indication that the sheer size of the plane was becoming a technological unknown.[266]

In November 1966, the 50% production design release point was reached.[267] By January 1967, Lockheed came forward with a drastic proposal to eliminate the empty weight guarantee from the contract and, in addition, proposed that no other weight parameters be made contractual. In concert with General Electric, it also proposed to reduce the temperature requirement for take-off and climb performance from 89.5 degrees to 75 degrees while increasing the thrust of the engine 2000 pounds to carry the extra weight. Again, these were to involve no change in contract price or schedule. Unfortunately, their proposals undermined contingency missions in the near-equatorial latitudes for which the C-5A was primarily designed.[268] Thus, the SPO rejected the proposals concluding, "Incremented relaxation of . . . basic requirements any time the contractor claims to have a design problem undermines the integrity of the total procurement contract philosophy."[269]

In January 1967, Lockheed requested an additional $78.5 million in RDT&E funds to continue working until June 30, 1967,[270] the end of Fiscal Year-1967. [In those years, the government fiscal year ran from July 1 to June 30 as opposed to October 1 to September 30 today]. The additional funding would also assure that cost overruns would be paid by the government in the event of program cancellation.[271] This was 57% higher than the plan for 1967.[272] The Air Force could not provide all these funds because they had not been allocated by DoD.[273] This was in line with McNamara's earlier decision on the application of DoD Directive 7200.4. A number of options for providing the funds were recommended by Lockheed including using existing FY67 production monies.[274] The SPO recommended disallowing Lockheed's request; however, a decision at the DoD level was made to provide about $22 million of new RDT&E.[275] This amount, combined with funds that had been set aside to pay fiscal year profits that would clearly not be earned, covered the shortfall.[276]

The mounting costs were beginning to cause concern in the Congress.[277] McNamara in his testimony on the Hill explained, "The cost estimates for this airplane were not satisfactory. We knew it before the contract was let."[278] He quoted a spokesman from one of the competitors for the C-5A contracts as admitting afterward that "it was a liar's contest."[279] Although *TPP* in its first application had not eliminated unrealistic bids and inflated performance claims, McNamara believed the new method had served notice to industry that "the moment of truth" was near.[280]

One month later, in February 1967, and just over one year into the contract, the technical problems had become so onerous that the SPO, without mentioning the funding problem,[281] issued a "cure notice" threatening cancellation of the contract for default, stating:

> It was apparent from the contractor's briefings and from informal contact that no clearly defined plan existed to meet contract guarantees on all aircraft, particularly with regard to weight empty, initial cruise altitude, landing distance, and payload/ range (when constrained by take-off and landing distance requirements).[282]

This cure notice was no routine event. In fact, a number of sources believe that this was the first time one had been issued on a major contract.[283] It probably was for the Air Force. Lockheed had 30 days to respond. The company was in the midst of preparing a public distribution of company securities and had a major stake in resolving the notice quickly.[284] Lockheed's Chairman and Secretary Charles got involved, and both questioned the need for such drastic action.[285]

The company also attempted to soften the language but was rebuffed by the SPO.[286] Finally, the company proposed a top-level corporate technical team to look into the problems highlighted by the SPO, and by the end of February, the Air Force backed away from termination.[287] Despite the aversion to program shut down, the combined technical, cost, and schedule progress to date caused the SPO to report to the Aeronautical Systems Division:

> This is the first major aircraft system to begin operational system development after completing an extended contract definition phase. The central idea of contract definition is to define achievable performance and to develop realistic schedules and credible cost estimates in relation thereto. Clearly Lockheed flunks the course on this basis.[288]

As 1967 progressed, another weight-related problem began to emerge, one that would not be solved completely for two decades. In the 1964 RFP, the Air Force had instructed the competitors to specify technical performance values, such as range and payload, that would become part of the contract. Wing area was not one of the items specified,[289] as this was not a performance value. In Lockheed's rush to revise its proposal and remain competitive with Boeing, it increased the wing area, which in turn increased the unladen weight of the airframe. To meet the technical requirements, however, Lockheed reduced the estimated weight of the new wing to below that of the earlier and smaller design.[290] The Air Force evaluators, focusing on the overall weight of the plane, never challenged the unexplained reduction in the wing.[291] By early 1967, the Air Force realized that the wing stress values left little margin for potential static overloading or the effect of metal fatigue.[292] Lockheed agreed to deal with the issue, but its ability to do so was to become problematic.[293]

In May 1967, the 90-percent design release point was reached.[294] This provided a convenient point to measure the magnitude of the engineering effort and to project the eventual costs.[295] Lockheed's proposal estimates had been based on its experience with the C-130 and C141, and "scaled up" using engineering man-hours per pound formulas. At the 90-percent design release point, these numbers were found to be underestimated by almost 75 percent.[296] Not only was the design of the first planes proving more difficult, but the sustaining engineering required for later planes was also increasing. By the summer of 1967, the projected cost increase due to engineering alone was almost $100 million.[297]

The program was also being impacted by the phase-out of the C-141 program at Lockheed. The last C-141 was scheduled for delivery in February 1968, and a cut-back in direct labor was already underway. The C-5A now would have to carry more of the plant overhead and General & Administrative (G&A) expenses, which again increased costs.[298] Thus, technical problems, overhead/G&A increases, higher subcontractor rates, and uncertain economic conditions were all affecting the program. In 1967, the Air Force began to omit cost increases from its contract summaries and management reports because their disclosure "might put Lockheed's position in the common stock market in jeopardy."[299] A pattern of behavior was forming.[300] On one hand, the Air Force would threaten Lockheed if its performance did not improve. On the other hand, it would go out of its way to protect the contractor's reputation fearing the program might not survive if Lockheed was tarnished.[301] In November 1967, Air Force Chief of Staff General John P. McConnell informed McNamara that the program was under the 1965 Air Force Estimate, when it was projected to be well above that figure.[302] The DoD Controller Robert Anthony warned the Secretary that McConnell's information

was incorrect.[303] However, by now, McNamara was more focused on the Vietnam War.[304]

McNamara resigned as Secretary of Defense in February 1968 and was replaced by Clark Clifford. As he left, the C-5A problems were just beginning to emerge. Clifford himself was to serve less than a year before the Nixon Administration took office in January 1969. Despite the changes at the top, the Air Force continued to suppress information deemed detrimental to the program.[305]

The year 1968 started with great promise. In March, the Air Force celebrated the "roll-out" of the first hand-made RDT&E aircraft.[306] At the event, held at Dobbins Air Force Base in Georgia, President Johnson asserted, "For the first time, our fighting men will be able to travel with their equipment to any spot on the globe where we might be forced to stand – rapidly and more efficiently than ever."[307] Mrs. Harold Brown, wife of the Air Force Secretary, formally christened the plane, "Galaxy."[308]

Five months later, in June 1968, the plane took off and flew for the first time.[309] Within the next 12 months, the four other RDT&E planes took to the air. All reportedly performed well.[310] For example, in June 1969, the second C-5A took off at 762,000 pounds and landed at 600,000 pounds stopping in 1,500 feet. Both weights were records.[311] Also in June 1969, the fifth C-5A flew at Mach 0.8 at 35,000 feet and then climbed to an altitude of 40,200 feet.[312] Other impressive feats followed. A C-5A became the heaviest aircraft to refuel in flight, taking on 100,000 pounds of fuel from a tanker. Another C-5A took off at 768,000 pounds, carried 308,000 pounds of fuel with 198,000 pounds simulated cargo, and landed in 1200 feet.[313] In addition, drag at cruise speed was better than expected, suggesting that the aircraft's range and payload might exceed expectations.[314]

Despite the successes, the weight of the aircraft continued to be a problem throughout 1968 and 1969. One primary reason was Lockheed's inability to use the planned amount of titanium.[315] The company had originally planned to use 27,000 pounds of titanium in each airframe, but the first plane off the line contained less than 10,000 pounds.[316] Aluminum was used instead, which added weight and off-set the benefits of a lighter landing gear design that had been adopted in late 1967.[317] The company would later point to its weight reduction efforts as the cause of 20 percent of the cost increase.[318]

Costs in tooling and manufacturing were also increasing.[319] The early philosophy that C5A was just a scaled-up C-141 with about the same number of parts was proving wrong. The giant size of the plane also caused significant production problems.[320] Expensive fabrication techniques such as chem milling and metal bonding were being required in greater amounts and covering larger areas than had been expected.[321] Extraordinary material handling procedures and sophisticated manufacturing methods were also needed.[322] As an example of these difficulties,

> While one person could handle a 20-foot stringer used in the fuselage of the C-141, three or more people were required to handle a 48-foot stringer needed for the C-5A. Tools for machining the extremely large fuselage frames had to be designed as current tools could not be effectively modified. Problems in keeping the aircraft within the contract weight guarantee demanded the expanded use of titanium and metal bonding, and extensive honeycomb development.[323]

In addition, closer tolerances were needed to meet the huge airframe structural requirements.[324] Few of these problems had been anticipated, and their solutions again added to contract costs.[325]

Three new technical problems also emerged in 1968. In November, eight months into testing, cracks were discovered in the fuselage of one C-5A. Lockheed believed that these were caused by a lack of coordination among various subcontractors and took steps to resolve this problem.[326] When the Air Force reviewed the company's solutions, it found that a comprehensive plan for engineering inspections was needed.[327] While the Air Force knew the dangers of metal fatigue and corrosion from other programs, the cracking problem was not fixed immediately and would reappear later in a more dangerous form.[328] A second problem was that the leading edge slats failed occasionally during landings. Lockheed believed that the system's erratic performance was caused by the airflow and the aircraft's maximum takeoff weight.[329] To resolve this, the company had to redesign the moving island portion of the slat system. Third, and of most immediate concern, was the inability of the main landing gear on the first two planes to work properly. Lockheed attributed the malfunction to the "interim configuration" of the two planes. However, the next aircraft's gear also failed. Correction of this problem would take years and require a complete redesign and refit of all C-5A landing gears after the planes had became operational.[330]

Throughout 1968, the cost increases gradually went more and more public. Early in the year, the SPO began to question Lockheed's estimates. In February, on evaluating the company's 1967 year-end cost report, the SPO found possible cost growth greater than the Air Force had recognized before.[331] The SPO quickly conducted two of its own estimates, and both showed significant cost increases.[332] When these estimates were shown to Lockheed, the company disputed them with estimates of its own.[333] An Aeronautical Systems Division cost team was dispatched to Lockheed and came up with yet another estimate confirming the SPO's findings.[334] It was in this timeframe that the SPO came to believe that Lockheed finally recognized the seriousness of the cost problem, as this is when the company began to question a number of contract provisions and seek interpretations that would be in its favor.[335]

The SPO's findings proceeded up through DoD until June 6, 1968, when they were presented to DoD Comptroller Robert N. Anthony, Assistant Secretary Charles, and other DoD officials. These officials agreed with a SPO suggestion that the information be closely held because of Lockheed's complete disagreement and their fear of possibly damaging the company's commercial position.[336] It was felt that publicizing the overrun estimate might bring a libel suit from Lockheed's stockholders.[337] Moreover, only one hand-made aircraft had been completed, and with four years remaining on the contract, the risk of being wrong was deemed too great.[338] Anthony also seems to have made a decision to limit the reporting of the latest estimates.[339]

By July, some members of the SPO recognized that a "reverse incentive" existed in the contract. The projected costs were now so far above target cost that Lockheed was motivated to spend even more, since the repricing formula would return more than a dollar for each dollar spent on Run A if all 57 Run B aircraft were ordered.[340] Not only might Lockheed be incentivized to be inefficient, but some observed that the contract had essentially become a *cost-plus-percentage-of-cost* arrangement which had been illegal since World War I.[341] The ultimate price of the Run B option was becoming a real problem.

In November 1968, Senator Proxmire informed Secretary Clifford of his concern regarding the "cost overruns" in C-5A.[342] Any further procurement of aircraft, he declared, should await an on-going investigation by the General Accounting Office (GAO).[343] The senator also began holding hearings on the "Economics of Military Procurement" before the Joint Economic Subcommittee, which he chaired.[344] At his early hearings, A. Ernest Fitzgerald, a civilian cost analyst and management systems deputy to the Assistant Secretary of the Air Force for Financial Management, predicted the total C-5A program would have an overall cost of $5.2 billion, a "staggering" increase of $1.8 billion over the $3.4 billion endorsed by McNamara in 1965.[345] Fitzgerald was to make many return trips to Capitol Hill. Criticism from both parties began to grow.

In this atmosphere, the need to execute the Run B option took center stage. Since the actual costs of Run A were unknown, the SPO was initially directed to establish a price for Run B based on the current estimates for Run A. If this price was satisfactory, it would be offered to Lockheed on a non-negotiable basis. Otherwise the Run B option might not be exercised.[346] This was not an attractive alternative to either side. The Air Force still needed planes, and it appeared that Lockheed's financial condition had deteriorated so much that it might not be able to even complete Run A without cash flow from Run B.[347] Despite the desire to continue on both sides, negotiations proved to be very frustrating.[348]

Besides exercising the Run B option, DoD officials were also faced with two other decisions: (1) the ultimate size of the C-5A force and (2) whether to change the contract.[349] The Air Force Secretariat took charge throughout November and December. Now Secretary of the Air Force Harrold Brown met with Charles and other Air Force officials and agreed that the 57-plane Run B option would be broken into three separate buys of which the first would be 23 aircraft.[350] The clock for deciding on the option, set by contract as "January 1969," was negotiated with Lockheed to be 31 January,[351] which would be after the departure of the Johnson Administration. Thus, Secretary Clifford decided that, instead, the deadline would be prior to 20 January, the Administration's last day.[352]

In early January, Air Force Secretary Brown notified Lockheed that the Government intended to execute the option. On 18 January, Clifford endorsed this intent but revised it to limit the buy in FY70 (beginning June 1969) to 23 aircraft.[353] In addition, Clifford decided to slow down the production rate from four to three airplanes per month, recognize a four-month schedule slip,[354] and leave the execution of the full option to the next administration.[355] This decision was implemented by a contract revision called Supplemental Agreement 235.

This decision was not met with enthusiasm by Lockheed. They felt that Brown's notification had obligated the Air Force to the complete 57-plane Run B. In fact, they proposed using the FY70 funding to order parts for all 57 aircraft to box the Air Force in.[356] The Service balked, but by now the program had become so "notorious" that people higher than the Air Force were exerting control.[357]

With all the technical and cost problems, meeting the schedule had become a useless endeavor. Until January 1969, schedule was the one parameter Lockheed had refused to give up.[358] It had spent excessive amounts on overtime and use of out-of-plant installations to maintain schedule. But by early 1969, it was obvious that the attempts were futile.[359] New problems were mounting during the transition from "hand-made" aircraft to production-line versions. Quality was lost and processes had to be corrected.[360] Soon the four-month schedule slip was not enough, and at the end of February, the Chief of Staff of the Air Force approved an IOC change from December 1969 to June 1970. No mention was made of the $11 million penalty for late delivery, but Lockheed began compiling a list of events beyond their control to fight it.[361]

The cacophony on the Hill was getting louder. Lockheed fanned the fire by refusing to give the GAO or Congress the cost data they requested.[362] Fitzgerald, Charles, and other program officials, were called to testify. In fact, Charles resigned on May 5, 1969, a few days after his testimony before Proxmire's Committee.[363] The Nixon Administration was now arriving, and Melvin Laird was the new Secretary of Defense. While it is normal to change public officials at such times, Laird directly linked the departure of Charles and others to the woes in the C5A.[364] He announced that he intended to straighten out the financial mess and immediately directed the new Secretary of the Air Force, Robert Seamans, to review the program.[365] This evaluation became known as the Whittaker Report, led by Phillip Whittaker, Charles' replacement as Assistant Secretary of the Air Force for Installations and Logistics.[366] The report concluded that, while there were technical problems, "no major design deficiencies" were present, and there was a "high probability" that all range, payload, takeoff, and landing performance requirements would be met.[367]

Proxmire offered an amendment to strip the FY70 C-5A funds from the defense bill. Perhaps because of the Whittaker Report's encouraging findings, the amendment was defeated. In fact, Senator Stuart Symington of Missouri, arguing for the plane, observed, "It may be a poor buy, but what is bought is essential for our national security."[368] The defeat of the Proxmire amendment ended a turbulent period in the C-5A story[369] and gave the program some breathing space. But the program was not yet out of danger.

By mid-1969, the buyer and the seller were "practically at each other's throats."[370] Lockheed contended that Supplemental Agreement 235 limiting the buy to 23 aircraft was invalid and that Secretary Brown's original letter of intent bound the Service to buy all 57 planes.[371] The company threatened to take the case to the Armed Services Board of Contract Appeals (ASBCA).[372] The Air Force feared that Lockheed may have cause to terminate the contract, or if the Air Force acted to terminate itself, huge penalties would be due. In either case, the completion of Run A was in doubt, and there was a chance that the government might be spending huge sums to buy partial airplanes.[373]

In November 1969, the Nixon Administration decided to end the program with the additional 23 planes, making a total of 81 aircraft. Change Order 521 to the contract was issued unilaterally to implement this decision and threatened to challenge any unauthorized spending on any production other than the 81 planes.[374] Lockheed immediately went into litigation, taking its case to the ASBCA, claiming that the government had terminated the contract for "convenience of the government." A severe adversarial environment resulted, three years before the contract was to end.[375]

The Aeronautical Systems Division now conducted another cost estimate, revealing that Lockheed, having spent more than $3.1 billion, stood to lose $650 million.[376] There were soon indications that the company's financial position might be more precarious than it wished to admit.[377] In February 1970, as the case reached the ASBCA, Lockheed proposed a new delivery schedule, reducing monthly production from three to two aircraft, increasing cost again, and postponing delivery of all 81 aircraft from June 1972 to February 1973.[378] Some of the reasons given for this proposal were the need to keep the production line warm so new C-5As or the hoped-for commercial L500 could be ordered.[379] In March, Lockheed's Chairman wrote to Deputy Secretary of Defense David Packard that Lockheed's work on all its defense contracts would cease unless the company received $600-700 million, most of it for the C-5A.[380] Moreover, the company asserted that it could not

wait for the ASBCA to render a decision and had to have at least interim financing in place by December 1970 to maintain uninterrupted performance on the C-5A.[381] In reaction, an Air Force negotiating committee proposed a memorandum of agreement as the basis for a new contract to replace the *TPP* vehicle. It would be another year before such an agreement could be worked out.[382]

Simultaneous with all this activity through 1969 and 1970, the Securities and Exchange Commission (SEC) had been investigating whether DoD and Lockheed officials had benefited from the alleged cover-up of the program's difficulties. The report in mid-1970 found no improprieties on the government side, but, while containing no evidence of illegal trading, it did disclose that certain Lockheed executives sold their stocks at the top of the market in late 1965 just after contract award when Lockheed's future was bright and its stock was selling for up to $70 a share. By 1970, it had plummeted to $10.[383]

In June 1970, the Congressional season leading to the start of FY71 was again contentious. The Senate Armed Services Committee authorized $200 million in contingency funds to meet Lockheed's progress payments. This did not come easily, however. Since Lockheed had not cooperated with the GAO, Proxmire tried to prevent the Armed Services Committee from approving any funds until the company disclosed its cash position. Shortly before the vote, he argued that Lockheed's crisis was caused by its commercial ventures, not by government contracts.[384] Amendments to delete the $200 million were ultimately defeated in both houses, but there were a lot of angry congressmen from both parties now voting against the C5A.

The Air Force accelerated its efforts to sustain the program, making sure it was "truly saved," not "merely granted a stay of execution."[385] In September 1970, the banks and airlines, which had already lent the company $450 million, agreed to lend $250 million more if the company could settle its dispute with the government.[386] The amount in dispute now totaled $758 million. Two months later, Packard met with Senator John Stennis of Mississippi, Chairman of the Senate Armed Services Committee, and revealed the seriousness of the situation.[387] Prolonged litigation would leave Lockheed with "insufficient cash and inadequate commercial credit to finance the continued operation of vital defense programs."[388]

The company needed government and bank support to forestall bankruptcy. Moreover, because of its relationship with other defense companies and suppliers, Lockheed's failure could set off a "disastrous chain reaction" in the aerospace industry.[389] Packard presented two alternatives. One was to begin funding the contractor fully and let litigation determine whether 81 or 115 aircraft had been ordered and what effect the repricing formula would have on the final cost to the government. The other was to persuade Lockheed to abandon legal proceedings in return for being paid the amount at issue except for $200 million, which the company would accept as a loss.[390] Packard preferred the second solution because it was prompt and permanent, but whichever alternative prevailed, the Air Force would have to exert a "more active" role in managing the contract and provide "all the funds to complete" the program.[391]

Lockheed balked and threatened continued litigation, but it could not endure; it was running out of funds.[392] In February 1971, the company agreed to accept the $200 million fixed loss. $100 million had already been spent by the company and would not be repaid by the government. The other $100 million would be paid back to the government beginning in January 1974 with annual payments of $10 million or 10% of corporate profits, whichever was greater.[393]

In May 1971, the Administration asked Congress for a $250 million loan guarantee to ward off bankruptcy. The loan guarantee focused on Lockheed, but the engine manufacturer, General Electric, also was to benefit.[394] General Electric too had been in litigation with the government along the same lines as Lockheed, but because its dollar amounts were so much less, it had been just a sideshow to the main dispute.

On May 31, 1971, Supplemental Agreement 1000 replaced the October 1965 C5A contract, as amended over the years, and marked the official demise of the first application of *TPP*.[395] Lockheed agreed to waive all existing claims, rights to performance incentive payments, and profits from spare parts and other items.[396] In addition, it accepted extraordinary management controls by the government and agreed to cancel numerous provisions that had been part of the *TPP* contract, including responsibility for total system performance, pricing of government-imposed changes, and adjustment for economic fluctuations.[397] Under the close control of the SPO,

which soon got a larger staff, the program began to gain respectability.[398]

Despite the move to a new way of doing business in mid-1971, the technical problems had not yet been solved. Wing, landing gear, and structural failures continued. The year before, in June 1970, while the first hand-built C-5A was touching down at Charleston Air Force Base, a tire on one of the main landing gear trucks blew. A wheel also came off another truck and bounced wildly down the runway.[399] This happened before a crowd of officers and senior officials that included Representative L. Mendel Rivers, a powerful supporter of the program. A few months later, another C-5A caught fire and exploded, killing a mechanic.[400] In addition, there were problems with key avionics and navigation components such as the multimode radar, the Doppler radar, and the radar altimeter, which required costly and lengthy fixes stretching out into 1974.[401]

It was the wing, however, that was the most onerous. Metal fatigue and corrosion, which are often interrelated and always difficult to predict, proved extremely hard to correct.[402] In September 1971, the effects of fatigue and corrosion destroyed an aircraft at Altus Air Force Base in Oklahoma when the number one engine and pylon tore loose from the wing while it was preparing to take off.[403] An investigation revealed a long crack on the inboard titanium longeron. Fatigue failure of the inboard cap of the aft pylon truss accounted for the separation.[404] The solution required a new pylon design.[405] In the meantime, all the planes were grounded and their pylons inspected. Pylons on 21 C-5As were found to be defective, and it took until May 1972 to replace them. While this was going on, a new pylon was designed, and by the end of 1973, every C5A received new pylons.[406]

Until 1971, the contract had restricted the Air Force's ability to correct such technical deficiencies. In fact, at the beginning of the program the idea that the Air Force might be able to help, given Lockheed's history of success, seemed "laughably improbable"[407] to many officials in the government. Yet a year-and-a half before the 1971 contract modification, the Secretary of the Air Force had directed the Air Force Scientific Advisory Board, assisted by a "disinterested" panel of aerodynamics experts, to study the wing.[408] This panel, headed by MIT professor Raymond Bisplinghoff, recommended strengthening the wing and fuselage, restricting payload and mean takeoff weight and reducing the wing loading.[409] The media caught wind of these recommendations in June 1970, and reports surfaced that the structural problems would limit the aircraft's service life to just one-fourth of the 30,000 flying hours desired.[410] The Secretary confirmed that modifications were needed, but the C-5A could "perform the primary mission for which it was built."[411] Of course, the fact that any fixes would add to the "already formidable" costs simply flamed more controversy.[412]

Despite the pylon redesign and strength modifications, the wing cracking remained unsolved.[413] The service life of the plane declined from 30,000 hours to 2,250. A modification took it up to about 7,000 hours, but this was still a long way from requirement.[414] A development effort was begun to extend the life out to 13,000 hours, but this would not be ready until 1973. Meanwhile, operational restrictions to reduce stress and metal fatigue were imposed on the aircraft, including reduced-power takeoffs, fewer touch-and-go landings, and fuel load limitations, which, of course, reduced the plane's range.[415] Through 1972, a number of panels within Lockheed and the government investigated the wing, and a Wing Life Improvement Program was begun within the company.[416] Despite these initiatives, the C-5A remained under severe restrictions, including a maximum takeoff weight of 712,500 pounds, a maximum payload of 174,000 pounds, maximum range to 3,250 nautical miles, and maximum maneuver load of 2 Gs. In-flight refueling was abandoned because of the restrictions on such maneuvers brought on by the structural weaknesses of the wings.[417] Despite these restrictions, however, no other aircraft in the world could come close to the C-5A in performance.[418] In July 1970, the plane flew around the world without refueling to demonstrate its capability. As one source has noted, this was "more of a stunt than a serious test of operational effectiveness."[419] Nevertheless, it was impressive.

Besides the plane's structural problems, logistics support, maintenance, and reliability were also marginal. After December 1971, the supply problems improved, and the number of C5As not ready because of a lack of parts began to shrink.[420] However, aircraft off-line because of maintenance problems fluctuated around 40 percent, and it took 60 to 70 hours of maintenance to keep a plane in the air for

one hour.[421] As bad as these numbers were, the Air Force expected improvements to occur after depot modifications were made and the aircraft mechanics acquired the needed experience.[422]

The IOC finally occurred during the Vietnam War in September 1970, nine months late.[423] Moreover, it seems that the original definition of IOC as 16 operational planes had been changed to about half that number.[424] Throughout 1971, airdrop testing took place with no serious difficulties, proving the plane could be an "outstanding" airdrop platform.[425] By September 1971, The Air Force furnished a version of the C-5A to haul cargo for NASA's Skylab Space Station Program. The plane did not actually appear in Vietnam in a truly operational capacity until August 1971.[426] In the months that followed, it played a major role in the Southeast Asia airlift, including the evacuation of troops, tanks, vehicles, and other cargo. In May 1972, a single C-5A carried six tanks, each weighing 98,000 pounds, to the forward airfield at Da Nang, stopped and unloaded in seven minutes and then spent less than 30 minutes on the ground.[427] Throughout 1971 and 1972, C-5As flew numerous missions into Vietnam, including 109 special assignment missions during May 1972.[428] C-5As also flew 145 critical missions in less than two weeks during the 1973 Arab-Israeli war. Many of these missions airlifted vital M48 and M60 tanks which could only be carried by C-5As.[429] Despite these successes, the airlift to Israel once again dramatized the limitations caused by the inability to refuel C-5As in the air. When the Arab petroleum producers refused to sell oil to the U.S., the military risks of depending on overseas bases became clear.[430]

The 81st and last C-5A rolled out of the plant on January 31, 1973, and was accepted by the Military Airlift Command (successor to MATS) five months later.[431] This was several years behind the original schedule.[432] The costs, calculated several different ways, were significantly over the original estimates. On a total program basis, McNamara had agreed to $3.4 billion for 115 airplanes, which included the engines, logistics support, aerospace ground equipment, and replenishment spares for five years after delivery. This number, which was considered very generous and almost twice what Lockheed had bid, had grown to $4.5 billion for 81 aircraft. This was a 32% increase and for 34 fewer planes. The unit cost had risen 88% from $29.5 million per plane to $55.4 million, which included the $46.9 million paid to Lockheed for each plane.[433] These numbers do not include the losses taken by Lockheed nor the loan costs that were needed to keep the company in business.

Nor do these costs include the continuing investment that was needed to keep the C5As flying. Five years after the production line was closed, the Air Force, with Lockheed, embarked on a lengthy development program to redesign and rebuild the wing. This effort took from 1978 to 1983, longer than it took to build the first C-5A. It was not until July 1987 that all the in-service C-5As were rewinged and the long-ago required service life restored.[434] By that time, a total of five planes had been lost, four of them attributable to fires or "improper" maintenance.[435] One had crashed in Vietnam in 1975, killing 172 refugees.[436] Despite the modifications, the plane was never able to land on "unimproved" airstrips as had originally been envisioned.[437] However, it proved to be a valuable military asset and is still in active service.

The saga of the C-5A, however, was not yet over. During the Reagan Administration in 1982, an improved version, the C-5B, went into production.[438] This version incorporated all the upgrades that had been made to the C-5A, including the new wings and new avionics. The first C-5B became operational in January 1986, and 50 aircraft were built.[439]

There have been many hypotheses why the C-5A program went awry. Packard asserted that "the Air Force asked for more features on the C-5A than were really necessary."[440] Secretary of the Air Force Seamans disagreed, as did the Air Force, insisting that the C-5A reflected years of airlift experience, especially the Berlin airlift in 1948-49. Former Air Force Chief of Staff General David Jones thought the C-5A was a "fine aircraft" and blamed the *TPP* contract for the excessive cost overruns.[441] Others, however, did not believe that the contract was the "boondoggle" portrayed in popular accounts. Assistant Secretary Charles pointed out that the plane's cost history compared favorably with those of other defense projects, "very few of which experience overruns of less than 100 percent."[442]

A report written by two Air Force officers in 1970, a little over two years before the program ended, asserted that the disowning of *TPP* was

brought on by a new administration seeking to disassociate itself from previous policies.[443] They concluded that, in fact, "most problems of the C-5A program are not attributable to the total package procurement concept, and that many features of the concept should be retained in future procurements."[444] It was their opinion that "doing away with the entire concept is similar to killing the messenger who brings bad news."[445] It was not the method that caused the problems in their minds, it just revealed them. The cost increases became obvious because they were aggregated under one contract.[446] In their view, the C-5A contract was "the first attempt to give the Air Force, and the Congress, a credible cost figure for a system's development, production, and follow-on requirements."[447] According to these officers, *TPP* provided "highly visible base-lines for the program parameters of performance, schedule and cost" that were "no longer vaguely optimistic goals, but instead were binding contractual obligations on which the contractor's financial rewards depended."[448] In hindsight, these judgments seem somewhat premature. Ironically, Secretary Seamans saw some savings in the fact that Lockheed had to bear a significant loss ($200 million). As one source notes, this was "an achievement of dubious merit as far as the national interest is concerned but obviously constituting a savings to the taxpayer."[449]

Another aspect of the C-5A controversy was that it brought into the spotlight critics who eloquently portrayed an image of defense procurement to the common person that emphasized major allegations heard still today:

- "Commercial customers, unlike the Air Force, must spend their own money and are therefore not as understanding as the Defense Department when confronted by huge cost overruns. As a result, cost overruns somehow do not occur in commercial aerospace contracts anywhere near as often as they do on defense contracts."[450]
- "Men dealing with their own money would probably demand a bit more precision... as for the generals, admirals, and Pentagon procurement officials, perhaps it is unreasonable to expect them to show any more respect for the public's money than a child would show for the allowance received from an overly generous father."[451]

Ultimately, the failure of the C-5A to meet expectations had impacts beyond the program and the Air Force. One author tied the C-5A's technical shortcomings, Lockheed's cost overruns, the Air Force's concealment of relevant information, in combination with the long Vietnam conflict, to the hardening of public and congressional attitudes toward military spending.[452] Principally because of the C-5A program, *TPP* was discredited as a concept, and by mid-1970, Deputy Secretary of Defense Packard was moving to terminate it. Despite its demise, which will be discussed in detail later, the Navy proceeded to commit to using the concept in two of its largest shipbuilding programs, LHA and DD-963.

CHAPTER 5
THE NAVY JOINS UP

Soon, the new business practices were impacting the Navy. Shipbuilding was having a hard time competing in McNamara's new PPBS budget process, while withstanding the attacks of OSD system analysts. Budget decisions were being formulated along mission lines as opposed to long-held Service orientations. "Cost-effectiveness" in meeting a mission was the key criteria in starting new programs, and young systems analysts in the Office of the Secretary of Defense (OSD), or "whiz kids" as they were then called, conducted the effectiveness trade-offs across the Services. Shipbuilding was losing out, and a number of "new starts" were cancelled. In 1965, the Assistant Secretary of Defense for Systems Analysis, Russell Murray, issued a paper asserting that the only way shipbuilding could compete and survive the analysts was to employ modern mass production techniques, including modularization, assembly line processing, and standardization. These would allow economies of scale to be applied to equipment and materials used in shipbuilding, thus allowing costs to be controlled.[453]

In an article in the January 1966 issue of *United States Naval Institute Proceedings*, entitled "Can We Modernize U.S. Shipbuilding," these ideas were fleshed out by a systems analyst in OSD, LCDR Charles DiBona (later to head the Center for Naval Analyses). DiBona highlighted inefficiencies inherent in U.S. shipyards, which some people considered to be the world's most inefficient.[454] U.S. shipbuilding had not recovered from its drastic shrinkage following World War II, even though worldwide shipbuilding had been expanding dramatically.[455] By the late 1960s, new, large aerospace conglomerates began purchasing American shipyards from the old steel corporations.[456] Unlike shipbuilding, the U.S. aerospace industry was considered the world's most efficient.[457] Thus, when these purchases occurred, the shipyards came under the financial control of confident directors who had little knowledge of shipbuilding[458] but were eager to bring in their aerospace ways.

Through the years, private shipbuilding in the U.S. had been a boom or bust industry, more susceptible to such cycles than most "durable goods" industries,[459] and largely dependent on the Navy for survival. In the latter part of the 1800s, with the coming of steel ships, the steel industry had taken over or built the major private shipyards as an extension of its core business. However, it could not change the "boom or bust" cycle. During wars, the industry expanded rapidly then shrank drastically afterward. This phenomenon had occurred after World War I, when the Navy had turned almost exclusively to its own shipyards at the expense of private yards. While the Navy did not repeat this policy after World War II, nevertheless, by the mid-1960s, the private yards were again hurting.

There were a number of major problems. One was maintaining enough work backlog to retain a stable workforce. During slack periods, shipyards lost people, sometimes up to 70 percent. When business returned, it was difficult to rehire the skilled trades, which could get better pay in the construction industry.[460] The result was a chronic fluctuation in the levels of skilled workers.[461] With no backlog and no guarantees of work, it was also difficult for shipbuilders to finance better facilities.[462] Countries like Japan, which were dependent on shipping for their economic health, had national policies that directed a backlog of work.[463] The U.S. had no coherent national policy to address the inefficiencies in its own industry.[464] Another problem was the length of a shipbuilding effort, which extended the financial risk to the government and the shipbuilder. Requirements and technology changed during these long construction periods, impacting business and increasing risk.[465]

In 1966, the government was subsidizing half the commercial shipbuilding costs in the U.S., as well as funding the Navy's limited construction program.[466] Other countries, on the other hand, had fully taken over their shipbuilding industries and were directly investing government funds in modern shipyards. This was having results. From 1967 to 1971, Japan produced more than 50 percent of the world's deadweight tonnage; Sweden, about 8 percent; and West Germany, almost 7 percent. The U.S. was far behind at less than 2 percent.[467]

The aerospace industry, on the other hand, was booming. The Korean War and the expansion of passenger airlines were feeding its growth as one of America's top industries. Now patterned and modeled after the automotive industry, airplane production made

use of more unskilled labor than shipbuilding and could surge and shrink more easily.

DiBona suggested that the solution was to pattern the "production and procurement" of ships after aircraft.[468] He recommended standardizing designs, producing ships in large blocks (25 to 35), and awarding all ships of one design to one contractor.[469] He indicated that the U. S. should pattern its yards after those in Japan, Germany, and Sweden where ships were built modularly as opposed to "from the keel up." By using modular construction, shipbuilders could build in an assembly-line manner for less money.[470] He believed significant savings would evolve from "strong learning curves" (a production-line cost-measuring technique based on quantities built over time) when all the ships were in one yard. This would also encourage shipbuilders to modernize their facilities.

DiBona further suggested that the Navy should alter its procurement process and include the design as well as production in one contract.[471] Historically, the Navy had done the concept and preliminary designs for its own ships with naval architects at the Bureau of Ships (BUSHIPS). These designs were then evolved to a "Contract Design," which was presented to industry for bid. The bidders—private shipyards—were mainly hull fabricators and parts assemblers.[472] Other contractors provided the weapons and electronics, which were first delivered to the Navy and then redelivered to the shipyard as "Government Furnished Equipment" (GFE). This Navy design practice was due, in part, to the inability of shipyards to carry a sufficient number of designers and naval architects on their payrolls for long periods of time and still maintain efficiency. They were thought of as overhead from a business perspective. Thus, the Navy husbanded its own architects and maintained them through up and down periods. DiBona was now suggesting that the Navy define the task the ship was to perform and let the shipbuilders provide the preliminary and contract designs as part of a competitive procurement.[473] This meant that the Navy would first contract to a *performance specification* as opposed to more specific designs. Essentially DiBona was recommending a variation of the *TPP* approach that the Air Force was using for aircraft.

McNamara and Secretary of the Navy Paul Nitze, who had replaced Secretary Korth, were zealous proponents.[474] In 1965, Nitze issued a directive that "suggested. . . new methods for designing, contracting for, and constructing ships."[475] According to some, the greatest attraction was the opportunity to pursue innovation by going outside of the Navy's BUSHIPS design team to take advantage of the large and diversified capabilities of companies like General Dynamics, which built submarines, missiles, combat systems, and seaplanes.[476] These proponents believed that such industrial titans should be able to "design advanced and original warships from scratch" and build them cheaply using aerospace mass-production methods.[477] LCDR DiBona's recommendation, however, was controversial to many within the Navy.

The first attempt to use *TPP* in shipbuilding was for Fast Deployment Logistics (FDL) ships. These ships were one of three McNamara thrusts to reduce the cost of deploying troops rapidly around the world. The C-5A and a new Navy amphibious assault ship, LHA, were the other two. Previously, in 1965, BUSHIPS prepared a preliminary design for FDL, which incorporated gas turbine propulsion. When McNamara, however, cancelled the Navy's other new shipbuilding programs, FDL was the only one left with enough ships to make *TPP* a viable approach. Thus, BUSHIPS' design was discarded; and, OSD directed that the project be restarted using *TPP*.[478] Secretary Nitze saw it as a "trial application" of the new approach.[479] He hoped to:

- Add impetus to modernizing shipbuilding facilities
- Lower the average costs of ships
- Increase standardization of ships
- Increase industry input into naval ship design and construction[480]

Internal Navy opposition to this and other changes pushed by McNamara crested with the designation of FDL as a *TPP*. It came on the heels of the OSD-ordered destruction of the powerful, 120-year-old bureau structure that had been responsible for material planning and acquisition in the Navy since 1842. Four Navy bureaus, which had once been only two levels below the President, were reformed into six systems commands now five levels down and reporting to a newly created Chief of Navy Materiel (NAVMAT), who, in turn, answered to the Chief of Naval Operations (CNO). Both the commander and deputy commander of the new Naval Ships Systems Command (NAVSHIPS, formerly BUSHIPS) resigned in protest over the FDL plan, shipyard closings, reductions in their authority, and the implication that *TPP* contractors would replace the Navy's ship designers.[481] They had just seen their authority downgraded from a position appointed by the President to that of a subordinate of NAVMAT, and now they were being excluded from key acquisition decisions.[482] Their parting was soon followed by a

further reorganization of NAVSHIPS that moved the ship designers out of the command to a subordinate division called the Naval Ship Engineering Center (NAVSEC) in the suburbs of Washington D.C. Soon afterwards, naval architects were relegated to administrative work instead of designing ships.[483]

Rear Admiral Nathan Sonenshein, a naval architect and head of Design, Shipbuilding, and Fleet Maintenance at BUSHIPS/NAVSHIPS, was named the project manager for the FDLs. While project management had been pioneered in the Navy with the Polaris program, its extension to FDL was an OSD initiative.[484] Moreover, as project manager, Sonenshein was placed in NAVMAT where he had authority independent of NAVSHIPS.

Sonenshein met with the Air Force to learn more about *TPP*, and soon recognized significant differences. While the Air Force had always depended on industry to design its airplanes, commercial shipbuilders had no naval ship preliminary design experience and had always relied on the Navy for it. In addition, aircraft procurement made use of prototype airplanes, while ships went straight from design to construction. Thus, *TPP* had to be adapted to meet the Navy's needs,[485] especially as it applied to Phase II "Development/Production."

The FDL project was cancelled in 1969. However, before it was terminated, the front part of the *TPP* process was applied. The project went through Concept Formulation and Contract Definition, beginning in 1966, with the awarding of contracts to Litton, Lockheed, and General Dynamics, all new entrants into shipbuilding.[486] Each got $5 million to compete during this phase and to finish both the FDL design and a new automated shipyard.[487] Ultimately, Litton won the right to proceed into construction. However, two forces merged to kill the project. First, Congress refused to support FDL in 1967 and 1968, not wanting to promote the impression that the U. S. was becoming the "world's policeman." Second, the Navy was reluctant to divert funds from its other ship construction projects to this OSD acquisition experiment. The FDL technical director, Captain Richard Henning, concluded, "It was a great artistic success that failed at the box office."[488]

LITTON INDUSTRIES AND INGALLS SHIPBUILDING

The Navy and OSD were not the only ones looking at the way the nation built its warships. In the mid-1960s, Litton Industries sent a team of experts to tour the world's best shipyards and gain first-hand data on modular ship construction.[489]

Litton Industries was the brainchild of Tex Thornton, McNamara's mentor and boss, both during his tour in the Army and early career at Ford Motor Company. In fact, Thornton had brought McNamara to Ford. When Thornton left Ford, he went to Hughes, which he subsequently left under fire amidst allegations of mischarging Air Force contracts. According to Hughes' corporate auditors, he was "unprincipled and ruthless" and not to be trusted.[490] Despite this, he and colleague Roy Ash, who was also involved in the Hughes caper, landed on their feet and, in the mid-1950s, purchased Litton Industries, a small company with about $3 million in sales.

They set out to grow the company by acquiring other companies and they did extremely well. By 1963, after just a decade of operation, they had acquired some 37 companies and had become an electronics and aerospace conglomerate. Litton had gone from about $8 million in assets to over $330 million and was growing in sales at between 30 to 50 percent a year.[491] Thornton, the Chairman of the Board, handled external matters, while Ash, as President, ran the internal day-to-day operations.[492]

The company was not without its skeptics. Some on Wall Street felt its stock was overpriced, that its after-tax profits were not spectacular, and that organization problems resulting from too rapid growth were imminent.[493] Nevertheless, Litton continued to grow and by 1968 had acquired about 66 more companies, predominantly by using its stock as the medium of exchange.[494] Its executives were young with bold ideas and new expertise, especially, in space-age electronics.[495]

In 1961, about the same time that OSD began pressuring the Navy to reorganize the way it built ships, Litton purchased Ingalls Shipbuilding in Pascagoula, Mississippi. The company saw ships and submarines as logical destinations for many of its diverse products and believed that, within the next 10 years, the Navy

would contract complete weapons systems to private contractors.[496] This meant that electronics and weapons would be part of shipbuilding contracts in addition to the traditional hull fabrication.

Prior to becoming a Litton subsidiary, Ingalls had been slowly gaining experience building ships for the Navy. The company had begun in 1910 as a small iron shop owned by the Ingalls family in Birmingham, Alabama, and had diversified into steel shipbuilding in 1938, establishing a new yard on 50 acres of land on the east bank of the Pascagoula River in Pascagoula, Mississippi.[497] Ingalls did not receive its first Navy contract until 1951 when it was awarded construction of five LSTs. By 1958, the company had a sizeable backlog, with two destroyers, three nuclear submarines, a tanker, two ocean liners, two tugs, a cement carrier, and an offshore drilling rig.[498] A steel strike, however, along with materials price increases and management problems, caused the company to post a $4 million loss in 1961.[499] Even more destructive was an ongoing ten-year feud within the Ingalls family that was jeopardizing the entire operation. Thus, though valued at $40 to $60 million, Ingalls was sold to Litton for a mere $8 million.[500]

Litton's "expert" tour of the world's shipyards precipitated a round of investment and expansion at the Ingalls yard. The company proposed to create a "modern" shipyard on the west bank of the Pascagoula River across from the original "East Bank" Ingalls yard. This modern yard was to be based on modular design and construction techniques that had evolved from those pioneered by Henry Kaiser in building World War II Liberty ships. During design, the ship was to be broken down into modules, assemblies, subassemblies, and so on.[501] Each subsystem of the ship was to be placed in a specific dedicated assembly whose weight, size, and space limitations were derived from the total ship design.[502] In construction, small trolley cars were to bring the work to the workers in an assembly line process. Each assembly was to be built and outfitted before being stacked with great precision into (usually 3 or 4) major modules of the ship, all moving along the assembly line. The modules were to be finally integrated into one vessel as the work got closer to a launch facility. Eventually, the ship was to be rolled onto a submersible pontoon and floated off.[503] The ship did not go "down the ways" in the glamorous fashion of traditional shipbuilding. The Japanese, in particular, had done a lot of work refining this concept. It promised to allow a more independent division of both design and construction labor so that ships could be built quicker by moving the construction away from one building site and relieving interference.

This new process and new yard were to be designed and managed completely by aerospace professionals from Litton's Advanced Marine Technical Division (AMTD) in Culver City, California. They had no experience with shipbuilding—a plus in the eyes of many. Not only did they know little about shipbuilding, but they planned to design a yard that could be operated by unskilled workers.[504] In addition, AMTD was to do the ship design and engineering functions from their geographically remote location.[505]

Litton convinced the State of Mississippi to float a $130 million bond issue to finance the modernization. The company was to lease the yard for 30 years, after which it would be owned free and clear. Furthermore, the company did not have to start paying on the lease until 1972 and could invest the financing. In return, the state expected the creation of about 12,000 new jobs.[506] Construction of the new yard began in early 1968.[507]

The company then embarked on an aggressive campaign to win new Navy contracts. Interestingly enough, it had no firm commitments from the Navy when it negotiated its deal with the state. However, it may have had good reason to believe that contracts were forthcoming. John H. Rubel, a former Assistant Secretary of Defense under McNamara, who had worked out the "Concept Formulation-Concept Definition" bidding procedures in *TPP*, had been working as a vice-president at Litton since late 1963.[508] Joseph S. Imirie, former Air Force Assistant Secretary for Material and another McNamara man, had also been brought onto the payroll.[509] Others were to follow.

Winning the FDL ship competition was the first glimpse that the company's strategy might pay off. While that ship did not come to fruition, two other significant programs did. In rapid succession, Litton was to win the LHA and DD-963 classes. Both were *TPP* projects, and the size of the Navy's commitment was no longer either a trial application or an experiment. The history of these two programs is intimately intertwined and, while they are discussed sequentially below, they should be viewed together to understand them.

LHA *TARAWA* CLASS AMPHIBIOUS ASSAULT SHIPS

Photo courtesy of NavSource

FIGURE 10. LHA *Tarawa* Class Helicopter Assault Ship

As indicated earlier, McNamara launched two shipbuilding programs to reduce the costs of rapidly deploying troops to suppress hostilities around the world. While FDL was killed, the Landing Helicopter Assault (LHA) ship **(Figure 10)** survived. The LHA was to transport Marines, their helicopters, landing craft and assault equipment. The concept was a follow-on to the Landing Platform Helicopter (LPH-2) *Iwo Jima* class, the first class to support Marine helicopter operations for amphibious assaults. The LHAs were to be larger, faster ships and include a well derck for increased flexibility in embarking troops. In May 1969, LHA became the next major defense weapons systems acquisition program after the C-5A to be contracted under the *TPP* concept. Ironically, just over a year later, *TPP* was officially killed by Packard.

The LHA went through Concept Formulation and Contract Definition in the mid-1960s. A ship performance specification was prepared, and small *fixed-price* contracts (Litton's was a little over $6M) were signed with Litton, General Dynamics, and Newport News to prepare ship designs that met the specified performance.[510] As in the earlier aircraft programs, the contractors also put up their own money. In May 1968, after four months of evaluation, discussion, and negotiation, the source selection board had found none of the proposals satisfactory.[511] The Navy deemed only Litton's worth pursuing. Its proposal was for six ships at a cost of about $105 million each.[512]

In August 1968, Litton was directed to re-price its proposal, based on technical corrections that had been made to its original submission, and to increase the number of ships from six to nine. Its repricing figure was rejected, and for the rest of 1968 and early 1969, the parties worked and reworked designs to include all the technical requirements to meet the Navy's needs, as well as to arrive at a stable price.[513] This period of constantly changing design became the basis for most of the claims Litton later filed. The company was to claim that it did not have enough time to completely study the effects of the changes on the total system.[514] Since its studies were not complete when the contract was awarded, the company said there was no way it could take them into consideration in determining the contract price. Litton was to assert that it was bidding on a ship of unknown dimension and price.[515]

The Chief of NAVMAT, the command one level above NAVSHIPS, let the contract negotiators consider either a *fixed-price-incentive contract with successive pricing targets* (*FPIS*) for all ships or a *cost-plus-fixed-fee* (*CPFF*) contract for the lead ship and a *firm-fixed-price* contract for the follow ships. The reasons given for these options were that there was not a competitive climate, the cost data associated with the new yard was uncertain, and the contractor was constantly increasing its cost estimates.[516] The per-ship estimate had already increased 29 percent over the original offer.[517]

However, under the mandates for *TPP*, fixed pricing was to be used for major weapons procurements. Thus, on May 1, 1969, an *FPIS* contract for a nine-ship buy was signed with re-negotiations to occur in 34 months (1 March 1972), just a little less than halfway through the contract. This would allow the final target prices to be reset. The difficulty of the job, the contract form, and the date for repricing set a collision course in motion. The attitudes of the parties were to amplify the importance of these factors. According to a former Litton executive, it was Litton's normal practice in the course of development and production to renegotiate its government contracts to one-and-a-half times their original value.[518] Members within the government, on the other hand, believed a "contract is a contract."

The initial target price per ship was set at $112.5 million for a nine-ship total of $1.01 billion; the ceiling price was $133 million per ship for a total of $1.19 billion.[519] The first ship was to deliver 47 months after contract award—March 30, 1973.[520] The other ships were to follow in rapid succession with the fifth ship to deliver on April 1, 1974, and the ninth to deliver March 31, 1975.[521] This fast rate was the expected payoff of the new productionized yard. All these numbers were the initial contract values. The total program costs of the LHA would be somewhat higher, as there was a modest amount of Navy furnished equipment for installation in the ships.

The payment provision in the contract was composed of two different methods. For the first 40 months (until September 1, 1972) or until LHA-1 was delivered (if it occurred beforehand), Litton would be paid for all allowable costs. Thus, for most of the first four years, the contractual process was very "cost-like." For the remainder of the contract, payments would be based on the percent of physical progress (a payment method typical of fixed-price contracting). During a transition phase between these two periods, the amount paid to Litton would be adjusted to account for any difference between what had been paid under the cost system and what should have been paid under the progress system.[522]

Another provision in the contract gave the Navy the opportunity to cancel all ships after the fiscal year in which such a notice was given. The average ship target price had been computed to range from $284 million for one ship to the $112.5 million average for nine ships. In accordance with a schedule in the contract, Litton was entitled to significant payments if some of the ships were cancelled. For example, cancelling the last four ships would cost the Navy $109.7 million,[523] close to the target price of one ship in a buy of nine.

The Navy agreed to maintain a "hands-off" policy in executing the contract, so a *Total System Responsibility* clause was included. Litton assumed full responsibility for delivering LHAs that met or exceeded the contract performance specifications. Any changes Litton might make to fulfill the contract were to be at no expense to the Navy and with no changes to the schedule.[524] The Navy did, however, have to approve changes that affected the ship's mission.

Litton now embarked on the new program and the building of its new yard at the same time. In just over a year, in June 1970, the company was awarded a contract to build thirty DD-963s—another *TPP* effort. Simultaneous with LHAs and DD-963s, Litton also contracted to build eight merchant ships, four each for two different shipping lines, Farrell Lines and American President Lines. The plan was to use these relatively simple ships to initiate the "assembly-line" concept prior to the building of LHAs[525] and DD-963s. Unfortunately, the merchant ships quickly fell behind schedule. When the first Farrell ship was floated off in 1971, six months after it should have delivered with still a long way to go, numerous technical problems were also discovered. The problems forced Litton to shift the four American President ships to the East Bank yard so as not to interfere with the LHAs.[526] The assembly line "warm-up" had failed, and the new techniques were now applied, without further ado, to the Navy's ships.

Progress on the LHA also began to slip quickly. Management mistakes and startup problems at the new yard were delaying production and causing higher costs.[527] To make matters worse, Hurricane Camille, in the fall of 1969, increased the delay by damaging buildings, toppling a 170-foot gantry crane, and wrenching a 602-foot ship from its moorings and blowing it across the Pascagoula River.[528]

After LHA contract award and through most of 1970, Litton was fully occupied with completing a design baseline that would gain Navy approval. To recoup lost time, the company proposed several changes to the ship. Since the Navy's primary role was to ensure that any changes introduced by the shipbuilder would not hinder the ship's overall mission, it reviewed the changes and, in September 1970, presented Ingalls with 2,905 documented comments on its drawings and specifications.[529]

After surveying the Navy's comments, Litton announced, in December 1970, that the first LHA would be delayed 10 months and that it would be submitting a claim, known as a "Request for Equitable Adjustment" (REA), that would increase the contract price. Much later, Litton was to justify this REA based on four problems it said plagued them during this period:[530]

- Studies incomplete at contract award and studies required after award, including rearrangement of medical facilities, changes in the model of air search radar, design problems with the electronic countermeasure systems, landing craft handling and

stowage tests, and ship rudder and screw location options.

- Changes in requirements after award affecting contractor design and development, including additions to the radar/IFF systems; changes in radio systems that hindered interfaces with subcontracted equipments; and revisions to the island, commissary, living spaces, cargo handling system, and a number of habitability improvements.
- Lack of information concerning Government Furnished Equipment at time of award, including the lack of data on electronic systems, computer programs, certain weapons capabilities and ship's manning.
- Inadequate identification of the magnitude of potential design problems at time of award, including previous problems encountered by the Navy with a conventional style sterngate, requirements to comply with shock mount designs known to be inadequate, and a lack of data on the required performance of lightwater fire fighting systems.[531]

To complicate matters further and add to an "already strained relationship,"[532] the Navy cut the number of LHAs from nine to five, prompted by constraints in program planning beginning in fiscal year 1972 (called POM-72*). Multiple reasons were given for this. First was the reduction in forces and commensurate reduction in force transport requirements brought on by the gradual withdrawal from Vietnam.[533] Second, the Navy needed to build more destroyers, frigates, and submarines than amphibious ships to counter the expanding Soviet fleet.[534] Finally and more speculatively, in the words of one person at the Federal Maritime Commission, the Navy was "very concerned and frightened" about the problems at Pascagoula.[535]

These anxieties soon included concerns over the condition of the first Farrell Lines ship, *Austral Envoy*, the simpler commercial ship intended as a "warm-up" for the West Bank "assembly-line construction process. Her deckhouse sagged more than half an inch, many of her 240 steel sections did not fit properly, bulkheads buckled, one cargo hold was too shallow, the anchor would not house properly and the ship was three inches too short. Navy estimators concluded that losses on the merchant ships could go as high as $100 million. The general opinion was that much better management and some luck would be needed to "debug" the yard to avoid similar problems in the Navy's ships.[536]

Due to the changes and delays, the Navy and Litton signed a Memorandum of Agreement (MOA) in April 1971, effective until March 1972, the date final price reset negotiations were to be completed. This MOA provided for schedule slips of up to 14 months per ship without prejudice to the rights of either party.[537] By October 1971, the contractor was to submit a reset proposal to the target cost and price, ceiling price, delivery schedule, and sharing ratio reflecting the MOA. The MOA also introduced contract revisions to speed up the review of proposed changes to the design by both sides and to reduce the scope of program reviews.[538] These revisions backed the Navy oversight further away from program execution.

In July 1971, Litton informed the Navy that the reset proposal would be late and would not be delivered until the end of the agreement period (March 1972). The company asserted that the key people needed to do the proposal were also needed to manage the LHA design and start fabrication of LHA-1 the next month. This manpower shortage was soon complicated by a one-month strike. During the shutdown from August 30 to October 4, about 800 of 5200 west bank employees left for other jobs, and recruiters estimated that they lost up to 1000 prospective workers. Despite these losses, Litton still asserted that its goal was a 350 worker per month net increase to meet the manpower needed by 1973.

Few believed they could meet this target.[539] Moreover, the aerospace management team believed so deeply in their plan to man the shipyard with unskilled workers that they resisted hiring skilled workers from the East Bank. They believed it would be difficult to teach these workers new methods.[540] A stable workforce was to remain an issue throughout the contract.

An increasingly suspicious Navy had its doubts verified when Litton submitted its reset proposal in March 1972. The proposal indicated that LHA-1 would be over 19 months late and LHA-5 late by over two years.[541] Also included was the earlier threatened REA. It was for $247 million, the first LHA formal "claim" against the Navy. The REA was an estimate of the additional costs that would be incurred over the life of the program and included a doubling of the man-hours required to complete construction.[542] Another 40% of the growth was

* POM-72 = Program Objectives Memorandum for 1972. This was (and still is) a fiscal planning tool used by the Navy to recommend program funds for 1972 and four years thereafter through 1976 as part of the DoD PPBS.

coupled to changes in design after the initial bid in 1968. The proposed reset ceiling price for all five ships was $1.05 billion, or $210 million per ship.[543] This $1.05 billion exceeded the contracted nine-ship target price. In addition, the company requested a 20-month extension to the cost-style payment period. This pushed the proposed schedule extension out to December 1974 for LHA-1 but was to be applied to all the ships. Litton placed the entire blame for the shipbuilding delays on the Navy, despite what one writer called "their own start-up problems such as planning inaccuracies and manpower shortages."[544]

The Navy did not concur with the proposal. In addition, it denied the request for extending cost payments by 20 months and said there was not enough information in the proposal to adequately review the REA. Litton responded that it would submit a justification in July 1972. At the same time, Litton began lobbying Congress to get the extended cash flow relief the Navy would not allow.[545] In May, Litton, at the corporate level, reported a third quarter loss of $14 million for fiscal year 1972, attributed totally to its shipbuilding operations.[546] There is at least one report that Roy Ash visited NAVSHIPS during the year and quietly asked the Navy to take over the yard altogether and release Litton from its shipbuilding contracts. The Navy is said to have refused.[547]

Both parties still needed a reset contract, as the 34-month "successive target" date and the MOA had run out. The Navy assessed its alternatives, ranging from holding to the prices in the original contract to cancelling some of the LHAs and DD-963s to terminating both programs. Cancellation would not be without costs, however—up to $750 million for the LHAs and $400 million for the DDs. In addition, the Navy still needed the ships.[548] Negotiations and meetings ran through the summer. One of Litton's primary goals was improving its monthly cash flow while the Navy continued to look for data to justify the REA and Litton's need for cash.[549]

While the contractual stalemate held, schedules continued to slip and the price kept increasing. The Navy's application of *TPP* was not working very well. Rather than lowering the average cost of ships, costs were spiraling. The attempt to increase industry input into shipbuilding was also proving troublesome. Furthermore, modular construction was turning out to be a tremendous challenge for a ship as large as an LHA,[550] bringing into question the goal of greater ship standardization. The modular construction process was also suffering in the early DD-963s,[551] which were much smaller but more complex.

There were a number of reasons for the problems. First, in traditional shipbuilding, distributed systems such as fire mains, fuel lines, compressed-air pipes, ventilation ducts, and electrical conduits were installed generally at once during construction by skilled tradesman. The architects routed these systems during detail design but indicated only general locations for very small pipes and conduits, leaving yard workers to install them wherever they fit best. This did not work in modular design where every subsection had to connect precisely to an adjacent subsection.[552] When Litton began implementing modular assembly in its first LHAs, DD-963s, and commercial ships, it was not uncommon that systems that went throughout the ship did not line up[553] at specifically designated interface points between construction subsections. This was part of the reason for the delay in delivery of the Farrell Lines ship *Austral Envoy*. With more distributed systems in the more complex and integrated naval warships, this problem was even more pronounced. In a commercial tanker, for example, such as was being built by foreign "modern" shipyards, only one such system was present. In warships like LHA and DD-963, there were many of these systems. More detail design direction was needed on the production line.

Exacerbating this problem was the separation of the Advanced Marine Technical Center design and engineering teams in California from the shipbuilders in Mississippi. The Culver City team was oriented to engineering for aerospace production in which strict tolerances, critical to aerospace production techniques, differed from those in ship construction. For instance, it was discovered in the first ships that the steel had been cut to such precise measurements that there was insufficient excess to allow welding.[554] John Williams, Vice President of Production at Ingalls, explained the problem as one of "having competent aerospace designers who knew little about building ships and capable shipbuilders who were unfamiliar with aerospace design techniques."[555]

Finally, and unique to the LHA, was the size of the ship. Litton was concerned that the weight of the ship would be so great that it could not be transitioned to the launch dock on the trolleys. The amount of outfitting to be done on land versus in the water became an issue. Ultimately, moving the LHA, a ship weighing 38,000 tons, was to be called by some, "the heaviest thing ever moved by man on land."[556]

Litton, with all its corporate knowledge, was not adequately dealing with the complexity of the work at Ingalls.[557] Between 1969 and 1973, the top four

positions at the yard changed 17 times.[558] Finally, in the summer of 1972, Litton moved its East Bank manager, Ned Marandino, to be President of Ingalls and to head the yards on both banks of the Pascagoula. Marandino immediately replaced most of the West Bank's aerospace officials with shipbuilders from the East Bank. He also combined both yards under one management and began inserting more traditional shipbuilding methods into the modular construction process in an attempt to reduce some of the weaknesses in the new productionized process. Skilled workers were transferred from the East to the West Bank. In addition, the company attempted to fix its design problems by relocating AMTD and about 1400 of its people from California to Mississippi.[559] First, however, it laid off almost a third of AMTD's design force. All these changes were to eventually help solve the problems, but they were to disrupt ongoing work for awhile. Solutions were finally in hand by the 13th DD-963 but were more difficult to apply in LHAs since there were only five of them. Much more traditional construction techniques were ultimately used in LHA.[560]

Politics also continued to play a role. In November 1972, President Nixon announced that Roy Ash would become Director of the Office of Management and Budget (OMB). He was replaced at Litton by Fred W. O'Green. The company, which had done well in the Kennedy-Johnson years with Thornton currying political favor, now had an intimate friend in the new administration. This did not prevent Congress from complaining. In December, Senator Proxmire's subcommittee opened hearings to discuss major defense contracts and cost overruns. At these hearings, the GAO testified that, if Litton's requests were granted, the LHAs would cost over $200 million per ship and that the schedules had already slipped up to 32 months, depending on the ship.

The second day of the hearings found Gordon Rule, Director of NAVMAT's Procurement Control and Clearance Division, before the committee. Rule was very critical of the recent appointment of Roy Ash. While Ash had agreed to sell his Litton stock and sever connections with the company, Rule believed that the job should not have been offered, and that Ash made a worse mistake in accepting it. He testified that the free enterprise system had broken down in the area of giant defense contracts. He felt major contracting had become a "quasi-welfare industry" with the government rescuing large companies from bankruptcy while letting smaller firms go out of business.[561] This situation was aggravated, he said, by top industry executives accepting high-ranking posts in the government.[562]

Rule also felt that competitive bidding had deteriorated. The competition process forced contractors to cut their bids drastically at the last minute to try to "buy-in." He recommended that companies should be responsible for the first $500 million if financial problems arose.[563] He then fired a shot at modular construction for the LHAs, stating that these ships, as large as World War II *Essex*-class carriers, did not lend themselves to the new process.[564]

Negotiations trudged along on the reset proposal into early 1973. In January, the new Litton leadership, O'Green and Marandino, met with Admiral Isaac Kidd, Chief of NAVMAT, and other Navy representatives to discuss business at the yard. Litton "sunk costs" in the new yard, claims on a number of other ships and submarines from earlier years, and fears that the banks would not continue financing were all argued by Litton to demonstrate its cash flow predicament. The tensions between the parties are obvious in Kidd's record of the meeting:

> "I told him [O'Green] that we would enter into immediate negotiations to ...find palatable ways to handle their cash flow problem. I told him that in doing so, we would not look with any favor on any approach that wasn't cleaner than a hound's tooth. Mr. O'Green got a little testy at this assertion and told me that such a stand would indicate that I didn't trust Litton. I told O'Green that that wasn't too wide of the mark because they [Litton] had been over the past two years of my association with them, somewhat less than convinced [sic] that the contract was worth anything. Mr. O'Green harked back to what we heard so many times in the past from Litton to the effect that the contract was really a vehicle with which to get started and that it had needed reforming for a long time."[565]

Expectations were not being managed well. Litton was pressing for contract modifications based on its need for profits and cash flow. The Navy, on the other hand, was bent on achieving the lower costs promised by *TPP*. In fact, these low costs had been guaranteed to Congress and the public at large. The GAO, DCAA, and accountants galore were soon brought in to work

the financial problems. No similar attention was being spent on the ships themselves.

On February 28, 1973, nearly a year after the reset agreement was to have been completed, the Navy's contracting officer attempted to unilaterally break the deadlock. Exercising his rights in the contract's *Disputes* clause, he issued a Contracting Officer's Final Decision that recognized a new schedule—LHA-1 slipping more than 23 months to March 1975 and LHA-5 slipping 32 months to December 1976. In so doing, he accepted seven months excusable delay—six the responsibility of the Navy and one month for the strike. The remaining slippage was the fault of the shipbuilder.[566] He also raised the now combined target and ceiling price to $795 million.[567] The contract had thus become a *firm-fixed-price* effort versus a *fixed-price-incentive,* since there was no difference in the target and ceiling prices. It was also priced at least $210 million below Litton's reset proposal.

In addition, cost payments already had been extended for the six-month slippage accepted by the Navy as its responsibility and were now completed. Thus, payments would no longer be based on cost but would be converted to percent work completed as was called out in the original contract and as is typical of *FFP* contracts. The Navy determined that the LHA program was only 44 percent complete and re-computed payments based on those findings. These computations showed that Ingalls had been overpaid by about $55 million in cost-based payments. The Navy decided to take the difference out of Litton's payments over the next three months. The effect was that Litton would receive no payments for the next three months and would still owe a $15 million lump sum debt.[568] This, of course, exacerbated Litton's cash flow problems, and the company immediately appealed for a deferment on repaying the $55 million. The Navy denied the appeal.

Litton appealed to the District Court in Biloxi, Mississippi, based on the "spirit" of the contract that discouraged "undue hardship" for the shipbuilder.[569] It quickly received a temporary restraining order on March 7, later extended indefinitely, requiring the Navy to continue cost-type progress payments while refraining from collecting the overpayment. Litton also appealed the Contracting Officer's Final Decision to the Armed Services Board of Contract Appeals (ASBCA), listing its claims at a new value of $376 million.[570] In June, the Justice Department asked the United States Court of Appeals for the Fifth Circuit in New Orleans to stay the District Court's temporary restraining order. The lawyers were now in charge and were hard at work in two legal forums.

Facing claims and legal battles was nothing new to the Navy. It had been in disputes with private shipbuilders since as early as 1862 when it had contracted for a side-wheeler to be built in 176 days for $75,000, not counting another $500 that went to a separate boiler manufacturer. Due to changes from the Navy and delays caused by the boilermaker, the ship was on the ways for over a year and overran by $16,000. The Navy accepted $5000 as its fault and levied the rest on the shipbuilder, who went bankrupt.[571] The LHA situation, of course, was much more complex than this, with concurrent political, legal, schedule, cost, and technical problems.

The Navy was in a bind. It needed the ships, but they were becoming significantly late and ever more expensive, eating up budgets intended for other ships. At the same time, the company was making good progress on the DD-963s, so it had demonstrated that it had the capabilities.[572] Though negotiation was obviously necessary to bridge the gaps, the Navy was not totally a free agent to negotiate. Congress limited the amount of money the Service could pay without prior approval of the Armed Services Committees.[573] The Armed Services Procurement Requlations (ASPR) also limited the allowable payments to the contractor. Thus, the Navy continued to seek auditable numbers from Litton.

Public image was another concern. The Navy could not be seen as bailing out an inefficient shipbuilder.[574] Congress, in the person of Representative Les Aspin of Wisconsin, a former McNamara "whiz kid," was also turning up the heat. Aspin had been holding hearings and making speeches on the House floor since the MOA had been consummated. Early on, he accused the Navy of giving Litton a $3 million gift when it agreed to delay the ships at least a year each.[575] Later, when the contracting officer had extended cost payments to February 1973, he charged that the Navy had "completely caved in to Litton's demands."[576]

In October 1973, the Court of Appeals overturned the District Court's restraining order. The Navy could now stop payments, but such an action might force Litton to stop work and perhaps close the yard.[577] To break the log jam, the parties agreed to an intense 21-day negotiation session. As a prelude to the negotiations, Litton agreed to temporarily cap its claim and defer the two court cases. In return, the Navy agreed to defer collecting the $55 million payback.[578]

Despite high hopes, negotiations went very slowly. They were slowed further when the Justice Department inserted itself, apprehensive that the negotiations would interfere with its effort to pursue the claims issue in court. On November 2, the Office of General Counsel stopped payments to Litton. Litton immediately refused to submit a new proposal. The Secretary of the Navy had to intercede with the Attorney General to reestablish payments and get negotiations going again.[579]

Litton then submitted a proposal on November 12 and, based on Navy comments, revised it four days later. The revised plan was also unacceptable to the Navy, and the bargaining positions remained far apart. Talks stalled. Some believed that this was because Litton could not figure out how to tell its stockholders and the public why it was willing to accept much less money than it had claimed.[580] Thus, in spite of a request for a 14-day extension, Rear Admiral Robert C. Gooding, the Commander of NAVSHIPS, stopped payments on November 19. He also directed collection of interest due and the withholding of progress payments until the entire $55 million had been repaid.

The prospect that Ingalls would stop work continued to loom on the horizon. The Navy sought to remind Litton of a guarantee, made in 1971, that it would financially support Ingalls and its contracts.[581] At the same time, the Navy gave consideration to the extreme step of taking over the yard if the company defaulted on its contract.[582] In this eventuality, the Navy may have faced opposition from the State of Mississippi, which still owned the land.[583]

The problems in this failing marriage continued to both increase and escalate up the ladder. In late January 1974, Deputy Secretary of Defense William Clements and Navy Secretary John Warner joined the negotiations. Litton again brought letters from the bank warning of coming restrictions. The Navy still pressed for a cap on claims. The sparring persisted during the year with little results. The Navy continued to ask for data to support Litton's requests, and the company continued to resist. At one point, Litton asked, "What do you want us to do? Build ships or prepare claims?"[584] Progress payments finally resumed in February 1974, after the Navy had recouped the entire $55 million. Physical progress was now just 58% on the entire program,[585] almost a year behind the original delivery date for LHA-1.

Despite the resumption of payments, Litton continued to look for more cash flow relief. Cost increases in the DD-963s and a failure to reach agreement on a reset proposal in those ships, claims in court on earlier submarines and other projects, as well as significant losses on the now-completed merchant ships were all complicating the situation. Proposals and counter-proposals continued into mid-1974. There was no indication that the Navy intended to fund Litton's shortfalls.[586] Tex Thornton warned that Litton was having trouble renewing its lines of credit and had sold 16 subsidiaries to maintain its required loan ratios.[587] Its fiscal year closed in mid-1974, and the company needed to cement its credit lines.

In May 1974, Marandino indicated that Ingalls was ready to resolve the outstanding issues and suggested an out-of-court settlement. He indicated that the corporate leaders had retreated, and he was empowered to reach a settlement. He suggested the best approach was a total yard/total cash flow/total issue solution.[588] This would involve all Navy work. Litton would consider a $250 million claims cap on all its ships. This got the Navy's attention, but there was still little substantiation.[589] The Thornton statement on the need to sell 16 companies was also brought into question—it appears that these had little to do with Litton's supposed cash flow problems.[590] Admiral Kidd and Thornton began to engage in almost daily conversations.[591] Despite this, no further explanations were offered by the company, and discussions again stalled. In July 1974, after nine months of concentrated negotiations,[592] Ingalls informed the Navy that it intended to resume its appeals through the ASBCA rather than totally relying on bilateral resolution, which was going nowhere.

Complicating negotiations were a number of other factors. First, Ingalls was not the only division of Litton in difficulty. Profits in several business equipment divisions were also dropping, and a number of corporate officers were reassigned.[593] The corporation was also caught in an inflationary economy. The Materials Index for NAVSHIPS Steel Vessel contracts had increased approximately 30 percent from the previous year, which meant that electrical, machinery, and steel product prices were going up. The country was experiencing an energy shortage, which not only affected costs and delivery schedules for critical materials, but also encouraged skilled workers, the ones in most demand, to leave for higher paying energy-related construction jobs.[594] Then, there was another strike at the shipyard. The strike started in November 1974 and extended into December. About 14,000 workers were ultimately involved. It ended with wage increases and, for the first time, a cost-of-living provision in the union's contract,[595] but work had slowed down.

The beginning of 1975 found the two parties still deadlocked, with Litton reporting about a $40 million net loss for the previous year.[596] In the fall of 1974, the ASBCA had directed the company to quantify its claims in its LHA appeals. In April 1975, Litton did so, extending them to $505 million, including amounts for changes, delay, inflation, and disruption.[597] Included with the new REA were new delivery schedules, which slipped completion of LHA-1 by a total of 37 months (to May 1976) and LHA-5 by 65 months (to September 1979).[598] With the gap between Litton and the Navy widening and negotiations going nowhere, Ingalls began shifting its work force to the DD-963s and submarine repairs, efforts that showed possibilities for profits. Anticipating heavy losses on the LHAs, Litton would make them suffer the labor shortage[599] instead of pulling down its other programs with them.

In March 1975, Vice Admiral Gooding, now the Commander of the Naval Sea Systems Command (NAVSEA), successor to NAVSHIPS, sent a proposal to the Secretary of the Navy. He suggested that mutual responsibility for the LHA claims had been recognized and that Public Law (PL) 85-804 might bring the dispute to closure.[600] This law provided for modifying contracts through extraordinary means in the interest of national defense and circumvented the often bewildering procedures related to normal settlements. The law also stipulated that Congress must be notified of its impending use, followed by a 60-day waiting period. Gooding recognized that additional compromises would be needed, such as a release of claims, a firm delivery schedule, cash flow relief, and a commitment by Litton that funds from Navy contracts would only be used for shipyard work.[601] This "fencing" idea arose from a concern over the financial difficulties in other Litton divisions and was amplified in later negotiations to provide for a separate bank account for shipyard use only. Ultimately, it was dropped over larger concerns that such "over management" might lead to more complaints.[602]

In order for Vice Admiral Gooding's proposal to reach the Secretary of Navy, it had to go through Admiral Kidd, Chief of NAVMAT, who believed that if the public law was invoked, Litton would be relieved of the responsibility to substantiate its REA. The company had been given ample opportunity to provide supporting data and had not done so. To Kidd, extraordinary measures were not warranted until the claim had been substantiated, so he did not forward the proposal.[603] The Navy did agree internally that any contract change must include firm delivery dates for the LHAs, with severe penalties for even later deliveries.[604]

Discussions on the DD-963 reset proposal continued simultaneously with the discussions on the LHAs. The ultimate prices for the destroyers seemed to have been understood by both parties, but there were major disagreements over the Navy's desire to be released from any claims prior to the destroyer reset proposal.[605] The LHAs also continued to impact the negotiations. Finally, in July 1975, the DD-963 reset proposal was signed, and the destroyer complication was removed from the table.

The Navy hoped that the DD-963 success might spill over into the LHA.[606] The trial in ASBCA was not to begin until mid-1976, and ASBCA's track record suggested a judgment might take three to four years, a situation that was unacceptable to both parties.[607] The opportunity for better business relations soon appeared. In April, Admiral Kidd was replaced as Chief of NAVMAT by Admiral F. H. Michaelis, and Ned Marandino was replaced by Leonard Erb as President of Ingalls.[608]

To reach resolution, there were two general attitudes in the Navy on how to proceed on Litton's overall claim, which included not only the LHAs but much smaller claims on other Navy ships in the yard as well. The Navy Secretariat believed that one large payment through the Extraordinary Means Provision of PL 85-804 or a reformed contract was the most acceptable way to clear the air and get on with business. In contrast, leaders in NAVMAT and the new NAVSEA opted for continuous, smaller payments. Small payments would attract less attention from Congress and would be easier to allocate between the fixed-price and cost contracts in the yard.[609]

Meanwhile, Litton's cash flow worsened, and the company predicted that it would go negative by the end of September 1975.[610] Bankers turned up the heat on the company to resolve the dispute. To understand the situation better, Gary Peniston, the Assistant Secretary of the Navy for Financial Management, hired an outside accounting firm to review Litton's books. The accountants determined that company's losses on the LHA could go as high as $350 million.[611]

In December 1975, the Secretary of the Navy, recognizing that a work stoppage was possible, offered Litton a "Plan of Action" that could result in Litton's long-awaited financial assistance.[612] The plan attempted to separate out short-term topics such as portions of the claim ($246 million) that resulted from the six-month delay already

accepted in the Contracting Officer's Final Decision. It also allowed more time for Litton to respond than in the past—February 1976 for the short-term relief and June 1977 for the long-term. The Navy asked Litton to withdraw its appeal to the ASBCA and begin new discussions immediately. If Litton could provide the data to support the claim, the Navy could begin its payouts.[613]

In January 1976, the Plan of Action, containing short-term financial relief for Litton, was officially enacted. Litton agreed to begin submitting supporting data immediately for the 50 or so claim elements. The final submission was to be December 1976. The two parties petitioned ASBCA to dismiss the LHA claim, and the request was quickly granted. Both parties seemed ready to move forward on a well-planned mission to resolve their dispute.[614]

While the dispute with Litton was on-going, the Navy was also in court with its other large shipbuilders, General Dynamics and Newport News. At the beginning of 1976, the claims backlog had grown to $1.7 billion, primarily with these three companies.[615] In early June, Litton's share alone accounted for $822 million, almost half of the total. Of that, $505 million was for the LHAs.[616]

In March 1976, Deputy Secretary of Defense Clements decided to take over all claims negotiations and to pursue a settlement through PL 85-804. He felt that the claims issue at-large would have to be settled soon if the Navy was to continue competitive contracting with the nation's shipbuilders.[617] The existing settlement processes had been totally ineffective and extremely expensive. It was taking up to five years or longer for the ASBCA to make decisions.[618] One of the sticking points was the contract escalation clauses in vogue at the time.[619] In those clauses, typically, no escalation was paid after the contract delivery date passed and schedules slipped. In the case of the LHA, this clause would force Litton to work without escalation reimbursement for more than five years. As these were highly inflationary times, Clements offered to revise such clauses and allow escalation payments to continue after the contracted delivery date. This promised a significant increase in the payments to Litton.[620] Clements informed the House and Senate Armed Services Committees that he intended to invoke the public law and targeted June 1976 to reach an agreement with the shipbuilders.

At the end of May 1976, the first LHA was commissioned.[621] It was at least three years late. When June came around, Clements notified Congress that he had been unsuccessful in reaching agreements with Litton and Newport News. While Litton favored using PL 85-804, the Clements-proposed escalation changes would net it only a little over $300 million of its $822 million in claims.[622] If the company accepted the Clements offer for dismissal of present and future claims, it would have to absorb not only the more than $500 million remaining, but perhaps any future increases. In fact, by the end of June, the LHA claims were raised again, this time from $505 million to $702 million.[623] Since Clements' plan had been to settle all the shipbuilders' claims at once, he withdrew it and assured Congress that the Navy would move expeditiously through normal channels to resolve the problem,[624] a trip that already had a painful history of failure.

The rejection of the Clements' offer by Litton once again revived fears of an LHA work stoppage.[625] Litton was now receiving about 30 cents on every dollar of cost on the LHAs.[626] Cash flow would go negative in the next two months.[627] The DD-963s were also projected to have a negative flow.[628] The Navy reopened negotiations under the Plan of Action. It also began looking for methods to expedite claims for provisional payments.[629]

All this attention was now raising the antennas of the Litton stockholders and the public. In late June, a *New York Times* article suggested that the situation was not as bad as had been given to the Navy.[630] O'Green told a reporter, "We are healthy and strong and are generating cash. We have never said that we would be unable to fulfill the [LHA] contract."[631] Almost simultaneously, the situation reached the breaking point. Tex Thornton announced in a letter to Clements that work on the LHA would cease on August 1, 1976. The same letter reminded Clements that DoD had admitted the failure of *TPP* after awarding the LHAs but had refused to provide relief from the inequities of the concept.[632] He offered two options to prevent work stoppage: one was to reform the contract to a cost type with Litton accepting a fixed loss; the other was to provide provisional payments during the long settlement processes.[633]

Litton's official termination notice to the Contracting Officer cited a number of legal justifications for its decision. One was its charge that the Navy had disregarded its "hands off" approach in favor of "reengagement." [This philosophical change by the Navy, done actually for the DD-963 program, will be discussed with those ships.] Litton felt that this change gave the Navy control over design and production and considered it a blatant violation of the original contract.[634]

An extraordinary settlement seemed the only alternative, as the outlook for a settlement through litigation was still bleak.[635] Litton suggested converting the contract through the use of PL 85-804. To achieve this reformation, it provided a two-volume proposal that dealt with correction of escalation inequities, correction of the wrong type of contract (*TPP*), settlement of claims, and payment of short- and long-term expenses until final agreement was reached. The proposal also stated Litton's willingness to accept a loss.[636]

Litton informed the Navy in July 1976 that it would no longer participate in the Plan of Action, and the Navy's claims team broke off negotiations. All planning for provisional payments was deferred.[637] In July, the District Court in Biloxi issued a preliminary injunction directing Ingalls to continue building the remaining four LHAs and stop its termination notices to more than 3000 employees. In return, the court directed the Navy to pay the actual construction costs of those ships until April 1977.[638] The Navy paid the first invoice but challenged the rest, stating that the court had not intended for the Navy to pay overhead and administrative costs. The court subsequently clarified its decision and required the Navy to pay 91 percent of the costs incurred.[639]

The Navy's approach now became primarily legal. In parallel, it sought a permanent injunction from the District Court to replace the preliminary injunction, returned to the ASBCA and requested a continuation of the LHA appeal that had been suspended with the Plan of Action, and appealed to the Fifth Circuit Court of Appeals to set aside the District Court's order to continue cost payments.[640] As always, there were numerous other complicating factors. First, the Navy was running out of program funds and did not relish returning to Congress for additional monies.[641] Second, the costs being paid the contractor now were outstretching his progress, so the aura of another recoupment fight was on the horizon.[642] Third, Litton increased its claims again, this time to over $1 billion, and had finally submitted the supporting documentation promised in the Plan of Action.[643] Finally, 1977 brought President Jimmy Carter and a new administration, the third since the award of the LHAs.

The new Carter Administration wanted the claims issue off the table. Secretary of the Navy Graham Claytor directed his Assistant Secretary of Manpower, Reserve Affairs and Logistics, Edward Hidalgo, to concentrate on solving all existing claims against the Navy. In September 1977, Hidalgo entered into talks with O'Green. By October, they reached an oral agreement on how to solve the problem. The Navy could reduce its payments from 91 to 75 percent in return for expediting its claims processing. Through the end of the year, discussions continued, and it became apparent that there was, finally, common ground for a solution.[644]

In January 1978, a plan to gain a bilateral agreement as allowed by PL 85-804 was presented to Congress. Following hearings in March and the 60-day waiting period, the necessary modifications to the contract were made, and 75 percent payments were extended indefinitely.[645] The adversaries were closer to agreement than they had been in six years. Secretary Hidalgo continued negotiations with Litton into the summer of 1978.

In late June, a tentative settlement was reached. Litton would absorb a fixed loss, the ceiling prices of both the LHA and DD-963 contracts would be raised, and future payments would be based on physical progress.[646] As with many other matters on the LHAs, the numbers can be very confusing. Ultimately the claims filed by Litton reached about $1.09 billion,[647] of which the LHAs were the overwhelming part. The company settled for less than half—about $494 million.[648] The new "estimate at completion" was $1.3 billion[649] for the five ships, which did not include the $200 million in losses accepted by Litton. It also did not include the significant costs associated with the work of the Navy Claims Team. The new estimate at completion compares to the $1.01 billion original contract for nine ships and the $795 million price for five ships in the Contracting Officer's Final Decision (which was derived from the original contract). The contract unit cost had gone from $133 million each for nine ships or $159 million each for five ships to $260 million; a 95- or 64- percent growth, depending on which way one is counting. There may have been some other costs that were added after the June 1978 agreement, but we have not yet found them. The story is poor enough as it stands. Moreover, the final LHA did not commission until May 1980,[650] just after it was delivered to the Navy. This was six years late. Thus ended 10 years of controversy that began with the signing of an inflexible contract for delivery of a partially defined warship in a yard that was not yet built using a construction process that had never been tried on a ship this complex.

LHA OUTCOME

The history of the LHA is a case study in how not to run a program. It is remarkable that almost all the source material on the project is administrative in nature, full of legal proceedings, negotiations, and audits, much of which has been recounted here. Absent from the printed sources is practically any mention of the Navy's Project Office, PMS 377, and unmentioned in all the deliberations is the Project Manager. The involvement of numerous other agencies and political appointees should be duly noted, however, although they were constantly changing. It is clear that, ultimately, the Navy Secretariat and OSD took charge of the program. Unfortunately, they knew nothing about shipbuilding and could only take legal or political actions to address problems that were ultimately technical in nature.

One reference noted, "the level of effort necessary to satisfy the demands of the legal proceedings had been costly for both participants and had almost become superior in importance to construction of the ships."[651] We would only abridge this observation by deleting the word "almost." In fact, most remarkable is the absence of any real information in our sources on the technical difficulties involved in building the ships. Modular construction proved harder than envisioned, and modular construction for a ship this size, in Gordon Rule's mind, was not practical. At first, the modules would not match up, and piping runs were misfit. A major redesign of the island on the ship seems to have proved necessary, but rancorous.[652] In addition, Ingalls was trying to build two and sometimes three other ship types simultaneously with its new "production" concept. Synchronization and segregation of these different efforts proved more difficult than in a traditional shipyard with building ways.[653] The difficulty of mixing different products on a single production line had been known for years; however, it was carried into shipbuilding without any recognition of its applicability. Over time, many of these problems were worked out, but at higher costs than anticipated.

No one came out smelling clean. Litton clearly overestimated the cost savings it could get with the new yard and the ease with which it could be put in operation. Its decision to put its aerospace managers in charge of the shipyard proved disastrous. Litton also overestimated the Navy's willingness to renegotiate contract terms. Thus, its traditional strategy of renegotiating contracts proved very contentious. This was exacerbated by the questionable reputation of Tex Thornton and his people from the old Hughes days. The project went through double-digit inflation in the national economy, an energy shortage, and violent hurricanes that damaged the yard. There were skilled labor shortages and strikes. Most of this was unpredicted at the outset. On the Navy side, leaders kept insisting on firm fixed prices and schedules. Time and again, they seemed more interested in just the right measure of cost payments or a precise piece of data than in getting a ship fit for war.

DD-963 *SPRUANCE* CLASS DESTROYERS

In the fall of 1966, McNamara commissioned the Major Fleet Escort Study to identify replacements for about 100 World War II ships and to represent the Navy of the future. The study was led by then Captain (later Chief of Naval Operations) Elmo "Bud" Zumwalt, a systems analyst in OSD. It reported out in 1967 and recommended the DX/DXG/DXGN* *family* of ships.

The DXG was to be the family linkage and was to have the same propulsion as the DX and the same combat system as the DXGN. Many weapons and systems were to be common across the classes.[654] Very early on, the DXGNs, as nuclear ships, split away from the family and became the CGN-36 and -38 Classes (see Chapter 7). The DX and DXG were to stay a consolidated program for some years. Of the two, the DXGs were never appropriated and built directly for the U.S. Navy. A version of DXGs was built for Iran and was later retained by the U.S. when the Shah was overthrown. They became the four ships of the Kidd Class, DDG-993. The DX evolved into the DD-963 *Spruance* Class destroyer **(Figure 11)** a two gun, 30-knot, multipurpose task group escort for shore bombardment and antisubmarine protection of attack carriers and other high-speed naval forces. Thirty-one of these ships were built, all but one using *TPP*—the largest *TPP* contract ever let and the last.[655]

The story of the DX/DXG actually began some years before the Major Fleet Escort Study. For years the Navy had been trying to make the case for carrier and surface strike forces to McNamara and his OSD staff. Such ships were "combatants" and could go into the teeth

* U.S. naval nuclear-powered ships are designated with an "N" after the ship type. Nuclear ship programs required the participation of the Naval Reactors Directorate in the Naval Ship Systems Command.

Photo courtesy of National Archives

FIGURE 11. *Spruance* Class Destroyer

of the enemy and prevail. Unfortunately, throughout most of the McNamara years, the Navy had been unsuccessful. Shipbuilding cuts exceeded $30 billion. Not counting submarines, between 1963 and 1969, only one cruiser, one destroyer and one aircraft carrier were laid down,[656] while World War II-vintage combatants were becoming "block obsolete" and having to be retired in large numbers.[657] Similarly, development of new weapons and combat systems also stumbled, with no new combatants to target. Instead, only convoy escorts (destroyer escorts or frigates), amphibious ships, and support vessels were approved.

McNamara and his staff also paid little attention to how the Navy thought the ships that were approved should be configured and took little advice from them on how wars should be fought. During McNamara's tenure, a CNO was dismissed and officer resignations increased tremendously. Cynicism flowed down from the most senior officers into the ranks.[658]

Ultimately, the situation became urgent as old destroyers and cruisers could no longer be supported easily. Moreover, operationally, they could be outrun by Soviet submarines,[659] the predominant threat to control of the seas. A number of studies recommended solutions. By 1966, even the OSD system analysts could see the block obsolescence problem and proposed building two notional classes.[660] DX would be a destroyer escort (DE) with only anti-submarine warfare (ASW) armament, and DXG would be a cruiser with both ASW and air defense weaponry. These concepts were not originally the Navy's,[661] and therefore their genesis was not born of Navy tradition. For example, OSD used the "X" as an indicator of different specialized ship "missions," such as anti-air warfare (AAW) or anti-submarine warfare (ASW), and the traditional roles and distinctions between cruisers and destroyers were soon lost in this mission-oriented terminology.[662] The ships were to be successive building blocks off the same production line, in much the same way the automotive industry was heading. Since a destroyer was the least common denominator, it became the start point, and the designator "D" was used for all the successive blocks, regardless of whether they were traditional destroyers or not.

OSD saw DX/DXGs as simple ships that could be built cheaply and in quantity.[663] It wanted the DXG to cost between $41 and $57 million, depending on the number of ships ordered. The DX was to be a down design from the DXG that would each cost about $20 million after production learning curve savings.[664] In fact, one publicized OSD table had the cost of a DX reducing to precisely $19.7 million after two years of building. Despite the improbable precision of this number, the fact that no weapons costs were included in that estimate, and McNamara's warnings that the figures were "highly tentative," members of Congress remembered it as the total cost of the ship. They were enraged when years later a fully equipped *Spruance* cost many times more.[665]

To keep costs down, OSD envisioned buying the entire ship commercially with no government furnished equipment. The shipbuilder would buy and install weapons and equipment that were already in production. New weapons would be developed in parallel under separate contracts and installed in an overhaul.[666] Instead of installed weapons, the ships would be built with a large amount of "space and weight." While this was not a totally new concept, it was unique to the degree it was to be employed and the reason for it—to lower contract costs. Ultimately, OSD intended to use this project, in addition to the LHA, as a policy measure to revolutionize warship design and the shipbuilding industry.[667] The signal soon flowed to the Navy that, if it followed the *TPP* concept, a class of destroyers would finally be approved.[668]

The Navy saw a completely different need. It wanted a combatant, not a simple ship. To coordinate the new program, it created a DX/DXG Program Coordination Office in late 1966 to sponsor and sell the program. OSD brought in Navy Captain Ray Peet to head it up.[669] He was the first commanding officer of the nuclear cruiser *USS Bainbridge* and a World War II veteran. His job, as program coordinator, was to set the military requirements for DX/DXG. He focused first on DXG and prepared the Concept Formulation study to define its missions, with guidance from both the CNO and the Chief of NAVMAT to build the best ship.[670] He soon defined DXG as a high-end combatant, as powerful as a guided-missile cruiser, not a destroyer escort, and DX as a reduced DXG.[671] He planned to evaluate both gas turbine and nuclear propulsion. Besides capability, the Navy also was much more concerned about the quality of its combatants than it was about its other ships. Contrasted to FDL and LHA, many experienced naval officers saw a combatant as a much more complex ship and perhaps not applicable for *TPP*. CAPT Peet was one of these officers; he wanted to await the results of *TPP* in FDL and LHA before committing the DX/DXG program to it. He also believed that the minimal Navy participation required under *TPP* could be fatal for a combatant as capable as he envisioned.[672]

All these factors clashed with Secretary of the Navy Nitze's guidelines—use conventional propulsion, follow *TPP*, and build many low-cost ships for convoy duty.[673] The controversy was enjoined—DXG as a combatant or DX as a convoy escort. Peet had a public confrontation with Nitze when he told the Secretary to put his guidance in writing; otherwise, he thought it was improper, since military guidance should come from the CNO.[674] Nitze would not do so. Peet was fired and replaced by Rear Admiral Thomas Weschler. The firing did not hurt Peet's career, as he was to be promoted numerous times, retiring as a Vice Admiral after declining a fourth star.[675] Nitze, who had been unwilling to accept public responsibility for his directions, was also soon promoted to Deputy Secretary of Defense.[676]

DX now became the leading member of the family, and "up design" not "down design" became the approach. The Navy continued to fight with OSD (System Analysis) trying to show that even the "bare-bones" ship needed for forward operations was a far more powerful destroyer than OSD envisioned.[677] Fortunately, Peet's Concept Formulation plan for DXG survived as the mission basis for DX as well.[678] Along the way, the Navy had to accept *TPP,* as this was the only way OSD would approve ship construction.[679] Thus, a larger, more powerful destroyer came at the expense of embracing *TPP*.[680]

It was to be the largest destroyer ever built, between 6,000 and 8,000 tons. The 8,000 tons was a cap since a ship displacing more than this, by law, had to be nuclear propelled, and this would have brought the nuclear reactor lobby into the debate.[681] The Major Fleet Escort Study was conducted in parallel with the Phase 0 Concept Formulation and defined the numbers needed for each type ship, including the DXGNs. It also determined that ASW was the top priority mission, and that more ASW ships were needed than AAW ships.

Thus, the missions for the new class were an ASW-focused subset of CAPT Peet's original DX/DXG missions:

- Operate with strike, amphibious, or ASW forces to shield them, as well as replenishment groups and military and mercantile convoys against submarines
- Detect and destroy submarines alone or as part of a coordinated system
- Destroy shore targets at close range
- Provide naval gunfire support for ground forces
- Conduct surveillance and trailing of enemy ships and submarines
- Conduct blockades
- Provide air control for ASW, search and rescue, and patrol[682]

The conflict between DX as a combatant versus DX as a convoy escort had been resolved by combining the roles, increasing the size of the ship, and incorporating a vast amount of space and weight for future weapons. At that time, this was a major victory for the Navy.

McNamara put all three ship classes (DX, DXG, DXGN) into the Five Year Defense Plan (FYDP) and the DX into the 1969 budget request that went to Congress. Congress postponed DX construction until 1970 but did appropriate $30 million for a design competition leading up to a contract award. As DX was now a more capable warship that could be converted upward to include other Navy missions like AAW, the zest for DXG went away and it eventually died.[683] At the same time, the ship to be built was now far more complex than the original DX for which *TPP* had been approved.

In 1967, towards the end of the DX/DXG concept debate, a DX/DXG Project Office, PMS 389, was established in NAVSHIPS, in keeping with OSD directives. It was co-located with the Program Coordination Office in the Navy Department building on Constitution Avenue in Washington, D.C. until the middle years of the program, after which the Program Coordinator moved to the Pentagon.[684] Captain Richard Henning, the former Technical Director of the FDL project, was named the first project manager. By Navy instructions, he was to be the single central executive responsible for the entire project. His office was one of the first implementations of the new Ship Acquisition Project Manager, or SHAPM, concept.[685]

Prior to the SHAPM concept, shipbuilding had been handled in BUSHIPS by a functional organization, the New Construction Branch, with Type Desks for each class or ship type. Other Bureaus had significant pieces of the ship over which the Type Desks could only exercise limited control. The new SHAPM would be head of a project organization, more powerful than the Type Desks. Both contracting and legal officers were to be subordinate to the SHAPM and were to sit in his office. Technical professionals in all the disciplines of shipbuilding and design were also to be in his office.[686] In fact, one source believed that the Technical Division was the strongest part of PMS 389.[687] However, the SHAPM still did not hold all the power and resources. There were other managers, called Participating Managers, or PARMs, in the Naval Ordnance (NAVORD) and Naval Electronics (NAVELEX) Systems Commands who were responsible for key radars, weapons, communications, and control systems that went into new ships. The SHAPM had the power of the purse over these managers, as he controlled the ship construction dollars. All these organizational changes, plus *TPP,* were occurring in the Navy as the DX/DXG Project set out.[688]

In early 1968, following completion of the Major Fleet Escort Study, the DX/DXG Project Office announced in the Commerce Business Daily that "the Navy contemplates the procurement of Contract Definition Studies leading to the selection of a contractor to design, construct, and deliver destroyer type vessels."[689] Just a few months before, a pre-solicitation conference had been held in Washington, D.C., with 147 attendees representing eleven shipbuilders.[690] Prospective shipbuilders were to propose how they would develop a preliminary design for the destroyers and show a plan for new production facilities.[691] The advertisement stated that a qualified bidder's list would be compiled based on applications and, from that list, qualified firms would be solicited to bid on a Phase I "Contract Definition" effort with two or more offerors being selected to go into the Phase II engineering development and production. All of these preparations fit the *TPP* process, including the development and production terminology that was used.

Six companies submitted proposals and each spent between $1 and $2 million on them.[692] Aerospace firms were used to such expensive proposals, but they were new to shipbuilders.[693] By July 1968, the competitors were reduced to two aerospace firms, Litton, with its shipyard in Pascagoula, Mississippi, and General Dynamics, with its shipyard in Quincy, Massachusetts, and one shipbuilder, Bath Iron Works, in Bath, Maine. Each was awarded a design contract to complete the Contract Definition Phase. The designs were to be based on performance specifications, not the Navy's customary General Shipbuilding Specifications that incorporated the great body of knowledge learned across the years building and operating warships. Instead, each contractor was to provide the Navy with a rationale when the General Specifications were not invoked.[694] About $30 million in design money was to be disbursed among the teams, and each would also spend significant amounts of their own funds.

In the middle of the design competition, the Nixon Administration took office. While new officials were quickly in place, they made little immediate impact on major weapons acquisitions. In fact, it would take more than a year before they did. The DX design competition using the *TPP* approach went on unabated.

In April 1969, the Navy received designs from all three bidders. Litton's may have been the largest ever submitted up to that time and required a truck to haul it in.[695] None was fully satisfactory to the Navy. In particular, Litton's and Bath's unit prices were too high for the FY 1970 Congressional Authorization level for five ships.[696] General Dynamics offered the lowest price, and the Navy spent half of its effort evaluating its design.[697] However, GD's design sacrificed performance valued by the Navy, and its reputation at the time was extremely poor.[698] Thus, in September, the Navy dropped the low bidder. GD had spent $20 million on its design effort and was only reimbursed for $2.5 million.[699]

Requests for Proposal Supplements were issued to Bath and Litton in September 1969 and again in January 1970, first to fix technical problems and then to reduce prices. By February 1970, the third proposals from each were in,

and the prices were fairly equal. However, they were still too high to support a first-year, five-ship buy, so the new Secretary of Defense, Melvin Laird, notified Congress that only three ships could be acquired in the first year.[700] The Navy then asked, in March 1970, for "best and final" offers in yet a fourth round of competition with no further technical changes requested. The major change was the introduction of an *FPIS* contract instead of an *FPI*. This allowed a new target price to be set 39 months after contract award.[701] In addition, the cost incentive share line was changed from 70/30 to 85/15, and the ceiling price was raised from 125 to 130 percent of target cost.[702]

Following these changes, Litton underbid Bath by over $8 million per ship,[703] and the Navy's Source Selection Advisory Council recommended a contract with Litton. The recommendation was forwarded to the new Defense Systems Acquisition Review Council (DSARC) via the new Secretary of the Navy, John Chaffee. Before the award could be made, Senator Margaret Chase Smith of Maine, the ranking Republican on the Senate Armed Services Committee, sent a series of heated letters to the President, Laird and Chaffee protesting the plan to award all 30 ships to a single yard.[704] After a number of meetings, Laird and the DSARC stuck with the Navy's recommendation, and DD-963 became the first program to pass through the DSARC process.[705] Ironically, one month before the DD-963 contract was actually awarded, Deputy Secretary of Defense Packard, as a result of the C-5A's negative publicity, issued his memorandum effectively killing *TPP*. The Navy proceeded nevertheless.

Litton was awarded a "Development and Production" contract on June 23, 1970.[706] The multi-phased, Contract Definition competition had taken a little over two years. With this event, the Navy's ambitions for a healthy shipbuilding program seemed promising indeed. The project was the largest in U.S. history during peacetime, and the award was the largest ever to one shipbuilder. It came just 13 months after the award of LHA to Litton. RADM Sonenshein announced that the first ship would be christened *USS Spruance*, DD-963, after Admiral Raymond A. Spruance, the hero of the Battle of Midway who had died the year before.[707]

The contract was termed a "*modified TPP*" contract.[708] This phrasing was used because, unlike the Air Force *TPP* contracts, there was almost no front-end research and development (R&D) that could be followed by production dollars with fixed targets.[709] The shipbuilding application was virtually all production dollars. Instead, emphasis was placed on earlier in-service planning, which often got lost in the intensity of shipbuilding.[710]

The award called for development and production of the first 30 ships of the class. In addition, system integration and interim logistics support, including reliability and maintainability engineering, technical manual preparation, assembly of spare parts lists, manning requirements determination, and initial crew training were contained in the award.[711] The contract was an *FPIS* with a target price of $1.79 billion, or about $60 million per ship, and a ceiling price of $2.14 billion, or about $71 million per ship.[712] None of these numbers were the actual cost of the ships, as they did not include all of the weapons, many of which were to be GFE. That number was approximately $85 million per ship.[713] The first ship was to deliver in October 1974, and the other 29 were to deliver rapidly thereafter, up to 12 per year, until the last delivery in June 1978.[714]

While the contract amount was slightly less than twice as large as the LHA contract, in other respects it was practically identical. It had similar payment provisions; that is, for the first 40 months (October 1973), payments would be based on incurred costs, after which payment would be based on measured progress. Final contract prices were to be renegotiated 37 months after award (July 1973) versus the 34 months in the LHA.

The destroyers were to be 560 feet long, with a beam of 54 feet and a displacement of 7000 tons. Each ship was to have four gas turbines on two shafts—firsts for a major U.S. surface combatant—and was to have controllable, reversible pitch propellers (CRPP). The ship specifications invoked were Litton's, based on the Navy's original performance specifications.[715] There was a design guarantee clause in the contract that required the correction, in all ships, of any design deficiencies related to that performance.[716] Besides the cost incentive, the contract included a $24 million (for all 30 ships) silencing incentive, a liquidated damages clause, an escalation clause, and a one-year warranty on each ship, starting from time of delivery. It also included a *Total System Responsibility* clause. This clause obligated Litton to deliver ships that met or exceeded the performance specification, excluding any Navy furnished or specified equipment.[717] Supporting this concept, the Navy adopted a "hands-off" or "arms-length" approach to the contract once it was signed.[718]

The major new introduction in Litton's design was to be the propulsion system—new engines with an automated propulsion control system, new distillate fuel, and

new propellers. Gas turbine engine technology in the 20,000-horsepower regime had already been prototyped and tested by the Navy and had been used as boost propulsion in some Coast Guard ships. Contemporary with the DD-963s, the Canadians were designing the *Iroquois* Class of destroyers with gas turbine propulsion and were about two years ahead using almost all American equipment.[719] The technology would eventually yield one of the best engines of the century. In the decade before 1970, three separate U.S. destroyer or frigate programs had gone through various stages of design with gas turbines, only to be cancelled in the budget process.[720] The two leading engine candidates for DD-963 were the Pratt and Whitney FT-4 and the General Electric LM2500. The Pratt and Whitney engine had been under development by the Navy since 1961 and had accumulated thousands of hours of operations in the Sea Command Ship *Admiral William M. Callaghan*.[721] The LM2500 was a newer generation and, when DD-963 began, had started testing, also in *Callaghan*.[722] In its design, Litton proposed the Pratt and Whitney FT4 with diesel-driven service generators for electrical power to operate the systems and facilities in the ship, but included an option for the LM2500 for main propulsion. In December 1970, based on potential fuel economy, Litton proposed to substitute the LM2500 for the FT4. The Navy approved the change. The Navy also approved, in 1971, a change from diesels to Allison 501K gas turbines as the prime movers for the ship service electrical generators.

Controllable, reversible pitch propellers of the type required in DD-963 had also operated in Navy and Coast Guard ships for some time. However, they were only three-fourths the size and half the horsepower required (40,000 HP) in DD-963. Propellers of this larger size had not yet been produced, although two designs were scheduled for at-sea test in 1971—one developed by Baldwin-Lima-Hamilton (BLH) aboard *USS Patterson* (FF-1061) and a second by Propulsion Systems, Inc. (PSI) in *USS Barbey* (FF-1088). These were both after the scheduled start of construction of the DD-963.

Thus, simultaneously with the DD-963 program, the Navy was either testing or planning to test critical components of the new propulsion system at sea. In addition, Litton contracted with a division of the Naval Ship Engineering Center in Philadelphia to create a prototype land-based integration test bed for a one-half ship set of propulsion equipment with a water brake in place of the propellers.[723] The three propulsion innovations—engines, fuel, and propellers—were considered by the SHAPM to be the only risk items at the DSARC Review. All were considered "low risk" and to be schedule risks versus technical or cost in nature,[724] despite doubts from OSD, some members of Congress, and other Navy experts.[725] Much of this confidence came from Project Office visits to the *Iroquois* building yards in Quebec, not from actual Navy operational experience with the technologies.[726]

The principal weapons in the destroyer were to be its ASW suite, gun system, and point defense AAW system. The ASW system included extensive ship silencing features, a hull-mounted long-range active search sonar, two triple-tube torpedo launchers, an ASW rocket launcher (ASROC), embarked helicopters, sonobuoys and an integrated ASW analog fire control system. The ship would also have command and control facilities to coordinate on-scene ASW units.[727] She was to be the first ship that could prosecute multiple submarine contacts simultaneously.[728] The five-inch gun system had two mounts controlled by a new Mk 86 digital fire control system, which was still in development and was to be supplied by the Navy as GFE. Both the ASW and gun fire control systems were to be digitally linked to the central command and control system to a greater degree than in previous combatants. A combat information center (CIC) with associated sensors and an ASROC launcher which was to be installed at a land-based site at AMTD in Culver City, California, to support the development of the operational computer programs and to help arrange the CIC spaces.[729] The principal air defense weapon was to be the NATO Sea Sparrow Missile System, then in development by the Navy.

There were other new elements in the design. These included waste heat boilers to use energy from the 501K Allison gas turbine generator exhausts instead of auxiliary steam boilers, solid state 400-Hz frequency converters, integrated combat system switchboards instead of stand-alone switchboards, and a new sewage treatment plant.[730] Standard crew size was to be 250 versus the 400 that would have been normal in a ship as complex as this.[731] In addition, DD-963 was to have significantly better berthing and lavatory spaces than older destroyers. Above all, the ship was to have a module-based design with subsystems placed in specific dedicated assemblies derived from the total ship design. This approach, coupled with design discipline, was to allow subsystem designers independence[732] and the ship to be assembled (versus constructed) on a module-based production line. This module concept was amplified to include reserving deck space with standardized mechanical and electrical interfaces for prefabricated deck-mounted

weapons such as the SLQ-32 electronic warfare system and the Phalanx 20mm gun system—both systems still in development but planned for installation later in the ships' service life.[733]

Almost none of the equipment was to be supplied by the Navy. Early on, the plan, following the OSD lead, did not include any GFE, as all equipment was to be purchased by Litton. This was later changed to just eleven major items of GFE. Much of what in previous ships had been GFE was changed to Government Specified Equipment (GSE), which meant that the Navy told Litton what to buy but left procurement up to the company. According to the DD-963 project office, this worked pretty well.[734]

Some of these ideas had flowed down from previous OSD work, as did the requirement for an unprecedented 25-percent margin for equipment additions during the ship's service life and an additional 15-percent set aside for specific systems that were already designated.[735] In practice, these designated development systems were mostly GFE, such as NATO Sea Sparrow, WSC3 satellite communications, and WLR-1G microwave signal detectors, among others, which were scheduled for installation after ship delivery and shakedown by the shipbuilder.[736] This approach promised to speed delivery of the ships by decoupling the "platforms" from the "payloads" (both aviation terms). This was done because it would take longer to develop such systems than to build the ship hulls to mount them. It also reduced the contract cost, scope, and risk associated with the *TPP* effort. The tradeoff was that the ships were "not fully equipped to fight at sea upon delivery,"[737] and they "looked swollen and lightly armed."[738] This condition was to be sharply criticized later. One senior officer was to say often that "you can't kill the enemy with space and weight,"[739] and many complained about the never-ending overhaul periods it took to "arm" the ships throughout their service lives. As late as the 1980s, critics called the ships "yachts masquerading as warships."[740]

As with the F-111, getting started was painful. Six days after contract award, Senator Smith addressed the Senate and again severely criticized the Navy's decision to award all 30 ships to one yard.[741] Bath was the largest commercial employer in the State of Maine, and loss of the destroyer contract left it desperate for work. Ingalls, on the other hand, had a backlog of commercial and Navy contracts and was supported by the powerful Senator John Stennis (DMiss.), chairman of the Senate Armed Services Committee.

Senator Smith reiterated to the Senate the earlier concerns she had sent to the Administration about the competition, especially the last-minute change from an *FPI* to an *FPIS* contract that, in her mind, allowed Litton to underbid Bath by $270 million.[742] She asked why the Navy would award a $2 billion contract to a company who already had the largest backlog in the industry and was embarking on a new construction process in which it had no experience. If this failed, she pointed out, it would cause a serious impact on national security. Moreover, she believed the *TPP* contract took control away from Congress because of the large cancellation penalties due if all or part of the program was cancelled. Senator Smith also questioned awarding the contract to a yard that had already modernized, thus jeopardizing the competitive base and increasing future ship prices.[743] Finally, she alleged that there were leaks in the bidding process that violated the law and undermined the competition. In a letter to the Attorney General, she disclosed that Representative William Hathaway of Maine was told two months prior to contract award that Litton had underbid Bath by $270 million. This intelligence came on a golf course from members of the merchant lines for whom Litton was building ships. She suggested that Litton had access to Bath's bid, thereby enabling it to underbid, knowing that it could recover through the 37-month reset provision.[744]

In August 1970, Senator Smith addressed the Senate twice amplifying her concerns about the production base and labeling Litton's fourth proposal "a buy-in." She further challenged a classified memorandum to Senator Stennis from RADM Sonenshein (the former FDL Project Manager and now the Commander of NAVSHIPS) stating that splitting the DD-963 contract would cost about $225 million. A few weeks after issuing the memorandum, the Admiral told the media the cost would be $600 million – a scare tactic, according to Senator Smith.[745] She also requested a GAO investigation into the award.[746] Meanwhile, Senator Stennis defended the award, disputed Senator Smith's arguments, and stated that Congress would be setting a poor precedent if it repudiated a contract already awarded to a private firm.[747]

Senator Edmund Muskie of Maine also came to the support of Bath, introducing an amendment in the Senate that would require Ingalls to subcontract half of the DD-963s to another yard. Senator Stennis argued that Congress had already turned down a previous amendment to split the award, introduced by Republican Representative Louis Wyman of New Hampshire. While the House of Representatives had approved Wyman's

amendment, the Senate Armed Services Committee, with Stennis as chairman, struck it from the authorization bill. Senator Muskie's amendment was also defeated.[748] The New Englanders had the numbers, but Mississippi had the power.

Complaints also began inside the Navy. A week after contract award, former OSD systems analyst, now Admiral, Zumwalt became the CNO. He created the notion of naval forces as *High* or *Low* and ordered another study, called Project 60, to determine the right mix to meet the Navy's needs. Zumwalt believed, "there was more than enough High, more than enough Too High, already under construction or under contract when I began Project 60 and almost no Low at all."[749] He believed the DD-963s were *High* ships but too expensive[750] and soon ended hopes that any more than the original 30 would be built.[751] He was to say, "the trouble with them was that they were too good in the sense that the Navy had given up too much to get them."[752] There were many more in the Navy then and in the years to come who believed the *Spruance* Class was clearly not good enough.[753]

Meanwhile, Litton was having its management, labor, and weather problems in Pascagoula, most of them discussed earlier under the LHAs. The Navy had originally scheduled DD-963 construction to begin in 1972 to reduce interference with other ships in the yard. The original plan for the merchant ships and LHAs would have had them all delivered by 1975, and the yard almost in automatic by 1972. However, the problems and schedule stretch-outs in these ships were now impacting the start-up of the DD-963s. There was speculation that the cost of the destroyers would increase because of escalation and rising materials costs, and the construction schedule was already in question.[754] By April 1972, the House Armed Services Committee announced that it was going to investigate Litton's handling of the LHA and DD-963 programs. Representative Aspin announced that the GAO was looking into Litton's request for $455 million in inflation charges for the DD-963s, about $145 million more than the Navy's estimate. Aspin also asserted that the shipyard was suffering from start-up and labor problems and criticized the Navy for sinking $3 billion in new orders over 13 months into a new and untested shipyard.[755]

It was the summer of 1972, and it was already clear that Litton had badly underestimated the man-hours for both LHAs and DD-963s. The company had committed to estimates based on the vast promises of modular construction, and modular construction, as discussed under the LHA, was having growing pains. At that time, the *Spruance* destroyers were the most complex ships ever to be built using this technique anywhere in the world.[756] They had many times more distributed systems than the commercial ships for which modular construction had been originally used.

The Navy had concerns about modular construction during contract negotiations, and as a result, Litton agreed to build the first two destroyers relatively traditionally, from the keel up in three major sections. Using these first ships, the designs for modular construction could be updated with the actual locations and materials needed to assemble each module. The rest of the class was to be built modularly. This dual effort was difficult to coordinate and was proving very costly to Litton.[757] It was now, as troubles mounted and schedules slipped, that Litton moved Ned Marandino and his East Bank management team to lead Ingalls at large. He began to revisit the way the company-built ships, particularly the DD-963s since they had the longest production run. Under his new plan, DD-963s would be constructed on the West Bank and floated off when they were 40- to 60-percent complete. They would then be moved to outfitting piers on the East Bank where they would be completed in a traditional manner. In practice, the West Bank could "produce" ships faster than the East Bank could outfit them. This caused bottlenecks in the use of construction crews. Over a period of years, the company went back to using more of the modular approach and launched ships when they were about 70- to 75-percent complete. Nevertheless, the reinsertion of more traditional shipbuilding methods was required to reduce further problems in the rest of the LHAs and DD-963s.[758] This confusing start-up period cost many man-hours, and even though modular construction proved ultimately to work quite well by the 13th ship, DD-975,[759] both ship classes were considerably behind schedule.

The Navy went into the contract for the destroyers trying to honor DoD Directive 3200.9. According to that directive, the contractor was to be given the greatest latitude in contract performance. Thus, the Navy took a "hands-off" position. During the first year or so of the contract, the Navy followed this dictum for fear of giving Litton ground for claims. However, the greatest expertise for Navy systems lay with the Navy's military and civilians. Many of them had been intimately involved in the lengthy contract definition phase. At contract award, these knowledgeable experts were told to withdraw

and let the program take its course to avoid possible claims of interference. This proved difficult, as close contacts had been established between Navy and Litton professionals. With the "hands-off" policy, a communication gap was created, and, to some extent, this gap was never fully overcome. Because of it, many people within the Navy engineering and support structure never took full ownership of the DD-963s.[760]

Just a year and a half into the program, the Navy became so dissatisfied with Litton's performance that it abandoned its "hands-off" approach to the DD-963s. Coupled with the lack of an adequate management information system, problems were rising to unacceptable proportions,[761] not the least of which was the fact that Litton had purchased many items of equipment that were unsatisfactory for an at-sea environment.[762] In all too many cases, Litton was making design decisions totally on the basis of the lowest cost for a component.[763] Decisions were also being made without the benefit of the experience that was embedded in the Navy's General Specifications for Shipbuilding.[764] Litton's corporate experience with aviation led the company to not only underestimate the hostility of the sea environment but also the roughness of sailors compared with aviation personnel.[765] When the Navy did suggest changes, Litton usually responded that the work was already done and an expensive change order would be needed to fix it.[766] The Navy recognized this trend; and, while it "re-engaged," it was too late to fix the problems entirely. The ships were to suffer with unseaworthy components for years after their commissionings. In hindsight, the Project Office felt that they had waited too long and that "the [hands-off] period was too long and proved costly."[767]

As the Navy "re-engaged," new questions began to surface regarding three contract provisions: (1) Continuing Evaluation of Contractor Performance: Government Intervention Rights, (2) Subcontracts Management, and (3) Total System Responsibility. In hindsight, the dilemmas were:

- Did the Navy improperly invade the design prerogatives of the contractor by issuing thousands of comments and objections concerning the contractor's proposed design?
- Did the contractor have a unilateral right to change contract specifications and subordinate specifications and drawings, so long as contractual performance and capability requirements were not compromised?
- Was the contractor required to obtain Navy approval of proposed Engineering Change Proposals?
- Did the Navy have the right to conduct on-site reviews?
- Did the Navy expand Quarterly Program Reviews beyond contractual requirements?
- Did the Navy have the right to expand its audits and reviews commensurate with contractor performance?
- Should the Navy have the right to conduct an administrative and technical review of proposed subcontracts?
- Should the Navy have the right to withhold subcontract consent for purely technical reasons?[768]

These questions complicated contract administration and caused the SHAPM to require that all visits to and correspondence with Litton had to be cleared through the project office.[769] In its "Lessons Learned," the SHAPM felt the "hands-off" policy had been grossly inconsistent with the fact that:

> "Effective design and production of the ships required large and competent engineering and production work forces, an infrastructure, efficient shipbuilding facilities, and capable management with shipbuilding experience. None of these resources was in place when Litton proposed the work."[770]

Ultimately, the project office concluded that an open interface between the Navy and the contractor was best and that "an arms length interface will not work."[771]

Controversy over the ship continued. Congress authorized none of the seven destroyers requested by the Navy in FY73 but did authorize long-lead-time items.[772] However, despite opposition from Aspin, Senator George McGovern of South Dakota (the failed Democratic candidate for President), and others, the remaining ships on the contract were authorized in FY74 and FY75. Much of the debate internal to the Navy surrounded a conflict between "Sea Control" and "Power Projection" as the dominant mission for force planning and ship design.[773] In 1973, Admiral Zumwalt, who had disliked the cost of the destroyers, initiated a low-cost frigate program, the FFG-7. He continued to want "a larger number of cheaper escorts, each of them less capable, but in numbers that will let us cover the convoy lanes."[774] In 1974, his successor as CNO, Admiral James Holloway, announced that his top priority was to increase the firepower of the fleet. To some, the still-to-come *Spruance* Class was clearly the cause of

this firepower deficiency.[775] Numerous articles critical of the class and its lack of installed weaponry began to appear in professional Navy journals.

The destroyer program, heretofore overshadowed by the LHAs, took the limelight in April 1974, when Litton requested a $350-million price increase as part of the Price Reset negotiations.[776] This raised the target price to $2.14 billion and was just what Senator Smith from Maine had predicted. Litton asserted that this was not a cost over-run because the original ceiling price of $2.14 billion had not been exceeded, and that this was a one-time price adjustment allowed by the contract. Litton further announced that it was expecting an additional $485 million to cover materials costs and that some of the destroyers might be five months late.[777] Despite the purpose of the reset provision, Congressman Aspin exhorted the Navy to "not give them an extra dime."[778] Nevertheless, the Navy did approve a $200-million increase in billing base due to the rising costs of materials. Just a few months later, Aspin was told by the Navy that the last of the destroyers might be as much as 18 months late. At this time, the LHAs were already two to three years behind schedule.

In August 1974, during a crash-back maneuver by *USS Barbey*, all five blades on her CRPP separated from the propeller hub, showing that the alloy of the blade carrier was too brittle.[779] The propellers were rebuilt, retested, and later applied successfully to the DD-963s.[780] In November–December 1974, a machinist's union strike took 14,000 workers out at Ingalls.[781] Meanwhile, Litton and the Navy ontinued haggling over the DD-963 reset prices into 1975.[782] The Navy's desire to remove the liability for any claims on the DD-963s from work done prior to the reset was a major sticking point.[783] Finally, in July 1975, a new reset contract was signed that included the release of Navy liability for any destroyer claim not related to the LHAs from the past.[784]

Despite these on-going woes, the destroyer program maintained a very positive cash flow through 1975.[785] The cash payment schedule, based on costs incurred, was so positive that it maintained the solvency of Ingalls amidst losses on all its other programs, both Navy and commercial, as well as the significant cash outlays it made to build the yard.[786] It was not until the 1975 and 1976 timeframe that the DD-963 cash cow began to wane as the most significant salvation factor for the yard.

In February 1975, *Spruance* went to sea on her builder's trials. She performed well. In particular, her hull vibration was much better (lower) than the requirement. She was the quietest destroyer built to that time, and, she exceeded requirements in maneuverability, seakeeping, full-power reversals and keeping her sonar dome wet but her decks dry in stormy seas.[787] Litton received the full $24 million silencing incentive.[788] After one of her trials, *Spruance* was damaged slightly while being moved back into the launch platform for routine work. The ship almost fell off the keel blocks and risked significant structural damage. While supposedly Litton's problem to solve, a Navy salvage team corrected the situation in 15 days leaving only dented propeller blades.[789] By the 13th destroyer, the program was finally over the technical hump,[790] and a new destroyer began commissioning every one to two months. In 1978 and 1979, a total of 15 ships were turned over to the fleet.

Ultimately 31 DD-963s were delivered to the Navy. After the 30 constructed under *TPP*, one more, DD-997 (*Hayler),* was contracted in the late '70s to help bridge Ingalls to the new AEGIS *Ticonderoga* Class which began in 1978. *Spruance*, DD-963 herself, having started construction in June 1972, delivered in August 1975 about nine months behind contract schedule. The second ship, DD-964, *Paul F. Foster*, actually delivered earlier than Spruance, just a few months behind schedule. The last ships of the class were over two years late. None of these dates included the extensive post shakedown and overhaul periods required to install their full complement of weapons. This took another two years after commissioning.[791] The first 17 destroyers were completed by naval shipyards. For the rest of the class, Ingalls installed the GFE and corrected the warranty items.[792]

The final overall contract cost was $3.73 billion versus the original ceiling price of $2.14 billion.[793] This was a $124 million per ship unit cost and represented a growth of 105 percent from the original target price of $60 million and 75 percent from the original ceiling price of $71 million. Again, as with the schedule slips, none of these costs included the two-year post delivery costs.

In general, while the Ingalls support to the ship in its post-delivery period got high marks, this period became another source of controversy surrounding the ship. As earlier recounted, the period was part of a deliberate plan that had flowed down from OSD. To some associated with the shipbuilding program, it worked well, because it removed the problem of synchronizing weapons development with ship construction. Unfortunately, while the DD-963 program was underway, the Congress voted to limit the term of ship construction dollars to five years. Thus, new funds to handle many of the problems and installations

over the two years after commissioning had to be re-budgeted by the Navy, and the amounts were not always readily predictable. The resulting frustration can be seen in the testimony of VADM James Doyle, former Deputy Chief of Naval Operations for Surface Warfare and the sponsor of the DD-963s when they began going to sea. He found a large number of technical problems that he had to fix and fund after the ships were delivered:

> First of all, a lot of equipment wasn't ready. For example, the SLQ32, which had its own problems, was a design-to-cost piece of ECM gear that couldn't meet specifications. In any event, it wasn't ready for *Spruance*. NATO *Sea Sparrow* wasn't ready either, so these ships went to sea initially without the SLQ-32 or *Sea Sparrow*. The 400Hz system was seawater cooled and had lots of leaks. That was changed to fresh water in the AEGIS ships. The engines were in the early stages of testing and control and couldn't achieve full power or if they did they couldn't run a four-hour full power test. Even the toilets didn't work. The Mark 86 gunfire control system had a lot of problems tracking targets. The design of the propeller was bad because it introduced stress on the bolts, which later resulted in fatigue. Trying to get a sonar dome to pass the pressure test was a frustrating, time-consuming evolution. We tried time and time again to get the dome not to leak in order to pass various tests. [794]

A study for the Under Secretary of Defense for Acquisition called the DD-963 program "an operational success but a financial disaster."[795] The program, combined with the LHA, almost bankrupted Litton Industries. Although there was never a pure DD-963 claim filed by Litton, a claim for cross impact between the LHA and DD-963 programs was filed. It involved two allegations. First, Litton asserted that the Navy's dereliction on the LHA adversely affected Litton's performance on the destroyers and resulted in delay and disruption of the destroyer program. Second, the contractor alleged that the Navy prioritized the destroyer contract to the detriment of the LHA.[796] The Navy acknowledged that there was cross impact in manpower and facilities, with additional shipyard start-up costs being shifted to the DD-963 contract, but these costs were considered by the Navy to be Litton's responsibilities.[797] The most common reasons for the LHA claims, such as excessive Navy involvement, infringement on contractor latitude, late GFE/GFI, and superior government knowledge not shared with the contractor did not appear in any DD-963 claims, and therefore analyses in these areas were never performed by the government. PMS-389, however, believed that the contracts for the LHAs and DDs were so similar that if Litton had not gotten what it wanted from the LHA claims, it probably would have submitted claims against the DD-963.[798] By the same token, the project office believed that many of the lessons learned from the LHA claim process could apply equally to the DD-963.[799]

DD-963 OUTCOME

PMS-389 also had the following view of the situation in relation to the *TPP* concept:

> Multi-ship procurement (from a single source) is not without its disadvantages. A primary disadvantage of the DD-963 acquisition concept, the "all the eggs in one basket" situation, is a legitimate concern. The dependence on a single shipbuilder and the lack of real alternatives for completing the program if his performance is marginal is not in the Navy's best interest. This undesirable feature was manifest in the following way: the shipbuilder became overloaded with the combined LHA/DD workloads at about a quarter point of the [DD-963] program. There was no feasible action the Navy could take to overcome the problem without cancelling or significantly delaying one or both programs. The Navy took no action. The contractor unilaterally decided to delay the LHA program. This contributed to a significant cost over-run in that program, a large part of which the Navy ultimately funded as a result of contractor claims and the Public Law 85-804 settlement.[800]

In preparation for the *TPP* contract for DD-963, technical risks were presumed to be low at the DSARC despite:

- Use of gas turbine propulsion for the first time in a major combatant.
- Use of the shipbuilder to develop the operational

computer programs for the Command and Decision System and to develop a new Underwater Fire Control System.

- Use of controllable, reversible pitch propellers in a higher horsepower range than in previous ships.
- Use of waste heat boilers to use energy from the electric generator prime movers.
- Use of solid-state 400Hz frequency converters.
- Use of integrated combat system switchboards instead of separate switchboards.

Land-based test sites helped address some of these risks, but one of the project office's "Lessons Learned" was that "every technical advance or innovation in a program should be considered an inherent risk."[801]

Among non-technical problems the DD-963 faced were the two labor strikes in 1971 and 1974, a shortage of qualified labor, and double-digit inflation. Cost risk also proved to be higher than expected. From the onset, extreme pressure from above was put on both the Navy and Litton to keep the costs low. This pressure led to the destructive four rounds of initial bidding. The contract target price was increased when the contract was reset, but the ceiling remained the same. Thus, the target-ceiling margin was so small that when the ceiling was subsequently exceeded, the cost incentive feature became ineffective.[802]

Despite all these flaws, the DD-963 program was far and away the most successful of all the *TPP* efforts we reviewed. It is the only program to achieve the force levels contracted. A direct comparison with the contemporary LHAs is instructive. First and foremost, the Navy did not maintain its "hands off" strategy in the DD-963 Program. Unlike in the LHA program, where contract adjustments over time pushed the Navy and its experts further away from the program, in the case of the DD-963, the Navy, led by an active project office, intentionally and methodically "re-engaged." Without the rescue effort that came when Navy expertise was brought to bear, it is doubtful if the Congress would have funded more than 16 ships.

Second, the Navy seems to have been much more flexible in the case of the destroyers than with the amphibious ships. Time and again the litany in LHA is "Litton proposed xyz change...the Navy rejected it." This behavior does not seem to appear in the destroyer program. New engines and new prime movers for the generators were readily approved, and even the DD-963 reset proposal, while rancorous, was settled before the LHAs. Perhaps this flexibility stemmed from the fact that in the DD-963s, the program office seems to have handled most of the matters, while the LHAs went the legal route and top-level officials, who knew little about shipbuilding, took the lead.

A third difference between the LHAs and DD-963s was the way the contract payment provisions affected the programs and the company in general. The LHAs were fewer in number and were certainly more seriously impacted than the DD-963s by the slow start-up associated with building the yard and trying out the commercial ships. In addition, not long after the LHA program began, the numbers were reduced. Thus, the amount of money that flowed during the 34-month cost reimbursement period was not as large as may have been expected. The DD-963s, on the other hand, did not start construction until 1972, when the yard was essentially complete.[803] With 30 ships and significant class-wide, up-front costs that were incurred over their 37-month cost payment period, significant funds were provided to sustain the solvency of the yard. By the time the cost payment period was over, Ingalls had reached the 13th destroyer and was practically over its technical problems. It seems clear that the Navy's contracting specialists created the cost payment provisions to try and overcome OSD's fixed-pricing directions on the lead ships in both programs. If so, their plan worked rather well on the DD-963s but could not overcome the problems of the LHAs.

However, perhaps of even greater import was the eventual change in Administrations. With the coming of the Nixon Administration and the new thrust to delegate major weapons acquisition back to the Services, the Navy was once again able to take charge of its programs. Professionalism could be brought to bear instead of magic formulas. After Secretary Packard terminated *TPP in 1971*, the Navy could ignore *TPP*'s principles, which, in the case of DD-963, it clearly did.

CHAPTER 6
ENDING IN A "THUD"

None of the star programs of the *Total Package Procurement* era—C-5A, LHA, and DD-963—was a success. Nor was F-111, which would have been *TPP* if the ability to contract them all at once had been in place sooner. In fact, all these programs were considered by most of the critics of the day to be abject failures. None of the four came in at or near the cost desired, which was the principal reason for the concept in the first place. Only the DD-963 program resulted in the quantities originally planned. The force requirements for the others were never met. By the mid-1970s, the DD-963 program had been so modified that it was no longer a true *TPP* program. The Navy had to reengage to make it work and had devised a contracting structure to make it a significant cost-reimbursement vehicle over the highest risk years.

Some of the outcomes were disastrous. The C-5A became a *cause celebre* in the press and on Capotol Hill. The Proxmire Committee had a field day on the issues of poor government management and "cost overruns," a term invented in those days. The name of Ernie Fitzgerald, the first "whistle blower," will be forever linked with the C-5A. Fitzgerald, the Deputy Assistant Secretary of the Air Force for Management Systems, testified before Proxmire's committee in November 1968. He revealed the magnitude of the cost overruns at a time when both the Air Force and DoD were trying to keep them out of the public view. For his testimony, he was transferred to Thailand, ironically, to review the high cost of a bowling alley. Ultimately, both the Air Force and Lockheed lost. The Air Force did not get the number of planes it wanted and had to ante up more money to get the ones it did. Lockheed almost went bankrupt over the C-5A and other poor corporate decisions.

The Navy was in court with almost all of its major shipbuilders, all of whom were submitting claims following the use of fixed-price contracts for new shipbuilding programs, even those that were not strictly *TPP.* The claims reached more than $2.7 billion.[804] These disputes dragged on for more than ten years and were not settled ultimately until the late 1970s.

The eventual costs associated with the four programs were even greater than those cited earlier in the individual program sections. In all four examples, the contractors lost money and did not earn the profits they expected. Both the government and the contractors spent significant amounts fighting court cases. These sums, in many respects, were lost to the programs themselves. Significant amounts were also spent fixing quality and technical problems, replacing faulty components, or adding improvements after the systems delivered—the total cost of which can not be added up. Moreover, critics of DoD said that contractors were still "buying in" early and "getting well" later. Only the form of "getting well" had changed, they said; now it included bailouts, loans and "corporate welfare." Both Lockheed and Litton almost went bankrupt, and Lockheed had to get an extraordinary loan in the name of national interest from the Nixon Administration to stay afloat. None of these costs show up in individual program accountings.

Eventually, Deputy Secretary Packard killed *TPP.* The opportunity came when administrations changed. In 1970, the Fitzhugh Commission found:

> There is only one approach [to weapons acquisition] that the Panel thought should be generally rejected, as being inconsistent with sound acquisition principles. That is the concept of *Total Package Procurement*....It is difficult to imagine *Total Package Procurement* of a large weapon system which would be either in the Government's interest or the contractor's interest.[805]

In May 1970, David Packard, the new Deputy Secretary of Defense under Melvin Laird, decreed that *fixed-price* contracts would not be used until development had reached a point where the production design was well specified. *Cost-plus-incentive-fee* contracts were to be preferred for

development work. This was "nail one in the coffin." *TPP* could not exist without a *fixed-price* contract to implement it. Notably, this decision took place just before the Navy had signed its DD-963 contract. To a very great extent, this decision and the atmosphere that came with it allowed the Navy to later rescue that program.

The *TPP* concept was ultimately put to rest completely in Packard's new DoD 5000.1 Directive in July 1971, which stated:

> It is not possible to determine the precise production cost of a new complex defense system before it is developed; therefore such systems will not be procured using the *Total Package Procurement* Concept or production options that are contractually priced in the development contract.[806]

Packard moved to delegate major weapons acquisition back to the Services. He modified OSD's role to one of intermittent review and reduced the power of the systems analysts. At the same time, he removed the long-term commitments embedded in *TPP* and replaced them with an incremental decision-making approach as part of the review process. This process was to become known as the "DSARC Process." It got its name from the Defense Systems Acquisition Review Council, a body of OSD officials who oversaw the process and advised the Secretary or Deputy Secretary on major weapons acquisition. Its successor is known today as the Defense Acquisition Board, or DAB, Process. Initially, major weapons acquisition was broken into three, then later, four phases in which the development of a weapon got ever more mature as it proceeded from one phase to the next. Reviews, called DSARC Milestone Reviews, were established in between the phases so that the DSARC could make recommendations to the Secretary on whether and how a program should proceed to the next phase. Concept Formulation/Contract Definition as used in *TPP* was eliminated, and "Design-to-Cost" was soon to be created to address the cost issues that *TPP* had focused on.

CHAPTER 7
ELSEWHERE IN THE NAVY – THE CGNs

Any study of *Total Package Procurement* and its application to shipbuilding in the 1960s and '70s would not be complete without reviewing what else was going on in Navy shipbuilding at the same time. Between 1968 and 1977, the Navy averaged about 13 ships per year in construction.[807] In 1978, there were 96 Navy ships under contract, with 65 of them in three shipyards—Tenneco/Newport News, General Dynamics/Electric Boat, and Litton/Ingalls. As has been mentioned earlier, the Navy by the mid-'70s was in court with all of these shipbuilders. About $2.7 billion in claims were at issue at the end of 1977,[808] and work stoppages were threatened by more than one builder. While over $1 billion in claims ultimately came out of Litton and its LHA *TPP* efforts, at issue were other significant claims on contracts that were not *TPP*. About $890 million was from Newport News, involving 14 ships.[809] Of particular relevance were the *California* and *Virginia* Class cruisers, both of which, over their building periods, had claims. One of the *Virginia* Class, CGN-41, in particular, resulted in a long, acrimonious dispute.

NEWPORT NEWS SHIPBUILDING

Newport News Shipbuilding and Drydock Company was founded by railroad entrepreneur Collis P. Huntington in 1886 to help create a port terminus for his railroad, the Chesapeake and Ohio.[810] The yard was family owned until it went on the New York Stock Exchange in 1940. In 1968, the company merged with the conglomerate, Tenneco, which had interests in chemicals, gas pipelines, oil, automotive parts, farm and construction equipment, packaging, and land use.[811]

In the era of *TPP*, Newport News was the largest shipyard in the U.S. and one of the best equipped in the world.[812] It could build the world's largest warships and was the only builder of nuclear surface combatants and aircraft carriers in the country. In fact, it was the first to build an aircraft carrier from the keel up, *USS Ranger in 1931-34*, and had subsequently built all of America's nuclear carriers. It also built nuclear submarines and had a significant amount of commercial and repair work. In the 1970s, it was turning away about $50 million in work a year.[813]

For decades, while the company was privately owned, Newport News was proud of the quality of its work. One of the first signs visible to anyone entering the yard near the main office read:

> We shall build good ships here
> At a profit - if we can
> At a loss - if we must
> But always good ships
>
> —Collis Potter Huntington

This sign came down immediately when Tenneco took control and was later donated to the Mariner's Museum elsewhere in the city. Such a sign did not reflect the philosophy of the modern corporation. In the 1960s, there was plenty of work in the yard, but profits had been shrinking for years.[814] When Tenneco took over, vast changes were made, and profits were to be assured. Prior to Tenneco, the president of the shipyard had risen through the ranks and had remained in office for many years. After Tenneco, the yard had four presidents in ten years, and none was a shipbuilder.[815] The first new president, Bud Ackerman noted:

> I frankly did not recognize how much resistance there would be to change...For example, in the automotive industry from which I came, we were constantly getting employees who had worked in some other company or in some other industry. They bring in fresh ideas. In shipbuilding, we simply have not had that. We've had as many as four generations in one family working here in the shipyard...There wasn't the well of ideas from other places. It seems to be indigenous to the industry.[816]

Such men seemed to have had little patience with creating the skills required for ship construction and could not understand why it could not be productionized to allow an almost limitless labor force. Tenneco, much like Litton at Ingalls, soon expanded its yard in search of higher profits and began erecting new facilities for commercial shipbuilding. Such ventures were to drain the talent pool in the 1970s and impact its work.

CALIFORNIA (CGN-36) AND *VIRGINIA* (CGN-38) CLASSES

Another family member in the Major Fleet Escort Study of the early 1960s was the DXGN, soon to be designated, in NATO terminology, a "nuclear guided missile frigate" (or DLGN) and later redesignated a "nuclear guided missile cruiser" (or CGN). This family nomenclature gave rise to two ship classes—the *California* Class with two ships and the *Virginia* Class with four ships.

Photo courtesy of Federation of American Scientists

FIGURE 12. *USS California* CGN-36

The first of the six ships, *USS California* (CGN-36) **(Figure 12)** was allocated to Newport News under an FPI contract in July 1968. The second, CGN-37, or *South Carolina*, was contracted a year later.

In June 1970, the Navy signed a third contract with Newport News, for pre-construction work needed to build *USS Virginia* (DLGN-38), later designated CGN-38 **(Figure 13)**. This contract contained an option that could be exercised for the actual construction of the ship.[817] Follow-on negotiations between the Navy and Newport News were influenced by direction outside the Navy from the Deputy Secretary of Defense and bargaining inside the Navy between Admiral Zumwalt, the Chief of Naval Operations, and Admiral Hyman G. Rickover, the head of the Navy's Nuclear Reactor Program. These led, in December 1971, to a multi-year contract modification for the construction of CGNs-38 through 40 with options for CGNs-41 and 42 to be executed in 1973 and 1974, respectively.[818] Both the modification and the options were *FPI* in form. The ships beginning with CGN-38 were called the *Virginia* Class.

The *Virginia* Class was to have the same hull form as the *California* Class but was to be better armed and have a helicopter hangar and stern elevator.[819] As the *Virginia* Class ships entered the yard, CGNs-36 and -37, the carriers CVNs-68 and -69, as well as a number of SSN-688 nuclear attack submarines, were already there, competing for attention. Before all the CGNs were completed, another carrier was also placed under contract. In addition, Newport News had commercial and overhaul work to do and was pursuing more commercial work.

None of the *California* and *Virginia* ships were contracted under the *TPP* philosophy or just a performance specification, as McNamara had edicted for all other major new programs. In fact, the Navy's own architects created the Contract Designs that included nondeviation drawings for nuclear propulsion items and extensive installation and testing instructions. When we asked VADM (Ret.) James H. Doyle, an officer who lived through this period, how it could be that these cruisers and the SSN-688 submarines were not *TPP*, his response was

Photo courtesy of Federation of American Scientists

FIGURE 13. *USS Virginia* CGN-38

self-explanatory: "Are you kidding? Rickover wouldn't have let any of those guys near the ships."[820]

Hyman G. Rickover had been selected for Rear Admiral in 1953 and every two years since 1962, he had been extended past his statutory retirement age. His beliefs were very complex. For many years, he believed that problems plaguing shipbuilding were not due just to socio-economic conditions but poor shipyard management. In his opinion, private shipyards were being run by legal, financial, and contract experts, not technical people or experienced shipbuilders. He attributed this situation to the fact that the shipyards had been bought by large corporate conglomerates whose primary interest was in making money, not building quality ships.[821] Rickover also believed in the validity of the *FPI* contract for lead ships since he believed it gave financial incentive to the contractors. In his testimony to the Congress in 1978, he recommended that if the shipbuilder problems of the day could not be resolved, the government should acquire all the shipyards and contract with private companies for their operation. As a precedent, he cited the aerospace industry where facilities to produce aircraft were owned by the government and contracted to industry for their use.[822] Rickover was to be a thorn in the side of Newport News throughout the building of the nuclear cruisers, always insisting on living to the letter of the contract.

Newport News began detail design and construction of the *California* Class in 1968 and the *Virginia* Class in 1970. Soon they were all in trouble. Delays developed, in part, because of conflicting work in the yard that required workers the company did not have. The problems got worse in 1972 when Tenneco announced plans to build commercial facilities at Newport News and construct three Liquified Natural Gas Tankers (LNGs),[823] creating another competitor for skilled labor. From a low of 18,000 workers in 1970, the company grew to 27,500 in 1972;[824] and, there were still not enough workers. Low productivity was also a concern as less-skilled workers seemed to be involved. In 1973, DCAA attributed overruns of 1.7 and 1.3 million man-hours on CGNs-36 and -37 to this decreasing productivity.[825] Finally, the yard decided that greater employment was not possible and, in 1974, asked its employees to voluntarily work six-day weeks.[826] By 1975, the Navy pointed out to the company that 1000 fewer workers per day were being assigned to Navy ships than in 1974.[827]

California got into trouble first. The ship took longer than expected, and costs grew past the contract values. Claims were submitted on both CGNs-36 and -37 for $35 million, then adjusted upward to $151 million and subsequently settled for $44 million.[828] Most of these claims were for delay and disruption attributed to Navy change orders. While these claims were of administrative concern, of more concern was the failure of *California*'s more digital combat system during its 1974 acceptance trials. This resulted in a detailed review by the Chief of NAVMAT of the management practices used in the acquisition of modern, sophisticated combat systems. The magnitude of the problem caused the Navy to accept the CGN-36 "as is" and to complete the work after delivery.[829] It took two more years after delivery before the ship could deploy. The fiasco was to later give rise to the use of land-based test sites in later shipbuilding programs. Both CGNs-36 and -37 took almost six years to design and build, and this did not include the extensive Navy fix-up, reinstall, and test periods.

The first three ships of the *Virginia* Class were not much better, also taking about six years each to design and build. About $160 million in claims on these ships were in negotiation by 1976.[830] The schedule slips in the ships of both classes exacerbated labor assignments, as new work was still coming into the yard. Delays also exposed the programs to the double-digit inflation of the era,[831] which the contract escalation clauses were not structured to handle. As mentioned earlier in the LHA discussion, the escalation clauses were generally keyed to contract milestones and provided for escalation payments that ended at the planned delivery date. If there was a schedule slip (and there was), the shipbuilder was not to be paid escalation for schedule slip time.

The delays in CGNs 38-40 also postponed executing the options for the last two ships of the *Virginia* Class.[832] Thus, instead of the CGN-41 being appropriated in 1973 and CGN-42 in 1974, they were each pushed out up to two years. In early 1973, Newport News and the Navy executed a contract modification that moved the last option for CGN-41 to 1975 with a proposed delivery date of October 1978,[833] a target price of $85.7 million, and a ceiling price of $100.9 million.[834]

During the early years of the *Virginia* Class program, working relations were good.[835] In fact, changes and claims were routinely adjudicated through the Navy's internal claims processing channels. This, however, changed when, over the company's objections, the Navy unilaterally executed its option for CGN-41 on January 31, 1975,[836] just one day before it expired.[837] A month before, Newport News had submitted a document outlining why it felt the option was no longer valid. Eleven

specific areas were addressed, but key sticking points were the severe inflation conditions, material shortages, and numerous changes that had been made to the earlier ships since the option had first been negotiated. According to the company, the Navy had made so many changes to CGNs-38, -39 and -40 that CGNs-41 and -42 were "new" ship designs, not true "follow" ships. All of these concerns, in the company's view, caused the option to be underpriced and beyond the control of the shipbuilder.[838] It wanted to extend the delivery of CGN-41 by 19 months and CGN-42 by 23 months, recognizing that if it was forced to execute the option as written, the company could expect to incur critical losses. The Navy proceeded anyway.

As hostility increased, the two parties signed a Memorandum of Understanding in an attempt to create a cooling off period and prevent court actions from being used to resolve the problems. This did not prevent letters from flying back and forth. Allegations concerning faulty Newport News management of late contractor (or vendor) furnished material, slow Navy authorization of long-lead funds, lack of Navy assistance in obtaining long-lead-time materials, Newport News desires to use workers targeted for Navy ships on more profitable commercial work, and the inability of Newport News to extend vendor options were all bandied about. Six months after the option was exercised, an official from Newport News met with Navy contracting officers and told them that the company did not recognize the option. He asked that the ceiling price be raised by $25 million and the schedule for CGN-41 extended by a year and a half.[839] The company threatened not only to stop work on the CGN-41, but all other Navy ships in the yard. It also threatened to withdraw on-going offers on SSN-688 submarines. In August 1975, Newport News informed the Navy that it expected to lose $38 million on CGN-41 and was not obligated to construct the ship. On 27 August, the Memorandum of Understanding was cancelled, and all work on CGN-41 was suspended.[840]

The matter quickly moved to the Federal District Court of Eastern Virginia. Two days after Newport News stopped work, the Navy sought a preliminary injunction and temporary restraining order to force the company back to work on CGN-41.[841] In court on the same day, both parties agreed to continue work for a year, unless terminated by either party given prior notice, with the Navy paying on a cost plus seven percent fee basis. The parties also agreed that CGN41 would incorporate all the changes that had been made to CGNs-38 through -40. Thus, a restraining order was unnecessary, and both parties agreed to negotiate in good faith.[842]

By October, there were heated and high-level discussions among Navy and OSD officials on whether to stop negotiations and get a ruling on the validity of the option. Some believed that failure to resolve the option issue would open the Navy to charges that it acquiesced to delaying the ship.[843] Newport News still maintained that new contract terms and conditions were required, a position the Navy opposed. These two polar positions set in place what would become an extended "fight to the death,"[844] with Newport News on one side and Admiral Rickover leading the Navy on the other. After some changes in the Navy's negotiating team, Admiral Evans, the head of the team, recommended that the Navy request a court ruling on the validity of the option. This recommendation was denied by the Assistant Secretary of the Navy (Shipbuilding and Logistics), who urged the team to make every effort possible to reach settlement.[845]

Now NAVMAT's Gordon Rule entered the fray. In July 1976, Deputy Secretary of Defense Clements appointed Rule to be chief negotiator for CGN-41 with authority to bind the United States to a compromise agreement.[846] He was subsequently given an appointment as Contracting Officer with "unlimited authority" to negotiate with Newport News concerning CGN-41.[847] Earlier, in March 1976, he had written an article that appeared in the Shipbuilder's Council of America newsletter and later *The Congressional Record* addressing the question of how the Navy could find the shipbuilding capacity to build its required ships, since there was no longer a mobilization base for Navy shipbuilding in the U.S.[848] The secondary question of the article was, if the capacity could be found, under what terms and conditions would it be available. Rule identified a number of issues that had to be understood in dealing with the general shipbuilding problems of the day and, more specifically, the Newport News situation:

- Shipbuilding involves concurrent development and production
- Concurrent development leads to changes
- Lead/follow yard methods inherently lead to claims and delays
- Shipbuilding labor is 30-35% non-productive
- The Navy makes unfair shipbuilding contracts and industry knows this
- Unfair contracts lead to claims
- A review of claims shows that the Navy is not learning
- The Navy went to court against Newport News and was told to negotiate[849]

Although Rule felt that the short-term goal should be a settlement of the shipbuilders' claims, he recognized that, in the long run, claims were only a symptom of a greater problem. Over time, he began recommending (a) returning to the allocation of ships to private yards, (b) changing from *FFP* and *FPI* contracts to two-step contracts for lead ships—*cost with no fee* and later definitization to *FPI*, (c) not contracting for the entire class until one or two ships were built, and (d) getting creditable target prices.[850] In April, he made a long list of the causes of the Navy's problems:

- Price competition for warships
- Forward pricing of fixed-price contracts
- Unrealistic delivery dates
- Misjudging the impact of inflation
- Wrong types of contract
- Unfair matrix of contracts [in a shipyard]
- Unfair and inappropriate escalation clauses
- Contracting to budget estimates
- Late GFE and GFI
- Failure of Navy to recognize a nationwide shortage in shipbuilding labor[851]

Rickover, for the most part, disagreed with Rule. He believed that the contracts were mutually agreed upon, the escalation clauses were fair, that Newport News was not submitting its claims in a timely fashion nor justifying them, and that a *cost-no-fee* contract would put the Navy in a bad bargaining position.[852]

After Clements appointed Rule as chief negotiator for the government, Rickover was kept at arm's length. Rule negotiated a compromise that changed the CGN-41 delivery schedule to August 1980 and revised the escalation clause corresponding to the new schedule.[853] Ultimately, this raised the price of the ship by at least $22 million[854] and probably even higher.[855] Soon thereafter , the Navy and the Justice Department disagreed with Rule's compromise and tried to undo it by revoking his authority and rejecting his compromise. The issue went back to the District Court. Ultimately, the Court found the Navy had not negotiated in good faith, ratified the essential features of Rule's settlement, and settled the issue.[856] This judgment governed the completion of the CGN-41 effort and the ship finally delivered on September 29, 1980,[857] two years later than required by the option unilaterally executed in 1975. The recurring problems in the CGNs' construction essentially killed the nuclear cruiser program. CGN-42 was never built.

RELEVANCE TO *TPP*

The *Virginia* Class CGNs had troubles not unlike C-5A, LHA and DD-963; however, they were not *TPP* efforts. There were a number of significant differences:

- There was no competitive contract definition phase
- They were not built to a performance specification but to a contract design specification that had been prepared by Navy in-house architects
- The ships were allocated to one yard, not competed
- The Navy was intimately involved in the shipbuilding effort; there was no "hands-off" approach, particularly in the nuclear reactor spaces
- In-service and logistics support were not included in the construction contract

The ships, of course, were nuclear powered, and this by itself probably disqualified them for the *TPP* concept. Nonetheless, there were also some significant similarities with *TPP:*

- The entire class was essentially contracted at once. A multi-year contract was used with the first three ships contracted at the same time and the next two as options, all across a number of appropriation years
- An FPI contract for the lead ship was used, with fixed-price production options. In later years, this combination caused a Lockheed official on the P-7 airplane program to call such a contract a "total package procurement"[858]
- The Navy was trying to reduce cost by moving risk to the contractor and requiring it to share in any cost overruns
- There was no flexibility in the contracting vehicles to handle the economic uncertainties, labor shortages, and technology risks

CHAPTER 8
LESSONS IN NEED OF LEARNING

Total Package Procurement was the first major attempt by the new Department of Defense to impose cost control on the acquisition of weapons systems.[859] It has certainly not been the last. Prior to DoD, weapons acquisition had been done exclusively by the Services. One writer has called the concept both "the most ambitious attempt ever made to reform defense contracting"[860] and "the most ambitious attempt to reform weapons acquisition through contractual financial incentives."[861] It was often referred to as a "concept" or a "philosophy," as opposed to just an acquisition strategy or procurement approach, and was deemed to have been "comprehensive." There is little doubt that, while it was first advertised as an experiment or trial, it ballooned rapidly into a DoD-wide edict applicable to all major weapons systems.

TPP was fundamentally an attempt to bring "best business practices" to the defense establishment. The "business model" was constructed around the production assembly line and the desire to generate commodities in large volume. In fact, in those days, business was synonymous with production, and perhaps it still is today. Pencils, batteries, bicycles, and aspirin tablets were typical commodities. The automotive industry was the champion business of the day. Ford, for example, was cranking out more than 2.15 million automobiles a year in 1965,[862] none of which was meant to last 20 or more years. This was where McNamara came from, and where the statistical control techniques he believed in so fervently originated. During World War II, it had been the automotive industry that revolutionized the aircraft industry. It was its "lessons learned" that were being taught at the emerging business schools of the day, led by Harvard. "Efficiency," a management term having almost no *measureable* meaning unless connected to production, was one of its hallmarks. Producing large quantities was much more efficient than producing low quantities and thus a key goal.

Not surprisingly, a 1967 Logistics Management Institute study pointed out that *TPP* forced a technically oriented defense industry to emphasize more and more the business aspects of weapons acquisition.[863] One corporate executive is quoted as saying, "We need business managers to manage these programs, not engineers."[864] This trend clearly impacted the way the Air Force acquired weapons and trained its officers and was, over a longer period of time, to affect the Navy as well. The Air Force set up its "business" school at Wright Patterson Air Force Base in Ohio, which was soon followed by a DoD-wide school (currently the Defense Systems Management College) at Fort Belvoir, Virginia. This business legacy is still with us, and the business model has not changed dramatically.

As a reflection of this business model, *TPP* took stands on some of the major conflicting currents discussed in the *Preamble* of this report. There was little ambiguity about which side of each conflict it came down on: business was better than government, the production/assembly line was the model of business efficiency, the government should competitively contract with business to obtain that efficiency and get out of its way, and all contracts should be *fixed-price* to ensure this happened. The conflict between the complexity of a modern weapon system and the simplicity demanded for efficient production was settled in terms of what was good for the production line. The conflict between "in-house" versus "out-house" was settled in terms of "out." The conflict between contract competition and contract allocation was settled in terms of competition. The conflict between competing forms of a contract was settled in terms of *fixed price*.

There were numerous techniques embodied in the concept to carry these beliefs out—standardizing designs, contracting all quantities at once, using a multi-phased design competition, going directly to industry with a performance specification, settling on the requirements and designs before final contracting, outlawing changes, eliminating GFE, forcing government to keep "hands-off," and so on. That it failed to make the contractor stay within a predetermined price and reduce the time to delivery, does not seem debatable. Why didn't it work?

BUSINESS VERSUS DEFENSE

In a study published in November 1992, the Institute for Defense Analyses found, after reviewing major systems acquisition across more than 30 years, that "there is little indication that acquisition program outcomes are getting either substantially better or substantially worse."[865] This was true despite considerable efforts at greater standardization and institutionalization of the acquisition process and attempts to inculcate more business practices. Seven years later, this finding was

backed up by a study in the *Acquisition Quarterly,* which found that the recommendations implemented as a result of the Packard Commission in 1986 "did not improve the cost performance of defense acquisition contracts."[866] This new study also reiterated that "there has been no substantial improvement in cost performance of defense programs for more than 30 years."[867] Other studies have found the same results, after reviewing more than 250 defense contracts.[868]

There are many possible explanations for this—one being that government is less suited than business and must be "reinvented" in a business image; another being that government people just didn't do the process advocated at the time "right." Both of these explanations showed up in some of the studies we reviewed. We choose to believe another explanation; that is, the programs being done are very, very difficult. In fact, they represent the most difficult engineering challenges, the most difficult things humans choose to create and build. The track record when humans take on very difficult challenges is not very good—be it baseball, where the best hitters fail seven out of ten times, or even businesses, where most fail. Such challenges are not susceptible to ultimate solutions that can be applied universally.

During this study, one seasoned professional stated that if we did not care what the product was, then *Total Package Procurement* would have been an acceptable concept.[869] However, the country does care about the products it gets for our national defense. Telling an American that his or her son or daughter will sail in a "low mix" ship does not resonate. It is this concern to create capable and quality weapons that produced some of the cost growth in the F-111, C5A, LHA, and DD-963. The risks of achieving such a product were broached at the beginning of this paper. They permeate every aspect of major system acquisition. In *TPP*, when government tried to shift risk to industry but did not get the performance it wanted, it had to abandon its "hands-off" policies and become more involved. Clearly, the Air Force and Navy understood this and were more recalcitrant when it came to the F-111s and DD-963s, which were to go into harm's way, than they were with the C-5As or FDLs. In defense, the primacy of quality and performance is what makes the use of "best business practices," based on efficient production, a terribly flawed approach to acquiring weapons. It is handling those risks, not efficiency, that is the driver in weapons acquisition.

So how does business handle risk? Risk in business, especially as it has been taught in our best business schools since World War II, is primarily financial, not product performance. The primary forcing function is not cost but profit. The risk is whether there will be an adequate return on investment. In a strictly free market, the higher the risk, the higher the profits and payoffs expected. Many entrepreneurs, for example, do not even get interested unless 200- or 300-percent returns are available. Many commercial companies have "hurdle rates" for their projects in the double digits, as high as 20 to 30 percent, and look for continuing return through expanding markets. Almost all "business practices" in this era are driven by this profit-making motive and are attempts to handle the financial risks. Thus, financial risks to a corporation are managed by reducing "exposure"— reducing costs, using someone else's money, reducing the quality of the product, or sharing the risk with someone else. A "turn-key" contract backed up by a willingness to litigate or go out of business is one way to achieve this. Another way is to only invest in items that have short "cycle times" to market. Many major corporations usually will not risk the long-term financial exposure that comes with the many years it takes to obtain new warships and aircraft (pharmaceutical companies may be an exception). In fact, in the private sector, many of the groundbreaking technologies have come from start-up companies, which will often accept more exposure than major corporations. Of course, they also go out of business more frequently. When business people come to defense as political appointees, they bring their backgrounds, methodologies, and experiences with them. Thus, they kill the A-12 (a Navy program in the 1980s-90s) to "cut our losses," regardless of how such a decision impacts the future of naval air power.

Unfortunately, profits in defense contracting are frowned on. Excess profits have always been an issue with the public at large. Driving back to the country's beginnings, the people have looked askance at too much money being made on "things war." The attitudes reflected in the debates that followed World War I are still with us. R & D contracts, for instance, are capped at 15-percent fees with numerous unallowable costs. Moreover, when the government shifts technical risk to a contractor, through a fixed-price contract, the profit margins commensurate with such risk-taking in the marketplace do not shift easily or quickly.

One balancing side to the profit motivation in commercial business is the "product liability" risk. While the promise of profits in the private sector is sometimes very high, a business must also be careful not to do harm with its products. When a company loses this

balance, it can be held liable in court. Examples are the massive recalls we read about in the automotive industry and extremely high penalties being exacted against the tobacco industry. However, this situation is different in defense. Consider the product liability implications associated with Liberty ships, the best pure example of a ship production line ever. Liberty ships were built recognizing that they might survive only one voyage to Europe. Known as "floating coffins," their designs reflected their expendability, and many of them sunk quickly either on their own (due to a significant design flaw) or at the hands of the enemy. A tort lawyer would have had a field day with them in the commercial world. However, businesses doing work in defense are generally protected from product liabilities because they are implementing government military decisions. The courts have generally chosen not to review decisions made for military purposes, including those made in the creation of weapons, and, thus, contractors are sheltered. This high cover becomes more fragile as the government takes a more "hands off" approach.[870] If a sailor is killed using weapons made for totally "business" reasons, it is much more likely that commercial liability penalties will accrue.

Yet another serious difference between the world of business and the world of defense is its constituency. In any venture, success can often have many different interpretations, depending on what is important to the constituent or critic. This was true of the *TPP* outcomes. The question is who are the important critics? In the business model, it is generally the owners or stockholders, board of directors, officers of the corporation, or the marketplace at large. This construct is sometimes transferred directly to government. Thus, President George W. Bush announced that he wanted his cabinet officials to be "Chief Operating Officers" when he took office in 2001. Unfortunately for this perspective, our Government has three equal branches – executive, legislative and judicial – and numerous agencies in each. There is no straight decision line as in the business model. The contractors we studied clearly understood this. Litton did not see its shipbuilding contracts as "iron clad" but renegotiable through Congress. Over and again, agents of the DoD thought they had control, only to be overruled in midstream by other branches or agencies of the government.

Finally, the production quantities associated with major weapons acquisition in DoD do not nearly approximate those that interest the commercial sector. The private sector's interest in quantities is in the millions, not the hundreds and the tens. Huge profits based on small margins per unit do not exist in the world of major weapons acquisition. For example, the C-5A did not begin to approximate the quantities associated with its losing competitor, the Boeing 747. The one shining accomplishment of *TPP*'s "all at once" contracting approach, the modern Ingalls shipyard, has never truly paid off. In DD-963, it took 13 out of the 30 ships produced to work out the kinks before production efficiencies set in. In LHA, the quantities were too low to get true production economies. Since then, no program has taken advantage of the yard's building rate capacity. Only three to four ships per class have been built there per year. At those rates, the yard is not much cheaper than its less-modern competitors. While modular production techniques have made ship construction more efficient, and every shipbuilder uses them today, they have also increased the risk of obtaining a warship. Now, when a shipbuilder threatens to stop work or has its yard disrupted by strike or calamity, the ship can not be towed out as easily to another yard for completion.

For all these reasons, the management techniques used in the private world—known as "best business practices"—while interesting, are ultimately not applicable. The model that was the underpinning of *TPP* is seriously flawed for defense procurement.

FOCUS, FOCUS, FOCUS

This dichotomy between business focus and the need for DoD to focus on best product performance has been reflected in the attitudes of its leaders. Throughout our study, two polar attitudes were held by many of the principals. We called them "Attitude A" and "Attitude B."

In Attitude A, cost and business or administrative matters are the most important priorities. For such attitudes, one way to control cost is to shift risk to industry and get out of its way. Another way is to create a process or formula, edict it for everyone, and insist they "do right." Competition in the marketplace is a tool that will control both cost and quality. This attitude believes that "a contract is a contract," and the government must "hold the contractor's feet to the fire," even if it means driving him into bankruptcy. He must not be bailed out.

Much of this attitude was embodied in McNamara himself. It also showed up in the Navy Secretariat in the 1980s. It is reflected in *TPP's* almost total emphasis on low costs in the 1960s, "design to cost" in the 1970s, "affordability" in the 1980s, and later, "cost as an

independent variable." As one interviewee, a former top DoD contracting official surmised, "It's a mindset that says it's a simple matter; just cite a spec, give it a schedule, give it a fixed price, and bring it in." He went on to say, "Unfortunately, time after time, experienced people are wrong. There are scores and scores of examples to the contrary, but we just put our heads down and do it again."[871] After all, isn't it just like buying automobiles off a production line?

Perhaps one of the best pure examples of Attitude A appeared in a *Washington Post* report on the A-12, a Navy program that was cancelled in 1991:

> John Lehman, who insisted on fixed-price contracts when he was Secretary of the Navy, tells a story that illustrates the hazards of cost-plus contracts. Back in the '80s, he says, while the Navy was setting up the A12 on a fixed-price contract, the Air Force was developing its F22 stealth fighter under a cost-plus contract. "Both programs started at the same time, and they were roughly of the same magnitude of effort and cost," he says. "And the Air Force, 14 years later, has committed $16 billion and they still don't have an airplane. They only have a prototype. But they have their program! The Navy spent $3 billion and was going to go to 5—not 16, but 5!—and it got cancelled because it was fixed-price, trying to save money."
>
> So the perverse lesson, he says, is for the Pentagon to go the more expensive route. "What we should have done is what the Air Force did—enter the lying game, the buy-in game. Say, 'Yes, we're going to do it for $3 billion but we're going to do it cost-plus like the contractors want.' Then we'd be at $16 billion, too but we'd still have an airplane alive!"[872]

The story of the A-12 is riddled with this attitude. When questioned by a cost analyst as to what he would do about the fact the A-12 contractors were $500 million over the ceiling price, the program manager responded: "It's a fixed price contract. They'll have to deal with it."[873] Following a briefing on the cost growth problems from the contractors, the same program manager responded, "I and my staff unanimously rejected the fund transfer approach as a 'bailout,' and reminded the contractor that the FSD [full scale development] contract was valid, we intended to enforce it, and that they should continue to execute the contract."[874] If one had known the LHA story, he could have easily predicted the A-12 outcome. As of this writing, the parties are still legally at each other's throat.

In Attitude B, performance and schedule are what we're after; cost is a *dependent* variable. Technical quality, for them, is the driver because the nation and lives are at risk. Rear Admiral Wayne E. Meyer, the Project Manager of the AEGIS Shipbuilding Program (which came after *TPP* and had none of its angst), has said often, "What is the price of failure?"[875]

Attitude B people insist that you can't "buy" weapons, and, thus, continuous competition can be destructive. They believe expertise, professionalism, partnership, teamwork, and trust are essential. They believe you must be able to quickly and equitably adjust contracts, that dictating will not work, and that there is a lot that argues for flexibility in contracting. They believe, at the levels of technical risk being undertaken, no one ever perfectly understands the requirements when they set out; they are discovered on the way. Synthesis, not analysis, is the key. Thus, contract vehicles and provisions and government/private working relations must protect the ability to change easily. Expertise and experience on both sides, government and industry, will also be required. The report card on the experts during the *TPP* days is instructive for Attitude B. Time and again, McNamara overruled his experts and made a "smart" business decision to the nation's peril.

Overridingly more important, Attitude B people also believe the government is the only entity that can be held ultimately accountable for defense. It represents the owner, and it must be fully engaged. They believe that we must forget labels and slogans and focus, focus, focus on the mission we're trying to achieve. Time and time again, they will point out that the failure to focus on mission by *TPP* or, more broadly, the business mentality it implemented, cost the nation the required number of C-5As, F-111s, and LHAs and gave it a DD-963, which, when it first deployed, was woefully underarmed.

Admiral Rickover reflected some of this attitude. While there were many problems in *California* and *Virginia* Class ships because of some of the same reasons *TPP* got into trouble, their nuclear plants' performance was never an issue. One of his major motives in the CGN controversy was to drive the businessmen out of Newport News. Admiral Rickover always believed that expertise and professionalism were the key and that "the devil is in

the details." Rear Admiral Meyer has also said, "You must make every decision [on these programs] as if this will be the last job you ever do."

SPECIFIC CAUSES OF *TPP's* DOWNFALL

Numerous studies and surveys have been done over the years trying to diagnose the specific outcomes of *TPP*. Some hold on to the belief that it should have or could have worked. One analysis, for example, looked at it strategically and concluded that "while the goal of the concept was desirable, the quantum leap, which implementation of the concept represented, was a factor in its failure." It was "an effort to change 30 years of acquisition in a single step," and "if the concept had been implemented in a more orderly fashion, it may have been successful."[876] Another theorized that it was killed by politics because a new administration wanted to "disassociate itself from previous procedures and policies."[877] This latter study also concluded that most of the C-5A's problems were "not attributable to the *total package procurement* concept, and that many features of the concept should be retained in future procurements."[878] In the view of this C-5A study, *TPP* did not cause any problems, it just revealed them.[879] Thus, doing away with the entire concept was similar to "killing the messenger who brings bad news."[880]

This and other studies concentrated on the techniques of *TPP* and found faults in their implementation, not in the concept itself; it could have been made to work. From this perspective, one of the reasons it did not work on the DD-963s was "inadequacies in the performance requirements statement stemming from inexperience in preparing such a document for the total ship system."[881] Cost overruns came on C-5A because of "the deliberate understatement of the original target cost"[882] and "deficiencies in the Lockheed airframe design."[883] These judgments would be easier to take if the people of that day had not spent almost 15 years trying to make it work. Attitude A apologists, however, seem to find that the fault is in the people, not the concept. They would truly like to try it again.

In 1992, the Institute for Defense Analyses (IDA) revisited the criteria for *TPP* to work. These were:

- The system should be thoroughly and clearly defined in a contract definition phase.
- The program should be a low-risk development.
- The project should be short-term; five years or less.
- An announcement should be made at the outset that substantial changes are not permitted.[884]

These mate very well with the Logistics Management Institute's forecast in 1967 that "*TPP* should not be applied to systems when the technology is rapidly changing and responsive to changing military needs or to systems which require an interface application."[885] These criteria would eliminate almost any major weapons procurement program, which is exactly what David Packard concluded when he acted to terminate *TPP.*

Ultimately, this study came down on the side of Attitude B. We believe that the entire *TPP* concept, with its exclusive business model underpinning, was flawed. In that light, the downfall of the concept can be attributed to a number of specific factors:

1. ***TPP* attempted to contract for too much over too long a period of time**. The number of ships and aircraft; the complete lifecycle functions of development, production, construction, and logistics support; and the number of years involved; all set records for defense contracting. This was done primarily to gain production efficiencies; however, much of this work was brand new to the contractors involved and beyond their chosen fields or market sectors. They were experts in certain aspects of production or construction, not the entire system lifecycle. Thus, when problems began to appear, they rippled throughout every aspect of the contract, and the contractor was often ignorant on how to bound the ripple effects. The length of the contract itself brought problems. Again, in the words of one of our interviewees, "Over a long period of time, there is lot of uncertainty that argues for incrementalism instead of *total package procurement*. Technology may change, the threat may change, funding may not be available—it's development work, economic uncertainty, availability of materials...."[886] Another source proclaimed, "all sorts of things can happen in the space of seven years, and in the case of the C-5A, most of them have."[887] In fact, the myriad of unexpected problems was a compelling story in every program we studied.

2. ***TPP* assumed that requirements and designs can be clearly understood at the beginning and left no room for learning.** The belief was that once the

designs were known, then other requirements could be "forecasted" and managed efficiently using the right metrics. Thus, there was a clear commitment to analyses, models, and simulations that walked away from expertise, experience, and judgment. The recommendations of numerous source selection panels were dismissed. The ventures McNamara and his followers had pursued at Ford and in the Army seemed to support their beliefs. Unfortunately, their experiences were not from the world of major weapons systems development. By its nature, every new weapon system pushes the state of the art—*it has not been done before*. It is almost never the case that the requirements are clearly understood at the beginning. One of our interviewees said, "You don't find out what's wrong until you get underway."[888] Time and again, the drumbeat on the programs we looked at was that "executing xyz was more difficult than expected." The problems and workload could not be forecasted reliably, and so there was no basis for efficiency. Unfortunately, *TPP* left no room for modifying the work as it became better understood and, in fact, sought to outlaw changes.

3. The concept tried to shift responsibility to a contractor and force the government to keep "hands off." This was done in the name of controlling costs. However, **it completely ignored the responsibilities of the government as an owner**. In fact, nowhere in the *TPP* concept or in any of the documents we researched was there any mention of an owner, just business deals between two parties. The government cannot relinquish its responsibilities as owner; the public will not allow it. A recent story illustrates this. In 1994, Lockheed contracted with the Department of Energy (DoE) to remove deadly radioactive waste from a hole called "Pit 9" in Idaho Falls, Idaho. The contract gave DoE an "ironclad guarantee" that Lockheed would do the job for $179 million or lose money if it cost more.[889] DoE had insisted during the bidding that the winner make an "unbreakable oath" to stick to the fixed-price contract no matter what problems it met.[890] In 1997, already two and one-half years behind schedule, the money gone, cost estimates triple the original bid, and "not one shovelful of muck removed,"[891] Lockheed was seeking relief from Congress and had suspended work. While the dispute ended in court and is a tedious story, the lesson to be learned is revealed in the criticism of the Governor of Idaho, Philip Batt: "We are outraged by DoE's failure to make meaningful progress on the Pit 9 project."[892] The DoE, not Lockheed, was at fault.

4. **The concept created unrealistic expectations** both in the Congress and public at large, as well as among the parties involved in the programs. Based on *TPP*'s promises, DoD and Navy officials were constantly assuring Congress that ships and airplanes would cost ambitiously low amounts and be delivered on very optimistic schedules. In addition, they would not involve any advances in the "state-of-the-art."[893] Except for DD-963, all the programs we examined were cut by Congress when they failed to meet expectations. The DD-963 program would probably also have been terminated, had administrations not changed and *TPP* been abolished. *TPP* was also predicated on certain behavior patterns, and issued detailed instructions on how contractors and government agencies should behave in the execution of a contract. When one or both of the parties failed to live up to these expectations, the courts and Congress got involved. We came to believe that all of the programs we examined may have been executed in their entirety with all their technical problems, if expectations had been managed better and no "iron clad" promises made at the outset. But then that would not have been consistent with a *TPP* approach.

5. Ultimately, the downfall of the concept was that **it contained no provisions to allow a program to be easily revised or expertise brought to bear if conditions affecting the program changed**. It did not provide enough degrees of freedom. *TPP,* with its goals and objectives, could not be done without a form of *fixed-price* contract. Without this device, responsibility could not be shifted to a contractor; and, in the view of its advocates, costs could not be controlled. Unfortunately, *fixed-price* contracting, in any of its many forms, is not flexible enough to handle the risks or the number of variables that occurred in the programs we reviewed. This is revealed clearly in the detailed blow-by-blow stories of the shipbuilding programs. Similar lengthy stories could have been told for the aircraft programs. It is mind-boggling that any government official attempted to undertake such state-of-the-art efforts on a fixed price basis. Moreover, considering the years the programs took, the technologies required, the economics at play, and the politics involved, why would any contractor sign up for such an effort at a fixed price? Why would either party consider a fixed price for the DD-963—30 ships, new yard, first-time propulsion system, new labor force, new management—all happening simultaneously? One reason, of course, was that they were ordered to. Perhaps more fundamental is that

the *fixed-price* environment offered to merge two different agendas—that of the businessman on one side who wanted to earn larger profits that can only come with a *fixed-price,* and Attitude A government people on the other who believed *fixed price* guaranteed a set cost.

IMPERATIVES

As we conducted this study, researched the extensive references, went through the "war room" process, and interviewed those from the past, we became convinced that there are a number of imperatives that must be satisfied if any major system acquisition program is to be successful:

1. The program **must field a proven system**, be it weapon, ship, or aircraft. The ultimate goal is to defeat an enemy or threat, not to constrain cost. If constrained costs were the primary goal, the cheapest approach would be not to procure any weapons.

2. The program **must allow for change**. This imperative must become the central operational theme of any acquisition strategy.

3. The program **must make allowances for the unpredictable**. Programmed reserves, fall-backs, and parallel approaches are all examples of such allowances. **"What if?"** and **risk** drive the philosophy, culture, organization, and techniques of successful weapons acquisition programs, not **"efficiency."**

4. The program leadership **must remain flexibly engaged and accountable at every step**. The Government can not give up its role as owner. Just as no owner would build a house on a performance requirement and then keep "hands off," neither can the government in weapons acquisition.

5. The program **must allow contractors to make profits**. Companies are in business to make a profit. This must be understood as long as the government seeks to use private companies to provide its production base. Thus, all parties must win for any contract to be successful. To "hold their feet to the fire" or "make them eat the losses" or "drive them out of business" (all attitudes we came across in this study) should simply be seen as attacks on the nation's own infrastructure.

6. **Credible leadership and professionalism are demanded**. This will be very difficult in an era where political appointees, not elected officials, hold so much power. A broad base of strong, vibrant, and experienced in-house professionals is required. We believe that, ultimately, leadership demands expertise and experience in the venture being led. Someone must be able to take people from the abstract to the concrete. Someone must be able to distinguish technical difficulty from thievery. None of the political appointees that we came across in this study could do this in weapons acquisition—neither technically nor operationally. They were either rank amateurs or novices in the field. Both of the Services on which we spent time, Navy and Air Force, have moved seriously away from requiring technical expertise in their program managers and program office staff and have abstracted them to become more generalists. This is similar to an approach taken earlier in business that emphasized a business major as a prerequisite to business leadership. It is not clear that it has worked in business and we do not believe it is likely to produce very many successful programs or program management in defense.

CHAPTER 9
THE WAY AHEAD?

As the nation enters a new century of major systems acquisition, which attitude will prevail—A or B? Just as in the 1950s and 1960s, DoD is in a draw-down mode. Demobilization from the end of the Cold War has brought four rounds of Base Realignment and Closure (BRAC), with more possibly in the offing. At least 20 of 27 major companies have left the defense sector because of market concerns. Instead of facing up to demobilization as officers did after World Wars I & II, a revolution in business affairs is being proposed instead. It promises to remedy the downsizing problems by once again bringing more efficiency to defense—sometimes called "doing more with less" or "better, faster, cheaper."

In some cases, even a return to fixed-price development contracts is being advocated. In December 1997, the Under Secretary of Defense for Acquisition and Technology released a memorandum entitled "Fixed Price Contracts for Development with Commercial Companies."[894] The premise of this memorandum is that there are commercial companies who can help DoD but who will not contract on a cost basis because of the audits and oversight they invoke. To attract such contractors, therefore, *fixed-price* development should be considered once again.

To implement this revolution, DoD is trying to shift more risk and responsibility to industry, "hands-off" approaches to contracting are being encouraged, and pressure is being exerted for DoD to employ better business practices and become more like private industry. Today, the champion industry to be copied is the computer industry, not the automotive industry. Such beliefs are held in both political parties. Business reform, not effective weapons, sometimes seems to be the primary goal, just as it was in the McNamara era.

The launch pad in warship building for acquisition reform and the revolution in business affairs was the *Arsenal Ship*, a program that began in the mid 1990s, but was terminated in 1997. It embodied almost every new business initiative of the day and, like the FDL in *TPP*, was called by some "an experiment."[895] While the program was terminated, its approach and many of its leaders proceeded on into SC-21, then DD-21, and subsequent shipbuilding programs. To date, none of these programs has produced a ship. *Arsenal Ship's* resemblance to a *TPP* concept is uncanny. It included:

- As one of the fundamental purposes of the program, the acceleration of the Navy's on-going Acquisition Reform Initiatives so that the Navy could buy "improved ships at a lower cost."[896]
- An acquisition approach that sought to (1) entice non-traditional DoD companies, (2) encourage innovation, and (3) decrease the overall time and cost to design, build, and deliver ships.[897]
- A design phase kicked off by a very top-level performance requirement.
- A design competition divided into two competitive phases. Phase I was a six-month Concept Definition effort to develop an "A spec" (not a traditional shipbuilding specification but a weapons specification describing the complete system). Phase II was a 12-month Functional Design effort. The purposes of these phases were almost identical to those of the *TPP* Concept Formulation and Contract Definition Phases. In fact, the Functional Design phase has been described as "similar to Contract Design in maturity."[898]
- Each phase to be competed among an ever-decreasing set of contractors—five in Phase I, three in Phase II, and ultimately one winner to build the ships. The lead ship was to be called a "Demonstrator," and the follow five ships were to be called "Production" ships.
- Both the Demonstrator and the Production ships to be procured under a *firm-fixed-price* agreement,[899] executable in part through "irrevocable offers" for the Production ships made at the conclusion of Phase II, by the competing teams.[900] The design was to be based on a "Price as Established" not to exceed $541 million for the first ship and a firm acquisition cost threshold for the follow-ships of $450 million goal/$550 million cap "unit sailaway cost"[901] (another term modeled after a similar one in the aircraft industry).
- Intimate contact between government and contractor technical experts throughout the design

phases to take advantage of government-only expertise.

- Minimal government direction as a key factor to success.[902] The government could give advice and share knowledge but could not direct. In addition, some consideration was being given to a degree of contractor "self-certification" of his products when the program died.[903]
- An evaluation of the cost risk to the government as "low" because "the fixed price agreement along with current cost ceiling that have been established... mitigates a significant amount of cost risk to the Government."[904]
- The elimination of Government Furnished Equipment.[905] This would allow the contractor to set his production schedules and relieve the government from claims of delay and disruption due to late GFE.[906]
- Military Standards offered as guidance only,[907] just as the Navy's General Shipbuilding Specifications had been treated in LHA and DD-963. Extensive use of commercial specifications was expected.
- The use of production techniques, called "commercial building practices" in shipbuilding. The program concluded that it had demonstrated it was possible to take advantage of commercial practices, such as "(1) parallel structure and outfit construction processes, (2) reduced number of installation parts, (3) "building block" vice "stick built" products, and (4) repeatable products and processes."[908] These seem identical to the ideas and techniques that led to the new yard at Ingalls in the 1960s.

In total, these sound remarkably like the *Total Package Procurement* movement. However, there were also some significant differences:

- The program was co-managed by the Defense Advanced Research Project Agency (DARPA), an OSD technology development agency, and the Navy—not the Navy alone. DARPA had no previous experience in managing a major shipbuilding project.
- The program had a stated philosophy of "no requirements"[909] besides its unit sailaway price and a crew size of 50 or less.[910] This was to open up the "trade space" to the contractors to meet these goals.[911] Performance was to be traded off almost as in impulse buying.
- The *Arsenal Ship* Joint Program Office (ASJPO) was to be very small (6 to 9 people), in addition to a modest amount of contractor administrative and technical support. This was "an essential element of the ASJPO acquisition reform approach. A large number of people would have had a stifling affect on industry's innovation, just from the sheer magnitude of opinions that would be expressed by such a group and industry's intense desire to please its customers."[912]
- The program was to use FY 1994 Defense Authorization Act, Section 845 language versus traditional contracting authority. This approach, used primarily for the early stages of research and development, threw out almost all the procurement rules in order to free up the contractor's options and to encourage the insertion of commercial technology.
- The program was to include a Demonstrator ship to act as a prototype before production commenced. This ship was to be funded out of RDT&E accounts (never done before) and to be fully constructed before the follow-ships began—a period of over two years.[93] This is yet another example of trying to fit shipbuilding into a development/production model. Such an approach had been considered unworkable in the days of *TPP* and was one of the principal differences between its application to shipbuilding and aircraft production.
- Teaming between contractor consortia and government labs and agencies was encouraged.

Reviewing these differences, one can see that the new acquisition reform movement is willing to push even further than *TPP* did. It may even lead to more cataclysmic outcomes. A ship is still not an automobile, an airplane, or a computer.

The *Arsenal Ship* Program was terminated in 1997 when Congress refused to fund it in the amounts required. The project office compiled an extensive "lessons learned" document. This document is extremely optimistic when one understands the Navy's experience with *TPP*. In fact, its very first "lesson learned" is that "Acquisition Streamlining Works."[914] It then goes on to extol the schedule and cost savings achieved and innovative thinking encouraged, despite the fact that not one detail design drawing had been released for fabrication and not one piece of steel had been cut.

At this stage in each of the four major programs we reviewed, they were a success also. The fun had not yet begun. Using those programs as precedent, *Arsenal Ship* would have been in deep trouble within two years of contract award. There would have been one critical difference. Unlike in the days of the DD-963s, there would not have been significant in-house Navy resources and expertise that could have come to the rescue. With all the base closures, early-outs, retraining and downsizing, the Navy's in-house capabilities are not nearly as robust as they were in the 1960s and '70s. Since the first ship was to be funded out of the RDT&E appropriation, not the SCN appropriation, it is highly possible that the Demonstrator ship, once in trouble, would have never been completed. Congress would have simply refused to continue the incremental appropriations. It would probably be more accurate in describing the *Arsenal Ship* to recall the words of the FDL Technical Director, "It was a great artistic success that failed at the box office."

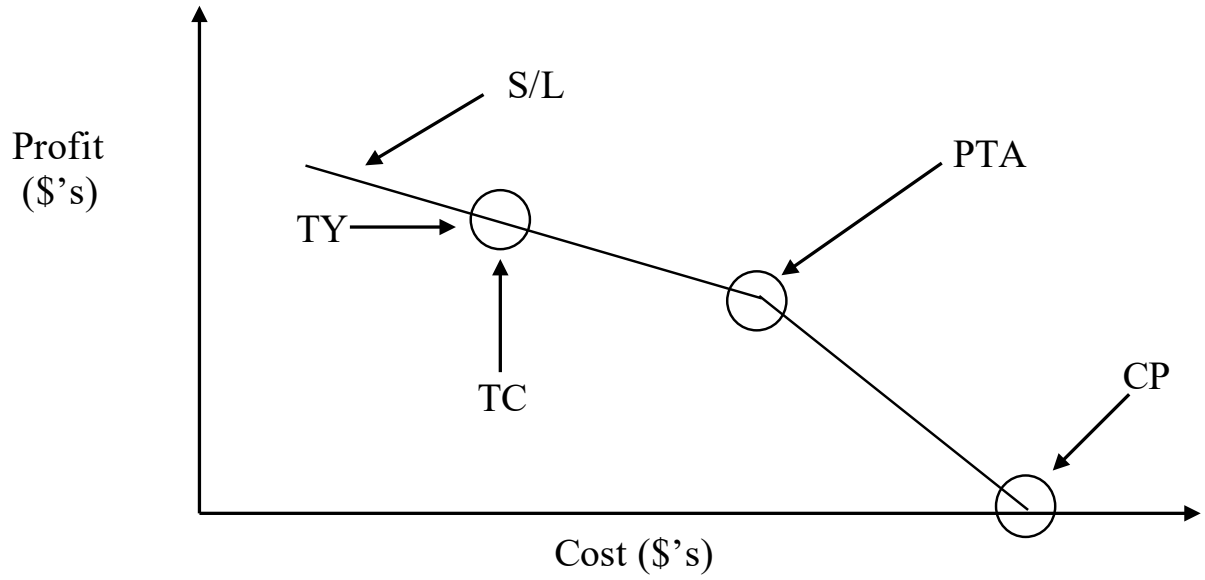
The "lessons learned" of the *Arsenal Ship* were transported directly into the DD-21 program without much critical review as to why the *Arsenal Ship* really failed. In fact, it was at a review of the DD-21's acquisition strategy that a retired officer from the 1970s asserted, "You guys are just doing *Total Package Procurement* all over again."[915] It was that comment that gave rise to this report, since almost no one in the room had ever heard of *TPP*—a reflection on many of the DoD's schoolhouses.

COULD IT BE, IN THE WORDS OF YOGI BERRA,
"DEJA VU ALL OVER AGAIN"?

APPENDIX A
MECHANICS OF A FIXED-PRICE-INCENTIVE CONTRACT[916]

TARGET PRICE = Target Cost + Target Profit

CEILING PRICE = Target Cost x Negotiated Percentage



CP = Ceiling Price

TC = Target Cost

TY = Target Profit

S/L = Share Line

PTA = Point of Total Assumption = $\frac{\text{Ceiling Price} - \text{Target Price}}{\text{Government Share}}$ + Target Cost

Over Run = amount of costs above the Target Price and below the Ceiling Price that is shared by the contractor and the government according to the share line.

Under Run = amount of savings below the Target Price that is available for additional profits to the contractor according to the share line.

EXAMPLE FOR DD-963

TC = $1.64607 Billion
TY = $.14313
CP = $2.1399
S/L = 85/15

Then:

$$PTA = \frac{2.1399 - (1.64607 + .14313)}{.85} + 1.64607$$

$$= \frac{2.1399 - 1.7892}{.85} + 1.64607$$

PTA = $2.05607 Billion

FIXED-PRICE-INCENTIVE, SUCCESSIVE TARGET (FPIS) CONTRACT

The *fixed-price-incentive, successive target* contract is the same as the *fixed-price-incentive* contract, except that a new target price can be negotiated at one or more specified future dates. In the case of the DD-963, there was only one reset date (within 90 days after the end of the 37th month after the execution date of the contract). In no case, however, can the new target price exceed the original ceiling price.

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